PADCO

PLANNING AND DEVELOPMENT COLLABORATIVE INTERNATIONAL, INC.

HG-005

Private Participation in Environmental Services

ANALYSIS OF STANDARDS AND DEFINITION OF PERFORMANCE REQUIREMENTS FOR THE LIQUID WASTE SECTOR IN TUNISIA

Final

Prepared for

Regional Housing and Urban Development Office
Near East and North Africa (USAID)

Prepared by

PADCO and Société d'Ingénierie pour le Développement Economique et Social (SIDES)

Jean-Pierre Beaumont
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Analysis of Standards and Definition of Performance Requirements for the Liquid Waste Sector in Tunisia

Executive Summary

The objective of this study is to provide ONAS with the regulatory means to manage and supervise efficiently the private companies that will replace ONAS as provider of liquid waste services.

The terms of reference have defined three tasks: revise Tunisian liquid waste standards, define performance requirements, and elaborate the basic structure of a data management system.

The study discusses the difficulty of complying with standards that are not always adapted to conditions in Tunisia. In some areas, potable water quality is inferior to effluent chlorine and sulfate standards. The standards for other parameters, such as phosphate levels, are quite rigorous and complete compliance would require installing a costly system. At the same time, diluting effluent in order to attain compliance is not explicitly prohibited.

Since none of the ONAS treatment plants has the equipment required to ensure complete compliance with the standards, contracting private firms to provide operations and maintenance services will require clear definition of effluent quality levels in the contract. These levels may have to be modified to suit different types of equipment.

In the short run, the study recommends formulating effluent and operation requirements for each existing treatment plant according to that plant's particularities. These requirements should then be stated in an agreement between ONAS and the ANPE. It is unrealistic and financially untenable to envision modifying treatment plants to comply completely with all of the existing standards.

In the long run, the study recommends revising the standards structure to eliminate insurmountable constraints. This revision would only affect ONAS treatment plants if a new standard specific to liquid waste treatment is specified.

The study proposes a detailed two-part program. The first part formulates the effluent requirements applicable to both treatment plants and network overflow structures. The second formulates operations requirements applicable to both treatment plants and overflow structures and is supplemented by a monitoring program.

The study examines in detail monitoring of contractors and lists the principal duties that the Performance Monitoring Unit (PMU) will undertake once it is set up.

The study advises how to prepare the activity monitoring notebook that is a part of each contract with a private firm and also describes the contents of this notebook.

The study concludes with a description of a computerized data management system and includes a detailed list of the duties it must perform.

1 Introduction

1.1 Objectives

The Government of Tunisia demonstrates increasing commitment to greater private sector participation in the delivery of urban environmental services. The National Sanitation Agency (ONAS[1]), the main operator in the liquid waste sector, currently entrusts the execution of most studies as well as the construction of new facilities to the private sector. ONAS is now interested in expanding the participation of the private sector to include project operation and financing.

The objective of this study is to provide the Performance Monitoring Unit of ONAS with the regulatory means to manage and supervise the private enterprises which will provide liquid waste services in Tunisia. Furthermore, this study will inform the development of a national strategy for private sector participation in environmental services

This study was financed under the Private Participation in Environmental Services (PPES) program, a joint effort of the Government of Tunisia and USAID (PACT reference: 3.B.II).

1.2 Terms of Reference

The terms of reference for the study describe three tasks: review of liquid waste standards, definition of performance requirements, and elaboration of the basic structure of a performance monitoring system.

The review of liquid waste standards includes an assessment of all existing regulations produced and/or enforced by Tunisian governmental entities: ONAS, the Ministry of Environment and Regional Planning, the National Environmental Protection Agency, the Ministry of Agriculture, the Ministry of Public Health, and the National Institute of Standards and Patent Rights (INNORPI[2]). This assessment will involve the identification of constraints related to these standards and ONAS' difficulties in complying with them, as well as constraints on prospective private enterprises that will be involved in water pollution control.

This first task also includes proposals for general recommendations to resolve potential conflicts between existing standards and the goal of increasing private sector participation in water pollution control. These recommendations should allow the application of national standards so as to take into account Tunisia's physical characteristics as well as existing liquid waste infrastructure. Recommendations for performance indicators that will allow ONAS to evaluate the services of the private enterprises will complete this activity.

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[1] *Office National de l'Assainissement.*

[2] *Institut National de la Normalisation et de la Propriété Industrielle.*

The definition of performance requirements will enable ONAS to specify the quality and volume of work which can be expected of private enterprises, and to prepare maintenance requirements for the sanitation and related equipment entrusted to private enterprise. These recommended requirements will then be applied to pilot projects and, based on the lessons learned, be adapted to other projects.

The objective of the third task is to enable ONAS to monitor the performance of the private enterprises involved in liquid waste service delivery. The main components of a "Performance Monitoring Notebook" will be identified. This management tool will allow verification of compliance with effluent and operation requirements, as well as quality control of infrastructure and equipment maintenance services.

2 Analysis of Tunisian Effluent Standards

2.1 Overview of Standards in Tunisia

INNORPI is the official publisher of Tunisian standards. It keeps an updated record of all standards, be they official, recorded, or in process. The most recent register available is the "1993 Catalogue," which evaluated the standards development on December 31, 1992. Official standards are those that have been published in the Official Journal of the Republic of Tunisia (JORT) and whose application is mandatory. Recorded standards, which are not published in the JORT and are not mandatory, serve as technical guidelines. The Catalogue also indicates the progress of standards in preparation.

One hundred twenty-two Technical Committees (TCs) have been created to prepare standards in as many different areas. As of December 31, 1992, 98 TCs had contributed standards to the INNORPI Catalogue. Among these, the following are related to the field of water pollution control (neither water pollution control nor liquid waste is specifically mentioned by the committees):

- TC 09 WATER QUALITY (guides to sampling, measurement and/or determination of several physical and chemical parameters, bathing waters and swimming pool water, terminology).
- TC 16 FOOD MICROBIOLOGY (includes general guidelines for counting total and faecal coliforms, streptococcus, etc.)
- TC 106 ENVIRONMENTAL PROTECTION (standards for effluents of negligible harmfulness [EP], effluent disposal in aquatic environments [HOM], agricultural use of treated wastewater [HOM]).
- TC 110 QUALITY ASSURANCE (terminology, statistical interpretation, sampling rules, quality management, etc., laboratories,* maintenance**)

* see NT (Tunisian Norm) 110 - [46, 47, 48, 49 (1988)] and [110, 111, 112 (1990)]
** see NT 110 - [79 (1990)] and 81, 90 (1992)]

The corresponding pages of the 1993 Catalogue listing the above-mentioned standards are reproduced in Annex A.

2.2 Current Standards for Effluent Disposal in Aquatic Environments

The two official standards of the technical committee No. 106 entitled "ENVIRONMENTAL PROTECTION" deal directly with the area of liquid waste.

Standard No. NT 106.002 (1989), "EFFLUENT DISPOSAL IN AQUATIC ENVIRONMENTS," defines disposal conditions for treated and untreated effluents in aquatic environments requiring approval. The standard also defines the conditions for connecting to the public sewerage system and disposing of effluents. In addition to standards for the analysis of various applicable parameters, NT 106.002 specifies the allowable characteristics of discharges in marine environments, aquatic environments, and public waterways.

The standard pertains to the usual physicochemical parameters that characterize wastewater (temperature, pH, COD, BOD_5, SS, and nitrogen and phosphorus compounds), bacteriological contamination parameters, several metals, pesticides, and some more complex chemical compounds (ABS, hydrocarbons, PCB/PCT, pesticides, and phenols).

The standard fixes the mg/l concentration that the effluent must not exceed for everything except temperature, pH, and bacteriological contamination parameters.

Standard No. NT 106.003 (1989), "AGRICULTURAL USE OF TREATED WASTEWATER — PHYSICOCHEMICAL AND BIOLOGICAL SPECIFICATIONS," completes decree No. 89-1047 of July 28, 1989, which establishes the conditions for agricultural use of treated wastewater. It indicates the maximum concentrations as well as the methods of determination for 22 physicochemical and biological parameters. The notice "except for a special waiver" applies to the COD, BOD_5, and SS.

These two standards are reproduced in Annex B.

2.3 Agencies Involved in the Monitoring of Effluent Standards

Tunisia has created a large arsenal of legislative tools aimed at strict management of water and effluent quality by a number of agencies. In some cases, there is overlap between the jurisdictions of the different regulatory bodies. The relevant entities, by type of environment, are as follows:

MARINE ENVIRONMENT			
Ministries	**Directorates and Agencies**	**Fields of Intervention**	**Means**
Housing and Services	DSAM	Water Resources Management	Prosecution
Environment and Regional Planning	Envir[illegible]l Prot[illegible]ard		
	National Environmental Protection Agency (ANPE)	Management of Effluent Standards	Law enforcement - prosecution
Public Health	Hygiene and Environmental Protection Board	Management of bacteria levels in bathing areas	Hygiene laboratories
Agriculture	Fishing Board	Protection of shores and fisheries	
	INSTOP	Water quality related to fishing	Studies and research
Interior - Local Governments	Municipalities	Physical management of bathing areas	Enforcement of laws and regulations
	Governorates	Management of water quality of bathing areas	

AQUATIC ENVIRONMENT (public waters, oueds, aquifers, reservoirs, etc.)			
Ministries	**Directorates and Agencies**	**Fields of Intervention**	**Means**
Housing and Services	DHU	DPH, Water works management	Studies and construction
Environment and Regional Planning	Environmental Protection Board		
	ANPE	Management of effluent standards	Monitoring, law enforcement, prosecution
	ONAS	Application of effluent standards	Studies, construction, monitoring
Public Health	Hygiene and Environmental Protection Board	Management of bacteria levels in beverages	Hygiene laboratories
Agriculture	EGTH Directorate	Water management, Planning	Studies and construction
	DRE	Water management, Planning	Studies and research, regulating protected areas
Interior - Local Government	Municipalities	Physical management of bathing areas	Enforcement of laws and regulations
	Governorates	Management of drinking water quality	

The above tables show the complexity and multiplicity of the various agencies intervening in the area of environmental protection.

The recently created National Environmental Protection Agency (ANPE) may gradually replace the agencies in the area of quality management. With its currently limited resources, it mainly records actions carried out by the various authorities that have traditionally managed, regulated, or used the resources of the various sectors. ANPE, however, plays a more active role when it comes to industrial polluters.

The fact that ANPE's and MEAT's supervisory resources are spread out means that it will take a few more years for them to plan and carry out the consolidation of all the supervisory and management resources available in the various agencies.

The activities of the various Ministries and Agencies are briefly described below.

Ministry of Housing and Services

In marine environments, the Ministry executes or supervises the execution of such projects as commercial ports and coastline protection against erosion. It also intervenes in the delineation of the public marine domain.

Ministry of Environment and Regional Planning

The Ministry of Environment and Regional Planning is responsible for all aspects of marine conservation. While the ministry acquires some monitoring tools from Mediterranean Sea protection programs, it develops others through its Environmental Protection and Regional Planning boards.

The National Environmental Protection Agency, which answers to the Ministry, is responsible for the management and enforcement of effluent standards through punitive measures and incentives such as the pollution control fund (FODEP).

Ministry of Public Health

The Hygiene and Environmental Protection Board monitors the bacteria levels of bathing areas. It regularly conducts analyses in the Ministry's central and regional laboratories and sends the results to the national or regional authorities which determine when to issue warnings on unsafe conditions.

Ministry of Agriculture

Historically, sanitation in Tunisian cities has been the responsibility of the Ministry of Agriculture, which provided support to local governments. Since the creation of ONAS, the Ministry and its agencies have focused primarily on the marine environment. Thus, the fisheries directorate (INSTOP) manages fishing resources and installs facilities to encourage the development of the fishing industry. INSTOP also conducts studies in order to delineate and protect fishing resources. As such, it often measures the effects of pollution in lakes and along the coastline (Gulf of Tunis, Gulf of Gabès, Bougrara Sea, Tunis Lake, Bizerte Lake, and El Bibane Lake, Sfax coastline, etc.)

Ministry of the Interior

Through local government groups (municipalities, delegations, and governorates), the Ministry of the Interior manages bathing areas. Furthermore, it enforces laws and regulations at the request of ANPE or the Ministry of Public Health.

The various agencies which manage surface and ground waters are as follows:

Ministry of Housing and Services

The Ministry of Housing and Services acts mainly through the Urban Water Works Board (DHU), which circumscribes and defines the Public Water Works Domain (DPH). DHU

carries out flood protection studies, constructs related facilities, and participates in the preparation of urban development plans to protect the Public Water Works Domain.

Ministry of Environment and Regional Planning

The Ministry of Environment and Regional Planning is responsible for the overall policy of aquatic environmental protection through:

- the Environmental Protection Board;
- ANPE, which manages effluent standards and enforces laws and regulations; and
- ONAS, which designs, builds, and operates wastewater facilities.

Ministry of Public Health

The Hygiene and Environmental Protection Board monitors the bacterial content of beverages. It conducts analyses in its laboratories and sends them to the regional and national authorities. In addition, the Board carries out bacteriological and parasitological analyses in order to monitor the re-use of treated wastewater.

Ministry of Agriculture

The Ministry of Agriculture plays a fundamental role in the management of water resources. The Directorate of Major Water Works (EGTH) manages surface water resources and plans for their utilization (construction of dams, aquifer recharge). EGTH is responsible for the allocation of resources to the various users (domestic, industrial, agricultural, and tourist).

The Directorate of Water Resources (DRE) manages ground water resources. It monitors surface and ground water resources through a widespread network of rain recording gauges, flow gauging stations, and piezometers. It maintains a large hydrological and hydrogeological data bank. DRE creates and updates a list of pollution factors which threaten surface and ground water resources.

Ministry of the Interior

At the request of the Ministry of Public Health or other agencies, the Ministry of the Interior enforces the laws and regulations regarding the protection of public water works.

2.4 Constraints

2.4.1 General

The current standards do not take into account certain conditions specific to Tunisia. For example, in some regions, potable water does not meet the chloride and sulfate standards. This means that the quality of the water that users discharge into the environment must be higher than that of the water retrieved from wells or provided by the piped water system. In this case, full compliance with the standards presents a serious handicap to any form of development. If the governmental agencies responsible for standards compliance want to allow urban growth, they will have to interpret the standards loosely, which may subject

them to undue criticism (lack of rigidity or flexibility, overzealousness or favoritism, depending on the source).

The standards were formulated on the basis of lengthy bibliographical research in an effort to attain idealistic objectives. For certain parameters, full compliance with the standards would require the installation of sophisticated treatment plants that would be very costly to build and operate. To cite one example, the standards limit phosphorus concentrations to 0.1 mg/l for disposal in marine environments and 0.05 mg/l in the public water works domain; however, the attainment of such low concentrations requires more than the simple addition of chemicals, which is the conventional approach to attain concentrations between 1.0 and 0.5 mg/l.

In the case of the physicochemical parameters which characterize wastewaters (COD, BOD_5, SS, and nitrogen and phosphorus compounds), the standards contain a weakness that must be pointed out. Since they are defined only in terms of concentration, they might suggest to an individual or an organization that is having difficulties complying with them to dilute the wastewaters. The standards do not explicitly prohibit this activity.

2.4.2 Constraints on ONAS Infrastructure

Presently, ONAS' water pollution control infrastructure is designed to provide primary treatment (removal of gross solids) as well as secondary biological treatment.

Some treatment plants are able to provide biological denitrification and phosphate removal under certain conditions. However, they are not equipped for chemical feeding which allows a much better control of efficiency.

A few waste treatment lagoons, or the stations whose effluent goes through a polishing pond, allow for a significant decrease of bacteriological content, but such is not the case for the majority of the existing treatment plants.

When it comes to metals and other more complex chemical compounds, ONAS policy, in concert with ANPE, is to regulate the upstream connection of industrial wastewaters to its sewer networks. This preventive approach is very safe and attests to sound management since the biological processes applied in the treatment plants are not designed to remove these substances.

With respect to standards compliance, ONAS treatment plants fall into three main groups:

- those that provide a secondary biological treatment and are capable of ensuring reduction of BOD_5 and SS;
- those that also provide biological denitrification and/or phosphate removal and can therefore reduce the concentration of nitrogen and/or phosphorous compounds;
- those that include lagoons or polishing ponds and can reduce bacteriological parameters.

It is crucial to take into account the specific equipment found in a given treatment plant when considering the expected quality of its effluent. ONAS treatment plants can be effective against certain but not all the parameters mentioned in the present standards.

2.4.3 Constraints on Private Firms

In order to interest private enterprises in operating treatment plants in Tunisia, a formula must be found which reconciles objectives of the standards with the treatment capacities of the existing treatment plants. To demand that an enterprise operating a treatment plant guarantee full compliance with all the parameters of the existing standards would constitute an almost insurmountable obstacle to the involvement of private enterprises in operations and maintenance activities.

