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Small Village Wastewater Treatment Systems Project

Operation & Maintenance Advise and Assist Training Program

FINAL REPORT

July 2012

This publication was produced for review by the United States Agency for International Development. It was prepared by CDM Smith.

Small Village Wastewater Treatment Systems Project Phase II

OPERATION & MAINTENANCE ADVISE & ASSIST TRAINING PROGRAM

LEBANON

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1.0 Background and Schedule

1.1 Advise & Assist Program Background

Operation and maintenance is a challenge faced by most municipalities and utilities throughout the developing world and much of the developed world, and Lebanon is no different. But at the same time, O&M is the most critical issue to establish a treatment plants sustainability and useful life. Currently, no single organization or utility in Lebanon has the capacity to operate and maintain wastewater treatment plants, which is one reason why USAID has chosen to work on the municipal level where the benefactors have operational and maintenance responsibility.

Operational responsibility also is a formidable challenge faced on all levels in Lebanon, not only the small municipalities. Although the Lebanese government has arranged for the formation of "Water and Wastewater establishments" to oversee operation and maintenance at facilities such as these, the Bekaa Water Establishment is still not up and running and ready to accept operational responsibility for any of the new USAID funded WWTPs. Municipal governments are operational, and thus currently have an advantage over the Bekaa Water establishment, but still village municipalities lack the funds, training, understanding and continued interest required to successfully operate such treatment facilities.

To address both O&M and operational responsibility, USAID have funded this *Operations and Maintenance Advise & Assist program* to work together with each recipient village municipality to establish a sustainable operation and maintenance program for the constructed treatment facility. This technical assistance and training program is designed to provide the knowledge, and develop the skills, necessary for the efficient and safe operation and maintenance. A key component of this advise & assist program is the daily supervision and guidance being provided to the assigned village operators in performing all required facility O&M activities and duties. This is a program of learn-by-doing. Village Operators will assume more of the day-to-day responsibility of running the plant as the advise & assist period progresses. At the end of the advise & assist period the village operators should be able to perform routine activities unassisted.

1.2 Program Schedule

Program Schedule: The Operations and Maintenance Advise & Assist program is the third and final phase component (following phase-1 design and phase-2 construction activities) of the Small Village Wastewater Treatment Systems Phase II Project which is fully funded by USAID.

For each constructed wastewater treatment facility the A&A training program was scheduled to begin at the end of the construction and commissioning period and continue for up to twelve months for Aitanit and Fourzol WWTPs and nine months for the Ablah Village WWTP (see simplified project schedule diagram on the following page). The A&A training program scheduled for the Ablah Village Municipality O&M staff did not happen due to the village municipality delay in providing staff to receive training and operate the WWTP. However, CDM Smith did train one local technician (Mr. Mohamed Boudaye) who was working part time with the CDM Smith as an O&M assistant during the Ablah project commissioning and startup testing period. This technician was introduced to many of the key WWTP O&M skills during his work

experience and CDM Smith monitored and tracked his skills accomplishments which are now presented in this report in Section 2.x Ablah WWTP Operator Training Summary.

2.0 Student Data – Presentation Table

USAID SMALL VILLGES WASTEWATER TREATMENT SYSTEMS
Advise & Assist Training Student Data

Aitanit Village WWTP

						Previous Training and Experience					Work History at WWTP			
Trainee Name	Male/Female	Status	Village	Position	Birth Date	Basic Schooling	Advanced Schooling	Previous Work Experience	Foreign Languages	Certificates	work start date	work end date	# of days at work	Reason for Departure
	Male	Active	Aitanit	Operator			Mech. Certificate		English		Feb-09			
	Male	Active	Mashghara		1985		Mech. Certificate		French		Feb-09			
	Male	Departed	Qaraoun				University, AutoCAD		English - very good		Feb-09	11-Mar-10	403	Misconduct
	Male	Active	LaLa								Feb-09			
	Male		Qaraoun	Proposed Chief Operator	1978	Grade-12	2-yrs University	Teacher for 10-years	English - very good		Feb-09			never started work w/ Municipality but worked with CDM for 2 years
	Male	Departed	LaLa	Operator	1981	Grade-12		5-months at Poppins Facto	English		Feb-09	Mar-09	30	conflict w/ 1st job
	Male			Security / Helper							Feb-09			

Fourzol Village WWTP

						Previous Training and Experience					Work History at WWTP			
Trainee Name	Male/Female	Status	Village	Position	Birth Date	Basic Schooling	Advanced Schooling	Previous Work Experience	Foreign Languages	Certificates or Special Skills	work start date	work end date	# of days at work	Reason for Departure
	Male	Departed	Fourzol	Operator	1973	Grade-12	University, BS	None	English -Very Good	Accounting	1-Jul-09	11-Feb-10	225	Misconduct - data falsification and fuel theft
	Male	Departed	Fourzol	Operator	1977	Grade-8			English- poor	Plumbing Welding	1-Jul-09	11-Feb-10	225	Misconduct - data falsification and fuel theft
	Male	Departed	Fourzol				3-months of English.				1-Jul-09	11-Feb-10	225	Misconduct - data falsification and fuel theft
		Rehired/departed		Operator	1974	Grade-7	1-mth computer trng.	Security guard for 2yrs	English-Good		15-Mar-10	10-Jun-10	87	not attending training
	Male	Departed		Operator		Grade-12	Electrical technician	Electrician Tech.		Electrician	14-Jun-10	1-Sep-10	79	Salary dispute
	Male	part time	Fourzol	not official Operator							Jul-10			
	Male	Departed	Fourzol	Helper							Aug-10			Misconduct - fighting (also known to bring firearm to work site)
	Male	Departed	Syria	Security / Helper							1-Jul-09			

Ablah Village WWTP

						Previous Training and Experience					Work History at WWTP			
Trainee Name	Male/Female	Status	Village	Position	Birth Date	Basic Schooling	Advanced Schooling	Previous Work Experience	Foreign Languages	Certificates	work start date	work end date	# of days at work	Reason for Departure
	Male	Full time	Tamnine Tahta	Chief Operator	6/22/1980	Grade-12	University - engineering	Sewer design and installation	English - excellent		1-Jul-12	ongoing		

3.0 Training Summary Data

3.1 Aitanit WWTP Training Results Summary

CDM Constructors Inc.

Aitanit Village WWTP

Subject: Plant Staff - Summary Listing of Attended Training Events

	Date	Course Subject	Training Title	Instructor	Location	Student Names					
1	10-Mar-09	Maintenance	Standby Power Generator - Introduction to basic O&M	quipment Vend	Field	2	2	2	-	2	
2	10-Mar-09	Safety	Confined Space - Use of Portable Air Ventilation Blower	CDM	Field	1	1	1	-	-	
3	11-Mar-09	Maintenance	Submersible pumps - Introduction to installed pumps	quipment Vend	Field	2	2	2	-	-	
4	11-Mar-09	Maintenance	Generator - How to change engine oil.	quipment Vend	Field	1	1	1	-	1	
5	12-Mar-09	Safety	Electrical Grounding (Earthing Pit Testing)	EMCO	Field	1	1	1	-	-	
6	12-Mar-09	Maintenance	Process valves - O&M	EMCO	Field	2	2	2	-	-	
7	23-Mar-09	Maintenance	Sewer Manholes - Inspection procedures	CDM	Field	3	3	3	-	-	
8	24-Mar-09	Maintenance	Sewer Manholes - Inspection procedures	CDM	Field	3	3	3	-	-	
9	4-Apr-09	Maintenance	Pipeline exfiltration testing - Dye testing River outfall pipe.	CDM	Field	4.5	4.5	4.5	-	-	
10	6-Apr-09	Maintenance	Trickling Filter - Ventilation fan maintenance inspection	CDM	Field	1	1	1	-	1	
11	14-Apr-09	Maintenance	Submersible Pumps - System overview	CDM	Field	1	1	1	-	1	
12	22-Apr-09	Maintenance	Pump capacity testing (wetwell draw-down method)	CDM	Field	1	1	1	-	-	
13	22-Apr-09	Maintenance	Trickling Filter - Distribution Arm Lubrication	CDM	Field	1	1	1	1	1	
14	24-Apr-09	Safety	Safety & First Aid	RED CROSS	Field	14	14	14	10	-	
15	27-Apr-09	Maintenance	Ductile iron pipe leak testing	CDM	Field	3	3	3	-	3	
16	27-Apr-09	Maintenance	Diaghram pump usage	CDM	Field	1	1	1	-	1	
17	28-Apr-09	Maintenance	Air pressure of plant water tank	CDM	Field	1	1	1	-	-	
18	28-Apr-09	Water Quality	Daily sample reading	CDM	Field	2	2	2	2	-	

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Aitanit Village WWTP

Subject: Plant Staff - Summary Listing of Attended Training Events

	Date	Course Subject	Training Title	Instructor	Location	Student Names					
19	5-May-09	Maintenance	Submersible Pump Repair	quipment Vend	Field	2	2	2	2	-	
20	9-May-09	Maintenance	Sewer pipe leakage test	CDM	Field	1	1	1	-	1	
21	11-May-09	Treatment Process	Equip. Overview (Pump Stations & Clarifiers)	EMCO	Field	1	1	1	-	1	
22	12-May-09	Maintenance	Automatic transfer switch - Introduction	quipment Vend	Field	1	1	1	-	-	
23	13-May-09	Treatment Process	Control panels - Functional Introduction	quipment Vend	Field	2	2	2	-	-	
24	15-May-09	Treatment Process	Elect. Power Distribution	CDM	Field	1	1	1	-	-	
25	21-May-09	Maintenance	Plant Water - hydrant inspection	CDM	Field	2	2	2	-	2	
26	22-May-09	Safety	Fire Alarm System	quipment Vend	Field	1	1	1	-	-	
27	29-May-09	Water Quality	Clarifier Sludge Blanket Measurment	CDM	Field	1	1	1	-	-	
28	24-Jun-09	Maintenance	Plug Valve O&M	TAJJ	Field	1	1	1	1	-	
29	24-Jun-09	Treatment Process	Process Piping - Overview of pipe routing and function	TAJJ	Field	1	1	1	1	-	
30	7-Jul-09	Maintenance	Fine Screen - How to drain	CDM	Field	1	1	1	1	-	
31	May-July-09	Maintenance	Pump Capacity Testing - Wetwell Drawdown Method	CDM	Classroom	1	1	1			
32	May-July-09	Treatment Process	Influent Pump Station - Operation Guidelines	CDM	Field	2	2	2			
33	May-July-09	Treatment Process	Primary Clarifier - Operation Guidelines	CDM	Field	2	2	2			
34	May-July-09	Treatment Process	Fine Screen Facility - Operation Guidelines	CDM	Field	2	2	2			
35	May-July-09	Treatment Process	Trickling Filter Pump Station - Operation Guidelines	CDM	Field	2	2	2			

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Aitanit Village WWTP

Subject: Plant Staff - Summary Listing of Attended Training Events

	Date	Course Subject	Training Title	Instructor	Location	Student Names					
36	May-July-09	Treatment Process	Biotower Tanks - Operation Guidelines	CDM	Field	2	2	2			
37	May-July-09	Treatment Process	Final Clarifier - Operation Guidelines	CDM	Field	2	2	2			
38	May-July-09	Treatment Process	Chlorine Contact Tank - Operation Guidelines	CDM	Field	2	2	2			
39	May-July-09	Treatment Process	Plant Water System - Operation Guidelines	CDM	Field	2	2	2			
40	May-July-09	Treatment Process	Anaerobic Digester - Operation Guidelines	CDM	Field	2	2	2			
41	May-July-09	Treatment Process	Standby Power Generator - Operation Guidelines	CDM	Field	2	2	2			
42	May-July-09	Treatment Process	Wet-Weather Diversion Structure - Functional Description	CDM	Field	2	2	2			
43	May-July-09	Treatment Process	Plant Yard Piping & Valves - Functional Description	CDM	Field	2	2	2			
44	May-July-09	Treatment Process	Plant Electrical Power Distribution - Functional Description	CDM	Field	1	1	1			
45	May-July-09	Maintenance	Trickling Filter - Oil and Grease Lubrication	CDM	Field	2	2	2			
46	May-July-09	Maintenance	Trickling Filter - Distributor Arm Flushing & Cleaning	CDM	Field	1	1	1			
47	May-July-09	Maintenance	Portable Diaphragm Pump - O&M Guidelines	CDM	Field	1	1	1			
48	May-July-09	Maintenance	Portable Air Ventilation Blower - O&M Guidelines	CDM	Field	1	1	1			
49	May-July-09	Treatment Process	Chemical Feed Pumps - Operation Guidelines	CDM	Field	1	1	1			
50	May-July-09	Maintenance	Standby Power Generator - Routine Service - Lubrication	CDM	Field	1	1	1			
51	May-July-09	Maintenance	Administration Building AC - O&M Guidelines	CDM	Field	1	1	1			
52	May-July-09	Maintenance	Administration Building - Potable Water Tank	CDM	Field	1	1	1			

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Aitanit Village WWTP

Subject: Plant Staff - Summary Listing of Attended Training Events

	Date	Course Subject	Training Title	Instructor	Location	Student Names					
53	May-July-09	Maintenance	End Suction Sludge Pumps - Seal Water Supply System	CDM	Field	1	1	1			
54	May-July-09	Maintenance	End Suction Sludge Pumps - Packing Replacement	CDM	Field	1	1	1			
55	May-July-09	Maintenance	Submersible Pump - Hoisting Procedures	CDM	Field	1	1	1			
56	May-July-09	Treatment Process	Septage Receiving Pump - Operation Guidelines	CDM	Field	1	1	1			
57	May-July-09	Treatment Process	Final Clarifier Pump Station - Operation Guidelines	CDM	Field	1	1	1			
58	May-July-09	Maintenance	Trickling Filter Fans - Propeller shaft alignment	CDM	Field	2	2	2			
59	May-July-09	Maintenance	Workshop Tool Inventory - How to Update Inventory List	CDM	Workshop	2	2	2			
60	May-July-09	Safety	Plant Operator Safety Handbook	CDM	Classroom	2	2	2			
61	May-July-09	Water Quality	Dissolved Oxygen Meter - Calibration & Use	CDM	Classroom	2	2	2			
62	May-July-09	Water Quality	pH Meter - Calibration and use	CDM	Classroom	2	2	2			
63	May-July-09	Water Quality	Settleability Test - Procedure and Record Keeping	CDM	Classroom	2	2	2			
64	May-July-09	Water Quality	Sludge Settling Test - Procedure and data recording	CDM	Classroom	2	2	2			
65	May-July-09	Water Quality	Field Sample Collection - Procedure and data recording	CDM	Field	2	2	2			
66	May-July-09	Maintenance	Plant Water - Hydropneumatic Tank Air Fill Procedure	CDM	Field	1	1	1			
67	May-July-09	Maintenance	Plant Water - Control Panel Troubleshooting	CDM	Field	1	1	1			
68	May-July-09	Management	Plant Cost Accounting - Preparing Monthly Cost Summary	CDM	Classroom	1	1	1			
69	May-July-09	Management	Financial Mgt. - Estimating power and fuel costs.	CDM	Classroom	1	1	1			3

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Aitanit Village WWTP

Subject: Plant Staff - Summary Listing of Attended Training Events

	Date	Course Subject	Training Title	Instructor	Location	Student Names					
70	May-July-09	Maintenance	Sludge Piping - How to flush a plugged line	CDM	Field	2	2	2			
71	May-July-09	Process Control	Digester - Decanting Procedures and data recording	CDM	Classroom	4	4	4			
72	6-Dec-09	Process Control	Pump Capacity test at the F.C.P.S	CDM	Field	1	1	1	1		
73	9-Dec-09	Maintenance	Hoisting - Safe use of crane trolley and chain hoist.	CDM	Field	2	2	2	2		
74	18-Dec-09	Maintenance	Tool Use - Drilling a hole in a blind flange	CDM	Field	2	2	2	2		
75	21-Dec-09	Maintenance	Valve and pipe Installation and replacement	CDM	Field	30	30	30	30		
76	25-Dec-09	Treatment Process	Charts updating Electronically	CDM	Field	5	5	5	5		
77	30-Dec-09	Water Quality	Re-training on the Ph-and DO calibration	CDM	Classroom	1	1	1	1		
78	14-Jan-10	Safety	Safety Training	CDM	Field	6	6	6	6		
79	17-Apr-10	Treatment Process	Basic Math for Operators - Fractions	CDM	Classroom	3	3	0	3		
80	21-Apr-10	Treatment Process	Basic Math for Operators - Decimals	CDM	Classroom	3	3	0	3		
81	29-Apr-10	Treatment Process	Basic Math for Operators - Powers & Rounding	CDM	Classroom	3	3	0	3		
82	15-May-10	Treatment Process	Basic Math for Operators - calculating perimeter + volume	CDM	Classroom	4	4	0	4		
83	21-May-10	Skill Test	Field Data Collection & Record Keeping	CDM	Field	1	1	0	0		
84	21-May-10	Skill Test	Process Tank Identification	CDM	Field	1	1	0	0		
85	21-May-10	Skill Test	Clarifier Sludge Blanket Measurement	CDM	Field	0.5	0.5	0	0		
86	21-May-10	Skill Test	Sludge Settleability Test 2-Liter Settling Beaker	CDM	Laboratory	1	1	0	0		

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Aitanit Village WWTP

Subject: Plant Staff - Summary Listing of Attended Training Events

	Date	Course Subject	Training Title	Instructor	Location	Student Names					
87	21-May-10	Skill Test	How to calibrate the pH meter pH-and DO calibration & use	CDM	Laboratory	0.5	0.5	0	0		
88	21-May-10	Skill Test	Settle able Solids Test Imhoff Cone	CDM	Laboratory	1	1	0	0		
89	21-May-10	Skill Test	Trickling Filter Flow Distributor	CDM	Field	0.5	0.5	0	0		
90	21-May-10	Skill Test	Trickling Filter ventilation fan	CDM	Field	0.5	0.5	0	0		
91	21-May-10	Skill Test	Primary Clarifier Pumping to the Anaerobic Digester	CDM	Field	0.5	0.5	0	0		
92	21-May-10	Skill Test	Fuel Storage Tank	CDM	Field	0.5	0.5	0	0		
93	21-May-10	Skill Test	Fine Screen	CDM	Field	0.5	0.5	0	0		
94	21-May-10	Management	Daily report Data Collected and faxed to CDM-Office	CDM	Classroom	1	1	0	1		
95	29-May-10	Treatment Process	Advice and Assist - Plant walk-through tour with Operator	CDM	Field	2	2	0			
96	4-Jun-10	Management	Maintenance cards,summery table and schedule	CDM	Classroom	2	2	0	2		
97	4-Jun-10	Water Quality	Sampling - Collection, Labeling, Preservation, Chain-of-Cus	CDM	Field	1	1	0	1		
98	4-Jun-10	Safety	Re-Training on the Safety guide book	CDM	Classroom	2	2	0	2		
99	4-Jun-10	Treatment Process	Advice and Assist - Secondary Clarifier Sludge handling	CDM	Field	1	1	0	1		
100	11-Jun-10	Treatment Process	Advice and Assist - Plant walk-through tour with Operator	CDM	Field	1	1	0	1		
101	11-Jun-10	Management	Facility Budget - How to prepare quarterly updates.	CDM	Classroom	2	2	0	2		
102	17-Jun-10	Treatment Process	Advise and Assist-Plant tour control panel electric problem	CDM	Field	2	2	0	2		
			Total Hours to Date			**207**	**207**	**173**	**90**	**14**	**3**

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AITANIT VILLAGE TREATMENT PLANT

Subject: Operator Technical Skills Testing - Summary Results

	Skill Area	Skill Name	Skill Pass/Fail Measurement Method	Skill Testing Location		Village Staff Skill Learning Results				
				Field or Classroom	Location	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
						Pass/Fail & Date	Pass/Fail & Date	Pass/Fail & Date	Pass/Fail & Date	Pass/Fail & Date
1	Water Quality	**pH Meter,** calibration and use	Student demonstration of learned skill			PASS 12 jun 10	PASS 12 jun 10	PASS 12 jun 10		
2	Water Quality	**Dissolved Oxygen Meter,** calibration and use	Student demonstration of learned skill	Classroom	Aitanit WWTP ADMN BLD	PASS 21 May 10	PASS 21 May 10	PASS 12 jun 11		
3	Water Quality	**Imhoff Cone,** Settleable Solids Test	Student demonstration of learned skill	Classroom	Aitanit WWTP ADMN BLD	PASS 21 May 10	PASS 21 May 10	PASS 12 jun 12		
4	Water Quality	**2-Liter Settleometer -** Sludge Settling test	Student demonstration of learned skill	Classroom	Aitanit WWTP ADMN BLD	PASS 21 May 10	PASS 21 May 10	PASS 12 jun 10		
5	Water Quality	**Sludge Judge Core Sampler** - Clarifier Sludge Depth Measurement	Demonstration of step procedure	Field	Primary Clarifier	PASS 21 May 10	PASS 21 May 10	PASS 11 jun 10		
6	Water Quality	**Sample Collection Procedure for Offsite AUB Analysis**	Demonstration of step procedure and associated paperwork							
7	Safety	**Safety Guidelines for Plant Operators,**	Student discussion & explanation of required safety procedures	Classroom	Aitanit WWTP ADMN BLD	PASS 11 jun 10	PASS 11 jun 10	PASS 11 jun 10		
8	Management	**Equipment Running Hour Field Data Collection and Summary Report**: Data entry and calculation	Demonstration of data collection, form filling, and Report making	Field & Classroom	Aitanit WWTP ADMN BLD	PASS 21 May 10	PASS 21 May 10	PASS 11 jun 10		
9	Management	**Plant Operations Daily Summary Report**: Data entry and calculation	Demonstration of data collection, form filling, and Report making	Classroom	Aitanit WWTP ADMN BLD	PASS 21 May 10	PASS 21 May 10			
10	Management	**Computer use in Data Management**	Demonstration of learned skill	Classroom						
11	Maintenance	**Fuel Storage Tank** - Level Measurement	Demonstration of step procedure and associated paperwork	Field	Aitanit WWTP Fuel tank	PASS 21 May 10	PASS 21 May 10	PASS 11 jun 10		
12	Maintenance	Portable Drill Use	Demonstration of step procedure							
13	Maintenance	**Trickling Filter Flow Distributor** Lubrication	Demonstration of step procedure and associated paperwork	Field	Aitanit WWTP Trickling filter Tank # 1	PASS 21 May 10	PASS 21 May 10	PASS 11 jun 10		
14	Maintenance	**Trickling Filter Ventilation Fan:** Inspection & Maintenance	Demonstration of step procedure and associated paperwork	Field	Aitanit WWTP Fan # 3 & 5	PASS 21 May 10	PASS 21 May 10	PASS 11 jun 10		
15	Treatment Operations	**Process Tank Identification** - Knowladge of Tank Name and Basic Functional Understanding of Tank Duty	Student demonstrates understanding during plant walkthrough tour	Field	Aitanit WWTP	PASS 21 May 10	PASS 21 May 10	PASS 11 jun 10		
16	Treatment Operations	**Fine screen -** Functional Understanding of	Student demonstrates understanding during plant walkthrough tour	Field	Aitanit WWTP Fine screen facility	PASS 21 May 10	PASS 21 May 10	PASS 11 jun 10		
17	Treatment Operations	**Employee Safety Handbook**	Student discussion & explanation of required safety procedures	Classroom	Aitanit WWTP ADMN BLD	PASS 11 jun 10	PASS 11 jun 10	PASS 11 jun 10		

3.1 Fourzol WWTP Training Results Summary

CDM

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FOURZOL VILLAGE TREATMENT PLANT

Subject: Operator Technical Skills Testing - Summary Results

	Skill Area	Skill Name	Skill Pass/Fail Measurement Method	Skill Testing		Village Staff Skill Learning Results			
				Field or Classroom	Location	[redacted]	[redacted]	[redacted] Pass/Fail & Date	[redacted] Pass/Fail & Date
1	Water Quality	**pH Meter,** calibration and use	Demonstration of step procedure	classroom	Fourzol WWTP	Operator Dismissed by Village Mayor	Operator Dismissed by Village Mayor	PASS 27 May 10	
2	Water Quality	**Dissolved Oxygen Meter,** calibration and use	Demonstration of step procedure	classroom	Fourzol WWTP			PASS 27 May 10	
3	Water Quality	**Imhoff Cone,** Settleable Solids Test	Demonstration of step procedure	classroom	Fourzol WWTP			PASS 27 May 10	
4	Water Quality	**2-Liter Settleometer -** Sludge Settling test	Demonstration of step procedure	classroom	Fourzol WWTP			PASS 27 May 10	
5	Water Quality	**Sludge Judge Core Sampler** - Clarifier Sludge Depth Measurement	Demonstration of step procedure	Field	Fourzol WWTP			PASS 27 May 10	
6	Water Quality	**Sample Collection Procedure for Offsite AUB Analysis**	Demonstration of step procedure and associated paperwork						
7	Safety	**Safety Guidelines for Plant Operators,**	Student discussion & explanation of required safety procedures						
8	Management	**Equipment Running Hour Field Data Collection and Summary Report**: Data entry and calculation	Demonstration of data collection, form filling, and Report making	Field & Classroom	Fourzol WWTP			PASS 27 May 10	
9	Management	**Plant Operations Daily Summary Report**: Data entry and calculation	Demonstration of data collection, form filling, and Report making						
10	Management	**Computer use in Data Management**	Demonstration of learned skill					**ON HOLD**	
11	Maintenance	**Fuel Storage Tank** - Level Measurement	Demonstration of step procedure and associated paperwork	Field	Fourzol WWTP			PASS 27 May 10	
12	Maintenance	Portable Drill Use	Demonstration of step procedure						
13	Maintenance	**Trickling Filter Flow Distributor** Lubrication	Demonstration of step procedure and associated paperwork	Field	Fourzol WWTP			PASS 27 May 10	
14	Maintenance	**Trickling Filter Ventilation Fan:** Inspection & Maintenance	Demonstration of step procedure and associated paperwork						
15	Plant Operations	**Primary Clarifier Sludge Pumping** to Digester	Demonstration of step procedure and associated paperwork	Field	Fourzol WWTP			PASS 27 May 10	

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Fourzol Village WWTP

Subject: Plant Staff - Summary Listing of Attended Training Events

	Date	Course Subject	Training Title	Instructor	Location	Students					
						[redacted] (Plant Operator)	[redacted] (Plant Operator)	[redacted] (Plant Operator)	[redacted] (Plant Operator)	Security / Plant Assistant	Municipality Accountant
1	25-May-09	Maintenance	Pump Capacity Testing - Wetwell Drawdown Method	CDM	Class & Field	1	1	1			
2	Aug-Sept 09	Treatment Process	Influent Pump Station - Operation Guidelines	CDM	Field	2	2	2			
3	Aug-Sept 09	Treatment Process	Primary Clarifier - Operation Guidelines	CDM	Field	2	2	2		2	
4	Aug-Sept 09	Treatment Process	Fine Screen Facility - Operation Guidelines	CDM	Field	2	2	2		2	
5	Aug-Sept 09	Treatment Process	Trickling Filter Pump Station - Operation Guidelines	CDM	Field	2	2	2			
6	Aug-Sept 09	Treatment Process	Biotower Tanks - Operation Guidelines	CDM	Field	2	2	2			
7	Aug-Sept 09	Treatment Process	Final Clarifier - Operation Guidelines	CDM	Field	2	2	2		1	
8	Aug-Sept 09	Treatment Process	Chlorine Contact Tank - Operation Guidelines	CDM	Field	2	2	2			
9	Aug-Sept 09	Treatment Process	Plant Water System - Operation Guidelines	CDM	Field	2	2	2			
10	Aug-Sept 09	Treatment Process	Anaerobic Digester - Operation Guidelines	CDM	Field	2	2	2			
11	Aug-Sept 09	Treatment Process	Standby Power Generator - Operation Guidelines	CDM	Field	2	2	2			
12	Aug-Sept 09	Treatment Process	Wet-Weather Diversion Structure - Functional Description	CDM	Field	2	2	2			
13	Aug-Sept 09	Treatment Process	Plant Yard Piping & Valves - Functional Description	CDM	Field	2	2	2			
14	Aug-Sept 09	Treatment Process	Plant Electrical Power Distribution - Functional Description	CDM	Field	1	1	1			
15	Aug-Sept 09	Maintenance	Trickling Filter - Oil and Grease Lubrication	CDM	Field	2	2	2		1	
16	Aug-Sept 09	Maintenance	Trickling Filter - Distributor Arm Flushing & Cleaning	CDM	Field	1	1	1		1	
17	Aug-Sept 09	Maintenance	Portable Diaphragm Pump - O&M Guidelines	CDM	Field	1	1	1			

CDM Constructors Inc.

Fourzol Village WWTP

Subject: Plant Staff - Summary Listing of Attended Training Events

	Date	Course Subject	Training Title	Instructor	Location	Students					
						[redacted] (Plant Operator)	[redacted] (Plant Operator)	[redacted] (Plant Operator)	[redacted] (Plant Operator)	Security / Plant Assistant	Municipality Accountant
18	Aug-Sept 09	Maintenance	Portable Air Ventilation Blower - O&M Guidelines	CDM	Field	1	1	1			
19	Aug-Sept 09	Treatment Process	Chemical Feed Pumps - Operation Guidelines	CDM	Field	1	1	1			
20	Aug-Sept 09	Maintenance	Standby Power Generator - Routine Service - Lubrication	CDM	Field	1	1	1			
21	Aug-Sept 09	Maintenance	Administration Building AC - O&M Guidelines	CDM	Field	1	1	1			
22	Aug-Sept 09	Maintenance	Administration Building - Potable Water Tank	CDM	Field	1	1	1			
23	Aug-Sept 09	Maintenance	End Suction Sludge Pumps - Seal Water Supply System	CDM	Field	1	1	1			
24	Aug-Sept 09	Maintenance	End Suction Sludge Pumps - Packing Replacement	CDM	Field	1	1	1			
25	Aug-Sept 09	Maintenance	Submersible Pump - Hoisting Procedures	CDM	Field	1	1	1			
26	Aug-Sept 09	Treatment Process	Septage Receiving Pump - Operation Guidelines	CDM	Field	1	1	1			
27	Aug-Sept 09	Treatment Process	Final Clarifier Pump Station - Operation Guidelines	CDM	Field	1	1	1		1	
28	Aug-Sept 09	Maintenance	Trickling Filter Fans - Propeller shaft alignment	CDM	Field	2	2	2			
29	Aug-Sept 09	Maintenance	Workshop Tool Inventory - How to Update Inventory List	CDM	Workshop	2	2	2			
30	Aug-Sept 09	Safety	Plant Operator Safety Guidelines Handbook	CDM	Classroom	2	2	2			
31	Aug-Sept 09	Treatment Process	Dissolved Oxygen Meter - Calibration & Use	CDM	Classroom	2	2	2			
32	Aug-Sept 09	Treatment Process	pH Meter - Calibration and use	CDM	Classroom	2	2	2			
33	Aug-Sept 09	Treatment Process	Settleability Test - Procedure and Record Keeping	CDM	Classroom	2	2	2			
34	Aug-Sept 09	Treatment Process	Sludge Settling Test - Procedure and data recording	CDM	Classroom	2	2	2			

CDM Constructors Inc.

Fourzol Village WWTP

Subject: Plant Staff - Summary Listing of Attended Training Events

	Date	Course Subject	Training Title	Instructor	Location	Students					
						(Plant Operator)	(Plant Operator)	(Plant Operator)	(Plant Operator)	Security / Plant Assistant	Municipality Accountant
35	Aug-Sept 09	Treatment Process	Field Sample Collection - Procedure and data recording	CDM	Field	2	2	2			
36	Aug-Sept 09	Maintenance	Plant Water - Hydropneumatic Tank Air Fill Procedure	CDM	Field	1	1	1			
37	Aug-Sept 09	Maintenance	Plant Water - Control Panel Troubleshooting	CDM	Field	1	1	1			
38	Aug-Sept 09	Management	Plant Cost Accounting - Preparing Monthly Cost Summary	CDM	Classroom	1	1	1			2
39	Aug-Sept 09	Management	Plant Cost Accounting - Estimating Electricity & Fuel Monthly Costs	CDM	Classroom	1	1	1			
40	Aug-Sept 09	Maintenance	Sludge Piping - How to flush a plugged line	CDM	Field	2	2	2		2	
41	Aug-Sept 09	Treatment Process	Digester - Sludge Decanting Procedures and record keeping	CDM	Classroom	4	4	4		2	
42	Aug-Sept 09	Management	Operation Data Trending and Charts - Introduction	CDM	Classroom	2	2	2			
43	10-Jun-09	Maintenance	Check Valve O&M	TAJJ	Field	1	1	1			
44	10-Jun-09	Maintenance	Plug Valve O&M	TAJJ	Field	1	1	1			
45	10-Jun-09	Maintenance	Plant Water Pump System - how to clean the pump suction strainer	CDM	Field	1	1	1			
46	16-Jun-09	Treatment Process	Facility Power Distribution - Introduction	TAJJ	Field	2	2	2			
47	22-Jun-09	Maintenance	Final Clarifier - Telescoping valves - How they work & routin	TAJJ	Field	1	1	1			
48	29-Jun	Maintenance	Generator System Introduction - Fuel piping and fuel bulk st	TAJJ	Field	1	1	1			
49	29-Jun	Maintenance	Generator System Introduction - Day tank, Fuel pump, supp	TAJJ	Field	1	1	1			
50	1-Oct-09	Maintenance	Plumbing - How to unplug the Admin Bldg drain lines.	CDM	ADMN	1	1	1		1	
51	4-Oct-09	Maintenance	Generator Day Tank - How to replace pipe union fitting	TAJJ	Field	3	3	3		3	

CDM Constructors Inc.

Fourzol Village WWTP

Subject: Plant Staff - Summary Listing of Attended Training Events

	Date	Course Subject	Training Title	Instructor	Location	Students					
						(Plant Operator)	(Plant Operator)	(Plant Operator)	(Plant Operator)	Security / Plant Assistant	Municipality Accountant
52	16-Oct-09	Maintenance	Sludge Pumping - How to unplug the sludge piping using flu	CDM	Field	3	3	3		3	
53	17-Oct-09	Maintenance	Plant Water Pump System - how to clean the pump suction strainer	CDM	Field	1	1	1		1	
54	20-Oct-09	Treatment Process	Chlorine contact tank - periodic draining and cleaning	CDM	Field	3	3	3		3	
55	23-Oct-09	Maintenance	Plant water pump - run hour meter installation	TAJJ	Field	1	1	1			
56	29-Oct-09	Maintenance	Emergency air blower & diaphragm pump lubrication and exercise	CDM	Field	2	2	2			
57	30-Oct-09	Treatment Process	Digester startup - 1st filling of tanks after emptying sludge to drying beds	CDM	Field	2	2	2			
58	30-Oct-09	Water Quality Testing	How to calibrate the DO meter and pH meter	CDM	Field	1	1	1			
59	2-Nov-09	Maintenance	Digester Sludge Pump - How & when to flush clean the piping	CDM	Field	2	2	2		2	
60	3-Nov-09	Maintenance	Sludge Pump - How & when to flush clean the seal water su	CDM	Field	1	1	1		1	
61	4-Nov-09	Management	Water quality historic data - How to complete the 'Data Histo	CDM	Classroom	3	3	3			
62	15-Nov-09	Maintenance	Venting air out of the plant water pumps after strainer clean	CDM	Field	1	1	1		1	
63	16-Nov-09	Treatment Process	Flow meter reading	Modon	Field	2	2	2			
64	17-Nov-09	Maintenance	Sludge Drying Beds - How to remove rain water w/ sump pu	CDM	Field	3	3	3			
65	Dur-Nov-09	Management	Computer data entry and data trending - for WWTP process	CDM	Classroom	15	15	15			
66	1-Dec-09	Maintenance	Generator - How to check the oil and water levels	TAJJ	Field	1	1	1			
67	1-Dec-09	Maintenance	Generator - how to check and install anti-freeze solution to	TAJJ	Field	2	2	2			
68	18-Dec-09	Treatment	How to pump sludge from the Final Clarifier to the Digester.	CDM	Field	2	2	2		2	
69	19-Dec-09	Maintenance	Pump capacity testing - Final Clarifier Pumps	CDM	Field	1	1	1			

CDM Constructors Inc.

Fourzol Village WWTP

Subject: Plant Staff - Summary Listing of Attended Training Events

	Date	Course Subject	Training Title	Instructor	Location	Students					
						[redacted] (Plant Operator)	[redacted] (Plant Operator)	[redacted] (Plant Operator)	[redacted] (Plant Operator)	Security / Plant Assistant	Municipality Accountant
70	9-Jan-10	Management	Plant Cost Accounting - Preparing Monthly Cost Summary	CDM	Classroom	1	1	1			2
71	17-Apr-10	Treatment Process	Basic Math for Operators - Fractions	CDM	Classroom	Operator Dismissed by Village Mayor	Operator Dismissed by Village Mayor	3			
72	21-Apr-10	Treatment Process	Basic Math for Operators - Decimals	CDM	Classroom			1			
73	29-Apr-10	Treatment Process	Basic Math for Operators - Powers & Rounding	CDM	Classroom			0			
74	15-May-10	Treatment Process	Basic Math for Operators - calculating perimeter + volume	CDM	Classroom			0			
75	21-May-10	Management	Daily report Data Collected and faxed to CDM-Office	CDM	Classroom			1			
76	27-May-10	Skill Test	Field Data Collection & Record Keeping	CDM	Field			1			
77	27-May-10	Skill Test	Process Tank Identification	CDM	Field			1			
78	27-May-10	Skill Test	Clarifier Sludge Blanket Measurement	CDM	Field			0.5			
79	27-May-10	Skill Test	Sludge Settle ability Test 2-Liter Settling Beaker	CDM	Laboratory			1			
80	27-May-10	Skill Test	Ph-and DO calibration & use	CDM	Laboratory			0.5			
81	27-May-10	Skill Test	Settle able Solids Test Imhoff Cone	CDM	Laboratory			1			
82	27-May-10	Skill Test	Trickling Filter Flow Distributor	CDM	Field			0.5			
83	27-May-10	Skill Test	Trickling Filter ventilation fan	CDM							
84	27-May-10	Skill Test	Primary Clarifier Pumping to the Anaerobic Digester	CDM	Field			0.5			
85	27-May-10	Skill Test	Fuel Storage Tank	CDM	Field			0.5			
86	27-May-10	Skill Test	Fine Screen	CDM	Field			0.5			
87	28-May-10	Treatment Process	Advice and Assist - Secondary Clarifier Sludge handling	CDM	Field			2			

CDM Constructors Inc.

Fourzol Village WWTP

Subject: Plant Staff - Summary Listing of Attended Training Events

	Date	Course Subject	Training Title	Instructor	Location	Students					
						[redacted] (Plant Operator)	[redacted] (Plant Operator)	[redacted] (Plant Operator)	[redacted] (Plant Operator)	Security / Plant Assistant	Municipality Accountant
88	29-May-10	Treatment Process	Advice and Assist - Secondary Clarifier Sludge handling	CDM	Field	Operator Dismissed by Village Mayor	Operator Dismissed by Village Mayor	2			
89	3-Jun-10	Maintenance	Maintenance cards, summery table and schedule	CDM	Classroom			2			
90	3-Jun-10	Water Quality Testing	Samples: Grapping, Tagging, Cooling , Chain of Custody	CDM	Field			1			
91	3-Jun-10	Safety	Re-Training on the Safety guide book	CDM	Classroom			2			
92	3-Jun-10	Treatment Process	Advice and Assist - Secondary Clarifier Sludge handling	CDM	Field			1			
93	5-Jun-10	Treatment Process	Advice and Assist - Secondary Clarifier Sludge handling	CDM	Field			1			
94	10-Jun-10	Treatment Process	Advice and Assist - Plant walk-through inspection tour w/ Plant Operator	CDM	Field			1			
95	10-Jun-10	Water Quality Testing	Sampling - How to collect, label, preserve, and fill in chain-c	CDM	Field			1			
96	14-Jun-10	Treatment Process	Advice and Assist - Plant walk-through inspection tour w/ Plant Operator	CDM	Field			Operator Dismissed by Village Mayor	3		
97	14-Jun-10	Treatment Process	Primary Clarifier Sludge handling	CDM	Field				1		
98	14-Jun-10	Treatment Process	Secondary Clarifier Sludge handling	CDM	Field				1		
99	14-Jun-10	Management	Equipment run hours record keeping	CDM	Field				2		
100	16-Jun-10	Water Quality Testing	Sludge Setteability test form: 2- Liter test	CDM	Classroom				1		
101	16-Jun-10	Water Quality Testing	Daily Treatment Process sampling sheet	CDM	Field				1		
102	16-Jun-10	Treatment Process	Sludge drying bed sheet : Level , bed Temp , air Temp	CDM	Field				1		
103	16-Jun-10	Treatment Process	Evaporation pan daily measurement	CDM	Field				1		
104	16-Jun-10	Maintenance	Generator engine - oil + filters change	CDM	Field				2		

CDM Constructors Inc.

Fourzol Village WWTP

Subject: Plant Staff - Summary Listing of Attended Training Events

	Date	Course Subject	Training Title	Instructor	Location	Students					
						[redacted] (Plant Operator)	[redacted] (Plant Operator)	[redacted] (Plant Operator)	[redacted] (Plant Operator)	Security / Plant Assistant	Municipality Accountant
105	17-Jun-10	Treatment Process	Advice and Assist - Plant walk-through inspection tour w/ Plant Operator	CDM	Field	Operator Dismissed by Village Mayor	Operator Dismissed by Village Mayor	Operator Dismissed by Village Mayor	2		
106	18-Jun-10	Treatment Process	Decanting from Digester tank # 2 to Digester tank # 1	CDM	Field				1		
107	18-Jun-10	Water Quality Testing	Setteability Cone test	CDM	Classroom				1		
108	18-Jun-10	Treatment Process	Advice and Assist - Plant walk-through inspection tour w/ Plant Operator	CDM	Field				1		
109	18-Jun-10	Maintenance	Installing a plug valve at Digester # 1 decant line	CDM	Field				1		
110	18-Jun-10	Management	Weekly summery sheet equipment run hours records	CDM	Classroom				2		
111	19-Jun-10	Treatment Process	Advice and Assist - Plant walk-through inspection tour w/ Plant Operator	CDM	Field				1		
112	21-Jun-10	Management	Daily operation report	CDM	Classroom				2		
113	21-Jun-10	Management	Daily operation Fax report	CDM	Classroom				1		
114	21-Jun-10	Treatment Process	Sludge handling Treatment Process sheet- Septic truck receiving	CDM	Classroom				1		
115	21-Jun-10	Treatment Process	Sludge wasting from secondary clarifier to Anaerobic digest	CDM	Field				1		
116	21-Jun-10	Treatment Process	Calculating flow -Raw sewage volume	CDM	Classroom				0.5		
117	21-Jun-10	Treatment Process	Calculating volume of pumped sludge from primary to the d	CDM	Classroom				0.5		
118	21-Jun-10	Treatment Process	Calculating volume of pumped sludge from secondary to the	CDM	Classroom				0.5		
119	21-Jun-10	Treatment Process	Calculating volume of pumped sludge from septic to the dig	CDM	Classroom				0.5		
120	22-Jun-10	Water Quality Testing	DO-Calibration & use	CDM	Field				0.5		
121	22-Jun-10	Water Quality Testing	Ph-Calibration & use	CDM	Field				0.5		

CDM Constructors Inc.

Fourzol Village WWTP

Subject: Plant Staff - Summary Listing of Attended Training Events

	Date	Course Subject	Training Title	Instructor	Location	Students					
						[redacted] (Plant Operator)	[redacted] (Plant Operator)	[redacted] (Plant Operator)	[redacted] (Plant Operator)	Security / Plant Assistant	Municipality Accountant
122	22-Jun-10	Maintenance	West-tech distributor arm : upper bearing lubrication	CDM	Field	Operator Dismissed by Village Mayor	Operator Dismissed by Village Mayor	Operator Dismissed by Village Mayor	0.5		
123	22-Jun-10	Maintenance	West-tech distributor arm : lower bearing lubrication	CDM	Field				0.5		
124	22-Jun-10	Maintenance	West-tech distributor arm : flushing and cleaning	CDM	Field				0.5		
125	22-Jun-10	Maintenance	Strainers- flushing and cleaning	CDM	Field				1		
126	22-Jun-10	Maintenance	Exercising the fans	CDM	Field				0.5		
127	22-Jun-10	Maintenance	Blowers usage and exercising	CDM	Field				1		
128	22-Jun-10	Maintenance	Diaphragm pump usage and exercising	CDM	Field				1		
129	22-Jun-10	Treatment Process	Advice and Assist - Plant walk-through inspection tour w/ Plant Operator	CDM	Field				1		
130	23-Jun-10	Treatment Process	Advice and Assist - Plant walk-through inspection tour w/ Plant Operator	CDM	Field				1		
131	23-Jun-10	Treatment Process	Introduction to the chlorine feeding process	CDM	Field				1		
132	24-Jun-10	Treatment Process	Advice and Assist - Plant tour	CDM	Field				1		
133	24-Jun-10	Treatment Process	Anaerobic digester decanting process back to the Influent p	CDM	Field				4		
134	24-Jun-10	Maintenance	Influent pump capacity test	CDM	Field				1		
135	24-Jun-10	Water Quality Testing	DO-meter membrane change	CDM	Classroom				1		
136	25-Jun-10	Treatment Process	Advice and Assist - Plant walk-through inspection tour w/ Plant Operator	CDM	Field				2		
137	25-Jun-10	Treatment Process	Anaerobic digester decanting process and measurement	CDM	Field				2		
138	26-Jun-10	Treatment Process	Advice and Assist - Plant walk-through inspection tour w/ Plant Operator	CDM	Field				2		

CDM Constructors Inc.

Fourzol Village WWTP

Subject: Plant Staff - Summary Listing of Attended Training Events

	Date	Course Subject	Training Title	Instructor	Location	Students					
						(Plant Operator)	5 (Plant Operator)	(Plant Operator)	(Plant Operator)	Security / Plant Assistant	Municipality Accountant
139	30-Jun-10	Treatment Process	Advice and Assist - Plant walk-through inspection tour w/ Plant Operator	CDM	Field				1		
140	30-Jun-10	Water Quality Testing	Grapping samples to send for AUB-Lab & filling the sample forms	CDM	Field				5		
					Total Hours to Date:	**127**	**127**	**127**	**57**	**29**	**4**

3.3 Ablah WWTP Training Results Summary

ABLAH VILLAGE TREATMENT PLANT

CDM Constructors Inc.

Subject: Operator Work Skills Training - Summary Results

Skill Area	Skill Name	Skill Pass/Fail Measurement Method	Skill Testing Location		Village Staff Skill Learning Results	
			Field or Classroom	Location	[redacted]	
					Pass/Fail & Date	Pass/Fail & Date
Site Laboratory	**pH Meter,** calibration and use	Demonstration of step procedure	classroom	Ablah WWTP	PASS Nov. 2011	
Site Laboratory	**Dissolved Oxygen Meter,** calibration and use	Demonstration of step procedure	classroom	Ablah WWTP	PASS May 2012	
Site Laboratory	**Imhoff Cone,** Settleable Solids Test	Demonstration of step procedure	classroom	Ablah WWTP	PASS Nov. 2011	
Site Laboratory	**2-Liter Settleometer -** Sludge Settling test	Demonstration of step procedure	classroom	Ablah WWTP	PASS May 2012	
Site Laboratory	**Sludge Judge Core Sampler** - Clarifier Sludge Depth Measurement	Demonstration of step procedure	Field	Ablah WWTP	PASS April 2012	
Site Laboratory	**Sample Collection Procedure for Offsite AUB Analysis**	Demonstration of step procedure and associated paperwork	Field	Ablah WWTP	PASS May 2012	
Safety	**Safety Guidelines for Plant Operators,**	Student discussion & explanation of required safety procedures		Ablah WWTP	PASS Nov. 2011	
Records & Reports	**Equipment Running Hour Field Data Collection and Summary Report**: Data entry and calculation	Demonstration of data collection, form filling, and Report making	Field & Classroom	Ablah WWTP ADMN BLD	PASS Nov. 2011	
Records & Reports	**Plant Operations Daily Summary Report**: Data entry and calculation	Demonstration of data collection, form filling, and Report making	Field & Classroom	Ablah WWTP	PASS Nov. 2011	
Records & Reports	**Computer use in Data Management**	Demonstration of learned skill	Field & Classroom	Ablah WWTP	PASS Nov. 2011	
Maint.	**Fuel Storage Tank** - Level Measurement	Demonstration of step procedure and associated paperwork	Field	Ablah WWTP	PASS Nov. 2011	
Tools	Portable Drill Use	Demonstration of step procedure	Field	Ablah WWTP	PASS Nov. 2011	
Maint.	**Trickling Filter Flow Distributor** Lubrication	Demonstration of step procedure and associated paperwork	Field	Ablah WWTP	PASS Nov. 2011	
Maint.	**Trickling Filter Ventilation Fan:** Inspection & Maintenance	Demonstration of step procedure and associated paperwork	Field	Ablah WWTP	PASS Nov. 2011	
Plant Operations	**Primary Clarifier Sludge Pumping** to Digester	Demonstration of step procedure and associated paperwork	Field	Ablah WWTP	PASS Nov. 2011	
Plant Operations	**Final Clarifier Sludge Pumping** to Digester	Demonstration of step procedure and associated paperwork	Field	Ablah WWTP	PASS Nov. 2011	
Plant Operations	**Plant Water Pump System** - Understanding of Control Logic	Student demonstrates understanding during plant walkthrough tour	Field	Ablah WWTP	PASS Nov. 2011	
Plant Operations	**Digester Pump System** - Understanding of Control Logic	Student demonstrates understanding during plant walkthrough tour	Field	Ablah WWTP	PASS Nov. 2011	
Plant Operations	**Final Clarifier Pump System** - Understanding of Control Logic	Student demonstrates understanding during plant walkthrough tour	Field	Ablah WWTP	PASS Nov. 2011	
Plant Operations	**Trickling Filter Pump System** - Understanding of Control Logic	Student demonstrates understanding during plant walkthrough tour	Field	Ablah WWTP	PASS Nov. 2011	
Plant Operations	**Yard Piping Network** - Functional Understanding of Piping and Valves	Student demonstrates understanding during plant walkthrough tour	Field	Ablah WWTP	PASS Nov. 2011	
Plant Operations	**Standby Power Generator Monitoring**: Observation and data recording	Student demonstrates understanding and skill during on-the-job work activities.	Field	Ablah WWTP	PASS Nov. 2011	
Plant Operations	**Power Distribution Panel Board -** Functional Understanding of trip settings and control switches.	Student demonstrates understanding and skill during on-the-job work activities.	Field	Ablah WWTP	PASS Nov. 2011	
Plant Operations	**Sludge Digester Decant** Procedure	Demonstration of step procedure and associated paperwork	Field	Ablah WWTP	PASS April 2012	
Plant Operations	**Sludge Drying Bed Filling** Procedure	Demonstration of step procedure and associated paperwork	Field	Ablah WWTP	PASS June 2012	
Maint.	**Sludge Pump** - Seal packing gland adjustment.	Student demonstrates understanding and skill during on-the-job work activities.	Field	Ablah WWTP	PASS Nov. 2011	
Plant Operations	**Sludge Pump Seal Water System** - Functional Understanding of	Student demonstrates understanding and skill during on-the-job work activities.	Field	Ablah WWTP	PASS Nov. 2011	
Plant Operations	**Process Tank Identification** - Knowladge of Tank Name and Basic Functional Understanding of Tank Duty	Student demonstrates understanding during plant walkthrough tour	Field	Ablah WWTP	PASS Nov. 2011	
Plant Operations	**Fine screen -** Functional Understanding of	Student demonstrates understanding during plant walkthrough tour	Field	Ablah WWTP	PASS Nov. 2011	
Plant Operations	**Employee Safety Handbook**	Student discussion & explanation of required safety procedures	Field & Classroom	Ablah WWTP	PASS Nov. 2011	
Plant Operations	**Potable Water System -** Knowledge and skills for operating all valves in system and filling tank from either Plant Water supply or private tanker trailer.	Student demonstrates understanding and skill during on-the-job work activities.	Field	Ablah WWTP	PASS Jan. 2011	
Maint.	**Welding Machine** - Skills in safe use of welder for small jobs.	Student demonstrates understanding and skill during on-the-job work activities.	Field	Ablah WWTP	PASS Jan. 2011	
Maint.	**Plumbing Skills** - ability to work with metal and plastic pipe in cutting, threading, installing valves and fittings, leak testing, and thermal insulation.	Student demonstrates understanding and skill during on-the-job work activities.	Field	Ablah WWTP	PASS Jan. 2011	
Maint.	**Slide Gate Maintenance** - stem lubrication, slide guide cleaning, gate installation, leak checking, seal replacement and adjustment.	Student demonstrates understanding and skill during on-the-job work activities.	Field	Ablah WWTP	PASS Jan. 2011	
Maint.	**Standby Power Generator** - Routine preventive maintenance - scheduling w/ local service agent and inspection of completed work, and record keeping of performed maintenance.	Student demonstrates understanding and skill during on-the-job work activities.	Field	Ablah WWTP	PASS April 2012	
Maint.	**Plant Water System** - Pump control troubleshooting and repair. Installation and adjustment of pressure switch, installation and adjustment of zero flow switch.	Student demonstrates understanding and skill during on-the-job work activities.	Field	Ablah WWTP	PASS May 2012	
Maint.	**HDPE Pipe Welding** - practical work in making 1-inch and 1/2-inch pipe installations.	Student demonstrates understanding and skill during on-the-job work activities.	Field	Ablah WWTP	PASS May 2012	
Maint.	**Septage Receiving Pump** - Pump unplugging and cleaning.	Student demonstrates understanding and skill during on-the-job work activities.	Field	Ablah WWTP	PASS May 2012	

3.4 Operator Skills Training & Testing Templates

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Forzoul WWTP

Type of Training	[ ] on-the-job [x] lassroom [ ] other
Date of Training:	Date:16 jun 09 Start Time:10:00 Duration:2h
Instructor:	TAJJ-Electrical subcontractor, Ms. Channel
Location:	Administration Building
Training Topic:	**Plant Electrical Systems - Functional Description**

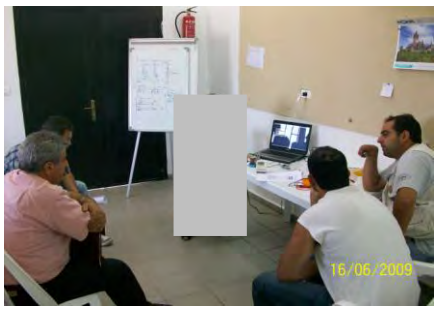
Training Event Outline or Summary

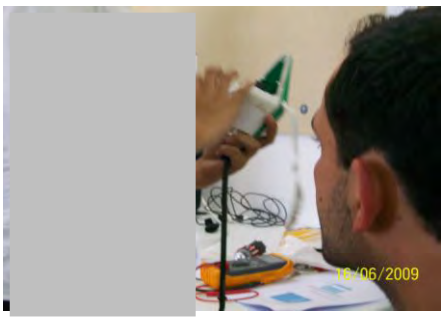
1) Pump Controls - float switches - functional description
2) Control Panels - selector switches and indicators (amps and volts)
3) Control panels - inside components identification
4) Control Panels - PLC logic settings
5) Plant Main power distribution panel - functional description
6) ATS Panel - functional description
7) Plant buried cable - routing in yard
8) Buildings - lighting panel circuit description

Training Materials

Handout, float switch cut-away, PLC example, white board, as-built drawings

Training Photos





Plant Operator Name	Signature
[redacted]	
[redacted]	
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Forzoul WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:24 AUG 09 Start Time:14:00 Duration:1H
Instructor:	Kohler Technician
Location:	On-site
Training Topic:	**Generator Engine Oil Change**

Training Event Outline or Summary

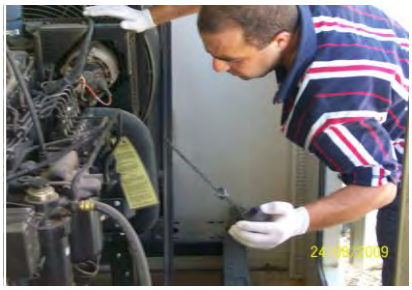
1) Oil change frequency - maintenance task overview
2) Tools and equipment used in oil change work task
3) Safety concerns - equipment lockout prior to start of work
4) Oil draining steps - (also discuss disposal of used oil)
5) New oil filling steps

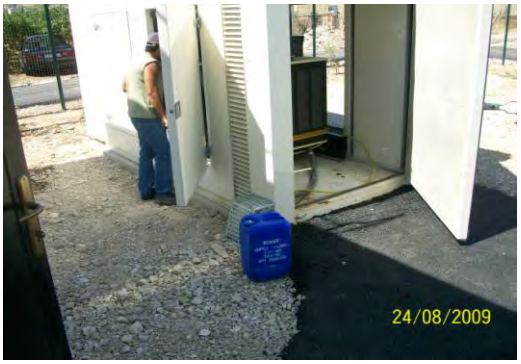
Training Materials

Equipment O&M Manual ,hand tools,oil, filters,

Special Notes:

Training Photos





Plant Operator Name	Signature
[redacted]	
[redacted]	
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Fourzol WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:10-jun-09 Start Time:9:00 Duration:1h
Instructor:	CDM - Matt Antill & Issam Deeb
Location:	On-site
Training Topic:	**Trickling Filter Fan Inspection**

Training Event Outline or Summary

1) Purpose of fan inspection - routine check after 30 days running
2) Maintenance tools overview
3) Maintenance task safety concerns (equipment lockout, proper selection of tools)

3) Inspection Criteria and maintenance tasks - belt condition and tension check, fan shaft bearing lubrication, fan metal housing dirt & rust inspection/removal, motor bearing lubrication
4) Maintenance recordkeeping
5) Safety concerns and precautions

Training Materials

Equipment O&M Manuals, hand tools

Special Notes:

Training Photos

Plant Operator Name	Signature
[redacted]	
[redacted]	
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Fourzol WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:25May-09 Start Time:10:00 Duration:1H
Instructor:	CDM - Issam Deeb
Location:	Classroom then at the pump location
Training Topic:	**Pump Capacity Testing - Wetwell Drawdown Method**

Training Event Outline or Summary

1) Purpose of pump capacity testing
2) Wetwell volume determination (measurement and calculation)
3) Steps for measuring wetwell drawdown level (before & after pumping)
4) Recordkeeping requirements (levels, pressure gauge, motor amps, and pump running time measurements)
5) Safety concerns - wetwell confined space reminder

Training Materials

Whiteboard, meter, calculator,

Special Notes:

Training Photos

Plant Operator Name	Signature
[redacted]	
[redacted]	
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Forzoul WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:10jun09 Start Time:14:00am Duration:1h
Instructor:	TAJJ - Bassem Gayda
Location:	On-site
Training Topic:	**Check Valve O&M**

Training Event Outline or Summary

1) Overview of check valves installed and their location.
2) Valve operation - open/close mechanism
3) Valve disassembly & inspection.
4) Valve routine maintenance.
5) Safety concerns and precautions

Training Materials

Equipment O&M Manuals,hand tools

Special Notes:

This training provided by TAJJ was introductory information only.
CDM will provide more comprehensive training on valve O&M at a later date.

Training Photos

Plant Operator Name	Signature
[redacted]	
[redacted]	
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Fourzol WWTP

Type of Training	___on-the-job x classroom ___other
Date of Training:	Date:9jun09 Start Time:9:00am Duration:1h
Instructor:	TAJJ - Bassem Gayda
Location:	Facility Workshop
Training Topic:	**Plug Valve O&M**

Training Event Outline or Summary

1) Overview of plug valves installed and their location.
2) Valve operation - open/close mechanism
3) Valve disassembly & inspection.
4) Valve open/close adjustment procedure.
5) Safety concerns and precautions

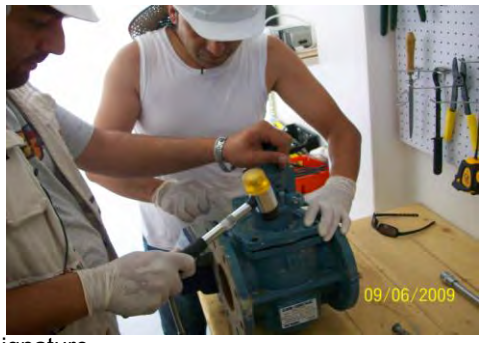
Training Materials

Equipment O&M Manuals, hand tools

Special Notes:

This training provided by TAJJ was introductory information only. CDM will provide more comprehensive training on valve O&M at a later date.

Training Photos



Plant Operator Name	Signature
[redacted]	
[redacted]	
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Fourzol WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:4 AUG 09 Start Time:9:00 Duration:1H
Instructor:	CDM -ISSAM DEEB
Location:	Primary clarifier &Secondary clarifier
Training Topic:	**Clarifier Cleaning Procedures**

Training Event Outline or Summary

1) Discussion of clarifier cleaning - Why & How
2) Scum skimmer & Weir cleaning - steps to follow
3) Wall cleaning - choosing the proper brush & technique
4) Fiberglass trough cleaning - brush and hose technique
5) Clarifier surface scum removal - use of skimmer net.
6) Safety concerns and precautions

Training Materials

Brushes, flushing hose & nozzle

Training Photos

Plant Operator Name	Signature
[redacted]	
[redacted]	
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date_22jun2009 Start Time:10:00 Duration:1h
Instructor:	TAJJ -Aliawad
Location:	Final Clarifier Tank
Training Topic:	**Telescopic valves O&M**

Training Event Outline or Summary

1) Overview of telescopic valves installed and their location (Telescopic type)
2) Valve operation - open/close mechanism
3) Valve disassembly & inspection.
4) Valve routine maintenance.
5) Safety concerns and precautions

Training Materials

Equipment O&M Manuals, hand tools

Special Notes:

This training provided by TAJJ was introductory information only. CDM will provide more comprehensive training on valve O&M at a later date.

Training Photos

Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Fourzol WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:29 jun-09 Start Time:10:00 Duration:1H
Instructor:	TAJJ-Bassem Gayda
Location:	On-site
Training Topic:	**Generator Fuel System (Storage, Day Tank, Supply Piping)**

Training Event Outline or Summary

1) Discussion of the Generator fuel supply system
2) Bulk Fuel tank & piping - functional description
3) Fuel Day Tank - Functional description
4) Tank level measurement - steps to follow
5) Safety concerns and precautions

Training Materials

Equipment O&M Manuals

Special Notes:

Training Photos

Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Fourzol WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:21 AUG 09 Start Time:11:00 Duration:1h
Instructor:	CDM
Location:	On-site
Training Topic:	**Trickling Filter Distribution Arm Flushing**

Training Event Outline or Summary

1) Discussion about distributor arm maintenance - Why and How
2) Arm flushing - Steps to follow
3) Arm Cleaning with brush - Steps to follow
4) Safety concerns and precautions

Training Materials

Special Notes:

Training Photos

Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Fourzol WWTP

Type of Training	___ on-the-job x classroom ___ other
Date of Training:	Date:2 AUG 09 Start Time:10:00 Duration:2h
Instructor:	CDM
Location:	Classroom - Admin Building
Training Topic:	**Operator Safety Guidelines**

Training Event Outline or Summary

1) Detailed discussion of the contents of the Plant Safety Guidelines manual.

Training Materials

Operators Safety Guidelines Manual

Special Notes:

Training Photos

Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Fourzol WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:10-jun-09 Start Time15:30 Duration:1h
Instructor:	CDM
Location:	Plant Water Pump Station
Training Topic:	**Plant Water - O&M Discussion**

Training Event Outline or Summary

1) Overview of the plant water system
2) System controls - functional description
3) Tank Maintenance - Checking/Adding air to the hydropneumatic tank.
4) Strainer routine maintenance
5)Troubleshooting

Training Materials

1) Air Compressor, pressure gauge, hand tools

Special Notes:

Training Photos

Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Forzoul WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:4 AUG 09 Start Time:10:00 Duration:1H
Instructor:	CDM
Location:	Fine screen facility & Bar screen
Training Topic:	**Bar Rack and Fine Screen - Routine Cleaning Procedure**

Training Event Outline or Summary

1) Discussion of Screen function - How it works
2) Screen cleaning - When and How
3) Screen Cleaning - Tools to use
4) Safety concerns and precautions

Training Materials

Special Notes:

Training Photos

Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Fourzol WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:3 AUG 09 Start Time:9:00 Duration:2H
Instructor:	CDM Matt Antill
Location:	On-site
Training Topic:	**Process Monitoring - Introduction to water sampling, test instruments, and data recording.**

Training Event Outline or Summary

1) Overview of the treatment process sampling & monitoring requirements.
2) Dissolved oxygen meter calibration, use, and data recording.
3) pH meter calibration, use, and data recording.
4) Sample collection from process tanks - demonstration
4) Temperature - Measuring and Data recording.
5) Settleable solids test - demonstration
6) Laboratory general safety concerns and precautions.

Training Materials

Dissolved Oxygen Meter, pH Meter, Sampling Bucket, Safety Gloves

Training Photos

Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Fourzol WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:6 AUG 09 Start Time:12:00 Duration:--
Instructor:	CDM-ISSAM DEEB
Location:	ADMN-Office
Training Topic:	**Process Control - Data Recording and Management**

Training Event Outline or Summary

1) Field Data collection - Purpose and importance
2) Field data collection - fill-in-in the data collection field forms
3) Data summary - filling-in the data summary table
4) Data Management - Calculating summed values

Training Materials

Running hours data sheet, Summary sheets

Special Notes:

Training Photos

Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Forzoul WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:22 Apr 09 Start Time:10:00 Duration:1h
Instructor:	CDM -Issam Deeb
Location:	Trickling Filter No.1 & No.2
Training Topic:	**Trickling Filter distribution arm bearing lubrication**

Training Event Outline or Summary

1) Overview of distribution arm support bearing
2) Bearing lubrication - Why and How discussion
3) Steps for grease lubricating bearing.
4) Steps for oil lubrication of bearing
5) Safety concerns and precautions

Training Materials

1) Oil, grease , grease gun, oil, funnel, wrenches, allen keys
2) Equipment O&M Manuals, hand tools

Training Photos

Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Fourzol WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:2 AUG 09 Start Time:9:00 Duration:1H
Instructor:	CDM - Matt Antill
Location:	Plant Lab Area
Training Topic:	**pH and Dissolved Oxygen Meter Calibration**

Training Event Outline or Summary

1) Discussion on the importance of instrument calibration
2) pH meter calibration - Steps to follow
3) DO meter calibration - Steps to follow

Training Materials

DO & PH-meter, PH Buffer
Equipment O&M Manuals

Special Notes:

Training Photos

Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Fourzol WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:25 AUG 09 Start Time:9:00 Duration:3H
Instructor:	CDM-Issam Deeb
Location:	AD # 1
Training Topic:	**Sludge Settleability Test**

Training Event Outline or Summary

1) Sample collection from the sludge pump discharge tap (steps to follow).
2) Sample pouring into the setting beaker and making observations during the settling period
3) Recording the Reading of the floating materials and the settable materials
4) Reading of the clear zone in the middle of the Beaker
5) Safety concerns and precautions

Training Materials

2L Beaker , settlebility test data sheet

Special Notes:

Training Photos

Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - forsook WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:3 Sept. 09 Start Time:14:30 Duration:1h
Instructor:	CDM
Location:	Final Clarifier Tanks
Training Topic:	**Clarifier Sludge Level Measurement**

Training Event Outline or Summary

1) Overview about tank configuration and dangers of too much sludge accumulation.
2) Core-tube assembly steps
3) Core-tube use - steps for lowering tube into the water and collecting a sample.
4) Core-tube level measurement reading and data recording
5) Core-tube disassembly and cleaning.

Training Materials

Sludge level core-tube sampler.

Special Notes:

Training Photos

Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Fourzol WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date: 9 March 09 Start Time:9:00 Duration:2h
Instructor:	CDM-Issam Deeb
Location:	Fourzol WWTP
Training Topic:	**Plant Orientation for New Staff**

Training Event Outline or Summary

1) General discussion of plant major components using the site drawing.
2) Plant walking tour - Identification of each tank structure.
3) Plant process flow - basic discussion of flow path starting at influent pump station and ending at chlorine contact basin.
4) Process tank - functional description of each.

Training Materials

Plant site drawing

Training Photos

Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Fourzol WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:9 sept-09 Start Time:9:00 Duration:2h
Instructor:	CDM-ISSAM DEEB
Location:	Chemical BLD
Training Topic:	**Chemical pump capacity test**

Training Event Outline or Summary

1)Overview on the chemical feed pumps and the way they work
2) Pump chemical feed hose installation
3) Running the pump on/off switches
4) Pump stroke setting and speed control
5) A pump capacity test to calculate the volume at different speeds and strokes
6) Safety concerns and precautions

Training Materials

Stop watch, Graduated Cylinder

Special Notes:

Training Photos

Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Fourzol WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:10 sept-09 Start Time:10:30 Duration:2h
Instructor:	TAJJ-sub-ZOD
Location:	ADMN-BLD. Office
Training Topic:	**Fire alarm system**

Training Event Outline or Summary

1) Overview on the fire alarm system
2) Resetting of the fire alarm system points.
3) Entering phone numbers into the dialer memory.
4) System testing - activating the smoke detector in each room.

Training Materials

Equipment O&M Manuals, hand tools

Special Notes:

Training Photos

Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Forzoul WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:28 sept 09 Start Time:9:00 Duration:5h
Instructor:	HOMA-Rojaa youssef
Location:	On-site
Training Topic:	**FairBanks-Morse Pump - Packing Replacement**

Training Event Outline or Summary

1) Overview on the FairBanks Morse pumps and the way they work
2) Explanation of the pump parts using the O & M manual
3) Pump disasambley step by step after power turn off in the Main control panel & AD panel
4) Cleaning of the Pump parts
5) Changing the Packing with new ones
6) Pump reasambling
7) Runing the pump for check out
8) Safety concerns and precautions

Training Materials

Hand tools,packing,Glooves

Training Photos

Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

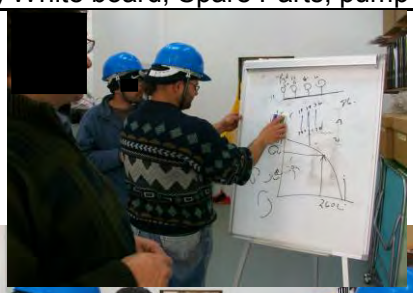
Type of Training	☐ on-the-job ☒ classroom ☐ other
Date of Training:	Date:11Mar 09, Start Time:10:00 Duration:2h
Instructor:	HOMA Pumps, Maroon Azar
Location:	Aitanit WWTP - Workshop
Training Topic:	**Introduction to Submersible Pump O&M**

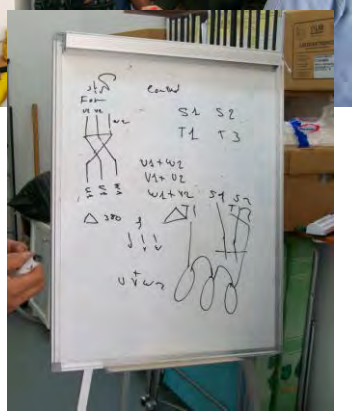
Training Event Outline or Summary

1) Pump components overview - motor, stator, impeller, housing jacket, power feed cable
2) Motor wiring and starter function
3) Routine maintenance
4) Troubleshooting - leakage relay, motor winding thermal protection, abnormal sounds
5) Safety concerns

Training Materials

1) White board, Spare Parts, pump cut-away diagram, actual pumps installed





Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	☐ on-the-job ☒ classroom ☐ other
Date of Training:	Date:10 Mar09 Start Time:9:00 Duration:2h
Instructor:	Kohler - EDI DAKASH
Location:	Classroom & at the equipment
Training Topic:	**Starting, Stopping, and Monitoring Generator Operation**

Training Event Outline or Summary

1) Equipment parts and function overview
2) Step procedure for starting the unit automatically.
3) Step procedure for starting the unit manually.
4) Normal readings and measurements (temp, volts, rpm, etc)
5) Safety concerns and precautions

Training Materials

1) Equipment O&M Manual

F Sig

[redacted]

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:11Mar Start Time:9:00 Duration:1h
Instructor:	Kohler Technician
Location:	Aitanit WWTP - Generator Area
Training Topic:	**Generator Engine Oil Change**

Training Event Outline or Summary

1) Oil change frequency - maintenance task overview
2) Tools and equipment used in oil change work task
3) Safety concerns - equipment lockout prior to start of work
4) Oil draining steps - (also discuss disposal of used oil)
5) New oil filling steps
6) Safety concerns and precautions

Training Materials

1) Equipment O&M Manual

Signa

[redacted]

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

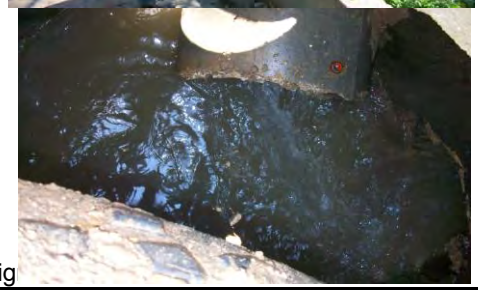
Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:23/24Mar 09 Start Time 8:00Duration:6h
Instructor:	CDM
Location:	Masghraa &Qaroun villages collection system
Training Topic:	**Sewer Flow Monitoring thru Manhole Opening.**

Training Event Outline or Summary

1) Village sewer network - review of network drawings and locations of manholes.
2) Sewer flow monitoring - flow rate observations from manhole openings.
3) Measuring the Temp of the sewage
4) Record the flow rate in the collection system all the way down to the plant
5) Safety concerns and precautions

Training Materials

1) Map of the village collection sewer line system, temp.gun



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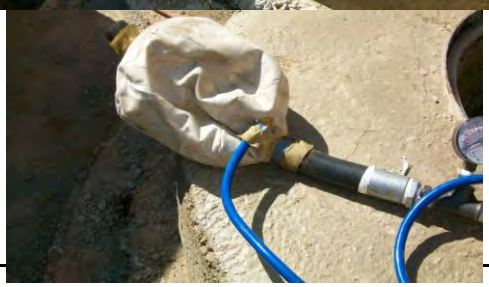
CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:9May09 Start Time:8:30 Duration:1h
Instructor:	CDM - Issam Deeb
Location:	Sludge Drying Bed Decant Piping
Training Topic:	**Sewer Pipe Leak Testing**

Training Event Outline or Summary

1) Purpose of pipe testing - functionality check during pre-commissioning
2) Testing equipment introduction (plug, air fill rig, pressure measurement, test pump)
3) Pipe testing with air - safety concerns
4) Test procedure & data recording (time & pressure)
5) Test Pass / Fail determination
6) Testing safety concerns (air blowout of plug, manhole entry)

Training Materials



Plant Operator Name

[redacted]

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:6 April 09 Start Time:8:00 Duration:1h
Instructor:	CDM
Location:	At the equipment - eight fans installed
Training Topic:	**Trickling Filter Fan Inspection**

Training Event Outline or Summary

1) Purpose of fan inspection - routine check after 30 days running
2) Maintenance tools overview
3) Maintenance task safety concerns (equipment lockout, proper selection of tools)

3) Inspection Criteria and maintenance tasks - belt condition and tension check, fan shaft bearing lubrication, fan metal housing dirt & rust inspection/removal, motor bearing lubrication
4) Maintenance recordkeeping
5) Safety concerns and precautions

Training Materials

Pl

Signa

[redacted]

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

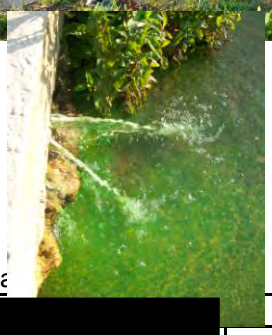
Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:4April09 Start Time:6:00 Duration:4.5h
Instructor:	CDM - Issam Deeb
Location:	Aitanit Plant Outfall - Chita River
Training Topic:	**Dye Testing - Pipeline Outfall Location**

Training Event Outline or Summary

1) Purpose of pipeline investigation - locate buried effluent outfall pipe
2) Procedure & materials overview (fluorescent dye)
3) Safety concerns (2 km hike in River bed and banks, snake avoidance, falling hazards, use of walkie-talkie with person back at plant facility.)
4) Locating and marking points of exfiltration along pipeline

Training Materials

1) Fluorescent dye, walkie-talkie



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[redacted]

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:27April09 Start Time:11:00 Duration:3h
Instructor:	CDM - Issam Deeb
Location:	Sludge Drying Bed Sludge Piping
Training Topic:	**Ductile Iron Pipe Leak Testing**

Training Event Outline or Summary

1) Purpose of pipe testing - functionality check during pre-commissioning
2) Testing equipment introduction (blind flange, pressure measurement, test pump)
3) Pipe testing with pressurized water - safety concerns
4) Test procedure & data recording (time & pressure)
5) Test Pass / Fail determination
6) Testing safety concerns (air blowout of plug, manhole entry)

Training Materials

Plant Operator Name	
[redacted]	
[redacted]	
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:14April 09 Start Time:9:00 Duration:1h
Instructor:	CDM / EMCO
Location:	At each pump well
Training Topic:	**Submersible Pump Lifting & Inspection**

Training Event Outline or Summary

1) Proper & Safe Lifting Procedure
2) Hoist & Chain Inspection
3) Pump Lifting Chain Rigging
4) Wetwell Safety (confined space) warning reminder
5) Pump Casing Inspection & Cleaning
6) Pump Motor Power Cable - Handling Care during Lifting

Training Materials

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:22April 09Start Time:10:00 Duration1h
Instructor:	CDM - Matt Antill & Issam Deeb
Location:	Classroom then at the pump location
Training Topic:	**Pump Capacity Testing - Wetwell Drawdown Method**

Training Event Outline or Summary

1) Purpose of pump capacity testing
2) Wetwell volume determination (measurement and calculation)
3) Steps for measuring wetwell drawdown level (before & after pumping)
4) Recordkeeping requirements (levels, pressure gauge, motor amps, and pump running time measurements)
5) Safety concerns - wetwell confined space reminder

Training Materials

Whiteboard, calculator,

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:12Mar 09 Start Time:9:00 Duration:1h
Instructor:	EMCO-ISSAM
Location:	Ground pits at site
Training Topic:	**Grounding measurement training**

Training Event Outline or Summary

1) Overview about purpose of equipment grounding.
2) Checking the location of all the ground boxes for the structures and control panels
3) Measuring the Amps of the grounding line during the wet weather
4) Measuring the Amps of the grounding line during the dry weather
5) Safety concerns and precautions

Training Materials

1) Muiltmeter, Electric cables, Site Electrical Drawing

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:11Mar 09 Start Time:11:00Duration:1h
Instructor:	EMCO-NEAM CHIBEL
Location:	Mechanical Piping around Plant Site
Training Topic:	**Introduction to Knife Gate Valves**

Training Event Outline or Summary

1) Overview of Knife Gate valves installed and their location.
2) Valve operation - open/close mechanism
3) Valve disassembly & inspection.
4) Valve routine maintenance.
5) Valve troubleshooting

Training Materials

1) Equipment O&M Manuals

Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	☐ on-the-job ☒ classroom ☐ other
Date of Training:	Date:12Mar 09 Start Time11:00 Duration:2h
Instructor:	EMCO-NEAM CHIBEL
Location:	Facility Workshop
Training Topic:	**Introduction to Valve O&M**

Training Event Outline or Summary

1) Overview of type of valves installed and their location (Plug, Check, & Gate type)
2) Valve operation - open/close mechanism
3) Valve disassembly & inspection.
4) Valve routine maintenance.
5) Valve troubleshooting

Training Materials

Equipment O&M Manuals, hand tools

P[redacted]

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:22May09 Start Time:9:00 Duration:1h
Instructor:	Equipment Vendor
Location:	Administration Building - Office Room
Training Topic:	**Fire Alarm System**

Training Event Outline or Summary

1) Overview of the fire alarm system
2) Resetting alarm system
3)signing in the operators name in the memory dialer
4) Testing the fire alarm bell zone by zone#1,2,3,4

Training Materials

Equipment O&M Manuals, hand tools

Plant Operator Name re

[redacted]

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	☐ on-the-job ☒ classroom ☐ other
Date of Training:	Date:17APRIL 09 Start Time:15:00 Duration:2h
Instructor:	Red cross - Local Chapter Instructor
Location:	Administration Building - Office Room
Training Topic:	**Red Cross - First Aid Training**

Training Event Outline or Summary

1) Plant walk-through inspection noting safety concern areas.
2) First aid for falling accidents.
3) First aid for broken bone accidents
4) First aid for suffocation type accidents.
5) First aid for burns
6) Importance of safety regulations in preventing accidents.

Training Materials

1) first aid kit

P[redacted] Signat

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:21May09 Start Time:10:00 Duration:2h
Instructor:	CDM
Location:	Plant site
Training Topic:	**Installation of Yard Hydrants**

Training Event Outline or Summary

1) Overview about the hydrant
2) Ground excavation to locate hydrant buried piping.
3) How to install a new hydrant (proper use of tools and selection of pipe fittings).
4) Safety concerns and precautions

Training Materials

Shovel, hand tools, pipe fittings

[redacted]

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:12May09 Start Time:12:00 Duration:1h
Instructor:	EMCO-ISSAM
Location:	Electric room of the ADMNBUILD
Training Topic:	**Operation of Main Power ATS Switch**

Training Event Outline or Summary

1) Overview of the auto. Transfer switch role
2)hand/auto control of the switch
3)showing the connection of the switch from the generator to the panel &EDL
4)testing the autoswitch by shutting down the EDL breaker
4) Safety concerns and precautions

Training Materials

Equipment O&M Manuals

Plant Ope

Signature

[redacted]

CDM Constructors Inc.

SUBJECT: Site-[x]cific Training Record - Aitanit WWTP

Type of Training	on-the-job [ ] classroom [ ] other
Date of Training:	Date:29May Start Time:14:30 Duration:1h
Instructor:	CDM - M. Antill
Location:	Clarifier Tanks
Training Topic:	**Clarifier Sludge Level Measurement**

Training Event Outline or Summary

1) Overview about tank configuration and dangers of too much sludge accumulation.
2) Core-tube assembly steps
3) Core-tube use - steps for lowering tube into the water and collecting a sample.
4) Core-tube level measurement reading and data recording
5) Core-tube disassembly and cleaning.

Training Materials

Sludge level core-tube sampler.

Signature

[redacted]

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:13May09 Start Time:9:00 Duration:2h
Instructor:	EMCO-ISSAM
Location:	All control panels
Training Topic:	**Pump Control Panels - Function Overview**

Training Event Outline or Summary

1) Overview of the control panels - functional description
2) Panel components
3) Control timer settings.
4) Control panel controls and indicators (ON/OFF switches, alarm lights, Amp meter, Volt meter,
5) Safety concerns and precautions

Training Materials

Electrical as-built drawings

[redacted]

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:15May09 Start Time:10:00 Duration:1h
Instructor:	EMCO-ISSAM
Location:	SITE
Training Topic:	**Electric Power Distribution**

Training Event Outline or Summary

1) Walking tour of buried cable installation routing.
2) Main power distribution panel - Functional description.
3) Power distribution to local control panels - functional description.
4) Plant Buildings - Electric Lighting Panel Boards.
5) Safety concerns and precautions

Training Materials

Electrical as-built drawings.

Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:28April 09 Start Time:15:00 Duration:1h
Instructor:	CDM - Matt Antill
Location:	Plant water station
Training Topic:	**Plant Water - O&M Discussion**

Training Event Outline or Summary

1) Overview of the plant water system
2) System controls - functional description
3) Tank Maintenance - Checking/Adding air to the hydropneumatic tank.
4) Strainer routine maintenance
5)Troubleshooting

Training Materials

1) Air Compressor, pressure gauge, hand tools

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:24 June 09 Start Time:9:00 Duration:1h
Instructor:	TAJJ-Eng-Bassem Gayda
Location:	Plant Workshop
Training Topic:	**Plug Valve O&M**

Training Event Outline or Summary

1) Overview of type of valves installed and their location (Plug)
2) Valve operation - open/close mechanism
3) Valve disassembly & inspection.
4) Valve routine maintenance.
5) Valve troubleshooting

Training Materials

Equipment O&M Manuals, hand tools

[redacted]

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:24 Jun 09 Start Time:11:00 Duration:1h
Instructor:	TAJJ-ENG Bassem
Location:	Administration Building & Site Tour
Training Topic:	**Underground Process Piping - Overview of Pipe Routing and Function**

Training Event Outline or Summary

1) Discussion of the As-built drawing that shows the under ground pipes
2) Locating each pipe shown on the drawing in the field.
3) Discussion of each process pipe (material, diameter, end points)
4) Demonstration/exhibit of the installed pipes (upvc, DI)
5) Types of pipes (gravity and pressure)
6) Safety concerns and precautions

Training Materials

As-built drawing

Pla

Signature

[redacted]

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:22April 09 Start Time:11:00 Duration:1h
Instructor:	CDM
Location:	Trickling Filter No.1
Training Topic:	**Trickling Filter distribution arm bearing lubrication**

Training Event Outline or Summary

1) Overview of distribution arm support bearing
2) Bearing lubrication - Why and How discussion
3) Steps for grease lubricating bearing.
4) Steps for oil lubrication of bearing
5) Safety concerns and precautions

Training Materials

Oil, grease , grease gun, oil, funnel, wrenches, allen keys

Plant Operator Name	Signature
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:27April 09 Start Time:9:00 Duration:1h
Instructor:	CDM
Location:	On-site
Training Topic:	**Portable Diaphragm pump - Setup and Operation**

Training Event Outline or Summary

1) Overview about diaphragm pumps
2) Pump pre-start - checking the pump fuel & oil
3) Pump hose installation - suction & discharge
4) Pump suction hose - foot valve installation (why & how).
5) Starting the pump and setting the RPM speed.
6) Safety concerns and precautions

Training Materials

1) Diaphragm pump, 4" hose, Foot Valve, Pipe Wrench

[redacted]

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:28 April 09 Start Time:9:00 Duration:2h
Instructor:	CDM - Matt Antill
Location:	Process Tanks and Site Laboratory Room
Training Topic:	**Process Monitoring - Introduction to water sampling, test instruments, and data recording.**

Training Event Outline or Summary

1) Overview of the treatment process sampling & monitoring requirements.
2) Dissolved oxygen meter calibration, use, and data recording.
3) pH meter calibration, use, and data recording.
4) Sample collection from process tanks - demonstration
4) Temperature - Measuring and Data recording.
5) Settleable solids test - demonstration
6) Laboratory general safety concerns and precautions.

Plant Operator Name	
[redacted]	

CDM Constructors Inc.
SUBJECT: Site-Specific Training Record - Aitanit WWTP

Type of Training	[x] on-the-job [ ] classroom [ ] other
Date of Training:	Date:10Mar 09 Start Time:9:00 Duration:1h
Instructor:	CDM - M.Antill
Location:	Generator fuel tank containment structure
Training Topic:	**Portable Air Blower for Confined Space**

Training Event Outline or Summary

1) Overview about blower usage
2) Engine pre-start checkout.
3) Installing the discharge hoses to the blower
4) Keeping the exhaust away to avoid burning
5) Starting the blower
6) Safety concerns and precautions

Training Materials

1) Air Ventilation Blower Unit

P

[redacted]

4.0 Advise and Assist Training Activities Summary

4.1 Aitanit WWTP – Advise and Assist Activities Summary

Aitanit WW Treatment Plant – A&A Activities during the Reporting Period

The Advise & Assist period for the Aitanit WWTP started on April 24th, 2009 with the first addition of sewage flow into the treatment facilities.

Review of major milestone activities following plant startup:

- April 24th, 2009 - Plant startup with Machghara Village dilute sewage flow (Aitanit Village sewage flow not available at this time).
- May & June 2009 – Dilute sewage continuing to enter the WWTP through the Machghara Village sewer collector system. Plant unit biological systems process fine tuning and adjustment ongoing but not efficient due to the under-design characteristics of influent sewage flow.
- June 2009 - CDM and Village WWTP staff perform sewer manhole inspection brief tour looking for source of infiltration water entering the Machghara sewer collector system. Inspection team discovered that each of the two branch sewers feeding the main collector pipe are transporting diluted sewage flow. The exact location(s) where ground water is being purposely allowed to enter the sewer pipes was not found.
- July 5th, 2009 – Zero flow entering plant due to Machghara farmers' interception of sewage flow ahead of WWTP (dilute sewage now being used for irrigation of apple orchards and pear trees).
- July 6th to August 2nd, 2009 – Plant biological process kept wet and partially active by recirculating trickling filter effluent. Primary clarifier tanks are emptied of sludge to the digester. No measurable flow entering the plant during this period.
- August 3rd, 2009 – CDM initiated WWTP liquid process systems shutdown due to prolonged period of nearly zero influent flow. Biological growth on trickling filter tank is mostly gone and cannot be recovered without first receiving a fresh supply of influent sewage flow. Shutting down the primary & secondary treatment process equipment will reduce the monthly electric power cost by approximately $3,000.
- August 5th, 2009 - Sludge drying bed first filling. Digested sludge from digester tank No.2 is pumped into Drying Beds. Digester tank and sludge piping is flushed cleaned, drained, and placed offline.
- August and September 2009 – Zero amount of influent sewage flow available to enter the plant. All WWTP equipment is offline during this two month period except the plant water booster pump station, standby power generator system, administration building facilities, and outside street lighting.

- October 6th to 14th, 2009 – Fine Screen modification work performed (raising the screen outlet invert elevation by 30-cm).
- November 11th, 2009 – Machghara farmers remove temporary plugs from sewer collector pipe allowing sewage flow to again enter the WWTP Wet Weather chamber.
- November 12th, 2009 – CDM direct the plant Operators to open the flow from the wet weather facility and allow flow to enter the plant and to startup the Influent Pump Station and Primary Treatment process systems only (not the secondary process system) because the influent sewage is black in color and looks to be contaminated with olive processing waste material (known to be toxic to secondary treatment biological process).
- November 17th & 18th, 2009 – CDM and Village Operator staff conduct tour of sewer collection network piping looking for source of olive processing waste flow. An illegal pipe connection into a sewer manhole was found near a Machghara olive processing factory. The factory owner had buried 80 meters of 1-inch PVC pipe underground and connected it to the sewer manhole chamber and was pumping olive press waste liquid from the factory waste pit into the sewer. Village officials were informed of the problem. The Village stated that there is nothing they can do at the immediate time (without causing a disturbance in the local community) to stop the factory owner from discharging this waste material. The Village asked CDM to delay the startup of the plant for a couple of weeks until the end of the olive pressing season. The Village asked CDM if there is any pre-treatment filter that can be installed at these types of olive processing factories.
- November 27th, 2009 – Approximately at 7:00 am the standby power ATS switch malfunction (generator starts on loss of EDL power but ATS does not transfer power automatically to generator)
- November 27th, 2009 – Approximately at 12:00 am the Influent Pump No.1 trip on thermal overload. Pump did not reset indicating possible problem with motor or protection instruments. CDM notified the installing subcontractor of the problem and asked them to visit the site to troubleshoot the pump.
- December 9th, 2009 – Removal of Influent Pump No.1 from wetwell for inspection (HOMA pump manufacturer local vendor onsite). Pump is cleaned and made ready for transport to repair workshop.
- December 9th, 2009 – Standby power ATS switch (out of service since November 27th) is removed by EMCO for repair in their Beirut workshop. During the period that the ATS switch is removed it is no longer possible to operate the plant on generator power.
- December 10th, 2009 – Influent Pump No.1 is transported from site and delivered to the HOMA authorized pump repair workshop located in Beirut.
- December 10th to 13th, 2009 – Influent flow to the WWTP is stopped for three days (wet weather outlet valve closed) to allow repairs to be made to primary clarifier inlet flow splitter box stop plate gasket replacement, primary clarifier No.3 outlet weir plate resealing, and secondary clarifier inlet flow splitter box stop plate gasket replacement. Influent flow was restarted into the WWTP on 13 December.

- December 13th to 15th, 2009 – WWTP receiving influent flow again and providing primary treatment only.
- December 16th, 2009 – Olive waste in influent sewage flow no longer visible. End of olive pressing season.
- December 17th to 20th, 2009 – Heavy rain storm, wet weather chamber shows sewer pipe running full, clear water mixed with sand, dilute sewage only. Wet weather chamber is accumulating sand and rocks.
- December 22nd, 2009 – Plant staff observe a large rock in the wet weather chamber wedged against the closed outlet valve. Staff partially opened the valve to allow flow to empty from the surcharged wet weather chamber into the influent pump station inlet channel. Staff removed the large rock from the wet weather chamber and tried to re-close the valve but the valve does not seat completely and a small amount of flow continues to enter the pump station. The flow entering the pump station is mostly sewer infiltration water mixed with sand.
- December 23rd to 27th, 2009 – Zero flow to wet weather observed. Plant staff discovered the Machghara sewer 4th man hole ahead of the wet weather chamber overflowing. The Machghara Village officials are informed about the sewer blockage. The Village said they will send a team of laborers to remove the blockage.
- December 27th, 2009 to January 8th, 2010 – Zero flow condition at wet weather continues.
- January 8th, 2010 – Machghara Village sent labours to remove the blockage at the 4th manhole. Sewage flow to the wet weather chamber is reestablished.
- January 12th, 2010 – Influent pump No.1 (damaged on November 27th 2009) is reinstalled and tested.
- January 14th, 2010 - CDM and Plant Staff working at Influent PS trying to remove accumulated sand. Entered the wetwell and inspected the quantity of accumulated sand.
- January 16th, 2010 - Plant staff working on manufacture of blind flange w/ 1-1/2-inch valve connection.
- January 30th, 2010 - Village WWTP site truck was removed to a private workshop in Qaraoun Village for repair. Problem is with the turbo unit.
- February 23rd, 2010 - EMCO on site to repair the phone line, repair float switch for the Septage haul pump, replace generator door hinge, and try to repair ATS again (failed to repair).
- February 25th, 2010 - EMCO on site to reinstall the old ATS as a temporary solution allowing manual switching only. During this visit the generator failed to start and gave several fault alarms.
- March 2nd, 2010 - Eden generator group on site to repair generator.
- March 2nd, 2010 - EMCO on site to (1) paint digester piping, (2) repair street lights, (2) remove snubber units for all pressure gauges.

- March 2nd, 2010 - CDM directed Plant staff to start all digester pumps for exercising.
- March 2nd, 2010 - One of the Plant operators claimed he was injured on site. Accident report requested.
- March 3rd, 2010 - Plant staff cleaning rocks and debris from the wet weather chamber. This work required plugging the upstream manhole.
- March 4th, 2010 - CDM on site, TF arm lubrication, restart all plant equipment, TF pumps found with automatic control problem, repair stuck plug valve at FC PS.
- March 5th, 2010 - CDM site visit with USAID.
- March 9th, 2010 - EMCO at site 1) repair TF pump control panel, 2) FC No.3 fiberglass trough repair patch was installed to stop leakage.
- March 11th, 2010 - Plant operators installed new gate valve at the digester tank to replace one plug valve.
- March 12th, 2010 - Control panel problems found at the Influent PS and the Primary Clarifier PS. Burned wires noticed and Plant operators were instructed by CDM to shutdown these systems.
- March 14th, 2010 - Influent sewage flow from the Machghara Village was stopped by the municipality to allow repairs to be made to one broken sewer manhole (thought to be the source of the sand and rocks previously found entering the wet weather structure).
- March 15th, 2010 - EMCO on site to 1) repair the Influent PS and Primary Clarifier Control Panels. Repair of the Influent PS was not completed this day due to missing parts needed (electrical contactor needed). (2) EMCO install new mounting bolts for the Septage pump base plate.
- March 17th, 2010 - EMCO on site to continue work as follows (1) install fiberglass patch at sludge troughs for Final Clarifier tanks No. 1 & 2 to stop leakage, (2) Digester No.4 control panel burned wire replaced, (3) Plant Water control panel burned relay replaced, (4) Septage pump tested but excessive vibration and sound still noticeable.
- March 19th, 2010 - EMCO on site to finish the repair of the Influent PS control panel. During testing of the pumps, the No.2 pump showed high vibration and excessive noise.
- March 23rd, 2010 - EMCO on site to investigate influent pump No.2 problems. Pump lifted and then reseated on base elbow. Pump suction was checked for obstructions and none found. Pump still not discharging and excessive noise still happening.
- March 31th, 2010 – American Community School From Beirut Visiting the Site with around 75 Students and 5 Teachers to have a Field Explanation on How to Treat Wastewater.
- April 1st, 2010 – Baaloul Public School visiting the WWTP with 35 students and 3 teachers.

- April 2nd, 2010- Draining Anaerobic Digester Tank # 2 to Sludge Drying Bed # 1. The volume of pumped sludge sent to the drying bed was about 200 m3.
- April 6th, 2010 – The Municipality delivered the needed office furniture to the WWTP Administration Building.
- April 9th, 2010 – Machghara Public High School visiting the WWTP with around 80 students and 6 teachers.
- April 12th, 2010 – Influent Pump Station Control Panel – two wire terminals at the lower part of the panel were found to be melted. The Operators were instructed by CDM to disconnect electric power to this panel. EMCO were notified of the problem and requested to investigate and perform needed repairs ASAP.
- April 13th, 2010 – EMCO present at site to install the replacement drive motor for the ATS switching mechanism.
- April 13th, 2010 – EMCO present at site to reinstall the electrical cables (reverse the power phase terminal connections) for Influent Pump No.2 previously repaired on April 12th. The Pump went back to normal function after making this wiring correction.
- April 13th, 2010 – EMCO present at site, Testing the Septic Pump after adding the Bolts to the base Plate and the Pump Function Improved
- April 13th, 2010 – Machghara Public School Visiting the Site with around 40 Students and 2 Teachers to have a Field Explanation on How to Treat Wastewater.
- April 15th, 2010 – First preliminary final inspection site visit to check electrical panels for defaults and snags. Inspection team included CDM and outside specialist company experienced with equipment control panel building.
- April 19th, 2010 – Machghara Public Girls School Visiting the Site with around 35 Students and 2 Teachers to have a Field Explanation on How to Treat Wastewater.
- April 20th, 2010 – Qaroun Public School Visiting the Site with around 45 Students and 2 Teachers to have a Field Explanation on How to Treat Waste Water.
- April 23rd, 2010 – Flow from Machghara Village now entering the Wet Weather Diversion Chamber at an average rate of 700m3 per day. Operators opened the 300mm flow inlet valve feeding the influent pump station and started up the WWTP treatment using two Primary Clarifiers, one Trickling Filter, two Secondary Clarifiers, one Chlorine Contact Tank and one Anaerobic Digester tank.
- May 4th, 2010 – Flow from Machghara Village stopped (approximately zero) because the local farmers plugged the sewer line ahead of the WWTP.
- May 5th, 2010 – Plant Operators readjust the Influent Pump Station pump control level switches due to the very low flows entering the facility.
- May 6th, 2010 – CDM Issam Deeb meets with some of the local farmers who are controlling the stoppage of sewage flow to the WWTP. During the brief meeting the farmers explained that they intend to continue the practice of plugging this sewer line and using the backup flow for irrigation purposes until such time that an alternate source of irrigation water is made available from the LRA.

- May 7th, 2010 – Flow from Machghara Village stopped completely. No sewage entering the WWTP at this time.
- May 7th, 2010 – Plant Operators start adding approximately 300 m3/day clean water to the WWTP from the LRA pipeline (this action keeps the WWTP process tanks active with minimal flow in an effort to reduce the chance of odors and also keeps the facility in a standby mode in case flow returns from the Mashghara Village).
- May 7th, 2010 – EMCO staff onsite to work on warranty snags – 1) painting the generator soundproof enclosure, 2) installing silicone sealant at the outside control panel weather protection top covers.
- May 8th, 2010 – EMCO staff onsite to work on warranty snags – Influent Pump Station – troubleshooting/repair of AUTO control mode.
- May 11th, 2010 – KIC School Visiting the WWTP with 50 Students and 3 Teachers.
- May 22th, 2010 – EMCO staff onsite to work on warranty snags – street light lamp replacement.
- May 22th, 2010 – EMCO staff onsite to work on warranty snags – Final Clarifier fiberglass trough leak repairs.
- June 7th, 2010 – Najah School visit to the WWTP with 85 Students and 6 Teachers.
- June 13th, 2010 – A desktop computer was delivered to site by the Qaroun village.
- June 17th, 2010 – Second preliminary final inspection site visit to check electrical panels for defaults and snags. Inspection team included CDM and outside specialist company experienced with equipment control panel building.
- June 17th, 2010 – Sewage flow from Mashghara Village still off – WWTP running only on clean water being added through the LRA line. CDM instructed the plant operators close this LRA water valve and shutdown the WWTP process tanks but keep the digester tanks functioning for treating the daily septage haul truck waste.
- June 25th, 2009 - Septage Receiving Station – First time the WWTP receives septage waste - Three wastewater haul truck loads discharged at the septage receiving station this day.
- June 25th, 2010 – The new Chairman of the Lake Municipalities Union, Mr. Khaled Shranek visited the WWTP. Also attending the visit and site tour was the Mayor of Qaroun Village, Mr. Yahia Daher.

4.2 Fourzol WWTP – Advise and Assist Activities Summary

Fourzol WWTP – Advise and Assist activities during the 1st year operation

The Advise & Assist period for the Fourzol WWTP started on 04 August 2009 with the first entry of sewage flow into the treatment facilities.

Review of Major Milestone Events following Plant Startup

- August 4th, 2009 - WWTP startup with sewage flow.
- August 24th, 2009 - Septage Receiving Station – first haul truck received.
- November 1st, 2009 - First major rain storm – Plant effluent line (gravity line located outside the plant which discharges to the River) plugged backing up flow 33-cm high into the chlorine contact tank. The influent pump station wetwell water surface elevation flooded to about 60-cm from the top of the tank. The plant water pump station floor flooded but not up to the level of the pump motors, and the wet weather diversion chamber was flooded and full of rocks & debris. *The Village Mayor is alerted to the flooding problem and asked to remove the rocks from the wet weather diversion structure and other downstream manholes showing flooding conditions.*
- November 12th, 2009 – CDM and Plant Staff install an emergency plant bypass 250-mm gate valve at the end of the pipe feeding the Influent Pump Station (*purpose of valve is to control the rate of influent flow during wet weather events to prevent flooding of influent pump station and plant water pump station*)
- November 15th, 2009 – The Village starts cleaning rocks and debris from the wet weather diversion chamber (*debris material first deposited during the November 1st wet weather event*).
- November 17th, 2009 – Wet weather event – Emergency plant bypass valve closed.
- November 18th, 2009 – Emergency Plant Bypass valve reopened.
- November 21st, 2009 - WWTP Dedication Ceremony (USAID & Govt. of Lebanon attendance).
- December 13th, 2009 - Wet weather event – Emergency plant bypass valve closed.
- December 14th, 2009 – Emergency Plant Bypass valve reopened.
- December 17th, 2009 - Wet weather event – Emergency plant bypass valve closed.
- December 19th, 2009 – Emergency Plant Bypass valve reopened.

- January 4th and 5th, 2010 – Influent sewage color is dark brown – home wine manufacturing waste suspected.

- January 10th & 11th, 2010- Sludge Drying Bed first filling *(Bed No.1 filled w/ sludge from Digester No.1).*

- January 12th, 2010 – Influent sewage color is dark (blood) red. Color stays red for about 1-hour and then returns to normal gray/clear color.

- January 18th, 2010 - Wet weather event – Emergency plant bypass valve closed.

- January 26th, 2010 – Emergency Plant Bypass valve reopened – open position set at 25%.

- January 27th, 2010 – Village Municipality hired an excavator to dig in the street and look for the location of the broken effluent pipe. The excavator operator dug in four locations and broke the line in two separate locations. CDM asked the Plant Operators to install safety warning tape around the areas in the street where open holes were dug and left unprotected.

- January 28th, 2010 – Emergency Plant Bypass – valve position increased to 50% open.

- January 29th, 2010 – Emergency Plant Bypass – valve position decreased to 25% open due to increase in dilute sewage flow (rain event).

- January 30th, 2010 – Cold weather freezing conditions – Plant water pressure gauge broken and pressure switch leaking water.

- February 2nd, 2010 – Emergency Plant Bypass – valve position adjusted to 100% open.

- February 3rd, 2010 – Emergency Plant Bypass – valve closed completely due to heavy rain and snow.

- February 6th, 2010 – Emergency Plant Bypass – valve position adjusted from fully closed to 25% open.

- February 6th, 2010 - Freezing conditions onsite – Sludge pump seal water strainer plastic housing broken.

- February 7th, 2010 – Emergency Plant Bypass – valve position adjusted from 25% open to 50% Open.

- February 8th, 2010 – Emergency Plant Bypass – valve position adjusted from 50% open to 100% open.

- February 9th, 2010 – CDM and Plant Operators install HDPE pipe for sludge drying bed rain water discharge into final effluent manhole.

- February 10th, 2010 – Generator maintenance –replace the air filter.

- February 11th, 2010 – CDM and Plant Operators install digester tank surface mixing piping (branch line off of sludge pump discharge pipe).

- February 11th till March 15th, 2010 - CDM providing one O&M technician (Mr. Issam Deeb) during the day shift (8am to 4 pm) to operate the WWTP.

- February 12th, 2010 – CDM install new piping to allow sending final clarifier sludge to the plant drain manhole which then gravity flows back to the influent pump station. This secondary sludge is then pumped with the incoming raw sewage flow to the primary clarifier. The combined primary sludge and secondary sludge is then pumped to the digester tanks. This new arrangement better concentrates the sludge being sent to the digester each day (less volume pumped at a higher concentration).

- February 15th, 2010 – Plant water Pump No.2 fault – Circuit Breaker trip – Reset and restarted pump.

- February 16th, 2010 – Village Municipality hired an excavator to dig in the street and to remove pipe blockages causing plant effluent overflowing on to the land area of local farmers. One of the Village Municipality members requested permission to break the final effluent line manhole (located by the well house outside the WWTP) so that the effluent flow could enter the existing open channel earth trench. CDM refused this proposal and suggested that a new channel be constructed in the location of the old train track road to prevent water from overflowing on to the farmer's land.

- February 17th, 2010 – CDM install ground-fault circuit breakers – at outside control panels to allow safe use of plug-in receptacles.

- February 18th, 2010 – CDM install ceiling light fixture in the storage room located under the Fine Screen facility.

- February 19th, 2010 – Sludge Drying Bed – Infiltration water noticed. Plant operators were instructed to measure the water surface level daily and to look for any possible leak locations.

- February 22nd, 2010 – CDM install new pressure gauge and pressure regulator at the seal water station for the Primary Sludge Pumps.

- February 26th, 2010 – Emergency Plant Bypass – valve position adjusted from 100% open to 100% closed due to heavy rain this day.

- March 3rd, 2010 – Emergency Plant Bypass – valve position adjusted from 100% closed to 20% open.

- March 5th, 2010 – USAID visit to the site – Eng. Rami Wehbeh.

- March 19th, 2010 – Emergency Plant Bypass – valve position adjusted from 20% open to 100% open (Influent Pumps now operating in Automatic mode).
- March 20th, 2010 – Emergency Plant Bypass – valve position adjusted from 100% open to 75% open.
- March 22nd, 2010 – Emergency Plant Bypass – valve position adjusted from 75% open to 100% open.
- March 25th, 2010 – Emergency Plant Bypass – valve position adjusted from 100% open to 25% open due to heavy increase in flow that day pushing two pumps to start.
- March 26th, 2010 – TAJJ present at site for installing the Engine exhaust smoke detector.
- March 26th, 2010 – CDM present at site to inspect sludge drying bed No.1 leakage problem.
- April 28th, 2010 – Emergency Plant Bypass – valve position adjusted from 20% open to 100% open (Influent Pumps now operating in Automatic mode with all flow entering the WWTP – 0% bypass).
- April 29th, 2010 – Water quality sample collection - collection of samples for AUB laboratory analysis.
- May 6th, 2010 – Generator maintenance –replace the oil & diesel filters plus changing the oil.
- May 7th, 2010 – Plant improvement- installation of a temporary HDPE- 1 1/4" line for mixing the surface of anaerobic digester # 1. If this method is successful in minimizing the thickness of the scum layer on the tank surface a more permanent pipe connection will be installed.
- May 10th, 2010 - Septage Receiving Station – Two haul trucks received.
- May 14th, 2010 - Septage Receiving Station – Two haul trucks received.
- May 17th, 2010 – Farmers plugging the final effluent line (outside the fence of the WWTP just after the wet-weather box chamber) with sand bags and then pumping the accumulated water for crop irrigation. The plugged effluent line backed up flow in the chlorine contact tank and raised the level to 10-cm above the outlet weir. CDM informed the Village Mayor about the problem after which the Mayor sent an excavator to the location to remove five sand bags.
- May 20th, 2010 –Water quality sample collection - collection of samples for AUB laboratory analysis.
- May 28th, 2010 – Septage Receiving Station – one haul truck received.

- June 3rd, 2010 – Water quality sample collection - Collection of samples for AUB laboratory analysis.

- June 10th, 2010 – Water quality sample collection - Collection of samples for AUB laboratory analysis.

- June 14th, 2010 –Village O&M Staff- One new plant operator, Mr. Michel Matter started his first day of work at the village WW treatment facility. CDM begins a 2-week fast track training program for the new operator.

- June 17th, 2010 – Water quality sample collection - collection of samples for AUB laboratory analysis.

- June 18th, 2010 – Plant improvement- Digester No.1 sludge recycle/mixing revised modification to improve surface mixing.

- June 23, 2010 – Water quality sample collection - collection of samples for AUB laboratory analysis.

- June 30th, 2010 – Water quality sample collection - collection of samples for AUB laboratory analysis.

4.3 Ablah WWTP – Advise and Assist Activities Summary

Ablah & Fourzol Village WWTPs
Advise & Assist Training Attendance - May 2011 to June 2012

Advise & Assist activity listing by day

Day	Date	Start time	End time	Total hours	Work Location	Student, On-the-Job Training daily activity Description
Thursday	26-May-11	13:30	16:00	2.5	Fourzol	Start of Training and site checkup
Friday	27-May-11	12:30	15:30	3	Fourzol	Training and site checkup
Saturday	28-May-11	10:30	13:00	2.5	Fourzol	Training
Sunday	29-May-11					day off
Monday	30-May-11	9:30	10:30	1	Fourzol	Training day and review of paperwork
Tuesday	31-May-11	10:00	11:00	0.5	Fourzol	plant check up
Wednesday	1-Jun-11			1	Fourzol	plant check up
Thursday	2-Jun-11			0.5	Fourzol	plant check up
Friday	3-Jun-11			0	Fourzol	plant check up
Saturday	4-Jun-11			1	Fourzol	plant check up
Sunday	5-Jun-11			0		
Monday	6-Jun-11			0		
Tuesday	7-Jun-11			1	Fourzol	plant check up
Wednesday	8-Jun-11			0		
Thursday	9-Jun-11			0		
Friday	10-Jun-11			0.5	Fourzol	plant check up
Saturday	11-Jun-11			0		
Sunday	12-Jun-11			0		
Monday	13-Jun-11			1	Fourzol	plant check up
Tuesday	14-Jun-11			0		
Wednesday	15-Jun-11			0.5	Fourzol	plant check up
Thursday	16-Jun-11			0.5	Fourzol	plant check up
Friday	17-Jun-11			0	Fourzol	
Saturday	18-Jun-11			0		
Sunday	19-Jun-11			0		
Monday	20-Jun-11	5:00 PM	6:00 PM	1	Fourzol	plant check up
Tuesday	21-Jun-11	12:00 PM	1:00 PM	1	Fourzol	plant check up
Wednesday	22-Jun-11			0		
Thursday	23-Jun-11	10:00 AM	11:00 AM	1	Fourzol	plant check up
Friday	24-Jun-11			0		
Saturday	25-Jun-11	7:00 PM	7:30 PM	0.5	Fourzol	Nobody at the plant, plant check up
Sunday	26-Jun-11	9:00 PM	10:00 PM	1	Fourzol	Nobody was at the plant, and all the lights were on
Monday	27-Jun-11			2	Fourzol	Return of Flow
Tuesday	28-Jun-11			5	Fourzol	WWTP - Facility re-startup
Wednesday	29-Jun-11			6	Fourzol	WWTP - Facility re-startup
Thursday	30-Jun-11			6	Fourzol	WWTP - Facility re-startup
Friday	1-Jul-11			1	Fourzol	plant check up
Saturday	2-Jul-11			1	Fourzol	plant check up
Sunday	3-Jul-11			0		Day Off
Monday	4-Jul-11			2	Fourzol	plant check up & review of paperwork
Tuesday	5-Jul-11			1.5	Fourzol	plant check up & review of paperwork
Wednesday	6-Jul-11			1.5	Fourzol	plant check up & review of paperwork
Thursday	7-Jul-11			2	Fourzol	plant check up & review of paperwork
Friday	8-Jul-11			3	Fourzol	plant check up & review of paperwork
Saturday	9-Jul-11			2	Fourzol	plant check up & review of paperwork
Sunday	10-Jul-11			5	Fourzol	plant check up, Drain influent line into digester and straight into SDB#3

Monday	11-Jul-11			1	Fourzol	plant check up & review of paperwork
Tuesday	12-Jul-11			2	Fourzol	plant check up & review of paperwork
Wednesday	13-Jul-11			2	Fourzol	plant check up & review of paperwork
Thursday	14-Jul-11			3	Fourzol	plant check up & review of paperwork
Friday	15-Jul-11			1	Fourzol	plant check up & review of paperwork
Saturday	16-Jul-11			1	Fourzol	plant check up & review of paperwork
Sunday	17-Jul-11			0		Day Off
Monday	18-Jul-11			2	Fourzol	plant check up & review of paperwork
Tuesday	19-Jul-11			3	Fourzol	plant check up. Empty digester into SDB#3
Wednesday	20-Jul-11			2	Fourzol	plant check up
Wednesday	20-Jul-11			2	Ablah	Looking for Tony the metal worker to try and get the blank flanges from him and checking on work at the Ablah Plant as per Sam's request.
Thursday	21-Jul-11			2	Fourzol	plant check up
Friday	22-Jul-11			5	Fourzol	Plant check up in morning then Return T 8:00 PM till 10:30PM due to a problem with the main Electrical board.
Saturday	23-Jul-11			4	Fourzol	Go see the mayor about the electrical problem and request a load of diesel for the generator, which got delivered on the same day, then wait in the plant for both electrician and diesel load.
Sunday	24-Jul-11			0		
Monday	25-Jul-11			2	Ablah	1) Checkup on the work at Ablah plant, and head to the SS fabricator in Zahleh as per Sam's request 2) Tried to get in contact with tony the metal worker in Ablah at his shop with no avail after 2 trips to his shop and home
Monday	25-Jul-11			2	Fourzol	plant check up & review of paperwork
Tuesday	26-Jul-11			2	Fourzol	plant check up & review of paperwork
Wednesday	27-Jul-11			1	Ablah	Looking for Tony the metal worker and checking on work at the Ablah Plant
Wednesday	27-Jul-11			2	Fourzol	plant check up & review of paperwork, draw a chart for generator diesel consumption and running hours.
Thursday	28-Jul-11	10:00 AM	2:00 PM	4	Fourzol	plant check up, Meeting with CDM, Mayor and neighbor
Friday	29-Jul-11	10:30 AM	1:30 PM	3	Fourzol	Plant checkup and stop Melhem from attacking Jasem, and ask him to leave the site, The flow stopped around 10:00 AM
Saturday	30-Jul-11			1	Fourzol	Checkup on the plant and Jasem. No flow at site.
Sunday	31-Jul-11			0		
July 2011 - Varied Dates and Times				9.5		AutoCAD drawing preparation, Ablah WWTP 300mm sewer from road intersection to WWTP wet weather box. Drawings include Layout, Main Line to Plant: Rev-0, Rev-1, and Rev-2
Monday	1-Aug-11	9:00 AM	1:00 PM	4	Fourzol	Plant walk through, open Influent valve and adjust the flow until it was safe to leave it in auto.
Tuesday	2-Aug-11	10:00 AM	2:00 PM	4	Fourzol	Plant walk through, open Influent valve and adjust the flow until it was safe to leave it in auto, check the septic receiving tank control panel.
Wednesday	3-Aug-11	10:00 AM	1:00 PM	3	Fourzol	plant check up, and review maintenance list with George.
Thursday	4-Aug-11	12:00 PM	2:00 PM	2	Fourzol	Meeting with Matt, discuss graphs and data entry
Friday	5-Aug-11	8:45 AM	12:45 PM	4	Fourzol	Plant checkup, ask George to enter the data on the computer which he refused to.
Friday	5-Aug-11	1:00 PM	4:00 PM	3	Ablah	Review with Sam Hala work for the coming weekend
Saturday	6-Aug-11	1:00 PM	4:00 PM	3	Fourzol	Check paperwork, tour the plant. Enter all missing data since the restart of the plant. Check an electrical malfunction at the septic receiving tank control panel.
Sunday	7-Aug-11			0		Day Off
Monday	8-Aug-11	1:00 PM	5:00 PM	4	Fourzol	Meeting with USAID at Fourzol plant

Tuesday	9-Aug-11	12:00 PM	2:00 PM	2.5	Fourzol	Check paperwork, meeting with George and Jasem, George mentioning his interview with the press at the site, talk to Rami and start recording the level of the smell, review reasons and ways to stop bad smell, go back to site at 7:00 pm to check for the smell near site and near neighbor's house
Wednesday	10-Aug-11	10:00 AM	4:00 PM	6	Ablah/ Fourzol	Start taking the digester pump #3 apart for maintenance, meeting in Ablah to discuss next meeting with mayors, review of my job description
Thursday	11-Aug-11	7:30 AM	8:30 AM	1	Fourzol	plant tour, open influent valve al the way, key in the door couldn't get inside admin building.
Thursday	11-Aug-11	8:45 AM	10:15 AM	1.5	Ablah	checkup on my to do list and draw up the telescopic valve mechanism, make calls to try to find non detergent 30 oil
Thursday	11-Aug-11	10:30 AM	12:30 PM	2	Fourzol	Take digester pump #4 apart and talk to George about the closed valve, which was due to lack of bags for grit removal.
Friday	12-Aug-11	8:00 AM	9:30 AM	3	Fourzol	Check the site, reopen the almost close influent valve and tweak the primary to handle the extra backed up flow.
Friday	12-Aug-11	9:45 AM	3:15 PM	5.5	Ablah	Review to do list with Matt, make a prototype of the telescopic valve, add new items to list, including a grit chute for fine screens
Friday	12-Aug-11	3:30 PM	5:30 PM	2	Ablah/ Fourzol	Meet the metal worker Elias at Fourzol to show him the fine screen chute and ask him to make a replica of it for the 2 fine screens at Ablah, talk to plumbers to do the plant water system at Ablah (call Elias for 2 min and call 2 plumbers for 5 min)
Saturday	13-Aug-11					
Monday	15-Aug-11	9:30 AM	4:00 PM	6.5	Ablah	get the table and a plumber to site, walk through and show him the work with Mathew, meeting with CDM to discuss this week's work.
Tuesday	16-Aug-11	10:00 AM	3:00 PM	5	Ablah	get another plumber show him around the site what to do, then go over the to do list with Mathew
Wednesday	17-Aug-11	10:00 AM	4:00 PM	6	Ablah	Check up on site and Hala work, and pump installation
Thursday	18-Aug-11			2	Ablah	go over the plant water system and any changes and snags
Friday	19-Aug-11	10:00 AM	12:00 PM	2	Fourzol	Check up on plant and maintenance
Saturday	20-Aug-11	10:30 AM	12:30 PM	2	Ablah	Check up on site and Hala work, take pics of Fourzol plant water system.
Monday	22-Aug-11	10:00 AM	3:00 PM	5	Ablah	Check up on site, review plant water system, show pics to Alaa and Sam,
Tuesday	23-Aug-11	10:30 AM	2:30 PM	4	Ablah	Go to zahleh and saedmail to get price check for hydraulic hoses, 25$ from Nicola Ibri and 27$ from Sultan for each hose, then got the ok to order them, then went to Ablah to meet with Sam.
Wednesday	24-Aug-11	11:00	6:00 PM	7	Ablah/ Fourzol	go to Zahleh to get the hydraulic hoses for the pumps at Ablah, stop by Fourzol and do a checkup walk, then head to Ablah and go over the plant water system with Matt, then get the machined bolts from Matt and try them at Fourzol, but they were the wrong type, then head to the welder to machine another system for the telescopic valve, with the requested adjustments
Thursday	25-Aug-11	11:00 AM	2:00 PM	3	Ablah	Install the new Telescopic valve system, check work, follow up Hala work
Friday	26-Aug-11	9:00 AM	12:30 PM	2	Zahleh/ Saednail	Look for the parts for the plant water system in Ablah then Fourzol then Zahleh, found them finally in Tamnine (needed 2" GF parts) then went to Saednail to get the bolt machined for the pumps in Fourzol.

Friday	26-Aug-11	1:00 PM	2:00 PM	1	Ablah	Drop off the parts and show Ahmad the work that needed to be done (although it was reviewed with Alaa me and Mathew the previous day)
Friday	26-Aug-11	2:00 PM	3:30 PM	1.25	Fourzol	try to flush the suction line for pump #1 at the digester.
Friday	26-Aug-11	3:30 PM	4:00 PM	0.5	Ablah	Go to Ablah and get the pics for the pressure test of the line between influent and fine screen, and get old pressure test forms for Sam.
Friday	26-Aug-11	4:00 PM	5:30 PM	1.5	Fourzol	Flush the suction line again 3 more times, open the influent valve all the way again.
Saturday	27-Aug-11	10:00 AM	1:00 PM	3	Fourzol	Go to the machine shop in Saednail and get the bolts then head to Fourzol, try them, remove the back plate and impeller for both pumps # 3 & 4
Monday	29-Aug-11					Off for Eid
Tuesday	30-Aug-11					Off for Eid
Wednesday	31-Aug-11					Off for Eid
Thursday	1-Sep-11	8:00 AM	11:00 AM	3	Fourzol	Found Jasem not able to breath right and in a bad condition, took him to Tal Shiha hospital, stopped on the way at the insurance office in Zahleh to get new accident reports from there. Call the mayor and Matt to keep them updated.
Friday	2-Sep-11	10:00 AM	11:00 AM	1	Fourzol	Check up on Jasem, walk through site, call mayor to tell him we almost out of diesel, and ask him if I could see him to discuss my situation in the plant, he asked me to come on Monday.
Saturday	3-Sep-11	11:00AM	12:00 PM	1	Fourzol	check up on Jasem, walk through the plant, and adjust influent valve, pump final.
Sunday	4-Sep-11					Off
Monday	5-Sep-11	10:00 AM	11:00 AM	0.5	Fourzol	Head to Fourzol mayor's office as per appointment, but he couldn't meet me due to a previous engagement, then head to plant to check on Jasem and help him as I could.
Monday	5-Sep-11	11:00 AM	1:00 PM	2	Ablah	Install the telescopic Valve Prototype, show it to Matthew then to Sam.
Tuesday	6-Sep-11	7:30 AM	1:30 PM	6	Fourzol	Put digester pumps back together, discuss with George emptying the digester once we get the diesel and in my presence, and filling digester Nb 2 from primary, Call the mayor to request diesel and labor to clean up site.
Tuesday	6-Sep-11	1:30 PM	3:00 PM	1.5	Ablah	Meeting with CDM
Wednesday	7-Sep-11	11:00 AM	11:30 AM	0.5	Fourzol	check up the plant, call city hall about the lack of diesel,
Wednesday	7-Sep-11	10:00 AM	10:30 AM	0.5	Ablah	Try to start work on chemical line and cleaning of pipes but I had no workers available to help out.
Thursday	8-Sep-11	9:30 AM	5:00 PM	7.5	Beirut	head to Beirut Office, visit Debbas plant to review control panel progress.
Friday	9-Sep-11	10:30 AM	11:00 AM	0.5	Ablah	Adjust telescopic valve, call Fourzol at 3:30 PM for 3 min then EDZ for 1 min then Mr. Raed for 3 min. then Fourzol for 1 min then Mr. Raed for 1 min
Saturday	10-Sep-11	9:30 AM	10:00 AM	0.5	Fourzol	check the plant, find out there is no flow, but got the flow back while I was there.
Saturday	10-Sep-11	8:00 AM	4:30 PM	8	Ablah	Get the oil for the TFT rotary distribution system. Get on worker from Jack to help me clean the TFT pump station, primary clarifier, influent and final clarifier. And drain the primary tank and the TFT pump station.
Sunday	11-Sep-11					Off
Monday	12-Sep-11	10:00 AM	4:30 PM	6.5	Ablah	get one worker from Jack and finish cleaning the pipes at digester and final, and finish scrubbing the primary pipes. Put oil in TFT rotary distribution system.
Monday	12-Sep-11	9:30 AM	10:00AM	0.5	Fourzol	Check if we had diesel, walk through site.

Tuesday	13-Sep-11	11:00 AM	1:00 PM	2	Fourzol	Meeting with Melhem Ghassan and Raed Ghantous in Fourzol's city hall
Tuesday	13-Sep-11	2:00 PM	7:30 PM	5.5	Fourzol	Finish emptying digester #1 and restart pumps # 3&4, troubleshoot pump # 3 and get it to work properly, monitor the removal and deposal of dried sludge from beds 2 & 3, waited for the electrician to arrive (he was late), during which I pumped the final clarifier, replaced the broken connection at the fine screen plant water valve.
Wednesday	14-Sep-11	6:00 AM	8:30 AM	2.5	Fourzol	came in early in hopes of finding workers on site, found the generator's fuel filter leaking which I replaced, then reopened the influent valve, pumped the final, checked the digester, cleaned the influent screen.
Wednesday	14-Sep-11	11:00 AM	1:45 AM	2.75	Fourzol	waited for the workers, monitored the electrician and mechanic working on both the control panel at the septic receiving and generator
Wednesday	14-Sep-11	1:45 AM	4:30 PM	2.75	Ablah	Meeting with CDM, review of task work sheet
Thursday	15-Sep-11	9:00 AM	3:00 PM	6	Fourzol	Work on site to get it cleaned and ready for the tour on Friday
Friday	16-Sep-11	6:30 AM	11:00 AM	4.5	Fourzol	Get site cleaned and ready for group tour.
Saturday	17-Sep-11					Off
Sunday	18-Sep-11					Off
Monday	19-Sep-11	8:30 AM	5:00 PM	8.5	Ablah	Went to Nabhan and got the Vice and screws for board in Admin building, installed the back strips for 2 boards, located all the nipples and valves in storage and handed them to Hala.
Tuesday	20-Sep-11	10:00 AM	3:00 PM	5	Ablah	Fix back strips for the boards in Admin building, get nipples for Hala to install, show them where to put them, go to Nabhan, Zino and Rizk to get parts for the board and look for bolt covers as per Sam's request.
Wednesday	21-Sep-11	7:45 AM	3:00 PM	7.25	Ablah	Fix Boards in Admin building, go over as built plans with Sam, go to Nabhan and Rizk to get bolts and bolt covers for Sam and Jack, call George Maalouf and set a meeting with him for Thursday.
Thursday	22-Sep-11	9:00 AM	5:00 PM	8	Ablah	
Friday	23-Sep-11	9:30 AM	4:30 PM	7	Ablah	meet with Mathew and Alaa and come up with a new system for telescopic valve and then build a prototype
Saturday	24-Sep-11	10:00 AM	2:00 PM	4	Ablah	Went to Zahleh and got a zero flow switch then to Tamnine to get parts for the telescopic valves then took them all to Ablah.
Sunday	25-Sep-11					Off
Monday	26-Sep-11	9:30 AM	10:00 AM	0.5	Fourzol	Work on the final clarifier control panel
Monday	26-Sep-11	10:00 AM	4:30 PM	6.5	Ablah	Work on telescopic valve and plant water system
Tuesday	27-Sep-11	9:30 AM	4:00 PM	6.5	Ablah	check site, get Tony to take the parts that I got for the telescopic valves, show him what to do and check on him at his shop
Wednesday	28-Sep-11	9:30 AM	5:00 PM	7.5	Ablah	check site, help fix miss matched control panel stands, assembly of chemical feed line first box and tube to chemical building
Thursday	29-Sep-11	9:00 AM	4:00 PM	7	Ablah	Check on Tony then call him to get the telescopic valves back, then assemble one, change 2" valve at the plant water feed line.
Friday	30-Sep-11	9:30 AM	11:30 AM	2	Ablah	check site, and Hala work
Saturday	1-Oct-11	9:30 AM	3:00 PM	5.5	Ablah	Assemble the telescopic valves at the final clarifier
Sunday	2-Oct-11			OFF	Ablah	Day Off
Monday	3-Oct-11	10:00 AM	4:30 PM	6.5	Ablah	Test the telescopic valves at the final clarifier, assemble some hose stations

Tuesday	4-Oct-11	9:30 AM	5:00 PM	7.5	Ablah	Troubleshoot the plant water system, pump and pressure switch.
Wednesday	5-Oct-11	10:00 AM	3:00 PM	5	Ablah	Install outside conduits for chemical tubing, install handles for scum skimmers at final clarifier.
Thursday	6-Oct-11	9:00 AM	4:00 PM	7	Ablah	Try the suction line, for plant water then remove for troubleshooting
Friday	7-Oct-11	10:00 AM	5:30 PM	7.5	Ablah	Install drainage hoses for the digester pumps.
Saturday	8-Oct-11	10:30 AM	2:30 PM	4	Ablah	Fill up the septage receiving tank, tie the ladders on the digester tank with chains.
Monday	10-Oct-11	9:00 AM	3:00 PM	6	Ablah	Install drainage hoses for the primary pump and septage receiving, and testing the septage receiving pump.
Tuesday	11-Oct-11	9:30 AM	3:00 PM	5.5	Ablah	Cut thread and install oil filling pipe for trickling filter distribution arms
Wednesday	12-Oct-11			OFF	Ablah	Day Off
Thursday	13-Oct-11			OFF	Ablah	Day Off
Friday	14-Oct-11	9:00 AM	6:00 PM	9	Ablah	test the trickling filter panel, run digester pumps
Saturday	15-Oct-11			OFF	Ablah	Day Off
Monday	17-Oct-11	9:00 AM	4:30 PM	8.5	Ablah	Install the new tank for the plant water system, change the location of the pressure switch. Go to locale hardware store to get a 2000 L L clamp
Tuesday	18-Oct-11	9:00 AM	5:00 PM	8	Ablah	Make new hose reels, run digester and trickling filter pump
Wednesday	19-Oct-11	9:15 AM	4:15 PM	7.5	Ablah	Install hose reel, hose station and hose.
Thursday	20-Oct-11	9:30 AM	4:30 PM	8	Ablah	Install float switches in influent well.
Friday	21-Oct-11	9:00 AM	4:00 PM	7	Ablah	Test the influent pump #3 with float switches and install a connection box at the bottom of the panel
Saturday	22-Oct-11			OFF	Ablah	Day Off
Monday	24-Oct-11			OFF	Ablah	Day Off
Tuesday	25-Oct-11	9:00 AM	5:00 PM	8	Ablah	test pumps in final clarifier
Wednesday	26-Oct-11	9:30 AM	5:00 PM	7.5	Ablah	oversee the installation of electric panel sunshades, and request backing plates for the panels.
Thursday	27-Oct-11	9:30 AM	4:00 PM	6.5	Ablah	Pump capacity test for influent pump 3 and primary pumps, run digester pumps.
Friday	28-Oct-11	9:00 AM	2:00 PM	5	Ablah	grounding test, install dock bumpers on TFT pump station
Saturday	29-Oct-11	9:30 AM	2:00 PM	4.5	Ablah	plant checkup, run digester pumps and septage receiving
Sunday	30-Oct-11			OFF	Ablah	Day Off
Monday	31-Oct-11	10:00 AM	12:00 PM	2	Ablah	EID Holiday, 2-hr visit at WWTP for status checkup
Tuesday	1-Nov-11	10:00 AM	2:30 PM	4.5	Ablah	Site check up, run pumps.
Wednesday	2-Nov-11	9:00 AM	4:00 PM	7	Ablah	Install pressure gages at the pump stations and pumps
Thursday	3-Nov-11	9:15 AM	5:30 PM	8.25	Ablah	Install fire extinguishers in admin and chemical buildings, assemble and install hose station in the back of the admin building
Friday	4-Nov-11	9:00 AM	4:30 PM	7.5	Ablah	Install quick connect to suction line flushing valves in the digester and primary
Saturday	5-Nov-11	10:00 AM	2:00 PM	4	Ablah	receive the pumps back and unload them and get them installed
Sunday	6-Nov-11			OFF	Ablah	Day Off
Monday	7-Nov-11	9:00 AM	5:00 PM	8	Ablah	Reconnection of the pumps
Tuesday	8-Nov-11	9:00 AM	5:00 PM	8	Ablah	Finish reconnection of pumps and test them
Wednesday	9-Nov-11	9:00 AM	4:00 PM	7	Ablah	Test all the pumps,
Thursday	10-Nov-11	9:00 AM	4:30 PM	7.5	Ablah	Install signs on the TF #1 primary and digester, install hose to primary pump #1
Friday	11-Nov-11	9:00 AM	5:00 PM	8	Ablah	Install hose stations and hose reel at digester
Saturday	12-Nov-11	9:30 AM	2:30 PM	5	Ablah	Fabricate a sludge level devise for the digester
Sunday	13-Nov-11			OFF	Ablah	Day Off
Monday	14-Nov-11	9:15 AM	4:30 PM	7.25	Ablah	Install eye wash station at the chemical building, install chemical tubing

Tuesday	15-Nov-11	9:00 AM	5:00 PM	8	Ablah	Install shelf for chemical pump, and pump.
Wednesday	16-Nov-11	9:00 AM	3:45 PM	6.75	Ablah	Test the chemical pump, and plant water system, and all available pumps
Thursday	17-Nov-11	9:15 AM	4:30 PM	7.25	Ablah	Install hose at the primary,
Friday	18-Nov-11	9:00 AM	4:00 PM	7	Ablah	Measure the septage receiving tank, influent and primary.
Saturday	19-Nov-11	9:30 AM	3:00 PM	5.5	Ablah	Fill up the digesters and septage receiving tanks, and measure the digester
Sunday	20-Nov-11			OFF	Ablah	Day Off
Monday	21-Nov-11	9:30 AM	5:15 PM	7.75	Ablah	Put up the signs on the tanks, install dock bumpers at the final clarifier.
Tuesday	22-Nov-11			OFF	Ablah	Day Off
Wednesday	23-Nov-11	8:30 AM	4:30 PM	8	Ablah	Pretest startup of plant, troubleshoot TF pump3 and distributor arms in tft1
Thursday	24-Nov-11	7:45 AM	12:00 AM	16.25	Ablah	7 DAY TESTING, DAILY& BYHOURLY READINGS AND CHECKUP ON EQUIPMENTS AND TROUBLESHOOTING.
Friday	25-Nov-11	12:00 AM	12:00AM	24	Ablah	
Saturday	26-Nov-11	12:00AM	6:00 PM	18	Ablah	
Sunday	27-Nov-11	8:30 AM	3:30 PM	7	Ablah	
Sunday	27-Nov-11	5:30 PM	9:00 PM	3.5	Ablah	
Monday	28-Nov-11	7:30 AM	12:00 AM	16.5	Ablah	
Tuesday	29-Nov-11	12:00 AM	12:00AM	24	Ablah	
Wednesday	30-Nov-11	12:00 AM	5:00 PM	17	Ablah	
Thursday	1-Dec-11	9:00 AM	3:00 PM	6	Ablah	Take readings of the pumps and run the influent, primary and trickling filter pumps. Work on a new diesel measuring device, get a float gauge for the diesel tank from George Maaloof.
Friday	2-Dec-11	9:00 AM	2:30 PM	5.5	Ablah	Run the plant in a cycle and take readings of pumps run hours. Review snag list and add to it the light switch in the admin building and phone jack, and try again the fire alarm system. Clean the chemical building (sweep). Adjust the float switches in the final clarifier pumping station.
Saturday	3-Dec-11	off		0		
Sunday	4-Dec-11	off		0		
Monday	5-Dec-11	9:30 AM	3:00 PM	5.5	Ablah	Talk to George Maalouf about the site. Take pumps and diesel readings. Work on a prototype for measuring the water level in the digester. Go to the shop and pick the furniture for the admin building and guard room.
Tuesday	6-Dec-11	9:00 AM			Ablah	call Rizk and follow up with him about the furniture for the office and guard room in the admin building.
Wednesday	7-Dec-11	9:00 AM	4:00 PM	7	Ablah	Majed and kourkomaz technicians came on site. Meger all trickling filter pumps and influent pumps, check packing and adjust for pump #1. changed timers in influent PS to 30 sec and the ones in the TFPS to 15 sec and the timers in the digester panel #1 to 45 sec and the timer in the digester panel #2 to 60 sec. set over voltage to +4% and under voltage to 2% and first timer in the ATS to 3 min and second timer to 3 sec
Thursday	8-Dec-11	9:00 AM	3:00 PM	6	Ablah	Buy weather resistant foam for Plant water piping. Drain all plant water pipes. Problems with the ATS that wouldn't allow EDZ to enter except for a a few min at a time, So I called Majed and he recommended that i would change the under voltage to 6% and changed the second timer in the ATS to 3 min and turned on 2 influent pumps and 2 Trickling filter pumps to test if the load affected the ATS which it didn't.