3 Prospects for Further Development of Standards

3.1 Assumptions

In order to fully appreciate Tunisia's heritage in the area of water pollution control, we need to review current standards structure. Their rigidity and the exhaustive list of parameters make their enforcement very difficult and costly.

Any revision of standards structure must include a wider range of effluent quality which accounts for the specific conditions of the receiving environment and the intended uses of the effluents. The parameters of the effluents could therefore be specified in terms of their final destination.

In the case of a future treatment plant, it is important to identify possible disposal sites for the effluent, as well as the potential uses of treated wastewaters. It is at this level that standards need to be more flexible, or rather, need to be broadened while taking into account a more extended definition of possible receiving environments. Thus, it could prove more economical to locate a treatment plant, or at least its discharge point, farther from a particularly sensitive area. The more distant, less fragile receiving environment would allow the projected treatment plant to be less efficient and thus less costly to build and operate. The same argument can be applied to potential wastewater reuse.

In those cases in which the standards for certain parameters have been relaxed, it is essential to verify that they do not exceed the recuperative or assimilative capacity of the receiving environment.

The notion of total organic load (expressed in kilograms per day: kg/d) needs to be introduced for parameters such as COD, BOD_5, and SS. This makes it possible to quantify the effluent and thereby prioritize interventions aimed at preserving the environment. This notion also prevents attempts to dilute effluent.

It would therefore be possible to define concentration as well as specific pollution load standards, for each treatment plant.

The notion of operation requirements is central to the successful introduction of private operation of treatment plants. The requirements make it possible to ensure that all wastewaters conveyed to the station go through the complete treatment chain and are discharged through the outfall or directed toward reuse, as required.

Requirements must also be set for the overflow facilities within the network. Efforts to operate a treatment plant effectively must not be undermined by uncontrolled overflows within the network.

It is appropriate to connect small industrial, agricultural, or commercial units to public waterways leading to a treatment plant, provided that their effluents are compatible with biological treatment and are not likely to damage public water pollution control facilities. These effluents must receive a pre-treatment limited to the bare minimum (for example: neutralization, grit removal, lowering of peak flows, etc.) and their organic load must be negligible with regard to the capacity of the treatment plant.

Currently, the NT 106.002 limits the concentrations of BOD_5 and SS discharges into ONAS' collection system to 400 mg/l, which corresponds to the average concentration in Tunisian wastewater. This leaves little room for industrial or commercial pollution that may be treated by an existing or planned treatment plant. However, it is often very difficult and costly for small factories or workshops to provide on-site secondary treatment; it may well be more efficient for the ONAS to treat this effluent in its treatment plants.

The notion of total organic load could eventually inform the adoption of a polluter-pays principle for increasing user participation in capital expenditures and operation costs. Moreover, the current wastewater fee already takes into account the large amount of pollution produced by industrial users without directly measuring organic load that is discharged into the sewer network.

3.2 Proposals for Relaxation of Standards

The effluent standards which were designed to provide absolute protection of the receiving environment did not take into account the capacity of these environments to assimilate pollution without a negative or discernable impact. The only exemptions in the standards pertain to nitrogen and phosphorus concentrations when restrictive use is allowed.

In fact, numerous uses that do not require sophisticated treatment can be considered. Thus, primary treatment effluents may be used for the recharge of deep aquifers or for irrigation for the purposes of forestation.

While aquifers dry up, salt water areas encroach, and forests continue to be in short supply, wastewaters are often discharged into the sea.

There is a poor fit between ONAS, which delivers treated wastewater that almost but not quite complies with the standards, and the Ministry of Agriculture, which is not organized to accept all the treated wastewater.

The views of the Ministry of Public Health and of the farmers oddly complicate the situation; the former imposes crop restrictions that the latter are reluctant to obey.

ONAS' constraints should be alleviated by investing less in treatment and more in infrastructure for disposal toward potential reuse sites, and by integrating an intermediate cycle between treated or untreated wastewater and agricultural use. Any action to make the use of treated wastewater comparable to that of dam or aquifer water could eliminate apprehension or psychological impediments to reuse.

The important directions that seem to emerge from an analysis of the overall situation of treatment and reuse are the following:

- prior to the installation of any new treatment plant, a detailed study on the potential for recharge and reuse in the areas of agricultural and forest cultivation should be considered;
- the level of treatment should be optimized, since treatment expenditures could be used to build the facilities conveying effluents to the reuse sites;
- such an endeavor must be undertaken as much through the intervention of the Ministry of Agriculture as through the relaxation of present standards;
- ANPE, through its impact studies, should be able to adjust treatment levels as a function of the discharge site and the potential for reuse; and
- the outcome of the impact study must serve as a planning and implementation tool not only for ONAS, but also for the Ministry of Agriculture (EGTH or DRE).

It is thus possible to define different stages of wastewater treatment in relation to treated effluent quality. These stages are as follows:

Stage 0	▸	Homogenized effluents after the removal of oil, large and easily settleable solids
Stage 1	▸	Primary treatment effluents
Stage 2a	▸	Secondary treatment effluents (without denitrification)
Stage 2b	▸	Secondary treatment effluents (with denitrification)
Stage 3	▸	Tertiary lagoon effluents
Stage 4	▸	Advanced disinfection effluents

Uses corresponding to these different stages could be the following:

TREATMENT STAGE	USES
Stage 0	Infiltration, land disposal, forestation
Stage 1	Infiltration, land disposal, forestation
Stage 2a	Forages, cotton, cereals, arboriculture, aquifer recharge
Stage 2b	Marine discharge, aquifer recharge
Stage 3	Recreational fields, non-restrictive agricultural use
Stage 4	Recreational fields, non-restrictive agricultural use

3.3 Implications for ONAS Infrastructure

Four scenarios can be considered regarding the implications of the standards for ONAS infrastructure.

One of them consists of upgrading the treatment plants (by adding denitrification, phosphate removal, disinfection, filtration, etc.) to guarantee constant compliance with all parameters of the standards. This scenario is obviously unrealistic and financially infeasible.

A second approach consists of determining effluent and operation requirements for each existing treatment plant, taking into account overall plant capacity, and submitting these requirements to ANPE for a sanitation agreement between ONAS and ANPE, as provided for in Article 6[3] of the law creating the latter.

This approach is advisable for pilot projects that bring private enterprises into the field of water pollution control.

A third scenario consists of modifying the structure of the current standards on discharges in the water environment by broadening the range of the quality of treated effluents in relation to the receiving environment and the intended uses. A 2-3 year period seems realistic to define and set up a new effluent standards structure. Nevertheless, resistance to such modification could be strong.

The fourth scenario is in fact a variation of the third, but it appears less likely to provoke strong resistance. It consists of creating a technical committee to establish standards specific to ONAS' treatment plants. The standards would be designed on the basis of the range mentioned in the third scenario.

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[3] "Within the context of its environmental protection actions, the Agency may sign agreements with agencies or enterprises to establish a program of elimination of polluting discharges."

4 Effluent and Operation Requirements

4.1 Objectives

Effluent requirements applicable to a treatment plant should be restricted to those parameters that the station manager can control directly. These parameters are generally limited. For secondary biological treatment, they are mainly BOD_5 and SS. Under certain conditions, biological denitrification and/or phosphate removal are also feasible.

However, it is advisable to require the operator to provide sufficient data to allow monitoring of the general situation and evaluation of the quality of the operation. These operating requirements must be clearly defined. One simple procedure entails the formulation of some general operating instructions in addition to the obligation to implement an operation monitoring program. This program will be clear and sufficiently detailed so that compliance with the effluent requirements, the quality of the operation as well as the general condition of the treatment plant can be evaluated at the same time. Proper use of the operating requirements will ensure that all wastewater collected in the network is treated at the station.

4.2 Effluent Requirements

4.2.1 Treatment Plants

Effluent requirements should state the general characteristics applicable to all stations of the same type, as well as those characteristics unique to individual stations. These requirements should also take into account the wide range of yearly seasonal variations that can affect a treatment plant.

All stations are required to follow general requirements as to the average year-round concentration and efficiency; this is also true for shorter periods (quarter, month, or week) depending on the station category. The categories depend on the hydraulic capacity of the treatment plants or on the population equivalent. Annex C contains proposed categories for Tunisian treatment plants.

For each of those periods (annual, quarter, month, or week), the requirements are defined in terms of average concentration (mg/l), efficiency (percentage), and load (kg/d).

The average concentration (mg/l) is used to determine the optimal efficiency of the treatment plant in case of an influent organic overload. This concentration may be exceeded provided the specified efficiency is reached. Thus the efficiency is considered an optimum performance for the treatment type and period in question.

Concentration and efficiency are determined for all plants according to the type of treatment.

An average load in kg/d of effluent is assigned to each treatment plant, depending on its specific characteristics (design flow, organic loading, or characteristics used for requirements calculations). Such a load constitutes a limit to the size of the facility (pollution load treated). It quickly becomes difficult to find the required effluent load when the influent load increases significantly. It must then be decided to modify the treatment plant, to increase the treatment level, to modify the final destination of the treated effluent, or to increase the effluent pollution load.

Annex C includes a method of calculating requirements for an activated sludge treatment plant, as well as a proposed formulation of effluent requirements for a fictitious treatment plant.

The combination of these three types of requirements (concentration, efficiency, and allocated effluent load) covers most treatment plant situations and consequently forces operators to maintain their stations within their design efficiency range.

4.2.2 Networks

The sewer networks and the treatment plants form an indivisible whole. A treatment plant loses much of its usefulness if part of the wastewater is discharged upstream.

Effluent requirements must be formulated for sewer networks. In fact, this means that the network should be operated in such a way as to limit wastewater overflows upstream from a treatment plant to emergency situations or to significant rainstorms, in the case of combined networks. It is equally desirable to have baffles at all potential overflow points to keep as much floating matter as possible within the sewer networks.

More stringent requirements can also be specified for overflow works that were designed specifically to limit overflows, such as those linked to storage reservoirs or those whose pipes are designed to hold a predetermined volume of water during a rainstorm.

The terms used to formulate the requirements must be properly defined. The term "emergency situation" applies only to unforeseeable situations lasting 48 hours or less.

Once all the potential overflow points are identified, basic data (their design or the design of networks that includes them) must be obtained. The data will be used to determine whether more severe requirements may be imposed on one structure or another.

An example of proposed effluent requirements for overflow works appears in Annex D. This example covers three possible cases. The first one concerns a secondary pumping station created to pump all the flow collected in the sewer network. The second is for a pumping station in a combined sewer network. The third is a storage reservoir outlet designed to hold excess water carried through a partially combined sewer network and for a rainfall likely to occur three times a year. This example is deliberately limited because it is only intended to present a concept.

4.3 Operation Requirements

4.3.1 Treatment Plants

Since effluent requirements are limited to the parameters directly under the control of the operator, operation requirements allow for control over additional aspects of running a treatment plant. They also clearly indicate to the operator what data he should periodically include in his performance reports.

Annex E contains proposed effluent and operation requirements for a treatment plant. It is important to note that this formulation refers to effluent requirements presented in Annex C. It also proposes a "Monitoring Program for an Activated Sludge Treatment Plant."

A "Maintenance Program" must also be defined to ensure that the facilities will last. However, a detailed description of such a program is beyond the scope of this study.

These two programs will facilitate the simultaneous evaluation of compliance with effluent requirements, quality of operation, as well as the overall condition of the treatment plant (percent of design flow and of loads actually treated by the station, conditions of infrastructure and equipment, etc.).

To simplify the presentation of this report, the details of a proposed "Monitoring Program of an Activated Sludge Treatment Plant" are included in Annex E. This program is relatively elaborate because it covers the monitoring of a wide range of equipment not necessarily found in any one treatment plant. Non-applicable sections can be removed from the general program to formulate a monitoring program specific to each treatment plant.

The program is structured according to treatment plant categories defined in Annex C. For the larger treatment plants, a higher frequency of measurements and analysis of the various parameters is required. This approach matches the requirements calculation method also proposed in Annex C where the periods of requirements verification, other than the annual period, decrease with increasing treatment plant categories. Therefore, Categories 1 and 2 treatment plants are subject to quarterly requirements; Categories 3 and 4 are subject to monthly requirements; and the large category stations are subject to weekly requirements.

4.3.2 Networks

Sewer network operating requirements must allow for more than monitoring the overflow works. They must also indicate to the operator what his responsibilities are to all clients connected to the system, and must therefore include performance indicators for the operation of the sewer network.

Annex F proposes effluent and operation requirements applicable to a sewer network, as well as guidelines for the preparation of a "Network Maintenance Monitoring Program" and for the formulation of performance indices for sewer network operation. It also proposes an

"Overflow Structures Monitoring Program" pertaining to effluent requirements of overflow structures presented in Annex D.

A "Maintenance Program for Sewer Network Operation Tools" might be required for some types of private sector intervention in network operations and maintenance. However, the preparation of such a program is beyond the scope of this study.

4.3.3 General Remarks

The approach suggested here is inspired by European and North American experiences in the field of liquid waste. Numerous variations exist from one country to the other and even within a single country. In the United States, considerable differences can be found from one state to another, and in Canada, from one province to another. Regional particularities can also be found in European countries.

Existing administrative structures strongly influence liquid waste management and performance monitoring methods. However, technical analysis of wastewater infrastructure is based on the same fundamental parameters used to design the infrastructure and it must allow for the evaluation of effluent quality and quantity (concentration, efficiency, load).

Effluent and operation requirements proposed in this study take into account the specific conditions encountered in Tunisia at the time of the mission.

5 Management of Contractors

5.1 Performance Monitoring Unit

A specially trained team will oversee subcontractors. A Performance Monitoring Unit (PMU) is made up of technical personnel qualified in the design and operation of liquid waste facilities (sewer networks and treatment plants). This team will:

- prepare monitoring programs specific to each facility (treatment plant and network) and ensure that they are adopted by the private contractor;
- receive monthly reports from the operators;
- compile and analyze;
- verify compliance with the standards and requirements and take necessary actions in the case of non-compliance;
- recommend required corrective work for the liquid waste facilities;
- prepare an annual performance evaluation report for the liquid waste facilities, including:
  - compilation of results;
  - analysis of results relative to the private company's mandate;
  - verification of the performance of liquid waste facilities with respect to standards and requirements;
  - production of operation cost statistics;

  - analysis of the private company's general performance; and
  - recommendations on the private company's mandate; and
- provide scientific data for the design of new liquid waste projects, i.e., convey to designers the positive and negative lessons learned.

5.2 Activity Monitoring Notebook

In order to fulfill its mandate, the PMU should have a document containing all of the data relative to each treatment plant and sewer network for which operations and maintenance are contracted out to a private firm. This "activity monitoring book" must include:

- a detailed description of the liquid waste facilities in the contract, including:
  - a list of targeted environmental benefits;
  - a detailed list of treatment plants and network installations with a location map; and
  - a summary of design criteria for the treatment plant, pumping station, control works, etc.;
- a complete list of effluent and operation requirements applicable to these facilities;
- a description of monitoring and preventive maintenance programs for the treatment plant and sewer network;
- a list of personnel including their required training and a description of each position's tasks and responsibilities;
- a description of the content of the private company's annual report;
- an updated list of industries connected to the sewer network; and
- the final disposal site of treated effluent and sludge from the treatment plant.

This activity monitoring book, which is the main document used by the PMU and the private company to evaluate a given facility, should be continuously updated.

5.3 Data Management System

To fulfill its mandate, the PMU must rely on an efficient data management system. The computerized processing of data from all the facilities (treatment plants and networks) is essential to provide a global picture of liquid waste operations and of the performance of private firms.

The computerized system must take into account the structure of existing data systems, where they exist. It should be implemented in concert with the various ministries and agencies concerned with water pollution control in order to integrate their needs as much as possible into the new system.

The computerized data management system has three main functions: facilities inventory, data compilation and processing, and intervention planning and monitoring. It should include:

- an inventory of liquid waste facilities which makes it possible to locate and characterize the installations — this data must be constantly updated;
- identification of companies responsible for the operation of each facilities, including a list of key contact people;
- a follow-up of the PMU interventions (letters, notices, etc.);
- a summary of the main design criteria for each treatment plant;
- a description of effluent and operation requirements of each liquid waste facility;
- data collection through the monitoring programs to verify the requirements. Data can also be gathered on quantity and final destination of treated effluents and sludge from the treatment plant. It is useful to set up some form of data validation to detect errors and facilitate the work of the officers (e.g., BOD_5/COD ratio, influent load vs. design load, etc.). The feasibility of electronic data transfer at the source in order to decrease input efforts must be verified;
- the capacity to carry out certain calculations (e.g., loads, averages, etc.);
- monitoring forms specific to each project;
- control reports;
- monthly monitoring forms;
- compilation of monthly and yearly data and compliance with the requirements;
- inventory reports relating to project characteristics (e.g., list of installations, regrouping according to certain design criteria, etc.);
- reports on interventions, planned or completed; and
- management and/or statistical reports.

6 Conclusions

In the short run, it is necessary to formulate effluent and operation requirements and design an operation monitoring program for the upcoming pilot projects in contracting out liquid waste services. These requirements will be the subject of a sanitation agreement between ONAS, the owner of the facility, and the ANPE, which is in charge of effluent standards enforcement. The requirements and the program must be included in the contract between ONAS and the private enterprises selected for the pilot projects.

With respect to the relaxation of standards, it is preferable to wait for the results of the pilot projects (after a full year of operation) before deciding between the third and the fourth scenarios described in Section 3.3. The actual experience should allow an even better adaptation of the selected option and contribute to reducing the resistance to change.

Effluent and operation requirements for a treatment plant and a sewer network, effluent requirements for overflow structures, monitoring programs for activated sludge treatment plants, network maintenance, and overflow structure maintenance, as well as the tool maintenance program for sewer network operations, work together to ensure longer lasting and better performing equipment. The goal of using a variety of terms is to underline particular aspects of performance monitoring.

In order for ONAS to adequately oversee the performance of private enterprises involved in water pollution control, the following tasks, among others, must be carried out more precisely:

- the preparation of standardized forms for data collection (treatment plants: procedure and maintenance; networks: maintenance and overflow structures); and
- the precise description of the method of evaluating treatment plant procedures (calculation of loads, efficiencies, and concentrations, assessment of compliance with the requirements, etc.)

These two tasks are essential. The former will facilitate the implementation of a computerized system of data management, while the latter will avoid unnecessary disputes with private operators who might be tempted to contest their evaluation results.

These two tasks are obviously not the only ones. Section 5 of this report describes many others. Although the list is long, ONAS already possesses several tools which it will be able to adapt to its program for greater private sector participation in liquid waste services.

Finally, it is worth noting that the standards, requirements, and monitoring programs proposed in this report are strongly influenced by the North American experience, in particular that of Quebec. Although the authors have made an effort to adapt the lessons of that experience to the Tunisian context, further adaptation may result in increasingly appropriate conclusions.

Annex A

Extracts from INNORPI's Catalogue

INNORPI

Catal

Edité par l'Instit
de la Normalisation et de la
Adresse Postale : B.P. 23 - 1C
Tél.: 785.922 - Télé

CT 09 Qualité des eaux
Water quality

NT 09.01(1983) *Eqv* ISO 5667/1-1980
EP QUALITE DES EAUX - ECHANTILLONNAGE - GUIDE GENERAL POUR L'ETABLISSEMENT DES PROGRAMMES D'ECHANTILLONNAGE
WATER QUALITY - SAMPLING - PART 1 : GUIDANCE ON THE DESIGN OF SAMPLING PROGRAMMES

NT 09.02(1983) *Eqv* ISO 5667/2-1982
HOM QUALITE DES EAUX - ECHANTILLONNAGE - GUIDE GENERAL SUR LES TECHNIQUES D'ECHANTILLONNAGE
WATER QUALITY - SAMPLING - GUIDANCE ON SAMPLING - TECHNIQUES.

NT 09.03(1983)
HOM QUALITE DES EAUX - ECHANTILLONNAGE - PRECAUTIONS A PRENDRE POUR EFFECTUER, CONSERVER ET TRAITER LES PRELEVEMENTS
WATER QUALITY - SAMPLING - PRECAUTIONS TO BE TAKEN FOR CUTTING PRESERVING AND TREATING SAMPLES.

NT 09.04(1983)
ENR QUALITE DES EAUX - GUIDE POUR L'ETABLISSEMENT DES BULLETINS D'ANALYSES PHYSICO-CHIMIQUES
WATER QUALITY - GUIDE FOR THE ESTABLISHMENT OF PHYSICO - CHEMICAL ANALYSES REPORTS

NT 09.05(1983)
ENR QUALITE DES EAUX - MESURE COLORIMETRIQUE DU pH
WATER QUALITY - COLORIMETRIC MEASUREMENT OF pH

NT 09.06(1983)
HOM QUALITE DES EAUX - MESURE ELECTROMETRIQUE DU pH AVEC L'ELECTRODE DE VERRE - METHODE DE REFERENCE
WATER QUALITY - ELECTROMETRIC pH MEASUREMENT USING GLASS ELECTRODE - REFERENCE METHOD

NT 09.07(1985) *Eqv* ISO/DIS 8288
HOM QUALITE DES EAUX - DOSAGE DU Co,Ni,Cu,Zn ET Pb - METHODE PAR SPECTROMETRIE D'ABSORPTION ATOMIQUE AVEC FLAMME
WATER QUALITY - DETERMINATION OF Co,Ni,Cu,Zn,Cd, - FLAME ATOMIC ABSORPTION SPECTROMETRIC METHOD

NT 09.08(1985) *Eqv* ISO 6595-1982
HOM QUALITE DES EAUX - DOSAGE DE L'ARSENIC TOTAL - METHODE SPECTROPHOTOMETRIQUE AU DIETHYLDITHIOCARBAMATE D'ARGENT
WATER QUALITY - DETERMINATION OF TOTAL ARSENIC - SILVER DIETHYLDITHIOCARBAMATE SPECTROPHOTOMETRIC METHOD

NT 09.09(1985) *Eqv* ISO/DIS 7980
HOM QUALITE DES EAUX - DOSAGE DU Ca ET DU Mg - METHODE PAR SPECTROMETRIE D'ABSORPTION ATOMIQUE
WATER QUALITY - DETERMINATION OF CALCIUM AND MANGANESE - ATOMIC ABSORPTION SPECTROMETRIC METHOD

NT 09.10(1985) *Eqv* ISO 6058-1984
HOM QUALITE DES EAUX - DOSAGE DU CALCIUM - METHODE TITRIMETRIQUE A L'EDTA
WATER QUALITY - DETERMINATION OF CALCIUM CONTENT - EDTA TITRIMETRIC METHOD

NT 09.11(1983)
EP EAUX DE BAIGNADE - PARAMETRES PHYSICO-CHIMIQUES ET MICROBIOLOGIQUES — BATHING WATER - PHYSICO-CHEMICAL AND MICROBIOLOGICAL PARAMETERS

NT 09.12(1983)
EP EAUX DE PISCINES - QUALITES PHYSIQUES, CHIMIQUES ET BACTERIOLOGIQUES — SWIMMING POOL WATER - PHYSICAL, CHEMICAL AND BACTERIOLOGICAL PROPERTIES

NT 09.13(1983)
EP EAUX SUPERFICIELLES DESTINEES A LA PRODUCTION D'EAU ALIMENTAIRE — SURFACE WATER USED FOR THE PRODUCTION OF DRINKING WATER

NT 09.14(1983)
EP QUALITE DES EAUX DE BOISSON — QUALITY OF DRINKING WATER

NT 09.15(1983)
HOM QUALITE DES EAUX - MESURE DE L'INDICE DE DIFFUSION DITE MESURE DE LA TURBIDITE — WATER QUALITY - DETERMINATION OF THE DIFFUSION INDEX KNOWN AS TURBIDITY

NT 09.16(1983)
HOM QUALITE DES EAUX - MESURE DE LA COULEUR PAR COMPARAISON AVEC L'ECHELLE HAZEN — WATER QUALITY - COLOUR DETERMINATION BY COMPARISON WITH HAZEN SCALE

NT 09.17(1983)
HOM QUALITE DES EAUX - DETERMINATION DE L'ALCALINITE - (TITRE ALCALIMETRIQUE ET TITRE ALCALIMETRIQUE COMPLET) — WATER QUALITY - DETERMINATION OF ALKALINITY -(ALKALIMETRIC DEGREE AND COMPLETE ALKALIMETRIC DEGREE)

NT 09.18(1984)
HOM QUALITE DES EAUX - DOSAGE DE L'AZOTE AMMONIACAL — WATER QUALITY - DETERMINATION OF AMMONIACAL NITROGEN

NT 09.19(1984)
HOM QUALITE DES EAUX - MESURE DE LA DURETE AU REACTIF COMPLEXANT — WATER QUALITY - DETERMINATION OF HARDNESS BY THE CHELATING REAGENT

NT 09.20(1984)
HOM QUALITE DES EAUX - DETERMINATION DE LA DEMANDE BIOCHIMIQUE EN OXYGENE (DBO) — WATER QUALITY - DETERMINATION OF BIOCHEMICAL OXYGEN DEMAND (BOD).

NT 09.21(1984)
HOM QUALITE DES EAUX - DETERMINATION DES MATIERES EN SUSPENSION — WATER QUALITY - DETERMINATION OF SUSPENDED SOLIDS.

NT 09.22(1984)
HOM QUALITE DES EAUX - EFFLUENTS AQUEUX DES RAFFINERIES DE PETROLE - DOSAGE DES MATIERES ORGANIQUES EN SUSPENSION DANS L'EAU, EXTRACTIBLES A L'HEXANE — WATER QUALITY - AQUEOUS EFFLUENTS FROM PETROLEUM REFINERIES - DETERMINATION OF ORGANIC MATTERS IN SUSPENSION BY HEXANE EXTRACTION.

NT 09.23(1984)
HOM QUALITE DES EAUX - DETERMINATION DE LA DEMANDE CHIMIQUE EN OXYGENE (DCO) - METHODE PAR LE DICHROMATE DE POTASSIUM — WATER QUALITY - DETERMINATION OF CHEMICAL OXYGEN DEMAND (COD) - POTASSIUM DICHROMATE METHOD

NT 09.24(1983) *Idt* ISO 6107/1-1980
AD QUALITE DES EAUX - VOCABULAIRE - PREMIERE PARTIE — WATER QUALITY - VACABULARY - PART 1

NT 09.25(1985) *Eqv* ISO 6332-1982
HOM QUALITE DES EAUX - DOSAGE DU FER - METHODE SPECTROMETRIQUE A LA PHENANTHROLINE - 1.10 — WATER ANALYSIS - DETERMINATION OF IRON 1.10 - PHENANTHROLINE PHOTOMETRIC METHOD

NT 09.26(1984) *Eqv* ISO/DIS 7875
HOM QUALITE DES EAUX - DETERMINATION DES AGENTS DE SURFACE ANIONIQUES ET NON IONIQUES — WATER QUALITY - DETERMINATION OF ANIONIC AND NON - IONIC SURFACTANTS

NT 09.27(1984)
HOM QUALITE DES EAUX - DETERMINATION DE L'INDICE PHENOL — WATER QUALITY - DETERMINATION OF THE PHENOL VALUE

NT 09.28(1985) *Eqv* ISO/DIS 6333
HOM QUALITE DES EAUX - DOSAGE DU MANGANESE - METHODE SPECTROMETRIQUE A LA FORMALDOXIME — WATER QUALITY - DETERMINATION OF MANGANESE - FORMALDIXINE SPECTROMETRIC TECHNIQUE

NT 09.29(1984) *Eqv* ISO 5813-1983
HOM QUALITE DES EAUX - DOSAGE DE L'OXYGENE DISSOUS - METHODE IODOMETRIQUE — WATER QUALITY - DETERMINATION OF DISSOLVED OXYGEN - IODOMETRIC METHOD

NT 09.30(1984)
HOM QUALITE DES EAUX - DOSAGE DES NITRATES — WATER QUALITY - DETERMINATION OF NITRATES

NT 09.31(1984)
HOM QUALITE DES EAUX - DOSAGE DE L'AZOTE KJELDAHL — WATER QUALITY - DETERMINATION OF KJELDAHL NITROGEN

NT 09.33(1989) *Eqv* CODEX STAN 108-1981
HOM EAUX MINERALES NATURELLES — NATURAL MINERAL WATER

NT 09.34(1987) *Idt* ISO 7888-1985
AD QUALITE DES EAUX - DETERMINATION DE LA CONDUCTIVITE ELECTRIQUE — WATER QUALITY - DETERMINATION OF ELECTRIC CONDUCTIVITY

NT 09.35(1985) *Eqv* ISO 5961-1985
HOM QUALITE DES EAUX - DOSAGE DU CADMIUM - METHODE PAR SPECTROMETRIE D'ABSORPTION ATOMIQUE DANS LA FLAMME — WATER QUALITY - DETERMINATION OF CADMIUM - FLAME ATOMIC ABSORPTION SPECTROMETRIC METHODS

NT 09.36(1985)
HOM ESSAIS DES EAUX - DOSAGE SPECTROPHOTOMETRIQUE DU SELENIUM — TESTING OF WATER - SPECTROPHOTOMETRIC DETERMINATION OF SELENIUM

NT 09.37(1985) *Eqv* ISO 5666-1984
HOM QUALITE DES EAUX - DOSAGE DU MERCURE TOTAL PAR SPECTROMETRIE D'ABSORPTION ATOMIQUE SANS FLAMME — WATER QUALITY - DETERMINATION OF TOTAL MERCURY BY FLAMELESS ATOMIC ABSORPTION SPECTROMETRY

NT 09.38(1987)
AD QUALITE DES EAUX - EFFLUENTS AQUEUX DES RAFFINERIES DE PETROLE - ECHANTILLONNAGE

WATER QUALITY - AQUEOUS EFFLUENTS FROM PETROLEUM REFINERIES - SAMPLING

NT 09.40(1987)
AD QUALITE DES EAUX - EFFLUENTS AQUEUX DES RAFFINERIES DE PETROLE - DOSAGE DES PHENOLS

WATER QUALITY - AQUEOUS EFFLUENTS FROM PETROLEUM REFINERIES - DETERMINATION OF PHENOLS

NT 09.41(1988) *Idt* ISO 6703/1-1984
AD QUALITE DES EAUX - DOSAGE DES CYANURES - PREMIERE PARTIE : DOSAGE DES CYANURES TOTAUX

WATER QUALITY - DETERMINATION OF CYANIDE - PART 1 : DETERMINATION OF TOTAL CYANIDE

NT 09.42(1988) *Idt* ISO 6703/2-1984
ENR QUALITE DES EAUX - DOSAGE DES CYANURES - DEUXIEME PARTIE : DOSAGE DES CYANURES AISEMENT LIBERABLES

WATER QUALITY - DETERMINATION OF CYANIDE - PART 2 : DETERMINATION OF EASILY LIBERATABLE CYANIDE

NT 09.43(1988) *Idt* ISO 6703/3-1984
ENR QUALITE DES EAUX - DOSAGE DES CYANURES - TROISIEME PARTIE : DOSAGE DU CHLORURE DE CYANOGENE

WATER QUALITY - DETERMINATION OF CYANIDE - PART 3 : DETERMINATION OF CYANOGEN CHLORIDE

NT 09.44(1990) *Idt* ISO 6703/4-1985
AD QUALITE DES EAUX - DOSAGE DES CYANURES - DOSAGE DES CYANURES PAR DIFFUSION A pH 6

WATER QUALITY - DETERMINATION OF CYANIDE - DETERMINATION OF CYANIDE BY DIFFUSION AT pH 6

NT 09.45(1990) *Eqv* ISO 5814-1990
AD QUALITE DES EAUX - DOSAGE DE L'OXYGENE DISSOUS - METHODE ELECTROCHIMIQUE A LA SONDE

WATER QUALITY - DETERMINATION OF DISSOLVED OXYGEN - ELECTROCHEMICAL PROBE METHOD

NT 09.48(1990) *Idt* ISO 6777-1984
AD QUALITE DES EAUX - DOSAGE DES NITRITES - METHODE PAR SPECTROMETRIE D'ABSORPTION MOLECULAIRE

WATER QUALITY - DETRMINATION OF NITRITE - MOLECULAR ABSORPTION SPECTROMETRIC METHOD

NT 09.54(1989)
EP QUALITE DES EAUX - DETERMINATION DES RESIDUS SECS, DU RESIDU CALCINE ET DU RESIDU SULFATE

WATER QUALITY - DETERMINATION OF DRY RESIDUES, CALCINED RESIDUE AND SULFATED RESIDUE

NT 09.65(1989)
ENR QUALITE DES EAUX - DOSAGE DU SODIUM ET DU POTASSIUM - METHODE PAR SPECTROMETRIE D'EMISSION DE FLAMME

WATER QUALITY - DETERMINATION OF SODIUM AND POTASSIUM - FLAME EMISSION SPECTROMETRY METHOD

NT 09.66(1989)
ENR QUALITE DES EAUX - DOSAGE DU SODIUM ET DU POTASSIUM - METHODE PAR SPECTROMETRIE D'ABSORPTION ATOMIQUE

WATER QUALITY - DETERMINATION OF SODIUM AND POTASSIUM - ATOMIC ABSORPTION SPECTROMETRY METHODD

NT 09.72(1987) *Idt* ISO 6107/2-1981

AD QUALITE DE L'EAU - VOCABULAIRE - DEUXIEME PARTIE — WATER QUALITY - VOCABULARY - PART 2

NT 09.73(1987) *Idt* ISO 6107/3-1981

AD QUALITE DE L'EAU - VOCABULAIRE - TROISIEME PARTIE — WATER QUALITY - VOCABULARY - PART 3

NT 09.74(1987) *Idt* ISO 6107/4-1984

AD QUALITE DE L'EAU - VOCABULAIRE - QUATRIEME PARTIE — WATER QUALITY - VOCABULARY - PART 4

NT 09.75(1988) *Idt* ISO 6107/5-1986

AD QUALITE DE L'EAU - VOCABULAIRE - CINQUIEME PARTIE — WATER QUALITY - VOCABULARY - PART 5

NT 09.76(1988) *Idt* ISO 6107/6-1986

AD QUALITE DE L'EAU - VOCABULAIRE - SIXIEME PARTIE — WATER QUALITY - VOCABULARY - PART 6

NT 09.77(1989) *Idt* ISO/DIS 9297

EP QUALITE DES EAUX - DOSAGE DES CHLORURES - TITRAGE AU NITRATE D'ARGENT AVEC DU CHROMATE COMME INDICATEUR - (METHODE DE MOHR) — WATER QUALITY - DETERMINATION OF CHLORIDE - SILVER NITRATE TITRATION WITH CHROMATE INDICATOR (MOHR'S METHOD)

NT 09.78(1989) *Idt* ISO/DIS 9280

EP QUALITE DES EAUX - DOSAGE DES SULFATES - METHODE GRAVIMETRIQUE AU CHLORURE DE BARYUM — WATER QUALITY - DETERMINATION OF SULFATE - GRAVIMETRIC METHOD USING BARIUM CHLORIDE.