Friday	9-Dec-11	9:00 AM	1:00 PM	4	Ablah	Install weather proofing foam on the following pipes: Hose station between influent and fine screen hose station at digester tank number 2 Go to Nabhan in Zahle and get 7 rolls of Electric Tape and 1 blade.
Saturday	10-Dec-11	8:30 AM	1:00 PM	4.5	Ablah	remove trickling filter tank #2's Fan#4 and help load it into the truck, so the fan manufacturer would fix it. And wait for him to bring it back the same day during which I took readings and started a cycle from influent to the final.
Sunday	11-Dec-11	off				
Monday	12-Dec-11	9:00 AM	12:30 PM	3.5	Ablah	Install the TF fan (lift it into place and reconnect the wires to the motor) start it and let it run for 5 min, which it did with no major problems. Start the whole plant on EDZ to check the voltage which it did hold at 222v
Tuesday	13-Dec-11	8:00 AM	4:00 PM	8	Ablah	Unbolt the fan to check the minor sound that was still in there during the wind down. Go to the pipe supports fabricator in Saadnaeil to ask him to build more supports for the digester which he refused due to the fact that he only welded the parts that Alaa cut for him. So I went to Rayak to find a fabricator there to make the supports asked at two different places before I found one in Ali Nahri. Install the insulation around the 1/2'' pipes at the digester. Take samples at the WWDS and measure the PH, DO and temperature
Wednesday	14-Dec-11	8:00 AM	4:00 PM	8	Ablah	Put the cover back on the TFT fan install insulation, help the flow meter installation guy and learn how to operate and maintain it in Ablah and go to Fourzol and troubleshoot the flow meter in Fourzol. Show Dabbas's technician all the snags in the ATS and panels and explain and fix them. Show and explain to Majed the snags and oversee the connection from the earth to neutral in the ATS according to the Dar al Handassa's recommendations, and change the light bulbs for the emergency light sockets.
Thursday	15-Dec-11	9:30 AM	2:00 PM	4.5	Ablah	Finish the pipe insulation on site, monitor the voltage at the ATS because the power kept on coming on then off so I noticed it was dropping below 218 which caused it to disconnect, so I called Matt then Majed which recommended that I would change the setting for the under voltage to 8%. Then went to Nabhan to get more electrical tape to wrap the pipes, and took samples of raw sewage and tested the PH, DO and temperature. swept and mopped the Admin building

Friday	16-Dec-11	6:00 AM	5:30 AM	11.5	Ablah	Monitor and record the voltage, according to dar al handasa's recommendations. Go to Ali Nahri and get the pipe support fabricated for the bore hole's suction pipe for the plant water, the install the suction pipe and install the support. Go to Nabhan and get blade replacement, tape and a water gun for the digester. check emergency lights for proper operation which were except the one above the garage door. Go to Fourzol and ask jasem to monitor the EDZ voltage for a few days to compare it to Ablah's data Flush the plant water system at all the valves and get it cleaned, and protected from freezing. Call Rizk and ask him about the furniture for the admin building
Saturday	17-Dec-11	10:00 AM	8:30 PM	5	Ablah	receive a bed and dresser from the city of Ablah for the guard room. Clean the guard room and assemble the furniture. Take EDZ readings from 10 to 12 then from 6 pm to 8:30 pm when we lost power. Call Rizk and inform him that we received the Furniture.
Sunday	18-Dec-11	7:30 AM	6:00 PM	5.5	Ablah	Take EDZ readings from 7:30 AM to 10:00 AM then from 3:00 PM to 6:00 PM and make an excel sheet with all the data.
Monday	19-Dec-11	9:00 AM	8:00 PM	5	Ablah	Took EDZ reading from 9:00 AM to 12:00 then from 6:00 PM to 8:00 PM when power went out. Turn on the influent well pumps to empty the well which filled up due to rain. And turned on the primary pumps to get the water to the digester.
Tuesday	20-Dec-11	8:00 AM	6:00 PM	8	Ablah	Took EDZ readings from 8:00 AM to 10:00 AM and from 4:00 PM until 6:00 PM Run the trickling filter fans for 2 hrs.
Wednesday	21-Dec-11	8:30 AM	12:00 AM	10	Ablah	install the support for the AC atop of the admin building. Go to Azar in Zahle and get fuse holders and fuses for the TFT fans and get a price check for a portable millimeter with a removable memory card. install a blank flange for the drain of sludge drying bed number 2 and start filling it from the digester. The slide gate for SDB number 1 was leaking a lot so I checked the leaked and had to remove the seal at the bottom of the gate where the leak is and soaked it in a hot water bath so that it would regain it shape, which took 2 days to do so. Took voltage readings during the day and then came back later that night at 8:30 PM and stayed until midnight taking voltage readings , power went out at 11:50 pm
Thursday	22-Dec-11	8:00 AM	5:30 PM	9.5	Ablah	Make cuts in the sleeve for the bore hole. Take samples of raw sewage. drain the discharge box for SDB #1 using a bucket just enough to be able to stand on a ladder in it to work, Go to Fourzol and get the voltage readings from there. Go to Zahle and get 2 plugs and fuses from industrial city. Take EDZ readings until power went out at 5:20 PM
Friday	23-Dec-11	10:00 AM	2:00 PM	4	Ablah	Took EDZ readings. Tried to install the seal at the bottom of the gate of discharge box of SDB #1 but dropped one of the screws in the water and had to wait to get help to drain that box completely of water to retrieve the screw after trying to get it by hand then using a magnet to no avail.

Saturday	24-Dec-11	2:00 PM	4:30 PM	2.5	Ablah	Took EDZ voltage readings. Installed fuse holders to the TFT fan.
Sunday	25-Dec-11	7:00 AM	10:00 AM	3	Ablah	Empty the influent well which was over filled due to rain water and water spilling over the gate in SDB #2, so I had to divert that water to the digester using both influent and primary pumps. Welded the last fuse holder inside the fan switch box.
Monday	26-Dec-11	1:30 PM	6:00 PM	4.5	Ablah	Go to Nabhan and get fittings for the water gun and the prototype of level measuring device for the digester. Took voltage readings until power went out at 5:55 Tested the plant water pump after being off for a few days to make sure the foot valve was holding.
Tuesday	27-Dec-11	10:00 AM	4:30 AM	6.5	Ablah	drain the discharge box for SDB #1, find the lost screw, wait for Atieh to help me reinstall the seal and lower the gate, start filling the bed from digesters 3 &4. stop filling at 4:30 pm Take EDZ voltage readings
Wednesday	28-Dec-11	8:00 AM	2:00 PM	6	Ablah	Take EDZ readings . Resume filling SDB #1 from the digester and once the power went out at 10 switched digester tanks to keep filling using gravity. start plant water pump since I was using digester pumps (required). drain the plant water system at the end of the day. drain influent well because it had refilled again due to strong winds that pushed the water over the gate of SDB #2.
Thursday	29-Dec-11	10:00 AM	2:00 PM	4	Ablah	change the fuses for the TFT fans and get a higher rating fuses to match the motor rating, and test them. Take readings of EDZ voltage.
Friday	30-Dec-11				Ablah	off
Saturday	31-Dec-11				Ablah	off
Thursday	1-Mar-12			0		off due to snow
Friday	2-Mar-12			0		off due to snow
Saturday	3-Mar-12			0	Ablah	tried to get to the site but couldn't had to turn back at the tanmia sign due to the bad road condition and accumulated snow
Sunday	4-Mar-12	11:00 AM	12:00 PM	1	Ablah	Check up on the site after the snow storm we had to see if there was any damage, noticed the ground around the wet weather diversion structure was covered in sewage, and the river level was too high (above the little bridge) but no damage to anything on site.
Monday	5-Mar-12	9:00 AM	3:30 PM	6.5	Ablah	I visited Ablah site at 9:00 AM where I found out that the wet weather diversion structure was flooded, and the water in the influent well was to the second step of the stairs, so I emptied the influent into the digester tank #4 and I took all the pumps readings. Then checked the discharge boxes both at the end of the chlorine channel and the bypass line, where I saw the river level 10 cm above the flap valve. Then I headed to Fourzol where I e-mailed my invoice then went to Zahle to get another price check for an empty electrical panel size 1.2-1.2-0.4 from ammoury.
Tuesday	6-Mar-12	8:00 AM	10:30 AM	2.5	Ablah	I got to Ablah at 8:00 AM and took pics of the tools in the garage area but not the inside storage room due to lack of electricity. by 10:30 AM power didn't come back so I left the site.

Wednesday	7-Mar-12	6:45 AM	4:30 PM	9.75	Ablah	Went to Fourzol at 6:45 AM where I downloaded the tools list and printed it in Jack's office, then headed to Ablah where I started checking off the available tools off the list, around 7:45 AM Attieh came by and took the hard hats and paint from the garage to Fourzol. Then started the influent pump to empty the influent well while I worked inside, trying to finish the list, at 8:30 AM I called the surveyor for 2 min and he told me that he left me the drawing in Zahle at a shop, so I went to Zahle and picked it up then went back to Ablah, at 10:00 AM as I tried to start the trickling filter pumps as per Matt's instructions the power went out, so I started the generator and started the trickling filter pump as Matt arrived on site. We checked the river level then troubleshoot the rotary distributor arms on TFT#2 and changed the oil in both tanks. by then Majed came on site to work on the electrical snags (ground the fire alarm system, fix connections to the horns at the panels, label the wires in some of the panels) then after George Maaloof came to site he called a local metal worker to site then we headed to his shop to inspect a tanker he was making and some of his other work. then went back to site to finish up for the day, after Matt left I shut down the pumps and put the ATS on forced EDZ then locked and left at 4:30 PM
Thursday	8-Mar-12	2:30 PM	4:30 PM	2	Home	Review the Surveyor's work and mark the missing points on the drawing, after talking to Matt and agreeing on the extra points needed.
Friday	9-Mar-12	9:30 AM	4:30 PM	7	Ablah	Called the surveyor in the morning to find what time he was showing up, then headed to site where I made a list of the points previously agreed on, then ran the influent pump. During my wait, Jallad's rep came to site and checked the generator. AT 13:00 the surveyor showed up and took the readings we needed, then logged the points into the site plan drawing. We were done at 16:30
Saturday	10-Mar-12					off
Sunday	11-Mar-12					off
Monday	12-Mar-12	9:45 AM	2:00 PM	4.25	Ablah	Got to site at 9:45 where I checked off the items in the storage room, then reviewed the work done by the surveyor and compared it to the drawings we had previously, turned on the influent well pump, to empty the well. Checked the river's level, which was about the top of the discharge pipe.
Tuesday	13-Mar-12					Off
Wednesday	14-Mar-12	9:30 AM	4:00 PM	6.5	Ablah	I met the lightning protection guys in Fourzol and took them to Ablah, where they started working on installing the Rods in the ground and checking it's resistance until they reached the 2ohms mark after installing 6 rods in 3 locations and connected them with a cable about 10 cm below the ground surface.

Thursday	15-Mar-12	9:00 AM	5:00 PM	8	Ablah	Got to Ablah site at 9:00 AM, and shortly after that the guys from the lightning protection company arrived, and I stayed with them until 12:15, when I had to leave. Came back at 2:30 PM and met they guys on their way home, so I checked the site, picked up the warranty paper from the ground. then locked up and headed to Fourzol where Majed had sent 2 guys to repair the damaged wires. and stayed with them until 6:15 PM all during which I was sending updated photos of their work to the main office and was updating Matt of their work.
Friday	16-Mar-12	10:00 AM	4:00 PM	6	Ablah	Arrived to Ablah at 10:00 AM, emptied the influent well, then headed to Fourzol where I waited for Majed's guys to show up, when they did, we tested that the material they poured on the wires had hardened, then they rewrapped it in more electrical tape, then I turned on the lights on site to make sure the repair worked, then they meggered the line going from electrical room to the influent panel. Meanwhile me and George started putting the plant back online, and checking for any problems. I was done by 13:30 and headed to Ablah where I continued taking pics of the tools, until 16:00.
Saturday	17-Mar-12					Off
Sunday	18-Mar-12					Off
Monday	19-Mar-12	8:00 AM	5:30 PM	9.5	Ablah	Got to the site early to get it ready for the visit from CDM (starting up the plant). Around 3 p.m Majed showed up to finish the remainder of his snags Matt had to leave at 4:30 pm and I stayed with Majed until he was done in the site which was at 5:15 pm then I shut down the plant and locked up at 5:30.
Tuesday	20-Mar-12	2:30 PM	3:30 PM	1	Ablah	checkup on the site and see if everything was in place, just to show people around that there's someone in the site
Wednesday	21-Mar-12	9:00 AM	3:00 PM	6	Ablah	Got to the site and Took more Pics and updated the tools list to include quantities of items, then emptied the influent well, and worked on the structural as built drawings for Ablah, logging in the new elevations. And made an AutoCAD drawing of the pumps info sheet
Thursday	22-Mar-12	2:15 PM	3:15 PM	1	Ablah	Checkup on the site, and make my presence obvious to the neighbors.
Sunday	1-Apr-11				Ablah	Off
Monday	2-Apr-11	8:30 AM	4:00 PM	7.5	Ablah	First day for Faris Abboud's guys started working the drying beds, I got them some tools and provided them with water from the plant water system, they used the power washer to wash bed #2, stayed until 3:45 pm, after I put everything away, left at 4:00 pm
Tuesday	3-Apr-11	8:00 AM	4:00 PM	7	Ablah	came in from 8:00 am to 4:00 pm but left for class for about 2 hours, stayed most of the day with faris aboud's guys
Wednesday	4-Apr-11	8:00 AM	4:00 PM	8	Ablah	opened the door for farris aboud's guys, and got them screw driver and water from the plant water pump, had to control the pressure in the ballon manually.
Thursday	5-Apr-11	8:00 AM	4:00 PM	7	Ablah	Farris Aboud's guys worked on cleaning the first bed while grinding the second. Had to monitor the plant water, left for class for about 2 hours, Farris aboud's guys left at 3:50 pm, Raed Ghantous came to site to check the work

Friday	6-Apr-11	8:00 AM	4:30 PM	8.5	Ablah	Farris Aboud's guys worked on cleaning and grinding the beds, I started working on the getting the plant water working in auto mode, and the fans for the trickling filters, went to Azar in zahle and got a breaker for the fans and looked for a 2'' check valve with no luck then asked George Naser if he could order one for me which he did, and asked me to come back the next day to pick it up, then went back to Ablah, installed the new breaker, then tried to adjust it according to the engineer at azar's recommendations, it worked until the spring inside of the breaker came loose. then left at 4:30 pm after Farri Abboud's guys had finished for the day about 40 min before.
Saturday	7-Apr-11	8:00 AM	4:00 PM	8	Ablah	Farris Aboud's guys continued working today, and I went back to zahle after I opened the door for them and got them 3 phase power and lots of plant water from the channel. George Naser wasn't able to get the check valve and asked if I could comeback on Monday, then went to Azar and got 4 more breakers for the fans, went back quickly to site at Ablah and got working on installing the breakers and monitoring the plant water at the same time until 4:00 pm
Sunday	8-Apr-11	8:00 AM	4:00 PM	8	Ablah	Farris Aboud's guys showed up today and stayed until 4:00 pm, during the day I ran the primary and influents pumps. And monitored the work's progress on the drying beds.
Monday	9-Apr-11	8:00 AM	4:00 AM	8	Ablah	Farris Aboud's guys continued work on the beds, after I got them all they needed I headed to Zahle to try and get the check valve with no luck, and he asked until the end of day to get it, so I went back that afternoon with no luck therefore I went to another store that gave me a lower price and offered to call once he got it in the store, then went back to Ablah and stayed with fares aboud's guys until they left, I locked up after them and left at 4:00pm
Tuesday	10-Apr-11	8:00 AM	4:00 PM	7	Ablah	Farris Aboud guys continued work from 8:00 am until 4 pm, I got a call from the plumbing store that he got the check valve for me.
Wednesday	11-Apr-11	8:00 AM	4:00 PM	8	Ablah	Farris Aboud, work on the drying beds, went to zahle to pick up the check valve, which was to the correct dimensions, then went back to the site, to monitor the progress of work on the drying beds.
Thursday	12-Apr-11	8:00 AM	4:00 PM	7	Ablah	Farris Aboud guys working on the drying beds.
Friday	13-Apr-11	8:00 AM	4:00 PM	8	Ablah	Farris abboud guys working on the drying beds.
Saturday	14-Apr-11	8:00 AM	4:00 PM	8	Ablah	Farris abboud guys working on the drying beds.
Sunday	15-Apr-11	8:00 AM	4:00 PM	8	Ablah	Farris abboud guys working on the drying beds.
Monday	16-Apr-11	8:00 AM	4:00 PM	8	Ablah	Farris abboud guys working on the drying beds.
Tuesday	17-Apr-11	8:00 AM	4:00 PM	7	Ablah	Farris abboud guys working on the drying beds.
Wednesday	18-Apr-11	8:00 AM	4:00 PM	8	Ablah	Farris abboud guys working on the drying beds. (Called Faris Abboud)
Thursday	19-Apr-11	8:00 AM	4:00 PM	7	Ablah	Farris abboud guys working on the drying beds.
Friday	20-Apr-11	8:00 AM	10:30 PM	14.5	Ablah	**First Day we opened the main sewer valve to the plant and got it online** after working all day on getting it ready for the incoming flow, and because the worker that George provided was new, I had to stay with him late that night in case anything happened.

Saturday	21-Apr-11	8:00 AM	6:00 PM	10	Ablah	Second day of plant operation I started teaching the new worker, then went to zahle and picked up some items for the plant, buckets, bug spray, steel toe shoes, boots, 1'' valves, then went back to site where we changed a couple of flushing valves. Get the air blower from Fourzol plant and the diaphragm pump in Atieh's truck. (Called Farris Abboud)
Sunday	22-Apr-11	9:00 AM	2:00 PM	6	Ablah	Normal plant operations, and training the new employee of George, changed 3 broken flushing valves. Went back at night to check on their work and the pressure in the plant water tank, since we kept finding it empty
Monday	23-Apr-11	8:00 AM	5:00 PM	9	Ablah	Normal plant operation, plus training, cleaning the wet weather using a septic truck but with no luck, so I went azzi in zahle and got some clamps and 3'' hose for the diaphragm pump.
Tuesday	24-Apr-11	8:00 AM	4:00 PM	8	Ablah	Normal plant operations, started the diaphragm pump and started cleaning the wet weather diversion structure had to go to class for a bit but I was late leaving and was able to comeback in about an hour. Then troubleshot the plant water borehole suction line.
Wednesday	25-Apr-11	8:00 AM	5:00 PM	9	Ablah	Normal plant operations, training. Continue cleaning the wet weather diversion structure, we finished it this day, but only the influent side. Changed the 2 broken flushing valves at the septic receiving pump discharge and at the digester filling lines.
Thursday	26-Apr-11	8:00 AM	5:00 PM	8	Ablah	Normal plant operations, received two loads of septic wastewater so I was able to train George's worker on the procedure in unloading and continuous water spraying, had to troubleshoot the plant water again, borehole suction line, added silicone just above the foot valve. (called Matt)
Friday	27-Apr-11	8:00 AM	7:30 PM	11.5	Ablah	Normal plant operations, got 2 liters of gasoline, troubleshot the blower with matt. then got a new sparkplug, and cleaned the fuel lines and filter until it finally worked. reinstalled the plant water borehole suction line, installed some new hoses, stayed until the new night guy showed up to meet him and make sure to explain his do and don't.
Saturday	28-Apr-11	9:00 AM	1:00 PM	4	Ablah/ Fourzol	Normal plant operations, get to Fourzol and start the blower there to make sure they can use it on Monday.
Sunday	29-Apr-11	9:00 AM	12:00 PM	3	Ablah	showed up to get readings then, made a walkthrough the site to confirm normal operation, then refilled the balloon at the plant water station, and stayed with the worker until he finished spraying the tanks.
Monday	30-Apr-11	8:00 AM	6:00 PM	10	Ablah/ Fourzol	Normal plant operations in Ablah then after Matt got to site and did the walkthrough we headed to Fourzol, where we reviewed the progress of work with the Fence there with George, then I waited for the welder to get there to install the new support for the box in the final clarifier pumping station in Fourzol, and he didn't show up until 4:50 pm, and stayed with him until he finished making sure the blower was working. then left from there with the big wrench and took it to Ablah. (called Atieh and Matt)
Tuesday	1-May-11	8:30 AM	5:00 PM	6.5	Ablah	Took readings, samples and pumped sludge. Worked on the borehole suction hose, used silicone to try and stop any leaks, then reinstalled it. Started filling SDB #2 from digesters 2 and 3

Wednesday	2-May-11	8:00 AM	6:30 PM	10.5	Ablah	took readings and samples at Ablah. Installed bleeding valves on digester#3 and changed flushing valves on the suction line. Pumped clean water from septage receiving to digester 3. Installed the suction hose for the plant water and tried it successfully. Roy from ABB showed up today and Fixed the flow meter, but I had to disconnect it due to the lack of protection from overvoltage. Went to Azar and picked up led lights for the panels and replaced the one in the septage receiving panel. Called Rizk and asked him to send in the garbage truck twice a week and to get was 2 gallons of drinking water.
Thursday	3-May-11	8:00 AM	6:00 PM	10	Ablah	Took readings, and samples and pumped the primary and some of the final. Installed a new hose at the trickling filter pump station, monitored the unloading of 2 septage trucks. Alarm sounded at 2:00 pm in the influent panel, so we had to close the valve partially to deal with the problem. I received a call from the mayor of Ablah informing me that he contracted the Rim water company to send us water.
Friday	4-May-11	8:00 AM	4:00 PM	8	Ablah	
Saturday	5-May-11	9:00 AM	12:00 PM	3	Ablah	Took readings, samples and pumped sludge.
Sunday	6-May-11	10:00 AM	12:00 PM	2	Ablah	Took readings, samples and pumped sludge.
Monday	7-May-11	9:00 AM	4:00 PM	7	Ablah	Took Samples and pumped sludge. Went to Zahle and got the parts needed to install the old suction line from the borehole, cut the elbow off the old line and glued in the new elbow and fittings. And let it sit until the next day to be sure it cured.
Tuesday	8-May-11	8:00 AM	4:00 PM	8	Ablah	Took samples and pumped sludge. Installed the new suction line in the borehole, made sure that the foot valve was holding, the quick connect I tightened by hand because I didn't have the big wrench.
Wednesday	9-May-11	8:00 AM	5:00 PM	9	Ablah	When I got to the site this morning both Trickling filter tanks were offline, so I called matt and we troubleshot it, and got it working again, pumped the primary twice, opened 2 telescopic valves in the final clarifier to recirculate the sludge back to the trickling filters. Jallad came in at 9:30 and changed the oil and filters. received a septic load at 2:00 pm. I visited with Matt 2 stores to try and open an account for plant water piping.
Thursday	10-May-11	8:00 AM	12:00 PM	4	Ablah	Took samples and Pumped sludge. Had a problem with the generator, which we got fixed, and got load of septic water.
Friday	11-May-11	8:00 AM	4:00 PM	8	Ablah	Took samples and Pumped Sludge.
Saturday	12-May-11	8:00 AM	12:00 PM	4	Ablah	Took readings samples and pumped sludge.
Sunday	13-May-11				Ablah	off
Monday	14-May-11	8:00 AM	4:00 PM	8	Ablah	Took samples, and pumped sludge, then turned the trickling filter fans for 1 hour.
Tuesday	15-May-11	8:00 AM	12:00 PM	4	Ablah	go to Ablah, take readings and pump the primary, talk to Matt, before heading to Fourzol, had to go to the doctor which sent me to the hospital.
Wednesday	16-May-11			0		off, I was in the hospital
Thursday	17-May-11	9:00 AM	4:00 PM	5	Ablah	took samples, readings and pumped sludge. Finished unplugging the primary clarifier with Matt, and got it back in working condition, and pumped again before leaving. And started using digester # 3.
Friday	18-May-11	8:00 AM	4:00 PM	8	Ablah	Took samples, readings and pumped sludge.

Saturday	19-May-11	9:00 AM	1:00 PM	4	Ablah	Took readings, samples and pumped sludge. The fuses in the trickling filter panel were blown so I troubleshot it and replaced 1 fuse. Decanted digester 1.
Sunday	20-May-11	8:00 AM	11:00 AM	3	Ablah	Took readings, samples and pumped sludge.
Monday	21-May-11	8:00 AM	4:00 PM	8	Ablah	Took readings, samples and pumped sludge. Installed a new plant water pipe to the top of trickling filter#2 but was able to install clamps to a height of 4 meters, and hosed the distributor arms and walls got them cleaned. Had problems with the generator it turned off on its own, called the mayor and matt and informed them of what happened, then moved the fuel using a bucket from the bottom of 1 fuel tank to the second one and fed the generator from it that gave us an extra 200 L.
Tuesday	22-May-11	6:30 AM	4:00 PM	7.5	Ablah	Took readings, samples and pumped sludge. got a call from the guard that the generator didn't start, so I rushed to the site to find the fuel level low but not empty called Matt and the mayor and tried to restart but wasn't able to. Installed a new plant water pipe to the top of the digester, and started hosing the surface of the digester # 1. took samples to tal Amara lab for BOD and COD testing. Received 2000L of diesel and a load of septic.
Wednesday	23-May-11	6:10 AM	5:00 PM	11	Ablah	I received a call from the guard that the generator failed to start, so I came to site immediately and tried to troubleshoot it, then called matt, at 7:00 I called Jallad and they showed up at 8:10 changed the fuel filter and cleaned the strainers, and restarted the generator. I took readings, samples and pumped sludge. At 2:00 pm the generator failed to start again, so I had to call Jallad for the second time, and they showed up at 3:30 pm and got it working.
Thursday	24-May-11	8:00 AM	4:00 PM	6	Ablah	Took readings, samples and pumped sludge, had a problem with the generator not starting, EDZ voltage problems which cause the generator to fail, so I called EDZ and asked they would increase the voltage setting at the plant transformer then cleared the fault and primed the generator then started it. around 4:00 pm a team from EDZ showed up and increased the voltage setting.
Friday	25-May-11	9:00 AM	6:00 PM	5	Ablah	Took readings, samples and pumped sludge. Then I turned off digester 3 pumps for decant, which we did a couple of hours later, according to the sample we got. Had to leave form 12:00 to 4:00 pm since we can't do much out in the heat.
Saturday	26-May-11	8:00 AM	5:00 PM	8	Ablah/ Fourzol	Got to Ablah took readings and samples, then pumped primary and final clarifiers and charged the plant water, the fuses in the TFPS panel blew and changed 2 of them. Then around 3:00 pm headed to Fourzol where I started making a hose connection to the top of the digester, as soon as I started work I got a call from Ablah that Jallad's mechanic showed up to site and started working on the generator, I had to go back to Ablah and waited till he was done cleaning the fuel filter, then went back to Fourzol and finished the connection with one piece missing. which I didn't have.
Sunday	27-May-11	9:00 AM	12:30 PM	3.5	Ablah	Took readings, samples and pumped sludge.
Monday	28-May-11	9:00 AM	2:30 PM	5.5	Ablah	Took readings, samples and pumped sludge. Cleaned the admin building, and waited to make sure that the generator ran with no problems when the power went out.
Tuesday	29-May-11	9:00 AM	12:00 PM	3	Ablah	Took readings, samples and pumped sludge.

Wednesday	30-May-11	9:00 AM	4:30 AM	7.5	Ablah	Took readings, samples and pumped sludge. Then we loosened the flange to drain sludge drying bed #2 and installed new plant water piping from the pump discharge to the storage tank next to it.
Thursday	31-May-11	9:00 AM	6:30 PM	5	Ablah	took readings and samples, then received a load of diesel at 10:00 am I called the mayor and informed him that we received the diesel, then took the receipt for the diesel to the mayor. Stayed on site with matt till 12:00 noon, went to class then came back at 4:30 pm and stayed on site till 6:30 pm.
Friday	1-Jun-11	8:00 AM	3:30 PM	7.5	Ablah	Took readings, pumped sludge, took samples, took a sample of the fuel and mixed it with water to see if it acted normally and it did separate. But it was a dark red color fuel. I put back the plug for S.D.B #1 and got it ready to be filled with sludge.
Saturday	2-Jun-11	9:30 AM	4:00 PM	6.5	Ablah	Started emptying digester 1 into S.D.B# 1 took readings, pumped sludge twice to digester 3, took samples. And had to stay with digester 1 until it emptied, had to spray the sludge at the bottom to be able to get the most of it.
Sunday	3-Jun-11	10:00 AM	12:00 PM	2	Ablah	Took readings and pumped sludge once and asked the guard to pump the second time late afternoon. Made sure the site was in good operational condition then left.
Monday	4-Jun-11	8:00 AM	4:00 PM	8	Ablah	Took readings, pumped primary and final sludge. The generator wouldn't start at 9:00 am although we had fuel so I called jallad which showed up and changed the fuel filter and primed the generator and got it started again.
Tuesday	5-Jun-11	8:00 AM	4:00 PM	6	Ablah	Took readings, pumped sludge, cleaned the fuel line and bled the air out of it. Attempted to make a baffle for the S.D.B.
Wednesday	6-Jun-11	8:00 AM	4:30 PM	8.5	Ablah	Took readings, pumped sludge, took samples. As the generator stopped working Jallad showed up to change the oil and was able to restart it again.
Thursday	7-Jun-11	8:00 AM	4:00 PM	6	Ablah	Took readings, pumped primary sludge twice, and final sludge 4 times, bleed the fuel line in the generator and restarted it successfully. Influent pump # 1 had a fault, which I reset by resetting the thermal overload.
Friday	8-Jun-11	8:00 AM	2:00 PM	6	Ablah	Took readings, samples and pumped sludge. Cleaned the fuel filter and bleed the fuel line and restarted it again. Got the tool from Fourzol to remove the weeds at Ablah.
Saturday	9-Jun-11	9:00 AM	12:00 PM	3	Ablah	Took readings, samples and pumped primary and final clarifiers. Then bled the fuel line to the generator.
Sunday	10-Jun-11	9:00 AM	12:00 PM	3	Ablah	Took readings, samples, pumped sludge. Cleaned the fuel line on the generator. Reset the thermal overload on the trickling filter pump#1.
Monday	11-Jun-11	8:00 AM	4:00 PM	8	Ablah	Took readings, Samples and pumped sludge. Bled the fuel line from the filter to the generator. Returned the tool back to Fourzol because they needed it there.
Tuesday	12-Jun-11	8:00 AM	12:00 PM	4	Ablah	Took readings, Samples and pumped sludge.
Wednesday	13-Jun-11	8:00 AM	4:00 PM	8	Ablah	Took readings, samples and pumped sludge. Finished installing the hose station at the top of trickling filter tank#2.
Thursday	14-Jun-11	8:00 AM	4:00 PM	6	Ablah	Took readings, samples and pumped primary and final sludge, cleaned the fuel line to the generator. Went with Matt to Al Khatib to look at fuel water separator for the generator and pay for it.

Friday	15-Jun-11	8:00 AM	4:00 PM	8	Ablah	Took readings, samples and pumped primary sludge twice, and final clarifier 4 times. Had to clean the fuel filter for the generator and bleed the air out of the fuel line. We started on the line going from the plant water tank to the end of the chlorine channel.
Saturday	16-Jun-11	8:00 AM	2:00 PM	6	Ablah	Took readings, pumped primary and final sludge. Cleaned the fuel filter on the generator and restarted it again. Then the trickling filter panel stopped due to burned relays, I called matt and Majed and asked him to send someone asap.
Sunday	17-Jun-11	9:00 AM	4:00 PM	7	Ablah	the generator wouldn't start due to dirty fuel so we cleaned the filter and primed it and restarted it again, then took readings and pumped primary sludge twice and final sludge 4 times. Majed sent his guy to try and fix the panel for the trickling filter, which had burned relays, then I went to Baalbek to find relay for him which I found 5 but couldn't find any fuses after looking in 6 different stores. which Fadi burned again while trying to solve the problem.
Monday	18-Jun-11	9:00 AM	9:00 PM	12	Ablah	Fadi, Majed's guy came in and fixed the trickling filter panel. the generator wouldn't start so we had to let the air out from the fuel line and put some fuel in the filter then restarted it successfully. I noticed that the septage receiving pump wasn't pumping after we received 2 loads of septage, so we tried to back flush it which it didn't work then we took the elbow at the top of the pump off then tried to back flush it using the septage truck's pump which didn't do anything, after back flushing it and seeing the water go to the digester but not from the tank I was able to locate the plug, and we took that pipe segment off and cleared the line we were done at 8:00 pm. then we pumped primary and took readings. Al Khatib sent in his team that installed a fuel water separator.
Tuesday	19-Jun-11	10:00 AM	11:00 PM	13	Ablah	took readings and pumped sludge twice. We put back the piping for the septage receiving pump that took us until 4:00 pm. Then we tried it successfully using the relay from the influent panel since majed's guy left us short 1 relay for the panel. At 7:00 pm we worked on the piping from the plant water pump along the chlorine channel, we added more clamps and welded the end segments pumped primary sludge the second time at 10:30 pm before I left.
Wednesday	20-Jun-11	8:00 AM	6:00 PM	10	Ablah	Took readings, pumped primary and final sludge, took samples. We tried to restart the generator but wasn't able to, so I called jallad and they sent someone to restart it. Cleaned the admin building. After Jallad's latest recommendation and the fact that the generator stopped working later that afternoon we emptied one of the fuel tanks and tried to move only the more or less clean fuel into the second tank and got the isolated. and was able to keep out 200 L of the bad fuel in different containers outside the tank.
Thursday	21-Jun-11	9:00 AM	1:00 PM	4	Ablah	Took readings, pumped primary and final sludge. Received fuel from the municipality which was much cleaner.
Friday	22-Jun-11	9:00 AM	3:00 PM	6	Ablah	took readings then pumped 2 primary tanks down to the level of the suction line of the pump and put them off line while I left the third online, to recirculate the water and kept TFT#2 online to try and save the bacteria in it.

Saturday	23-Jun-11	8:00 AM	2:00 PM	6	Ablah	Took readings and drained S.D.B. #2, then headed to Fourzol and got measurements of the pipes that needed wrapping to protect from freezing. Then took some of the foam I got to Ablah with me to Fourzol and showed the workers there how to wrap the pipes at the digester.
Sunday	24-Jun-11	10:00 AM	5:00 PM	7	Ablah	Took readings and started emptying digester #3 into Bed #2
Monday	25-Jun-11	8:00 AM	5:00 PM	9	Ablah	Took final reading, and pumped digester#1 to both S.D.B. I went to Zahle and got foam wrapping for Fourzol plant and pvc wrapping tape.
Tuesday	26-Jun-11	8:00 AM	5:00 PM	8	Ablah/ Fourzol	Went to Fourzol got the workers working on wrapping the pipes in the plant then headed back to Ablah and started wrapping the pipes here, then started installation on the second hose station atop TFT #1. Then went back to Fourzol to check on the progress of work there, and fixed the hose connections at the primary and fine screen stations, and septage receiving.
Wednesday	27-Jun-11	8:00 AM	5:30 PM	9.5	Ablah	The welder showed up with the windows guards, got them installed, as he was working the generator stopped and didn't work, I had to call Jallad after attempting to restart it with no success, then Majed came in and Jallad showed up. They got the generator fixed and advised not to start it up again until we get new fuel, Majed was able to fix the MDB amp readings and Kw readings, and fixed the influent panel and the digester panels, by 5 pm he had to leave the trickling filter panel for the next visit.
Thursday	28-Jun-11	9:00 AM	1:00 PM	4	Ablah	Clean up admin building and workshop, waited for the tractor and gates to be delivered but neither showed up
Friday	29-Jun-11	10:00 AM	4:00 PM	6	Ablah	Waited for the tractor and gates to be delivered but none showed up. Installed the signs for the influent and septage receiving stations
Saturday	30-Jun-11	8:00 AM	5:00 PM	9	Ablah	Went to Fourzol zt 7:00 AM and got the workers to Ablah to start cleaning the site from weeds and painting the window guards, then we wrapped the pipe along the chlorine channel with foam, Went to Zahle got varnish and sanded then painted the workbench with it. At 4:30 pm took the workers back to Fourzol.
Monday	2-Jul-11	9:00 AM	3:00 PM	6	Ablah/ Fourzol	Check up on Ablah and clean up after the guard left the place a mess. Then headed to Fourzol for the meeting with Rami and the mayors. Then back to Ablah for a meeting with Ablah mayor and CDM.
Tuesday	3-Jul-11	9:00 AM	4:00 PM	7	Ablah/ Fourzol	Check up on George's work at Fourzol, then head back to Ablah once the gates arrived at Fourzol and waited for the tractor to arrive, then took possession of it.
			Total hours	**322**		

5.0 Lessons Learned and Recommendations

Sustainability of Constructed Infrastructure, in the narrow sense of preparing village municipality O&M staff to manage the day-to-day responsibilities for wastewater service delivery for the three constructed WWTPs (Aitanit, Fourzol, and Ablah), these objectives have been addressed and met through the Project Advise and Assist Training Program which delivered technical training, O&M systems, and maintenance procedures. The project overall assumptions of designing and constructing, appropriate technology wastewater treatment systems capable of being operated and maintained by local village municipality staff has come true.

In the broader sense, and outside the scope of this SVWWTS project, achieving self-sustaining local village wastewater treatment systems capable of collecting user service fees, retaining, budgeting, and managing resources has not yet occurred. Potential future strategies to be considered in the next generation of project designs and/or follow-up activities to this Project are discussed below.

5.1 Lessons Learned

- Lebanon electrical grid power supply is unstable (critical swings in delivered voltage) and unreliable (may be off-line for up to 14-hours per day). Electrical equipment (control panels, electric motors, switchgear) shortened life and early fatigue are certain to occur.

- WWTP energy costs (electrical grid power plus diesel fuel used for standby onsite power generation) makeup about 70% of the total operating costs. Having near constant electric grid power supply will reduce total operating costs by half.

- Household septage waste disposal (commercial waste haul tanker dumping) at village WWTPs is happening but remains mostly unregulated allowing unscrupulous waste haulers to continue the practice of direct river discharge even when within the close proximity of a WWTP with septage receiving facilities.

- O&M programs which build on local management structures have better prospects for sustainability than those which establish new or parallel structures.

- The capacity of newly established village wastewater utilities to manage new structures, systems, ideas and funds is low.

- Ministry of Environment (or any other governmental agency) oversight monitoring of treated sewage effluent water quality is not happening which contributes to an attitude of unconcern by village municipality staff regarding

WWTP performance and achieving treated water quality standards for direct river discharge.

5.2 Recommendations

- Look for ways to continue capacity building efforts for village municipality WWTP O&M staff so that already learned skills and procedures will not be lost due to lack of municipality management and government watchdog agency oversight.

- Private sector local service companies should be considered as an alternative to village direct hired O&M staff working at new WWTP facilities.

- USAID to consider providing assistance to Lebanon decision makers regarding standards and regulations for reuse of reclaimed wastewater.

- Look for Ministry of Agriculture laboratory facilities (Bekaa region near existing WWTPs) which can support village WWTPs by providing analysis of water quality samples.

- WWTP biosolids from sludge drying beds provides an opportunity for co-composting with local agriculture waste trimmings to produce a better and safer reusable biosolids product.

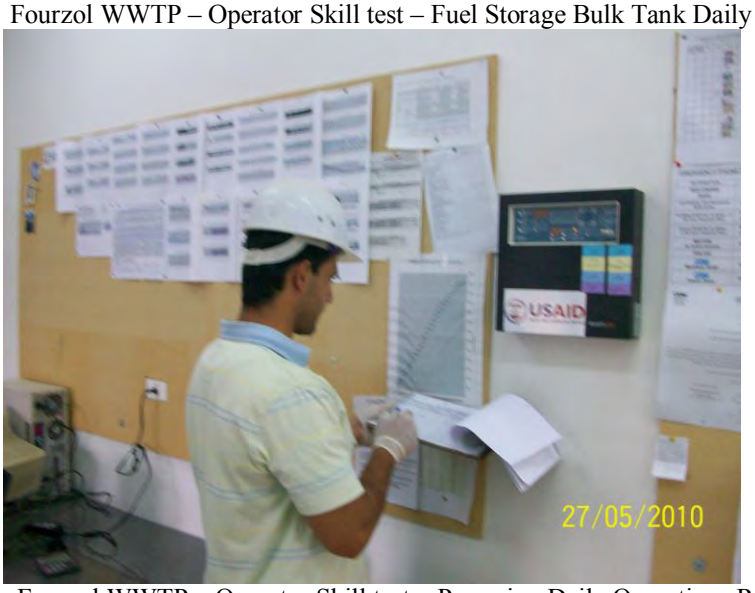
6.0 Progress Photos

Fourzol WWTP – Effluent Outfall Location at Litani River – Continues to receive non authorized solid waste dumping by local residents

Fourzol WWTP – Effluent Outfall Location at Litani

Fourzol WWTP – Digested sludge being added to the sludge drying bed

Fourzol WWTP – Operator Skill test – Fuel Storage Bulk Tank Daily Level Measurement



Fourzol WWTP – Operator Skill test – Preparing Daily Operations Report

Fourzol WWTP – Operator Skill test – Fine Screen Cleaning

Fourzol WWTP – Operator Skill test – pH Meter Calibration

Fourzol WWTP - Farmers plugging the final effluent line outside the fence of the WWTP & pumping to their crops

Fourzol WWTP – Effluent gravity pipeline inspection manhole with missing (stolen) cast iron cover (typical of five missing covers)

Fourzol WWTP - Septic waste haul truck dumping at the septic resaving station

Fourzol WWTP – Operator Training – Demonstration of Learned Skills

Fourzol WWTP – Operator Training – 60-minute Setteability Test

Fourzol WWTP – Operator Training – Dissolved Oxygen Meter Calibration Procedure

Fourzol WWTP – Operator Training – Dissolved Oxygen Field Measurement

Fourzol WWTP – Operator Training – pH Meter Calibration and Use

Fourzol WWTP – Operator Training – Dissolved Oxygen Field Measurement

Fourzol WWTP – Operator Training – Dissolved Oxygen Field Measurement

Fourzol WWTP – Operator Training – Daily Process Control Record Keeping

Fourzol WWTP – Operator Training – Dissolved Oxygen Field Measurement

Fourzol WWTP – Operator Training – Fuel Tank Level Measurement

Fourzol WWTP – Operator Training – Daily Evaporation – Pan Test

Fourzol WWTP – Operator Training – Portable Diaphragm Pump Routine Lubrication and Exercise

Fourzol WWTP – Operator Training – Safety Air Blower - Routine Lubrication and Exercise

Fourzol WWTP – Operator Training – Chlorine Solution Feed Pump O&M

Fourzol WWTP – Operator Training – Sludge Pump Packing Gland Adjustment

Fourzol WWTP – Operator Training – Pump Capacity Testing – Wetwell Drawdown Method

Fourzol WWTP – Operator Training – Generator Fuel Management – Calculating Daily Fuel Usage

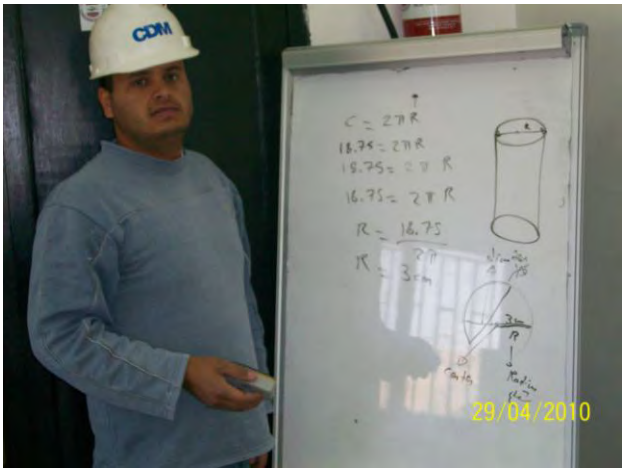
Aitanit WWTP – Grade-7 School tour of the WWTP

Aitanit WWTP – Grade-7 School tour of the WWTP

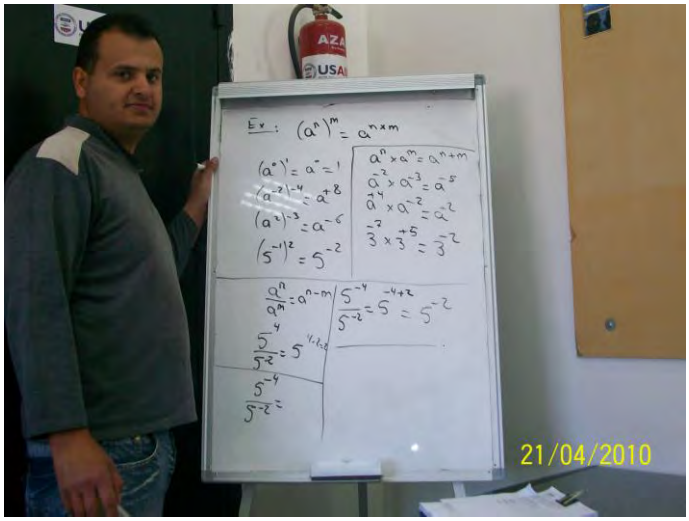
Aitanit WWTP – Grade-7 School tour of the WWTP

Sludge drying bed filling process

Aitanit WWTP – Control Panel Final Inspection and Troubleshooting



Aitanit WWTP — CDM Instructor teaching course on Basic Math for WWTP Operators



Aitanit WWTP – CDM Instructor teaching course on Basic Math for WWTP Operators

Aitanit WWTP – Plant operators attending training session

Aitanit WWTP – Operator Skill Tests – Basic Math for WWTP Operators

Aitanit WWTP – Operator Skill Tests – Basic Math for WWTP Operators

Aitanit WWTP – Operator Skill Tests – Fuel Tank Level Measurement

Aitanit WWTP – Operator Skill Tests – Trickling Filter Rotary Distributor – Routine Lubrication and Checks

Aitanit WWTP – Operator Skill Tests – Dissolved Oxygen Meter Calibration and Use

Aitanit WWTP – Operator Skill Tests – Trickling Filter Fan – Routine Lubrication and Inspection Checks

Aitanit WWTP – Operator Skill Tests – Primary Sludge Pump Controls

Aitanit WWTP – Operator Skill Tests – Daily Process Control & Recordkeeping

Aitanit WWTP – Operator Skill Tests – Daily Process Control & Recordkeeping

APPENDIX A

Training Materials
Village WWTPs – Lesson Plans

INTRODUCTION TO WASTEWATER SYSTEMS

WHAT IS IN THIS LESSON?

1. Introduction
2. Sources of Wastewater
3. Impact of Wastewater
4. Other Water Quality Considerations
5. The Solution
6. Natural Treatment
7. Biological Process
8. Manmade Treatment
9. The Collection System
10. Treatment Facilities
11. Preliminary Treatment
12. Primary Treatment
13. Biological Treatment
14. Chemical Treatment

مقدمة النظام المياه المبتذلة

ماذا في هذا الدرس؟

١. مقدمة

٢. مصادر مياه الصرف الصحي

٣. تأثير المياه المبتذلة

٤. اعتبارات اخرى لنوعية المياه

٥. الحل

٦. المعالجة الطبيعية

٧. النظام البيولوجي

٨. المعالجة البشرية

٩. نظام الجمع

١٠. منشآت المعالجة

١١. المعالجة المبدئية

١٢. المعالجة الاولية

١٣. المعالجة البيولوجية

١٤. المعالجة الكيميائية

INTRODUCTION TO WASTEWATER SYSTEMS

مقدمة أنظمة المياه المستعملة

INTRODUCTION

What is Wastewater?

We use water to wash our hands, wash the dishes, take a shower and flush the toilet. Water may also be used to clean the streets and to process foods such as olives and vegetables. The water picks up material associated with its use called contaminants. The water then carries the material away from houses and other buildings to the treatment plant. This used water is called wastewater.

مقدمة

ما هي المياه المستعملة

المياه اساس الحياة ونحن نستعملها في كل تفاصيل حياتنا اليومية بدءا من صناعة المأكولات الى غسل اجسادنا وايدينا وملابسنا وصولا إلى تنظيف منازلنا وشوارعنا. تلتقط المياه اثناء استعمالنا لها مواد ملوثة تسمى ملوثات فتحملها معها من المنازل والمباني اما الى محطة المعالجة. تدعى هذه المياه المستعملة بـ"المياه المبتذلة".

SOURCES OF WASTEWATER

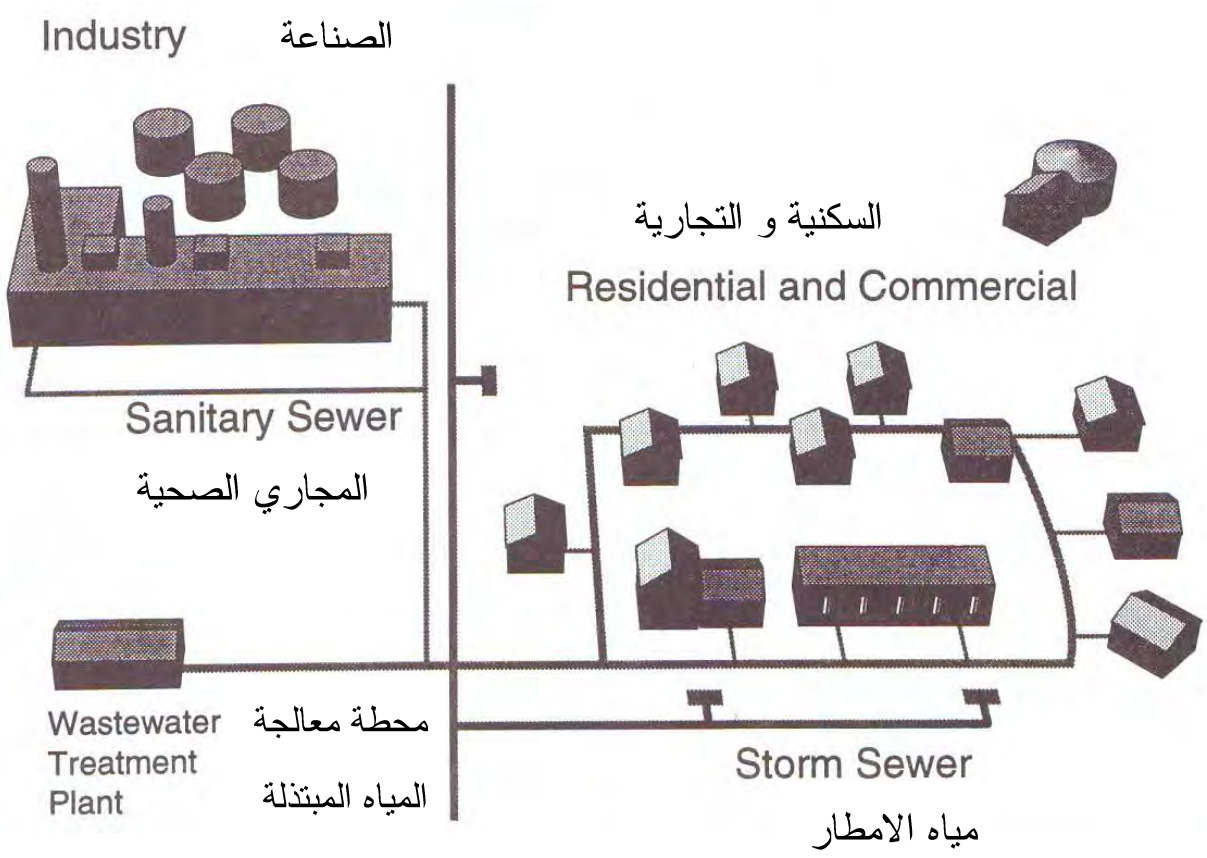
مصادر مياه الصرف الصحي

Three Categories

The used water (wastewater) is placed into one of three categories. The categories are based on the source of the wastewater. The three categories are: domestic wastewater, storm water and industrial wastewater.

ثلاث فئات

تنتمي المياه المبتذلة الى إحدى الفئات الثلاثة . تصنف هذه الفئات على أساس مصادرها. الثلاث وهي : المياه المبتذلة المنزلية، مياه الامطار والمياه المبتذلة الصناعية .



Domestic Wastewater

Domestic wastewater is the wastewater produced by homes, businesses, schools, hospitals, clinics and other typical buildings found in any town or village. Domestic wastewater includes human waste and graywater (water from sinks, showers, washing machines, etc).

المياه المنزلية

هي المياه المبتذلة الناتجة عن المنازل، المستشفيات، المدارس، المكاتب، العيادات واية منشأت مماثلة في القرى والبلدات. تشمل هذه المياه الفضلات البشرية ومياه المطابخ والغسيل. تتضمن المياه المبتذلة المنزلية :المياه السوداء (أي مياه المطبخ وكرسي الحمام) والمياه الرمادية (أي مياه الغسيل والإغتسال).

Storm Water

Storm water includes surface runoff from streets, the ground and roof drains.

الامطار

هي المياه السطحية الناتجة عن المتساقطات (شتاء، برد، ثلج...) على أسطح المنازل وفي الشوارع والاراضي.

Industrial Wastewater

Industrial wastewater is water coming from common industries such as olive press operations, produce wholesalers, chicken processing plants, cereal producers, leather manufacturers, butcher shop, and other similar sources. Industrial wastewater contains contaminants other than human waste.

المياه المبتذلة الصناعية

هي المياه الناتجة عن المصانع مثل معاصر الزيتون، مصنع تجليد الدجاج،الجزار و مصانع الالبان والاجبان، البلاط ، الصباغة. وهي تحتوي على ملوثات مختلفة عن مخلفات الانسان.

IMPACT OF WASTEWATER

تأثير المياه المبتذلة

Introduction

The impact of using water to carry away contaminants depends on the source and quantity of the wastewater and how it is handled, collected, transported and method of disposal.

مقدمة

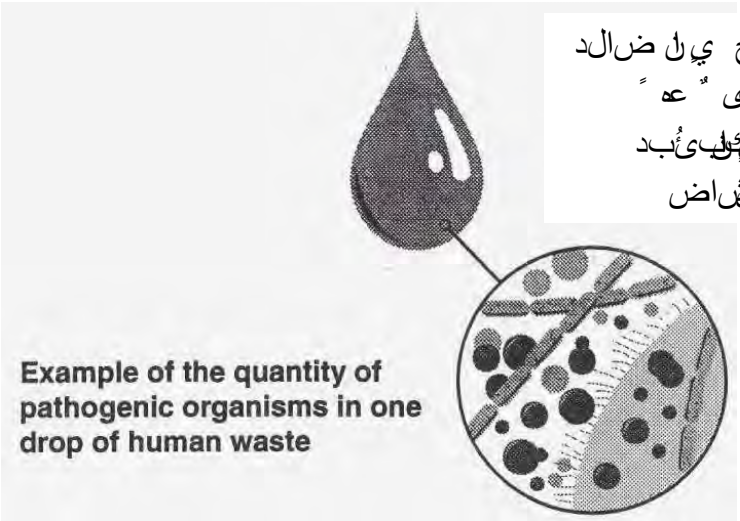
ان أثر المياه المستعملة لحمل ونقل الملوثات بعيدا مرتبط بمصدروكمية المياه المبتذلة وكيفية مواجهتها، جمعها، نقلها وطريقة التخلص منها.

Disease and Human Waste

For instance, human waste contains microorganisms that can cause disease. These microorganisms are commonly called germs, but more technically should be called pathogenic organisms. One drop of wastewater containing human waste can contain millions of these disease-causing microorganisms.

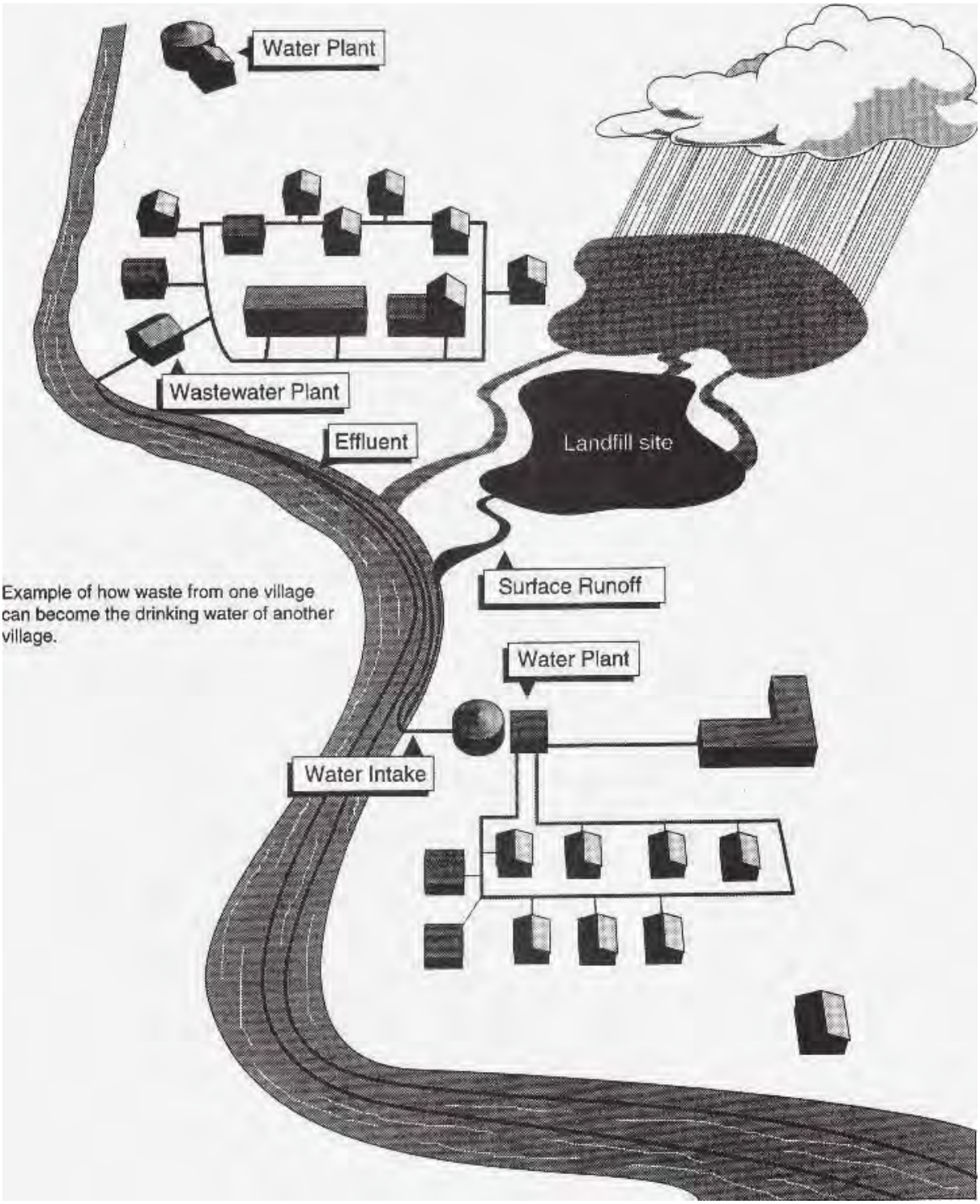
الأمراض والمخلفات البشرية

تحتوي المخلفات البشرية على كائنات مجهرية قادرة على التسبب بالأمراض. تعرف هذه الكائنات "بالجراثيم" بينما تقنيا تسمى "كائنات حية مسببة للامراض". يمكن لقطرة واحدة من الفضلات البشرية ان تحمل ملايين من تلك الكائنات.



Disposal in the Litani River

When domestic wastewater is disposed of in the Litani River, the disease-causing microorganisms are carried downstream and may be used for farm irrigation by another village or children may swim in the contaminated water.



Example of how waste from one village can become the drinking water of another village.

التصريف في مجرى مائي

عندما تصرف المياه المبتذلة المنزلية في مجرى مائي – كنهر الليطاني فأن الكائنات المسببة للامراض تنتقل بواسطته الى بحيرة القرعون حيث يسبح الأطفال كما يمكن أن تستعمل للري أو السباحة من قبل الأطفال.

OTHER WATER QUALITY CONSIDERATIONS

اعتبارات اخرى لنوعَة المَاه

Water Quality

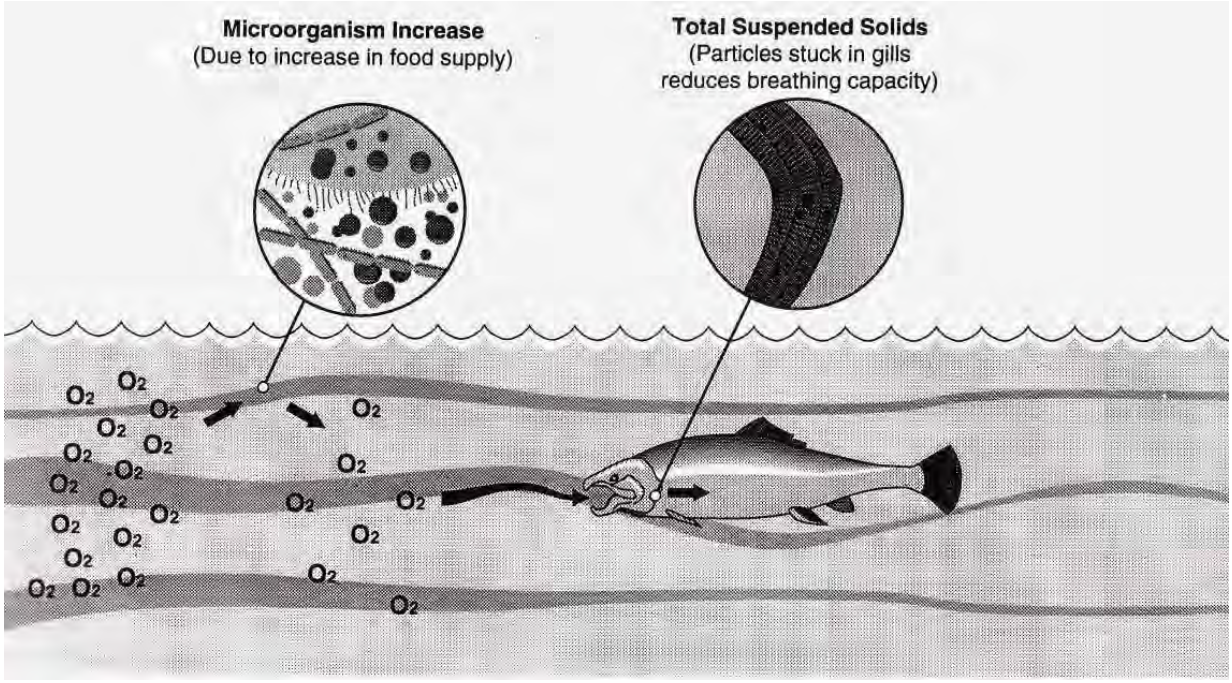
Besides the health problems associated with untreated or partially treated wastewater there are other considerations that have to do with the degradation of the quality of the receiving stream.

ن وعَة المَاه

بالاضافة الى المشاكل الصحية المرتبطة بالمياه الغير معالجة اوالمعالجة جزئياً فهنالك بعض الأمور التي يجب ان تؤخذ بعين الاعتبار والمتعلقة بتدهور نوعية مياه نهر الليطاني.

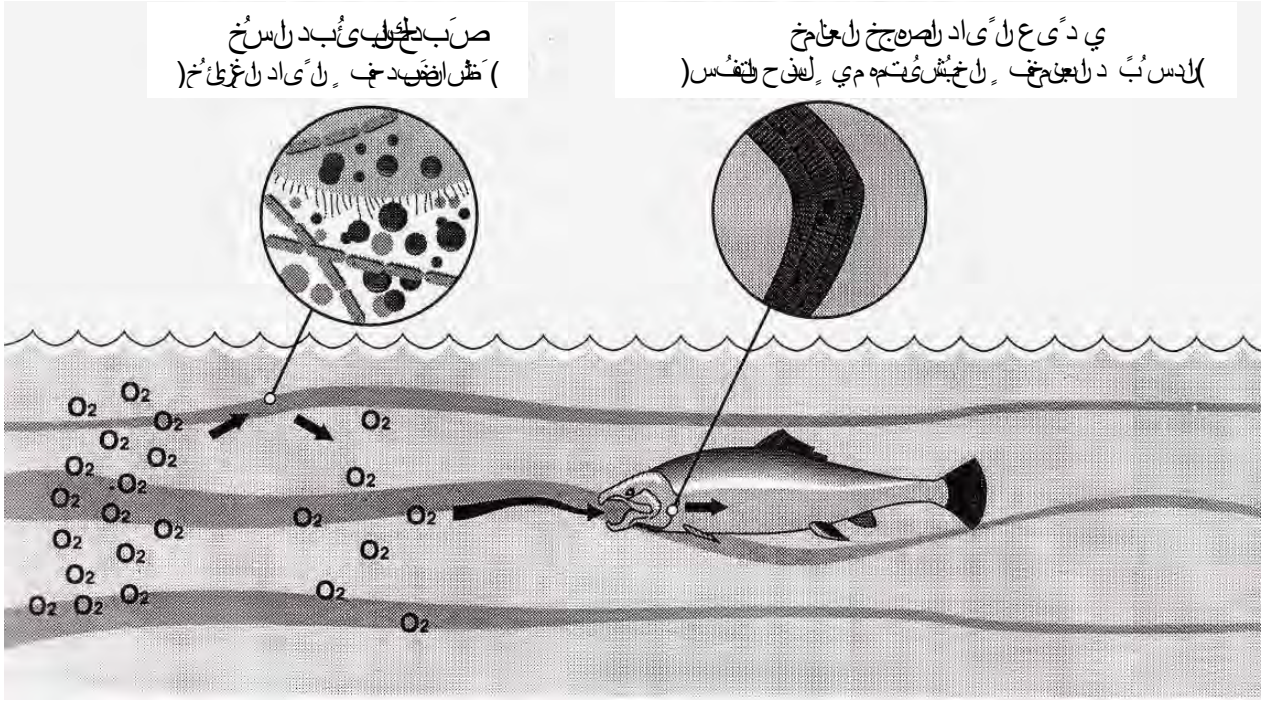
The Aquatic Environment

When wastewater is discharged into the Litani River it becomes an additional food source for the microorganisms in the River. This addition of food to the river causes an increase in the number of microorganisms. They multiply in response to the added food supply. As they consume this food, they also consume oxygen from the River. It is possible for the food supply to be so great that the increased numbers of microorganisms use more oxygen than the Litani River can supply, reducing the oxygen content of the River. The result is a deterioration of the quality of the water and the death of fish and other aquatic life.