NT 09.80(1989)

EP QUALITE DES EAUX - DOSAGE DE LA SILICE — WATER QUALITY - DETERMINATION OF SILICA

NT 09.83(1989) *Eqv* CODEX STAN 108-1981

HOM EAUX DE TABLE CONDITIONNEES — CONDITIONED BOTTLED WATER

CT 16 Microbiologie alimentaire / Food microbiology

NT 16.08(1983)
EP EAUX - ECHANTILLONNAGE EN VUE DU CONTROLE BACTERIOLOGIQUE — WATER - SAMPLING FOR BACTERIOLOGICAL ANALYSIS

NT 16.09(1983)
EP VIANDES ET PRODUITS A BASE DE VIANDE - EXAMEN MICROBIOLOGIQUE - PREMIERE PARTIE: ECHANTILLON POUR ESSAI - SUSPENSION MERE ET DILUTIONS — MEAT AND MEAT PRODUCTS - MICROBIOLOGICAL ANALYSIS - PART 1 : TEST SAMPLE - MOTHER SUSPENSION AND DILUTIONS

NT 16.10(1988) *Idt* ISO 4832-1978
AD MICROBIOLOGIE - DIRECTIVES GENERALES POUR LE DENOMBREMENT DES COLIFORMES - METHODE PAR COMPTAGE DES COLONIES OBTENUES A 30 DEGRES C — MICROBIOLOGY - GENERAL GUIDANCE FOR ENUMERATION OF COLIFORMS - COLONY COUNT TECHNIQUE AT 30 DEGREES C

NT 16.11(1988) *Idt* ISO 4831-1978
AD MICROBIOLOGIE - DIRECTIVES GENERALES POUR LE DENOMBREMENT DES COLIFORMES - TECHNIQUE DU NOMBRE LE PLUS PROBABLE APRES INCUBATION A 30 DEGRES C — MICROBIOLOGY - GENERAL GUIDANCE FOR THE ENUMERATION OF COLIFORMS - MOST PROBABLE NUMBER TECHNIQUE AT 30 DEGREES C

NT 16.12(1988) *Idt* ISO 7251-1984
AD MICROBIOLOGIE - DIRECTIVES GENERALES POUR LE DENOMBREMENT D'ESCHERICHIA COLI PRESUMES - TECHNIQUE DU NOMBRE LE PLUS PROBABLE — MICROBIOLOGY - GENERAL GUIDANCE FOR ENUMERATION OF PRESUMPTIVE ESCHERICHIA COLI - MOST PROBABLE NUMBER TECHNIQUE

NT 16.13(1991) *Idt* ISO 6888-1983
AD MICROBIOLOGIE - DIRECTIVES GENERALES POUR LE DENOMBREMENT DE STAPHYLOCOCCUS AUREUS - METHODE PAR COMPTAGE DES COLONIES — MICROBIOLOGY - GENERAL GUIDANCE FOR ENUMERATION OF STAPHYLOCOCCUS AUREUS - COLONY COUNT TECHNIQUE

NT 16.14(1991) *Idt* ISO 4833-1978
AD MICROBIOLOGIE - DIRECTIVES GENERALES POUR LE DENOMBREMENT DES MICRO-ORGANISMES - METHODE PAR COMPTAGE DES COLONIES OBTENUES A 30 DEGRES C — MICROBIOLOGY - GENERAL GUIDANCE FOR ENUMERATION OF MICRO-ORGANISMS - COLONY COUNT TECHNIQUE AT 30 DEGREES C

NT 16.15(1991) *Idt* ISO 6579-1990
AD MICROBIOLOGIE - DIRECTIVES GENERALES CONCERNANT LES METHODES DE RECHERCHE DES SALMONELLA — MICROBIOLOGY - GENERAL GUIDANCE ON METHODS FOR THE DETECTION OF SALMONELLA

NT 16.16(1983)
EP MICROBIOLOGIE ALIMENTAIRE - DIRECTIVES GENERALES POUR LE DENOMBREMENT DES LEVURES ET MOISISSURES — FOOD MICROBIOLOGY - GENERAL GUIDANCE FOR THE ENUMERATION OF YEASTS AND MOULDS

NT 16.17(1983)

EP MICROBIOLOGIE ALIMENTAIRE - DIRECTIVES GENERALES POUR LE DENOMBREMENT DES SPORES DE CLOSTRIDIUM SULFITO-REDUCTEURS MESOPHILES

FOOD MICROBIOLOGY - GENERAL GUIDANCE FOR THE ENUMERATION OF MESOPHILE SULFITO-REDUCING CLOSTRIDIUM SPORES

NT 16.18(1991) *Idt* ISO 7937-1985

AD MICROBIOLOGIE - DIRECTIVES GENERALES POUR LE DENOMBREMENT DE CLOSTRIDIUM PERFRINGENS - METHODE PAR COMPTAGE DES COLONIES

MICROBIOLOGY - GENERAL GUIDANCE FOR ENUMERATION OF CLOSTRIDIUM PERFRINGENS - COLONY COUNT TECHNIQUE

NT 16.19(1983)

EP MICROBIOLOGIE ALIMENTAIRE - RECHERCHE DE CLOSTRIDIUM BOTULINUM ET DE LA TOXINE BOTULIQUE

FOOD MICROBIOLOGY - DETECTION OF CLOSTRIDIUM BOTULINUM AND OF BOTULIN

NT 16.20(1983)

EP MICROBIOLOGIE ALIMENTAIRE - DIRECTIVES GENERALES POUR LE DENOMBREMENT DE BACILLUS CEREUS

FOOD MICROBIOLOGY - GENERAL GUIDANCE FOR THE ENUMERATION OF BACILLUS CEREUS

NT 16.21(1983)

EP EAUX - DIRECTIVES GENERALES POUR LE DENOMBREMENT DES COLIFORMES - TECHNIQUE DU NOMBRE LE PLUS PROBABLE APRES INCUBATION A 35 DEGRES C - 37 DEGRES C

WATER - GENERAL GUIDANCE FOR THE ENUMERATION OF COLIFORMS - MOST PROBABLE NUMBER TECHNIQUE AT 35 TO 37 DEGREES C

NT 16.22(1984)

EP EAUX - DENOMBREMENT DES COLIFORMES TOTAUX ET FECAUX - METHODE PAR FILTRATION SUR MEMBRANE

WATER - ENUMERATION OF TOTAL AND FAECAL COLIFORMS - MEMBRANE FILTRATION TECHNIQUE

NT 16.23(1984)

EP EAUX - DENOMBREMENT DES STREPTOCOQUES FECAUX - METHODE PAR FILTRATION SUR MEMBRANE

WATER - ENUMERATION OF FAECAL STREPTOCOCCUS - MEMBRANE FILTRATION TECHNIQUE

NT 16.24(1984)

EP EAUX - DIRECTIVES GENERALES POUR LE DENOMBREMENT DES STREPTOCOQUES FECAUX

WATER - GENERAL GUIDANCE FOR THE ENUMERATION OF FAECAL STREPTOCOCCUS

NT 16.25(1984)

EP CONSERVES - METHODE DE PRELEVEMENT ASEPTIQUE EN VUE DE L'ANALYSE MICROBIOLOGIQUE

PRESERVES - METHOD OF ASEPTIC SAMPLING FOR MICROBIOLOGICAL ANALYSIS

NT 16.26(1984)

EP MICROBIOLOGIE ALIMENTAIRE - CONSERVES DE pH SUPERIEUR OU EGAL A 4,5 - CONTROLE DE STABILITE

MICROBIOLOGY OF FOOD AND FEEDING STUFFS - PRESERVES WITH A pH VALUE GREATER THAN OR EQUAL TO 4,5 - DETERMINATION OF STABILITY

NT 16.27(1984)

EP MICROBIOLOGIE ALIMENTAIRE - CONSERVES DE pH INFERIEUR A 4,5 - CONTROLE DE LA STABLITE A 32 DEGRES C

MICROBIOLOGY OF FOOD AND FEEDING STUFFS - PRESERVES WITH A pH VALUE LOWER THAN 4,5 - DETERMINATION OF STABILITY AT 32 DEGREES C

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NT 16.28(1984)

EP MICROBIOLOGIE ALIMENTAIRE - PRODUITS DESHYDRATES - EXAMEN MICROBIOLOGIQUE

MICROBIOLOGY OF FOODSTUFFS - DEHYDRATED PRODUCTS - MICROBIOLOGICAL ANALYSIS

NT 16.29(1984)

EP MICROBIOLOGIE ALIMENTAIRE - ALIMENTS POUR ANIMAUX - EXAMEN MICROBIOLOGIQUE

FOOD MICROBIOLOGY - ANIMAL FEEDING STUFFS - MICROBIOLOGICAL ANALYSIS

NT 16.30(1985) *Eqv* ISO/DIS 6461/1

AD QUALITE DE L'EAU - RECHERCHE ET DENOMBREMENT DES SPORES DE MICRO-ORGANISMES ANAEROBIES SULFITO-REDUCTEURS (CLOSTRIDIA) - PREMIERE PARTIE : METHODE PAR ENRICHISSEMENT DANS UN MILIEU LIQUIDE

WATER QUALITY - DETECTION AND ENUMERATION OF SULFITO-REDUCING ANAEROBIC MICRO-ORGANISM SPORES (CLOSTRIDIA) - PART 1 : LIQUID MEDIUM ENRICHMENT TECHNIQUE.

NT 16.31(1985) *Eqv* ISO/DIS 6461/2

AD QUALITE DE L'EAU - RECHERCHE ET DENOMBREMENT DES SPORES DE MICRO-ORGANISMES ANAEROBIES SULFITO-REDUCTEURS (CLOSTRIDIA) - DEUXIEME PARTIE : METHODE PAR FILTRATION SUR MEMBRANE

WATER QUALITY - DETECTION AND ENUMERATION OF SULFITO - REDUCING ANAEROBIC MICRO-ORGANISM SPORES (CLOSTRIDIA) PART 2 : MEMBRANE FILTRATION TECHNIQUE

NT 16.39(1988)

AD SPECIFICATIONS MICROBIOLOGIQUES - INTERPRETATION DES RESULTATS D'ANALYSE

MICROBIOLOGICAL SPECIFICATIONS - INTERPRETATION OF ANALYSIS RESULTS

NT 16.40(1988)

AD SPECIFICATIONS MICROBIOLOGIQUES - LAIT ET PRODUITS LAITIERS

MICROBIOLOGICAL SPECIFICATIONS - MILK AND MILK PRODUCTS

NT 16.44(1991) *Idt* ISO 7667-1983

AD MICROBIOLOGIE - PLAN NORMALISE POUR LES METHODES D'EXAMEN MICROBIOLOGIQUE

MICROBIOLOGY - STANDARD LAYOUT FOR METHODS OF MICROBIOLOGICAL EXAMINATION

NT 16.45(1991) *Idt* ISO 6887-1983

AD MICROBIOLOGIE - DIRECTIVES GENERALES POUR LA PREPARATION DES DILUTIONS EN VUE DE L'EXAMEN MICROBIOLOGIQUE

MICROBIOLOGY - GENERAL GUIDANCE FOR THE PREPARATION OF DILUTIONS FOR MICROBIOLOGICAL EXAMINATION

NT 16.46(1991) *Idt* ISO 7218-1985

AD MICROBIOLOGIE - DIRECTIVES GENERALES POUR LES EXAMENS MICROBIOLOGIQUES

MICROBIOLOGY - GENERAL GUIDANCE FOR MICROBIOLOGICAL EXAMINATIONS

NT 16.47(1991) *Idt* ISO 7402-1985

AD MICROBIOLOGIE - DIRECTIVES GENERALES POUR LE DENOMBREMENT SANS REVIVIFICATION DES ENTEROBACTERIACEAE - TECHNIQUE DU NOMBRE LE PLUS PROBABLE ET METHODE PAR COMPTAGE DES COLONIES

MICROBIOLOGY - GENERAL GUIDANCE FOR THE ENUMERATION OF ENTEROBACTERIACEAE WITHOUT RESUSCITATION - MOST PROBABLE NUMBER TECHNIQUE AND COLONY COUNT TECHNIQUE

NT 97.12(1986) *Eqv* ISO/DIS 5730

AD	CHAUDIERES A TUBE DE FUMEE DE CONSTRUCTION SOUDEE (AUTRES QUE CHAUDIERES AQUATUBULAIRES)	STATIONARY SHELL BOILERS OF WELDED CONSTRUCTION (OTHER THAN WATER-TUBE BOILERS)

NT 97.13(1988)

AD	ROBINETS DE BOUTEILLES A GAZ DE PETROLE LIQUEFIE 13/25 Kg	VALVES FOR LIQUEFIED PETROLEUM GAZ CYLINDERS OF 13/25 Kg

CT 106 Protection de l'environnement
Protection of environment

NT 106.01(1983)

EP	NORMES DE REJETS DE NOCIVITE NEGLIGEABLE	STANDARDS FOR WASTES WITH INSIGNIFICANT NOXIOUSNESS

NT 106.02(1989)

HOM	PROTECTION DE L'ENVIRONNEMENT - REJETS D'EFFUENTS DANS LE MILIEU HYDRIQUE	PROTECTION OF ENVIRONMENT - EFFLUENT WASTES IN HYDRIC ENVIRONMENT

NT 106.03(1989)

HOM	PROTECTION DE L'ENVIRONNEMENT - UTILISATION DES EAUX USEES TRAITEES A DES FINS AGRICOLES - SPECIFICATIONS PHYSICO-CHIMIQUES ET BIOLOGIQUES	PROTECTION OF ENVIRONMENT - USE OF TREATED WASTWATERS IN AGRICULTURE - PHYSICO-CHEMICAL AND BIOLOGICAL SPECIFICATIONS

CT 110 Assurance de la qualité / Quality assurance

NT 110.01(1987) *Idt* ISO 3534-1977
ENR STATISTIQUE - VOCABULAIRE ET SYMBOLES — STATISTICS - VOCABULARY AND SYMBOLS

NT 110.02(1991) *Idt* ISO/DIS 3534/2
ENR STATISTIQUE - VOCABULAIRE ET SYMBOLES - PARTIE 2 : MAITRISE STATISTIQUE DE LA QUALITE — STATISTICS - VOCABULARY AND SYMBOLS - PART 2 : STATISTICAL QUALITY CONTROL

NT 110.03(1987) *Idt* ISO 3534/3-1985
ENR STATISTIQUE - VOCABULAIRE ET SYMBOLES - PARTIE 3 : PLANS D'EXPERIENCE — STATISTICS - VOCABULARY AND SYMBOLS - PART 3 : DESIGN OF EXPERIMENTS

NT 110.04(1987) *Idt* ISO 3301-1975
ENR INTERPRETATION STATISTIQUE DES DONNEES - COMPARAISON DE DEUX MOYENNES DANS LE CAS D'OBSERVATIONS APPARIEES — STATISTICAL INTERPRETATION OF DATA - COMPARISON OF TWO MEANS IN THE CASE OF PAIRED OBSERVATIONS

NT 110.06(1987) *Idt* ISO 3207-1975
ENR INTERPRETATION STATISTIQUE DES DONNEES - DETERMINATION D'UN INTERVALLE STATISTIQUE DE DISPERSION — STATISTICAL INTERPRETATION OF DATA - DETERMINATION OF A STATISTICAL TOLERANCE INTERVAL

NT 110.07(1987) *Idt* ISO 2602-1980
ENR INTERPRETATION STATISTIQUE DE RESULTATS D'ESSAIS - ESTIMATION DE LA MOYENNE - INTERVALLE DE CONFIANCE — STATISTICAL INTERPRETATION OF TEST RESULTS - ESTIMATION OF THE MEAN - CONFIDENCE INTERVAL

NT 110.08(1990) *Idt* ISO 3951-1989
ENR REGLES ET TABLES D'ECHANTILLONNAGE POUR LES CONTROLES PAR MESURES DES POURCENTAGES DE NON CONFORMES — SAMPLING PROCEDURES AND CHARTS FOR INSPECTION BY VARIABLES FOR PERCENT NONCONFORMING

NT 110.09(1987) *Idt* ISO 2854-1976
ENR INTERPRETATION STATISTIQUE DES DONNEES - TECHNIQUES D'ESTIMATION ET TESTS PORTANT SUR DES MOYENNES ET DES VARIANCES — STATISTICAL INTERPRETATION OF DATA - TECHNIQUES OF ESTIMATION AND TESTS RELATING TO MEANS AND VARIANCES

NT 110.10(1987) *Idt* ISO 3494-1976
ENR INTERPRETATION STATISTIQUE DES DONNEES - EFFICACITE DES TESTS PORTANT SUR DES MOYENNES ET DES VARIANCES — STATISTICAL INTERPRETATION OF DATA - POWER OF TESTS RELATING TO MEANS AND VARIANCES

NT 110.12(1990) *Idt* ISO 2859/1-1989
ENR REGLES D'ECHANTILLONNAGE POUR LES CONTROLES PAR ATTRIBUTS - PARTIE 1 : PLANS D'ECHANTILLONNAGE POUR LES CONTROLES LOT PAR LOT, INDEXES D'APRES LE NIVEAU DE QUALITE ACCEPTABLE (NQA) — SAMPLING PROCEDURES FOR INSPECTION BY ATTRIBUTES - PART 1 : SAMPLING PLANS INDEXED BY ACCEPTABLE QUALITY LEVEL (AQL) FOR LOT - BY - LOT INSPECTION

NT 110.14(1987) *Idt* ISO 2859/2-1985

ENR REGLES D'ECHANTILLONNAGE POUR LES CONTROLES PAR ATTRIBUTS - PARTIE 2 : PLANS D'ECHANTILLONNAGE POUR LES CONTROLES DE LOTS ISOLES, INDEXES D'APRES LA QUALITE LIMITE (QL)

SAMPLING PROCEDURES FOR INSPECTION BY ATTRIBUTES - PART 2 : SAMPLING PLANS INDEXED BY LIMITING QUALITY (LQ) FOR ISOLATED LOT INSPECTION

NT 110.17(1987) *Idt* ISO 8402-1986

ENR QUALITE - VOCABULAIRE

QUALITY - VOCABULARY

NT 110.18(1987) *Idt* ISO 9000-1987

ENR NORMES POUR LA GESTION DE LA QUALITE ET L'ASSURANCE DE LA QUALITE - LIGNES DIRECTRICES POUR LA SELECTION ET L'UTILISATION

QUALITY MANAGEMENT AND QUALITY ASSURANCE STANDARDS - GUIDELINES FOR SELECTION AND USE

NT 110.19(1987) *Idt* ISO 9001-1987

ENR SYSTEMES QUALITE - MODELE EN VUE D'ASSURER L'APTITUDE EN MATIERE DE CONCEPTION/DEVELOPPEMENT, DE PRODUCTION, D'INSTALLATION ET D'ENTRETIEN

QUALITY SYSTEMS - MODEL FOR QUALITY ASSURANCE IN DESIGN/DEVELOPMENT, PRODUCTION, INSTALLATION AND SERVICING

NT 110.20(1987) *Idt* ISO 9002-1987

ENR SYSTEMES QUALITE - MODELE EN VUE D'ASSURER L'APTITUDE EN MATIERE DE PRODUCTION ET D'INSTALLATION

QUALITY SYSTEMS - MODEL FOR QUALITY ASSURANCE IN PRODUCTION AND INSTALLATION

NT 110.21(1987) *Idt* ISO 9003-1987

ENR SYSTEMES QUALITE - MODELE EN VUE D'ASSURER L'APTITUDE EN MATIERE DE CONTROLE FINAL ET D'ESSAIS

QUALITY SYSTEMS - MODEL FOR QUALITY ASSURANCE IN FINAL INSPECTION AND TEST

NT 110.22(1987) *Idt* ISO 9004-1987

ENR GESTION DE LA QUALITE ET ELEMENTS DE SYSTEMES DE QUALITE - PRINCIPES DIRECTEURS

QUALITY MANAGEMENT AND QUALITY SYSTEM ELEMENTS - GUIDELINES

NT 110.24(1988)

ENR TABLES STATISTIQUES ET ABAQUES - BIBLIOGRAPHIE

STATISTICAL TABLES AND NOMOGRAMS - BIBLIOGRAPHY

NT 110.25(1988)

ENR VOCABULAIRE DU CONTROLE DE LA QUALITE

VOCABULARY OF QUALITY CONTROL

NT 110.26(1988)

ENR GENERALITES SUR LE CONTROLE DES FABRICATIONS CONTINUES

GENERAL RULES ON THE CONTROL OF CONTINUOUS MANUFACTURING

NT 110.28(1988)

ENR METHODES DE CONTROLE DE LA QUALITE TECHNIQUE D'UNE FOURNITURE DE PRODUITS INDUSTRIELS

CONTROL METHODS FOR TECHNICAL QUALITY OF A DELIVERY OF INDUSTRIAL PRODUCTS

NT 110.29(1988)

ENR ECHANTILLONNAGE DES PRODUITS LIQUIDES ET PULVERULENTS EN VRAC OU CONDITIONNES - CONSIDERATIONS GENERALES

SAMPLING OF LIQUID PRODUCTS AND POWDERS IN BULK OR PREPACKAGED

NT 110.30(1990) *Idt* GUIDE ISO/CEI 2-1986

ENR TERMES GENERAUX ET LEURS DEFINITIONS CONCERNANT LA NORMALISATION ET LES ACTIVITES CONNEXES

GENERAL TERMS AND THEIR DEFINITIONS CONCERNING STANDARDIZATION AND RELATED ACTIVITIES

NT 110.31(1988)

ENR APPLICATION DE LA STATISTIQUE - SELECTION DE PLANS D'ECHANTILLONNAGE POUR LE CONTROLE PAR COMPTAGE (PROPORTION D'INDIVIDUS NON CONFORMES ET NOMBRE MOYEN DE CARACTERES NON CONFORMES PAR UNITE)

APPLICATION OF STATISTICS - SELECTION AND SAMPLING PLANS FOR CONTROL BY COUNTING (PROPORTION OF NON-CONFORMING UNITS AND AVERAGE NUMBER OF NON-CONFORMING CHARACTERISTICS BY UNIT)

NT 110.32(1988)

ENR APPLICATION DE LA STATISTIQUE - SELECTION DE PLANS D'ECHANTILLONNAGE POUR LE CONTROLE PAR MESURAGE DE LA PROPORTION D'INDIVIDUS NON CONFORMES

APPLICATION OF STATISTICS - SELECTION OF SAMPLING PLANS FOR INSPECTION BY MEASURING THE PROPORTION OF NON-CONFORMING UNITS

NT 110.33(1988)

ENR PLANS D'ECHANTILLONNAGE PROGRESSIFS POUR LE CONTROLE PAR COMPTAGE - (PROPORTION D'INDIVIDUS NON CONFORMES ET NOMBRE MOYEN DE CARACTERES NON CONFORMES PAR UNITE)

SEQUENTIAL SAMPLING PLANS FOR INSPECTION BY ATTRIBUTES (PROPORTION OF NON-CONFORMING ITEMS AND AVERAGE NUMBER OF NON-CONFORMING CHARACTERISTICS PER UNIT)

NT 110.34(1988)

ENR PLANS D'ECHANTILLONNAGE PROGRESSIFS POUR LE CONTROLE PAR MESURAGE DE LA PROPORTION D'INDIVIDUS NON CONFORMES (ECART TYPE CONNU)

SEQUENTIAL SAMPLING PLANS FOR INSPECTION BY VARIABLES OF THE PROPORTION OF NON-CONFORMING TEMS (KNOWN STANDARD - DEVIATION)

NT 110.35(1989)

ENR CONTROLE EN COURS DE FABRICATION - CARTES DE CONTROLE

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NT 110.36(1988)

ENR APPLICATION DE LA STATISTIQUE - TRAITEMENT DES RESULTATS DE MESURE - DETERMINATION DE L'INCERTITUDE ASSOCIEE AU RESULTAT FINAL

APPLICATION OF STATISTICS - TREATMENT OF MEASUREMENT RESULTS - DETERMINATION OF UNCERTAINTY RELATED TO FINAL RESULT

NT 110.37(1988)

ENR APPLICATION DE LA STATISTIQUE - TRAITEMENT DES RESULTATS DE MESURE - UTILISATION DE GRANDEURS DE REFERENCE DANS LES METHODES DE MESURE

APPLICATION OF STATISTICS - TREATMENT OF MEASUREMENT RESULTS - USE OF REFERENCE QUANTITIES IN METHODS OF MEASUREMENT

NT 110.38(1988)

ENR APPLICATION DE LA STATISTIQUE - TRAITEMENT DES RESULTATS DE MESURE - PROPAGATION DES ERREURS

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NT 110.42(1988)
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NT 110.43(1988) *Idt* GUIDE ISO/CEI 14-1977
ENR INFORMATION SUR LES PRODUITS POUR LES CONSOMMATEURS

PRODUCT INFORMATION FOR CONSUMERS

NT 110.44(1988) *Idt* GUIDE ISO/CEI 39-1982
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NT 110.45(1988) *Idt* GUIDE ISO/CEI 37-1983
ENR INSTRUCTIONS D'EMPLOI POUR LES PRODUITS PRESENTANT UN INTERET POUR LES CONSOMMATEURS

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✓ NT 110.46(1988) *Idt* GUIDE ISO/CEI 39-1983
ENR PRESCRIPTIONS GENERALES POUR L'ACCEPTATION DES ORGANISMES DE CONTROLE

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✓ NT 110.47(1988) *Idt* GUIDE ISO/CEI 25-1982
ENR PRESCRIPTIONS GENERALES CONCERNANT LA COMPETENCE TECHNIQUE DES LABORATOIRES D'ESSAIS

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✓ NT 110.48(1988) *Idt* GUIDE ISO/CEI 38-1983
ENR PRESCRIPTIONS GENERALES POUR L'ACCEPTATION DES LABORATOIRES D'ESSAIS

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✓ NT 110.49(1988) *Idt* GUIDE ISO/CEI 43-1984
ENR DEVELOPPEMENT ET MISE EN OEUVRE DES ESSAIS D'APTITUDE DE LABORATOIRES

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ENR LIGNES DIRECTRICES POUR LA PRESENTATION DES RESULTATS D'ESSAIS

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NT 110.51(1989) *Idt* GUIDE ISO/CEI 49-1986
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ENR CARTES DE CONTROLE - PRINCIPES GENERAUX ET INTRODUCTION A L'EMPLOI

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NT 110.57(1989) *Idt* ISO/DIS 7873
ENR CARTES DE CONTROLE DE LA MOYENNE ARITHMETIQUE A LIMITES DE SURVEILLANCE

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NT 110.58(1989) *Eqv* ISO/DIS 8422
ENR PLANS D'ECHANTILLONNAGE PROGRESSIFS POUR LE CONTROLE PAR ATTRIBUTS

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NT 110.59(1989) *Eqv* ISO/DIS 8423

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NT 110.75(1989)

ENR MAINTENANCE - VOCABULAIRE DE MAINTENANCE ET DE GESTION DES BIENS DURABLES

MAINTENANCE - VOCABULARY FOR MAINTENANCE AND MANAGEMENT OF DURABLES

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NT 110.80(1989)

ENR ANALYSE DE LA VALEUR - VOCABULAIRE

VALUE ENGINEERING/ANALYSIS - VOCABULARY

NT 110.81(1992)

ENR CONTRATS DE MAINTENANCE - CLAUSES TECHNIQUES

MAINTENANCE CONTRACTS - TECHNICAL CLAUSES

NT 110.82(1989)

ENR DUREE DE VIE ET DURABILITE DES BIENS - VOCABULAIRE

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ENR MAINTENABILITE - LISTE DE CRITERES DE MAINTENABILITE D'UN BIEN DURABLE

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NT 110.105(1992) *Idt* ISO 9004/2-1991
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NT 110.107(1992) *Idt* ISO 8595-1989
ENR INTERPRETATION DES DONNEES STATISTIQUES - ESTIMATION D'UNE MEDIANE — INTERPRETATION OF STATISTICAL DATA - ESTIMATION OF A MEDIAN

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NT 110.125(1991) *Eqv* CEI 812-1985
ENR TECHNIQUES D'ANALYSE DE LA FIABILITE DES SYSTEMES - PROCEDURE D'ANALYSE DES MODES DE DEFAILLANCE ET LEURS EFFETS (AMDE) — ANALYSIS TECHNIQUES FOR SYSTEM RELIABILITY - PROCEDURE FOR FAILURE MODE AND EFFECTS ANALYSIS (FMEA)

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NT 110.134(1991) *Idt* ISO/DIS 9712
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NT 111.01(1985) *Idt* ISO/DIS 3461/1
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NT 111.05(1985) *Idt* ISO 7000-1984
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EP SYMBOLES DESTINES A L'INFORMATION DU PUBLIC — PUBLIC INFORMATION SYMBOLS

NT 111.07(1985) *Idt* ISO/TR 7239-1984
EP ELABORATION ET PRINCIPES DE MISE EN OEUVRE DES PICTOGRAMMES DESTINES A L'INFORMATION DU PUBLIC — DEVELOPMENT AND PRINCIPLES FOR APPLICATION OF PUBLIC INFORMATION SYMBOLS

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Annex B

Standard NT 106.002
Standard NT 106.003

CDU: 614.76.778

NORME TUNISIENNE	PROTECTION DE L'ENVIRONNEMENT - REJETS D'EFFLUENTS DANS LE MILIEU HYDRIQUE	N.T 106.002 (1989)

AVANT-PROPOS

La présente norme est un document résultant d'un long travail bibliographique entrepris par quatre ministères (Agriculture, Economie nationale, Santé publique et Equipement). Elle contribue à la bonne application du décret N° 85.56 du 2 janvier 1985 relatif à la réglementation des rejets dans le milieu récepteur et du décret n°79-768 du 8 septembre 1979, réglementant les conditions de branchement et de déversement des effluents dans le réseau public d'assainissement.

SOMMAIRE

1. OBJET ET DOMAINE D'APPLICATION

2. REFERENCES

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4. NOTES

Descripteurs: Milieu, Milieu hydrique, Rejet.

Date de prise d'effet : 1 octobre 1989	Norme homologuée par arrêté du ministre de l'Economie Nationale du 20 Juillet 1989, JORT N° 59, page 1322	© I.N.NOR.P.I. Droits de reproduction réservés pour tous pays

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1. OBJET ET DOMAINE D'APPLICATION

La présente norme a pour objet de définir les conditions auxquelles sont subordonnés les rejets d'effluents dans le milieu hydrique soumis à autorisation (cf chapitre III du décret 85.56 du 2 janvier 1985)et les conditions de branchement et de déversement des effluents dans le réseau public d'assainissement (cf décret n°79-768 du 8 septembre 1979).

2. REFERENCES

NT 09.05 (1983) : Qualité des eaux - Mesure colorimétrique du pH.

NT 09.06 (1983) : Qualité des eaux - Mesure électrométrique du pH avec l'électrode de verre - Méthode de référence.

NT 09.07 (1985) : Qualité des eaux - Dosage du Co, Ni, Cu, Zn, Cd et Pb- Méthode par spectrométrie d'absorption atomique avec flamme.

NT 09.08 (1985) : Qualité des eaux - Dosage de l'arsenic total - Méthode spectrophotométrique au diéthyldithiocarbamate d'argent.