البيئة المائية

عندما ترمى الاوساخ في نهر الليطاني، تصبح هذه الاوساخ بمثابة غذاء اضافي للكائنات المجهرية الموجودة في النهر. فيزداد عددها بفعل ازدياد الغذاء لها. فتتكاثر وتنمو وتستهلك هذه الاغذية المتوفرة. كما وتستهلك في نفس الوقت الاوكسيجين الذائب الموجود في المياه، وقد يرتفع وجود الكائنات المجهرية الحية الى درجة تستهلك فيها كل الاوكسيجين الذائب في مياه نهر الليطاني. وبنتيجة ذلك، تتدهور نوعية مياه النهر فينفذ الاوكسيجين من مياهه، وتموت الاسماك والحياة المائية فيه.



Solids in the Litani River

Some material that is deposited into the Litani River is suspended in the water. This material is commonly called solids. These solids can become lodged in the gills of fish making it difficult for them to breathe.

الجوامد في نهر الليطاني

تحمل مياه النهر بعض المواد المرمية في مجراه، وتدعى هذه المواد بـــ"الجوامد" وقد تعلق هذه الجوامد في حلق الاسماك فتؤدي الى اختناقها.

Recreation

Along with the food and solids are the disease-causing microorganisms that we have spent so much time discussing. Besides the contamination of a downstream user's irrigation water supply, these same organisms can pollute the swimming area near where the wastewater enters the Litani River and further downstream at the Litani Lake. As a result, individuals using this area can become infected with the disease carried by the wastewater.

الاستحمام

يتضمن الغذاء والجوامد كائنات حية مسببة للامراض ناقشناها سابقا. فعندما يتلوث نهر الليطاني وبحيرة القرعون بهذه الكائنات او الجراثيم، تصبح كل مسالكهما وروافدهما أيضا عرضة للتلوث بهذه الكائنات. وبنتيجة ذلك يصبح الناس الذين يستعملون تلك الضفاف عرضة للاصابات بأمراض منقولة بالمياه المبتذلة.

THE SOLUTION

الحل

What is the Solution?

The solution to human contamination within the village or community is to reduce contact with human waste. The solution to deterioration of water quality and preventing contamination of the Litani Rivera downstream users' water supply is proper treatment. Treatment can be natural or manmade.

ما هو الحل؟

إن الحل للحد من إصابة الإنسان في القرى والمجتمعات بالأمراض، هو بتجنيبهم التعرض لمخلفاتهم. فإذا تمكنا من حل مشكلة تلوث وتدهور نوعية مياه نهر الليطاني والبحيرة عندئذ نجنب الناس الذين يستعملون مياهه أو يرتادون ضفافه من التعرض للإصابة بالأمراض. يمكن حل مشكلة تلوث النهر إذا عولجت المياه المبتذلة بطرق طبيعية أو من صنع الإنسان قبل صرفها فيه.

NATURAL TREATMENT

المعالجة الطبيعية

Nature's Way

Nature has three ways of naturally dealing with waste. One is the process of dilution. The second is the movement of waste and the cleansing of water through the hydrological cycle and the third is the biological process of reducing the waste to harmless material.

الطرق الطبيعية

للطبيعة ثلاث طرق طبيعية للتعامل مع المخلفات. اولها هي عملية تخفيف حدتها بإضافة الماء عليها. ثانيها هي ازاحة المخلفات وتنقية المياه بالدورة الهيدرولوجية للمياه. وثالثها هي العملية البيولوجية لتحويل المخلفات الى مواد غير ضارة.

BIOLOGICAL PROCESS

Food

The third natural treatment process is called the biological process. When wastewater enters the Litani River, the microorganisms in the water eat material in the wastewater. In the process of eating this material, they increase their numbers and consume the oxygen that is dissolved in the water.

النظام البيولوجي

الغذاء

تدعى العملية الطبيعية الثالثة العملية البيولوجية، فعندما تدخل المياه المبتذلة الى نهر الليطاني و البحيرة البحيرة ، تأكل الكائنات المجهرية الحية في البحيرة المواد المتواجدة في المياه المبتذلة. وخلال عملية الاكل لهذه المواد، تتكاثر الكائنات وتستهلك الاوكسجين الذائب في المياه.

Oxygen

In the natural process, the oxygen is replenished by the water flowing downstream over rocks where it is aerated. In addition, oxygen is added to the Litani River water by the action of the wind on the surface.

الاوكسجين

في العملية الطبيعية، تتزود المياه المتدفقة بين الصخور بالاوكسيجين من خلال ارتطامها بها وبالتالي تعرضها للتهوئة.اضافة الى ذلك ، يدخل الاوكسيجين الى نهر الليطاني جراء عملية إحتكاك الهواء بسطح المياه.

Overload

When the quantity of oxygen used by the microorganisms in the Litani River water exceeds the quantity of oxygen that is entering the water, the quality of that water starts to deteriorate. The result is an unfavorable condition which may cause the death or reduction of aquatic life including fish.

الحمل الزائد

عندما تستهلك الكائنات المجهرية الحية الاوكسيجين بكميات تفوق تلك الكميات الموجودة أساسا في مياه نهر الليطاني والكميات التي تدخلها من الإحتكاك بالهواء او عبر الإرتطام بالصخور. عندئذ تتدهور نوعية مياه البحيرة . وتكون النتيجية غير مستحبة وقد ينتج عنها موت او انقراص الحياة المائية وخاصة الأسماك.

MANMADE TREATMENT

When natural treatment is not sufficient, we must turn to manmade treatment systems in order to prevent disease and protect the Litani River waters. These systems are commonly called sanitary facilities and are composed of two general groups of components; the collection system and the treatment plant.

المعالجة البشرية

بما ان المعالجة الطبيعية غير كافية، لذلك يتوجب على الإنسان التدخل في انظمة المعالجة لتجنب الامراض وحماية نهر الليطاني. وتدعى هذه الانظمة عادة بمنشأت الصرف الصحي وتتألف من مجموعتين عامتين : نظام الجمع (المجارير) ومحطة المعالجة.

THE COLLECTION SYSTEM

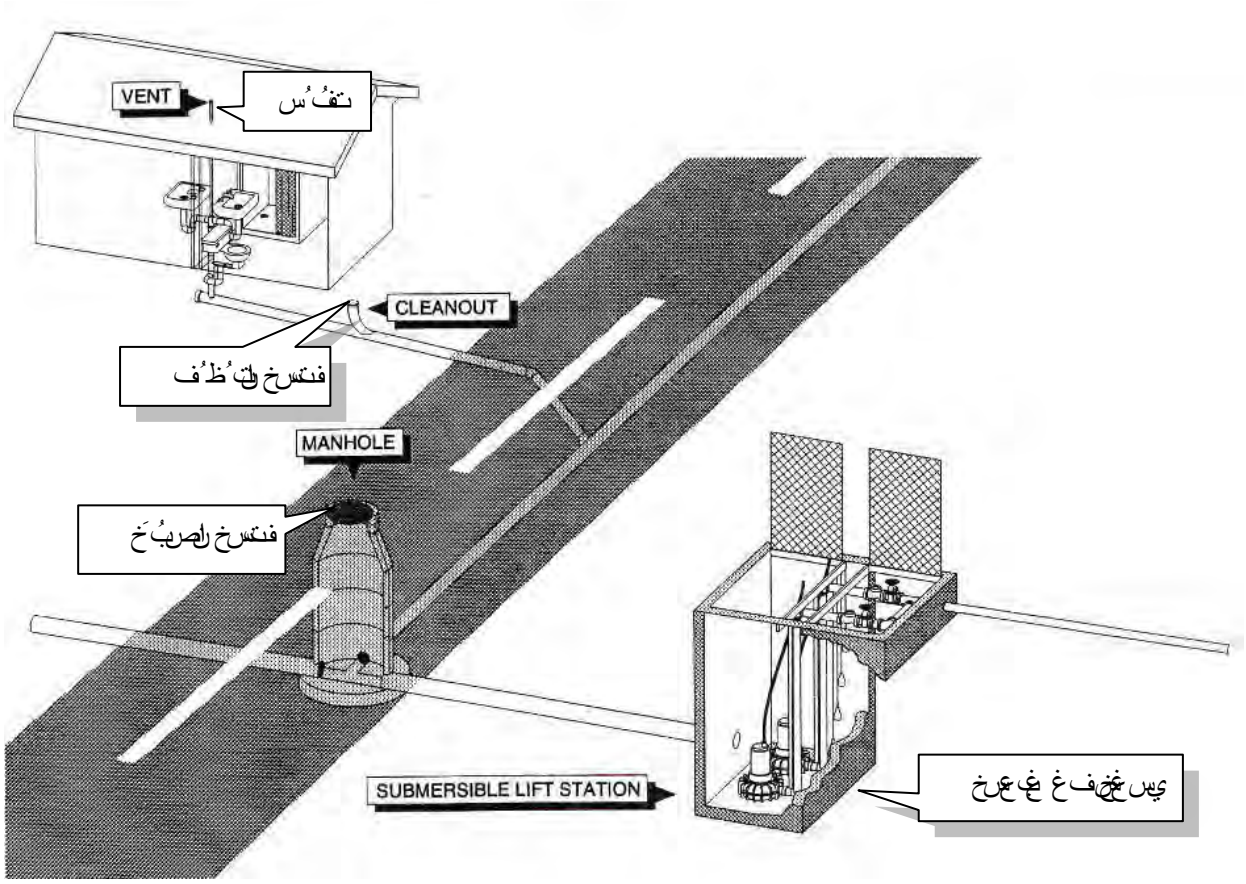
Individual System

The collection system may consist of individual holding tanks that are pumped and hauled or piped sewer systems.

نظام لجمع

نظام لجمع فرد

لذتأف اظبو فش د ي فش ص ش خ ض ت س ت ت ص م ظ ب س ب ع ت م ذ .



Piped System

A piped system is composed of a network of pipes that collect the wastewater and move it to the treatment plant (or directly to the Litani River if no treatment plant is available). Most piped systems work by gravity, that is, they are sloped downhill from the house to the treatment plant.

نظام المجاري

يتألف نظام المجارير من شبكة قساطل لجمع المياه المبتذلة وايصالها الى محطة المعالجة أو مباشرة الى نهر الليطاني في حال عدم وجود محطة معالجة . تعمل معظم هذه الشبكات بالجاذبية لا سيما في المنحدرات نزولاً من المنازل حتى محطة المعالجة.

Sewage Pumping Station

The topography of some villages does not allow a collection system to work entirely by gravity. Pumping stations are often needed to pump the wastewater over hills or to just lift it up and move it along its way.

محطة لرفع

لا تسمح طبوغرافية الارض لبعض القرى بتشغيل شبكة تجميع المياه المبتذلة بالجاذبية كليا. غالبا ما تدعو الحاجة الى محطات رفع لضخ المياه المبتذلة عبر التلال او لرفعها وتحريكها على طول مجراها .

Manholes

To allow access into the collection system for maintenance, manholes are installed at specific locations in the system.

خزائن التفتيش

تتيح خزائن التفتيش الوصول الى شبكة التجميع لصيانتها وتنظيفها عند الحاجة وتوضع في أماكن محددة من الشبكة .

TREATMENT FACILITIES

THE BASICS

Influent and Effluent

A treatment plant utilizes a combination of physical, biological and chemical processes in order to treat the wastewater. The wastewater stream that enters a plant is called the influent. The flow out of the plant and into the Litani River is called the effluent.

منشآت المعالجة

الأساسيات

المذفق الداخل والمذفق الخارج

تتخذ السيل الذي يدخل المعالجة في الأساس مصطلح "المذفق الداخل". المذفق الذي يخرج من المعالجة ويدخل النهر الليطاني يسمى "المذفق الخارج".

Wastewater Content

The material contained in domestic wastewater can unscientifically be divided into five categories.

- Material that sinks
- Material that is dissolved in the water
- Material that floats
- Material that is suspended in the water
- Pathogenic microorganisms

محتويات المياه المستدامة

يمكن تقسيم المواد الداخلة في المياه المستدامة غير العلمي إلى خمسة أقسام :

- المواد التي تغرق
- المواد التي تذوب في الماء
- المواد التي تعوم
- المواد التي تعلق في الماء
- الكائنات الدقيقة المسببة للأمراض

Physical Treatment

Treatment processes designed to remove those items that sink or float are generally physical processes and are called preliminary treatment and primary treatment.

لمعالجة لفـَزِاِئَة

ان عمليات المعالجة المصممة لازالة المواد التي تغرق او تعوم هي عادة العملية الفيريائية والتي تعتبر عملية معالجة مبدئية او معالجة ما قبل الأولية.

Biological Treatment

Processes designed to convert the material that is suspended into material that will either sink or float are usually biological processes and are called secondary treatment.

المعالجة البيولوجية

ان عمليات المعالجة المصممة لتحويل المواد العالقة الى مواد قابلة للغرق او العوم هي عادة العمليات البيولوجية وتدعى المعالجة الثانوية.

Chemical Treatment

While each of the processes removes some pathogenic organisms, it is the disinfection process that is the most effective in this action. This is normally a chemical process. This treatment plant uses the chemical chlorine (hypochlorite) to disinfect the treated wastewater before discharging the final effluent water into the Litani River.

المعالجة الكيميائية

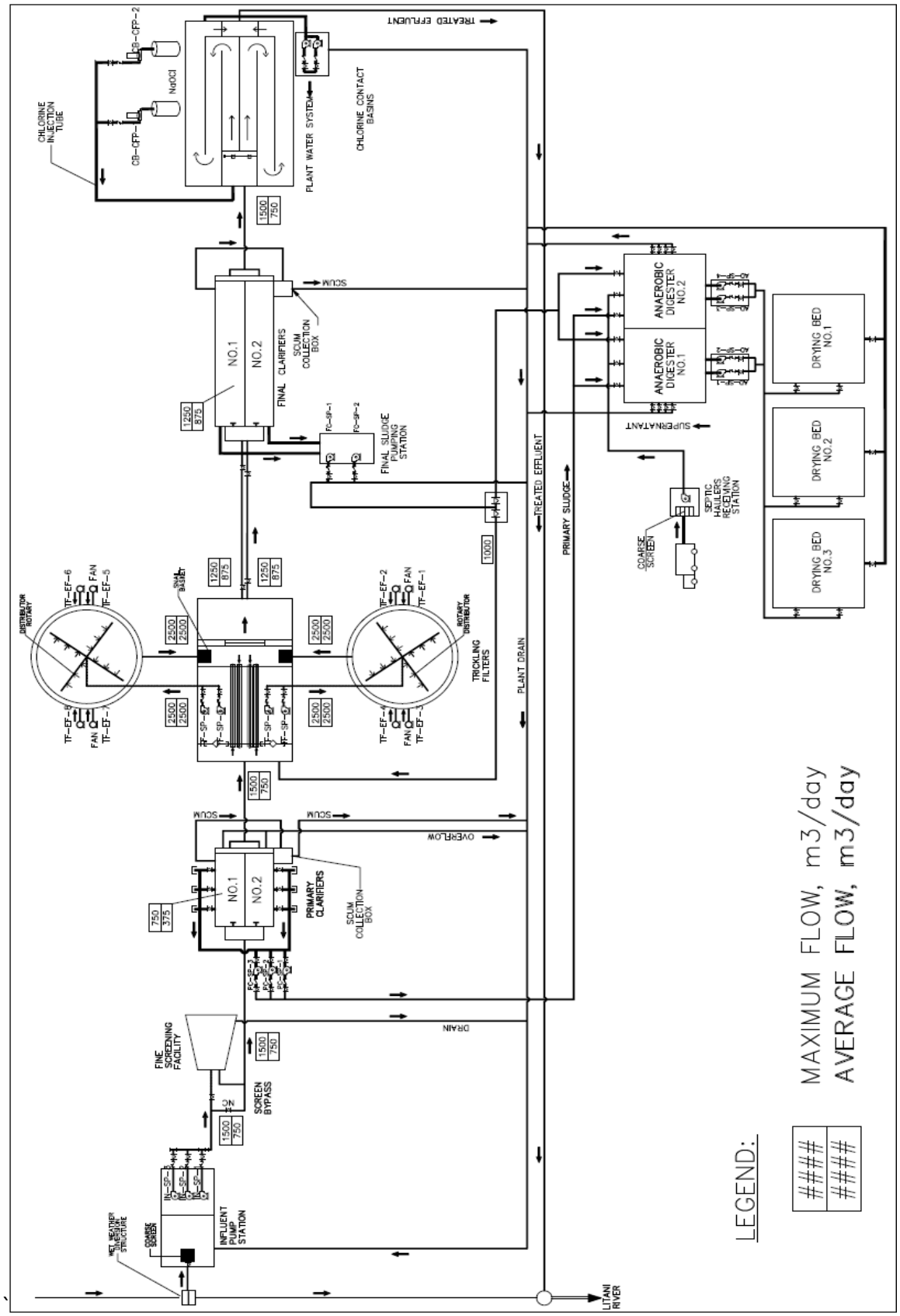
تسعى عمليات المعالجة لازالة بعض الكائنات الممرضة ولكن هنالك عملية التطهير التي هي الاكثر فعالية من خلال استخدام مادة الهيبوكلورايت فلذلك تسمى بـــ"العملية الكيميائية" للمعالجة. ان محطة المعالجة تستعمل الكلور من أجل تعقيم المياه المعالجة قبل رميها في نهر الليطاني.

Summary

The treatment process does not destroy the material that is in the wastewater, it only removes it from the water. Material that is removed is called sludge. It is not harmful and can be disposed of in landfills or used as a soil conditioner for certain agriculture.

ملخص

لا تدمر عملية المعالجة المواد الموجودة في المياه المبتذلة بل تزيلها فقط من المياه . وتدعى هذه المواد المزالة بـــ "الحمأة" او "الاوحال" انها غير مؤذية ويمكن طمرها أو استعمالها أسمدة لبعض المزروعات.



Process Flow Diagram - مخطط تدفق

PRELIMINARY TREATMENT

First Process

The first treatment process in the treatment plant is preliminary treatment. This process is used to remove rags and grit that could damage other equipment in the plant.

المعالجة الابتدائية

المعالجة الأولية

ان ً عً ُبد ال ًعن دخ ف ٍ ال ًس غخ ه "ال ًعن دخ ال ًجذ ُخ"التستخدو فز ِ ال ًعً ُخ الصلبة ال ًخ ق وس واس ت ن اس ص ور الشي م ال ت ٍ ال ت عن ت ٍ ال ت عغ م ي عذ اد ال ًس غخ.

Equipment

The equipment used to do this is trash racks and fine screens.

المعدات

ال ًعذ اد ال ت ٍ ت ٍ ح وث فز ِ ال ًعً ُخ ال و ن ً ه ال ًص ب ف ٍ.

PRIMARY TREATMENT

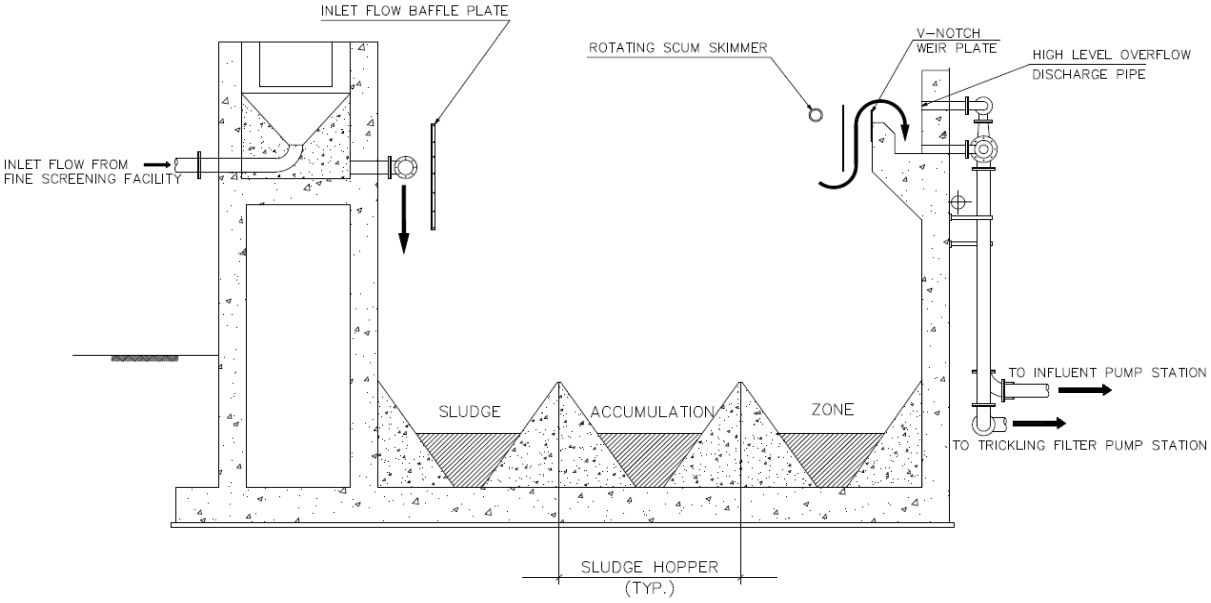
Second Process

The second stage of the treatment process is called primary treatment. This process is used to remove those materials that either float or sink. The major component in the primary treatment process is a rectangular tank with a steep sloped hopper bottom called a clarifier.

المعالجة الاولية

العملية الثانية

تدعى المرحلة الثانية من عملية المعالجة بـــ"المعالجة الاولية" . وتستخدم هذه العملية لازالة المواد التي تغرق او تعوم . ان العنصر الاساسي في عملية المعالجة الاولية هو حوض مستطيل ذو قعر منحدر ويسمى "خزان التصفية".



BIOLOGICAL TREATMENT

Natural Treatment Expanded

The third stage of treatment is a biological treatment unit. This process is an adaptation of the natural biological treatment process found in rivers. This process uses microorganisms that occur naturally in the wastewater to reduce the wastewater material to a product that can be disposed of without causing harm to people or the environment.

المعالجة البيولوجية

امتداد المعالجة الطبيعي

ان المرحلة الثالثة من المعالجة هي وحدة المعالجة البيولوجية. إنها مماثلة لعملية المعالجة البيولوجية الطبيعية في الانهر. وتستخدم هذه العملية الكائنات الحية المجهرية التي تتواجد طبيعياً في المياه المبتذلة لتحويل الفضلات الى ناتج يمكن التخلص منه دون الحاق اي ضرر بالانسان او البيئة.

Secondary Treatment

This biological treatment process is called secondary treatment. At this treatment plant the secondary treatment process uses Trickling Filters (Biotowers) for biological treatment of the wastewater.

المعالجة الثانوية

تدعى عملية المعالجة البيولوجية بـــ"المعالجة الثانوية" في هذه المحطة. ان المعالجة الثانوية تستعمل فلتر الترشيح للمعالجة البيولوجية للمياه المبتذلة.

Trickling Filter (Biotower) Plant

General Description

The purpose of trickling filters is to remove nonsettleable suspended and dissolved organic matter from settled sewage. This is accomplished by a biological slime growth on the filter media. Aerobic biological activity reduces the organics in the raw wastewater and produces a settleable sludge which is removed in the Secondary Clarifier.

فلتر الترشيح

لمحة عامة

ان هدف فلتر الترشيح هو إزالة المواد الغير مترسبة والعضويات الذائبة من المياه المبتذلة. وتنفذ هذه لازالة من خلال نشوء طبقة طحالب (اوخز) عضوية على "الميديا". يخفف النشاط البيولوجي الهوائي العضويات في المياه المبتذلة وينتج حمأة قابلة للترسب.

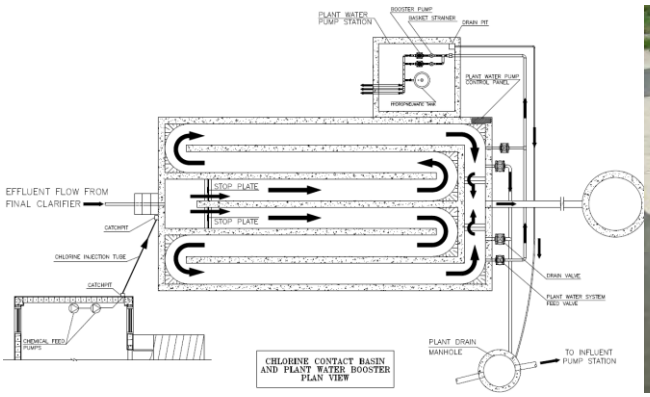
CHEMICAL TREATMENT

Chlorine

The clear water from the secondary clarifier is sent to a rectangular basin called a chlorine contact chamber. Chlorine (hypochlorite solution) is added to the flow as it enters the basin. The basin allows for sufficient contact time for the chlorine to drastically reduce the remaining number of pathogenic microorganism.

المعالجة بالكلور

تخرج المياه الصادرة عن خزان التصفية الثانوي الى حوض مستطيل يدعى غرفة الإحتكاك بالكلورين، حيث يضاف الكلورين المحلول "محلول الهيبوكلورايت" على المياه فور دخولها فيؤمن لها الحوض الوقت الكافي للاحتكاك فيما بينهما بشكل جيدً لكي تزال الكائنات المجهرية الحية الممرضة أوما تبقى منها بشكل كامل.



INTRODUCTION TO WASTEWATER SYSTEMS WORKSHEET

مقدمة لانظمة المياه المبتذلة ورقة عمل

1. Wastewater is:

_____

_____

١. المياه المبتذلة هي:

_____

_____

2. The three categories of wastewater are:

   a. _____

   b. _____

   c. _____

٢. الفئات الثلاثة للمياه المبتذلة هي:

أ. _____

ب. _____

ج. _____

3. The two main reasons for treating wastewater are:

   a. Prevent the spread of _____

   b. Protect _____ _____ users.

٣. السببين الرئيسين لمعالجة المياه المبتذلة هما:

أ. لمنع انتشار _____

ب لحماية مستعملي _____

4. In order to reduce the probability of the spread of disease in a community it is best to:

_____

٤. من اجل منع احتمال انتشار الأوبئة في المجتمع، من المفضل ان :

_____

5. Microorganisms that cause disease are called _____ organisms.

٥. تدعى الكائنات المجهرية الحية التي تسبب الأمراض بالكائنات الحية _____

6. Describe how untreated or partially treated wastewater impacts the aquatic environment?

_____

_____

٦. اشرح كيف تؤثر المياه المبتذلة الغير معالجة او المعالجة جزئياً على البيئة المائية؟

_____

_____

7. The primary function of a wastewater collection system is to reduce

   _____ with human waste and thus reduce the _____ of

   disease.

٧. الوظيفة الاولى لنظام جمع المياه المبتذلة هي للحد من _____ لمخلفات الانسان وبالتالي الحد من _____ بالامراض.

8. There are three natural processes of treating wastewater. They are:

   a. _____

   b. _____

   c. _____

٨. هنالك ثلاث عمليات بيولوجية طبيعية لمعالجة المياه المبتذلة وهي:

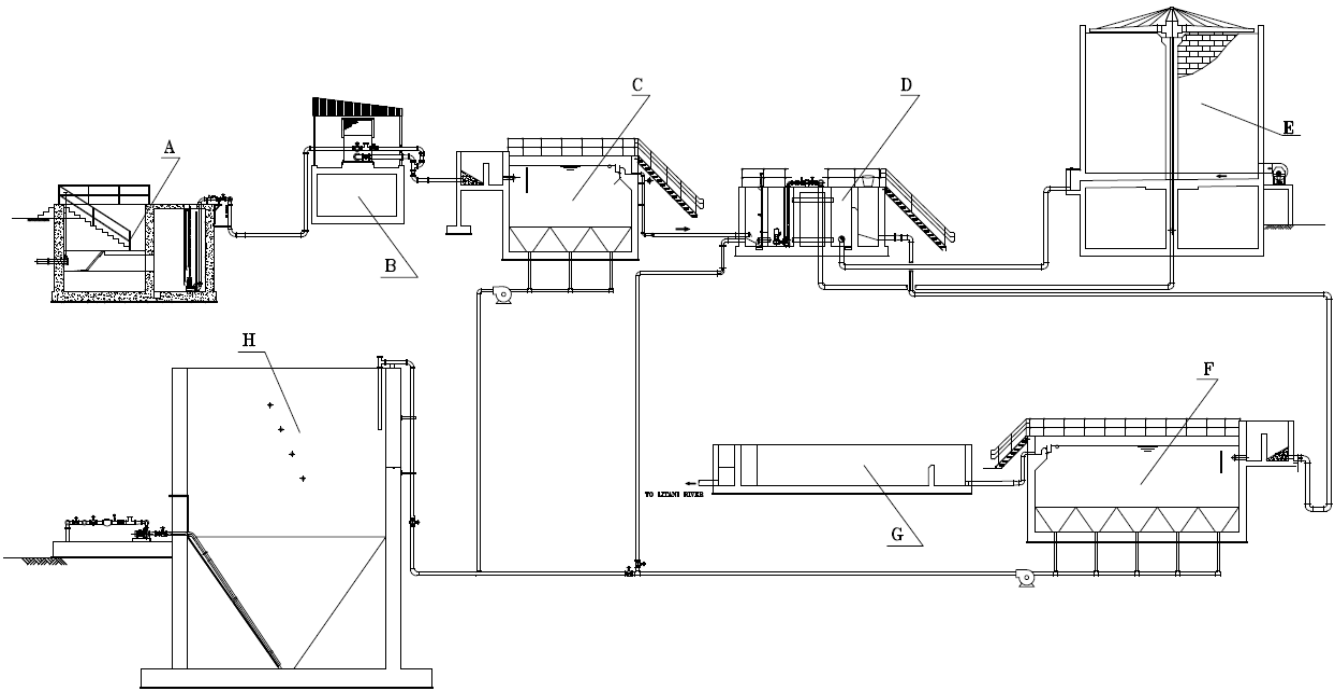
أ- .....

ة-.....

ج- .....

9. Using the treatment plant shown below identify the four basic treatment processes.

٩. حدد عمليات المعالجة الاربعة الأساسية مستخدماً محطة المعالجة الظاهرة أدناه.



A_____أ

B_____ة

C_____ج

D_____د

E_____ـ

F_____و

G_____ص

H_____ح

10. The two reasons for the use of a wastewater treatment facility are:

a. Prevent the spread of _____

b. Reduce the impact on _____ _____ users.

١٠. يتم استخدام وسائل معالجة المياه المبتذلة لسببين هما:

أ. لمنع انتشار _____

ب.تخفيض التأثير عن مستخدمي _____ _____

CHARACTERISTICS OF WASTEWATER

WHAT IS IN THIS LESSON?

1. The composition and characteristics of wastewater
2. pH and the components of its scale
3. Description of settleable solids, suspended solids, dissolved solids and total solids
4. The difference between organic and inorganic material found in wastewater
5. The difference between aerobic, anaerobic and facultative organisms
6. The temperature ranges for microorganisms
7. The three shapes of bacteria
8. Typical waterborne diseases caused by bacteria and protozoa
9. The process that bacteria use to collect and process food
10. The impact that increased organics have on water quality of a receiving stream
11. The appearance and odor of septic and fresh sewage
12. The different flow characteristics of a wastewater system
13. The temperature DO relationship in water
14. The common gases found in septic wastewater
15. The difference between aerobic and anaerobic decomposition
16. The importance DO has in wastewater treatment

مواصفات المياه المبتذلة

ماذا في الدرس الثاني؟

١. مركبات وخصائص المياه المبتذلة

٢. الحموضة وعناصر مقاييسها

٣. وصف الجوامد المترسبة، الجوامد العالقة، الجوامد الذائبة ومجموع الجوامد.

٤. الفرق بين المواد العضوية والغير عضوية الموجودة في المياه المبتذلة.

٥. الفرق بين الكائنات الحية الهوائية والغير هوائية.

٦. هوامش الحرارة للكائنات المجهرية الحية .

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٨. الامراض النموذجية المتكاثرة في المياه من البكتيريا والحيوانات الأحادية الخلية.

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١٦. اهمية الاوكسجين الذائب في معالجة المياه المبتذل

CHARACTERISTICS OF WASTEWATER

WHAT IS WASTEWATER?

WATER AND WASTEWATER

Sewage or Wastewater?

In this lesson, reference will be made to wastewater. The term wastewater is a broad, descriptive term. Generally, it includes liquid and water containing solids from homes, businesses and industry.

خصائص المياه المبتذلة

ما هي المياه المبتذلة ؟

المياه والمياه المبتذلة

مجارير ومياه مبتذلة

في هذا الدرس، سيكون مرجعنا هو المياه المبتذلة وهي مصطلح تعبيري واسع. فهي تتضمن عادة جوامد من المنازل والمصانع والمراكز التجارية.

From Water to Wastewater

Wastewater is primarily water from the drinking water system and from leaks in the collection system. This water is used to carry waste from homes and businesses into collection systems and ultimately to wastewater treatment facilities or disposal.

من المياه الى المياه المبتذلة

المياه المبتذلة هي اساساً مياه اتية من نظام مياه الشرب ومن تسربات في انظمة المجارير.تستخدم هذه المياه لحمل الاوساخ من المنازل والمتاجرالى شبكة الصرف الصحي ومنهـــا الـــى محطـــة معالجة المياه المبتذلة او مركز صرفها.

Types of Wastewater

If a collection system (called a sewer) is attached to homes and businesses in the community, the sewer is classified as a sanitary sewer and the treatment plant at the end of the pipe treats domestic sewage. If the sewer system also collects storm runoff, as well as domestic sewage, the sewage system is classified as a combined sewer and the treatment plant receives domestic sewage along with storm water during storm events.

انواع المياه المبتذلة

اذا كان نظام جمع المياه (المعروف بمجرى الصرف) متصلاً بالمنازل والمتاجر في المجتمعات، يعتبر المجرى بمثابة مجرور الصرف الصحي وتعالج المحطة التي يصب فيها عند خط النهاية الصرف الصحي المنزلي. اما اذا كان نظام مجرى الصرف يجمع مياه الامطار اضافة الى المياه المبتذلة فيصنف عندئذ بالمجرورالمشترك، وبالتالي تتلقى محطة المعالجة مجرى مياه الصرف الصحي ومياه الامطار خلال العواصف.

Mostly Water

On average, domestic wastewater contains 99.9% water and 0.1% solids. These solids or impurities are sometimes called constituents. These constituents and the components of the water are called the characteristics of the wastewater.

معظمها مياه

تحتوي مياه الصرف الصحي المنزلي عادة على ٩٩,٩ % مياه و ٠,١ % جوامد. أحيانا, تدعى هذه الجوامد والشوائب بالمركبات . تسمى هذه المركبات ومكونات المياه بخصائص المياه المبتذلة.

Drinking Water

The characteristics of the wastewater are influenced by the quality of the drinking water system, the quantity of leakage into the collection system and the material placed into the water by homes, businesses and industry.

مياه الشرب

تتأثر خصائص المياه المبتذلة بنوعية نظام مياه الشرب، ونسبة التسربات الى نظام الجمع والمواد المصروفة في المياه ضمن المنازل والمتاجر والمصانع.

CHARACTERISTICS

INTRODUCTION

Three Categories

The characteristics of wastewater can be divided into three categories

- Physical
- Chemical and
- Biological

الخصائص

مقدمة

ثلاث فئات

تقسم خصائص المياه المبتذلة الى ثلاث فئات:

- الفيزيائية
- الكيميائية
- والبيولوجية

Physical

The physical characteristics of wastewater include, flow, color, odor, temperature, turbidity and appearance.

الفيزيائية

تتضمن الخصائص الفيزيائية للمياه المبتذلة، كمية التدفق، اللون، الرائحة، الحرارة، العكارة والمنظر.

Chemical

The chemical characteristics include the solids, gases and chemical constituents found in the wastewater.

الكيميائية

تتضمن الخصائص الكيميائية الجوامد، الغازات، والمكونات الكيميائية الموجودة في المياه المبتذلة.

Biological

Each drop of wastewater contains millions of bacteria as well as other microorganisms. The biological characteristics of wastewater include these microorganisms, how they are impacted by the physical and chemical changes of the wastewater and how the microorganisms impact the wastewater.

البيولوجية

تحتوي كل نقطة مياه مبتذلة على ملايين البكتيريا كما وتحتوي أيضا على غيرها من الكائنات المجهرية الحية. تتضمن الخصائص البيولوجية للمياه المبتذلة هذه الكائنات المجهرية الحية ومدى تأثرها بالعوامل الفيزيائية والكيميائية للمياه المبتذلة ، وكيف تؤثر هذه الكائنات بدورها على المياه.

PHYSICAL CHARACTERISTICS

INTRODUCTION

Physical characteristics include flow, temperature, color, odor, turbidity and appearance.

الخصائص الفيزيائية:

مقدمة

تتضمن الخصائص الفيزيائية كمية التدفق، الحرارة اللون، الرائحة ، العكارة والمظهر.

FLOW CONSIDERATIONS

HYDRAULIC LOADING

The flow into a wastewater treatment plant is called the hydraulic loading. Each process unit in a treatment plant is designed to provide the most efficient treatment when the hydraulic loading is within a specific range. This range is selected by the design engineer.

اعتبارات التدفق

الحمل الهيدروليكي

يدعى التدفق الداخل الى محطة معالجة المياه المبتذلة بالحمل الهيدروليكي. تصمم كل وحدة عمل ضمن المحطة لتأمين أفضل معالجة عندما يتراوح الحمل الهيدروليكي ضمن هامش محدد . ويحدد المهندس المصمم هذا الهامش.

Average Flow

Wastewater treatment plants are designed to handle average flows. There's always some surface water and ground water that enters the collection system through breaks in the lines and some water exits through these same breaks. If the rain or snow melt is heavy, flows to the plant will increase. If the ground is tremendously dry, some decrease in flow could result as sewage escapes from the collection system into the ground.

معدل التدفق

تصمم محطات معالجة المياه المبتذلة على اساس التدفقات الوسطية . هناك دائماً بعض المياه السطحية والجوفية الى تتمكن من الدخول الى خطوط المجارير من خلال فتحات او تفسخات في الشبكة. في حالات الامطار الغزيرة او ذوبان الثلوج، تزداد التدفقات الى المحطة. اما إذا كانت الارض شديدة الجفاف، قد يتضاءل التدفق بسبب خروج بعض مياه المجارير الى الارض.

Dry Weather and Wet Weather Flow

Wastewater treatment plant design identifies wet and dry flow requirements. The wet weather flow is called peak flow. Flows above the peak flow could cause sewage to backup into the collection system and thus constitute a violation of the permit. This condition should be avoided.

التدفق في مناخ الجاف والرطب

إن تصميم محطة معالجة المياه المبتذلة يحدد متطلبات التدفق الجاف والرطب. ويدعى تدفق المناخ الرطب التدفق الاقصى. ان التدفقات التي تفوق التدفق الاقصى قد تسبب في رجوع المياه المبتذلة الى شبكة المجارير وعندئذ تشكل هذه الظاهرة انتهاكاً لما هو مسموح به. يجب تجنب حدوث هذه الحالة.

Reporting Requirements

In addition to flows at the plant and lift stations being recorded and reported on monitoring reports, they are important information for the operator. Process control and system analysis require accurate flow readings. Flow meters must be calibrated and maintained to reflect accurate flow readings.

متطلبات التقرير

بالإضافة الى تسجيل ومراقبة تدفقات المحطة ومحطات الرفع والافادة عنها بموجب تقارير، هنالك معلومات مهمة لمشغل المحطة. فمراقبة عملية المعالجة وتحليل النظام يتطلبان قراءة دقيقة للتدفق. يجب ضبط وصيانة اجهزة قياس التدفق من اجل اعطاء قراءات دقيقة عن التدفق.

COLOR AND ODOR

Fresh Sewage

If domestic sewage is delivered to the wastewater plant in a timely manner, the sewage will be gray in color and have a musty but not offensive odor with observable particles of paper, food, and “other” solids. Sewage with this appearance and odor is called fresh sewage.

المياه المبتذلة الحديثة

يكون لون المياه رمادياً اذا كانت المياه المبتذلة المنزلية تصل مباشرة من المصدر الى محطة المعالجة، كما وتفوح منها رائحة نتنة ولكن غير مزعجة ومرفقة ببقايا ورق وطعام وجوامد اخرى. تدعى هذه المياه "المياه المبتذلة الحديثة".

Septic Sewage

If wastewater is allowed to become old it will become anaerobic or septic, and the color and the odor will change. Septic wastewater has a black color and a smell resembling rotten eggs. Septic sewage is very difficult for a biological treatment plant to treat.

المياه الاسنة (العفنة)

اذا قدّر للمياه المبتذلة بأن تصبح قديمة، عندئذ تصبح لاهوائية او آسنة (عفنة)، ويتغير لونها ورائحتها. للمياه الآسنة العفنة لون اسود ورائحة تشبه رائحة البيض العفن. تصعب معالجة المياه العفنة في محطة معالجة بيولوجية.

Treating Septic Sewage

Continuous flow of septic sewage from the collection system is more difficult to treat than the septic material delivered by a septic tank truck. While the septic tank material is hard to treat, it is usually a small percentage of the flow and thus the aerobic bacteria at the plant can usually buffer its impact. If the overall influent flow to the plant has become septic, it will be very difficult to stimulate aerobic activity.

معالجة المياه العفنة

ان معالجة التدفق المستمر للمياه العفنة هو اصعب من معالجة المياه العفنة المنقولة في صهاريج صحية. ومع ان معالجة المياه العفنة صعبة، ولكنها عادة ما تكون قليلة نسبيا في التدفق، وهكذا فأن البكتيريا الهوائية الموجودة في المحطة تستطيع ان تدفق تأثيرها. واذا اصبح تدفق المياه الى المحطة عفن بالكامل عندئذ يصبح تحفيز النشاط الهوائي صعب جدا.

TEMPERATURE

Impact on Biological Activity

Temperature is very important to biological activity. The lower the temperature, the slower the biological activity. A rise in temperature increases biological activity. In conventional wastewater systems, sewage maintains an ambient temperature of about 13°C (55°F) due to biological activity. The temperature fluctuations that naturally occur in the influent should be documented daily. These changes can be used to make operational changes in the plant. For instance, as the temperature increases, biological activity increases and thus more oxygen may be needed. The increased demand for oxygen could require turning on the trickling filter vent fans.

الحرارة

اثرها على النشاط البيولوجي

إن الحرارة مهمة جداً للنشاط البيولوجي، فكلما انخفضت الحرارة يخف النشاط البيولوجي وعلى العكس، إذا ارتفعت الحرارة يزداد النشاط البيولوجي . في انظمة المياه المبتذلة التقليدية، تحتفظ المياه بحرارة ١٣ درجة مئوية بسبب النشاط البيولوجي. يجب تسجيل وارشفة التغيرات الحرارية للمياه يومياً . من الممكن استعمال هذه المتغيرات لتغير نماط تشغيل المحطة. ، فكلما ارتفعت الحرارة ارتفع النشاط البيولوجي وبالتالي تزداد الحاجة للاوكسيجين. لذا قد تتطلب زيادة الحاجة للاوكسيجين بتشغيل مراوح هوائية اضافية.

Decrease in Temperature

As temperature decreases, biological activity also decreases. It is important to monitor temperature and take the bacterial activity into account when contemplating operational changes and troubleshooting systems. In freezing conditions, additional time is required for biological wastewater treatment to take place.

انخفاض الحرارة

كلما انخفضت الحرارة، انخفض النشاط البيولوجي ايضاً. من المهم مراقبة الحرارة واخذ النشاط البيولوجي في الاعتبار عندما نتأمل في تغييرات التشغيل ومشاكل النظام. في حالات التجمد، تتطلب المعالجة البيولوجية للمياه المبتذلة وقتاً اضافياً لكي تكتمل.

TURBIDITY

Definition

Turbidity in wastewater is caused by suspended solids, usually particles of colloidal size. Turbidity is defined as that property of wastewater that causes light to be scattered or absorbed. High turbidity wastewater appears cloudy, whereas low turbidity wastewater often sparkles with clarity. Wastewater with low turbidity can still have dissolved solids, because most dissolved solids do not cause light to be scattered or absorbed. The measurement of turbidity can be a quick method of evaluating the quality of the final

effluent of a wastewater plant. Materials that cause turbidity can provide a place for microorganisms to hide and avoid disinfection.

العكارة

التعريف

تسبب الجوامد العالقة في المياه المبتذلة العكارة. وهي عادة حبيبات بأحجام الطين. تعرّف العكارة كميزة للمياه المبتذلة التي تتسبب بإمتصاص وتشتيت الضوء. عكارة عالية تعني مياه مبتذلة قاتمة، بينما عكارة منخفضة تعني مياه مبتذلة صافية وبراقة. قد تحتوي المياه المبتذلة المنخفضة العكارة على جوامد ذائبة لان معظم الجوامد الذائبة لا تمتص او تشتت الضوء. يعتبر قياس العكارة للمياه المعالجة الناتجة عن المحطة وسيلة سريعة لتقييم نوعية المياه النهائية. ان المواد التي تسبب العكارة تستطيع ان تؤمن مكاناً لاختباء الكائنات الحية وتجنب التعقيم.

CHEMICAL CHARACTERISTICS

Introduction

The chemical characteristics of wastewater include solids, gases and the chemical constituents of the wastewater.

الخصائص الكيميائية

مقدمة

تتضمن الخصائص الكيميائية للمياه المبتذلة الجوامد، الغازات ومركباتها الكيميائية.

SOLIDS

Introduction

Even though the solids content of the wastewater is only a small percentage (0.1%) of the total volume, their objectionable characteristics are one of the principle reasons for wastewater treatment. One of the primary functions of a wastewater treatment plant is to reduce and/or remove as many of these solids as possible. Therefore, it is important that the operator understand the nature of these solids.

الجوامد

مقدمة

بالرغم من ان الجوامد في المياه المبتذلة هي نسبة ضئيلة ٠,١ % من الحجم العام، فإن خصائصها الغير مرغوب فيها هي إحدى اهم اسباب معالجة المياه المبتذلة. احدى المهمات الاولية لمعالجة المياه المبتذلةهي تخفيف او ازالة الجوامد بقدر ما نستطيع. لذلك، فمن المهم ان يفهم المشغل نوعية كل الجوامد.

Divisions of Solids

All of the solids found in wastewater can be placed into one of two general groups. The solids are either organic or non-organic. Non-organic solids are called inorganic solids.

اقسام الجوامد

يمكن وضع كل الجوامد الموجودة في المياه المبتذلة في مجموعة عامة واحدة او اثنتين. فإما ان تكون الجوامد عضوية او غير عضوية. الجوامد الغيرعضوية تدعى جوامد لا عضوية.

ORGANIC MATERIALS IN WASTEWATER

Description

Organic solids come from plants and animals and contain oxygen and carbon. The principle organic compounds found in wastewater are proteins, carbohydrates, and fats. Most organic solids are a food source for microorganisms and are therefore said to be biodegradable. If not removed by treatment, they will decompose to produce objectionable odors and other undesirable conditions. Their removal and stabilization is therefore one of the primary objectives of wastewater treatment.

مواد عضوية في المياه المبتذلة

توصيف

تتأتى الجوامد العضوية من النباتات والحيوانات، وتحتوي على الأوكسجين والكربون. وأهم المركبات العضوية في المياه المبتذلة هي البروتين، الفحميات والشحوم. تشكل معظم الجوامد العضوية مصدر

غذاء للكائنات الحية المجهرية ولذلك يقال عنها "بيولوجية التحلل". اذا لم تتم ازالتها في المعالجة، ستتفكك لتنتج روائح مزعجة وحالات غير مرغوب فيها. ان ازالة وموازنة الجوامد العضوية هما اذا هدفين اوليين لمعالجة المياه المبتذلة.

Source of Organic Material

Organic material in wastewater includes any kitchen waste washed down drains, all sanitary connections including showers and toilets, and laundry facilities including clothes and dish washing. Basically, organic material includes any animal or vegetable material in sewage. Organic solids are a source of food for the bacteria in a wastewater treatment plant. The bacteria decompose the organic material in the wastewater so that the wastewater has a minimum impact on the environment. Because the wastewater treatment facilities are aerobic, it is important for this organic material to arrive fresh to the wastewater treatment plant. This allows the bacteria to provide the most complete treatment.

مصدر المواد العضوية

تتضمن المواد العضوية أي مخلفات مطبخية مصروفة في المجاري، كل مهارب الدوش والمراحيض وغسيل الثياب والصحون. تتضمن المواد العضوية بشكل اساسي كل المواد الحيوانية والنباتية في المجارير. ان الجوامد العضوية هي مصدر الغذاء للبكتيريا في المياه المبتذلة . تفكك البكتيريا المادة العضوية في المياه المبتذلة بشكل يحد من تأثير هذه المياه على الطبيعة. وبما ان محطات معالجة المياه المبتذلة هي هوائية، فمن المهم ان تصل المواد العضوية بأسرع وقت ممكن الى محطة المعالجة. فهذا الواقع يسمح للبكتيريا بتأمين معالجة كاملة.

INORGANIC MATERIALS IN WASTEWATER

Description

Inorganic solids include sand, gravel and silt, as well as the minerals or metals present from the water supply. Inorganic solids do not contain carbon and are not derived from living material and are therefore inert and cannot be decomposed.

المواد اللا عضوية في المياه المبتذلة

توصيف

تتضمن الجوامد اللا عضوية الرمل، البحص والأتربة والمواد المعدنية اضافة الى المعادن الموجودة في مياه المنازل. لا تحتوي الجوامد اللا عضوية على الكربون ولا تتحدر من اي مادة حية ولذلك فهي من العوادم ولا تتفكك.

Source of Inorganic Material

The inorganic material in sewage includes plastic, rubber, sand, grit, egg shells, etc. Specific inorganic materials that cause wastewater plant problems include disposable diapers, plastic food containers, clothing, cans, bottles, soils, sand, plastic, toys, plastic bags and many others. These materials are not biodegradable, that is, they will not decay or burn.

مصدر المواد اللا عضوية

تتضمن المواد اللا عضوية في المجارير البلاستيك، المطاط، الرمل والشوائب، قشر البيض الخ.. هنالك بعض المواد التي تتسبب بمشاكل للمحطة كالحفاضات، مغلفات الطعام البلاستيكية، الثياب ، التنك، القناني، الوحول، الرمول، الالعاب البلاستيكية ، اكياس النايلون الشفرات وغيرها. هذه المواد ليست بيولوجية التحلل مثلاً : لا تتعفن ولا تحرق.

Impact on Treatment

Inorganic materials will not breakdown in aerobic or anaerobic wastewater treatment systems. Eventually, these materials must be removed from the treatment system. Influent screening is used to reduce the impact inorganics have on the plant.

التأثير على المعالجة

لا تتحلل المواد اللا عضوية لا في انظمة معالجة المياه المبتذلة الهوائية ولا اللاهوائية. في النهاية، يجب ازالة هذه المواد من نظام المعالجة. فتستخدم التصفية الاولية للمياه المبتذلة لتخفيف تأثير المواد اللا عضوية على المحطة .

SOLIDS GROUPINGS

Introduction

While all solids are either organic or inorganic, it is common practice to describe the solids found in wastewater in other categories based on test results. These results are used to determine the efficiency of the treatment process. The key point here is that the solids found in wastewater are defined, not by their size but by the test used to identify them. The following is a brief description of the seven types of solids found in wastewater. These seven are:

- Settleable solids
- Floatable solids
- Suspended solids
- Dissolved solids
- Colloidal solids
- Total solids
- Volatile solids

مجموعة الجوامد

مقدمة

في حين ان الجوامد اما عضوية او لا عضوية، فإن الممارسة المتعارف عليها لتوصيف الجوامد في المياه المبتذلة بحسب اصنافها ترتكز على النتائج المخبرية. تستخدم هذه النتائج لتحديد فعالية عملية المعالجة . ويكمن مفتاح الحل هنا في تعريف الجوامد في المياه المبتذلة . ليس بحسب احجامها بل بنتيجة الفحص الذي يحددها تماماً.في ما يلي، تفصيل موجز حول الانواع السبع للجوامد الموجودة في المياه المبتذلة وهذه الأنواع هي:

- الجوامد المتركدة
- الجوامد العائمة
- الجوامد العالقة
- الجوامد الذائبة
- الجوامد الغروانية (الغبارية)
- مجموع الجوامد
- الجوامد المتطايرة

Settleable Solids

If the wastewater is allowed to sit quietly, as it does in a clarifier, most of the suspended solids will settle out and some solids will float. Solids that will settle in one hour in a funnel shaped glass, called an imhoff cone, are called settleable solids. Therefore, we can say that settleable solids are those solids that are heavy enough to settle in a specific period of time. The quantity of settleable solids in wastewater is measured and reported as mL/L.

الجوامد المتركدة

اذا تركنا المياه المبتذلة تركد بهدوء ، كما تترك في احواض التنقية، فإن معظم الجوامد العالقة ستتركد وسيعوم البعض الاخر. ان الجوامد التي ستتركد خلال ساعة واحدة في زجاجة على شكل قمع (تسمى القمع) تدعى الجوامد المتركدة.

Floatable Solids

There is no test for floatable solids. However, materials such as oils, grease, plastic and rubber goods will float. Most floatable material is not easily biodegradable by aerobic or anaerobic bacteria and is removed in the primary clarifier and sent to the digester.

الجوامد العائمة

لا يوجد اي اختبار للجوامد العائمة. في كل الاحوال، فإن المواد كالزيوت، الشحوم، البلاستيك والمطاطيات ستعوم حتما. ليس من السهل تحلل المواد العائمة بيولوجياً لا من قبل البكتيريا الهوائية ولا الغير هوائية وهي تزال بالتنقية الاولية وترسل الى الهاضم.

Suspended solids

If a sample of wastewater is thoroughly mixed and observed, it is typical to be able to see solids suspended in the liquid. When this sample is poured through a glass fiber filter, the material that is captured on the filter is called suspended solids (also called total suspended solids, TSS). Notice that if our sample were raw sewage, the suspended solids would include settleable and floatable solids. The quantity of suspended solids (TSS) in wastewater is measured and reported as mg/L.

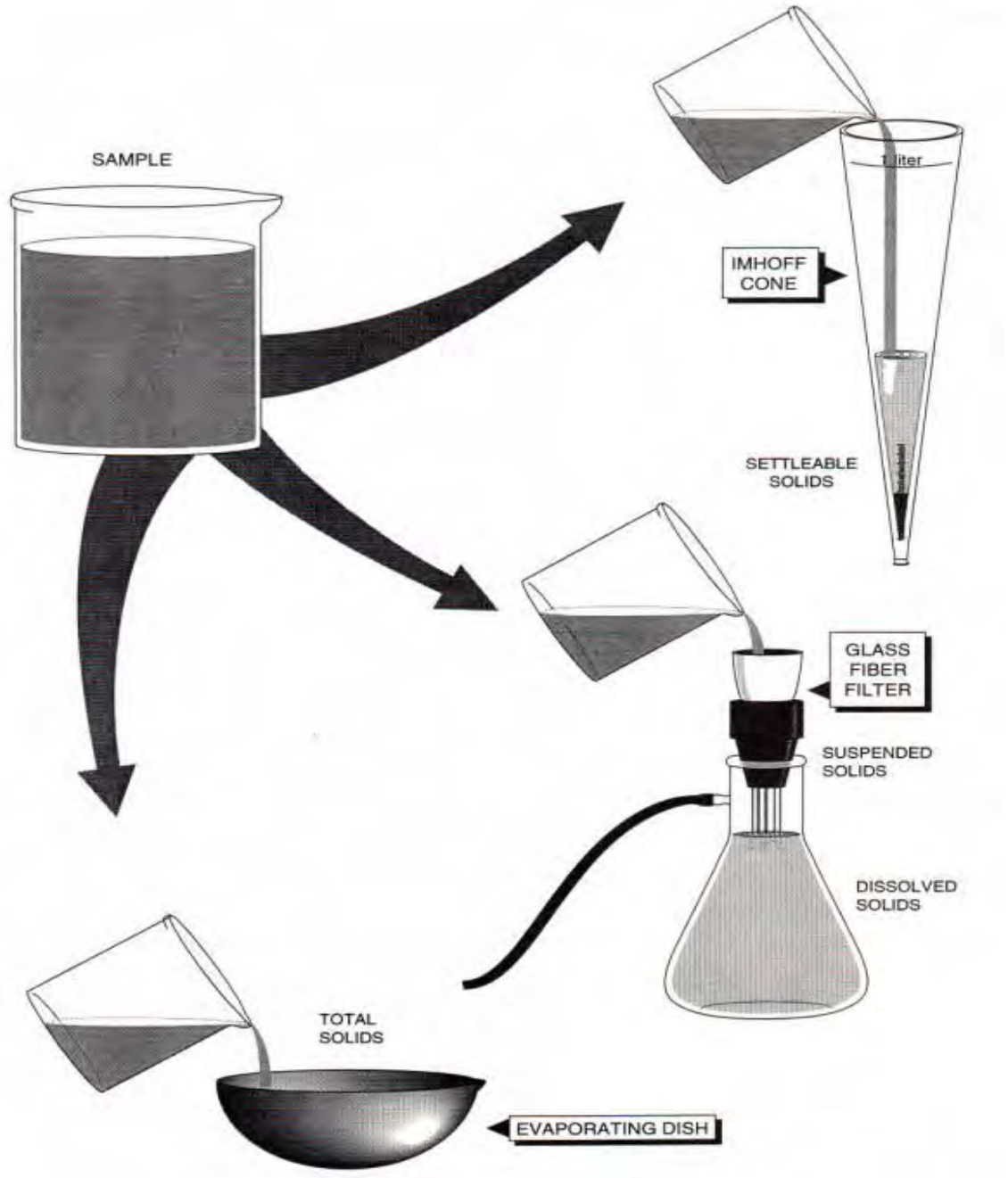
الجوامد العالقة

اذا خلطنا بإستمرار عينة من المياه المبتذلة وراقبناها، فهي النموذج الذي يمكن من خلاله رؤية الجوامد العالقة .فإذا سكبنا هذه العينة على فلتر من الألياف الزجاجية، فإن المواد التي تعلق في الفلتر

تدعى الجوامد العالقة (وتدعى أيضاً مجموع المواد العالقة) . انتبه الى انه اذا كانت عينتنا مأخوذة من المجرور الاساسي، فأن الجوامد العالقة ستحتوي على جوامد متركدة وعائمة. تقاس وتدون كمية المواد العالقة في المياه المبتذلة بـــ ملغ/ ليتر.

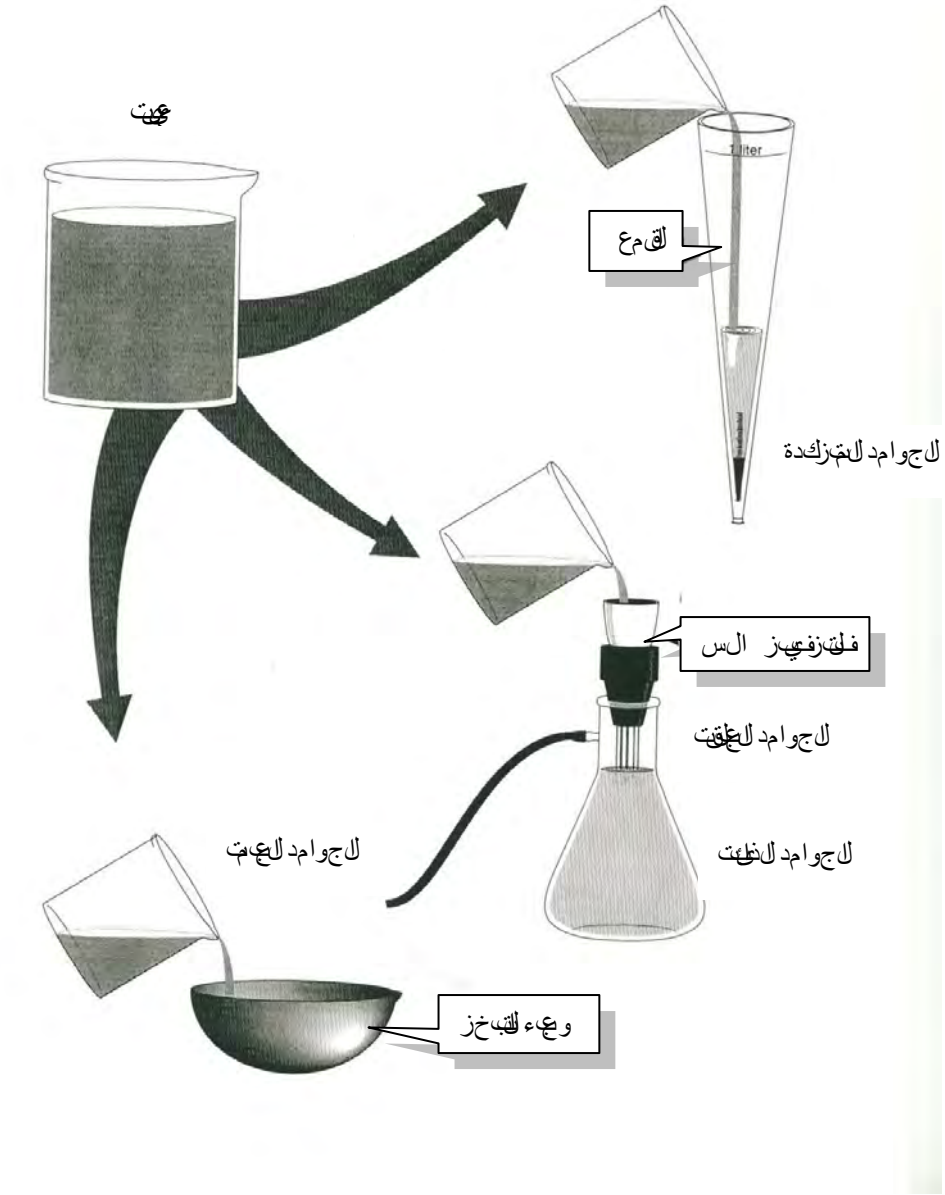
Suspended & Settleable

It is also important to note that the settleable solids contain some suspended solids. That is, settleable solids contain that portion of the suspended solids that will settle in a prescribed period of time.



الجوامد العالقة والمتركدة

انه من المهم ايضاً الاشارة الى انه قد تحوي الجوامد المتركدة بعض الجوامد العالقة . مثلاً تحتوي الجوامد المتركدة ذلك الجزء من الجوامد العالقة التي ستتركد في فترة محددة من الوقت .



Dissolved Solids

When our sample was poured through the glass fiber filter, a portion of the solids were caught on the filter (TSS) and a portion passed through the filter. The portion that passes through the filter is called dissolved solids. Approximately ninety percent (90%) of these solids are truly dissolved in the wastewater. The remaining ten percent (10%) are so small

that they are held in solutions. These solids are called colloidal solids. The quantity of dissolved solids in wastewater is measured and reported in mg/L.

الجوامد الذائبة

عندما مررنا عينتنا من خلال فلتر من الألياف الزجاجية، فإن جزءاً من الجوامد قد تم التقاطه على الفلتر (مجموع الجوامد العالقة) وجزءاً مرً عبر الفلتر. ان الجزء الذي عبر الفلتر يدعي الجوامد الذائبة . تسعون بالمئة تقريباً من هذه الجوامد الذائبة هي بالفعل ذائبة، اما العشرة بالمئة المتبقية فهي صغيرة جداً بحيث تبقى ضمن المحلول . تدعى هذه الجوامد "الجوامد الغروانية (الغبارية)".

Colloidal Solids

colloidal solids are suspended solids that are so small they will not settle even if allowed to sit quietly for days or weeks. They are not dissolved but even though they are extremely tiny, they often make the wastewater cloudy. In general, anything less than 1 micron (1/1000 of a millimeter) is considered a colloidal particle. Fine silt, tiny particles of vegetation, and bacteria are examples of colloidal particles. This is the only solid that has been defined by size. In addition, there is no specific test for colloidal solids. They are part of the dissolved solids and are not tested independently.

الجوامد الغروانية

ان الجوامد الغروانية (الغبارية) هي جوامد صغيرة عالقة في المياه لدرجة انها لا تتركد حتى ولو تركت هادئة لايام واسابيع. انها غير ذائبة ولكنها خفيفة جدا جداً فهي تجعل المياه قاتمة او غائمة . اي حجم اصغر من ١ ميكرون (يعني ١ على ١٠٠٠ من الميلمتر) يعتبر جزء غرواني. الدلغان (التراب) واجزاء الحشائش الصغيرة والبكتيريا هي مثال عن الاجزاء الغروانية .انها الجوامد الوحيدة التي تقاس بحجمها. بالاضافة ، ليس هنالك من اي اختبار لهذه الجوامد فانها جزء من الجوامد الذائبة ولا تفحص مستقلة.

Total Solids

If a portion of our original raw wastewater sample were poured into a ceramic evaporating dish and the water was allowed to evaporate, a residue would be left behind. This residue is called total solids. Total solids contain the suspended (includes floatable and settleable solids) and dissolved portions of the solids. The quantity of total solids in wastewater is measured and reported as mg/L.

مجموع الجوامد

اذا سكبنا جزءاً من مياهناً المبتذلة الاساسية على صحن التبخرالمصنوع من السيراميك، وتركنا المياه حتى تتبخر فسيبقى بعض الفضلات في الصحن. تدعى هذه الفضلات مجموع الجوامد. يحتوي مجموع الجوامد على الجوامد العالقة (المتركدة والعائمة) والجزء الذائب منها. تقاس وتدون كمية مجموع الجوامد في المياه المبتذلة بالـــ ملغ/ليتر .

Volatile Solids

Volatile solids are determined by igniting the above samples at 550°C and weighing the ashes. This test can determine inorganic compounds (inorganics do not burn at 550°C) and the test is used to determine microorganism densities.

لجوامدلمتطايرة

تحدد الجوامد المتطايرة بواسطة اشعال العينات على درجة ٥٥٠ مئوية ومن ثم وزن الرماد. يحدد هذا الاختبار المكونات الغيرعضوية اذا ان هذه المواد تشتعل على درجة ٥٥٠ مئوية) ويستخدم هذا الاختبار لقياس كثافة الكائنات الحية المجهرية.

SOLIDS AND TREATMENT

Influent and Effluent

One of the key measures of the efficiency of the treatment process is to measure the reduction in total suspended solids (TSS) through the plant. This is accomplished by comparing the TSS in the influent to the TSS in the effluent. The reduction in TSS is not accomplished by a single treatment process. Each process unit contributes to the overall reduction in the following ways.

الجوامد والمعالجة

الدفق الداخل والتدفق الخارج

احد المعايير المهمة لمعرفة مدى فعالية عملية المعالجة هي قياس نسبة تخفيف مجموع الجوامد العالقة بعد خروج المياه من المحطة. ونتحقق من ذلك هذه عند مقارنة مجموع الجوامد العالقة للدفق الداخل والتدفق الخارج. لا يتم تخفيف العوالق بعملية معالجة واحدة. فكل وحدة معالجة تساهم في التخفيف العام بالطرق التالية:

Preliminary and Primary Treatment

Settleable solids and floatable material are removed by the preliminary and primary treatment processes. In the removal of these solids, the TSS is also reduced.

معالجة مبدئية واولية

تزال الجوامد المتركدة والمواد العائمة في عمليات المعالجة المبدئية الاولية. وبإزالة هذه الجوامد، يخف مجموع العوالق الصلبة.

Secondary Treatment

After preliminary and primary treatment suspended and dissolved solids remain. The bacteria in the treatment process use the suspended and dissolved solids for food. They convert these solids to water, gases and settleable solids. While we measure the reduction of TSS as the efficiency of the treatment process, it is the dissolved solids that make up the major portion of the food supply for the bacteria in the secondary treatment process.

المعالجة الثانوية

تبقى الجوامد العالقة والذائبة بعد المعالجة المبدئية والاولية في المياه. تستخدم البكتيريا هذان النوعان من الجوامد كغذاء لها اثناء عملية المعالجة . فالبكتيريا تحول الجوامد الى مياه ، غازات أو جوامد متركدة وبينما تقاس ازالة العوالق لمعرفة فعالية عملية المعالجة ، تشكل الجوامد الذائبة الجزء الاكبر لتزويد البكتيريا بالغذاء في عملية التكرير الثانوية .

NUTRIENTS

Impact on Biological Activity

The proper nutrient balance for proper biological activity is defined as the Carbon: Nitrogen: Phosphorous ratio. This ratio requirement for wastewater treatment is 100:5:1 for every 100 kg of Carbon (BOD) entering the treatment plant, 5 kg of nitrogen (ammonia nitrogen + nitrate + nitrite) is required and 1 kg of phosphorous (as orthophosphate) is required to be available to the bacteria. If these minimum requirements are not met, the bacteria that will survive will not perform as expected. In another words, the nutrient deficient treatment plant will not make a clear effluent or produce a sludge that will settle or smell very good.

المغذيات

اثرها على النشاط البيولوجي

يحدد التوازن الغذائي المناسب للنشاط البيولوجي المناسب بنسبة الكربون : النيتـــروجين والفوســـفور. هذه النسبة المطلوبة للمياه المبتذلة هي ١٠٠ : ٥ : ١ أي لكل ١٠٠ كلغ من الكربون (من المتطلب الاوكسيجين البيوكيميائي) الداخلة الى المحطة مطلوب ٥ كلغ من النيتروجين (امونيـــا نيتـــروجين + نيترات + نيتريت)، ومطلوب ايضاً ١ كلغ من الفوسفور (اورتو فوسفات) من اجل البكتيريا. فإذا لـــم تؤمن هذه النسب، لن تعمل البكتيريا التي قد تبقى على قيد الحياة كمايجـــب ان تعمـــل. واذا نقصـــت المغذيات في المحطة فلن نحصل على ناتج نقي من المياه وستتراكم الاوســـاخ فـــي القعـــر وتنتشـــر الروائح.

DISSOLVED GASES

What Gases?

Oxygen, carbon dioxide, hydrogen sulfide, methane and nitrogen are examples of gases that dissolve in wastewater. With the exception of oxygen, all of these gases are produced by the decomposition of organic material. Not all gases dissolve to the same extent. Some dissolve easily and others not as well. Oxygen and carbon dioxide are two dissolved gases that are important to wastewater operations.

الغازات الذائبة

اي غازات؟

الاوكسيجين، ثاني اوكسيد الكربون، سلفيد الهيدروجين، المثان والنيتروجين هي امثلة عن الغازات التي تذوب في المياه. تنتج كل هذه الغازات عن تفكك المياه العضوية بإستثناء الاوكسيجين. لا تذوب كل الغازات في نفس النسبة. فالبعض منها يذوب بسهولة اكبر من البقية. الاوكسيجين وثاني اوكسيد الكربون هما غازات يذوبان في المياه ومهمان في عملية المياه المبتذلة.

DISSOLVED OXYGEN

The Impact of Dissolved Oxygen

Dissolved oxygen or D.O. is important to most aquatic organisms and to secondary treatment plants. It is of particular importance in the Litani River and Lake Qaraoun as an indicator of water quality. The amount of oxygen that can be dissolved in wastewater depends upon the temperature. The higher the wastewater temperature, the lower the saturation level; the lower the water temperature, the higher the saturation level. The trickling filter treatment process helps add oxygen into the wastewater to stabilize the organic matter before it is discharged into the River.

تأثير الاوكسيجين الذائب

للاوكسيجين الذائب اهمية لمعظم الكائنات المائية والمعالجة الثانوية في المحطات. انه مؤشر ذو اهمية مميزة لنوعية مياه نهر الليطاني و بحيرة القرعون. تعتمد كمية الاوكسيجين الذائب في المياه على درجة الحرارة. فكلما ارتفعت الحرارة تدنى مستوى التشبع، وكلما انخفضت الحرارة ارتفع مستوى التشبع. ان عملية المعالجة الثلاثية (الترشيح) تساعد على اضافة الاوكسيجين للمياه المبتذلة من اجل توازن المواد العضوية قبل تحويلها الى النهر.

OTHER SEWER GASES

Result of Biological Action

As mentioned above, there is a multitude of gases besides oxygen present in sewage. Most of these gases are byproducts of the decomposition of organics. While nothing can be done

to stop the production of most of these gases, an understanding of their effect and possible hazards will help in the overall operation of the sewer system.

غازات أخرى في المجارير

نتيجية النشاط البيولوجي

كما ذكر انفاً، هنالك عدد وافر من الغازات المتنوعة في المجارير الى جانب الاوكسيجين. تنتج معظم هذه الغازات بنتيجة التحلل البيولوجي للمواد العضوية. لا يمكن فعل اي شيء لمنع معظم هذه الغازات من التصاعد، لذلك فإن فهم تأثيرها ومخاطرها يساعد جداً على ادارة نظام المجارير.

The Impact of Carbon Dioxide

The decomposition of organic material that contains carbon results in the production of carbon dioxide gas. Carbon dioxide is released into the wastewater by microorganisms. In a sewage lagoon, a portion of the carbon dioxide is consumed by algae and aquatic plants. Carbon dioxide is only slightly soluble in water. Most of the carbon dioxide reacts with the water to form carbonic acid.

$$CO_2 + H_2O \leftrightarrow H_2CO_3$$

(carbon dioxide) (water) (carbonic acid)

Carbonic acid acts to lower the pH of the wastewater.

تأثير ثاني اوكسيد الكربون

ان تحلل المواد العضوية التي تحتوي على الكربون تنتج غاز ثاني اوكسيد الكربون. وينتشر هذا الغاز في المياه بواسطة الكائنات الحية. تستهلك الطحالب والنباتات المائية الحية في حوض المجارير جزء من ثاني اوكسيد الكربون. إن هذا الغاز قليل الذوبان في المياه. معظم غاز ثاني اوكسيد الكربون يتفاعل مع المياه ليكون المياه الاسيدية.

ثاني اوكسيد الكربون + مياه ←→ اسيد كربوني

يعمل الاسيد الكربوني على تخفيض الأس الهيدروجيني للمياه المبتذلة.

Hydrogen Sulfide

The biological breakdown of organic material under anaerobic conditions will produce hydrogen sulfide (H_2S). Hydrogen sulfide has a characteristic “rotten egg” odor. Hydrogen sulfide is toxic to humans, very explosive and produces sulfuric acid which is corrosive to the collection system and treatment plant equipment basins and piping. Hydrogen sulfide combined with water, results in sulfuric acid which will corrode piping and other metal and concrete structures.

سيليفيد الهيدروجين

ان تفكك المواد العضوية بغياب الهواء ينتج غاز سيلفيد الهيدروجين. لهذا الغاز ميزة في رائحته إذ تشبه رائحة البيض العفن. انه غاز سام للانسان، شديد الانفجار وينتج حامض السلفوريك وهو يشكل مادة تسرع عملية اهتراء نظام المجارير ومعدات محطة المعالجة والقساطل، وعندما يختلط غاز سيليفيد الهيدروجين بالمياه تصبح المياه حامضة مما يؤدي الى اهتراء حاد في القساطل والمعادن وحتى المنشآت الباطونية.

Methane

Another wastewater gas that is the by-product of anaerobic decomposition of organic material is Methane (CH_4). Methane, while dangerous, is not classified as toxic, but it can suffocate a person. Methane is also explosive.

الميثان

انه غاز اخر ينتج عن التفك البيولوجي للمواد العضوية بغياب الهواء في المياه المبتذلة ويدعى "الميثان" انه غاز خطر لكن غير سام، إنما قد يؤدي الى اختناق انسان، كما وانه شديد الانفجار.

pH

Definition

The term used to describe how acidic or basic the wastewater is pH. More technically, pH is a measure of the hydrogen ion (H^+) concentration and is measured with a meter or colorimeter. The pH scale ranges from 0 to 14 with 7 being neutral.

الحموضة الأس الهيدروجين

التعريف

يستخدم هذا الرقم pH او الاس الهيدروجين لمعرفة مدى حموضة أو قلوية المياه المبتذلـــة. تقنيـــا، يمثل الأس الهيدروجين قياس تركيز الايون الايجابي للهيدروجين (+H) ويتم قياسها بواسطة قياس اللون. يتراوح مدى الأس الهيدروجين بين صفر الى اربعة عشر مروراً بـــالرقم ٧ كونـــه العـــدد الحيادي.

0 حامض ٧ قلوي ١٤

_____!_____

مقياس الأس الهيدروجين

pH Scale

Low pH values are considered acidic and high pH values are basic.

مقياس الاس الهيدروجين

القيمة المتدنية للاس الهيدروجين تدل على مدى حموضة المياه والقيمة العالية تدل على مدى قلويتها.

Impact on Biological Activity

The pH of wastewater must be maintained as near neutral as possible because the bacteria that are most beneficial to wastewater treatment like a pH range of 6.8-7.2. The bacteria in a wastewater treatment plant will not tolerate pH variations and other, less desirable microorganisms such as certain fungus and filamentous bacteria will take over the plant. These organisms have a negative impact on wastewater treatment and thrive at low pH.

اثرها على النشاط البيولوجي

يجب ان يحافظ على الأس الهيدروجين للمياه المبتذلة قريباً من الرقم 7 قدر الامكان، لان البكتيريا المفيدة للمياه المبتذلة تفضل الهامش الذي يتراوح بين ٦،٨ و ٧،٢). لا تحتمل البكتيريا الموجودة في المياه المبتذلة تغييرات الاس الهيدروجين وغيره، وبالتالي فإن بعض الكائنات الحية كالفطريات والخياطيات الغير مستحبة ستسيطر على المحطة. تؤثر هذه الكائنات سلبياً على معالجة المياه المبتذلة وتنمو بسرعة عند انخفاض الاس الهيدروجين.

ALKALINITY

Definition

Alkalinity is a measure of water's ability to neutralize an acid. Alkalinity can also be defined as a buffer; a chemical system that tends to stabilize and prevent fluctuations in pH. It is usually beneficial to have significant alkalinity in wastewater because it would tend to prevent quick changes in pH. Quick changes in pH interfere with the trickling filter treatment processes.

القلوية

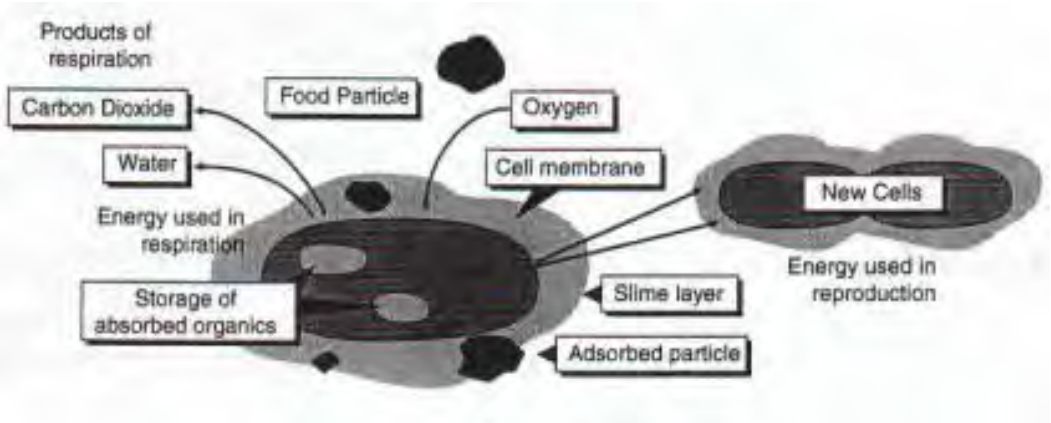
التعريف

القلوية هي مقياس قدرة المياه على محاربة الحموضة لجعلها حيادية. كما ويمكن تعريف القلوية بمخفف الصدمة ، انه جهاز كيميائي يسعى الى توازن ومنع التلاعب في الاس الهيدروجين. انه من المفيد عادة ان تكون المياه المبتذلة قلوية لانها تميل الى منع تغيرات سريعة في الاس الهيدروجين. ان التغيرات السريعة في الاس الهيدروجين تؤثر في عملية المعالجة الثلاثية للمياه.

BOD-BIOCHEMICAL OXYGEN DEMAND

Definition

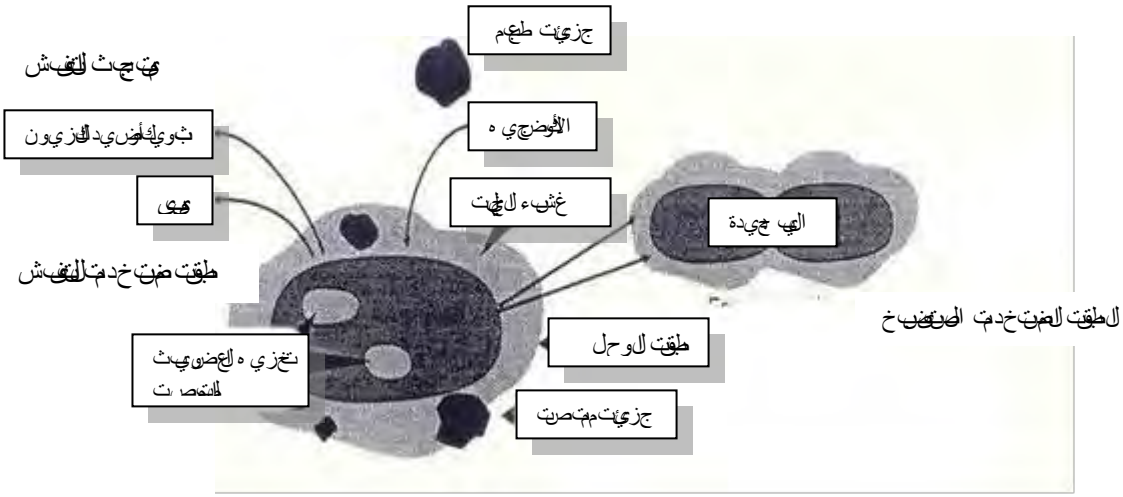
BOD or biochemical oxygen demand is a test used to measure the ability of microorganisms to oxidize organic material in the wastewater. The BOD of the wastewater is a direct reflection of its organic strength. The BOD test is used to determine the impact the effluent will have on the river. At a treatment plant, the BOD of the waste stream is referred to as the "food" for the microorganisms.



المتطلب الكيموحيوي للاوكسيجين:

تعريف

المتطلب الكيموحيوي للاوكسيجين هو فحص يستعمل لقياس قدرة الكائنات الحية المجهرية على اكسدة المواد العضوية في المياه المبتذلة. ان المتطلب الكيموحيوي للاوكسيجين في المياه المبتذلة هو عاكس مباشر لقدرتها العضوية . يستخدم هذا الفحص لتحديد مدى الأثر للمياه الداخلة على النهر. يعتبر المتطلب الكيمو حيوي للاوكسيجين في محطة المعالجة "غذاء" للكائنات المجهرية الحية.



Uses of BOD Measurements

The BOD test doesn't directly measure wastewater strength. The test measures the amount of oxygen that is consumed by microorganisms while stabilizing organic material. This oxygen consumption is considered a direct reflection of the organic strength of the wastewater. The amount of oxygen that can be consumed by microorganisms is based on a number of factors. Two of the most important are the amount of food and the length of time that the organisms are allowed to eat the food. Typical BOD measurements determine the amount of oxygen used over a five day period at 20° C.

استعمالات قياسات المتطلب الكيموحيوي للاوكسيجين

لا يقيس هذا الاختبار مباشرة قدرة المياه المبتذلة. بل يقيس كمية الاوكسجين المستهلك من قبل الكائنات المجهرية الحية خلال عملية توازن المواد العضوية. يعتبر الاوكسجين المستهلك، بمثابة مؤشر مباشر عن القدرة العضوية للمياه المبتذلة. ان كمية الاوكسجين المستهلك من قبل هذه الكائنات تعتمد على العديد من العوامل. اثنان من اهم العوامل هي كمية الغذاء، وفترة الزمن المتاحة للكائنات

لأكل الغذاء.ان المقاييس النموذجية للمتطلب الكيموحيوي للاوكسيجين تحدد قيمة الاوكسيجين المستعمل لفترة خمسة ايام متتالية على حرارة 00 درجة مئوية .

Plant Efficiency

The reduction of BOD throughout the treatment plant is one of the overall goals of wastewater treatment and pollution reduction. By measuring the influent BOD and measuring the effluent BOD and using the following equation, treatment can be determined.

$$\%\ efficiency = \frac{\text{BODin - BODout}}{\text{BODin}} * 100$$

فعالية المحطة

احد اهم الاهداف العامة لمعالجة المياه المبتذلة وتخفيف التلوث من خلال محطة المعالجة هو تخفيف المتطلب الكيموحيوي للاوكسيجين، ومن خلال قياس هذا المتطلب للمياه الداخلة والخارجة واستعمال القاعدة الحسابية التالية، نتمكن من تحديد نسبة الازالة:

$$\text{الفعالية } \% = \frac{\text{المتطلب الداخل – المتطلب الخارج}}{\text{المتطلب الداخل}} \times ١٠٠$$

Typical Removal

This treatment plant has specific percent removal requirements with 85% being the average. It takes a properly operating treatment plant to make these reduction requirements.

الازالة النموذجية

لمحطة المعالجة نسبة مئوية مطلوبة للازالة بقيمة ٨٥% نسبة وسطية . ويستوجب ذلك تشغيل مناسب للمحطة من اجل تخفيف هذه المتطلبات.

BIOLOGICAL CHARACTERISTICS

Impact of Microorganisms

All wastewater as it leaves a residence or commercial establishment is teaming with bacteria, virus, and protozoa and other microscopic organisms. These organisms, primarily the bacteria, begin immediately to consume the organic solids in the sewage. In addition, these organisms could carry communicable disease. The wastewater also carries large numbers of viruses that can cause waterborne disease.

الخصائص البيولوجية

اثر الكائنات الحية المجهرية

تخرج المياه المبتذلة من المنازل والمتاجر والمؤسسات مصطحبة معها البكتيريا والفيروس والكائنات ذات الخلية الواحدة (الأحاديات) وغيرها من الكائنات الحية المجهرية. تبدأ هذه الكائنات، لا سيما البكتيريا، بإستهلاك المواد العضوية مباشرة في المياه المبتذلة . ويمكن ان تحمل هذه الكائنات امراض تتكاثر تلقائياً في المياه. كما وتحمل المياه المبتذلة اعداد هائلة من الفيروس التي تسبب الامراض المتكاثرة في المياه.

Waterborne Diseases

Wastewater system operators must also be concerned about how to control microorganisms. They are a major health concern because many of them cause the spread of waterborne diseases. Organisms that cause disease by transmission through contaminated water are called waterborne pathogens.

الامراض المتكاثرة في المياه

يجب على مشغل نظام المياه المبتذلة ان يكون مهتماً بكيفية السيطرة على الكائنات المجهرية الحية. هنالك خطر صحي كبير ناتج عن الامراض المنقولة او المتوالدة في المياه المبتذلة. الكائنات التي تسبب الامراض عبر نقلها في المياه الملوثة تدعى الجراثيم المتوالدة في المياه.

Importance of Bacteria

The trickling filter wastewater treatment processes utilize microorganisms, mostly bacteria, to consume the organics and reduce the waste in the wastewater to water, carbon dioxide and biological solids. Efficient treatment depends on understanding the requirements for optimal growth as well as recognizing unfavorable biological conditions.

اهمية البكتيريا

تستخدم المعالجات الثلاثية للمياه المبتذلة الكائنات المجهرية الحية، لا سيما البكتيريا، لاستهلاك العضويات ولتحويل الاوساخ في المياه المبتذلة الى مياه، ثأني اوكسيد الكربون ومواد صلبة عضوية. وتعتمد فعالية المعالجة على تفهمنا لمتطلبات النمو المثلى للبكتيريا وادراك الشروط البيولوجية الغير مستحبة لها.

Groups of Microorganisms

While all types of microorganisms have some effect on wastewater or are affected by wastewater, bacteria, protozoa and algae are the most significant to the operator. The following discussion will provide an overview of these organisms.

مجموعة الكائنات المجهرية الحية

لكل الكائنات المجهرية الحية بعض التأثير على المياه المبتذلة، فإن البكتيريا، الكائنات ذات الخلية الواحدة والطحالب هي تعني الكثير لمشغل المحطة . وسيزودنا النص التالي بنظرة شاملة عن هذه الكائنات.

BACTERIA

Most Common Microorganisms

Bacteria are among the most common microorganisms in wastewater. Bacteria are primitive, single celled organisms with a variety of shapes and nutritional needs.

البكتيريا:

اكثر الكائنات المجهرية الحية المعروفة

البكتيريا هي من اهم الكائنات المجهرية الحية المعروفة في المياه المبتذلة. البكتيرية هي بالاساس، خلية واحدة حية بعدة اشكال وحاجيات غذائية.

Size Range

Bacteria range in size from 0.5 – 2 microns in diameter and about 1 – 10 microns long. A micron is a metric unit of measurement equal to one millionth of a meter or 1 thousandth of a millimeter. Another way to visualize the size of bacteria is to consider that it would take about 1000 bacteria laying side-by-side to reach across the head of a straight pin.

هامش الحجم

يتراوح قطر البكتيريا بين ٠،٥ و ٢ ميكرون وبطول ١إلى١٠ ميكرون. الميكرون هو : قياس طولية تساوي واحد على مليون من المتر او احد على الف من الملم. هنالك طريقة اخرى لتخيل حجم البكتيريا وذلك بالتفكير بأنه يلزمنا ١٠٠٠ بكتيريا جنباً الى جنب لتتساوى مع رأس الابرة.

Three Shapes

There are three general groups of bacteria based on their physical shapes. Rod shaped bacteria are called bacilli. Spherical shaped bacteria are called Cocci. Spiral shaped bacteria make up the third group.

ثلاثة اشكال

هنالك ثلاث مجموعات عامة من البكتيريا مقسمة على اساس شكلها الفيزيائي: تدعى البكتيريا التي تشبه شكل العصا "باسيللي" وتدعى البكتيريا التي تشبه شكل الكرة "كوكسي" وتدعى البكتيريا التي تشبه شكل اللولب " المجموعة الثالثة".

Bacili – rods (1st group) Cocci – Spheres Spiral

باسيللي (عصيات) كوكس (الكرويات) اللولبية (المجموعة الثالثة)

OXYGEN REQUIREMENTS

Introduction

Many bacteria are aerobic. They require free or dissolved oxygen. The bacteria responsible for most of the biological treatment of wastewater are aerobic. A few bacteria are anaerobic. They can only exist and multiply in an environment that lacks dissolved oxygen.

Anaerobic bacteria are responsible for most of the treatment that takes place in the digester tank. Some bacteria which are normally aerobic can exist under anaerobic conditions. These adaptable bacteria are said to be facultative.

متطلبات الاوكسيجين

مقدمة

تعيش معظم البكتيريا بوجود الهواء. وتتطلب اوكسيجين حر في الهواء او ذائب في المياه. البكتيريا الهوائية هي المسؤولة عن معظم المعالجة البيولوجية. قلة منها فقط تكون لاهوائية. وتعيش هذه الاخيرة وتتكاثر في بيئة تفتقد الى الاوكسيجين الذائب أو الحر. تكون البكتيريا اللاهوائية مسؤولة عن معظم المعالجة التي تنشأ في خزان الهضم المقفل، قد تستطيع بعض البكتيريا الهوائية العيش في ظل الشروط اللاهوائية. يدعى هذا النوع من البكتيريا الذي يعيش في البيئتين (الهوائية واللاهوائية) "البكتيريا الاختيارية" .

Aerobic Bacteria

If dissolved oxygen (DO) is available, the type of bacteria that will predominate will be the aerobic variety. These bacteria utilize free oxygen for metabolism and perform other duties in the most efficient manner. As opposed to the other types of bacteria listed in this section, an aerobic bacteria will consume and reduce the greatest volume of organics, thus reducing pollution faster with little odor.

البكتيريا الهوائية

اذا كان الاوكسيجين الذائب متوفراً، تكون البكتيريا الهوائية هي المسيطرة في ظل هذه الحالة. وتستعمل الاوكسيجين الحر لاستقلاب ولتنفيذ مهامها بالشكل الفعال. وبعكس كل انواع البكتيريا التي وردت في هذا القسم، فالبكتيريا الهوائية تستهلك وتزيل الحجم الاكبر من العضويات، وهكذا يتم تخفيف التلوث بشكل اسرع وبرائحة قليلة.

Anaerobic Bacteria

If no free oxygen is available to the bacteria and food is present, a type of bacteria known as anaerobic will prevail. These bacteria, while still utilizing oxygen for metabolizing the organics, get their oxygen by breaking the chemical bonds that attach the oxygen to other compounds. This chemically-bound oxygen is harder to get to and it takes longer for the bacteria to get air to do their work. As a result to this chemical process, gases are given off

as the oxygen molecule is lifted from the compounds. In large volumes these gases have terrific odors.

البكتيريا اللاهوائية

اذ توفر الغذاء ولم يكن الاوكسيجين الحر أو الذائب متوفراً للبكتيريا، عندئذ يستولي على هذه البيئة نوع من البكتيريا يعرف باللاهوائي. وتستخدم هذه البكتيريا، اثناء استقلابها للعضويات، الاوكسيجين من خلال كسر الاتحاد الكيميائي الذي يربط الاوكسيجين بالمركبات الاخرى. من الصعب الحصول على الاوكسيجين المتحد كيميائياً مع عناصر اخرى، وتتطلب البكتيريا وقتاً اطول لتحصل على ذاك الأوكسجين من اجل القيام بعملها. ونتيجة لهذه العملية الكيميائية، تتصاعد غازات من جراء نزع جزئيات الاوكسيجين عن تلك المركبات. وفي أحجام المياه المبتذلة الضخمة تكون لهذه الغازات روائح كريهة.

Anaerobic Digestion

Anaerobic bacteria are desirable and if managed properly, result in sludge digestion which reduces volume and odors.

الهضم اللاهوائي

ان البكتيريا اللاهوائية هي البكتيريا المستحبة في حال ادارتها جيداً، لهضم الوحول ولتخفيف حجمها وروائحها.

Food Requirements

Most bacteria require organic food to survive and multiply. This food comes from plant and animal material that gets in the wastewater. The bacteria convert the food to energy and use the energy to move around and make new cells.

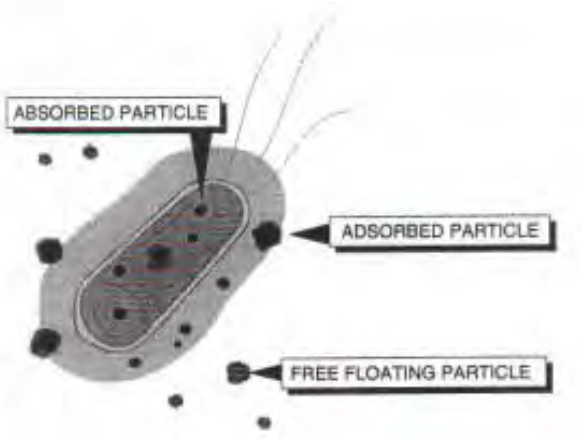
متطلبات الغذاء

تتطلب معظم البكتيريا الغذاء العضوي لتعيش وتتكاثر. ويأتي هذا الغذاء من المواد النباتية والحيوانية التي تصل الى المياه المبتذلة . تحول البكتيريا الغذاء الى طاقة فتستعمل هذه الطاقة لتتحرك وتصنع خلايا جديدة.

Intake of Food

Bacteria collect food as suspended organic material in a slime layer that surrounds the bacteria. This process is called adsorption. The bacteria then excrete an enzyme into the slime layer. The enzyme breaks down the food and allows it to pass through the semi permeable membrane wall of the bacteria using a process called absorption.

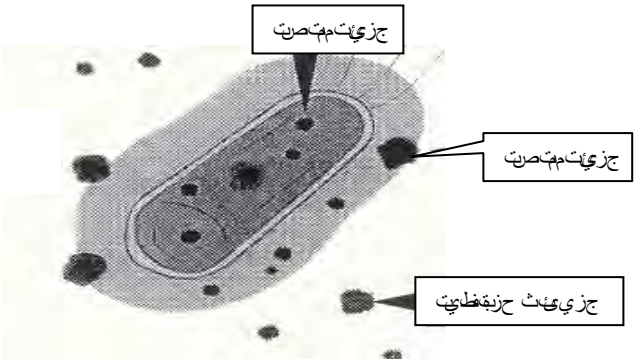
Bacteria Metabolism Process



مأخذ الغذاء

تجمع البكتيريا الغذاء كمواد عضوية عالقة في الطبقات الرخوة المحيطة بها. وتدعى هذه العملية "الامتزاز" .تفرز البكتيريا انزيما في الطبقة الرخوة، فيفكك الانزيم الغذاء ويسمح له بدخول الحائط النصف عازل في غشاء البكتيريا، تسمى هذه العملية "الامتزاز" .

عملية إستقلاب البكتيريا



Temperature Requirement

Temperature affects the rate at which bacteria grow. The warmer the environment, the faster the rate of growth. Generally, for each increase of 10°C, the growth rate doubles.

متطلبات الحرارة

تؤثر الحرارة على معدل نمو البكتيريا. كلما كانت البيئة دافئة كلما كانت عملية النمو سريعة. عادة، يتضاعف معدل النمو كلما ارتفعت الحرارة ١٠ درجات مئوية.

Temperature Ranges

In order to function at maximum efficiency, bacteria require a favorable temperature. They are very susceptible to changes in temperature which affects their growth and the amount of work they can do.

هوامش الحرارة

من اجل الحصول على الفعالية القصوى، يجب تأمين حرارة مستحبة للبكتيريا. انها حساسة جداً لتقلبات الحرارة التي تؤثر على نسبة نموها وكمية عملها التي تقدر عليه.

pH Requirements

pH affects bacteria growth. Most bacteria grow best at a neutral pH. Extreme acidic or basic conditions will inhibit growth.

متطلبات الأس الهيدوجيني

يؤثر الأس الهيدروجيني على النمو. معظم البكتيريا تنمو عند الحد الحيادي للاس الهيدورجيني. الحموضة الزائدة او البيئة القلوية توقف النمو.

Pathogenic Bacteria

Bacteria are responsible for a number of the most infamous epidemic diseases. If the water is not properly treated and disinfected, the bacterial pathogens responsible for these diseases enter potential drinking water supplies through fecal contamination and are ingested by humans. The table below lists a number of bacterial waterborne diseases.

Bacteria	Disease
Salmonella typhi	Typhoid Fever
Shigella spp.	Gastroenteritis
Vibrio cholerae	Cholera
Campylobacter spp.	Gastroenteritis
Enteropathogenic E. coli	Gastroenteritis
Leptospira spp.	Leptospirosis

البكتيريا المسببة للامراض

ان البكتيريا مسؤولة عن عدد من اكثر الامراض الوبائية ذات السمعة السيئة.اذا لم تعالج وتعقم الميـــاه جيداً ، فقد تدخل الفطريات المسؤولة عن هذه الامراض الى مياه الشرب عبر التلوث البرازي وتـــدخل بالتالي الى احشاء الانسان. وفي الجدول التالي لائحة بعدد من البكتيريا التي تنقل هذه الأمراض عبـــر المياه.

إسم البكتيريا	إسم المرض
سلمونيلا تيفو	حمى التيفوئيد
شيغيلا	تسمم وألم معويين
فيبريو كوليرا	الكوليرا
كمبي لوباكتر	تسمم وألم معويين
القولونيات المعوية	تسمم وألم معويين
ليبتوسبيرا	ليبتوسبيروسيس

Coliform Bacteria

One particular group of bacteria is used by water quality experts and wastewater plant operators to determine the effectiveness of disinfection in a wastewater system. This bacterial group is the fecal coliform bacteria. This is one of the subgroups of coliform bacteria. These are chosen as an indicator organism because they are less susceptible to destruction by chlorine than most of the pathogens. If the number of fecal coliforms is low, then it is assumed that there are few pathogenic bacteria present.

البكتيريا القولونية الشكل

هنالك مجموعة واحدة مميزة من البكتيريا التي تهم خبراء نوعية المياه ومشغل محطة المعالجة لتحديد فعالية التعقيم في نظام المياه المبتذلة. تدعى هذه المجموعة من البكتيريا البكتيريا القولونية البرازية. انها احد مشتقات مجموعات البكتيريا القولونية الشكل. واختيرت لتكون مؤشراً حياً لانها اقل عرضة للاضمحلال بالكلورين عن غيرها من الفطريات. فإذا كانت القولونيات البرازية قليلة، عندئذ يعتبر وجود البكتيريا الفطرية قليلة .

PROTOZOA

Definition and Size

Protozoa are one celled animal-like organisms with a fairly complex cellular structure. The protozoa are the giants of the microbial world. They are many times larger than bacteria. They range in size from 4 microns to 500 microns. The larger ones can almost be seen with the naked eye.

الاوليات أو الأحاديات

الاوليات هي حيوانات ذات خلية واحدة تشبه الكائنات الحية مع بنية خليوية معقدة قليلاً. هذه الخلايا هي العملاقة في عالم الميكروبات. هي في الاجمال اكبر من البكتيريا بأضعاف ويتراوح حجمها بين 4 الى 000 ميكرون . وقد يمكن رؤية اكبر اولية (أحادية الخلية) بالعين المجردة.

Significance

Protozoa are predators that feed on bacteria. The number of certain protozoa found in specific treatment process is a good indication of the quality of the treatment. In addition, certain protozoa are pathogenic.

الدلالة

الاوليات هي الحيوانات الضارية التي تأكل البكتيريا. فوجود عدد من بعض الاوليات في عملية معالجة معينة هي اشارة جيدة لنوعية المعالجة. بالاضافة، فإن بعض الاوليات هي فطريات.

Groups of Protozoa – Amoeba

Protozoa are placed into groups based on their method of locomotion. The amoeba moves about by a streaming or gliding action. The shapes of amoeba change as they sort of ooze from place to place.

مجموعة الاوليات – الاميبة

توزع الاوليات في مجموعات على اساس طريقة تنقلها. تتحرك الاميبة بفضل الانسياب او الانزلاق. ويعود شكل الاميبة المتغير الى فرزها رواسب طميية من مكان الى مكان.

Amoeba - **اميبة**

Ciliates

The ciliates are covered with short hair-like projections called cilia that beat rapidly and propel the ciliate through the wastewater. Most ciliates are free-swimming although some are attached to floating material or basin walls. Ciliates are the most important protozoa in stream pollution reduction and in wastewater treatment. Their presence in the trickling filter plant in high numbers is usually an indicator of good treatment.

الشعريات

يغطي الشعريات شعيرات قصيرة عامودية وتدعى الهدب التي تخفق بسرعة وتحرك الشعريات عبر المياه المبتذلة معظم الشعريات تسبح بحرية بالرغم من ان بعضها مرتبط بمواد عائمة او ملتصقة بالجدار. الشعريات هي من اهم الاوليات في تخفيف التلوث في الانهر ومحطات المعالجة. فوجودها في محطة فلتر الترشيح بأعداد هائلة هو عادة مؤشر لمعالجة جيدة.

Ciliates - الشعريات

Flagellates

The flagellates have one or more long whip-like projections called flagella that propel the free-swimming organisms. (Giardia lamblia is a flagellated protozoa).

السوطيات

للسوطيات سوط واحد او العديد منها مثل المساقط وتدعى السوطيات وهي التي تدفع الكائن الحي الى السباحة بحرية. (الجارديا لاميليا هي احدى الاوليات السوطية).

Food Requirements

Protozoa use organics for food. In fact, bacteria are one of their favorite prey. Protozoa are mostly aerobic or facultative. pH, toxic materials, and temperature affect their rate of growth in the same way as bacteria.

متطلبات الغذاء

العضويات هي غذاء الاوليات. في الحقيقة، ان البكتيريا هي من طرائدها المفضلة. معظم الاوليات هوائية واختيارية. يتأثر معدل نموها بالاس الهيدروجيني ، بالمواد السامة وبالحرارة تماماً مثل تأثر البكتيريا بهذه العوامل.

Food Chain Positions

The protozoa is higher up the food chain than bacteria. While the bacteria are the main contributors to waste treatment, they become food for the protozoa.

تسلسل موقع الغذاء

الاوليات اعلى شاناً من البكتيريا في سلسلة الغذاء. فبينما تكون البكتيريا هي المساهم الاول في المياه المبتذلة، تصبح بحد ذاتها طعاماً للاوليات.

Waterborne Diseases

Three protozoan waterborne diseases are listed in the table below:

Protozoa	Disease
Entamoeba histolytica	Amoebic dysentery
Giardia lamblia (5 to 21u in size)	Giardiases
Cryptosporidia (4 to 6u in size)	Cryptosporidosis

الامراض المتكاثرة في المياه

ثلاث انواع من الاوليات الناقلة للامراض في المياه:

الاوليات	المرض
الانتمو يباهيستوليكا الانتمو يباهيستوليكا	الزحار الاميبي او الديزنتاريا
الفارديا لمبليا (0–02ميكرون)	التهاب معوي (انحلال وضعف جسدي)
كريبوس بوريديا (4–6ميكرون)	فطريات (اوجاع في الرأس)

ALGAE

Description

Algae are a form of aquatic plant. Although in mass growths, algae mats are easily seen by the naked eye. They exist as microscopic, single celled forms and also as huge, multi-cellular forms, such as marine kelp. They occur in fresh and polluted water, as well as in salt water. Since they are plants, they are capable of using energy from the sun in the process called photosynthesis. In fact, they only grow where there is light (the daytime) and they grow better when there is bright sunlight, as opposed to cloudy weather. They usually grow near the surface of the water because light cannot penetrate very far through the water.

الطحالب

التوصيف

الطحالب شكل من النباتات المائية. تنمو بكميات كبيرة ومن السهل رؤية بساط الطحالب بالعين المجردة . انها نباتات مجهرية، على شكل خلية واحدة وضخمة، وتتجمع على شكل جزئيات مترابطة تشبه عشب البحر، يعرف في لبنان بإسم "الخز" تتكون الطحالب في المياه الملوثة الحديثة كما تتكون في المياه المالحة وبما انها نباتات ، فهي قادرة على استخدام الطاقة الشمسية في عملية تدعى "التوليف الضوئي ". في الواقع ، هي تنمو فقط في الضوء وتنمو تحت ضوء الشمس بشكل افضل، بعكس الطقس الغائم.انها تنمو قرب سطح الماء اذ انه من الصعب على الضوء اختراق المياه الى العمق.

Classification System

Algae are classified by their color (green, brown, blue-green). The green algae contain green chlorophyll and are found mostly in fresh water. This form is the green road-side ditch algae, and is found on clarifier and basin walls. Diatoms are golden-brown, single-celled forms that have a hard silica shell. Another organism, formerly called blue-green algae, are bluish green in color and undergo photosynthesis. They are now classified as a type of bacteria called *cyanobacterium.* The most serious algae problems in receiving water are associated with the growth of blue-green algae (bacteria).

نظام التصنيف

تصنف الطحالب (الخز) بحسب الوانها (اخضر، بني، ازرق- اخضر) تحتوي الطحالب الخضراء على الكلوروفيل الاخضر وتتواجد في المياه الحديثة . هذا النوع من الطحالب ينمو في الخنادق والحفر المجاورة للطرق، وينمو على خزان التنقية وجدران الاحواض. " دياتوم" هي خلية واحدة بلون بني – ذهبي ومشبعة بالسيليكا وطحلب اخر يعرف بالطحلب الازرق – الاخضر وهو بلون الاخضر المائل الى الازرق حيث ينشط التوليف الضوئي. وتصنف الطحالب حالياً كنوع من البكتيريا تحت اسم "سيانو بكتيريوم" واكثر المشاكل الجدية مع الطحالب في المياه مرتبطة بنمو الطحلب الاخضر – الازرق (بكتيريا).

HIGHER FORMS

The Food Chain

As we progress up the food chain from bacteria through protozoa we reach a group of organisms that the microbiologists call higher forms. These include simple multi-celled animals, crustaceans, worms and larvae.

اشكال اكبر:

سلسلة الغذاء

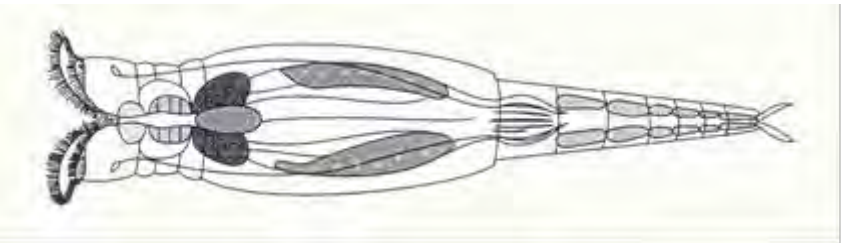
ومع تصاعد السلسة الغذائية من بكتيريا مروراً بالأوليات نصل الى مجموعة من الكائنات يدعوها علماء الاحياء المجهرية " الاشكال الكبرى" وتتضمن حيوانات متعددة كالخلايا، القشريات، الدود واليرقات.

Rotifers

The rotifer is the simplest of the multicellular animals. Its name comes from the apparent rotating motion of two sets of cilia on its head. This motion draws in food and moves the animal through the water. A well operated plant will contain a few rotifers in each drop of fluid. Rotifers are strict aerobes that feed on bacteria.

الدائريات

الدائريات هي من ابسط الحيوانات المتعددة الخلايا يأتي إسمها من حركتها الدائرية الظاهرة من شعيراتها الرأسية. تجذب هذه الحركة الغذاء وتحرك الحيوان في المياه. في حال تشغيل المحطة بشكل جيد، ستحتوي كل نقطة مياه على عدد ضئيل من الدائريات. ان الدائريات حيوانات هوائية وتتغذى بالبكتيريا.



Rotifers - الدائريات

THE EFFLUENT

Water Quality Requirements

The overall intent of the wastewater treatment plant is to minimize the pollution impact on the Litani River and protect downstream users from waterborne disease. The BOD test is used to measure the impact the plant effluent will have on the river. This is accomplished by measuring the potential of the effluent to deplete oxygen in the receiving water. Discharge permits allow certain amounts of BOD and Suspended Solids to be discharged to receiving streams.

المياه الخارجة:

متطلبات نوعية المياه

ان المقصود من معالجة المياه المبتذلة بشكل عام هوتخفيف اثر التلوث عن نهر الليطاني وحماية كل مستهلك للمياه التي تتفرع منه من الامراض التي تنتقل بالمياه. ان فحص الطلب الكيموحيوي للمياه المعالجة مهم لمعرفة مدى تأثيرها على النهر. فيعطينا فكرة عن امكانية استخدام المياه الداخلة الى النهر وللاوكسيجين الموجود في مياهه. يسمح للمياه المحولة الى النهر بكمية محدودة من المتطلب الكيموحيوي للاوكسجين والجوامد العالقة.

Objective of Wastewater Treatment

The objective of wastewater treatment is to reduce pollution and protect public health by containing and stabilizing raw sewage.

هدف معالجة المياه المبتذلة

ان هدف معالجة المياه المبتذلة هو تخفيف التلوث والمحافظة على الصحة العامة وذلك من خلال احتواء وتثبيت المجارير والمياه المبتذلة الخام.

CHARACTERISTICS OF WASTEWATER WORKSHEET

خصائص المياه المبتذلة وقت عمل

1. Typical domestic wastewater is _____% water and _____% solids.

١. المياه المبتذلة المنزلية النموذجية هي _____%مياه و_____ % جوامد.

2. The impurities in wastewater are called _____ or _____.

٢. الشوائب في المياه المبتذلة تسمى _____ او _____.

3. Peak flow will normally occur during (a) dry weather or (b) wet weather.

٣. يحصل الدفق الاقصى خلال: أ – الفصل الجاف أو ب – الفصل الرطب

4. The size of a treatment plant is based on _____ flow.

٤. يتم تحديد حجم محطة المعالجة على اساس الدفق _____.

5. The average hydraulic load contributed by each person in a community is _____ .

٥. ينتج عن الشخص حمل هيدروليكي يساوي _____ ليتر /للشخص/ باليوم.

6. Fresh sewage is _____ in color and has a _____ odor.

٦. المجارير الحديثة او الطازجة لونها _____ ورائحتها _____

7. Septic sewage is _____ in color and has a _____ odor.

٧. المياه الاسنة او العفنة : لونها _____ ورائحتها_____

8. Turbidity is the property of wastewater that causes light to be _____ or _____.

٨. العكارة هي خاصة بالمياه المبتذلة التي تجعل الضوء _____ او _____

9. Solids that can be captured on a filter are called _____ solids and solids that pass through a filter are called _____ solids.

٩. يلتقط الفلتر جوامد، تدعى الجوامد _____وأخرى تعبره وتدعى الجوامد _____

10. A solid that is less than 1µ in size is called a _____.

١٠. الجوامد التي يقل حجمها عن ١ ميكرون تدعى: _____

11. Compounds that are derived from material that was once alive are called _____ compounds.

١١. المركبات التي تنحدر من مواد كانت حية تدعى مركبات _____

12. Compounds that are derived from minerals are called _____ compounds.

١٢. المركبات التي تتحدر من معادن تدعى مركبات _____

13. When a gas is mixed in wastewater it is called a _____ gas.

١٣. عندما يمزج غاز بالمياه يسمى غاز _____

14. A gas with a rotten egg odor is _____ _____.

١٤. الغاز ذو رائحة البيض العفن يدعى : _____

15. The pH range is from _____ to _____. The acid portion of the range is from _____ to _____.

١٥. هامش الاس الهيدروجيني هو من _____ الى _____ . الجزء الحامض منه يتراوح بين _____ و _____.

16. What is alkalinity?

_____

١٦. ما هي القلوية ؟

_____

17. The problem with most metals that are found in wastewater is _____

١٧. المشكلة التي نواجها مع المعادن في المياه المبتذلة هي _____

18. BOD is a measure of the amount of _____ consumed by microorganisms.

١٨. المتطلب الكيموحيوي للاوكسيجين هو كمية _____ المستهلك من الكائنات الحية.

19. The process of food attaching to bacteria is called _____, and the process of this food passing through the wall of the bacteria is called _____.

١٩. تدعى عملية التصاق الغذاء بالبكتيريا_____، وعملية مرور الغذاء عبر حائطها _____

20. A high organic load on a receiving stream can cause a drop in its _____ _____

٢٠. تفريغ دفق ذو حمل عضوي عالي، قد يسبب انخفاضاً في _____ _____ للنهر المفرغ فيه.

21. Waterborne pathogens cause _____.

٢١. الطفيليات المتكاثرة في المياه تسبب: _____ _____

22. The three common shapes of bacteria are:

a. _____

b. _____

c. _____

٢٢. الاشكال الثلاثة للبكتيريا هي :

أ._____

ب._____

ج._____

23. Bacteria that utilize dissolved oxygen are called _____ bacteria.

٢٣. البكتيريا التي تستخدم الاوكسيجين الذائب تدعى البكتيريا : _____

24. Bacteria that can live with or without dissolved oxygen are called _____

٢٤. البكتيريا التي تحيا مع او بدون اوكسيجين ذائب تسمى بكتيريا : _____

25. Three waterborne diseases caused by bacteria are:

a. _____

b. _____

c. _____

٢٥. ثلاثة امراض تتكاثر في المياه تنتج عن البكتيريا هي :

أ._____

ب._____

ج._____

26. The bacteria used in wastewater as an indicator of disinfection efficiency is the

_____ bacteria.

٢٦. البكتيريا التي تستعمل كمؤشر لفعالية تعقيم المياه هي البكتيريا _____

27. Algae are forms of _____ plants.

٢٧. الطحالب هي اشكال من _____ النباتية .

28. The three major groups of microorganisms found in wastewater that cause diseases are:

a. _____

b. _____

c. _____

٢٨. اهم ثلاث مجموعات من الكائنات الحية الموجودة في المياه وتسبب الامراض هي:

أ._____

ب._____

ج._____

TREATMENT TECHNIQUES

WHAT IS IN THIS LESSON?

1. Introduction
2. Preliminary Treatment
3. Screening
4. Screening Operations
5. Screening Disposal
6. Primary Treatment
7. Sedimentation
8. Primary Clarifier
9. Operational Considerations
10. Secondary Biological Treatment
11. Trickling Filter
12. Equipment
13. Theory Of Operation
14. Operational Problems
15. Secondary Clarifiers

تقنيات معالجة المياه المبتذلة

ماذا في هذا الدرس؟

١. مقدمة
٢. المعالجة المبدئية
٣. التصفية
٤. عمليات التصفية
٥. التخلص من منتجات المصافي
٦. المعالجة الاولية
٧. الترسيب
٨. خزان الترسيب الاولي
٩. اعتبارات تشغيلية
١٠. المعالجة البيولوجية الثانوية
١١. فلتر الترشيح
١٢. التجهيزات
١٣. نظرية التشغيل
١٤. مشاكل التشغيل
١٥. خزانات الترسيب الثانوية

TREATMENT TECHNIQUES

INTRODUCTION

From Collection System to Treatment

After the wastewater has traveled through the collection system the process of removing the organics, the inorganics and as many pathogenic organisms as possible begins.

تقنيات معالجة المياه المبتذلة

مقدمة

من المجارير إلى المحطة

بعد انتقال المياه المبتذلة من شبكة المجارير إلى محطة المعالجة، تبدأ عملية إزالة العضويات والغير عضويات وبعض الكائنات المسببة للأمراض.

Function of Treatment

This lesson will cover the physical and biological treatment process used to stabilize wastewater to produce an effluent that can be discharged harmlessly into the environment.

وظيفة المعالجة

يغطي هذا الدرس عمليتي المعالجة الفيزيائية والكيميائية المستعملة لتثبيت المياه المبتذلة بحيث تخرج المياه صالحة لصرفها في الطبيعة دون اي اذى.

Solids Treatment

Lesson No.4 titled *Sludge Treatment and Disposal* will deal with the solids that are produced as the wastewater treatment process is accomplished. Solids that are removed from the wastewater are called sludge and require further treatment to reduce the risk from pathogens.

معالجة الجوامد

هنالك درس لاحق لشرح كيفية معالجة الجوامد التي تنتج عن عملية معالجة المياه المبتذلة. تسمى الجوامد المزالة من المياه المبتذلة بالحمأة وتتطلب معالجة إضافية لتجنب خطر الكائنات المسببة للأمراض

Treatment System

This treatment plant is composed of a combination of the following stages: 1) preliminary treatment, 2) primary treatment, 3) secondary treatment 4) Disinfection, and 5) treatment of sludge before disposal.

نظام المعالجة

تقسم محطة المعالجة إلى الأقسام التالية: المعالجة المبدئية، المعالجة الأولية، المعالجة الثانوية والمعالجة الثلاثية التطهير و معالجة الحمأة قبل التخلص منها.

PRELIMINARY TREATMENT

First Stage

The first stage of this wastewater treatment plant is called preliminary treatment and includes coarse screening, fine screening, and flow measurement.. Preliminary treatment screening is beneficial as it makes the sewage homogeneous, removes large untreatable material and reduces some of the inorganic solids in the flow.

المعالجة المبدئية

المرحلة الأولى

تسمى المرحلة الأولى من محطة معالجة المياه المبتذلة بالمعالجة المبدئية، وتتضمن مصفاة للشوائب فتجعل المياه المبتذلة متجانسة وخالية من المواد الكبيرة وتخفف الجوامد العضوية في المياه.

SCREENING

Function of Screens

The first stage of preliminary treatment is screening. Screens are used to remove large objects such as sticks and rags which may damage or plug pumps and piping, two types of screens are used in preliminary treatment: coarse screens and fine screens.

التصفية

وظيفة المصافي

التصفية هي المرحلة الأولى من المعالجة المبدئية. تستخدم المصافي لإزالة أشياء عديدة مثل القطع الصغيرة والأتربة التي قد تعطل او تسد القساطل والمضخات، . هنالك نوعان من المصافي : المصافي الواسعة والمصافي الدقيقة.

Coarse Screens

Coarse screens (commonly called a trash rack or bar screen), are made of vertical steel bars spaced 15mm apart. The screens are installed at an angle of 30 degrees, to facilitate manual cleaning.

المصافي الواسعة

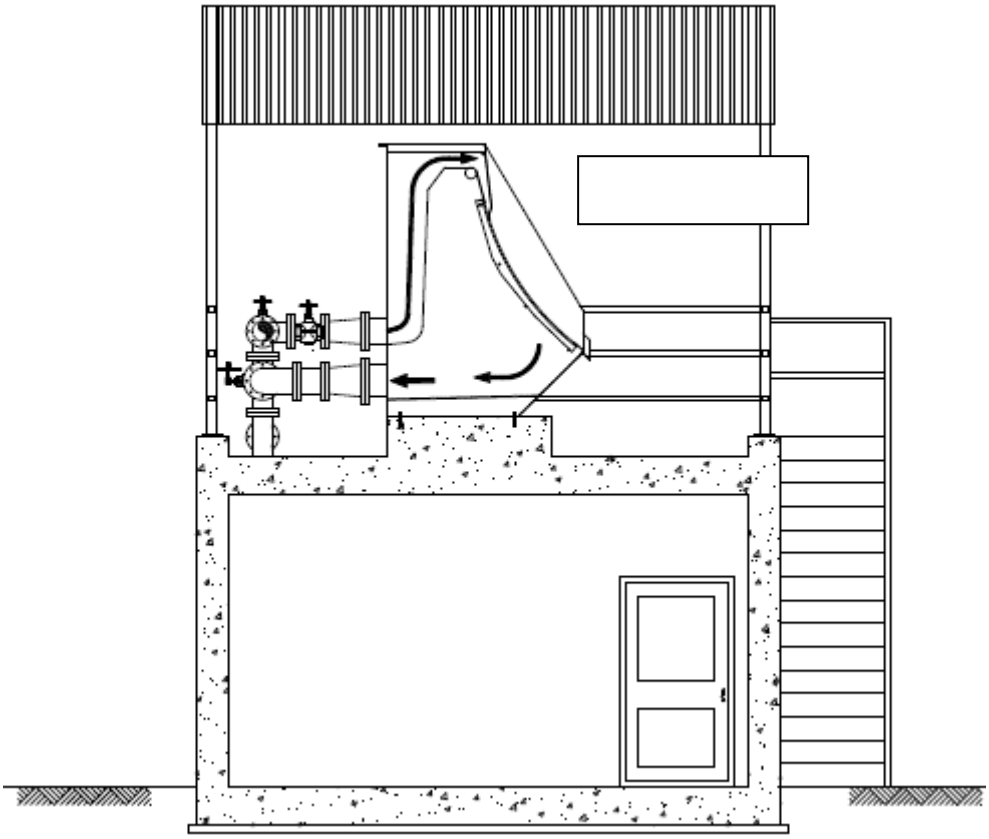
لمصافي الواسعة (تسمى عادة خانة النفايات او مصفاة الرواسب) وهي مصنوعة من قضبان حديدية عامودية متباعدة 15 مم عن بعضها البعض. وتثبت المصفاة بزاوية 30 درجة لتسهيل التنظيف اليدوي.

Fine Screens

Fine screens are used to remove rags and sticks just as bar screens and they also remove smaller solids.

المصافي الدقيقة

تستخدم المصافي الدقيقة لهدفين : الأول لإزالة القطع الصغيرة (حطام) والأتربة والثاني لازالة الجوامد الاصغر حجماً .



SCREENING OPERATIONS

Maintenance Requirements

During dry weather periods, coarse trash racks should be cleaned at least twice daily. During storm periods, they should be cleaned three to five times per day to maintain a free flow of sewage through the process.

عمليات التصفية

متطلبات الصيانة

خلال فترات الطقس الجاف يجب تنظيف حاجز أوساخ المصفاة الكبيرة على الأقل مرتين يوميا. أما في خلال فترات العواصف، فيجب تنظيفها ثلاث إلى خمس مرات يومياً للحفاظ على تدفق المياه من دون أي عوائق خلال عملية المعالجة.

Results of Poor Maintenance

Failure to clean the screens can result in one or more of the following:

1. The wastewater stream may go septic upstream of the screening process.
2. Blocking of the screens should cause a surcharge of sewers upstream of the screens.
3. Once the screens have been cleared a shock load could upset the hydraulics of the plant.

نتائج الصيانة الضعيفة

يؤدي عدم تنظيف المصافي إلى احدى النتائج التالية أو أكثر:

١. إمكانية ارتفاع منسوب المياه المبتذلة ورجوعها إلى الخلف فتتعفن خلال تجمعها.
٢. إمكانية انسداد المصافي فيمتلئ قسطل المجرور القادم إلى المحطة بالمياه المبتذلة
٣. إمكانية إصابة عملية المعالجة في المحطة بصدمة من الحمل العضوي والتدفق الزائد الغير متوقعين من جراء تنظيف المصافي فجأة بعد مدة طويلة من انسدادها

SCREENING DISPOSAL

Burial or Incineration

Disposal of screenings may be by hauling offsite and disposal in a sanitary landfill. It is common for small plants to dispose of the screenings from a bar screen by burial at the plant site or at the landfill. The screenings should be kept covered and removed to disposal at least twice a week.

التخلص من منتجات المصافي

الطمر أو الاحراق

يمكن التخلص من الشوائب العالقة على المصفاة بالطمر في المحطة أو في مطمر اخر. يجب ان تحفظ الشوائب في مكان مقفل حتى يتم التخلص منها مرتين في الأسبوع على الأقل. تطمر الشوائب الصغيرة عادة في المطمر او في مكان مخصص لها.

PRIMARY TREATMENT

Function and Names

Following preliminary treatment, sewage flows into rectangular basins where the wastewater flow is slowed further to allow the removal of those solids that will either float or settle out of suspension in a short period of time. This process is called sedimentation or clarification. The device used to provide this function is called a primary clarifier. This portion of the treatment plant is called primary treatment.

المعالجة الاولية

وظيفة وأسماء

بعد المعالجة المبدئية، تدخل المياه إلى حوض مستطيل حيث تسيل المياه ببطء كبير فيتسنى للجوامد من أن تعوم او تترسب في المياه خلال فترة وجيزة. تسمى هذه العملية بعملية الترسيب او الترويق. ويدعى هذا الحوض الذي يؤمن هذه العملية بحوض الترسيب الاولي. ويسمى هذا الجزء من محطة المعالجة بـــ " المعالجة الاولية".

SEDIMENTATION

Theory of Settling

The theory of settling is best described by looking at the rectangular primary settling tank. The wastewater enters one end of the tank and forms a prism across the tank. It then flows from one end of the tank to the other, coming back together at the far end and exiting the tank.

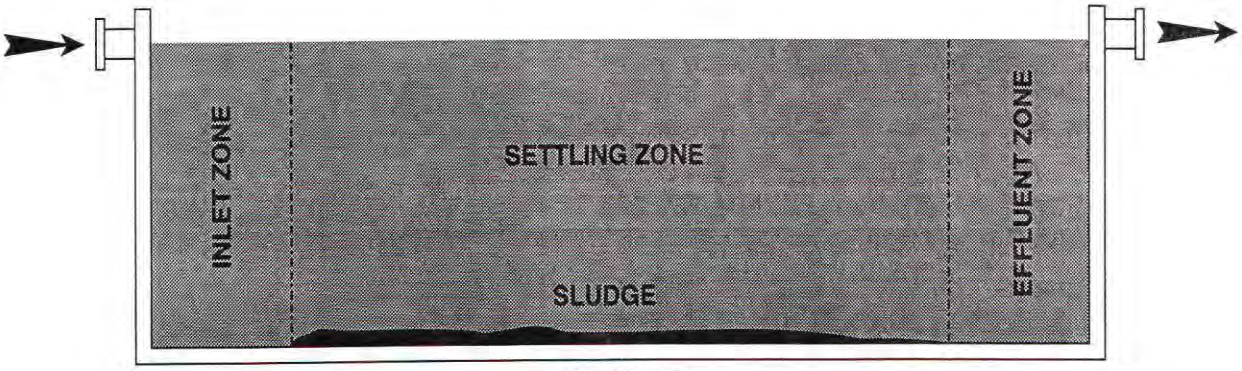
الترسيب

نظرية الترسيب

إن افضل ما يصف نظرية الترسيب هو النظر بإمعان إلى الخزان المستطيل المرسوم أدناه. استناداً إلى النظرية، تدخل المياه من احد أطراف الخزان المستطيل فتسيل حتى طرفه الأخر بعد أن تكون قد قطعت اطول مسافة ممكنة.

Tank Zones

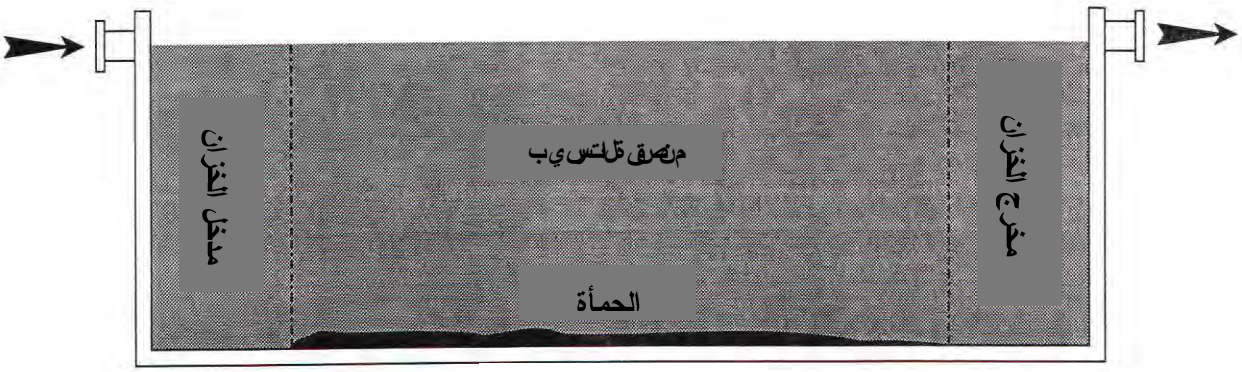
In the theory of settling, the tank is divided into four zones: the inlet zone, settling zone, effluent zone and sludge zone.



Clarifier Zones

مناطق الخزان

في نظرية الترسيب، يقسم الخزان الى اربعة مناطق، منطقة الدخول، منطقة الترسيب، منطقة الخروج ومنطقة الحمأة.



مناطق خزان الترسيب

Removal of Solids

Liquid travels from the inlet to the outlet of the clarifier at a steady velocity. This velocity is dependent on the size of the clarifier and the rate of flow. As the liquid flows through the basin, solids settle to the bottom. If a solids particle is large enough to fall to the bottom of the basin in the length of time it takes the fluid to flow through the basin, then it will be removed.

إزالة الجوامد

تتحرك المياه من مدخل إلى مخرج خزان الترسيب بسرعة ثابتة . وتتأثر هذه السرعة بحجم الخزان وكمية التدفق. فبينما تتدفق المياه في الخزان تترسب الجوامد الى القعر. إذا كانت حبيبة المادة الصلبة كبيرة كفاية لتسقط الى قعر الخزان خلال الفترة الزمنية التي تمضيها المياه لعبور الخزان، حيث تترسب و تزال.

PRIMARY CLARIFIER

Wastewater Flow

In the primary clarifier, raw wastewater enters through each end of a horizontal tee fitting near the surface along one end of the tank. A short baffle dissipates the influent velocity directing the flow downward. Water moves through at a very slow rate and discharges from the opposite end by flowing over a saw tooth plate called the effluent weir and into a concrete trough.

خزان الترسيب الاولي

تدفق المياه المبتذلة

تدخل المياه المبتذلة الخام إلى خزان الترسيب الأولي عبر سلسلة من الفتحات بالقرب من سطح المياه ومن جهة معينة للخزان . يعترض حاجز قصير تدفق المياه فيبدد سرعتها ويحول المياه المتدفقة إلى الأسفل. تتحرك المياه ببطء كبير في الخزان ثم تخرج فوق مسننات على شكل أسنان المنشار التي تسمى "سياج التدفق".

Sludge Flow Path

Settled solids are accumulated and concentrated at the bottom of the tank in sludge hoppers. Sludge of 5% to 7% solids is manually withdrawn using the primary sludge pump periodically (at least twice per day) from each sludge hopper and sent to the digester.

مسار تدفق الحمأة

تسقط الجوامد الى قمع الحمأة في قعر الخزان. يتم سحب هذه الحمأة كل فترة بعد فترة لارسالها الى الهاضم بواسطة مضخة الحمأة الأولية. هذه الحمأة تحتوي على ما يقرب الثلاث في المئة من الجوامد.

Scum Removal

Material floating on the water surface will enter a cylindrical tube with a slit along the top which is placed in front of the effluent weir. This tube is called a skimmer. The material that it collects is called scum. The skimmer is manually rotated, to allow scum collected on the surface to flow through the slot into the tube that slopes toward a scum pit which includes a net bag to catch the scum solids. From the scum pit the net bag is emptied into the solid waste rubbish can.

إزالة الزبد

تخرج المواد العائمة على وجه مياه خزان الترسيب لتدخل إلى أنبوب اسطواني مجهز بفتحات عامودية مستطيلة في اعلاه ومثبة في مقابل مسننات سياج التدفق. يسمى هذا الانبوب بمزيل الزبد، والمواد التي تجمع تسمى الزبد . يشغل مزيل الزبد يدوياً لكي يسمح للزبد المزال عن سطح المياه بالدخول عبر الفتحات العامودية المستطلية الى الانبوب الذي ينزل مباشرة الى حفرة الزبد حيث تتجمع في سلة كبيرة.

OPERATIONAL CONSIDERATIONS

Side-streams

The supernatant from digesters are piped back to the influent pump station. These flow streams are called side-streams and can contain significant BOD and TSS. These side-streams can cause several problems with the operation of the primary clarifier and secondary treatment system.

اعتبارات تشغيلية

التدفق الجانبي

كل ما يفيض من الهاضم يعاد ضخه إلى بداية المحطة. يدعى هذا الفائض بـــ" الدفق الجانبي" وقد يحتوي على حمل عالي من متطلب الاوكسيجين الكيموحيوي. ومجموع المواد الصلبة. قد تسبب هذه التدفقات الجانبية بمشاكل عديدة عند تشغيل خزان الترسيب الاولي ونظام المعالجة الثانوية.

Rising Sludge

If the clarifier sludge becomes too old, the clarification process can be upset. This could occur if the sludge is allowed to stay in the clarifier too long. In addition, a high volume side-stream can increase the effective age of the sludge in the clarifier (the side-stream contains old material). Storing sludge in a clarifier too long can also upset clarification. Microorganisms decomposing the waste organics produce gas that makes the solids more buoyant, thus expanding the sludge blanket and reducing the solids concentration. Detrimental biological activity is characterized by foul odors, floating sludge, and a darkening of the wastewater color.