NT 09.09 (1985) : Qualité des eaux - Dosage du Ca et du Mg - Méthode par spectrométrie d'absorption atomique.

NT 09.10 (1985) : Qualité des eaux - Dosage du calcium - Méthode titrimétrique à l'EDTA.

NT 09.15 (1983) : Qualité des eaux - Mesure de l'indice de diffusion dite mesure de la turbidité.

NT 09.16 (1983) : Qualité des eaux - Mesure de la couleur par comparaison avec l'échelle HAZEN

NT 09.17 (1983) : Qualité des eaux - Détermination de l'alcalinité - (Titre alcalimétrique et titre alcalimétrique complet).

NT 09.18 (1984) : Qualité des eaux - Dosage de l'azote ammoniacal.

NT 09.19 (1984) : Qualité des eaux - Mesure de la dureté au réactif complexant.

NT 09.20 (1984) : Qualité des eaux - Détermination de la demande biochimique en oxygène (DBO).

NT 09.21 (1984) : Qualité des eaux - Détermination des matières en suspension.

NT 09.23 (1984) : Qualité des eaux - Détermination de la demande chimique en oxygène (DCO)-Méthode par le dichromate de potassium.

NT 09.25 (1985) : Qualité des eaux - Dosage du fer - Méthode spectrométrique à la phénanthroline - 1,10.

NT 09.26 (1984) : Qualité des eaux - Détermination des agents de surface anioniques et non ioniques.

NT 09.28 (1985) : Qualité des eaux - Dosage du manganèse - Méthode spectrométrique à la formaldoxine.

NT 09.30 (1984) : Qualité des eaux - Dosage des nitrates.

NT 09.31 (1984) : Qualité des eaux - Dosage de l'azote Kjeldahl.

NT 09.34 (1987) : Qualité des eaux - Détermination de la conductivité électrique.

NT 09.35 (1985) : Qualité des eaux - Dosage du cadmium - Méthode par spectrométrie d'absorption atomique dans la flamme.

NT 09.36 (1985) : Essais des eaux - Dosage spectrophotométrique du sélénium.

NT 09.37 (1985) : Qualité des eaux - Dosage du mercure total par spectrophotométrie d'absorption atomique sans flamme.

NT 09.41 (1988) : Qualité des eaux - Dosage des cyanures totaux.

NT 09.65 (1989) : Essais des eaux - Dosage du sodium et du potassium - Méthode par spectrométrie d'émission de flamme.

NT 09.66 (1989) : Essais des eaux - Dosage du sodium et du potassium - Méthode par spectrophotométrie d'absorption atomique.

NT 09.77 (1989) : Qualité des eaux - Dosage des chlorures - Titrage au nitrate d'argent avec du chromate comme indicateur - Méthode de MOHR.

NT 09.78 (1989) : Qualité des eaux - Dosage des sulfates - Méthode gravimétrique utilisant le chlorure de baryum.

NT 16.21 (1983) : Eaux - Directives générales pour le dénombrement des coliformes -Techniques du nombre le plus probable après incubation à 35 - 37°C.

NT 16.22 (1984) : Eaux - Dénombrement des coliformes totaux et fécaux - Méthode par filtration sur membrane.

NT 16.23 (1984) : Eaux - Dénombrement des streptocoques fécaux - Méthode par filtration sur membrane.

NT 16.24 (1984) : Eaux - Directives générales pour le dénombrement des streptocoques fécaux .

3. SPECIFICATIONS RELATIVES AUX REJETS DANS LE DOMAINE PUBLIC MARITIME, LE DOMAINE PUBLIC HYDRAULIQUE ET LES CANALISATIONS PUBLIQUES

Le présent paragraphe définit la qualité de l'effluent en fonction du type et des particularités du milieu récepteur (voir tableau ci-joint).

Parametres	Expression des résultats	Domaine public maritime	Domaine public hydraulique	Canalisations publiques	Methodes de dosage
Temperature mesure au moment du prélevement	En degre Celsius (°C)	La temperature du rejet ne doit pas dépasser 1) 35°C	Doit être inférieure à (2) 25°C	Doit être inférieure à (2) 35°C	-
pH		6,5 < pH < 8,5	6,5 < pH < 8,5	6,5< pH < 9	NT 09.05 NT 09.06
Matieres en suspension : MES	mg/l	30	30	400	NT 09.21
Matieres décantables	ml/l apres deux heures	0,3	0,3	-	-
Demande chimique en oxygène DCO	mg O_2 /l	90 sur un echantillon moyen de 24H (pour la mer à l'exclusion des zones de baignade et 3) d'aquaculture)	90 sur un echantillon moyen de 24H	(4) 1000	NT 09.23
Demande biochimique en oxygene: DBO_5	mg O_2 /l en moyenne de 24H	30	30	(5) 400	NT 09.20
Chlorures:Cl	mg/l	sans exigence	(6) 600	(7) 700	NT 09.27
Chlore actif Cl_2	mgcl /l	0,05	0,05	1	NT 01.31
Bioxyde de chlore : ClO_2	mg/l	0,05	0,05	0,5	-
Sulfate : SO_4	mg/l	1000	600	(8) 400	NT 09.78
Magnesium :Mg	mg/l	2000	200	(9) 300	NT 09.09
Potassium : K	mg/l	1000	50	(10) 50	NT 09.66 NT 09.65
Sodium : Na	mg/l	sans exigence	(11) 300	1000	NT 09.66 NT 09.65
Calcium : Ca	mg/l	sans exigence	500	fixer selon le cas	NT 09.09 NT 09.10
Aluminium : Al	mg/l	(12) 5	(12) 5	(13) 10	-

Paramètres	Expression des résultats	Domaine public maritime	Domaine public hydraulique	Canalisations publiques	Methodes de dosage
Couleur	mg/l Echelle au platine cobalt	100	70	fixer selon le cas	NT 09.16
Sulfures : S	mg/l	2	0,1	(14) 3	-
Fluorures dissous : F	mg/l	5	3	(15) 3	-
Nitrates : NO_3	mg/l	(16) 90	50	90	NT 09.30
Nitrites : NO_2	mg/l	(17) 5	(18) 0,5	10	-
Azote organique et ammoniacal	mg/l	30	(18) 1	100	NT 09.18
Phosphore PO ou P total 4	mg/l	(18) 0,1	(18) 0,05	10	-
Phénols, composés phénoliques	mg/l	0,05(en mer)	0,002	1	-
Graisses et huiles saponifiables	mg/l	(19) 20	10	30	-
Hydrocarbures aliphatiques totaux(huiles, graisses et goudron)d'origine minerale	mg/l	10	2	(20) 10	-
Solvants chlorés	mg/l	0,05	0	0,1	-
Detergents anioniques du type alkyl Benzene sulfanate (ABS)	mg/l	2	0,5	5	NT 09.26

Parametres	Expression des resultats	Domaine public maritime	Domaine public hydraulique	Canalisations publiques	Methodes de dosage
Bore : B	mg/l	20	2	(21) 2	-
Fer : Fe	mg/l	1	1	(22) 5	NT 09.25
Cuivre : Cu	mg/l	1,5	0,5	1	NT 09.07
Etain : Sn	mg/l	2	2	2	-
Manganese: Mn	mg/l	1	0,5	(23) 1	NT 09.28
Zinc : Zn	mg/l	10	5	(24) 5	NT 09.07
Molybdene Mo	mg/l	5	0,5	5	-
Cobalt Co	mg/l	0,5	0,1	0,5	NT 09.07
Brome actif : Br_2	mg/l	0,1	0,05	1	-
Baryum : Ba	mg/l	10	0,5	10	-
Argent : Ag	mg/l	0,1	0,05	0,1	-
Arsenic : As	mg/l	0,1	0,05	0,1	NT 09.08
Beryllium: Be	mg/l	0,05	0,01	0,05	-
Cadmium Cd	mg/l	0,005	0,005	(26) 0,1	NT 09.35
Cyanures : CN	mg/l	0,05	0,05	0,5	NT 09.41
Chrome hexa-valent VI Cr	mg/l	0,5	0,01	0,5	-
Chrome tri-valent III Cr	mg/l	2	0,5	(25) 2	-
Antimoine : Sb	mg/l	0,1	0,1	0,2	-
Nickel : Ni	mg/l	2	0,2	2	NT 09.07
Selenium : Se	mg/l	0,5	0,05	1	NT 09.36

Parametres	Expression des resultats	Domaine public maritime	Domaine public hydraulique	Canalisations publiques	Methodes de dosage
Mercure : Hg	mg/l	0,001	0,001	0,01	NT 09.17
Plomb : Pb	mg/l	0,5	0,1	1	NT 09.07
Titane : Ti	mg/l	0,001	0,001	0,01	-
Pesticides et produits similaires : -Insecticides .Composes organophosphores. .Carbamates -Herbicides -Fongicides -PCB et PCT	mg/l	0,005	0,001	0,01	-
Coliformes fecaux	par 100ml	2000	2000	-	NT 16.21 NT 16.22
Streptocoques fecaux	par 100ml	1000	1000	-	NT 16.23 NT 16.24
Salmonelles	par 5000 ml	Absence	Absence	-	-
Vibrions cholériques	par 5000 ml	Absence	Absence	-	-

4. NOTES

1) Dans tous les cas, elle ne doit pas dépasser une valeur qui sera fixée en fonction des conditions locales et de la teneur en substances nutritives du milieu.
2) En cas de dépassement, elle ne doit pas excéder la température ambiante.
3) Des mesures plus ou moins strictes peuvent être fixées par le Ministère de l'Agriculture.

Note	Limite supérieure de tolérance mg/l	Après avis du Ministère de l'Equipement	Après avis du Ministère de l'Agriculture
(4)	jusqu'à 2000	x	
(5)	" 1000	x	
(6)	" 700		x
(7)	" 2000	x	
(8)	" 600	x	
(9)	" 2000	x	
(10)	" 1000	x	
(11)	" 1000		x
(12)	" 10		x
(13)	" 20	x	
(14)	" 8	x	
(15)	" 5	x	
(17)	" 10		x
(20)	" 20	x	
(21)	" 20	x	
(22)	" 15	x	
(23)	" 10	x	
(24)	" 50	x	
(25)	" 4 selon le cas	x	
(26)	" 1	x	

16) Des teneurs plus sévères peuvent être adoptées.
18) Pour des valeurs supérieures des dérogations peuvent être accordées par le Ministère de l'Agriculture.
19) En tout cas, elles ne doivent pas provoquer (après rejet) des filures superficielles.

NORME
TUNISIENNE
HOMOLOGUEE

NT 106.03
(1989)

Protection de l'environnement - utilisation des eaux usées traîtées à des fins agricoles - Spécifications physico-chimiques et biologiques

Norme tunisienne homologuée par arrêté du Ministre de l'Economie Nationale du 28/5/1990 JORT N°36 page 602

(Voir texte intégral de l'arrêté en annexe de la présente norme)

Editée et diffusée par l'Institut National de la Normalisation et de la Propriété Industrielle 10 bis Rue Ibn El Jazzar 1002 Tunis Belvédère

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AVANT-PROPOS

La présente norme a été élaborée par la commission technique CT 106 chargée de la normalisation dans le domaine de la protection de l'environnement, sur la base d'un document proposé par une commission interdépartementale regroupant les ministères de la Santé publique, de l'Agriculture, de l'Equipement et de l'Habitat; de l'Economie nationale et le Premier Ministère.

La présente norme vient compléter le décret n° 89-1047 du 28 juillet 1989, fixant les conditions d'utilisation des eaux usées traitées à des fins agricoles.

CDU:
Descripteurs:

SOMMAIRE

1. OBJET ET DOMAINE D'APPLICATION

2. REFERENCES

3. SPECIFICATIONS PHYSICO-CHIMIQUES ET BIOLOGIQUES.

1. OBJET

La présente norme a pour objet de fixer la concentration maximale admissible de certains éléments physico-chimiques et bactériologiques dans les eaux usées traitées à des fins agricoles.

2. REFERENCES

NT 09.05: (1983) Qualité des eaux-Mesure colorimétrique du pH.

NT 09.06: (1983) Qualité des eaux-Mesure électrométrique du pH avec l'électrode de verre-Méthode de référence.

NT 09.07: (1985) Qualité des eaux-Dosage du Co, Ni, Cu, Zn, Cd et Pb-Méthode par spectrométrie d'absorption atomique avec flamme.

NT 09.08: (1985) Qualité des eaux-Dosage de l'arsenic total-Méthode spectrophotométrique au diéthyldithiocarbamate d'argent

NT 09.10: (1985) Qualité des eaux-Dosage du calcium-Méthode titrimétrique à l'EDTA.

NT 09.20: (1984) Qualité des eaux- Détermination de la demande biochimique en oxygène (DBO).

NT 09.21: (1984) Qualité des eaux-Détermination des matières en suspension.

NT 09.23: (1984) Qualité des eaux-Détermination de la demande chimique en oxygène (DCO)-Méthode par le dichromate de potassium.

NT 09.25: (1985) Qualité des eaux-Dosage du fer-Méthode spectrométrique à la phénanthroline-1,10.

NT 09.28: (1985) Qualité des eaux-Dosage de manganèse-Méthode spectrophotométrique à la formaldoxine.

NT 09.34: (1987) Qualité des eaux-Détermination de la conductivité électrique.

NT 09.35: (1985) Qualité des eaux-Dosage du cadmium-Méthode par spectrométrie d'absorption atomique dans la flamme.

NT 09.36: (1985) Qualité des eaux-Dosage spectrophotométrique du sélénium.

NT 09.37: (1985) Qualité des eaux-Dosage du mercure total-Méthode spectrophotométrique d'absorption atomique sans flamme.

NT 09.77: (1989) Qualité des eaux-Dosage des chlorures-Partie 1: titrage au nitrate d'argent avec du chromate comme indicateur (Méthode du MOHR).

3. SPECIFICATIONS PHYSICO-CHIMIQUES ET BIOLOGIQUES

Paramètres	Concentration maximale	Méthode de dosage
- pH	$6,5 \leq pH \leq 8,5$	Voir NT 09.06 ou NT 09.07
- Conductivité	7000 μs/cm	Voir NT 09.34
- DCO	90mg 02/l (sur une moyenne de 24H) (sauf dérogation particulière)	Voir NT 09.23
- DBO_5	30mg 02/l (sur une moyenne de 24H) (sauf dérogation particulière)	Voir NT 09.20
- MES	30mg/l (sauf dérogation particulière)	Voir NT 09.21
- Chlorures	2000 mg/l	Voir NT 09.77
- Fluorures	3 mg/l	
- Organochlorés	0,001 mg/l	
- Arsenic	0,1 mg/l	Voir NT 09.08
- Bore	3 mg/l	
- Cadmium	0,01 mg/l	Voir NT 09.35
- Cobalt	0,1 mg/l	Voir NT 09.07
- Chrome	0,1 mg/l	
- Cuivre	0,5 mg/l	Voir NT 09.07
- Fer	5 mg/l	Voir NT 09.25
- Manganèse	0,5 mg/l	Voir NT 09.28
- Mercure	0,001 mg/l	Voir NT 09.37

- Nickel	0,2 mg/l	Voir NT 09.07
- Plomb	1 mg/l	Voir NT 09.07
- Sélénium	0,05 mg/l	Voir NT 09.36
- Zinc	5 mg/l	Voir NT 09.07
- Moyenne arithmétique des oeufs de nématodes intestinaux.	$\leq$ 1/1000 ml	

Arrêté du ministre de l'économie et des finances du 18 mai 1990, portant homologation de la norme tunisienne relative aux spécifications des eaux usées traitées à des fins agricoles

Le ministre de l'économie et des finances;

Vu la loi n° 75-16 du 31 mars 1975, portant promulgation du code des eaux;

Vu la loi n° 82-66 du 6 août 1982, relative à la normalisation et à la qualité et notamment les articles 2, 9 et 10;

Vu le décret n° 83-724 du 4 août 1983, fixant les catégories de normes et les modalités de leur élaboration et de leur diffusion,

Vu le décret n° 85-56 du 2 janvier 1985, relatif à la règlementation des rejets dans le milieu récepteur;

Vu le décret n° 89-1047 du 28 juillet 1989, fixant les conditions d'utilisation des eaux usées traitées à des fins agricoles;

Vu les résultats de l'enquête publique relative à la norme objet du présent arrêté, annoncée au bulletin officiel de l'institut national de la normalisation et de la propriété industrielle;

Vu le rapport du président directeur général de l'institut national de la normalisation et de la propriété industrielle;

Arrête :

Article premier. — Est homologuée la norme NT 106.03 (1989) : Protection de l'environnement, utilisation des eaux traitées à des fins agricoles, spécifications physico-chimiques et biologiques.