ارتفاع الحمأة

عندما تصبح حمأة خزان الترسيب قديمة تتأذى عملية الترسيب .ويحصل ذلك إذا ما تركنا الحمأة فترة طويلة جداً في خزان الترسيب من دون سحب. بالإضافة ، فإن ازدياد حجم التدفقات الجانبية قد تزيد من العمر الفعلي للحمأة في خزان الترسيب (بحكم أن التدفق الجانبي يحوي مواد قديمة) إن تخزين الحمأة لفترة طويلة من خزان الترسيب يعيق

هذه العملية .إذ إن الكائنات الحية المجهرية تحلل الحمأة وتنتج غازات، فتدخل هذه الغازات في الحمأة فتصبح الأخيرة خفيفة فتعوم إلى السطح وتتكون طبقة من الحمأة وبالتالي تخفف تركيز الجوامد في المياه. وبنتيجة صعود الحمأة إلى سطح المياه، ينشأ نشاط بيولوجي مؤذ وضار ويتميز بروائح عفنة وقذرة، مزود بالحمأة العائمة ولون المياه القاتم.

Slime Buildup

The one major operational problem with primary clarifiers is the buildup of algae and organic slime on the inlet flow baffle, effluent baffle, and on the effluent weirs and in effluent concrete troughs. This should be removed daily with a hose and long handled brush.

تكون الوحول

احد أهم مشاكل تشغيل خزان الترسيب هو تكون الطحالب (الخز) والوحول العضوية في اقنية المداخل وعلى المسننات وفي الاجران يجب ازالة هذه المواد يوميا بخرطوم المياه وفرشاة ذات مسكة طويلة .

SECONDARY BIOLOGICAL TREATMENT

Secondary Treatment

Treatment plants that contain primary treatment, followed by biological treatment, are called secondary treatment plants. A secondary treatment plant adds the biological process to further reduce organics in the wastewater.

المعالجة البيولوجية الثانوية

المعالجة الثانوية

تدعى المحطات التي تتألف من معالجة أولية مصحوبة بمعالجة بيولوجية بـــ"محطة معالجة ثانوية". هي تهدف الى إزالة المواد العضوية من المياه المبتذلة بعملية بيولوجية.

Treatment with Bacteria

Utilizing aerobic bacteria and other organisms to reduce the organics in the wastewater and developing a sludge that can be settled easily in the operational objective of secondary treatment.

TRICKLING FILTER

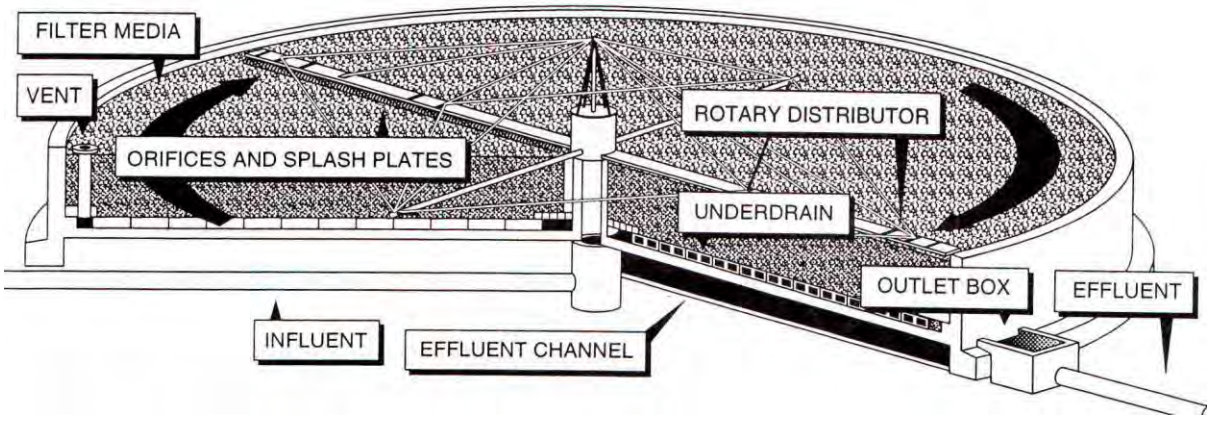
General Description

A trickling filter is an aerobic secondary treatment process that utilizes a fixed film media to grow an aerobic biological slime that is used to treat the wastewater.

فلتر الترشيح

لمحة عامة

إن فلتر الترشيح هو عبارة عن عملية معالجة ثانوية هوائية. أنها تستخدم الطبقة الرقيقة المكونة على المادة التي يحتويها الفلتر لتربية طبقة من الحشائش البيولوجية والكائنات الحية التي تساهم في معالجة المياه المبتذلة.



EQUIPMENT

Media

The heart of the trickling filters is its media. The media is a bed of plastic media which is placed over a collection system. The beds are six meters deep. The media is stacked to 10 layers on the collection system and containued in a concrete tank. This collection system (the under drain) serves to collect the treated wastewater and allows air to circulate through the filter media.

التجهيزات

أوساط الفلتر

إن قلب فلتر الترشيح هي المواد التي يتكون منها وسطه وتدعى "ميديا"، فالـــ "ميديا" هي عبارة عن تخت من المواد البلاستيكية، توضع فوق نظام جمع للمياه من الاسفل . يكون هذا التخت عميقاً بحوالي ٦ امتار يرصف تخت "الميديا" على عشر طبقات عامودية فوق نظام سحب المياه من اسفل الفلتر ومحاطة بخزان من الباطون . يساعد نظام سحب المياه من أسفل الفلتر الذي يسمى المهرب السفلي ومحاط بخزان من الباطون على جمع المياه المبتذلة ويسمح للهواء ليتحرك من خلال فلتر الميديا.

Water Flow

Wastewater is applied to the media bed through orifices placed in a rotating distributor arm. Splash plates are placed in front of the orifices to ensure even wastewater distribution onto the media. The hydraulic power of the wastewater leaving the orifices along the distributor arm causes the arm to rotate. As a result of turning, sewage is applied evenly over the surface of the media.

تدفق المياه

ترش المياه على الميديا من خلال فتحات في قسطل يدور على كامل الخزان الدائري ويدعى هذا القسطل بالموزع الدائري. ولضمان توزيع افضل للمياه على الميديا، تم تثبيت

صحون مقابل كل فتحة مياه. ويدور الموزع الدائري بفعل عزم خروج المياه من الفتحات. وبنتيجة الدوران، توزع المياه بالتساوي على كل سطح الميديا.

Air Flow

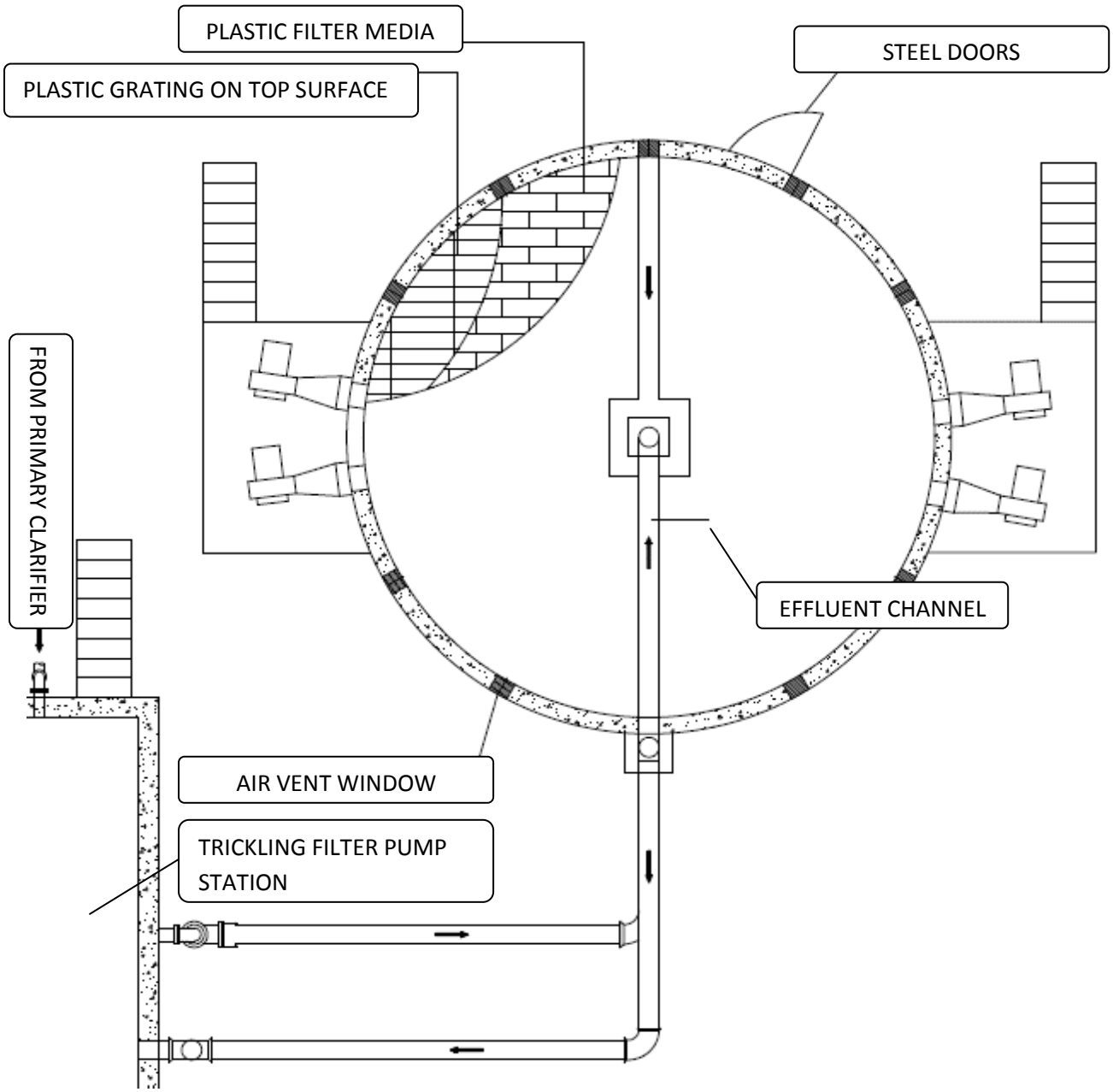
Air flows down the vents and up through the media or down through the media and up through the vents, depending of the difference between air temperature and the temperature inside the media.

تدفق الهواء

يتدفق الهواء نزولاً عبر الفتحات وصعوداً عبر الميديا نزولاً أو صعوداً عبر الفتحات وذلك بحسب الفرق الحراري بين حرارة الميديا وحرارة الجو.

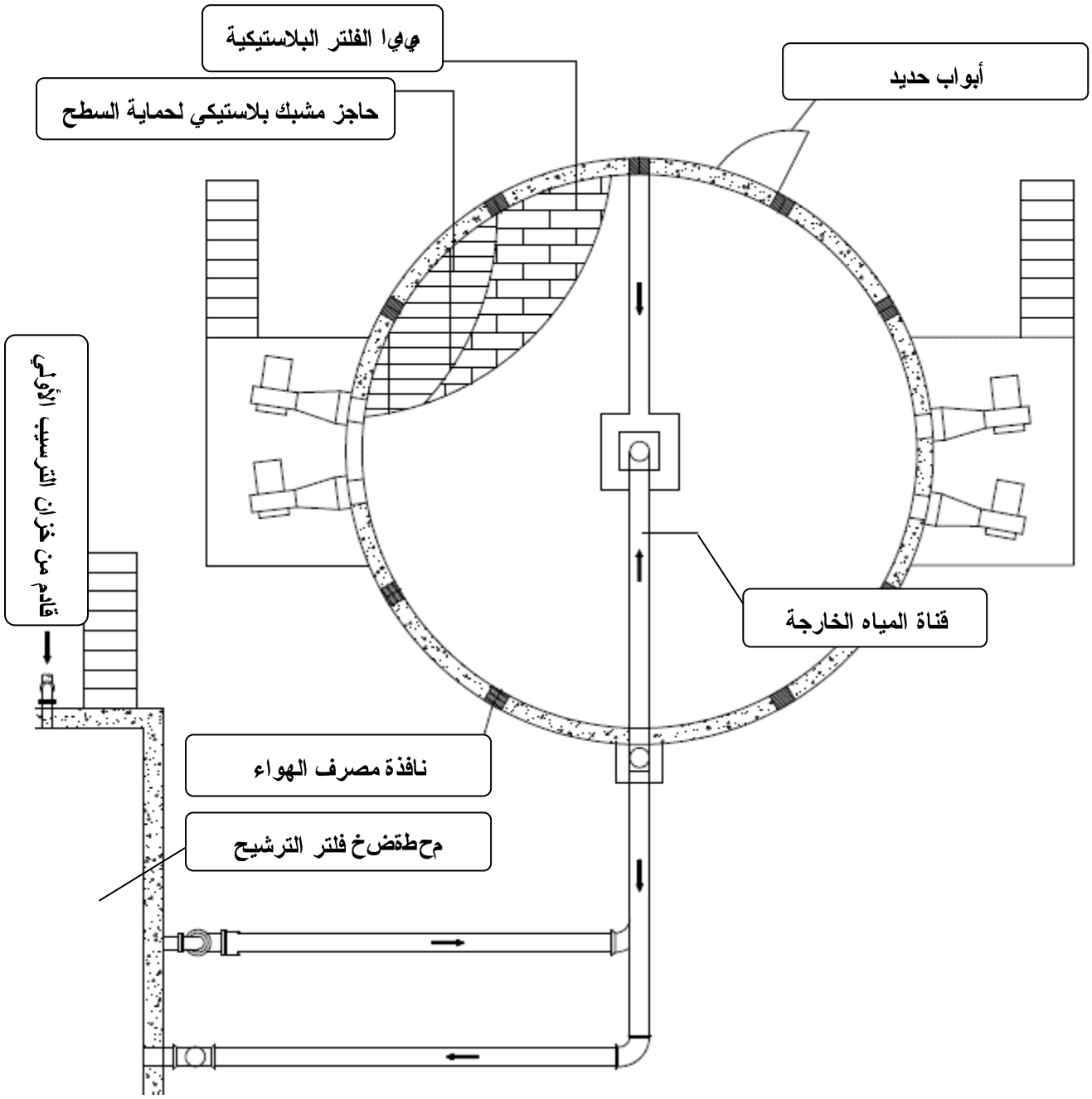
Piping

Besides the influent and effluent piping, each trickling filter has a recirculation pumping and piping system. The recirculation system pumps water from the effluent of the filter back to the influent of the filter. This system is used to maintain a constant flow over the media as well as improving removal efficiency.



شبكة القساطل

إلى جانب التدفق الداخل والخارج، فلكل فلتر ترشيح نظام مرور المياه مع شبكة قساطل. تضخ المياه عبر نظام اعادة الجريان من التدفق الخارج من فلتر الترشيح رجوعاً الى مدخل الفلتر. ويستعمل نظام اعادة الجريان هذا للحفاظ على تدفق ثابت فوق الميديا ولتحسين فعالية ازالة الملوثات.



THEORY OF OPERATION

General Description

The purpose of trickling filters is to remove non-settleable suspended and dissolved organic matter from settled sewage. This is accomplished by a biological slime growth on the filter media. Aerobic biological activity reduces the organics in the raw wastewater and produces a settleable sludge.

نظرية التشغيل

لمحة عامة

ان هدف فلتر الترشيح هو إزالة المواد الغير مترسبة والعضويات الذائبة من المياه المبتذلة. وتنفذ هذه لازالة من خلال نشوء طبقة طحالب عضوية على "الميديا". يخفف النشاط البيولوجي الهوائي العضويات في المياه المبتذلة وينتج حمأة قابلة للترسب.

ZOOGLEAL GROWTH

Contents of Film

Organisms such as bacteria, protozoa, fungi, and algae, attach themselves to the available surface area of the media and become what is called the zoogleal film. These organisms require at least two essential elements for life: food and oxygen.

نمو الهلام

محتويات الطبقة الرقيقة

إن الكائنات الحية المجهرية كالبكتيريا، الأحاديات والفطريات والطحالب تعلق نفسها على اي مساحة متوفرة في الميديا وتصبح بما يسمى "الطبقة الهلامية" وتتطلب هذه الكائنات عنصرين أساسين للحياة: الغذاء والهواء.

Food Source

Food is supplied in the form of sewage which is distributed on the surface of the filter and allowed to trickle through the voids, passing over the zoogleal film on the media.

مصدر الغذاء

يقدم الغذاء على شكل مجارير موزعة على سطح الفلتر وعبر ارتشاحها من خلال فراغات الميديا التي تمر فوق الطبقات الهلامية.

Oxygen and Air Movement

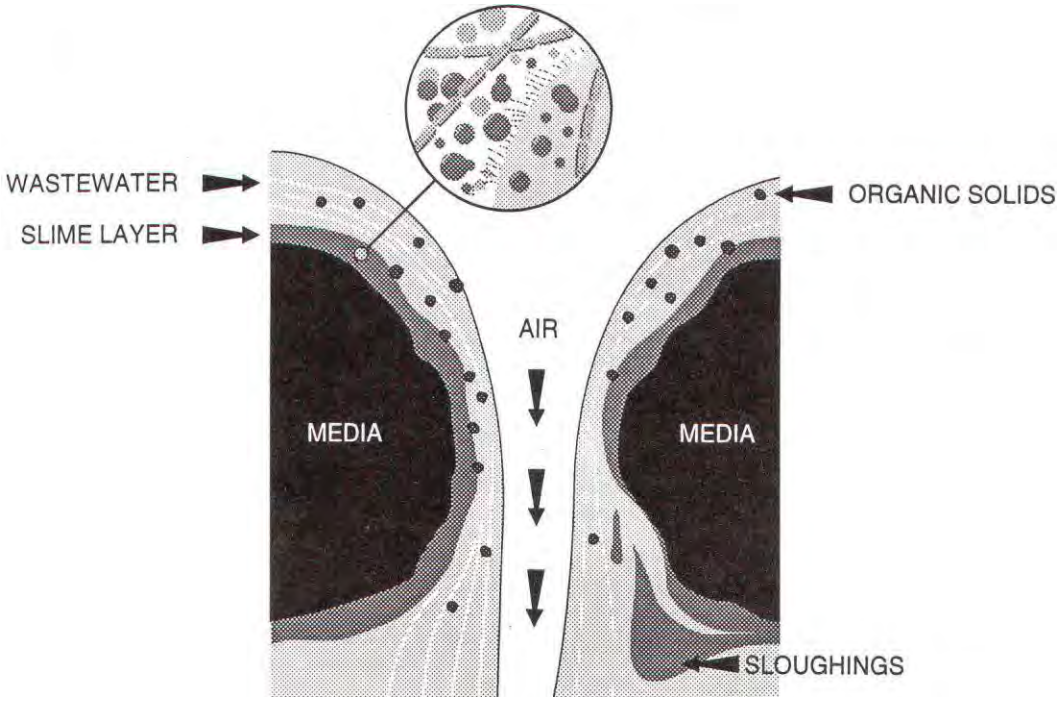
Oxygen is supplied in the form of air which may pass either upward or downward through the filter depending on the difference in temperature of the sewage and surrounding air.

الاوكسيجين وحركة الهواء

يتوفر الاوكسيجين من خلال الهواء التي يعبر الفتلر صعوداً ونزولاً عبر الفلتر متأثراً بالفرق الحراري في المجارير وحرارة الجو.

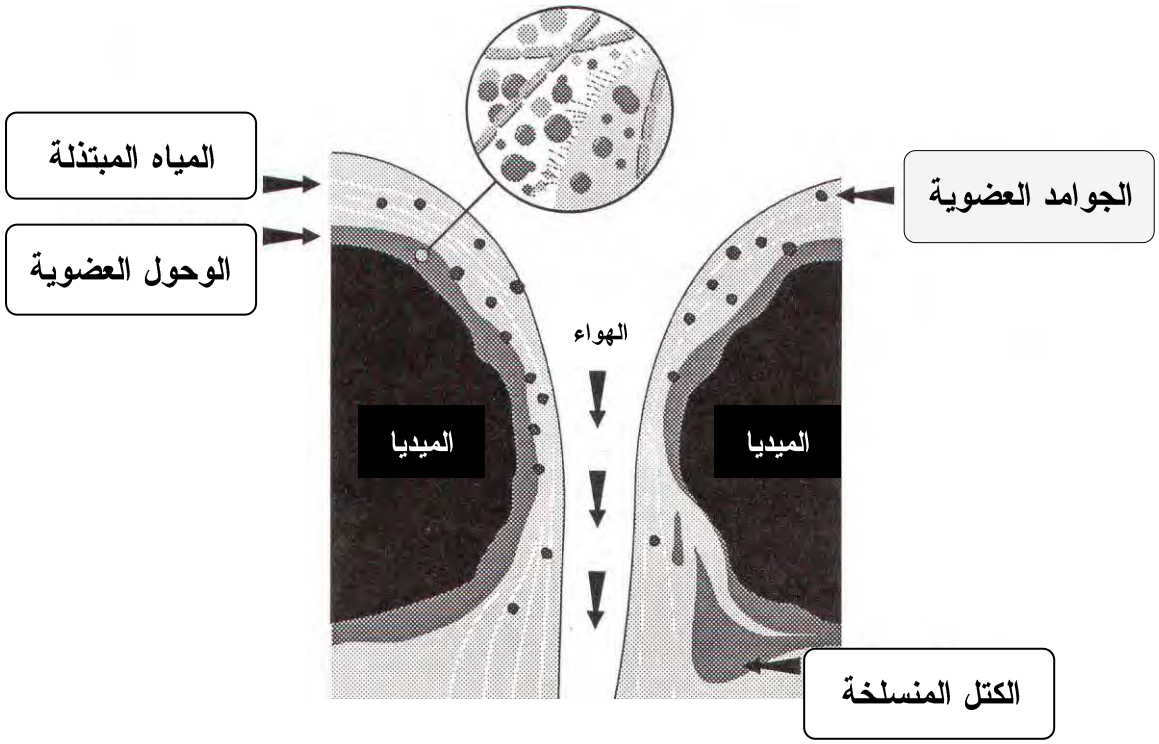
Production of Sloughings

As the sewage trickles over the organisms growing in the film or slime, some of the organic matter in the sewage is converted by the organisms to energy and some to produce new organisms, carbon dioxide, water and mineral solids. As the organisms grow they produce more and more slime. When the slime becomes too thick it “sloughs” or breaks off and is carried by the sewage flow to the final settling basin. The slime that breaks off is called sloughings.



انتاج الكتل المنسلخة

عندما ترشح المياه فوق الكائنات الحية النامية في الطبقة الرقيقة على الميديا، تتحول بعض المواد العضوية بواسطة هذه الكائنات إلى طاقة وبعضها الأخر إلى نمو كائنات جديدة، ثاني اوكسيد الكربون، مياه ومواد صلبة معدنية وبحكم نمو الكائنات الحية، تزداد الطبقة الرقيقة الملتصقة على الميديا سماكة وعندما تصبح هذه الطبقة سميكة بحيث لا تعود قادرة على التماسك بعضها ببعض عندئذ تنسلخ او تتقطع وتحملها المياه معها الى حوض الترسيب النهائي. تسمى هذه القطع المنسلخة بـــ "الكتل المنسلخة".



Flow Recirculation Requirements

In the trickling filter, the biological oxidation is accomplished in several passes of the wastewater through the filter. During normal operation the filter effluent is recirculated with the incoming sewage from one to three additional passes through the filter.

متطلبات إعادة جريان المياه

في فلتر الترشيح، تتم عملية الأكسدة البيولوجية من جراء المرور المتكرر للمياه المبتذلة عبر الفلتر. انه من الضروري اعادة جريان المياه الخارجة من الفلتر الى مدخله حوالي الثلاث مرات.

Alternate Operation - Final Clarifier Sludge Recirculation Requirements

Instead of recirculating filter effluent back through the trickling filter the operator has the option to pump sludge from the secondary clarifier back over the media. This is usually done during filter startup to help produce a heavy biological growth on the media.

متطلبات إعادة جريان الحمأة

تضخ الحمأة المتجمعة في حوض الترسيب الثانوي رجوعاً فوق الميديا لتساعد على انتاج نمو بيولوجي كثيف فيها. هذا يحدث عادة حين يتم تشغيل فلتر الترشيح بعد فترة توقف طويلة.

PROCESS CONTROL

Control of Removal

The only process control that is available with the trickling filter is the quantity of final clarifier sludge circulation. In addition, trickling filters operate best if the flow over the media does not vary from day to day.

عملية التحكم

التحكم بالازالة

إن عملية التحكم الوحيدة المتوفرة في فلتر الترشيح هي كمية إعادة جريان الحمأة من حوض الترسيب النهائي للحمأة. بالإضافة، يعمل فلتر الترشيح بالشكل الافضل إذا لم يتغير تدفق المياه فوق الميديا من يوم الى اخر.

Filter Effluent Recirculation

The operator does not have control of the recirculation rate of flow through the filter.. The trickling filter feed pump operates 24 hours per day at a constant flow rate. Recirculation accomplishes two things:

- It increases the efficiency of removal through the filter and
- It helps to reduce the thickness of the zoogleal film. If this film becomes too thick, it can cause plugging of the filter media.

اعادة الجريان

لا يتحكم مشغل المحطة بعملية إعادة الجريان، فمضخة فلتر الترشيح تعمل ٢٤ ساعة في اليوم و تتم عملية الضخ بطريقة متساوية و تحقق هذه العملية امرين:

- تزيد من فعالية الإزالة من خلال الفلتر
- تساعد في ازالة سماكة الطبقة الهلامية الرقيقة. فإذا اصبحت هذه الطبقة سميكة جداً، فقد تسبب بتسكير فلتر الميديا.

OPERATIONAL PROBLEMS

Introduction

There are four common trickling filter operational problems:

- Reduction of treatment efficiency
- Air temperature
- Odor
- Filter files

مشاكل التشغيل

مقدمة

هنالك أربع مشاكل تشغيلية في فلتر الترشيح:

- انخفاض في فعالية المعالجة
- حرارة الهواء
- الرائحة
- ذباب الفلتر

Organic loading

The average BOD removal efficiency of this trickling filter plant is about 85 to 90%. Therefore, to achieve an effluent BOD of 25 mg/L, the raw wastewater must be essentially a domestic waste with a BOD not greater than 400 mg/L. If influent wastewater contains organic loading greater than this, the final effluent quality may deteriorate and the filter may produce offensive odors.

الحمل العضوي

إن معدل فعالية ازالة المتطلب الكيموحيوي للاوكسيجين في محطة تزود بفلتر واحد هو ٨٥ % الى ٩٠ % تقريباً. لذلك، فمن اجل تحقيق مياه خارجة من المحطة بمتطلب كيموحيوي للاوكسيجين يساوي ٢٥ ملغ/ليتر، وجب على المتطلب الكيموحيوي للاوكسيجين للمياه المبتذلة المنزلية الداخلة ان لا يتعدى ٤٠٠ ملغ /ليتر، واذا تخطت معدلات المياه الداخلة هذه النسب فقد تتدهور المياه الخارجة وينتج عن المحطة روائح كريهة.

Temperature

In winter, the temperature of air and wastewater passing through the filter may be considerably lower and may adversely influence BOD removal.

الحرارة

في الشتاء، تنخفض حرارة المياه والهواء الداخلين عبر الفلتر مما قد ينعكس سلباً على نسبة ازالة المتطلب الكيمو حيوي للاوكسيجين.

Odor

The microbial zone immediately adjacent to the surface of the media is anaerobic and capable of producing offensive odors. If voids in the media become filled with excess biological growth, foul odors can be emitted during spring and fall when air temperatures reduce natural air circulation through the bed. In addition, the filter may become partially plugged, resulting in ponding of water on top of filter media.

الرائحة

تكون المنطقة الميكروبية المحاذية مباشرة لسطح الميديا غير هوائية وقادرة على انتاج روائح كريهة. واذا امتلأت هذه الفراغات في الميديا بنمو بيولوجي اضافي، فقد تصدر روائح كريهة خلال الربيع والخريف عندما تمنع حرارة الجو جريان الهواء الطبيعي في الميديا. بالاضافة، قد يصبح الفلتر مسدود جزئياً، ونتيجة لذلك تتجمع المياه على ظهر الفلتر لتحوله إلى حوض مياه ممتلئ.

Filter Flies

Filter files, or *Psychoda,* are a nuisance problem associated with trickling filters during warm weather. They breed in sheltered zones of the media and on the inside surfaces of the retaining walls. Although wind can carry these small files considerable distances, their greatest irritation is to operating personnel. Periodic spraying of the peripheral area and walls of the filter with a chlorine or herbicide solution help disrupt their hatching cycles.

ذباب الفلتر

ذباب الفلتر او "بسيكودا"، هي احد المشاكل المزعجة والمرتبطة بفلتر الترشيح في الطقس الدافىء . يبيض الذباب في المناطق المحمية من الميديا وداخل فراغات جدران الدعم. وبالرغم من ان الريح قادرة على حمل هذا الذباب بعيداً .إن رش محيط الجدران والمساحات المحيطة بالفلتر بشكل معتاد بمادة الكلور او محلول مضاد للحشرات يساعد على قطع دورة تفقيس البيض عندها.

SECONDARY CLARIFIERS

Introduction

The secondary clarifiers are an integral part of this biological treatment plant. Secondary clarifiers are similar to primary clarifiers with a few specific piping and physical changes.

خزانات الترسيب الثانوية

مقدمة

تشكل خزانات الترسيب الثانوية جزءاً لا يتجزأ من المعالجة البيولوجية للمحطة. تشبه خزانات الترسيب الثانوية خزانات الترسيب الأولية مع تغير بسيط في تمديدات القساطل والشكل.

Detention Time

The detention time for the secondary clarifiers is 1 to 2 hours. The detention time is controlled by the hydraulic loading.

زمن المكوث

تتراوح فترة مكوث المياه في خزانات الترسيب الثانوية من ساعة إلى ساعتين. يتم التحكم بهذا الزمن بواسطة الحمل الهيدروليكي.

Sludge Collection

The purpose of gravity settling following the trickling filter is to collect biological growth, or sloughings, flushed from filter media. These sloughed solids are generally well-oxidized particles that settle readily. Telescoping sludge withdrawal valves are used to slowly lift the accumulated solids from the bottom hopper for continuous discharge gives satisfactory performance. This is a different type of sludge collection mechanism that is used in the primary clarifier.

تجميع الحمأة

إن هدف عملية التركيز بالجاذبية التي تلي فلتر الترشيح هي لتجميع النمو البيولوجي او المواد المنسلخة، القادمة من فلتر الميديا. تكون هذه المواد المنسلخة جزئيات كاملة

التأكسد بالإجمال وهي تترسب بسهولة، تستخدم سكور لسحب الحمأة المتراكمة لضخها على مهل من قعر القمع بشكل متواصل حتى تعطي اداء جيد. انها طريقة مختلفة لالية جمع الحمأة التي تستخدم في خزان الترسيب الاولي.

Sludge Depth

Depth of accumulated sludge in the secondary clarifier bottom hoppers is normally less than one meter, if recirculation flow is drawn from the tank bottom.

عمق الحمأة

إن عمق الحمأة المتراكمة في قعر القمع في خزان الترسيب الثانوي هو عادة اقل من متر واحد اذا كان تدفق اعادة الجريان مسحوباً من عمق الخزان.

TREATMENT TECHNIQUES WORK SHEET

تقنيات المعالجة ورقة عمل

1. Coarse screens installed at the influent pump station are called _____ screens or trash _____.

١. المعدات ذات الفتحات الكبيرة التي توضع على مدخل المحطة تسمى _____

2. Another name for a fine screen used in preliminary treatment is a _____ screen.

٢. الإسم البديل لالمصافي الدقيقة التي تستعمل في المعالجة الأولية هو المصافي _____

3. What are the four processes that make up preliminary treatment and what is their function?

a. _____

b. _____

c. _____

d. _____

٣. ما هي العمليات الاربعة التي تكون المعالجة المبدئية وما هي وظائفها:

أ._____

ب._____

ج._____

د._____

4. List examples of material that are normally removed by the screens found in the headworks of the wastewater treatment plant.

a. _____

b. _____

c.

٤. عدد امثلة عن المواد التي تزال عادة بالمصافي الموجودة في اول محطة معالجة المياه المبتذلة؟

أ._____

ب._____

5. The two methods of disposal of screenings are:

a. _____

b. _____

٥. طريقتي التخلص من الشوائب العالقة على المصافي هي:

أ._____

ب._____

6. What is the purpose of grit removal?

_____.

٦. ما هدف ازالة التراب ؟

._____

7. Grit removal channels are designed with a velocity of _____.

٧. تصمم اقنية ازالة الاتربة على سرعة _____

8. Primary clarifiers are used to remove those solids that will _____ or _____ out of solution within _____ to _____ minutes.

٨. تزيل خزانات الترسيب الاولية المواد الصلبة التي قد _____ او _____

من المياه في خلال _____ او _____دقائق.

9. Identify the clarifier zones identified below:

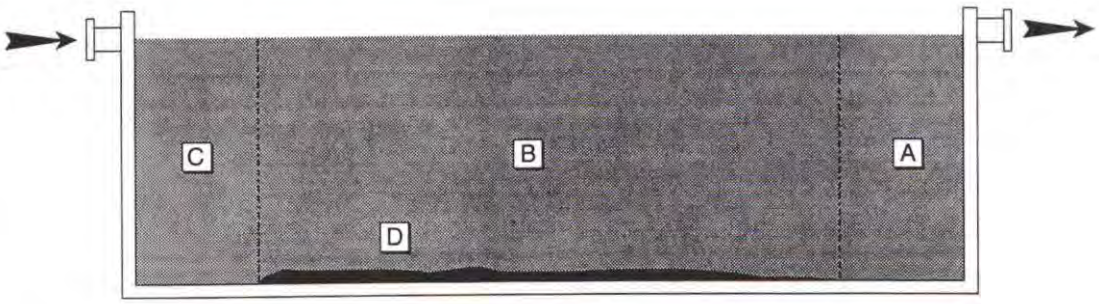
٩. عرف مناطق خزان الترسيب ادناه:

(A)_____.أ

(B)_____.ب

(C)_____ج.

(D)_____د.



10. The treatment provided by a primary clarifier is called _____ or _____.

١٠. تسمى المعالجة التي يؤمنها خزان الترسيب الأولي المعالجة: _____ او المعالجة_____

11. Influent baffles are placed in a primary clarifier in order to dissipate the influent _____.

١١. تثبت حواجز الدخول في خزان الترسيب الاولي من اجل تبديد _____ المياه الداخلة.

12. Primary sludge from a primary clarifier will commonly have a concentration of _____ to _____ % solids.

١٢. الحمأة الاولية الناتجة عن خزان الترسيب الاولي تحتوي عادة على ____% الى ____% جوامد.

13. What are primary clarifier removal ranges for the following items?

a. TSS _____to _____

b. BOD _____ to _____

c. SS _____ to _____

١٣. ما هي نسبة الإزالة في خزان الترسيب الاولي :

أ- مجموع المواد الصلبة _____ % الى _____ %

ب- متطلب الكيموحيوي للاوكسيجين ____% الى _____ %

ج- الجوامد العالقة _____ % الى ____ %

14. What is the major operational problem associated with primary clarifier inlet channels and weirs?

_____.

١٤. ما هي اهم المشاكل التي تعترض اقنية الدخول الى خزان الترسيب الاولي والفتحات؟

_____.

15. A trickling filter is classified as a _____ treatment process.

١٥. يصنف فلتر الترشيح بمثابة عملية معالجة _____

16. Bacteria and protozoa that provide the treatment in a trickling filter live in a slime called a _____ film.

١٦. البكتيريا الاحاديات التي تؤمن المعالجة في فلتر الترشيح تعيش على شكل طبقة وحل رقيقة تدعى _____

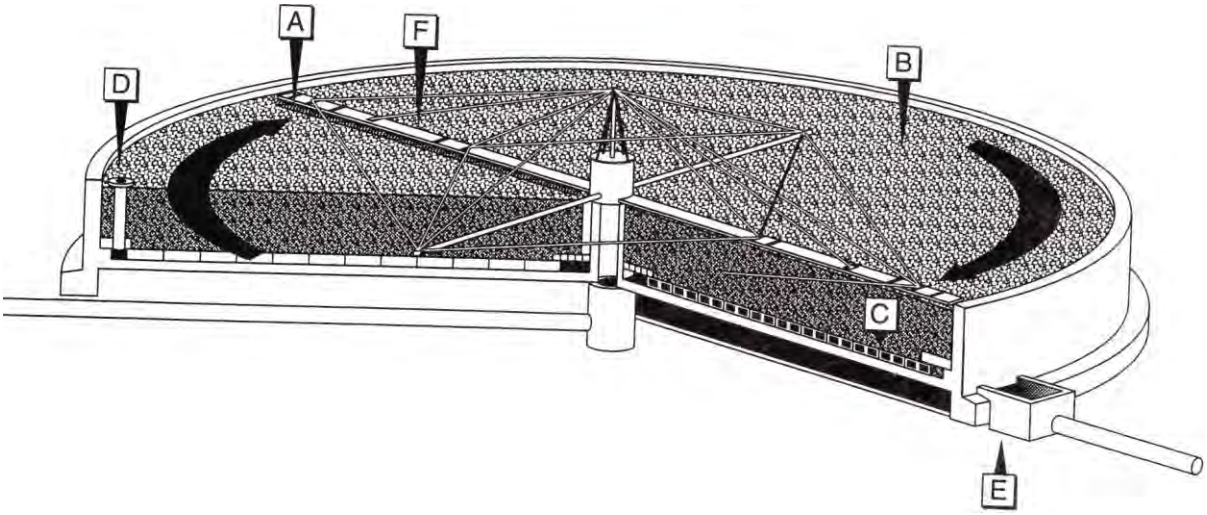
17. Oxygen is supplied to the biological film in the trickling filter by two methods: _____ and _____.

١٧. تزود الطبقة الرقيقة البيولوجية في فلتر الترشيح بالاوكسيجين بطريقتين.

_____ و _____

18. Identify the trickling filter components identified in the drawing below.

١٨. حدد مكونات فلتر الترشيح في المصور ادناه:



A _____ أ

B _____ ب

C _____ ج

D _____ د

E _____ هـ

F _____ و

19. What are the two purposes of recirculation in the trickling filter system?

a. _____

b. _____

١٩. لاعادة جريان المياه في نظام فلتر الترشيح هدفان هما :

أ. _____

ب. _____

20. What is the one process control change that an operator can make with the trickling filter?

_____.

٢٠. ما هي عملية التحكم الوحيدة بالتغيير التي يستطيع المشغل ان يفعلها في فلتر الترشيح؟

_____.

21. What type of media is installed in the trickling filter?

_____.

٢١. ما هو نوع الميديا الموضوع في فلتر الترشيح؟

_____.

22. Describe two common operational problems with trickling filters.

a. _____

b. _____

٢٢. تكلم عن مشكلتين شائعتين مع فلتر الترشيح.

أ._____

ب._____

23. The biomass that falls off of the media of a trickling filter is called _____

٢٣. تسمى الكتلة الحيوية التي تنسلخ عن الميديا داخل فلتر الترشيح: ال_____

24. Sludge that is removed from the secondary clarifier to the digester is called _____ _____.

٢٤. تسمى الحمأة التي تضخ من حوض الترسيب النهائي الى الهاضم اللاهوائي:
ال_____ _____

25. Describe how normal settling sludge would appear in settleometer.

_____

٢٥. كيف تظهر الحمأة المترسبة مقياس الترسيب في الأوقات الطبيعية من تشغيل المحطة؟

_____

26. The depth of the sludge blanket is controlled by _____.

26. تتحكم ال_____ بعمق الغطاء المكون من الحمأة.

27. What is the function of final clarifier sludge recirculation to the trickling filter?

_____

٢٧. ما هو هدف اعادة الجريان من حوض الترسيب النهائي الى فلتر الترشيح؟

_____

28. What are two causes of low DO in the trickling filter effluent?

a. _____

b. _____

٢٨. ما هي الأسباب التي تحفض منسوب الأكسجين الذائب الدفق الخارج من فلتر الترشيح؟

أ._____

ب._____

29. In the T.F. effluent, what is the normal operating value or range for each of the following?

a. PH _____

b. DO _____ mg/L to _____ mg/L

c. Settleometer reaches _____ of height after 60 minutes

d. Final clarifier sludge is _____ in color

٢٩. ما هي القيمة أو النسبة لكل من التالي للدفق الخارج من فلتر الترشيح؟

أ. الأس الهيدروجيني: _____

ب. الأكسجين الزائد: من_____ الى _____ mg/L

ج. نسبة الجوامد مقياس الترسيب من فلتر الترشيح هي_____ بعد ساعة

د. الحمأة الخارجة من خزان الترسيب النهائي _____ اللون

30. Secondary clarifiers are designed to settle _____ from a trickling filter.

٣٠. حوض الترسيب النهائي مصمم لترسيب ال _____من فلتر الترشيح

31. What would cause sludge to rise in a secondary clarifier?

_____

٣١. ماذا يسبب ارتفاع الحمأة في حوض الترسيب النهائي؟

_____

32. Typical detention time for secondary clarifiers is _____ to _____ hours.

٣٢. يقارب وقت الحجز في حوض الترسيب النهائي ال _____ الساعات

33. What are two reasons for accurately measuring of the flow through a wastewater treatment plant?

a. _____

b. _____

٣٣. ما هي الأسباب لتسجيل دقيق للدفق الآتي الى المحطة؟

أ._____

ب._____

SLUDGE TREATMENT AND DISPOSAL

WHAT IS IN THIS LESSON?

1. Introduction
2. Sources Of Sludge
3. Quantity Of Sludge
4. Sludge Stabilization
5. Solids Dewatering

معالجة وتصريف الحمأة

ماذا في هذا الدرس؟

١. مقدمة

٢. مصادر الحمأة

٣. كمية الحمأة

٤. تثبيت الحمأة

٥. تجفيف المواد الصلبة

SLUDGE TREATMENT AND DISPOSAL

INTRODUCTION

Removal of Solids

One of the functions of a wastewater treatment plant is to remove solids from the influent. The primary portion of the treatment process removes those solids that will easily float or sink. The secondary portion of the treatment plant converts dissolved and suspended solids to solids that will settle in the secondary clarifier. These solids that are removed as a result of primary and/or secondary treatment are called sludge.

معالجة وتصريف الحمأة

مقدمة

إزالة المواد الصلبة

إن إزالة المواد الصلبة هي إحدى وظائف محطة معالجة المياه المبتذلة. ففي الجزء الأولي من عملية المعالجة يتم إزالة تلك المواد الصلبة التي تطفو او تغرق بسهولة. وفي الجزء الثانوي من محطة التكرير تتحول المواد الصلبة الذائبة والعالقة إلى مواد صلبة قابلة للترسيب في حوض الترسيب الثَانوي. تلك المواد الصلبة المنبثقة عن المعالجة الأولية والثانوية تسمَى **بالأوحال او الحمأة.**

The Problem with Biosolids

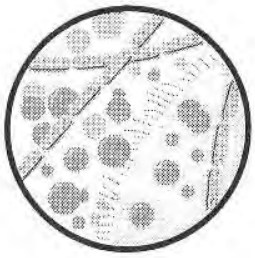
When this sludge is removed from the main treatment process full stabilization of the organic content of the sludge has not been completed. As a result the sludge contains a significant quantity of pathogenic organisms. If this sludge is disposed of on the land without any further treatment, anaerobic decomposition will proceed producing foul odors as well as providing a source of contamination to surface and groundwater supplies.

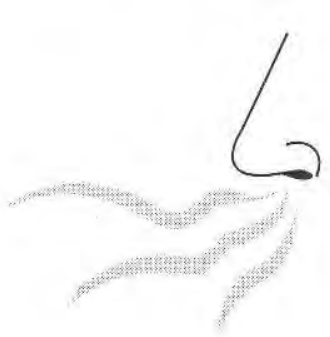
مشكلات الحمأة

عند إزالة هذه الحمأة من عملية المعالجة الأساسية، لا تكون محتوياتها العضوية مثبتة كليا. فإذا رميت هذه الحمأة على الأرض من دون أي معالجة إضافية، عندئذ يبدأ التحلل اللاهوائي ببث الروائح البشعة وتصبح الحمأة مصدرا لتلوث المياه السطحية والجوفية.

Two reasons for treating sludge: Reduce pathogens and reduce odors.

معالجة الحمأة لسببين: تخفيض مسببات الأمراض، كما وتخفيف انبعاث الروائح





Water Content

In addition to the problems with odor and pathogenic organisms, the sludge produced by a treatment plant contains only 0,5% to 10% solids. The major portion of the sludge is water. One of the goals of solids handling is to reduce the water content and thus reduce handling cost.

محتوى المياه

بالإضافة إلى مشاكل الروائح والكائنات الممرضة، تحتوي المياه المبتذلة الصادرة عن محطة تكرير على نسبة ٠،٥ % إلى ١٠ % فقط من المواد الصلبة، أما المكون الأكبر لها فهو الماء. أحد أهداف معالجة المواد الصلبة هو تخفيض نسبة المياه، وبالتالي تخفيض كلفة المعالجة.

Solving the Problem

To prevent or reduce these potential problems the sludge must be treated and disposed of properly. The process of treating and disposing of sludge is called solids handling. Solids handling is accomplished in three steps:

- Stabilization – to reduce pathogenic organisms and the organic content of the sludge.
- Dewatering – to reduce the volume
- Disposal – to prevent contamination

حمأة الشبكة

من أجل وقف او تخفيف هذه المشاكل المحتملة، يجب معالجة المياه المبتذلة والتخلص منها بطريقة مناسبة، من خلال عملية تعرف بمعالجة الحمأة. تطبق هذه العملية على ثلاثة مراحل:

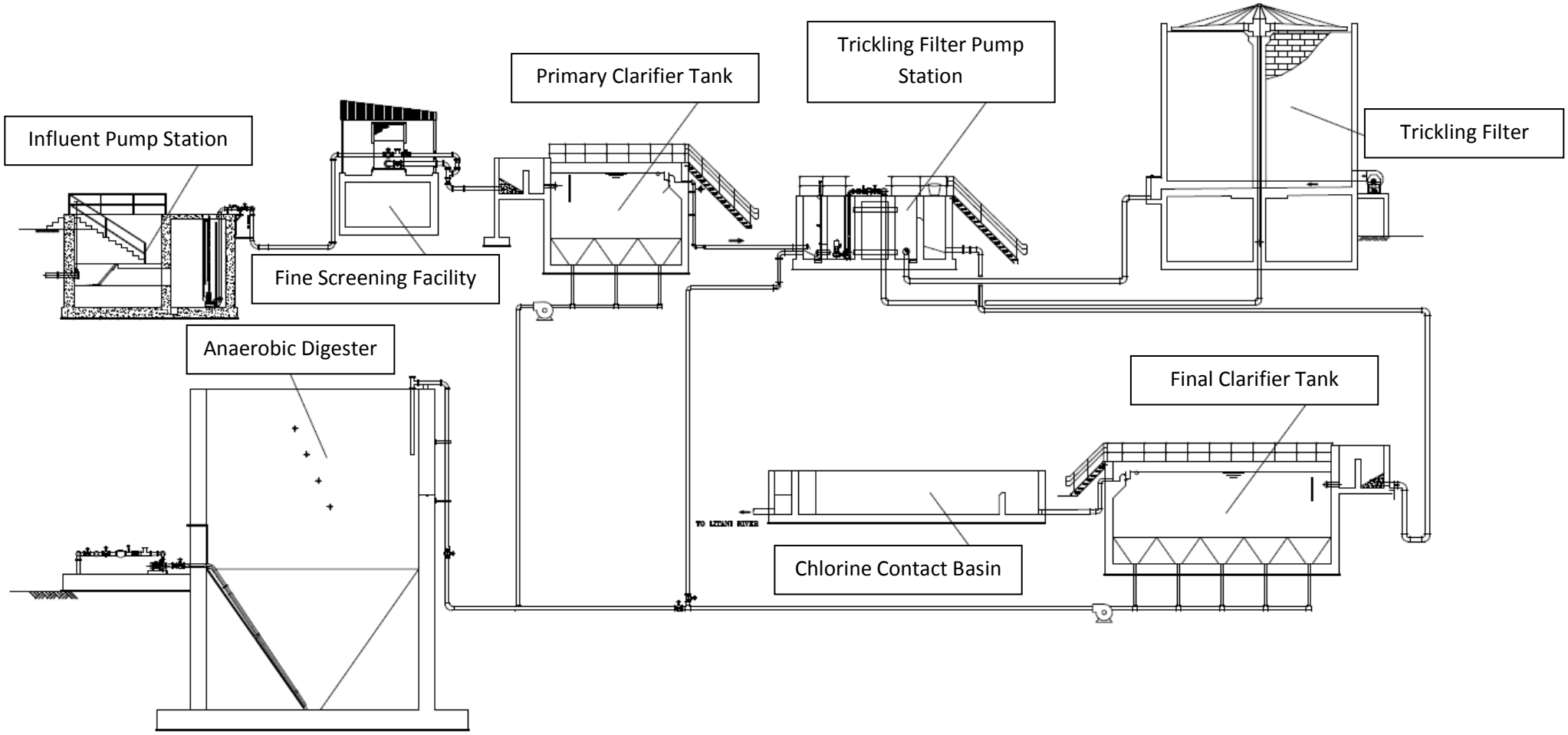
- التثبيت: تخفيض الكائنات الحية المسببة للأمراض والمواد العضوية في الحمأة.
- سماكة الماء: تخفيض الحجم.
- التشميع: تقليل الروائح.

Lesson Content

This will provide information on the sludge produced by primary and secondary biological wastewater treatment of domestic wastewater. Included in the section is the review of the sources of sludge, the treatment process used to stabilize sludge and reduce its volume and disposal or reuse techniques.

محتويات الدرس

سيزودنا ذلك بمعلومات عن الحمأة الناتجة عن المعالجة البيولوجية الأولية والثانوية لمياه المجاري المنزلية. يقع ضمن هذا القسم مصادر الحمأة، عملية المعالجة المستعملة لتثبيت الحمأة وتخفيض حجمها، والتخلص منها أو أساليب إعادة الإستعمال.



Treatment Plant Layout - نظام تخطيط محطة التكرير

SOURCES OF SLUDGE

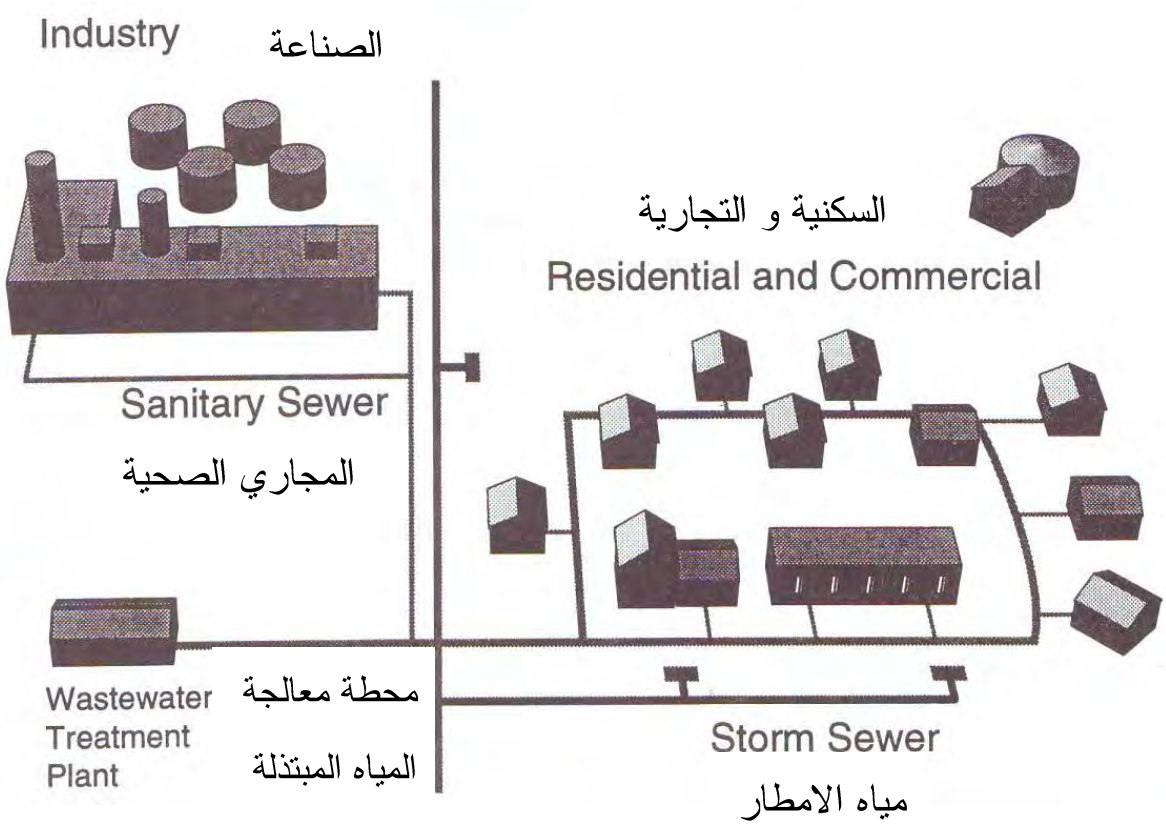
Basic Sources

The end product, or sludge, from a treatment plant comes from many sources. These sources include households, commercial users, industrial dischargers and septic tank haulers.

مصادر الحمأة

المصادر الأساسية

تنشأ الأوحال أو الحمأة عن عدة مصادر، فهي عبارة عن المنتج النهائي، الإنسان العمال المنتج، الصناعات، ومن مستخدمي المنتج.



Content of Wastewater – Solids

As wastewater is carried from households, the water carries food products, human waste, and some inorganic material such as plastics and grit. Wastewater from commercial users contains such materials as food and grease from restaurants and waste. Industrial users discharge many materials including Heavy Metals & Chemicals etc.

محتويات المياه المنزلية – المواد الطبيعية

خلال إنتقال المجاري المنزلية، تحمل المياه معها فضلات طعام، نفايات إنسانية، وبعض المواد الغير عضوية كالبلاستيك والحصى. أما بالنسبة للمجاري التجارية، فهي تحتوي على مواد كالطعام والدهون ومجاري الحمَامات. كما ويصدر عن المستهلكين الصناعيين العديد من المواد المعادن الثقيلة و المواد الكيميائية.

QUANTITY OF SLUDGE

Function of Treatment

The function of primary and secondary treatment is to remove suspended solids and BOD. Once removed this material becomes sludge. The quantity of sludge produced by a treatment plant is dependent upon the removal capacities of the plant, the strength of the raw sewage, the sources of the raw sewage and the ability of the solids treatment system to remove water.

كمية الحمأة

وظيفة المعالجة

ان وظيفة المعالجة الأولية والثانوية هي إزالة المواد الصلبة العالقة والمتطلب الكيموحيوي للأوكسجين، وعند إزالة هذه المواد تتحول إلى حمأة أو وحل. تعتمد كمية الحمأة الصادرة عن محطة المعالجة على قدرة هذه المحطة على المعالجة، قوة التدفق، مصادر هذه المجاري وقدرة نظام معالجة المواد الصلبة على إزالة المياه منها.

Quantity

As a general rule, for every kg of BOD entering a wastewater treatment plant, the wastewater operator will “handle” about ½ kg of dry solids.

لكاويت

كقاعدة عامة، لكل كيلوغرام من المواد ذات المتطلب الكيموحيوي للأوكسيجين داخلاً إلى محطة تكرير المياه المبتذلة، يتعامل النظام مع نصف كيلوغرام من المواد الصلبة الجافة.

TYPES OF SLUDGE

Once the sewage reaches the treatment plant, different types of sludge are produced depending on the type of treatment process. The type of treatment required varies with the type of sludge. The types of sludge produced will include:

- Primary or raw sludge
- Sloughing from a trickling filter
- Other solids including skimmings and scum

أنواع الحمأة

عند وصول المجاري إلى محطة المعالجة، ينتج عنها أنواعاً مختلفة من الحمأة، ويتم تحديد أنواع هذه الحمأة إعتماداً على نوع عملية المعالجة وعلى نوع المياه المبتذلة. تضم انواع الحمأة الأنواع التالية:

- الحمأة الأولية او الغير معالجة.
- البقايا الناتجة عن فلتر الترشيح.
- المواد الصلبة الأخرى مثل الرغوة والنفايات العائمة.

Four Basic Groups

Because of the availability of sludge treatment processes these various types of sludge are typically placed in one of four groups. The groups are:

- Primary sludge
- Biological sludge
- Scum
- Screenings

أربع مجموعات للحمأة

تستخدم محطات المعالجة الحمأة، من المتوقع أن يتم تصنيع الحمأة إلى أربع مجموعات:

- الحمأة الأولية.
- الحمأة البيولوجية.
- الشوائب أو النفايات.
- الرواسب الكيميائية

Primary Sludge

Primary sludge is sludge removed from a primary clarifier. Primary sludge has a solids concentration of 0.5 – 2%.

الحمأة الأولية

الحمأة الأولية هي الحمأة التي تتم إزالتها في حوض الترسيب الأولي، وتتراوح نسبة تركيز المواد الصلبة في هذه الحمأة ما بين ٠،٥ و ٢ %.

Biological Sludge – WAS

Secondary biological sludge will vary in concentration from 0.4 – 4% solids. Trickling filter sludge is the biological sludge material that is removed from the system. This sludge is primarily bacteria and other organisms that require further treatment before they can be disposed of safely. Trickling filter sludge, sometimes referred to as sloughing, is hard to treat as it does not settle or concentrate well.

الحمأة البيولوجية

يتراوح تركيز المواد الصلبة في هذه الحمأة ما بين ٠،٤ و ٤ %. الحمأة البيولوجية هي تلك الحمأة الناتجة عن نظام فلتر الترشيح. هذه الحمأة هي مبدئياً بكتيريا وكائنات حية

أخرى، مما يوجب معالجتها أكثر قبل التخلص منها بشكل آمن. تصعب معالجة الحمأة الناتجة عن فلتر الترشيح لأنها صعبة الترسيب والتركيز.

Scum

Scum can include skimmings from primary clarifiers which contain plastics and grease and biological foam from the secondary clarifier.

الرغوة أو الزبد

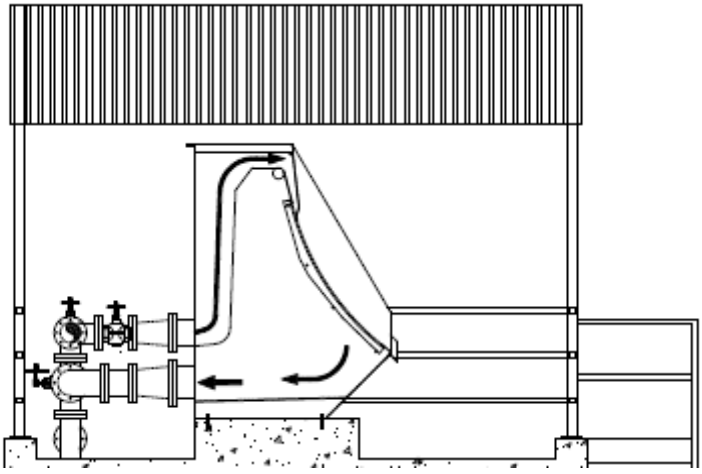
تشمل النفايات العائمة الرغوة الناتجة عن المنقي الأولي، التي تحتوي على البلاستيك والدهون، بالإضافة إلى الرغوة البيولوجية الناتجة عن حوض الترسيب الثانوي.

Screenings

Screenings include material removed by bar screens as well as the material removed by microscreen. Screenings require daily burial.

نفايات المصفاة

تشمل النفايات المصفّاة مواداً تتم إزالتها بواسطة الواح التصفية وأيضاً بواسطة المصافي المصغرة. يتطلب هذا النوع من النفايات دفناً يومياً.



Fine Screening Facility - **المصافي الدقيقة**

SLUDGE STABILIZATION

What is Stabilization?

The stabilization process reduces the number of pathogenic organisms while reducing the odor of the sludge and conditioning the sludge so that it can be dewatered more efficiently.

تثبيت الحمأة

ماهية التثبيت

تخفض عملية التثبيت من عدد الكائنات الممرضة كما تخفف من الروائح المنبعثة من الحمأة وتكيفها لكي يتم سحب المياه منها بشكلٍ فعال.

Stabilization Processes

The stabilization process used is anaerobic digestion. When properly controlled, this process can produce a sludge that is low in pathogenic organisms and does not produce an overly objectionable odor. In addition, the digestion process produces a sludge that can effectively be dewatered.

عملية التثبيت

عملية التثبيت المستعملة هي الهضم اللا هوائي. إذا تمت إدارة هذه العملية بطريقة مناسبة، يمكن ان تنتج أوحالاً بمعدل منخفض للكائنات الممرضة وبرائحة غير قوية. بالإضافة إلى ذلك، ينتج عن هذه العملية أوحالاً قابلة للتجفيف بشكلٍ فعال.

ANAEROBIC DIGESTION

General Description

In the anaerobic digestion process sludge is placed into a tank called a digester where it is mixed. Stabilization is accomplished by anaerobic bacteria. Stabilization of domestic wastewater by an anaerobic digester can be accomplished in approximately 20 to 25 days. When properly operated anaerobic digestion will:

- Effectively stabilize the sludge
- Reduce the water content of the sludge

Anaerobic digestion is a process that reduces sludge volume and destroys pathogens in an anaerobic environment. The process produces sludge that can be disposed of safely.

الهضم اللا هوائي

وصفٌ عام

خلال عملية الهضم اللا هوائي، توضع الحمأة في مستوعب يسمى الهاضم حيث يتم خلطها. تتم عملية التثبيت بواسطة البكتيريا الناشطة بغياب الأوكسيجين. يمكن تثبيت النفايات المنزلية بواسطة الهاضم اللا هوائي بمدة تتراوح ما بين ٢٠ إلى ٢٥ يوماً. إذا نُفِذت بشكلٍ مناسب، تستطيع عملية الهضم اللا هوائي أن:

- تثبِّت الحمأة بشكلٍ فعال.
- تخفف من كمية المياه في الحمأة.

إن عملية الهضم اللا هوائي هي عملية تخفف من حجم الحمأة و تقضي على الكائنات الممرضة في بيئةٍ خالية من الأوكسيجين. ينتج عن هذه العملية أوحالاً يمكن التخلص منها بأمان.

Sludge Types

Anaerobic digestion can be effective in stabilizing sludge from primary and secondary clarifiers as well as clarifier scum pits.

أنواع الحمأة

يمكن هضم الحمأة الناتجة عن حوض الترسيب الأولي والثانوي والإفراغات إن كان ذلك الناتج فعالاً في تثبيت داخل حوض الهاضم.

Solids Concentration

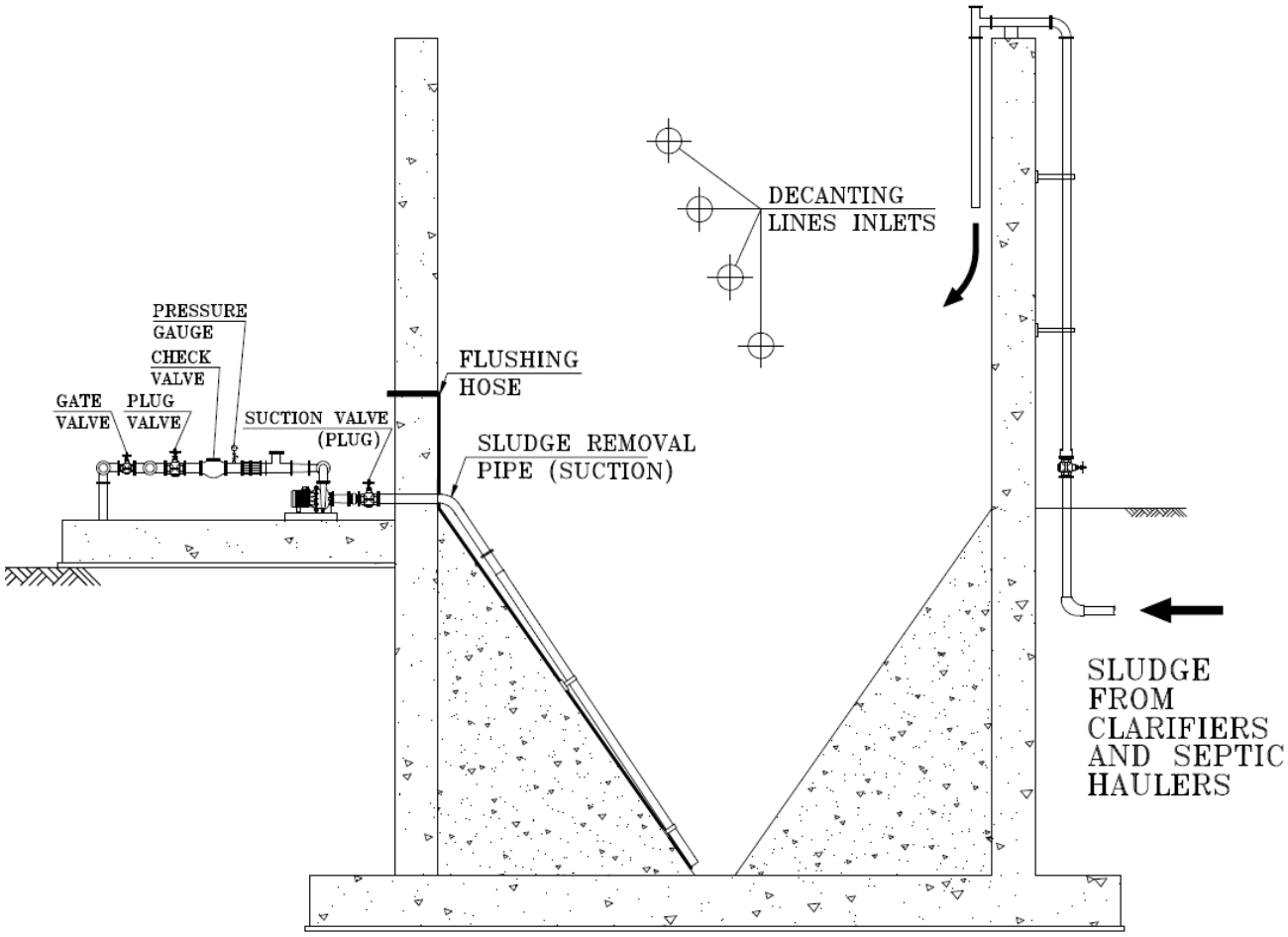
After thirty days of digestion, and with proper settling, anaerobic digesters can produce sludge with a 3 to 4% solids content.

شيلز لوى اد لطيت

بعد ٣٠ يوماً من الهضم المستمر والترسيب الملائم، ينتج الهاضم اللاهوائي أوحالاً تحتوي على نسبة ٣ إلى ٤ % من المواد الصلبة.