Art. 2. — La norme visée à l'article premier est d'application obligatoire, sous réserve des dérogations prévues par l'article 16 de la loi n° 82-66 du 6 août 1982 sus-visée.

Art. 3. — La norme prévue à l'article premier prend effet un mois après la publication du présent arrêté au *Journal officiel de la République tunisienne*.

Art. 4. — Les infractions aux dispositions du présent arrêté sont constatées, poursuivies et réprimées conformément aux dispositions du code des eaux sus-visé.

Art. 5. — Le Présent arrêté sera publié dans la partie officielle du bulletin officiel de l'institut national de la normalisation et de la propriété industrielle.

Tunis, le 18 mai 1990

Le ministre de l'économie et des finances
MOHAMED GHANNOUCHI

VU
Le Premier ministre
HAMED KAROUI

Annex C

Table of Treatment Plant Categories
Calculation of Requirements
Calculation Example
Requirement Formulation Example

C-1

TABLE OF TREATMENT PLANT CATEGORIES

CATEGORY	CAPACITY	
	m^3/d	Population Equivalent
1	< 500	< 5,000
2	500 - 5,000	5,000 - 50,000
3	5,000 - 15,000	50,000 - 150,000
4	15,000 - 50,000	150,000 - 500,000
5	$\geq$ 50,000	$\geq$ 500,000

EFFLUENT REQUIREMENTS CALCULATION METHOD

BOD_5 AND SS EFFLUENT REQUIREMENTS - ACTIVATED SLUDGE CALCULATION METHOD			
PLANT CATEGORY (*)	**PERIOD**	**AVERAGE CONCENTRATION OR EFFICIENCY**	**AVERAGE WASTE LOAD ASSIGNED (kg/d)(**)**
1-2- 3-4-5	YEARLY	30 mg/l or R_{ave} = 92%	A) 25 mg/l x QC B) (1-R_{ave}) x CHC > of A or B
1-2	QUARTERLY 01/01 - 31/03 01/04 - 30/06 01/07 - 30/09 1/10 - 31/12	40 mg/l or R_{ave} = 90%	A) 25 mg/l x QC B) (1-R_{ave}) x CHC > of A or B
3-4 5	MONTHLY WEEKLY		
TERTIARY TREATMENT SYSTEM			
1-2- 3-4-5	YEARLY	20 mg/l or R_{ave} = 95%	A) 20 mg/l x QC B) (1-R_{ave}) x CHC > of A or B
1-2	QUARTERLY 01/01 - 31/03 01/04 - 30/06 01/07 - 30/09 1/10 - 31/12	25 mg/l or R_{ave} = 90%	A) 25 mg/l x QC B) (1-R_{ave}) x CHC > of A or B
3-4 5	MONTHLY WEEKLY		

(*) For the definition of categories, see the "TABLE OF TREATMENT PLANT CATEGORIES."

(**) The average waste load assigned is the greater of A or B.

QC: Design flow of the treatment plant or flow used to set effluent requirements.

CHC: Design waste load of the treatment plant or load used to set the effluent requirements.

R_{ave}: Average efficiency to attain by default; it meets the requirement even if the average concentration exceeds the specified limit.

EXAMPLE CALCULATION

PHOSPHORUS EFFLUENT REQUIREMENT - ACTIVATED SLUDGE CALCULATION METHOD			
PLANT CATEGORY (*)	**PERIOD**	**AVERAGE CONCENTRATION OR EFFICIENCY**	**AVERAGE WASTE LOAD ASSIGNED (kg/d) (**)**
1-2	Total 5, 6 or 12 months	1.0 mg/l or R_{ave} = 80%	A) 1,0 mg/l x QC B) $(1-R_{ave})$ x CHC } > of A or B } < of C) $(1-R_{min})$ x CHC } (A or B) or C R_{min} = 60%
3-4-5	Total 5, 6 or 12 months	0.8 mg/l or R_{ave} = 85%	A) 0,8 mg/l x QC B) $(1-R_{ave})$ x CHC } > of A or B } < of C) $(1-R_{min})$ x CHC } (A or B) or C R_{min} = 60%
3-4	MONTHLY	0.8 mg/l or R_{ave} = 80%	A) 1,0 mg/l x QC B) $(1-R_{ave})$ x CHC } > of A or B } < of C) $(1-R_{min})$ x CHC } (A or B) or C R_{min} = 50%
5	WEEKLY		
TERTIARY TREATMENT SYSTEM			
1-2	Total 5, 6 or 12 months	0.5mg/l or R_{ave} = 90%	A) 0,5 mg/l x QC B) $(1-R_{ave})$ x CHC } > of A or B } < of C) $(1-R_{min})$ x CHC } (A or B) or C R_{min} = 70%
3-4-5	Total 5, 6 or 12 months	0,4 mg/l or R_{ave} = 92%	A) 0,4 mg/l x QC B) $(1-R_{ave})$ x CHC } > of A or B } < of C) $(1-R_{min})$ x CHC } (A or B) or C R_{min} = 70%
3-4	MONTHLY	0.5mg/l or R_{ave} = 90%	A) 1,0 mg/l x QC B) $(1-R_{ave})$ x CHC } > of A or B } < of C) $(1-R_{min})$ x CHC } (A or B) or C R_{min} = 60%
5	WEEKLY		

*) For the definition of categories, see the "TABLE OF TREATMENT PLANT CATEGORIES."

**) The average waste load assigned is set first by taking the greater of A or B, then the smaller of (A or B) or C.

)C: Design flow of the treatment plant or flow used to set effluent requirements.

'HC: Design waste load of the treatment plant or load used to set the effluent requirements.

ave: Average efficiency to attain by default; it meets the requirement even if the average concentration exceeds the specified limit.

min: Minimum efficiency to use in calculating the average waste load allocation as effluent requirement.

EXAMPLE OF CALCULATION OF REQUIREMENTS FOR A HYPOTHETICAL TREATMENT PLANT

Identification: "MODEL" TREATMENT PLANT

Type of Plant: Activated Sludge without chemical feed equipment.

Important seasonal variations projected

Flows: 01/01 - 15/06 and 15/09 - 31/12 =	25,000 m^3/d		
15/06 - 15/09 =	40,000 m^3/d		
weighted annual average	28,750 m^3/d		
Loads: 01/01 - 15/06 and 15/09 - 31/12 =	9,000 kg BOD_5/d		
		11,000 kg SS/d	
15/06 - 15/09	11,500 kg BOD_5/d		
		14,000 kg SS/d	
weighted annual average	9,625 kg BOD_5/d		
		11,750 kg SS/d	

Category: 4, thus "yearly" and "monthly" requirements

Calculation of the yearly requirement

...in BOD_5:	A) 30 mg/l x 28,750 m^3/d ÷ 1,000 =	862 kg/d	= assigned load
	B) (1 - 0,92) x 9,625 kg/d =	770 kg/d	
...in SS:	A) 30 mg/l x 28,750 m^3/d ÷ 1,000 =	862 kg/d	
	B) (1 - 0,92) x 11,750 kg/d =	940 kg/d	= assigned load

Calculation of the monthly requirement (15/06 - 15/09)

...in BOD_5:	A) 40 mg/l x 40,000 m^3/d ÷ 1,000 =	1,600kg/d	= assigned load
	B) (1 - 0,90) x 11,500 kg/d =	1,150 kg/d	
...in SS:	A) 40 mg/l x 40,000 m^3/d ÷ 1,000 =	1,600 kg/d	= assigned load
	B) (1 - 0,90) x 14,000 kg/d =	1,400 kg/d	

Calculation of the monthly requirement (01/01 - 15/06 and 15/09 - 31/12)

...in BOD_5:	A) 40 mg/l x 25,000 m^3/d ÷ 1,000 =	1,000kg/d	= assigned load
	B) (1 - 0,90) x 9,000 kg/d =	900 kg/d	
...in SS:	A) 40 mg/l x 25,000 m^3/d ÷ 1,000 =	1,000 kg/d	
	B) (1 - 0,90) x 11,000 kg/d =	1,100 kg/d	= assigned load

EXAMPLE: FORMULATION OF EFFLUENT REQUIREMENTS

"MODEL" TREATMENT PLANT

EFFLUENT REQUIREMENTS OF THE ACTIVATED SLUDGE TREATMENT PLANT

PARAMETERS	PERIOD	CONCENTRATION mg/l	ASSIGNED LOAD kg/d	
		average for the period		
			BOD_5	SS
BOD_5 and SS	YEARLY	25 (1)	862	940
	MONTHLY			
	01/01 - 15/06	30 (1)	1,000	1,100
	15/06 - 15/09	30 (1)	1,600	1,600
	15/09 - 31/12	30 (1)	1,000	1,100

✓ The assigned load should never be exceeded.

✓✓ (1) If the measured concentration exceeds the required concentration, it is still acceptable provided the influent BOD_5 and SS loads are reduced by at least 92% over the year and 90% monthly.

Data used to determine compliance with the requirements are those provided by the operator in accordance with the monitoring program required by ONAS as well as any data collected at ONAS' request or by the operator.

Annex D

Proposed Effluent Requirements for Overflow Structures

(Name of sector)

EFFLUENT REQUIREMENTS FOR OVERFLOW STRUCTURES

NO OVERFLOW IS ACCEPTABLE, except where indicated by X and provided the structure operates optimally and is equipped with baffles to hold floating matter:		
IDENTIFICATION OF THE STRUCTURE	E = EMERGENCY (unforeseeable situation lasting less than 48 hours)	
	E	RAIN WITH RUNOFF
OL PS No. 1	X	
OL PS No. 2	X	X
OL RESERVOIR No. 1	X	X, but with a limit of 3 times per year
OL IN NETWORK (location)	X	X

Data used to determine compliance with the requirements are provided by the operator according to the monitoring program required by ONAS as well as any data collected at ONAS' request or by the operator.

OL = OUTLET
PS = PUMPING STATION

Annex E

Proposed effluent and operation requirements for a treatment plant
Proposed monitoring program for an activated sludge treatment plant

Effluent and Operation Requirements for (Name of Treatment Plant)

Given the flows and pollution loads anticipated for the above-mentioned treatment plant and its equipment, the following effluent and operation requirements have been established:

1. All wastewaters conveyed to the treatment plant must, at all times, be submitted to the complete treatment and must be discharged into the receiving environment through the outfall.

2. The quantities of organic matter, expressed in BOD_5[1] (mg/l and kg/d) and SS (mg/l and kg/d), present in the treatment plant effluent should not exceed those indicated on the attached chart, "Effluent requirements of an activated sludge treatment plant" and according to prescribed conditions therein.

3. The monitoring program specially prepared for the above-mentioned treatment plant must be carried out entirely and the required monthly reports must reach ONAS at the latest six weeks following the month concerned. Test results from an independent laboratory must be attached to each report.

4. Monthly reports summarizing interventions carried out as part of the maintenance program must be attached to the monthly monitoring reports. They are thus subject to the same deadlines.

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[1] COD is not a biologically controllable parameter. However, its analysis is simpler, more rapid, and more reliable than that of BOD_5. For that reason, it is essential to determine the COD of each sample subject to a BOD_5 analysis, even if it is only to confirm the result of the latter. In most cases, the treatment station operator can determine the COD/BOD_5 ratio of the raw wastewater. This ratio varies from 2.5 to 4.0 for domestic wastewaters. Thus, too high a ratio may alert the operator to an industrial discharge incompatible with the biological process of the treatment station.

Monitoring of Activated Sludge Treatment Plants

The objective of a treatment plant monitoring program is primarily to verify compliance with effluent and operation requirements. The monitoring program must also depict general plant operation and the nature of its operational problems.

The monitoring program specifies what data the operator must send monthly to the agency supervising the plant's performance and operation. The operator must indicate on the monthly forms all the test results obtained during that month for the parameters described in the program. It is the program which sets the required minimum frequencies.

The list of parameters of the monitoring program is attached. It is desirable that the agency responsible for the control of the monitoring program prepares the forms for data transmission. The operator is requested to use these forms regularly to avoid duplication of information.

Note that the monitoring program varies according to the nature of effluent requirements and the size of the treatment plant (see "Table of Treatment Plant Categories" in Annex C).

The "Annex to the Monitoring Program" contains details on the information and tests required for monitoring. It should be noted that upon approval of the designated agency, certain parameters may be omitted when the equipment required to collect certain data has not been installed. The monitoring program presented, however, is a minimum standard program, so particular conditions may require additional parameters or higher reading frequencies.

The designated agency will also provide the operator with a document establishing the format of the treatment plant's annual operation report.

Monitoring Program Activated Sludge Plants

Information to provide monthly to the designated agency.

PARAMETERS	MINIMUM FREQUENCY REQUIRED ACCORDING TO THE STATION'S CATEGORY				
	1	2	3	4	5
1. Flows:					
-Influent: daily flow (m^3/d)	1/d	1/d	1/d	1/d	1/d
-Maximum and minimum hourly flows (m^3/d)	1/d	1/d	1/d	1/d	1/d
2. By-pass, outlet pipes					
-duration of operation (hr.)	1/d	1/d	1/d	1/d	1/d
-justification	1/d	1/d	1/d	1/d	1/d
3. Meteorology					
-rainfall (mm of water)	1/d	1/d	1/d	1/d	1/d
4. Bar rack					
-volume of debris (m^3/month)	1/m	1/m	1/m	1/m	1/m
- (m^3/1000 m^3 of water)	--	--	1/m	1/m	1/m
5. Grit removal					
-volume of sand (m^3/month)	1/m	1/m	1/m	1/m	1/m
- (m^3/1000 m^3 of water)	--	--	1/m	1/m	1/m
6. Influent (before the return of floating matter)					
* - COD (mg/l)	1/w	3/w	3/w	5/w	1/d
* - BOD_5 (mg/l)	1/2w	1/w	3/w	5/w	1/d
* - SS (mg/l)	1/2w	1/w	3/w	5/w	1/d
- VSS (mg/l)	--	1/w	3/w	5/w	1/d
- NH_4 (mg/l N)	--	1/m	1/w	1/w	2/w
- TKN (mg/l N)	--	1/m	1/w	1/w	2/w
- NO_3 + NO_2 (mg/l N)	--	1/m	1/w	1/w	2/w
* - O-PO_4 (mg/l P) (1)	1/w	1/w	3/w	5/w	1/d
* - P_{tot} (mg/l P) (1)	1/w	1/w	3/w	5/w	1/d

Note: 1/d = once daily (official symbol of the international system);
1/w = once weekly; 1/2w = once every 2 weeks
1/m = once monthly.

* test conducted once a month by a certified laboratory

(1) test required if phosphate removal is required for the period.

MONITORING PROGRAM

PARAMETERS	MINIMUM FREQUENCY REQUIRED ACCORDING TO THE STATION'S CATEGORY				
	1	2	3	4	5
7. Aeration Basins	1/d	1/d	1/d	1/d	1/d
- number of basins in operation	1/d	1/d	1/d	1/d	1/d
- total aeration volume (1000 m^3)	1/d	1/d	1/d	1/d	1/d
- number of working boosters	1/d	1/d	1/d	1/d	1/d
- air flow (m^3/hr)	1/d	1/d	1/d	1d	1/d
- number of aerators out of service	5/w	5/w	1/d	1/d	1/d
- average D.O. (mg/l)	1/w	1/w	3/w	5/w	5/w
- S.S. (mg/l)	--	1/w	3/w	5/w	5/w
-V.S.S. (mg/l)	--	--	1/w	1/w	1/w
- F/M ratio	1/w	1/w	3/w	5/w	5/w
-SVI (Mohlman)	--	1/m	1/w	1/w	1/w
- sludge age (d)	1/w	1/w	3/w	5/w	5/w
- sludge volume after 30 min. (%)					
8. Filtration					
- number of filters in operation	1/d	1/d	1/d	1/d	1/d
9. Chemical phosphate removal					
- type and quantity of chemical used	1/m	1/m	1/s	1/s	1/s
10. Chlorination					
- operation duration (d)	1/d	1/d	1/d	1/d	1/d
- effluent chlorine residual (mg/l)	1/w	1/w	3/w	5/w	1/d
- type and quantity of chemical used	1/m	1/m	1/w	1/w	1/w
11. Ultraviolet disinfection					
- number of lamps in operation	1/d	1/d	1/d	1/d	1/d
12. Effluent					
* - COD (mg/l)	1/w	3/w	3/w	5/w	1/d
* - BOD_5 (mg/l)	1/2w	1/w	3/w	5/w	1/d
* - SS (mg/l)	1/2w	1/w	3/w	5/w	1/d
- VSS (mg/l)	--	1/w	3/w	5/w	1/d
- NH_4 (mg/l N)	--	1/m	1/w	1/w	2/w
- TKN (mg/l N)	--	1/m	1/w	1/w	2/w
- NO_3+NO_2 (mg/l N)	--	1/m	1/w	1/w	2/w
* - O-PO_4 (mg/l P) (1)	1/w	1/w	3/w	5/w	1/d
* - P_{tot} (mg/l P) (1)	1/w	1/w	3/w	5/w	1/d
* - fecal coliforms (org./100 ml) (2)	1/w	1/w	2/w	2/w	1/d

Note: 1/d = once daily (official symbol of the international system);
1/w = once weekly; 1/2w = once every 2 weeks
1/m = once monthly.