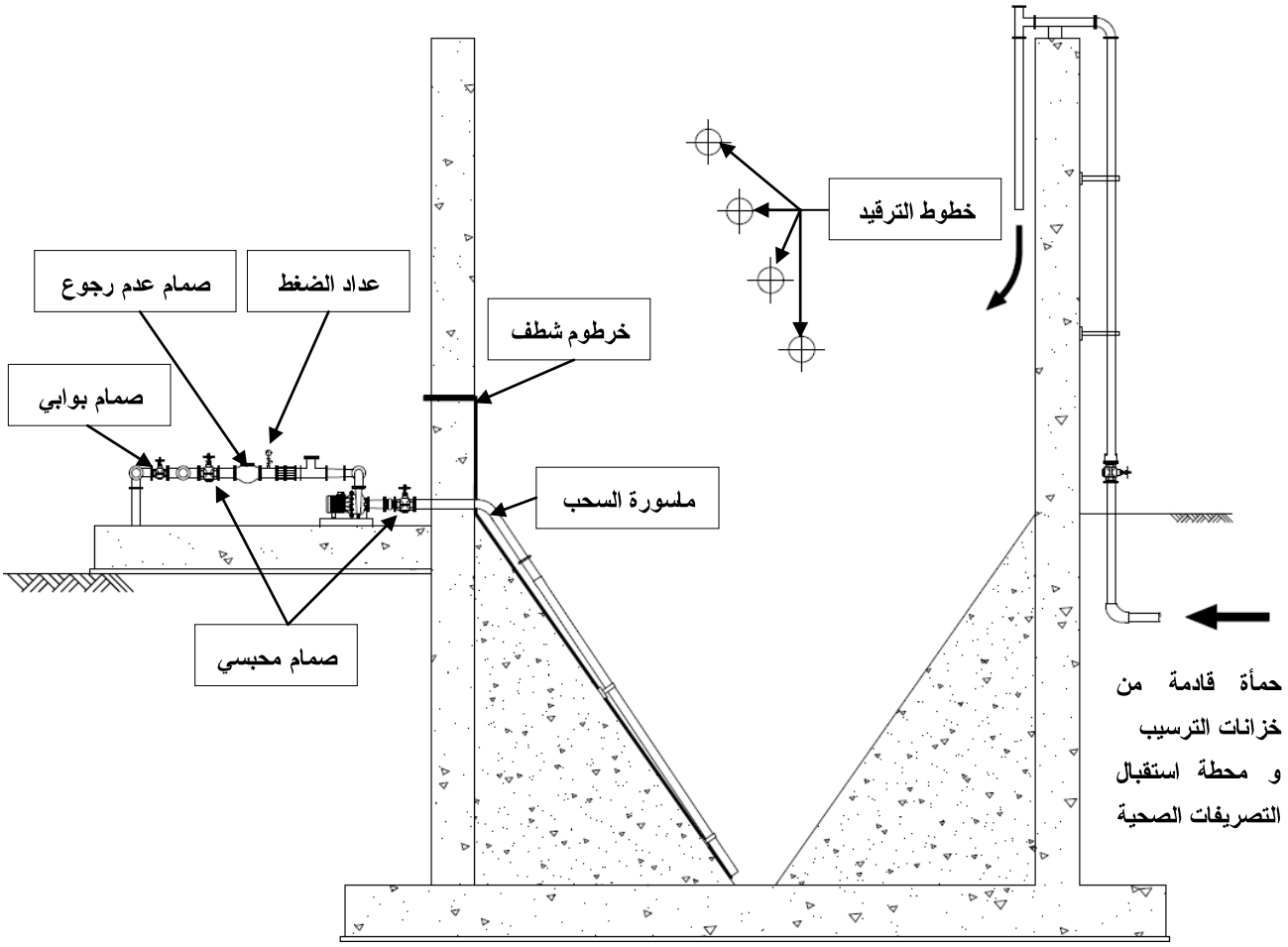
Basic Equipment

The main component of an aerobic digester is an airtight tank. The tank may be round, square or egg shaped. Mixing is provided by two end suction pumps alternating between one another, providing continuous mixing all the time. In addition, various valves, piping, and equipment make up the remainder of the basic digester equipment.



المعدّات الأساسية

المكون الأساسي للهاضم اللاهوائي هو مستوعب محكم الهواء. يمكن أن يكون شكل المستوعب دائري أو مربع أو بيضاوي. يتم الخلط بواسطة مضخات شفط تتناوب الضخ لتأمن خلط مستمر خلال النهار كله. بالإضافة إلى ذلك، يتكون باقي الهاضم من الصمامات، الأنابيب، وغيرها من المعدات.



DIGESTION PROCESS

Digestion – General Discussion

Anaerobic digestion is accomplished by the combined activities of two groups of bacteria. One group is called acid-formers, decompose the organic material and produce special acids. These acids are used by the second group for food. This second group are called methane-producers, because they produce methane gas (CH_4) and carbon dioxide (CO_2) gas. In addition, both groups of bacteria release water from the sludge and from their own bodies when they die.

عمليات الهضم

الهضم بنقاش عام

يتم الهضم اللاهوائي من خلال الجهود الموحَّدة لمجموعتين من البكتيريا. الأولى تسمى "مكونات الحوامض (او الأسيد)"، وهي تحلل المواد العضوية وتنتج حوامض مميزة. تشكل هذه الحوامض طعاماً للمجموعة الثانية التي تعرف بـــ "مكونات الميثان"، لأنها تنتج غاز الميثان (CH_4) وثاني أوكسيد الكربون (CO_2). بالإضافة إلى ذلك، تطلق مجموعتي البكتيريا ماءً ناتجاعن الحمأة وعنها هي شخصياً حين تموت.

Mixing

In order to reduce the amount of time required to stabilize sludge, these digesters are continuously mixed. The mixing increases the contact between the food supply and the microorganisms and thus reduces digestion time.

الخلط

لكي يتسنى لنا تخفيض الفترة الزمنية التي نحتاجها لتثبيت الحمأة، يتم خلط الهواضم بشكل مستمر. يرفع أسلوب الخلط من نسبة الإحتكاك بين الطعام والكائنات المجهرية، مما يخفض فترة الهضم.

Summary

In summary, an anaerobic digester produces three products:

- Methane gas
- Carbon dioxide
- Water

خلاصة

خلاصة لما سلف ذكره، نستنتج أن الهاضم اللاهوائي ينتج ثلاثة عناصر:

- غاز الميثان.
- ثاني أوكسيد الكربون.
- الماء.

OPERATION SEQUENCE

Feed

Sludge is fed to the digester one to two times a day. This sludge is mixed continuously.

مراحل التشغيل

التلقيم

يلقم الهاضم بالحمأة مرة إلى مرتين في اليوم، ويتم خلط هذه الحمأة بشكل مستمر.

Decanting

The fluid in an anaerobic digester stratifies in the digester tank to form a scum layer on the top, then a supernatant layer followed by a digestive layer. On the bottom is commonly a layer of grit. The operator must adjust the feed rate and the decanting piping so that supernatant is removed at the same rate as sludge is feed to the digester. This supernatant is returned to the influent of the plant.

الترقيد

يتراكم السائل في الهاضم اللاهوائي داخل مستوعب الهضم ليشكل طبقة من الزبد على السطح، ثم طبقة طافية فطبقة هضم الحمأة. أما في القعر، فنجد عموماً طبقة من الحصى. على عامل التشغيل أن يُعدَل نسبة التغذية وأنابيب الصب لكي يتسنى له إزالة المواد الطافية بنفس معدل تغذية الهاضم بالحمأة. تتم إعادة هذه المواد الطافية إلى المجرى الداخل إلى المحطة.

Repeat the Cycle

The cycle of feeding sludge, mixing, and decanting is repeated daily. During this process the concentration of the sludge in the digester gradually increases and the percent of the volume that is supernatant is gradually reduced.

تكرار الدورة

تتكرر دورة تلقيم الحمأة، خلطها وصبها بشكلٍ يومي. خلال هذه العملية، يرتفع معدل تركيز الحمأة تدريجياً داخل الهاضم، وتنخفض نسبة المواد الطافية في الحجم الكلي بشكلٍ تدريجي.

Disposal

Once the volume and concentration of the sludge has reached a point where there is little room remaining in the digester, the sludge must be removed to the drying beds.

التخلص منها

عندما يصل حجم وتركيز الحمأة إلى حيث لا تترك سوى القليل من المجال داخل الهاضم، يجب نقلها إلى وحدات التجفيف.

Operational Considerations

Because anaerobic digestion is carried out in an atmosphere with no oxygen, special anaerobic bacteria do the work. Indications of a poorly operating digester include: high or low PH, a change in methane gas production, and a change in odor. Anaerobic digested sludge does not have an offensive odor. Because the gas production is low and the gas of poor quality it is released into the atmosphere rather than being utilized. The sludge level should be checked frequently and not allowed to rise more than above the tank bottom.

إعتبارات عملية

بما أن الهضم اللاهوائي يتم بغياب الأوكسيجين، يتم العمل على يد بكتيريا خاصة ناشطة بغياب الأوكسيجين. من الدلالات على التشغيل الفاشل للهاضم:

- إرتفاع أو إنخفاض تركيز أيون الهيدروجين (pH).

- تغيير في إنتاج غاز الميثان.
- تغير الرائحة.

الحمأة المهضومة بغياب الأوكسيجين لا تصدر روائح كريهة، لأن إنتاج الغاز قليل، ويتم إطلاق الغاز ذات النوعية السيئة في الجو بدلاً من استعماله.

يجب التأكد من مستوى الحمأة بشكلٍ متكرر كي لا ترتفع أكثر من ٤٦ سم فوق قعر المستوعب.

SOLIDS DEWATERING

Why Dewater?

The largest portion of sludge is water. The cost of handling sludge can be drastically reduced by reducing its water content.

تجفيف الحمأة

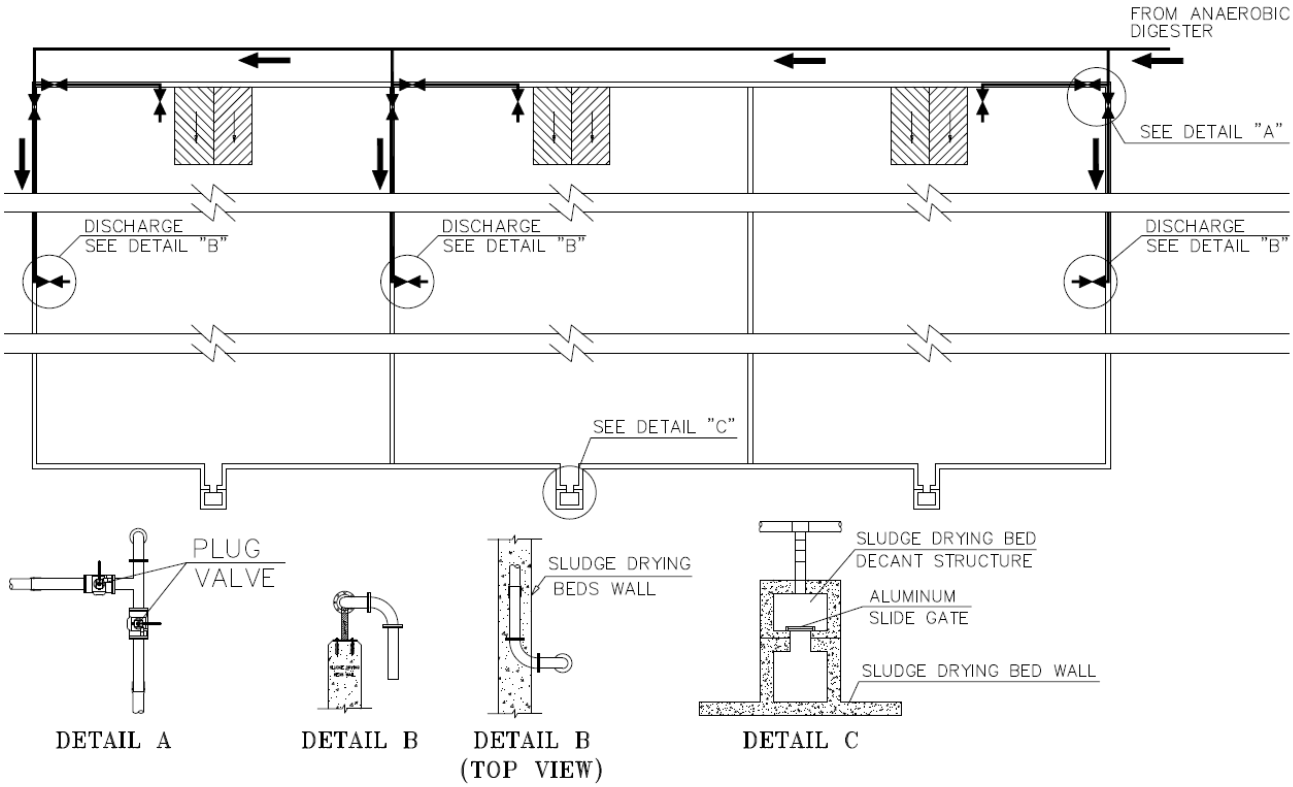
لماذا تجفيف؟

تشكل المياه الجزء الأكبر من الحمأة. تكلفة معالجة الحمأة في المحطات تنخفض بشكل كبير إذا تم تقليل محتواها المائي.

DRYING BEDS

Equipment

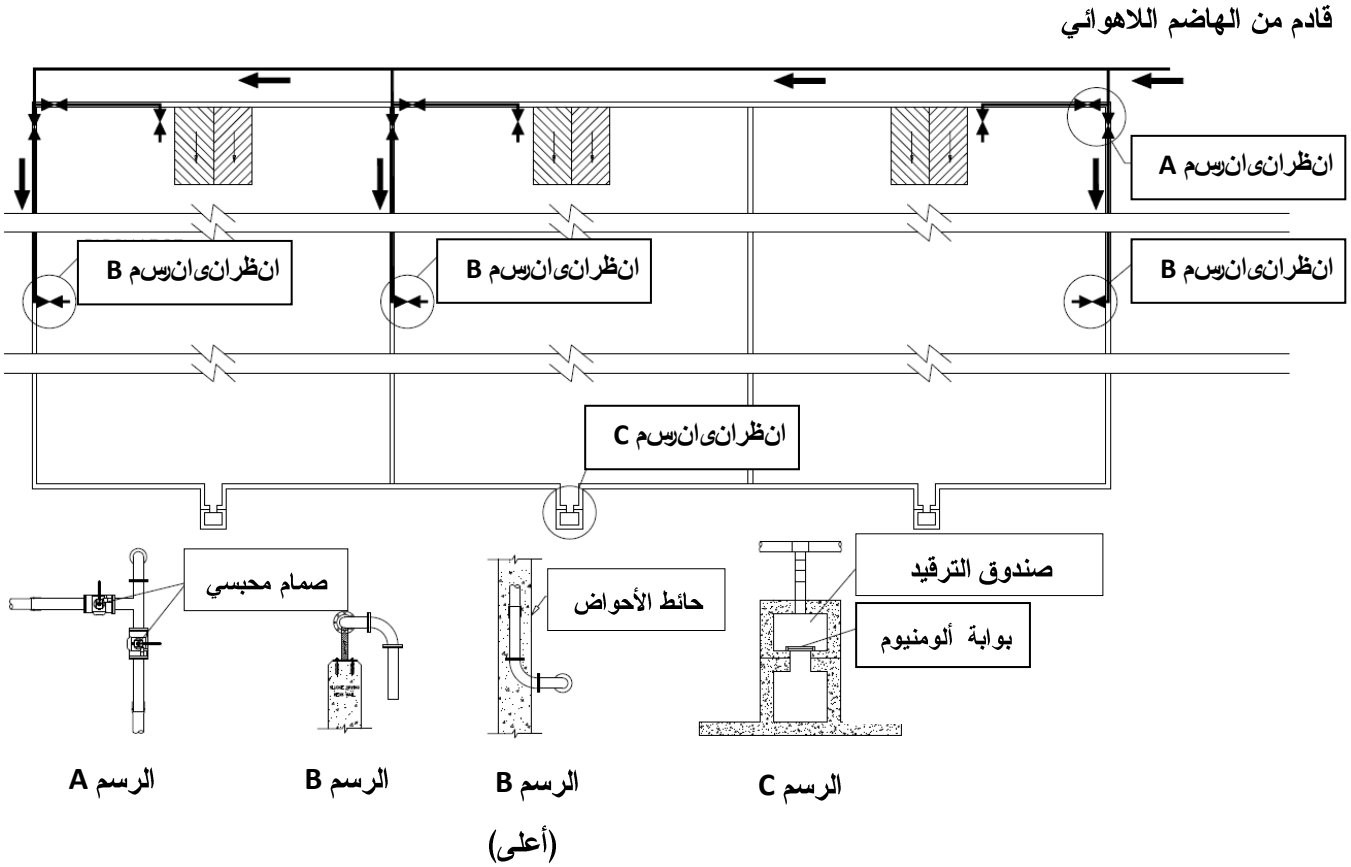
A drying bed is a cell that is constructed to hold 400m^3 of digested sludge at a depth no greater than 30 cm. Each cell is equipped with a solid concrete bottom.



أحواض التجفيف

المعدات

وحدة التجفيف هي خلية مبنية لتحمل ٤٠٠ متر مكعب من الحمأة المهضومة على عمق لا يزيد عن ٣٠ سم. كل خلية مزودة بقعرٍ من الإسمنت الصلب.



Operation

Operation of a drying bed is accomplished by simply filling to the 30 cm mark with digested sludge. This charging should be completed in one filling. The sludge is often allowed to dry. In addition to percolation, some of the water will evaporate from the sludge.

الشغيل

تتكون من سطح، يُجز عمم وحنج الجفُف تتم جرد مه ؤها حر ً إنزفاع ٣٠ سم تتراكم أج
الامه عمح. َ جة أن رَم هذا الش حه فعة واحنجنسُم ح ألوحال والاهيادالا فلُحت أن ذجف،
كما وس تُخر جزءٌ مه الماء.

Solids Production

If the weather conditions are right, drying beds can produce sludge that contains up to 25% solids.

انتاج الاهيادالصلبت

فٍ الظروف الاهيا خُح المؤاذُح، َمكه نهحذ اخ الجفُف الاهراج أوحالأ ذحر ىٌ عه ً ما َقارب
٢٥ % مه الاهيادالصلبح.

SLUDGE DISPOSAL

Third Step

The third step in solids handling is the disposal of the sludge.

سه ي الاحوأة

الخطوة الثالثت

الخ لحج الشلح فٍ معالجح الاهيادالصلبح هٍ الاخهص مه الاحمأج.

Common Methods

There are two methods of disposal available in Lebanon: land application and landfills. This section of the lesson provides information on these two methods.

الطرق الانعتمدة

الطرق الامعمفجفي ثنان نثحوان: الإنزعمالفي الأرلضي، أو الاقف في لك قنفي اخ.

LAND APPLICATION

Process

Land application of digested and dewatered sludge includes:

- Direct application on top of the land
- Use of the sludge as fertilizers for specific non-human consumption crops.

الاستعمال في الأراضي

يمكن استعمال الحمأة في الأراضي بطريقتين:

- طرحها مباشرة في الأراضي.

- استعمال الحمأة كأسمدة في مزارع الخضار غير المأكولة.

Composting

Composting sewage sludge can create a usable product that can be used to enrich poor soils or can be disposed of in landfill. However, the composing process must be carefully controlled and monitored.

التسميد

يمكن تسميد أو خلط الناتج من صرف الصحي أن يخلق منتجاً قابلاً للاستعمال، قادراً على إغناء التربة الفقيرة، أو يمكن التخلص منه في مطامر النفايات. إلا أن عملية التسميد يجب أن تراقب بعناية وتشكل مصدر حذر.

SOLIDS HANDLING WORKSHEET

معالجة المواد الصلبة ورقة عمل

1. Describe the following types of sludge

a. Primary sludge_____

b. Biological sludge _____

c. Scum _____

d. Screenings _____

١.صف الأنواع التالية من الحمأة:

أ- الحمأة الأولية _____

ب- الحمأة الثانوية _____

ج- الطافح _____

د- المصفاة _____

2. What are two major health and safety concerns associated with sludge disposal?

a. _____

b. _____

٢. سمِّ إثنان من المخاوف الرئيسية على الصحة والسلامة المرتبطتين برمي الحمأة.

أ- _____

ب- _____

3. The process unit used to collect and stabilize waste sludge is a _____.

٣. تعرف الوحدة المستعملة لتجميع وتثبيت الحمأة بـــ _____

4. The two reasons for sludge digestion are:

a. Reduction in _____ and

b. _____ stabilization.

٤. السببان وراء هضم الحمأة هما:

أ- تخفيض _____ و

ب- تثبيت _____ .

5. When the air is shut off to an aerobic digester the sludge will settle leaving a clear liquid at the top. This liquid is called the _____. The process of removing this liquid is called _____.

٥. عندما يوقف الخلط في الهاضم اللاهوائي، ستستقر الحمأة تاركة طبقة سائلة صافية في الأعلى. يعرف هذا السائل بـــ _____ ، كما وتعرف عملية إزالة هذا السائل بـــ _____.

6. A sludge stabilization process that uses an open tank is _____ _____ and requires approximately _____ days to complete.

٦. تستخدم عملية تثبيت الحمأة في الهاضم اللاهوائي مستوعباً مفتوحاً، وتتطلّب عملية الهضم هذه حوالي _____ يوماً لتكتمل.

7. _____ _____ is accomplished in the absence of oxygen and one of the byproducts is methane gas.

٧._____ _____يتم دون وجود الأكسجين و ينتج غاز الميثان من هذا التفاعل

8. Anaerobic decomposition will produce what by-products?

a. _____

b. _____

c. _____

٨. ما هي النواتج العرضية لعملية التحلل اللا هوائي؟

أ– _____

ب– _____

ج– _____

9. The primary reason for heating and mixing an anaerobic digester is to _____ the _____ of digestion.

٩. الهدف الرئيسي وراء مزج الهاضم هو _____ _____ الهضم

10. Before sewage sludge can be placed in a landfill for disposal the solids content must be at least _____%.

١٠. قبل رمي الحمأة في مكب دفن النفايات، يجب ان تصل نسبة المواد الصلبة إلى ما لا يقل عن _____ %.

11. In a sludge drying bed, water is removed from the sludge through two processes. These processes are:

a. _____

b. _____

١١. في وحدة تجفيف الحمأة الخاصة بهذه المحطة، تتم إزالة الماء من الحمأة بطريقتين هما:

أ- _____

ب- _____

12. List four sludge disposal processes:

a. _____

b. _____

c. _____

d. _____

١٢. سمِّ الطرق الأربعة المعتمدة للالتخلص من الحمأة:

أ- _____

ب- _____

ج- _____

د- _____

WASTEWATER DISINFECTION

WHAT IS IN THIS LESSON?

1. Introduction
2. Disinfection
3. Chlorine
4. Chlorine Properties And Chemistry
5. Hypochlorites
6. Chlorine Terms
7. Chlorine Chemistry - Briefly
8. Chlorine Facilities
9. Hypochlorite Systems
    - 9.1. Hypochlorites
    - 9.2. Sodium Hypochlorite
10. Hypochlorinator Feed Equipment
11. Routine Operations And Records
12. Operational Considerations

تعقيم المياه المبتذلة

ماذا في هذا الدرس؟

١. مقدمة

٢. التعقيم

٣. الكلور

٤. خصائص الكلور وكيميائيته

٥. الهيبوكلورايت

٦. المسطلحات حول الكلور

٧. كيميائية الكلور – مختصر

٨. منشآت الكلور

٩. أنظمة الهيبوكلورايت

٩.١. الهيبوكلورايتات

٩.٢. هيبوكلورايت الصوديوم

١٠. معدات تلقيم الهايبوكلوريناتور

١١. العمليات والسجلات الروتينية

١٢. إعتبارات عملية

WASTEWATER DISINFECTION

INTRODUCTION

Lesson Content

In this lesson on the introduction to wastewater disinfection the focus will be on the reasons for disinfection, the basic theory associated with disinfection with chlorine and the mechanical components of the chlorine feed systems.

تعقيم المياه المبتذلة

مقدمة

محتويات الدرس

في هذا الدرس حول المقدمة إلى تعقيم المياه المبتذلة، سيكون التركيز متمحوراً على أسباب التعقيم، النظرية الأساسية المتعلقة بالتعقيم بواسطة الكلور، والمكونات الميكانيكية لنظام تلقيم الكلور.

DISINFECTION

Definition

Disinfection is defined as the process used to control pathogenic organisms found in wastewater effluent and digested sludges. Disinfection prevents the spread of waterborne disease and disease associated with contact with human waste of feces.

التعقيم

تعريف

التعقيم هو العملية التي تستعمل للسيطرة على الكائنات الممرضة المتواجدة داخل المياه المبتذلة، والأوحال المهضومة. التعقيم يمنع إنتشار الأمراض التي تنتقل عبر الماء أو الأمراض المرتبطة بنفايات الإنسان أو البراز.

Goal

The goal of proper disinfection in a wastewater system is to destroy all disease causing organisms in order to protect downstream users of the water.

الهدف

إن الهدف وراء التعقيم في نظام معالجة المياه المبتذلة هو القضاء على الكائنات المسببة للأمراض، وذلك لحماية مستهلكي المياه الجارية.

How Do We Measure Effectiveness?

The effectiveness of disinfection in a wastewater system is measured by testing for the presence of fecal coliform bacteria. Fecal coliform bacteria that are found in wastewater are generally not pathogenic. They are indicators of contamination and the potential presence of pathogenic organisms. When they are present in low numbers, it is considered that the potential for pathogenic bacteria is low.

كيف يتم قياس فعالية

يتم قياس فعالية التعقيم في نظام معالجة المياه المبتذلة عبر إختبار وجود البكتيريا القولونية البرازية. لا يسبب هذا النوع من البكتيريا أي نوع من الأمراض عموماً، لكنها تعتبر مؤشراً للتلوث ولإمكانية وجود كائناتٍ مسببة للأمراض. عندما تتواجد البكتيريا القولونية البرازية بأعداد منخفضة، ذلك يشير إلى إنخفاض إمكانية وجود بكتيريا مسببة للأمراض.

CHLORINE

Background

Chlorine is the most common method used for disinfection of water, wastewater and swimming pools. Chlorine is produced as a gas, a liquid and a powder (the liquid and powder to chlorine are called hypochlorites). The addition of chlorine to wastewater effluent kills bacteria, viruses and protozoa.

الكلور

لمحة عامة

الكلور هو الأسلوب الأكثر إستعمالاً لتعقيم المياه، المياه المبتذلة، وأحواض السباحة. يُنتج الكلور بشكل غاز، سائل، وبشكل مسحوق (الكلور السائل والمسحوق يدعى هيبوكلورايت). إن إضافة الكلور إلى المياه المبتذلة كفيل بالقضاء على البكتيريا، الفيروسات، والبروتوزوا.

Equipment – Hypochlorination

In order to use powdered or liquid chlorine products (hypochlorites) they are commonly mixed into a tank and then fed into the system using a chemical feed pump.

المعدَات – المعالجة بالهيبوكلورايت

حتى نستطيع إستعمال الكلور السائل والمسحوق (هيبوكلورايت)، يتم عادة مزجها في مستوعب ومن ثم يتم تلقيمها إلى الجهاز بواسطة مضخة تلقيم كيميائية.

CHLORINE PROPERTIES AND CHEMISTRY

Chlorine Products

Chlorine for disinfection can be purchased as a solid, liquid or gas. Chlorine in its solid form is called calcium hypochlorite. It is available in powder or tablet form. Liquid chlorine or sodium hypochlorite is commonly known as bleach.

خصائص الكلور وكيميائيته

منتجات الكلور

يمكن شراء كلور التعقيم بشكل صلب، سائل أو غاز. يسمى الكلور الصلب هيبوكلورايت الكالسيوم، وهو متوفر بشكل مسحوق (بودرة) أو حبوب. أما الكلور السائل، أو هيبوكلورايت الصوديوم، فهو ما يعرفه الناس عامة بمبيض الغسيل.

HYPOCHLORITES

Two Hypochlorites

There are two hypochlorites used for the disinfection of wastewater, calcium hypochlorite and sodium hypochlorite.

الهيبوكلورايت

نوعان

هنالك نوعان من الهيبوكلورايت يستعملان لتعقيم المياه المبتذلة، هيبوكلورايت الكالسيوم وهيبوكلورايت الصوديوم.

Calcium Hypochlorites

Hypochlorites are produced by combining chlorine with either calcium or sodium. Calcium hypochlorites are either a powder or a tablet and can contain chlorine concentrations up to 67%. The powder or tablets must be dissolved in water.

هيبوكلورايت الكالسيوم

تنتج انواع الهيبوكلورايت عبر مزج الكلور إما مع الكالسيوم أو مع الصوديوم. يأتي هيبوكلورايت الكالسيوم بشكل مسحوق أو حبوب، ويمكن أن تحتوي على كلور مركز حتى ٦٧ %، يجب تذويب هذه الحبوب بالماء قبل إستعمالها.

Sodium Hypochlorite

Sodium hypochlorite is a liquid bleach. Sodium hypochlorite is found in concentrations up to 12.5%. Chlorine concentrations of household bleach range from 4.75% to 5.25%.

هيبوكلورايت الصوديوم

هيبوكلورايت الصوديوم هو مبيض سائل، وقد يصل تركيز الكلور حتى ١٢,٥ %. أما في المبيضات المنزلية الإستعمال، فقد يتراوح تركيز الكلور ما بين ٤,٧٥ % و ٥,٢٥ %

CHLORINE TERMS

Introduction

One of the major difficulties new operators have with the chlorination process is the understanding of the terms used to describe the various reactions and processes used in chlorination. The following is a brief description of the common terms used in chlorination.

المسطلحات حول الكلور

مقدمة

أحد أبرز الصعوبات التي يواجهها المشغلون الجدد في عملية المعالجة بالكلور هي فهم المسطلحات التي تشرح التفاعلات والعمليات المختلفة المستعملة في التعقيم بالكلور. من تلك المسطلحات نذكر التالي:

Dosage

Dosage is the amount of chlorine added to the system. The units used to describe dosage can be either milligram per liter (mg/L), kg per day or ppm (parts per million). The most common is mg/L.

الجرعة أو الكمية

الجرعة هي كمية الكلور التي تضاف إلى الجهاز. أما بالنسبة لوحدات قياس هذه الجرعات، فبالإجمال أكثر الوحدات إستعمالاً هي ملغ/ ل (ميليغرام/ليتر)، كما ويمكن قياسها بـــ كلغ / يوم ، أو بـــ ج / م (جزء / مليون) .

Demand

Demand is the amount of chlorine that is used by substances like nitrogen compounds, iron, manganese, algae and microorganisms in the water. As chlorine reacts with these substances, the quantity of chlorine available for disinfection drops. The quantity used by these substances is called demand. Demand, like dosage, is expressed in mg/L.

الحاجة أو الطلب

تمثل هذه الحاجة كمية الكلور التي تستعملها بعض المواد مثل مُركّبات النيتروجين، الحديد، المنغنيز، الطحالب والكائنات المجهرية المتواجدة في المياه. بينما يتفاعل الكلور مع هذه المواد، تنخفض كمية الكلور المخصصة للتعقيم. تسمى الكمية المستعملة من قبل هذه المواد بالحاجة أو الطلب. كما ويتم قياس الطلب كما الجرعة بـــ ملغ / ليتر.

Residual

Residual is the amount of chlorine remaining after the demand is satisfied. Residual, like dosage and demand, is expressed in mg/L. there are three types of residual; free, combined and total.

الفضلات

هي كمية الكلور المتبقية بعد إشباع الحاجة، ويتم قياسه كذلك بـــ ملغ/ليتر. هنالك ثلاثة أنواع من هذه الفضلات: الفضلات الحرة، الفضلات المركبة، الفضلات الأجمالية.

Free Residual

Free chlorine residual is the amount of chlorine as CL_2, hypochloros acid (HOCL) and the hypochlorite ion (OCl^-) in the water. Free chlorine is a stronger disinfectant than combined chlorine. In wastewater free residual is seldom detected and chlorine is usually in the combined residual form.

الفضلات الحرة

تتمثـــل بكميـــة الكلـــور بشـــكلCL_2، حـــامض هـــايبوكلوروس (HOCl) وأيـــون الهيبوكلورايت (OCl^-) في الماء. الكلور الحر هو معقم أقـــوى مـــن الكلـــور المشـــترك. نادراً ما يتم رصد الفضلات الحرة فـــي الميـــاه المبتذلـــة، بينمـــا يتواجـــد الكلـــور فيهـــا بالشكل المشترك.

Combined Residual

Combined residual is the result of combining free chlorine with nitrogen compounds such as ammonia. With typical chlorine residual test instruments we cannot test directly for combined chlorine residuals.

الفضلات المشتركة

الفضلات المشتركة هي نتيجة إتحاد الكلور الحر مع مُركّبات النيتروجين مثل الأمونيا. لا يتم رصد الفضلات المشتركة مباشرة بوسائل رصد الكلور المعتادة.

Total Residual

Total chlorine residual is the combination of free and combined residuals. Total residual can be determined directly with standard chlorine residual test kits. Total residual is the test required at the wastewater treatment facilities.

الفضلات الاجمالية

إن الفضلات الاجمالية هي مجموع الفضلات الحرة و المشتركة. يمكن تحديد الفضلات الاجمالية مباشرةً بواسطة عدة قياس فضلات الكلور العادية، وهو الإختبار المطلوب في منشآت معالجة المياه المبتذلة.

CHLORINE CHEMISTRY - BRIEFLY

Introduction

In order to explain the chlorination process it is necessary to have a basic understanding of the reactions of chlorine in water. The basic reaction is a two step process.

كيميائية الكلور – مختصر

مقدمة

لكي نفهم عملية التعقيم بالكلور، من الضروري أن يكون لدينا فكرة أساسية عن تفاعلات الكلور في الماء. فالتفاعل الأساسي هو عملية من خطوتين.

Hypochlorous Acid

When chlorine gas is added to pure water, the first reaction is the production of hypochlorous acid (HOCl), hydrogen and the chlorine ions. Hypochlorous acid is measured as free chlorine residual.

$$Cl_2 + H_2O \Leftrightarrow HOCl + H^+ + Cl^-$$

حامض هايبوكلوروس

عندما يضاف الغاز إلى الماء النقي، أول تفاعل هو تكوين حامض هايبوكلوروس (HOCl)، الهيدروجين وأيونات الكلور. حامض هايبوكلوروس يمكن قياسه كفضلات الكلور الحرة.

Hypochlorite Ion

In the second part of the reaction a portion of the hypochlorous acid disassociates (breaks apart) to form the hypochlorite ion (OCl^-), and hydrogen. The hypochlorite ion is also measured as free chlorine residual. When the PH of the waster is at 7.5 one half of the residual will be HOCl and one half will be OCl-

$$HOCl \Leftrightarrow H^+ + OCl^-$$

أيون الهيبوكلورايت

في القسم الثاني من التفاعل، ينقسم جزء من حامض هايبوكلوروس ليشكل أيون الهيبوكلورايت (OCl^-)، والهيدروجين. يتم قياس أيون الهيبوكلورايت كذلك كباقي كلور حر. عندما تنخفض نسبة تركيز الهيدروجين في الماء إلى ٧.٥ ، نصف الباقي سيصبح ($HOCl$) والنصف الآخر سيصبح (OCl^-).

$$HOCl \Leftrightarrow H^+ + OCl^-$$

Nitrogen Compounds

Nitrogen compounds present in the wastewater combine with hydrochlorous acid to form chemical compounds called chloramines. Nitrogen compounds include inorganic nitrogen compounds such as ammonia and organic nitrogen compounds like protein and amino acids.

مُرَكَّبات النيتروجين

تتحد مركبات النيتروجين في المياه المبتذلة مع حامض هايبوكلوروس لتشكِّل مُرَكَّبات كيميائية تدعى الكلورامينات. تضم مُرَكَّبات النيتروجين مُرَكَّبات غير عضوية مثل الأمونيا و مُرَكَّبات عضوية مثل البروتين والأحماض الأمينية.

Free to Combined

In the chemical reactions shown above, free chlorine (HOCl) is the first component produced. Combined chlorine residuals only occur after the free chlorine is produced. However, the reaction between the free chlorine and nitrogen compounds is so quick that we are unable to observe free chlorine in a test sample. Only after the demand (reactions with ammonia, turbidity, iron, manganese, microorganisms and other organic nitrogen compounds) has been

satisfied will the free chlorine become available. Because of the amount of ammonia in most wastewater effluents, the demand will be so high that free chlorine will not last longer than a few seconds.

من حر إلى مشترك

في التفاعلات الكيميائية المبيَّنة أعلاه، الكلور الحر (HOCl) هو أول مُرَكَّب يُنتج عنها. لا يُنتج باقي الكلور المشترك إلا من بعد ما يُنتج الكلور الحر. يحصل التفاعل بين الكلور الحر و مُرَكَّبات النيتروجين بسرعة كبيرة بحيث لا نستطيع ملاحظة الكلور الحر في عَيِّنة إختبار. لن يصبح الكلور الحر متوفراً إلا بعد إشباع الحاجة (التفاعلات مع الأمونيا، العكارة، الحديد، المنغنيز، الكائنات المجهرية ومُرَكَّبات نيتروجين عضوية أخرى). بسبب كميات الأمونيا الموجودة في معظم مجاري المياه المبتذلة، الحاجة ستكون كبيرة جداً لدرجة ان الكلور الحر لن يدوم لأكثر من ثواني قليلة.

Residual Requirements

Because of the quantity of ammonia in wastewater, it is not practical to inject enough chlorine to provide a free chlorine residual. Therefore, combined chlorine residuals are the common disinfection compounds used in wastewater treatment disinfection process. Combined residuals cannot be tested for directly. Therefore, it is common practice to test for total chlorine residual. In order to maintain an effective line of defense against pathogenic organisms, a total chlorine residual, at the point where the effluent exits the chlorine contact chamber, is usually maintained. Two important criteria for disinfection are contact time and chlorine residual concentration. When the contact time is low it is necessary to increase the residual.

إحتياجات افضلات

بسبب كمية الأمونيا في المياه المبتذلة، لن يكون حقن المزيد من الكلور لتأمين فضلات كلور الحرة عملياً. لذا، فضلات الكلور المشتركة هي من مُركَّبات التعقيم الأكثر إستعمالاً في عمليات تعقيم ومعالجة المياه المبتذلة. بما أنه لا يمكن إختبار وجود الفضلات المشتركة مباشرةً، فمن المعتمد إختبار وجود بقايا الكلور الاجمالية. لكي نحافظ على خط دفاع فعال ضد الكائنات الممرضة، يتم المحافظة عادةً على بقايا الكلور الاجمالية عند نقطة خروج المجرى من حجرة الإلتحام مع الكلور. هنالك صفتان مهمتان يجب ان تتميز بهما عملية التعقيم، هما: فترة الإلتحام، ومدى تركيز فضلات الكلور. عندما تكون فترة الإلتحام قصيرة، من الضروري أن تُرفع نسبة الفضلات.

Type of Residual

As we discussed above, free chlorine residual is the best of the disinfectants. However, due to practical limitations, combined residuals are used in wastewater. A typical wastewater effluent will have between 0.5 and 1.5 mg/L total chlorine residual. However, system limitations may require a higher residual than stated.

نوعية الفضلات

كما وصفنا سالفا، الكلور الحرة هي أفضل المعقِّمات نوعيةً. ولكن وبسبب قصور عملية، يتم إستعمال الفضلات المشتركة في المياه المبتذلة. يحتوي مجرى المياه المبتذلة النموذجي على ما بين ٠,٥ و ١,٥ ملغ / ليتر من فضلات الكلور الاجمالية. بأي حال، قصور هذا النظام قد تتطلّب فضلات أكثر من المطلوب.

Interfering Agents

Minerals, such as iron and manganese, combine with chlorine and increase the demand. Turbidity uses chlorine and provides a place for microorganisms to hide. Organic materials, such as leaves, combine with chlorine increasing the demand and reducing the residual.

العوامل المؤثرة

تتحد المعادن، كالحديد والمنغنيز، مع الكلور وترفع الحاجة أو الطلب. تستعمل العكارة الكلور وتؤمن بيئة مناسبة لإختباء الكائنات المجهرية. تتحد المواد العضوية مثل أوراق الشجر مع الكلور، رافعةًالحاجة أو الطلب، ومخفِّضةً الفضلات.

Contact Time

One of the key items in predicting the effectiveness of chlorine on microorganisms is contact time. Typical contact time in a chlorine contact chamber will range between 20 minutes and 30 minutes.

فترة الإلتحام

أحد المعايير الأساسية في توقع فعالية الكلور على الكائنات المجهرية هو فترة الإلتحام. فترة الإلتحام النموذجية في حجرة الإلتحام بالكلور تتراوح ما بين ٢٠ و ٣٠ دقيقة.

CHLORINE FACILITIES

Application Point

Chlorine disinfectants need time to react and are introduced in a wastewater treatment plant after all other treatment has been completed. Chlorine is introduced in a tank called the

chlorine contact chamber. This chamber is designed to maximize contact time between the chlorine and the pathogenic organisms.

منشآت الكلور

موقع التطبيق

معقمات الكلور تحتاج وقتاً لتتفاعل، وهي تستعمل في محطة تكرير المياه المبتذلة بعد إكمال كل المعالجات الأخرى. يُدخل الكلور في خزان يُدعى حجرة الإلتحام بالكلور. صُمِّمت هذه الحجرة لتطيل فترة الإلتحام بين الكلور والكائنات الممرضة.

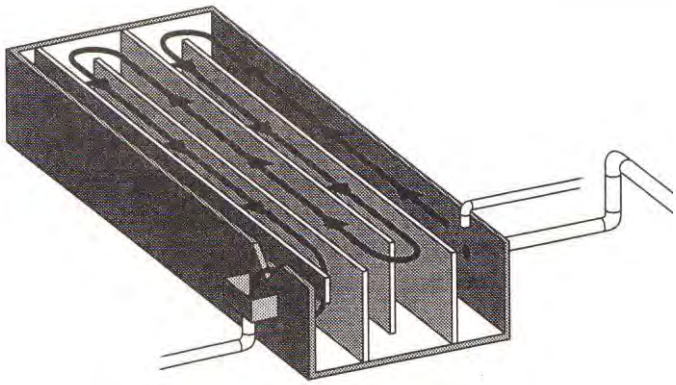
Contact Chamber Shape

To prevent short circuiting in the chamber and to provide the maximum contact time with the least amount of turbulence, chlorine contact chambers are designed so the flow snakes through them. This provides what is called plug flow through the chamber.

شكل حجرة الإلتحام

لمنع الفروقات في سرعة التدفق داخل الحجرة، ولتأمين الإلتحام الأقصى بأقل الإرتجاجات، صُمِّمت حجرات الإلتحام بالكلور بشكلٍ يسمح للجدول بالمرور من خلالها بشكل ملتوي كالأفعى. هذا يمنحنا ما يسمى بالدفق الثابت خلال هذه الحجرة.

Typical Chlorine Contact Basin Shape, with Plug Flow Lines



الشكل النموذجي لحوض الإلتحام بالكلورين،
حيث نرى مسار المياه المتعوج

HYPOCHLORITE SYSTEMS

HYPOCHLORITES

CALCIUM HYPOCHLORITE

Handling Calcium Hypochlorites

When mixing calcium hypochlorite the operator must wear chemical safety goggles, a cartridge respirator and rubberized gloves. Partially fill the vat with water before you add the powder. Placing powder into the vat first and then adding water could cause an explosion.

أنظمة الهيبوكلورايت

الهيبوكلورايتات

هيبوكلورايت الكالسيوم

كيفية التعاطي مع هيبوكلورايت الكالسيوم

عند مزج هيبوكلورايت الكالسيوم، يتوجب على العامل إرتداء نظارات حماية كيميائية، قناع للتنفس وقفازات مطّاطية. يجب وضع القليل من الماء في الوعاء قبل إضافة المسحوق، إذ أنه لو أضيف المسحوق أولاً ومن ثم الماء، قد يتسبب ذلك بإنفجار.

Storing Calcium Hypochlorite

Calcium hypochlorite should be stored in a cool, dry room away from oil, gas and other organic material. Calcium hypochlorite will ignite and burn at 350°F. Make sure the lid is closed tightly, check the container for cracks.

تخزين هيبوكلورايت الكالسيوم

يجب تخزين هيبوكلورايت الكالسيوم في غرفةٍ باردة وجافة، بعيداً عن الزيت، الغاز وغيرها من المواد العضوية. يشتعل هيبوكلورايت الكالسيوم على حرارة ٣٥٠ درجة فهرنهايت. يجب التأكد من إحكام إغلاق الغطاء، كما ويجب فحص المستوعب بحثاً عن أي شقوق.

SODIUM HYPOCHLORITE

Handling Sodium Hypochlorites

When mixing sodium hypochlorites the operator must wear chemical safety goggles and rubberized gloves.

هيبوكلورايت الصوديوم

كيفية التعاطي مع هيبوكلورايت الصوديوم

عند مزج هيبوكلورايت الصوديوم، يتوجب على العامل إرتداء نظارات حماية كيميائية، وقفازات مطّاطية.

HYPOCHLORINATOR FEED EQUIPMENT

Basic Equipment

The most common hypochlorinator system is composed of a 20 to 50 gallon plastic tank in which a hypochlorite solution is mixed. This solution is pumped into the system using a chemical feed pump.

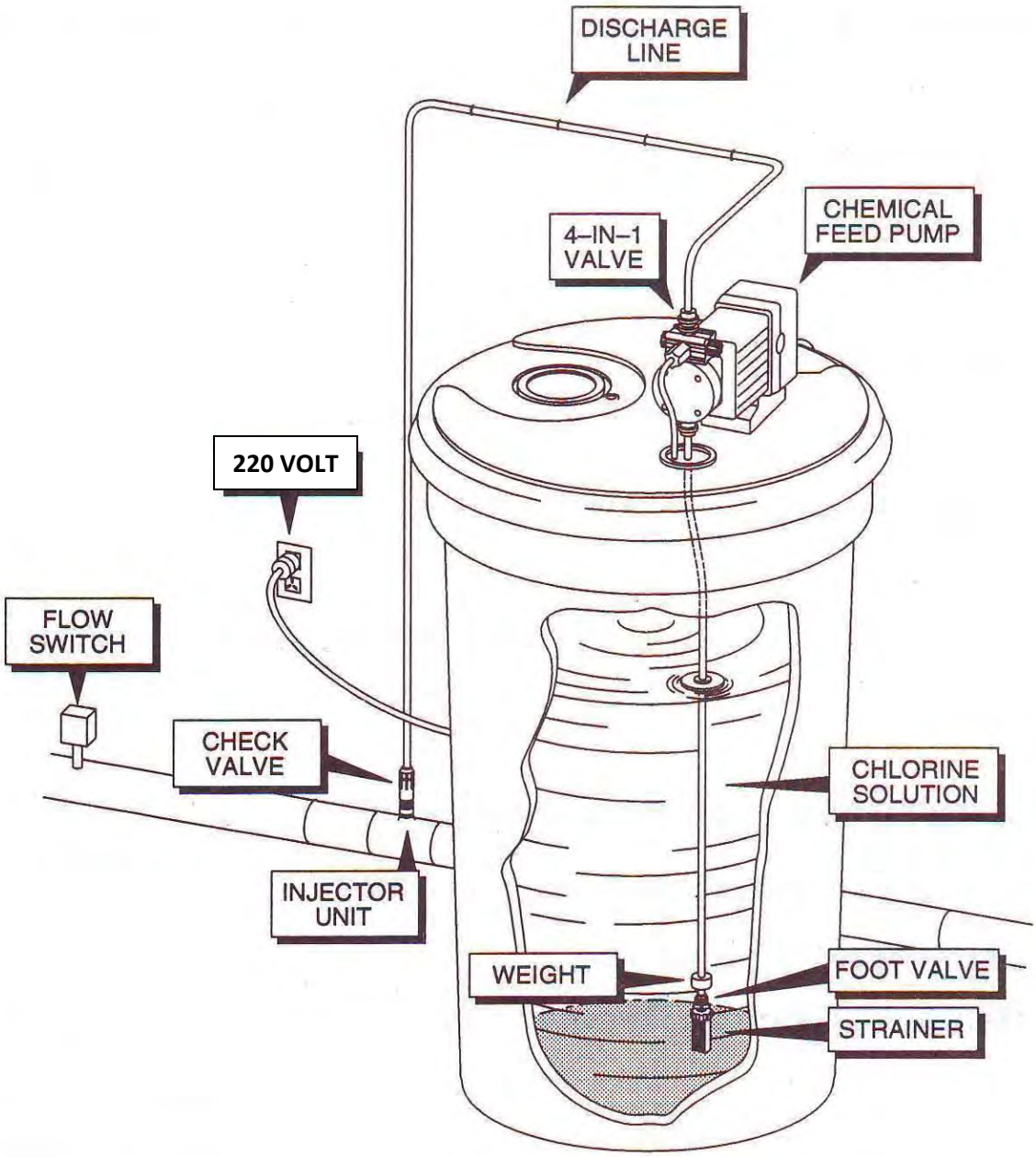
معدات تلقيم الهايبوكلوريناتور

المعدات الأساسية

إن أنظمة الهايبوكلوريناتور الأكثر شيوعاً تتكون من خزاناً بلاستيكياً تتراوح سعته ما بين ال٢٠ وال ٥٠ غالوناً، حيث يتم مزج محلول الهيبوكلورايت. يتم ضخ هذا المحلول إلى الجهاز عن طريق مضخة تلقيم كيميائية.

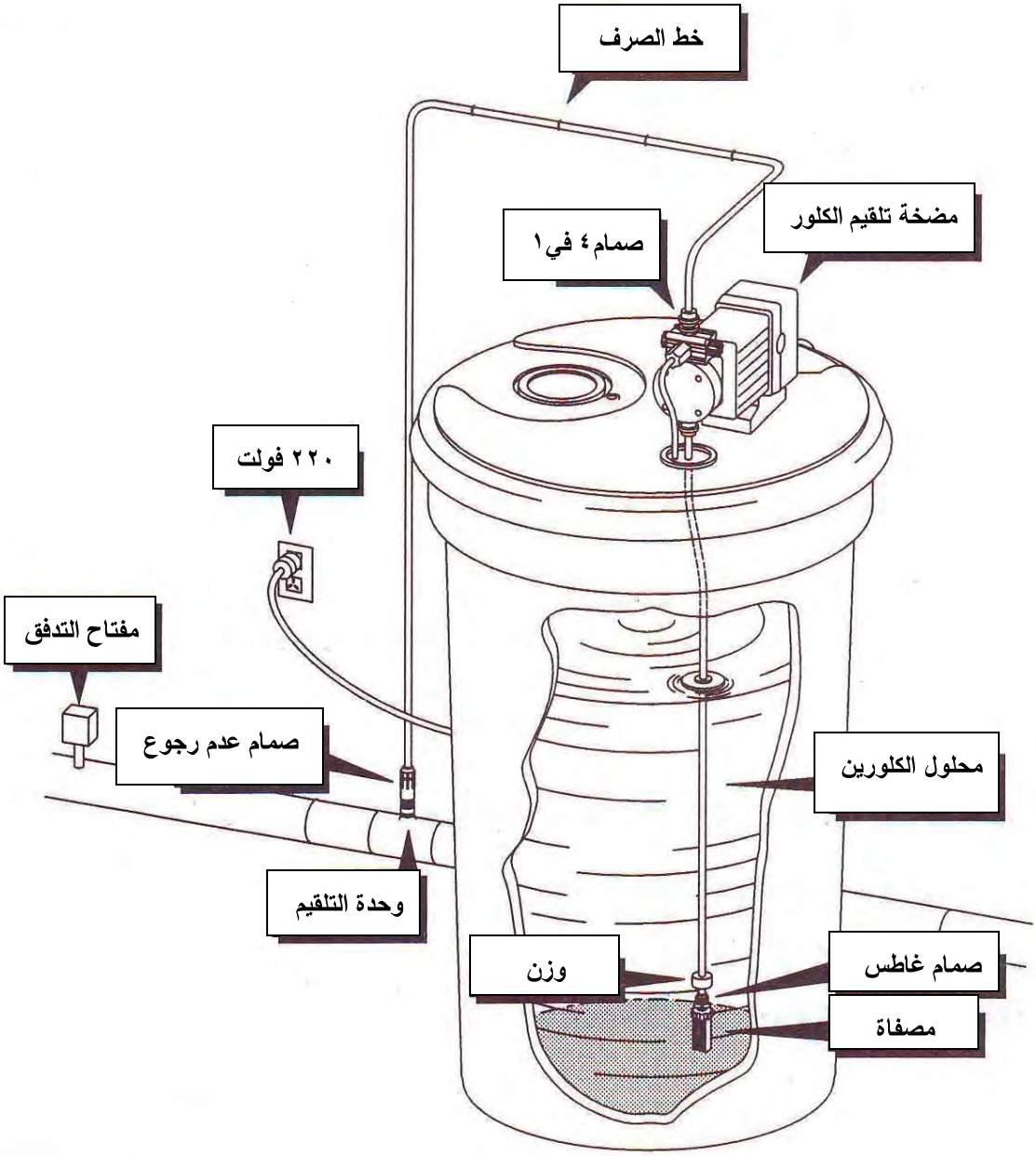
Piping System

To protect the pump, a strainer is placed on the end of the suction line. Also on the suction line is a weight and foot valve. The weight keeps the line in the solution and the foot valve helps to maintain the prime on the pump. On the end of the discharge line is another valve. This check valve prevents the water in the system from flowing back into the mixing tank.



الأنابيب

لحماية المضخة، يتم وضع مصفاة في آخر خط الإمتصاص. كما ويوضع على هذا الخط وزناً وصمام سفلي. يساعد الوزن في إبقاء الخط داخل المحلول كما ويساعد الصمام السفلي في إبقاء خرطوم السحب ممتليء بالمحلول قبل المضخة. كما ويوجد صمام آخر على آخر خط الخروج. يمنع هذا الصمام المحلول داخل الجهاز من العودة إلى خزان المزج.



ROUTINE OPERATIONS AND RECORDS

1. Check routine residual – daily
2. Determine quantity of chlorine used – daily
3. Determine the chlorine dosage – daily
4. Clean injector and ball valves – monthly
5. Rebuild pump, clean and replace gaskets – annually
6. Replace foot and diffuser check valves – annually
7. Clean injector and pump check valves as needed.

العمليات والسجلات الروتينية

١– فحص فضلات الكلور – يومياً.

٢– تحديد كمية الكلور المستعملة – يومياً.

٣– تحديد جرعة الكلور – يومياً.

٤– تنظيف الحاقن والصمامات – شهرياً.

٥– إعادة تركيب المضخة، تنظيف وإستبدال جلود العزل – سنوياً.

٦– إستبدال الصمام السفلي وصمام مراقبة الموزع – سنوياً.

٧– تنظيف صمام الحاقن وصمام مراقبة المضخة عند الحاجة.

OPERATIONAL CONSIDERATIONS

Chlorine Residual

When chlorine is used as a disinfectant, it is desirable to keep the amount of chlorine entering a receiving stream at a minimum and at the same time provide disinfection. Therefore, effective operations would be to maintain as low a residual as possible without exceeding the fecal coliform requirements.

إعتبارات عملية

فضلات الكلور

عندما يستعمل الكلور كمعقم، من الأفضل إبقاء كمية الكلور التي تدخل مجرى الدخول عند الحد الأدنى، وفي الوقت نفسه تأمين التعقيم. لذا، العمليات تُعتبر فعّالة عندما تحافظ على مستوى منخفض من الفضلات قدر الإمكان، شرط عدم تخطي إحتياجات البكتيريا البرازية القولونية.

Chlorine and the Environment

Chlorine can be deadly to fish and other aquatic life. For instance salmon fry can be killed with chlorine levels of as little as 6 µg/L (micrograms per liter).

الكلور والبيئة

قد يكون الكلور مميتاً للأسماك وغيرها من المخلوقات البحرية. فصغار أسماك السلمون على سبيل المثال قد تقتل بسبب وجود الكلور، على مستويات منخفضة حتى ٦ ميكروغرام/ ليتر.

WASTEWATER DISINFECTION WORKSHEET

1. Wastewater is disinfected in order to prevent _____.

١. يتم تعقيم المياه المبتذلة للحد من _____.

2. The tank used to provide contact time for disinfection in a wastewater treatment plant is called the _____ _____ chamber.

٢. الحوض الذي يستعمل لتعقيم المياه المبتذلة يسمى _____.

3. What does mg/L stand for? Is it the same as PPM?

٣. ماذا نعني بال(mg/l)؟ هل يساوي هذا المقياس ال(ppm) أو الجزء في المليون؟

4. The quantity of a chemical added to the water is called the _____. The quantity of a chemical used in a reaction is called the _____, and the quantity of chemical remaining after the reaction is called the _____.

٤. تسمى الكمية من المواد اكيميائية المضافة إلى المياه بال _____. الكمية المستخدمة في تفاعل كيميائي تسمى_____ و الكمية الفاضلة تسمى _____.

5. _____ time is the length of time water is kept in a basin.

٥. وقت ال _____ هو الوقت الذي تبقى فيه المياه في حوض ما.

6. Define disinfection: _____.

٦. عرف عن التعقيم: _____.

7. The ultimate test for disinfection is a bacteriological test for the _____ _____ bacteria.

٧. الفحص الأهم للكشف عن فعالية التعقيم هو فحص باكتيرولوجي للباكتيريا _____.

8. List four items that affect the germicidal efficiency of chlorine.

a. _____

b. _____

c. _____

d. _____

٨. عرف عن الأسباب الأربعة لإستعمال الكلورين كمعقم:

أ-_____

ب-_____

ج-_____

د-_____

9. Typical detention time in a chlorine contact chamber ranges between _____ and _____ min.

٩. يكون وقت الإحتجاز في حوض الكلورين بين ال _____ و ال _____ دقيقة.

10. There are two hypochlorites used to disinfect water: _____ hypochlorite which is commonly a liquid and _____ hypochlorite which is commonly a powder.

١٠. ما هما نوعا الهيبوكلوريت التي تستخدم في التعقيم؟

السائلة: _____.

المطحونة:_____.

11. When a chlorine residual is required in wastewater effluent, the type of residual tested for is commonly _____ chlorine residual.

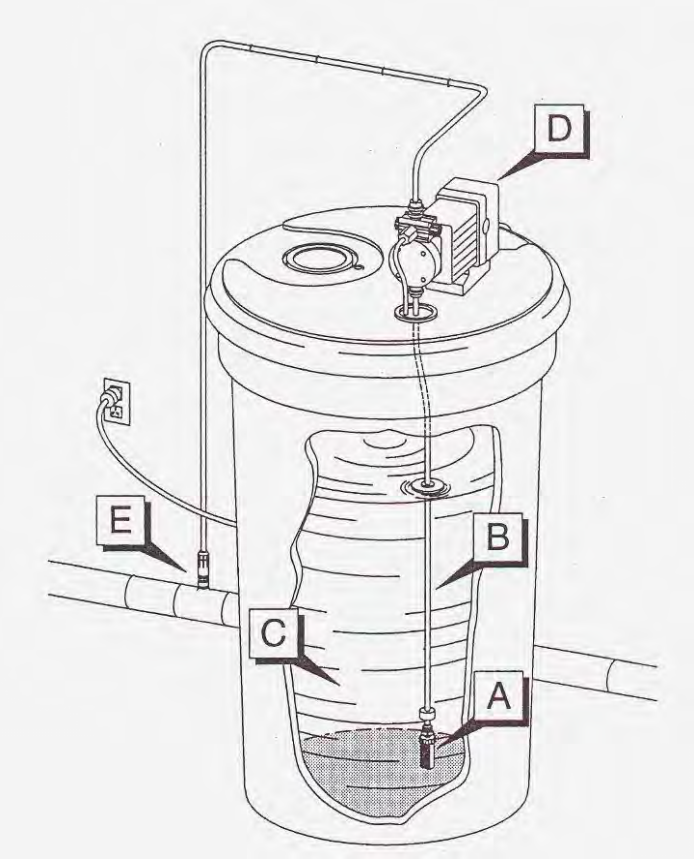
١١. عندما يحتاج الدفق الخارجي إلى فضلات من الكلورين، يجب إستعمال فحص الفضلات ال_____ للكلورين

12. The best PH range for disinfection is between _____ and _____.

١٢. ما هو المدى الأفضل للأس الهيدروجيني للحصول على تعقيم مناسب؟
من_____ إلى _____.

13. From the drawing, identify the items indicated to the list.

١٣. عرف عن الأجزاء المشار إليها في الرسم التالي:



A. _____ أ.

B. _____ ب.

C. _____ ج.

D. _____ د.

E. _____ ه.

APPENDIX B

Training Materials
Village WWTPs – Facility O&M Manuals

Aitanit WWTP O&M Manual

Facility O&M Manual – Volume-1
Unit Process Operation

TOC	Table of Contents
Chapter-1	Introduction to the O&M Manual
Chapter-2	WWTP Process Overview
Chapter-3	Preliminary Treatment
Chapter-4	Primary Treatment and sludge pumping
Chapter-5	Trickling Filter
Chapter-6	Secondary Clarification
Chapter-7	Disinfection System
Chapter-8	Anaerobic Digestion System
Chapter-9	Sludge Drying Beds
Chapter-10	Septage Receiving Pump Station
Chapter-11	Plant Water Booster Pump Station
Chapter-12	Sampling and Analysis Procedures
Chapter-13	WWTP Employee Safety Handbook
Chapter-14	WWTP Operator Job Description
Chapter-15	Guidelines for Hiring an O&M Service Contractor
Appendices	
Appendix-A	Brentwood Media System - O&M Manual
Appendix-B	Operator Standard Report Forms
Appendix-C	Facility O&M Budget Tables
Appendix-D	Equipment Warranty Certificates
Appendix-E	Spare Parts Inventory list
Appendix-F	Workshop Tools Inventory list
Appendix-G	Safety Equipment Inventory List
Appendix-H	Lebanees Effluent and Sludge Reuse Rules
Appendix-I	PID - Full Size Drawing
Appendix-J	Facility Yard Piping - Full Size Drawing
Appendix-K	Plant Hydraulic Profile - Full Size Drawing

Facility O&M Manual – Volume-2
Equip. Vendor O&M Manuals

Book-1	Plant Water Sys, Chem. Feed Pumps, Slide Gates, Sludge Pumps, Submersible Pumps, Static Screen, Rotary Arm Distributor, TF Media.
Book-2	Fire alarm sys, Laboratory equip., Valves, TF Fans, Portable pump, safety equip., Miscellanous Equip.
Book-3	Standby Power Generator, Electrical Components

Facility O&M Manual – Volume-3
Training Lessons - English & Arabic

Lesson-1	Introduction to Wastewater Systems
Lesson-2	Characteristics of Wastewater
Lesson-3	Treatment Techniques
Lesson-4	Sludge Treatment and Disposal
Lesson-5	Disinfection

Facility O&M Manual – Volume-4
Maintenance Management System

Part-1	MMS Description and Explanation Doc.
Part-2	Equipment Service Cards
Part-3	Maintenance Task and schedule master table
Part-4	WWTP Equipment Inventory Listing
Part-5	Tool and Workshop Equipment List
Part-6	Spare Parts List

Fourzol WWTP O&M Manual

Facility O&M Manual – Volume-1
Unit Process Operation

TOC	Table of Contents
Chapter-1	Introduction to the O&M Manual
Chapter-2	WWTP Process Overview
Chapter-3	Preliminary Treatment
Chapter-4	Primary Treatment and sludge pumping
Chapter-5	Trickling Filter
Chapter-6	Secondary Clarification
Chapter-7	Disinfection System
Chapter-8	Anaerobic Digestion System
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Chapter-10	Septage Receiving Pump Station
Chapter-11	Plant Water Booster Pump Station
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Appendix-K	Plant Hydraulic Profile - Full Size Drawing

Facility O&M Manual – Volume-2
Equip. Vendor O&M Manuals

Book-1	Plant Water Sys, Chem. Feed Pumps, Slide Gates, Sludge Pumps, Submersible Pumps, Static Screen, Rotary Arm Distributor, TF Media.
Book-2	Fire alarm sys, Laboratory equip., Valves, TF Fans, Portable pump, safety equip., Miscellanous Equip.
Book-3	Standby Power Generator, Part-1
	Standby Power Generator, Part-2

Facility O&M Manual – Volume-3
Training Lessons - English & Arabic

Lesson-1	Introduction to Wastewater Systems
Lesson-2	Characteristics of Wastewater
Lesson-3	Treatment Techniques
Lesson-4	Sludge Treatment and Disposal
Lesson-5	Disinfection

Facility O&M Manual – Volume-4
Maintenance Management System

Part-1	MMS Description and Explanation Doc.
Part-2	Equipment Service Cards
Part-3	Maintenance Task and schedule master table
Part-4	WWTP Equipment Inventory Listing
Part-5	Tool and Workshop Equipment List
Part-6	Spare Parts List

Ablah WWTP O&M Manual

Facility O&M Manual – Volume-1
Unit Process Operation

TOC	Table of Contents
Chapter-1	Introduction to the O&M Manual
Chapter-2	WWTP Process Overview
Chapter-3	Preliminary Treatment
Chapter-4	Primary Treatment and sludge pumping
Chapter-5	Trickling Filter
Chapter-6	Secondary Clarification
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Facility O&M Manual – Volume-3
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Lesson-1	Introduction to Wastewater Systems
Lesson-2	Characteristics of Wastewater
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Lesson-4	Sludge Treatment and Disposal
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Facility O&M Manual – Volume-4
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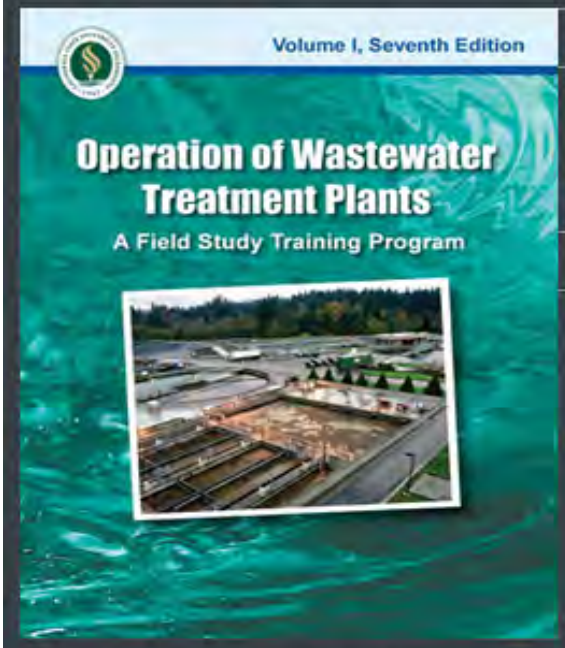
Part-1	MMS Description and Explanation Doc.
Part-2	Equipment Service Cards
Part-3	Maintenance Task and schedule master table
Part-4	WWTP Equipment Inventory Listing
Part-5	Tool and Workshop Equipment List
Part-6	Spare Parts List

APPENDIX C

Training Materials
Student Reference Books

Operation of Wastewater Treatment Plants, Volume I



Objective

Add to cart

This course is designed to train operators to safely and effectively operate and maintain wastewater treatment plants.

Scope

This course is designed to train operators in the practical aspects of operating and maintaining wastewater treatment plants, emphasizing the use of safe practices and procedures. Information presented includes the role and responsibilities of a treatment plant operator, an explanation of why wastes must be treated, and detailed descriptions of the equipment and processes used in a wastewater treatment plant. Operators learn to operate and maintain racks, screens, comminutors, sedimentation tanks, trickling filters, rotating biological contactors, package activated sludge plants, oxidation ditches, ponds, and chlorination facilities. Operators also learn to analyze and solve operational problems and to perform mathematical calculations relating to wastewater treatment process control.

Table of Contents

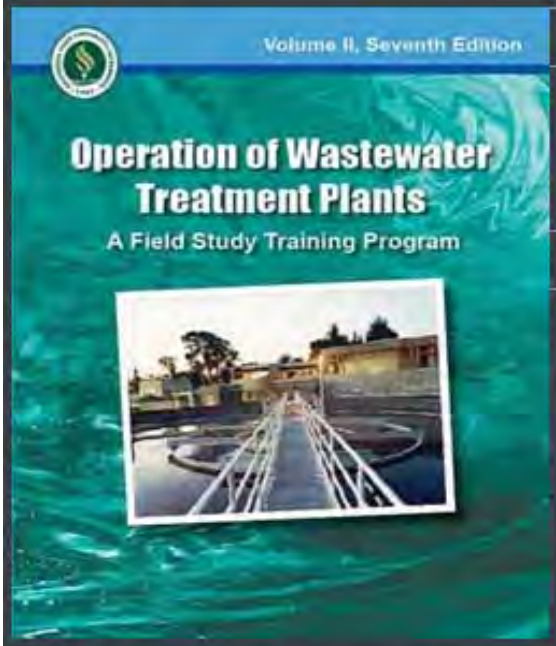
Learning Objectives (Click chapter title to open)

1. The Treatment Plant Operator
2. Why Treat Wastes?
3. Wastewater Treatment Facilities
4. Racks, Screens, Comminutors, and Grit Removal
5. Sedimentation and Flotation
6. Trickling Filters
7. Rotating Biological Contactors
8. Activated Sludge (Package Plants and Oxidation Ditches)
9. Wastewater Stabilization Ponds
10. Disinfection Processes

Appendix:

- Comprehensive Review Questions and Suggested Answers
- How to Solve Wastewater Treatment Plant Arithmetic Problems
- Wastewater Words
- Subject Index

Operation of Wastewater Treatment Plants, Volume II



Objective

Add to cart

This course is designed to train operators to safely and effectively operate and maintain wastewater treatment plants (continuation of Volume I).

Scope

This course is designed to train operators in the practical aspects of operating and maintaining wastewater treatment plants, emphasizing safe practices and procedures. Topics covered include conventional activated sludge processes, sludge digestion and solids handling, effluent disposal, plant safety and good housekeeping, plant and equipment maintenance, laboratory procedures and chemistry, use of computers for plant operation and maintenance, analysis and presentation of data, and records and report writing. Operators also learn to analyze and solve operational problems and to perform mathematical calculations relating to wastewater treatment process control.

Table of Contents

Learning Objectives (Click chapter title to open)

11. **Activated Sludge (Operation of Conventional Activated Sludge Plants)**
12. **Sludge Digestion and Solids Handling**
13. **Effluent Discharge, Reclamation, and Reuse**
14. **Plant Safety**
15. **Maintenance**
16. **Laboratory Procedures and Chemistry**
17. **Applications of Computers for Plant O&M**
18. **Analysis and Presentation of Data**
19. **Records and Report Writing**
20. **Treatment Plant Administration**

Appendix:

- Comprehensive Review Questions and Suggested Answers
- How to Solve Wastewater Treatment Plant Arithmetic Problems
- Wastewater Words
- Subject Index

Operation and Maintenance of Wastewater Collection Systems, Volume I

Objective

Add to cart

This course is designed to train personnel to safely and effectively operate and maintain wastewater collection systems.

Scope

This course is designed to train operators in the practical aspects of operating and maintaining wastewater collection systems, emphasizing safe practices and procedures. Information is presented on the importance and responsibilities of a collection system operator, the need for collection system O&M, and the components and typical layouts of collection systems. Operators learn safety procedures for construction, inspection and testing of sewers, inspection of manholes, and underground construction and repair. Detailed instructions are included for using closed-circuit television, clearing stoppages, cleaning sewers, and controlling roots, grease, odors, and corrosion in collection systems. This course focuses on the knowledge and skills operators need to identify actual collection system problems and select appropriate methods to solve them. Operators also learn to solve arithmetic problems relating to the operation and maintenance of wastewater collection systems.

Table of Contents

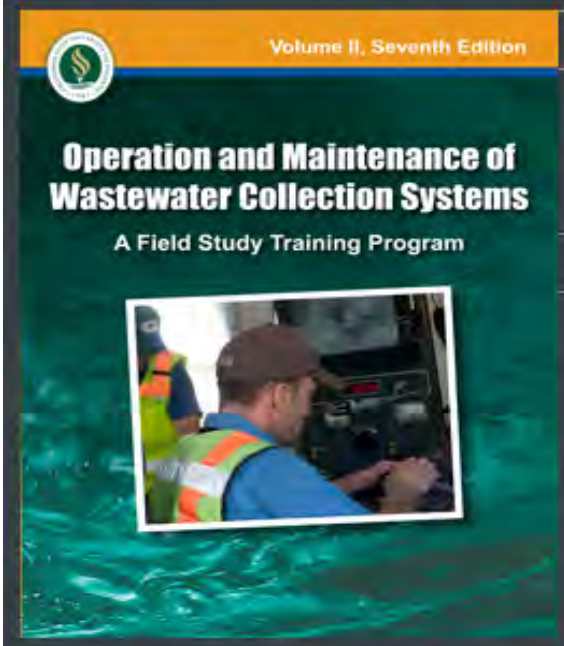
Learning Objectives (Click chapter title to open)

1. **The Wastewater Collection System Operator**
2. **Why Collection System Operation and Maintenance?**
3. **Wastewater Collection Systems**
4. **Safe Procedures**
5. **Inspecting and Testing Collection Systems**
6. **Pipeline Cleaning and Maintenance Methods**
7. **Underground Repair**

Appendix:

- Final Examination and Suggested Answers
- Collection System Words
- Applications of Arithmetic to Collection Systems
- Subject Index

Operation and Maintenance of Wastewater Collection Systems, Volume II



Objective

Add to cart

This course is designed to train personnel to safely and effectively operate and maintain wastewater collection systems.

Scope

This course focuses on three areas: (1) lift stations, (2) sewer rehabilitation, and (3) administration of a collection system agency. Detailed information is provided on the components and practical operation of lift stations. Operators learn to operate and maintain a variety of types of motors, supervisory controls, pumps, valves, and other equipment. They will also learn to examine the condition of a sewer system, set up a sewer rehabilitation program, and safely use various methods to replace or repair damaged sewers. This course also teaches operators critical aspects of effectively administering a wastewater collection agency or department. Administrative topics include overall organization of the agency as well as employment, training and compensation of personnel, selection and acquisition of equipment and facilities, system mapping, management information systems, report writing, and public relations. Operators learn to organize and administer all facets of a collection system agency.

Table of Contents

Learning Objectives (Click chapter title to open)

8. **Lift Stations**
9. **Equipment Maintenance**
10. **Sewer Renewal (Rehabilitation)**
11. **Safety/Survival Programs for Collection System Operators**
12. **Administration**
13. **Organization for System Operation and Maintenance**
14. **Capacity Assurance, Management, Operation, and Maintenance (CMOM)**

Appendix:

- Comprehensive Review Questions and Suggested Answers
- Collection System Words
- Subject Index

APPENDIX D

Ablah Municipality
Operator Correspondence
Training Completed

Office of Water Programs

California State University, Sacramento
http://www.owp.csus.edu/
wateroffice@owp.csus.edu
(916) 278-6142

Payment Receipt

Jul 8, 2011
This is not a bill

Payment
From: Matthew P. Antill
For: Boudaye, Mohamed
CDM
25 INDUSTRIAL AVE.
CHELMSFORD MA 01824
(950) 250-6727

Payment ID:	326392
Date:	Jul 08, 2011
Amount:	$50.00 USD

Matthew P. Antill Visa XXXXXXXXXXXX6845 Auth #: 06084B
This transaction will appear on your credit card statement as: **WATER PROGRAM**

Comments: Ship: US Postal Service Guest Email: bouda313@yahoo.com

Items:

Description	Invoice Number	Quantity	Amount
Boudaye, Mohamed			
601A - Wastewater Treatment: Facilities and Pretreatment, Ed 7			
Charge Enrollment	595968	1	$50.00

RETURN POLICY
Products - Returns are accepted within three months of purchase. Prior authorization must be obtained and shrink-wrap must be intact. A return fee of 10% of the value of the return will be deducted from the refund.
Enrollments - Returns of enrollments for any CEU course are accepted within one month of purchase, provided no coursework has been submitted and course materials are returned to us. A $10 processing fee will be deducted from the refund.

Office of Water Programs

California State University, Sacramento

http://www.owp.csus.edu/

wateroffice@owp.csus.edu

(916) 278-6142

Payment Receipt

Sep 8, 2011

This is not a bill

Payment

From: Matthew P Antill

For: Antill, Matthew

25 INDUSTRIAL AV.

CHELMSFORD MA 01824

(978) 250-6727

Payment ID:	330594
Date:	Sep 08, 2011
Amount:	$50.00 USD

Matthew P Antill Visa XXXXXXXXXXXX6845 Auth #: 02687B

This transaction will appear on your credit card statement as: **WATER PROGRAM**

Comments: Ship: US Postal Service

Items:

Description	Invoice Number	Quantity	Amount
Boudaye, Mohamed			
601B - Wastewater Treatment: Sedimentation and Flotation, Ed 7			
Charge Enrollment	600310	1	$50.00

RETURN POLICY

Products - Returns are accepted within three months of purchase. Prior authorization must be obtained and shrink-wrap must be intact. A return fee of 10% of the value of the return will be deducted from the refund.

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QSD and QSP Exams - No refunds will be given.

Office of Water Programs

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http://www.owp.csus.edu/
wateroffice@owp.csus.edu
(916) 278-6142

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CDM
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CHELMSFORD MA 01824
(950) 250-6727

Payment ID:	326392
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Matthew P. Antill Visa XXXXXXXXXXXX6845 Auth #: 06084B
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Items:

Description	Invoice Number	Quantity	Amount
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Charge Enrollment	595968	1	$50.00

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(978) 250-6727

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QSD and QSP Exams - No refunds will be given.

APPENDIX E

O&M Training Plan for Aitanit WWTP

CDM

U.S. Agency for International Development

Small Village Wastewater Treatment Systems Phase II Project for the Upper Litani River Basin

July 2008

Qaraoun-Aitanit Wastewater Treatment Plant

Operations & Maintenance Training Program

Contents – OM&T Training Plan

Section 1. Program Introduction
Section 2. Training Program Outline
Section 3. Training Needs Assessment
Section 4. Instructional Media
Section 5. Training Audience
Section 6. Training Goals
Section 7. General Course Objectives
Section 8. Specific Objectives of the Training Program
Section 9. Training Record System
Section 10. Books and References
Section 11. Lesson Plan Summary

Appendices

Appendix 1: Lesson Plans – Topic Summary

- Lesson-1 Introduction to Wastewater Systems
- Lesson-2 Characteristics of Wastewater
- Lesson- 3 Wastewater Treatment Techniques
- Lesson-4 Sludge Treatment and Disposal
- Lesson-5 Wastewater Disinfection

OPERATIONS AND MAINTENANCE TRAINING PROGRAM (OM&T)

1. Program Introduction

This Operations and Maintenance Training (OMT) Program described in this document is for the USAID/Lebanon – Small Villages Wastewater Treatment Systems Project is designed to provide the knowledge, and develop the skills, necessary for the efficient and safe operation and maintenance of the Aitanit/Qaraoun Villages new treatment facilities.

The training philosophy and approach taken by this program is based upon several factors. Each individual assigned to operation, maintenance, and management of the new treatment plants will receive training specific to the tasks to which they are assigned and the training will be specific to the plant facilities.

The OMT Program is conducted utilizing several methods:

- **Startup training** during the Commissioning period will use both classroom methods and On-The-Job (OJT) training activities.
- OJT includes **demonstrations and hands on activities,** with classroom lecture as necessary. This is the principal method used during the Commissioning and Advise and Assist periods.
- **Direct assistance training**, which is conducted during the course of the staff trainees performing normal work duties and assigned tasks.
- **Vendor training**, which combines classroom training and OJT conducted by vendor representatives during the pre-commissioning and commissioning periods as a part of equipment installation and startup.

At the end of the training program, all training materials such as handouts, etc., shall be turned over to USAID and the Aitanit/Qaraoun WWTP.

2. *Training Program Outline*

2.1 Training Subjects – Treatment Plant General O&M

The plant treatment O&M general subjects for which training will be given and the proposed instructor and training duration is listed below:

General Subjects	Instructor & Duration	Target Date
Qaraoun Sewer Network	CDM – 1-Day	TBD
Machghara Sewer Network	CDM – 1-Day	TBD
Safety – Working with Hypochlorite	CDM – 2-hr	TBD
Safety – Confined Space Training	CDM – 2-hr	TBD
Safety – Safety Equipment Use	CDM – 2-hr	TBD
Sampling – General Procedures	CDM – 4-hr	TBD
Workshop Equipment and Tool Use	CDM – 2-hr	TBD
Management - Maintenance Scheduling & Records	CDM – 2-hr	TBD
Management - Facility O&M Budget Preparation and Updates	CDM – 2-hr	TBD
Management - Facility Standard Records and Reports	CDM – 2-hr	TBD
Management – How to subcontract for O&M Services	CDM – 2-hr	TBD

2.2 Training Subjects – Treatment Process Specific

The plant treatment unit process for which training will be given and the proposed instructor and training duration is listed below:

Unit Treatment Process Name	Instructor & Duration	Target Date
Influent Pumping & Screening Treatment	CDM – 4-hr	TBD
Primary Treatment	CDM – 4-hr	TBD
Secondary Treatment	CDM – 8-hr	TBD
Effluent Disinfection	CDM/– 2-hr	TBD
Septage Receiving Facility	CDM – 1-hr	TBD
Anaerobic Digestion	CDM – 4-hr	TBD
Sludge Drying and Final Disposal	CDM – 2-hr	TBD
Site Laboratory - Process Control Tests	CDM/Local Lab Supplier – 6-hr	TBD
Qaraoun Sewer River Crossing - Maintenance	CDM – 2-hr	TBD
Plant Water System	CDM – 2-hr	TBD
Plant Drain System	CDM – 2-hr	TBD
Plant Lighting System	CDM – 2-hr	TBD
Final Effluent Disposal to the River	CDM – 2-hr	TBD

2.3 Training Subjects – Water Quality Testing - General Subjects

The water quality sampling & analysis subjects for which training will be given and the approximate number of hours of training is listed below:

Equipment Name	Instructor & Duration	Target Date
Laboratory Equipment	CDM – 2-hr	TBD
Basic Laboratory Techniques	CDM – 2-hr	TBD
Laboratory Safety	CDM – 1-hr	TBD
Sampling & Preservation	CDM – 1-hr	TBD
Process Control Testing	CDM – 1-hr	TBD
QA/QC	CDM – 1-hr	TBD
MoE Water Quality Reporting Requirements	CDM – 1-hr	TBD
Record Keeping	CDM – 1-hr	TBD

2.4 Training Subjects – Water Quality Testing – Analysis Procedures

The water quality sampling & analysis subjects for which training will be given and the approximate number of hours of training is listed below:

Water Quality Analysis	Instructor & Duration	Target Date
*Temperature	CDM – 1-hr	TBD
*pH	CDM – 1-hr	TBD
*Dissolved Oxygen	CDM – 1-hr	TBD
*Residual Chlorine	CDM – 1-hr	TBD
Settleable Solids	CDM – 1-hr	TBD
Clarity	CDM – 1-hr	TBD

**MoE Required Tests*

2.5 Training Subjects – Process Equipment Specific

The equipment for which training will be given and the approximate number of hours of training is listed below:

Equipment Name	Instructor & Duration	Target Date
Manual Bar Screen	CDM – 1/2-hr	TBD
Fine Bar Screen	CDM – 1-hr	TBD
Primary Clarifier Equipment	CDM/EMCO – 2-hr	TBD
Secondary Clarifier Equipment	CDM/EMCO – 2-hr	TBD
Trickling Filter – Power Ventilators	Green Heck Local Vendor/CDM– 2-hr	TBD
Trickling Filter – Rotary Distributor	CDM– 4-hr	TBD
Trickling Filter – Plastic Media	CDM– 1-hr	TBD
Disinfection Chemical System	CDM – 2-hr	TBD

Instrumentation & Control Equipment	CDM – 2-hr	TBD
Hoists and Cranes	CDM/EMCO – 2-hr	TBD
Valves O&M	CDM/EMCO – 2-hr	TBD
Pumping Systems and Equipment	Equip. Vendor (HOMA) + CDM – 4-hr	TBD
Standby Power Generator & Fuel Storage	Equip. Vendor /EMCO + CDM – 4-hr	TBD
Fire Detection System O&M	EMCO/CDM/ – 2-hr	TBD
Flow Meter O&M	CDM/ EMCO– 1-hr	TBD
Street Lighting	CDM/ EMCO– 1-hr	TBD
Electric Power Distribution	EMCO/CDM/ – 2-hr	TBD
Electrical Grounding System	EMCO/CDM/ – 2-hr	TBD

Process Equipment Training Subject Content – (Basic discussion points for each subject)

- Introduction
- Equipment Components
- Pre-Startup Checks
- Safety Checks
- Equipment Startup Procedures
- Routine Operational Checks
- Equipment Shutdown Procedures
- Emergency Operation Procedures
- Operator Responses to Abnormal Conditions
- Troubleshooting
- Environmental Reporting Requirements

3. Training Needs Assessment - General Approach

CDM completed an interview and brief assessment of the level of training needed for each Owner assigned plant staff person. At this time all of the staff proposed by the Union have adequate entry level experience (no previous treatment plant O&M experience).

4. Instructional Media

- Lesson Plans
- Facility O&M Manual Document
- Standard Operating Procedures
- Equipment Vendor O&M Manuals
- White marker board
- Handouts,

- PowerPoint
- Training Videos
- Technical Books and Manuals

5. Training Audience

The people who are expected to be interested in attending this training are listed below. The actual people who attend each train event may vary depending on the subject.

- Assigned Village Municipality plant O&M staff (see staffing recommendation report).
- Bekaa Water Authority staff (if available)
- Lebanon Environmental regulators (if available)
- Village local officials (if available)

6. Training Goals

Improving the likelihood of sustainability (prolonged functional use) of this wastewater treatment plant infrastructure project through the following activities:

1) Delivery of technical assistance which targets training non-experienced newly assigned plant O&M staff.

2) Providing institutional assistance in establishing rural WW utilities (not a formal project deliverable but CDM may be able to provide some limited help with this as a part of this program).

7. General Course Objectives

The following paragraphs define the training program main focus subjects and the associated objectives for each.

7.1 Operations

This course is designed to provide trainees with the knowledge and operational procedures necessary to efficiently and safely operate the facilities. Upon completion of the training, the trainees will be able to properly operate the facilities normally and also during emergencies.

7.2 Maintenance

The objective of the maintenance portion of the training program is to train the plant staff to maintain the facilities. The course provides training in performing basic maintenance activities for all major equipment items. In addition, maintenance management is also addressed by this course.

7.3 Water Quality – Sampling & Testing

The objective of the laboratory portion of the training program is to train the plant staff to perform basic water quality sampling and on-site analysis to support the process control of the trickling filter treatment processes. The course is designed to provide the trainees with the introductory knowledge, simple laboratory analysis procedures, techniques, skills, and

QA/QC procedures necessary to properly collect and analyze wastewater samples. *Note: Developing the capacity of new hire treatment plant Operators to perform and understand the results of process control laboratory water testing is a significant challenge for this short training program.*

7.4 Safety

The objective of the safety portion of the training program is to train all plant staff in proper safety procedures and practices. The course is designed to provide trainees with the knowledge, general safety procedures and strategies necessary to complete assigned tasks safely and to be continuously conscious of safety matters.

7.5 Management

The objective of the management portion of the training program is to train key plant staff in the proper functions and procedures related to managing and supervising the facilities. This portion of the training program, although general in nature, is designed to introduce and present examples of effective, positive plant management techniques and strategies. For example, records & reports, plant O&M budget preparation and updating, MoE water quality reporting, etc.

8. Specific Learning Concepts and Objectives

At the completion of this training the student should be able to do all of the following *fundamental concepts* and some of the *advanced concepts* listed below:

8.1 CONCEPT-1: PRINCIPLES OF TRICKLING FILTERS

Fundamental Concepts

- Describe the wastewater treatment process of Trickling Filters.
- Discuss the types of waste treated by a Trickling Filter.
- Explain the purposes served by the media in a Trickling Filter
- Describe the effect of algae growth and snails on the media of a Trickling Filter.
- List the reasons why good preliminary treatment fine screening and primary treatment is needed for effective Trickling Filter operation.
- Describe the flow path through the trickling filter process.

Advanced Concepts

- Describe the types of microorganism growth in a Trickling Filter.
- Define nitrification/denitrification and how the following variables affect the process:
  A. Temperature.
  B. Dissolved Oxygen.
  C. pH.
  D. Detention Time.

8.2 CONCEPT-2: STRUCTURE AND FUNCTION

Fundamental Concepts

- Describe the containment and type of media installed in the Trickling Filter.
- Discuss the structure and function of the following Trickling Filter mechanisms:
  A. Underdrains.
  B. Flow Distributor arm.
  C. Distributor End Gates.
  D. Speed Retarder Nozzles (Orifices).
  E. Turnbuckles and Stay Rods (Guy Wires).
  F. Trickling Filter Pump Station.
  G. Inlet and Outlet Pipes.
- Explain the function secondary clarifiers have in a Trickling Filter.

Advanced Concepts

- Discuss the plastic media installed in the trickling filter.
- Explain parallel operation of Trickling Filters (when are two filters needed and not needed).

8.3 CONCEPT-3: OPERATION

Fundamental Concepts

- Describe the appearance of biomass growth under the media layers of a Trickling Filter.
- List what an operator should look for when evaluating the condition of the biomass growth on Trickling Filter media.
- Explain the possible affects on the operation of uneven flow distribution over the media of a Trickling Filter.
- Explain the purpose of media ventilation in the operation of a Trickling Filter.
- Describe why dissolved oxygen levels in the TF outlet flow should be checked for proper TF plant operation.
- Describe the purposes and hydraulic scheme used for recirculation in the Trickling Filter.
- Explain why the Trickling Filter may at certain times need to be intentionally shock loaded with chlorine.
- Describe the potential affects on biomass growth from the following shock loads:

  A. Hydraulic Shock Load.
  B. BOD Shock Load.
  C. Toxic Shock Load.
- Explain the trickling filter recirculation ratios at each of the flow rates listed below:

A. Low-Flow
B. Average Design Flow
C. Peak Design Flow

- List the steps to take if one of the TF units is to be taken out of service for an extended period of time.
- Describe how to determine if enough sludge is being removed from the clarifiers.

Advanced Concepts

- Outline the procedure for start-up of a Trickling Filter.
- Describe the operational problems caused by various dissolved oxygen levels in the Trickling Filters.
- Explain the nitrification/denitrification affects on the following:

  A. Final Clarifier Operation.
  B. Oxygen Demand.
  C. Biochemical Oxygen Demand.
  D. Effluent Quality.

- Discuss what determines the normal rotational speed of a Trickling Filter distributor arm.
- List ways an operator can control the speed of the distributor arm of a Trickling Filter.
- Describe the term "filter channeling" in Trickling Filtration.
- Discuss the effects that seasonal temperature changes have on the operation of a Trickling Filter.
- List ways to test and improve Trickling Filter ventilation.
- List the items to consider when establishing a sludge removal schedule for a secondary clarifier.
- Describe the characteristics of secondary sludge from a Trickling Filter.
- Discuss clarifier weir overflow rates, and how they affect performance.
- Describe how recirculating flow through a Trickling Filter effects the following situations:

  A. To reduce wastewater organic strength to the filter.
  B. For increased hydraulic flow to increase sloughing and/or maintain flow rate over filter.
  C. To improve the dissolved oxygen level to filter effluent.

8.4 CONCEPT-4: MAINTENANCE

Fundamental Concepts

- Explain what to look for when inspecting the plastic media in the Trickling Filter.

- Describe the following tasks, and explain why each is important in the maintenance of Trickling Filters.

  A. Cleaning nozzles and splash plates.
  B. Flushing distributor arms.
  C. Adjusting stay rods (guy wires).
  D. Checking distributor bearings and lubrication.

- Discuss a method and frequency of cleaning Trickling Filter underdrains.
- Explain why clarifier weirs should be regularly brushed-down and/or washed-off.
- List three items to inspect when performing a maintenance inspection of the secondary clarifier.
- List the maintenance tasks to perform on the following trickling filter equipment:

  A. Distributor Main Bearings.
  B. Recirculation pumps
  C. Distributor arm nozzles.
  D. Media
  E. Air Fan Equipment.

- Discuss the key items included on the trickling filter maintenance schedule.

Advanced Concepts

- List the daily, weekly, monthly, quarterly, and annual activities for maintenance of a Trickling Filter.
- Demonstrate the safe removal of submersible pumps from the sump pits.
- Demonstrate media flushing procedure.
- Explain cold weather operation of the trickling filter system.

8.5 CONCEPT-5: MONITORING

Fundamental Concepts

- Identify the sampling locations to be used to determine BOD and suspended solids removal.
- Describe the laboratory test that best indicates the operating efficiency of a Trickling Filter.

Advanced Concepts

- Define the following variations of the BOD test and :

  A. Carbonaceous BOD.
  B. Nitrogenous BOD.
  C. Inhibited BOD.
  D. Soluble BOD.
  E. Ultimate BOD.

- Outline a procedure for sampling soluble BOD, and explain its significance in assessing trickling filter performance.
- Describe sample sites and tests that should be run to monitor the Trickling Filter process.

8.6 CONCEPT-6: TROUBLESHOOTING

Fundamental Concepts

- List three methods of reducing freezing problems of Trickling Filters.
- Outline the possible causes and corrective actions for the following Trickling Filter problems:

  A. Ponding.
  B. Excessive filter flies.
  C. Odor problems.
  D. Icing problems on media and/or clarifier.

Advanced Concepts

- Explain the effects of the following on Trickling Filter operations.

  A. Toxic Shock Loadings.
  B. Organic Shock Loadings.
  C. Hydraulic Shock Loadings.

- List the affects industrial discharges may have on trickling filter treatment efficiency, and give corrective steps to reduce their impact.
- List some reasons that would cause a Trickling Filter distributor not to turn.
- Describe the possible causes and corrective actions to be taken for the following problems in a Trickling Filter:

  A. Poor BOD removal efficiency.
  B. Failure to meet ammonia limits.
  C. Poor suspended solids removal efficiency.

- List some reasons why a clarifier can experience a build-up of sludge, even through adequate sludge pumping time is being provided.
- Describe the potential chain of events if secondary clarifier sludge pumping rates are consistently:

  A. Too Low.
  B. Too High.

- Suggest corrective actions for the following causes of low DO in a trickling filter unit:

  A. Influent Wastewater Causing an Organic Overload.
  B. In-Plant Sidestreams Causing an Organic Overload.
  C. Primary Clarifier Causing an Organic Overload.

8.7 CONCEPT-7: SAFETY

- List the safety precautions related to the operation of each of the process and equipment systems listed below:
    - Influent pumping facility
    - Fine screening facility
    - Septage receiving process
    - Primary and secondary clarifiers
    - Trickling filter pump station
    - Trickling filter tower
    - Anaerobic Digester Process tanks and equipment
    - Chlorine contact tank
    - Chlorine feed system and Chemical building
    - Sludge drying beds
    - Sludge Tanker filling process
    - Power Transformer Building
    - Standby power generator operation
    - Fuel storage facility
    - Power distribution panel
    - Field equipment motor starter and control cabinets
    - Plant drain piping network
    - Plant Water pump station
    - Laboratory and sampling
    - Wet weather operations
    - Night operations
    - Snow & ice condition operations

8.8 CONCEPT-8: CALCULATION

Fundamental Concepts

- Given data, calculate influent loading in kg of BOD per day/1000 cubic meters of media.
- Given data, calculate kgs per day of BOD from digester supernatant or other sidestreams.
- Given data, calculate kgs of BOD/load from one 10 cubic meter load of septic tank sludge.
- Given data, calculate the total kgs of soluble BOD per day to the secondary treatment unit.
- Given data, calculate the total surface area of a Trickling Filter unit(s).
- Given data, calculate the theoretical detention time in a primary and secondary clarifier.
- Given data, calculate the percent removal of BOD and suspended solids from a trickling filter unit.
- Given data, calculate a recirculation ratio.

- Given data, calculate the surface settling rate of a clarifier.
- Given flow and weir length, calculate weir overflow rate.
- Given data, calculate the organic loading rate to a Trickling Filter.
- Given data, calculate the hydraulic loading in cubic meters per day per square meter to a Trickling Filter.
- Given data, calculate the organic kg loading of BOD and Suspended Solids to a Trickling Filter.
- Given data, calculate the kgs BOD per day of recirculation loading.

9. Training Record System

A record system will be developed to support the training program. Each trainee will be tracked as to the number and subject of training courses attended.

10. Books and References:

- Arabic -Basics of Wastewater Treatment
- Arabic -Wastewater Treatment technologies
- Arabic -Operation and Maintenance of Wastewater Pumps
- Arabic -Wastewater Laboratory Analysis
- English -Troubleshooting and Optimizing Wastewater Treatment in Small Communities – Attached Growth Processes. (Instructor Guide and Participant Workbook)
- English - Confined Space Entry – Video Training Program.
- English – Volumes 1 & 2, sixth Edition, Operation of Wastewater Treatment Plants, U.S. EPA Office of Water Programs.
- English – Volumes 1 & 2, sixth Edition, Operation of Wastewater Treatment Collection Systems, U.S. EPA Office of Water Programs.

11. Training Lesson Plans

See listing in Appendix-1

Lesson Plans – Topic Summary

- Lesson-1 Introduction to Wastewater Systems
- Lesson-2 Characteristics of Wastewater
- Lesson- 3 Wastewater Treatment Techniques
- Lesson-4 Sludge Treatment and Disposal
- Lesson-5 Wastewater Disinfection

Appendix 1

Summary of Lesson Plans

LESSON 1

INTRODUCTION TO WATEWATER SYSTEMS

ماذا في الدرس الاول:
WHAT IS IN THIS LESSON?

1- مصادر المياه المبتذلة.

The sources of wastewater

2- فئات المياه المبتذلة.

The Categories of wastewater

3- اسباب معالجة المياه المبتذلة.

The reasons for treating wastewater

4- العملية الطبيعية لمعالجة المياه المبتذلة.

The natural processes of treating wastewater

5- عملية المعالجة المبدئية ، الاولية ، الثانوية ، التطهير.

The treatment process of preliminary treatment, primary treatment, secondary treatment and disinfection.

6- التدفق عبر محطة نموذجية لمعالجة المياه المبتذلة.

The flow through a typical wastewater treatment plant

7- السبب الرئيسي لوجود نظام تجميع المياه المبتذلة.

The main reason for having a wastewater collection system

LESSON 2

مواصفات المياه المبتذلة
CHARACTERISTICS OF WASTEWATER

ماذا في الدرس الثاني؟
WHAT IS IN THIS LESSON?

1. مركبات وخصائص المياه المبتذلة

The composition and characteristics of wastewater

2. الحموضة وعناصر مقاييسها

PH and the components of its scale

3. وصف الجوامد المترسبة، الجوامد العالقة، الجوامد الذائبة ومجموع الجوامد.

Description of settleable solids, suspended solids, dissolved solids and total solids

4. الفرق بين المواد العضوية والغير عضوية الموجودة في المياه المبتذلة.

The difference between organic and inorganic material found in wastewater

5. الفرق بين الكائنات الحية الهوائية والغير هوائية.

The difference between aerobic, anaerobic and facultative organisms

6. هوامش الحرارة للكائنات المجهرية الحية .

The temperature ranges for microorganisms

7. الاشكال الثلاثة للبكتيريا.

The three shapes of bacteria

8. الامراض النموذجية المتكاثرة في المياه من البكتيريا والحيوانات الأحادية الخلية.

Typical waterborne diseases caused by bacteria and protozoa

9. العملية التي تستخدمها البكتيريا لجمع وهضم الغذاء.

The process that bacteria use to collect and process food

10.أثر المواد العضوية العالية على نوعية مياه النهر التي ترمى فيه.

The impact that increased organics have on water quality of a receiving stream.

11.مظهر ورائحة المياه المبتذلة العفنة والحديثة.

The appearance and odor of septic and fresh sewage.

12.مواصفات التدفق المتغيرة على نظام المياه المبتذلة.

The different flow characteristics of a wastewater system.

13.العلاقة بين الحرارة والاوكسيجين الذائب في المياه.

The temperature DO relation in water.

14.الغازات المعروفة والموجودة في المياه المبتذلة العفنة.

The common gases found in septic wastewater.

15.الفرق بين التحلل الهوائي والتحلل الغير هوائي.

The difference between aerobic and anaerobic decomposition.

16.اهمية الاوكسجين الذائب في معالجة المياه المبتذلة

The importance DO has in wastewater treatment.

LESSON 3
تقنيات معالجة المياه المبتذلة

WASTEWATER TREATMENT TECHNIQUES

WHAT IS IN THIS LESSON?

ماذا في هذا الدرس :

The type of material that makes up grit

1- نوع المعدات التي تفرز رواسب البحص والرمال .

The mechanical components used in preliminary treatment

2- العناصر الميكانيكية المستعملة في المعالجة المبدئية ومهامها.

The processes that may be included in preliminary treatment

3- العمليات التي قد تتضمنها المعالجة المبدئية

The material that would normally be removed by screens

4- المواد التي قد تزال طبيعياً في المصافي

The functions of preliminary treatment

5- مهمات المعالجة المبدئية

The reason for removal of grit

6- سبب ازالة الرواسب

The concentration of primary sludge

7- تركيز الحمأة الاولية

The treatment process provided by a primary clarifier

8- عملية المعالجة التي يؤمنها "حوض التصفية الاولي"

Those items that would affect settling in a primary clarifier

9- العوامل التي تؤثر على الترسيب في "حوض التصفية الأولي"

The sludge and liquid flow through a primary clarifier

10-الحمأة والتدفق العابر في "حوض التصفية الاولي".

The normal detention time of primary clarifier

11-زمن المكوث الطبيعي لحوض التصفية الاولي.

The removal percentages in a primary clarifier for BOD, TSS, SS and Bacteria

12-نسبة الازالة في حوض التصفية الاولي لـ "متطلب الاوكسجين الكيموحيوي ، مجموع المواد الصلبة، والجوامد العالقة والبكتيريا .

The two functions of a primary clarifier

13-وظيفتا خزان التنقية المبدئية

Typical problems in the inlet channel of a primary clarifier

14-نماذج عن المشاكل عند مدخل التنقية المبدئية

The various zones of a clarifier

15-مناطق خزان التصفية المتنوعة.

The components of a clarifier

16-مكونات خزان التنقية

The function of baffles in a basin

17-وظيفة الحواجز في الحوض.

The aerobic treatment process as provided by secondary treatment

18-عملية المعالجة الهوائية حسب شروط المعالجة الثانوية

The removal percentages for TSS, SS, BOD provided by secondary treatment

19-نسبة ازالة مجموع المواد الصلبة، الجوامة العالقة ومتطلب الاوكسجين الحيوي حسب شروط المعالجة الثانوية.

The typical detention times in biological treatment processes

20-فترات مكوث المياه في عملية المعالجة البيولوجية.

How a trickling filter works

21-كيف يعمل فلتر الترشيح

The air and water flow through a trickling filter

22-تدفق المياه والهواء من خلال فلتر الترشيح

The components of the film found on the media in a trickling filter

23-مكونات الغشاء الموجود في اوساط فلتر الترشيح

The function of a trickling filter and the type of process

24-وظيفة فلتر الترشيح ونوع العملية

The components of a trickling filter

25-مكونات فلتر الترشيح

Basic trickling filter problems

26-المشاكل الاساسية لفلتر الترشيح

The one operational control change that an operator can make in a trickling filter plant

27-تغيير التحكم الوحيد بالتشغيل الذي يستطيع القيام به المشغل في محطة فلتر الترشيح

Media used in a trickling filter

28-المواد المستعملة في فلتر الترشيح

Two reasons for recirculation in a trickling filter

29-سبب اعادة تمرير المياه في فلتر الترشيح

The biological response of microorganism to high and low volumes of food

30-ردة الفعل البيولوجية للكائنات الحية المجهرية على كميات الغذاء العالية والمنخفضة

The characteristics of normal settling activated sludge

31-مميزات الترسيب الطبيعي للحمأة المنشطة

The sources of organic loading

32-مصارة الاحمال العضوية

The treatment process provided in a secondary clarifier

33-عملية المعالجة التي تفرضها المعالجة الثانوية

The cause of rising sludge by a secondary clarifier

34-سبب عوم الحمأة في خزان التنقية الثانوية

The normal detention time in a secondary clarifier

35-فترة المكوث العادية في خزان التنقية الثانوية

Why accurate flow measurements are needed at a WWTP

36-لماذا نحتاج لقياس التدفق بشكل دقيق في محطة المعالجة

LESSON 4
SLUDGE TREATMENT AND DISPOSAL

محتويات الدرس الرابع:

WHAT IS IN THE LESSON?

The required concentration of sewage sludge prior to disposal at a landfill.

١- التركيز المطلوب لحمأة المياه المبتذلة قبل دفنها في أي مطمر.

The processes used in drying beds to remove water.

٢- العمليات المستعملة في وحدات التجفيف لإزالة الماء.

The proper control of feed to an anaerobic digester.

٣- الإدارة الصحيحة لتغذية الهاضم اللا هوائي.

The sequence used t dry sludge in a drying bed.

٤- التسلسل المستعمل لتجفيف الحمأة في أحواض التجفيف.

The unit that is used to collect waste sludge.

٥- الوحدة التي تُستَعملُ لجَمْع الحمأة.

The reason for sludge digestion.

٦- سبب هضم الحمأة.

The anaerobic digestion processes.

٧- عملية الهضم اللا هوائي.

The detention time in an anaerobic digester.

٨- مدة الحجز في الهاضم اللا هوائي.

The by-products of anaerobic decomposition.

٩- المنتجات العرضية لعملية التحلل اللا هوائي.

The major health and safety concerns associated with sludge disposal.

١٠- المخاوف الرئيسية على الصحة والسلامة المرتبطتين بالتخلص من الحمأة.

The three sources of sludge in a wastewater treatment plant.

١١- مصادر الحمأة الثلاثة في محطة معالجة مياه الصرف الصحي.

The primary reason for mixing an anaerobic digester.

١٢- السبب الرئيسي لعملية المزج في الهاضم اللا هوائي

Lesson 5
Wastewater Disinfection
تعقيم المياه المبتذلة

WHAT IS IN THIS LESSON?
محتويات الدرس

The function of disinfection in wastewater treatment
١- وظيفة التعقيم في معالجة المياه المبتذلة.

The name of the tank used for disinfection
٢- إسم الخزان المستعمل للتعقيم.

The items that affect the germicidal effectiveness of chlorine
٣- العناصر المؤثرة في فعالية الكلور في إبادة الجراثيم.

Typical detention time in a chlorine contact basin
٤- الوقت المثالي للحجر في حوض معالجة بالكلور.

The function of a hypochlorinator
٥- وظيفة جهاز التعقيم بالكلور.

The proper handling, storage and mixing of sodium and calcium hypochlorites.
٦- التعامل، التخزين، والمزج الملائم للصوديوم والكالسيوم هايبوكلورايت.

The components of hypochlorination system
٧- مكونات نظام التعقيم بالكلور.

APPENDIX F

O&M Training Plan for Fourzol WWTP

CDM

U.S. Agency for International Development

Small Village Wastewater Treatment Systems Phase II Project for the Upper Litani River Basin

February 2009

Fourzol Wastewater Treatment Plant

Operations & Maintenance Training Program

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Appendix 1: Lesson Plans – Topic Summary

- Lesson-1 Introduction to Wastewater Systems
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- Lesson- 3 Wastewater Treatment Techniques
- Lesson-4 Sludge Treatment and Disposal
- Lesson-5 Wastewater Disinfection

OPERATIONS AND MAINTENANCE TRAINING PROGRAM (OM&T)

1. Program Introduction

This Operations and Maintenance Training (OMT) Program described in this document is for the USAID/Lebanon – Small Villages Wastewater Treatment Systems Project is designed to provide the knowledge, and develop the skills, necessary for the efficient and safe operation and maintenance of the Fourzol Village new treatment facilities.

The training philosophy and approach taken by this program is based upon several factors. Each individual assigned to operation, maintenance, and management of the new treatment plants will receive training specific to the tasks to which they are assigned and the training will be specific to the plant facilities.

The OMT Program is conducted utilizing several methods:

- **Startup training** during the Commissioning period will use both classroom methods and On-The-Job (OJT) training activities.
- OJT includes **demonstrations and hands on activities,** with classroom lecture as necessary. This is the principal method used during the Commissioning and Advise and Assist periods.
- **Direct assistance training**, which is conducted during the course of the staff trainees performing normal work duties and assigned tasks.
- **Vendor training**, which combines classroom training and OJT conducted by vendor representatives during the pre-commissioning and commissioning periods as a part of equipment installation and startup.

At the end of the training program, all training materials such as handouts, etc., shall be turned over to USAID and the Fourzol WWTP.

2. *Training Program Outline*

2.1 Training Subjects – Treatment Plant General O&M

The plant treatment O&M general subjects for which training will be given and the proposed instructor and training duration is listed below:

General Subjects	Instructor & Duration	Target Date
Fourzol Sewer Network	CDM – 1-Day	TBD
Safety – Working with Hypochlorite	CDM – 2-hr	TBD
Safety – Confined Space Training	CDM – 2-hr	TBD
Safety – Safety Equipment Use	CDM – 2-hr	TBD
Sampling – General Procedures	CDM – 4-hr	TBD
Workshop Equipment and Tool Use	CDM – 2-hr	TBD
Management - Maintenance Scheduling & Records	CDM – 2-hr	TBD
Management - Facility O&M Budget Preparation and Updates	CDM – 2-hr	TBD
Management - Facility Standard Records and Reports	CDM – 2-hr	TBD
Management – How to subcontract for O&M Services	CDM – 2-hr	TBD

2.2 Training Subjects – Treatment Process Specific

The plant treatment unit process for which training will be given and the proposed instructor and training duration is listed below:

Unit Treatment Process Name	Instructor & Duration	Target Date
Influent Pumping & Screening Treatment	CDM – 4-hr	TBD
Primary Treatment	CDM – 4-hr	TBD
Secondary Treatment	CDM – 8-hr	TBD
Effluent Disinfection	CDM/– 2-hr	TBD
Septage Receiving Facility	CDM – 1-hr	TBD
Anaerobic Digestion	CDM – 4-hr	TBD
Sludge Drying and Final Disposal	CDM – 2-hr	TBD
Site Laboratory - Process Control Tests	CDM 6-hr	TBD
Plant Water System	CDM – 2-hr	TBD
Plant Drain System	CDM – 2-hr	TBD
Plant Lighting System	CDM – 2-hr	TBD
Final Effluent Disposal to the River	CDM – 2-hr	TBD

2.3 Training Subjects – Water Quality Testing - General Subjects

The water quality sampling & analysis subjects for which training will be given and the approximate number of hours of training is listed below:

Equipment Name	Instructor & Duration	Target Date
Laboratory Equipment	CDM – 2-hr	TBD
Basic Laboratory Techniques	CDM – 2-hr	TBD
Laboratory Safety	CDM – 1-hr	TBD
Sampling & Preservation	CDM – 1-hr	TBD
Process Control Testing	CDM – 1-hr	TBD
QA/QC	CDM – 1-hr	TBD
MoE Water Quality Reporting Requirements	CDM – 1-hr	TBD
Record Keeping	CDM – 1-hr	TBD

2.4 Training Subjects – Water Quality Testing – Analysis Procedures

The water quality sampling & analysis subjects for which training will be given and the approximate number of hours of training is listed below:

Water Quality Analysis	Instructor & Duration	Target Date
*Temperature	CDM – 1-hr	TBD
*pH	CDM – 1-hr	TBD
*Dissolved Oxygen	CDM – 1-hr	TBD
*Residual Chlorine	CDM – 1-hr	TBD
Settleable Solids	CDM – 1-hr	TBD
Clarity	CDM – 1-hr	TBD

**MoE Required Tests*

2.5 Training Subjects – Process Equipment Specific

The equipment for which training will be given and the approximate number of hours of training is listed below:

Equipment Name	Instructor & Duration	Target Date
Manual Bar Screen	CDM – 1/2-hr	TBD
Fine Bar Screen	CDM – 1-hr	TBD
Primary Clarifier Equipment	CDM/TAJJ – 2-hr	TBD
Secondary Clarifier Equipment	CDM/TAJJ – 2-hr	TBD
Trickling Filter – Power Ventilators	Local Vendor/CDM– 2-hr	TBD
Trickling Filter – Rotary Distributor	CDM– 4-hr	TBD
Trickling Filter – Plastic Media	CDM– 1-hr	TBD
Disinfection Chemical System	CDM – 2-hr	TBD
Instrumentation & Control Equipment	CDM – 2-hr	TBD
Hoists and Cranes	CDM – 2-hr	TBD

Valves O&M	CDM – 2-hr	TBD
Pumping Systems and Equipment	Equip. Vendor (Local Rep.) + CDM – 4-hr	TBD
Standby Power Generator & Fuel Storage	Equip. Vendor /TAJJ + CDM – 4-hr	TBD
Fire Detection System O&M	Local Vendor/CDM/ – 2-hr	TBD
Flow Meter O&M	CDM 1-hr	TBD
Street Lighting	CDM/TAJJ– 1-hr	TBD
Electric Power Distribution	TAJJ/CDM/ – 2-hr	TBD
Electrical Grounding System	TAJJ/CDM/ – 2-hr	TBD

Process Equipment Training Subject Content – (Basic discussion points for each subject)

- Introduction
- Equipment Components
- Pre-Startup Checks
- Safety Checks
- Equipment Startup Procedures
- Routine Operational Checks
- Equipment Shutdown Procedures
- Emergency Operation Procedures
- Operator Responses to Abnormal Conditions
- Troubleshooting
- Environmental Reporting Requirements

3. Training Needs Assessment - General Approach

CDM completed an interview and brief assessment of the level of training needed for each Owner assigned plant staff person. At this time all of the staff proposed by the Village have adequate entry level experience (no previous treatment plant O&M experience).

4. Instructional Media

- Lesson Plans
- Facility O&M Manual Document
- Standard Operating Procedures
- Equipment Vendor O&M Manuals
- White marker board
- Handouts,
- PowerPoint
- Training Videos

- Technical Books and Manuals

5. Training Audience

The people who are expected to be interested in attending this training are listed below. The actual people who attend each train event may vary depending on the subject.

- Assigned Village Municipality plant O&M staff (see staffing recommendation report).
- Bekaa Water Authority staff (if available)
- Lebanon Environmental regulators (if available)
- Village local officials (if available)

6. Training Goals

Improving the likelihood of sustainability (prolonged functional use) of this wastewater treatment plant infrastructure project through the following activities:

1) Delivery of technical assistance which targets training non-experienced newly assigned plant O&M staff.

2) Providing institutional assistance in establishing rural WW utilities (not a formal project deliverable but CDM may be able to provide some limited help with this as a part of this program).

7. General Course Objectives

The following paragraphs define the training program main focus subjects and the associated objectives for each.

7.1 Operations

This course is designed to provide trainees with the knowledge and operational procedures necessary to efficiently and safely operate the facilities. Upon completion of the training, the trainees will be able to properly operate the facilities normally and also during emergencies.

7.2 Maintenance

The objective of the maintenance portion of the training program is to train the plant staff to maintain the facilities. The course provides training in performing basic maintenance activities for all major equipment items. In addition, maintenance management is also addressed by this course.

7.3 Water Quality – Sampling & Testing

The objective of the laboratory portion of the training program is to train the plant staff to perform basic water quality sampling and on-site analysis to support the process control of the trickling filter treatment processes. The course is designed to provide the trainees with the introductory knowledge, simple laboratory analysis procedures, techniques, skills, and QA/QC procedures necessary to properly collect and analyze wastewater samples. *Note: Developing the capacity of new hire treatment plant Operators to perform and understand*

the results of process control laboratory water testing is a significant challenge for this short training program.

7.4 Safety

The objective of the safety portion of the training program is to train all plant staff in proper safety procedures and practices. The course is designed to provide trainees with the knowledge, general safety procedures and strategies necessary to complete assigned tasks safely and to be continuously conscious of safety matters.

7.5 Management

The objective of the management portion of the training program is to train key plant staff in the proper functions and procedures related to managing and supervising the facilities. This portion of the training program, although general in nature, is designed to introduce and present examples of effective, positive plant management techniques and strategies. For example, records & reports, plant O&M budget preparation and updating, MoE water quality reporting, etc.

8. Specific Learning Concepts and Objectives

At the completion of this training the student should be able to do all of the following *fundamental concepts* and some of the *advanced concepts* listed below:

8.1 CONCEPT-1: PRINCIPLES OF TRICKLING FILTERS

Fundamental Concepts

- Describe the wastewater treatment process of Trickling Filters.
- Discuss the types of waste treated by a Trickling Filter.
- Explain the purposes served by the media in a Trickling Filter
- Describe the effect of algae growth and snails on the media of a Trickling Filter.
- List the reasons why good preliminary treatment fine screening and primary treatment is needed for effective Trickling Filter operation.
- Describe the flow path through the trickling filter process.

Advanced Concepts

- Describe the types of microorganism growth in a Trickling Filter.
- Define nitrification/denitrification and how the following variables affect the process:
  A. Temperature.
  B. Dissolved Oxygen.
  C. pH.
  D. Detention Time.

8.2 CONCEPT-2: STRUCTURE AND FUNCTION

Fundamental Concepts

- Describe the containment and type of media installed in the Trickling Filter.
- Discuss the structure and function of the following Trickling Filter mechanisms:
  A. Underdrains.
  B. Flow Distributor arm.
  C. Distributor End Gates.
  D. Speed Retarder Nozzles (Orifices).
  E. Turnbuckles and Stay Rods (Guy Wires).
  F. Trickling Filter Pump Station.
  G. Inlet and Outlet Pipes.
- Explain the function secondary clarifiers have in a Trickling Filter.

Advanced Concepts

- Discuss the plastic media installed in the trickling filter.
- Explain parallel operation of Trickling Filters (when are two filters needed and not needed).

8.3 CONCEPT-3: OPERATION

Fundamental Concepts

- Describe the appearance of biomass growth under the media layers of a Trickling Filter.
- List what an operator should look for when evaluating the condition of the biomass growth on Trickling Filter media.
- Explain the possible affects on the operation of uneven flow distribution over the media of a Trickling Filter.
- Explain the purpose of media ventilation in the operation of a Trickling Filter.
- Describe why dissolved oxygen levels in the TF outlet flow should be checked for proper TF plant operation.
- Describe the purposes and hydraulic scheme used for recirculation in the Trickling Filter.
- Explain why the Trickling Filter may at certain times need to be intentionally shock loaded with chlorine.
- Describe the potential affects on biomass growth from the following shock loads:

  A. Hydraulic Shock Load.
  B. BOD Shock Load.
  C. Toxic Shock Load.
- Explain the trickling filter recirculation ratios at each of the flow rates listed below:

A. Low-Flow
B. Average Design Flow
C. Peak Design Flow

- List the steps to take if one of the TF units is to be taken out of service for an extended period of time.
- Describe how to determine if enough sludge is being removed from the clarifiers.

Advanced Concepts

- Outline the procedure for start-up of a Trickling Filter.
- Describe the operational problems caused by various dissolved oxygen levels in the Trickling Filters.
- Explain the nitrification/denitrification affects on the following:

  A. Final Clarifier Operation.
  B. Oxygen Demand.
  C. Biochemical Oxygen Demand.
  D. Effluent Quality.

- Discuss what determines the normal rotational speed of a Trickling Filter distributor arm.
- List ways an operator can control the speed of the distributor arm of a Trickling Filter.
- Describe the term "filter channeling" in Trickling Filtration.
- Discuss the effects that seasonal temperature changes have on the operation of a Trickling Filter.
- List ways to test and improve Trickling Filter ventilation.
- List the items to consider when establishing a sludge removal schedule for a secondary clarifier.
- Describe the characteristics of secondary sludge from a Trickling Filter.
- Discuss clarifier weir overflow rates, and how they affect performance.
- Describe how recirculating flow through a Trickling Filter effects the following situations:

  A. To reduce wastewater organic strength to the filter.
  B. For increased hydraulic flow to increase sloughing and/or maintain flow rate over filter.
  C. To improve the dissolved oxygen level to filter effluent.

8.4 CONCEPT-4: MAINTENANCE

Fundamental Concepts

- Explain what to look for when inspecting the plastic media in the Trickling Filter.

- Describe the following tasks, and explain why each is important in the maintenance of Trickling Filters.

  A. Cleaning nozzles and splash plates.
  B. Flushing distributor arms.
  C. Adjusting stay rods (guy wires).
  D. Checking distributor bearings and lubrication.

- Discuss a method and frequency of cleaning Trickling Filter underdrains.
- Explain why clarifier weirs should be regularly brushed-down and/or washed-off.
- List three items to inspect when performing a maintenance inspection of the secondary clarifier.
- List the maintenance tasks to perform on the following trickling filter equipment:

  A. Distributor Main Bearings.
  B. Recirculation pumps
  C. Distributor arm nozzles.
  D. Media
  E. Air Fan Equipment.

- Discuss the key items included on the trickling filter maintenance schedule.

Advanced Concepts

- List the daily, weekly, monthly, quarterly, and annual activities for maintenance of a Trickling Filter.
- Demonstrate the safe removal of submersible pumps from the sump pits.
- Demonstrate media flushing procedure.
- Explain cold weather operation of the trickling filter system.

8.5 CONCEPT-5: MONITORING

Fundamental Concepts

- Identify the sampling locations to be used to determine BOD and suspended solids removal.
- Describe the laboratory test that best indicates the operating efficiency of a Trickling Filter.

Advanced Concepts

- Define the following variations of the BOD test and :

  A. Carbonaceous BOD.
  B. Nitrogenous BOD.
  C. Inhibited BOD.
  D. Soluble BOD.
  E. Ultimate BOD.

- Outline a procedure for sampling soluble BOD, and explain its significance in assessing trickling filter performance.
- Describe sample sites and tests that should be run to monitor the Trickling Filter process.

8.6 CONCEPT-6: TROUBLESHOOTING

Fundamental Concepts

- List three methods of reducing freezing problems of Trickling Filters.
- Outline the possible causes and corrective actions for the following Trickling Filter problems:

  A. Ponding.
  B. Excessive filter flies.
  C. Odor problems.
  D. Icing problems on media and/or clarifier.

Advanced Concepts

- Explain the effects of the following on Trickling Filter operations.

  A. Toxic Shock Loadings.
  B. Organic Shock Loadings.
  C. Hydraulic Shock Loadings.

- List the affects industrial discharges may have on trickling filter treatment efficiency, and give corrective steps to reduce their impact.
- List some reasons that would cause a Trickling Filter distributor not to turn.
- Describe the possible causes and corrective actions to be taken for the following problems in a Trickling Filter:

  A. Poor BOD removal efficiency.
  B. Failure to meet ammonia limits.
  C. Poor suspended solids removal efficiency.

- List some reasons why a clarifier can experience a build-up of sludge, even through adequate sludge pumping time is being provided.
- Describe the potential chain of events if secondary clarifier sludge pumping rates are consistently:

  A. Too Low.
  B. Too High.

- Suggest corrective actions for the following causes of low DO in a trickling filter unit:

  A. Influent Wastewater Causing an Organic Overload.
  B. In-Plant Sidestreams Causing an Organic Overload.
  C. Primary Clarifier Causing an Organic Overload.

8.7 CONCEPT-7: SAFETY

- List the safety precautions related to the operation of each of the process and equipment systems listed below:
  - Influent pumping facility
  - Fine screening facility
  - Septage receiving process
  - Primary and secondary clarifiers
  - Trickling filter pump station
  - Trickling filter tower
  - Anaerobic Digester Process tanks and equipment
  - Chlorine contact tank
  - Chlorine feed system and Chemical building
  - Sludge drying beds
  - Sludge Tanker filling process
  - Power Transformer Building
  - Standby power generator operation
  - Fuel storage facility
  - Power distribution panel
  - Field equipment motor starter and control cabinets
  - Plant drain piping network
  - Plant Water pump station
  - Laboratory and sampling
  - Wet weather operations
  - Night operations
  - Snow & ice condition operations

8.8 CONCEPT-8: CALCULATION

Fundamental Concepts

- Given data, calculate influent loading in kg of BOD per day/1000 cubic meters of media.
- Given data, calculate kgs per day of BOD from digester supernatant or other sidestreams.
- Given data, calculate kgs of BOD/load from one 10 cubic meter load of septic tank sludge.
- Given data, calculate the total kgs of soluble BOD per day to the secondary treatment unit.
- Given data, calculate the total surface area of a Trickling Filter unit(s).
- Given data, calculate the theoretical detention time in a primary and secondary clarifier.
- Given data, calculate the percent removal of BOD and suspended solids from a trickling filter unit.
- Given data, calculate a recirculation ratio.

- Given data, calculate the surface settling rate of a clarifier.
- Given flow and weir length, calculate weir overflow rate.
- Given data, calculate the organic loading rate to a Trickling Filter.
- Given data, calculate the hydraulic loading in cubic meters per day per square meter to a Trickling Filter.
- Given data, calculate the organic kg loading of BOD and Suspended Solids to a Trickling Filter.
- Given data, calculate the kgs BOD per day of recirculation loading.

9. Training Record System

A record system will be developed to support the training program. Each trainee will be tracked as to the number and subject of training courses attended.

10. Books and References:

- Arabic -Basics of Wastewater Treatment
- Arabic -Wastewater Treatment technologies
- Arabic -Operation and Maintenance of Wastewater Pumps
- Arabic -Wastewater Laboratory Analysis
- English -Troubleshooting and Optimizing Wastewater Treatment in Small Communities – Attached Growth Processes. (Instructor Guide and Participant Workbook)
- English - Confined Space Entry – Video Training Program.
- English – Volumes 1 & 2, sixth Edition, Operation of Wastewater Treatment Plants, U.S. EPA Office of Water Programs.
- English – Volumes 1 & 2, sixth Edition, Operation of Wastewater Treatment Collection Systems, U.S. EPA Office of Water Programs.

11. Training Lesson Plans

See listing in Appendix-1

Lesson Plans – Topic Summary

- Lesson-1 Introduction to Wastewater Systems
- Lesson-2 Characteristics of Wastewater
- Lesson- 3 Wastewater Treatment Techniques
- Lesson-4 Sludge Treatment and Disposal
- Lesson-5 Wastewater Disinfection

Appendix 1

Summary of Lesson Plans

LESSON 1

INTRODUCTION TO WATEWATER SYSTEMS

ماذا في الدرس الاول:
WHAT IS IN THIS LESSON?

1- مصادر المياه المبتذلة.

The sources of wastewater

2- فئات المياه المبتذلة.

The Categories of wastewater

3- اسباب معالجة المياه المبتذلة.

The reasons for treating wastewater

4- العملية الطبيعية لمعالجة المياه المبتذلة.

The natural processes of treating wastewater

5- عملية المعالجة المبدئية ، الاولية ، الثانوية ، التطهير.

The treatment process of preliminary treatment, primary treatment, secondary treatment and disinfection.

6- التدفق عبر محطة نموذجية لمعالجة المياه المبتذلة.

The flow through a typical wastewater treatment plant

7- السبب الرئيسي لوجود نظام تجميع المياه المبتذلة.

The main reason for having a wastewater collection system

LESSON 2

مواصفات المياه المبتذلة
CHARACTERISTICS OF WASTEWATER

ماذا في الدرس الثاني؟
WHAT IS IN THIS LESSON?

1. مركبات وخصائص المياه المبتذلة

The composition and characteristics of wastewater

2. الحموضة وعناصر مقاييسها

PH and the components of its scale

3. وصف الجوامد المترسبة، الجوامد العالقة، الجوامد الذائبة ومجموع الجوامد.

Description of settleable solids, suspended solids, dissolved solids and total solids

4. الفرق بين المواد العضوية والغير عضوية الموجودة في المياه المبتذلة.

The difference between organic and inorganic material found in wastewater

5. الفرق بين الكائنات الحية الهوائية والغير هوائية.

The difference between aerobic, anaerobic and facultative organisms

6. هوامش الحرارة للكائنات المجهرية الحية .

The temperature ranges for microorganisms

7. الاشكال الثلاثة للبكتيريا.

The three shapes of bacteria

8. الامراض النموذجية المتكاثرة في المياه من البكتيريا والحيوانات الأحادية الخلية.

Typical waterborne diseases caused by bacteria and protozoa

9. العملية التي تستخدمها البكتيريا لجمع وهضم الغذاء.

The process that bacteria use to collect and process food

10.أثر المواد العضوية العالية على نوعية مياه النهر التي ترمى فيه.

The impact that increased organics have on water quality of a receiving stream.

11.مظهر ورائحة المياه المبتذلة العفنة والحديثة.

The appearance and odor of septic and fresh sewage.

12.مواصفات التدفق المتغيرة على نظام المياه المبتذلة.

The different flow characteristics of a wastewater system.

13.العلاقة بين الحرارة والاوكسيجين الذائب في المياه.

The temperature DO relation in water.

14.الغازات المعروفة والموجودة في المياه المبتذلة العفنة.

The common gases found in septic wastewater.

15.الفرق بين التحلل الهوائي والتحلل الغير هوائي.

The difference between aerobic and anaerobic decomposition.

16.اهمية الاوكسجين الذائب في معالجة المياه المبتذلة

The importance DO has in wastewater treatment.

LESSON 3
تقنيات معالجة المياه المبتذلة

WASTEWATER TREATMENT TECHNIQUES

WHAT IS IN THIS LESSON?

ماذا في هذا الدرس :

The type of material that makes up grit

1- نوع المعدات التي تفرز رواسب البحص والرمال .

The mechanical components used in preliminary treatment

2- العناصر الميكانيكية المستعملة في المعالجة المبدئية ومهامها.

The processes that may be included in preliminary treatment

3- العمليات التي قد تتضمنها المعالجة المبدئية

The material that would normally be removed by screens

4- المواد التي قد تزال طبيعياً في المصافي

The functions of preliminary treatment

5- مهمات المعالجة المبدئية

The reason for removal of grit

6- سبب ازالة الرواسب

The concentration of primary sludge

7- تركيز الحمأة الاولية

The treatment process provided by a primary clarifier

8- عملية المعالجة التي يؤمنها "حوض التصفية الاولي"

Those items that would affect settling in a primary clarifier

9- العوامل التي تؤثر على الترسيب في "حوض التصفية الأولي"

The sludge and liquid flow through a primary clarifier

10-الحمأة والتدفق العابر في "حوض التصفية الاولي".

The normal detention time of primary clarifier

11-زمن المكوث الطبيعي لحوض التصفية الاولي.

The removal percentages in a primary clarifier for BOD, TSS, SS and Bacteria

12-نسبة الازالة في حوض التصفية الاولي لـ "متطلب الاوكسجين الكيموحيوي ، مجموع المواد الصلبة، والجوامد العالقة والبكتيريا .

The two functions of a primary clarifier

13-وظيفتا خزان التنقية المبدئية

Typical problems in the inlet channel of a primary clarifier

14-نماذج عن المشاكل عند مدخل التنقية المبدئية

The various zones of a clarifier

15-مناطق خزان التصفية المتنوعة.

The components of a clarifier

16-مكونات خزان التنقية

The function of baffles in a basin

17-وظيفة الحواجز في الحوض.

The aerobic treatment process as provided by secondary treatment

18-عملية المعالجة الهوائية حسب شروط المعالجة الثانوية

The removal percentages for TSS, SS, BOD provided by secondary treatment

19-نسبة ازالة مجموع المواد الصلبة، الجوامة العالقة ومتطلب الاوكسجين الحيوي حسب شروط المعالجة الثانوية.

The typical detention times in biological treatment processes

20-فترات مكوث المياه في عملية المعالجة البيولوجية.

How a trickling filter works

21-كيف يعمل فلتر الترشيح

The air and water flow through a trickling filter

22-تدفق المياه والهواء من خلال فلتر الترشيح

The components of the film found on the media in a trickling filter

23-مكونات الغشاء الموجود في اوساط فلتر الترشيح

The function of a trickling filter and the type of process

24-وظيفة فلتر الترشيح ونوع العملية

The components of a trickling filter

25-مكونات فلتر الترشيح

Basic trickling filter problems

26-المشاكل الاساسية لفلتر الترشيح

The one operational control change that an operator can make in a trickling filter plant

27-تغيير التحكم الوحيد بالتشغيل الذي يستطيع القيام به المشغل في محطة فلتر الترشيح

Media used in a trickling filter

28-المواد المستعملة في فلتر الترشيح

Two reasons for recirculation in a trickling filter

29-سبب اعادة تمرير المياه في فلتر الترشيح

The biological response of microorganism to high and low volumes of food

30-ردة الفعل البيولوجية للكائنات الحية المجهرية على كميات الغذاء العالية والمنخفضة

The characteristics of normal settling activated sludge

31-مميزات الترسيب الطبيعي للحمأة المنشطة

The sources of organic loading

32-مصارة الاحمال العضوية

The treatment process provided in a secondary clarifier

33-عملية المعالجة التي تفرضها المعالجة الثانوية

The cause of rising sludge by a secondary clarifier

34-سبب عوم الحمأة في خزان التنقية الثانوية

The normal detention time in a secondary clarifier

35-فترة المكوث العادية في خزان التنقية الثانوية

Why accurate flow measurements are needed at a WWTP

36-لماذا نحتاج لقياس التدفق بشكل دقيق في محطة المعالجة

LESSON 4
SLUDGE TREATMENT AND DISPOSAL

محتويات الدرس الرابع:

WHAT IS IN THE LESSON?

The required concentration of sewage sludge prior to disposal at a landfill.

١- التركيز المطلوب لحمأة المياه المبتذلة قبل دفنها في أي مطمر.

The processes used in drying beds to remove water.

٢- العمليات المستعملة في وحدات التجفيف لإزالة الماء.

The proper control of feed to an anaerobic digester.

٣- الإدارة الصحيحة لتغذية الهاضم اللا هوائي.

The sequence used t dry sludge in a drying bed.

٤- التسلسل المستعمل لتجفيف الحمأة في أحواض التجفيف.

The unit that is used to collect waste sludge.

٥- الوحدة التي تُستَعملُ لجَمْع الحمأة.

The reason for sludge digestion.

٦- سبب هضم الحمأة.

The anaerobic digestion processes.

٧- عملية الهضم اللا هوائي.

The detention time in an anaerobic digester.

٨- مدة الحجز في الهاضم اللا هوائي.

The by-products of anaerobic decomposition.

٩- المنتجات العرضية لعملية التحلل اللا هوائي.

The major health and safety concerns associated with sludge disposal.

١٠- المخاوف الرئيسية على الصحة والسلامة المرتبطتين بالتخلص من الحمأة.

The three sources of sludge in a wastewater treatment plant.

١١- مصادر الحمأة الثلاثة في محطة معالجة مياه الصرف الصحي.

The primary reason for mixing an anaerobic digester.

١٢- السبب الرئيسي لعملية المزج في الهاضم اللا هوائي

Lesson 5
Wastewater Disinfection
تعقيم المياه المبتذلة

WHAT IS IN THIS LESSON?
محتويات الدرس

The function of disinfection in wastewater treatment
١- وظيفة التعقيم في معالجة المياه المبتذلة.

The name of the tank used for disinfection
٢- إسم الخزان المستعمل للتعقيم.

The items that affect the germicidal effectiveness of chlorine
٣- العناصر المؤثرة في فعالية الكلور في إبادة الجراثيم.

Typical detention time in a chlorine contact basin
٤- الوقت المثالي للحجر في حوض معالجة بالكلور.

The function of a hypochlorinator
٥- وظيفة جهاز التعقيم بالكلور.

The proper handling, storage and mixing of sodium and calcium hypochlorites.
٦- التعامل، التخزين، والمزج الملائم للصوديوم والكالسيوم هايبوكلورايت.

The components of hypochlorination system
٧- مكونات نظام التعقيم بالكلور.