* test conducted once a month by a certified laboratory

(1) test required if phosphate removal is required for the period.
(2) test required if disinfection is required for the period.

ROUTINE MONITORING

PARAMETERS	MINIMUM FREQUENCY REQUIRED ACCORDING TO THE STATION'S CATEGORY				
	1	2	3	4	5
13. Sludge Recycle					
- SS	1/m	1/w	3/w	5/w	5/w
- VSS	--	1/w	3/w	5/w	5/w
- average recycle ratio (%)	1/m	1/w	1/d	1/d	1/d
- (recycled vol./influent vol.)					
14. Sludge treatment chain					
14.1 Primary sedimentation sludge					
- SS, VSS	--	1/w	3/w	5/w	5/w
- volume withdrawn (m^3)	1/d	1/d	1/d	1/d	1/d
14.2 Excess sludge (secondary sedim.)					
- SS, VSS	--	1/w	3/w	5/w	5/w
- - volume withdrawn (m^3)	1/d	1/d	1/d	1/d	1/d
14.3 Thickener's sludge (by gravity or flotation)					
- TS, TVS	--	1/w	1/w	3/w	3/w
-volume withdrawn (m^3)	--	1/d	1/d	1/d	1/d
14.4 Sludge from the storage basin					
- TS, TVS	--	1/w	1/w	3/w	3/w
- volume withdrawn (m^3)	1/d	1/d	1/d	1/d	1/d
14.5 Sludge from the digester					
- TS, TVS	--	1/w	1/w	3/w	3/w
- volume withdrawn (m^3)	--	1/d	1/d	1/d	1/d
14.6 Sludge from the drying system					
- dryness	1/m	1/w	1/w	3/w	3/w
- sludge volume withdrawn (m^3)	1/d	1/d	1/d	1/d	1/d

Note: 1/d = once daily (official symbol of the international system);
1/w = once weekly; 1/2w = once every 2 weeks
1/m = once monthly.

PARAMETERS	MINIMUM FREQUENCY REQUIRED ACCORDING TO THE STATION'S CATEGORY				
	1	2	3	4	5
14.7 Sludge evacuated from the station					
- dryness	1/m	1/w	1/w	3/w	3/w
- volume withdrawn (m^3)	1/d	1/d	1/d	1/d	1/d
* - tests	(A)	(A)	(B)	(B)	(C)
- TS (mg/l)					
- TVS (mgl)					
- TKN (mg/kg solids)					
- HN_4 (mg/kg solids)					
- NO_2+NO_3 (mg/kg solids)					
- K (mg/kg solids)					
- P_{tot} (mg/kg solids)					
- Calcium (mg/kg solids)					
-Magnesium (mg/kg solids)					
-pH					
- Aluminum (mg/kg solids) (1)					
- Arsenic (mg/kg solids)					
- Boron (mg/kg solids)					
- Cadmium (mg/kg solids)					
- Cobalt (mg/kg solids)					
- Chromium (mg/kg solids)					
- Copper (mg/kg solids)					
- Iron (mg/kg solids) (1)					
- Manganese (mg/kg solids)					
- Mercury (mg/kg solids)					
- Molybdenum (mg/kg solids)					
- Nickel (mg/kg solids)					
- Lead (mg/kg solids)					
- Selenium (mg/kg solids)					
- Zinc (mg/kg solids)					
- BPC (mg/kg solids) (2)					
15. Miscellaneous information					
- comments on microscopic analysis of the mixed liquor (except category 2; category 2 if necessary)	1/m	1/m	1/m	1/m	1/m
- abnormal odors	1/m	1/m	1/m	1/m	1/m
- major mechanical breakages	1/m	1/m	1/m	1/m	1/m
- summary of operation problems	1/m	1/m	1/m	1/m	1/m

Note: 1/d = once daily (official symbol of the international system);
1/w = once weekly; 1/2w = once every 2 weeks
1/m = once monthly.

NOTES FOR THE TABLE ON THE PRECEDING PAGE

1/d = once daily (official symbol of the international system);
1/w = once weekly; 1/2w = once every 2 weeks
1/m = once monthly.

* tests conducted by a certified laboratory.

(1) With phosphate removal, aluminum (Al) or iron (Fe) concentrations must be measured according to the chemical used, alum or an iron compound.

(2) Test to be conducted once a year only.

(A) If there is agricultural use (land application) = every time sludge is withdrawn from the station or once a month, whichever is less. If the sludge is buried = once a year.

(B) If there is agricultural use (land application): once a month. If the sludge is buried: twice a year.

(C) If there is agricultural use (land application): once a month. If the sludge is buried: once per quarter.

Annex to the Monitoring Program

Details on the Implementation of the Monitoring Program (Activated Sludge)

1 Overview

The monitoring program includes the data transmitted monthly to the designated agency on appropriate forms.

The operator should report all test results performed at the plant for parameters appearing on the forms. However, the regular control is based on some minimum frequencies, which can vary according to the importance of the plant and the sampling point.

Testing from various areas of the wastewater as well as sludge treatment chains should be done on samples gathered the same day if necessary.

Influent and effluent testing must be performed once a month by a certified laboratory for the following parameters: BOD_5, COD, SS, $O\text{-}PO_4$, P_{tot}, and fecal coliforms (effluents only). The other tests can be done on site except for those done on the sludge evacuated from the plant.

2 Sampling

Influent and effluent analyses must be performed on 24-hour composite samples.

- For Category 1 and 2 plants, the sampling may be made up proportionally to the time, with a minimum of four samples per hour.
- For Categories 3, 4, and 5, the influent sampling must be proportional to the flow, with a minimum of four samples per hour at the time of minimum hourly flow. Sampling elsewhere may be proportional to the time, with a minimum of four samples per hour.

Sampling for fecal coliforms must be instantaneous (manual). The samples must be taken between 9:00 am and 3:00 am, at least one hour earlier than the previous sampling day. When the sampling is done in an ultraviolet disinfection system, reactivating the microorganisms must be avoided: the sample must be placed immediately in an opaque bottle covered with aluminum and preserved at 4°C.

Samples for analysis from other points of the wastewater and sludge treatment chains may be taken manually. To make sure the results are representative, tests must be conducted on composites of at least four samples taken at regular intervals during the day or during a

pumping cycle or at different points in the basins. These samples are then mixed to obtain homogeneity.

Tests must be carried out in accordance with the most recent applicable Tunisian standards.

When tests are required for processes involving several units (e.g., primary and secondary clarifiers, aeration basins, etc.), the sample must be taken at an exit (or entrance) point common to all units; otherwise a result representing all the units must be provided.

3 Meteorology

Rainfall reading is from the plant's pluviometer. It must be done daily at the same time as influent flow reading.

Annex F

Proposed Effluent and Operation Requirements for a Sewer Network

Proposed General Guidelines to Prepare a
Monitoring Program of Network Maintenance and
Performance Indicators for the Operation of the Sewer Network

Proposed Monitoring Program for Overflow Works

Effluent and Operation Requirements for the (Name) Sewer Network

Description of sector boundaries:

Description of network components:

- R.C. pipes: "_ _" m of "_ _" mm Ø, etc.
- PVC pipes: "_ _" m of "_ _" mm Ø, etc.
- AC pipes: "_ _" m of "_ _" mm Ø, etc.
- "_ _" manholes
- "_ _" inlets and draining wells
- "_ _" junction boxes
- "_ _" pumping stations
- "_ _" m of force mains, - "_ _" mm Ø in "xxx"
- "_ _" overflow structures

Note: The description must be as complete as possible. If necessary, describe separately each type of network (separate, domestic, and storm).

Within the sector and for the overall components of the above network, the following effluent and operation requirements have been defined:

1. All necessary measures must be taken to make sure that all wastewater collected in the network is discharged as expected (stormwaters through an outlet and domestic or combined wastewaters into a treatment plant). The only allowable exceptions, where a portion of the wastewater is not conveyed as planned, are situations anticipated during the design of the network (for example, significant rainfalls in the case of a combined system) or emergency cases (unforeseeable situations of limited duration not due to negligence in the maintenance of a network component).

2. Monthly reports required in the "Monitoring Program of Network Maintenance" must reach ONAS by the third week after the end of the subject month.

3. All necessary measures must be taken to satisfy the conditions defined in the attached form, "Performance Indicators for the Operation of the Sewer Network."

4. Particular attention must be paid to the overflow works so as to facilitate compliance with the requirements of the attached form, "Effluent Requirements for Overflow Works."

5. The monitoring program specifically prepared for the above-mentioned overflow works must be carried out entirely, and the required monthly reports must be attached to the

monthly reports of the "Monitoring Program of Network Maintenance"; they are thus subject to the same deadlines.

6. Any monthly report required in the "Tool Maintenance Program for Sewer Network Operation" must be sent to ONAS at the same time as the other monthly reports mentioned above.

Proposed Guidelines for the Preparation of a Monitoring Program of Network Maintenance

The objective of the monitoring program of sewer network maintenance is to provide necessary data to check the performance of the operator responsible for the maintenance of the sewer network.

Thus the operator must prepare a monthly report to summarize its activities. Since the operator should prepare such a report for its own business management, this should not constitute an additional task or incur additional expenses.

The supervisory agency of the operator will define the content and format of this report. The idea is to establish a list of control parameters of interest to the agency so as to obtain a monthly balance.

Obviously, this monitoring program must be designed specifically for the network characteristics as well as the performance indicators concerned. Proposed guidelines for the preparation of these indicators are presented below. The list of control parameters to include in the monitoring program must not be limited to the cases where a performance indicator is presented.

For pumping stations, the parameters to include in the maintenance program should be selected based on maintenance manuals prepared during the construction of such stations. For example, the parameters selected should include meter readings, monitoring of bar rack operations (quantity of debris removed, their transport and disposal), and monitoring of pump repair, of ongoing electrical maintenance, of preventive maintenance, of major periodic maintenance (pumps, generators), of the maintenance of the basin, and of building maintenance.

Proposed Guidelines for the Preparation of Performance Indicators for Sewer Network Operation

Hiring private enterprises to operate sewer networks has two fundamental objectives:

- to improve the quality of service to the users; and
- to reduce operation costs.

To realize these two objectives, it is essential that contracts with the private enterprises be well balanced. Contracts that are too small do not allow the reduction of operation costs, while contracts that are too large may affect the quality of service to the users.

A current market study has among its terms of reference the definition of the size of sewer networks that can be operated by private enterprises. This definition must take into account the particular characteristics of the Tunisian sewer networks as well as the available technical means for their operation.

Thus, the operator will have to select its procedures and tools in relation to the overall sewer network under its responsibility. This choice must optimize the use of available resources to satisfy the above-mentioned two objectives.

At this stage of the privatization program in water pollution control, it is too early to precisely define performance indicators for sewer network operation. Besides, such indicators must be prepared specifically for each sector to be entrusted to a private operator.

However, it is useful to establish the bases for the future preparation of performance indicators adapted to each sector.

There are three types of performance indicators:

A. speed of intervention (expected response time between a service request and its realization);
B. volume of work accomplished; and
C. preventive activities.

Ranges are proposed below for the indicators. Note that ONAS' operation staff must validate the numbers suggested in these ranges.

A. SPEED OF INTERVENTION

REQUEST	EXPECTED RESPONSE TIME
Unblocking	4 to 6 hours (multiplied by 1.5 for evening or holiday calls)
Installing a new connection	One week
Cleaning campaign	According to the schedule of other parties involved

B. VOLUME OF WORK ACCOMPLISHED

Suggested performance indicators relate to equipment and/or methods used to carry out operation activities. The numbers proposed approximate ONAS' experience.

METHOD AND/OR EQUIPMENT	PIPE BLOCKAGE RATE		
	LOW	MEDIUM	HIGH
	EXPECTED QUANTITIES		
Combined	600 m/d	400 m/d	200 m/d
Hydrocleaner	500 m/d	300 m/d	150 m/d
Minicleaner	300 m/d	200 m/d	100 m/d
Bucket cleaner*	30 m/d	10 m/d	3 m/d
Aspirator	50 str/d	40 str/d	30 str/d
Mini-aspirator	25 str/d	20 str/d	20 str/d
Hydraulic pump	50 str/d	40 str/d	30 str/d
Cleaning machine	55 str/d	35 str/d	25 str/d

m/d = meters/day str/d = structures/day

* for diameter >600 mm only

Given the precise technical definition of a sector and the above ranges, it is necessary to determine the most appropriate methods and/or equipment (in order to establish the volumes of work expected of the operator). The volumes of work will be expressed in lineal meters or number of structures per month and per year.

C. PREVENTIVE ACTIVITIES

ACTIVITY	FREQUENCY
Systematic Cleaning	At least once every three years On the average once a year At most three times a year
Cleaning of basins	Once a month

Minimum frequencies apply to pipes in good condition with a sufficient slope to provide satisfactory self-cleaning. Average frequencies apply to pipes still in good condition but lacking self-cleaning flow. Finally, maximum frequencies apply to old, completely deteriorated pipes with rather stagnant flow conditions.

A good knowledge of the network makes it possible to establish the total length of each pipe category. One can then determine the "effective pipe length to clean per year" by multiplying these lengths by the corresponding frequencies. This length should be updated yearly to take into account sewer rehabilitation activities as well as network extensions.

The "total length of pipes cleaned during the year" can then be compared to the number mentioned above. As an incentive to the operator for the best service possible, a contract clause may provide a bonus for exceeding the "effective pipe length to clean per year."

Such an approach would also allow a more precise quantification of the additional maintenance cost of pipes in bad shape. It then becomes easier to determine which of these pipes must be rehabilitated first. When the 20-year present value maintenance cost of a pipe exceeds the rehabilitation cost of the same pipe, it is more advantageous to rehabilitate than to continue maintaining it.

Monitoring of Overflow Structures

The objective of the program of monitoring overflow structures of the sewer network is to verify that they meet discharge requirements under various conditions throughout the year.

For this purpose, the outlets will be visited periodically throughout the year to observe whether or not there are wastewater overflows. In some specific cases, the overflow structures may be equipped with a system that continuously measures the number and duration of overflows (autonomous recorder of overflow frequency and duration or telemetering system).

The attached document, "Monitoring Program — Case of Overflow Structures of Sewer Networks," defines monitoring procedures and frequencies according to whether or not there is a recording system. In a particular case, the list of overflow structures to monitor in a given sector must also be presented with the monitoring type required for each one.

It is also desirable to define the format of the information. Thus it is advisable to prepare monitoring forms adapted to the monitoring procedures, according to the following possibilities:

- weekly readings — case without a recorder
- weekly readings — case with or without a recorder
- daily readings

NOTE: The proposed program is designed for the northern part of Tunisia which has abundant rainfall. It could be reduced for the more arid areas in the southern part of the country.

Monitoring Program for Overflow Structures of Sewer Networks

1 Structures Concerned

All the structures upstream of the treatment plant and subject to wastewater overflows must be monitored. The attached table, "Identification of Overflow Structures and Required Monitoring," contains the list of structures concerned.

2 Type of Reading

2.1 Without a Recorder

This involves a visual observation of whether or not there is an overflow at the time of the visit.

Whenever the outlet is accessible and the overflows are judged rare, a visual mark is added. The reading consists of verifying whether or not the mark has moved since the last visit.

2.2 With a Recorder

The recorder measures the duration of operation of the overflow structure and the number of times it was used during a given period.

REMARK: At each reading, when an overflow is observed or recorded, it is COMPULSORY to indicate in the "COMMENTS" section of the monitoring chart the CAUSES of the overflow (e.g., breakage, breakdown, obstruction, rain, defective recorder, invalid reading because the sounding rod is dirty, etc.) and the IMPORTANCE of the overflow (e.g., trickle of water, pipe ¼ full, ½ full, etc.). Any obstruction must be removed and the observation repeated 24 hours later.

3 Reading Period, Frequencies, and Conditions

3.1 When There Is No Recorder

PERIOD: One year (from January 1 through December 31)

FREQUENCY: Once a week

NOTE: In some cases (e.g., very difficult access to the overflow structure), the frequency may be reduced AFTER AGREEMENT WITH THE MONITORING OFFICER.

CONDITIONS: Visit at the time of peak flow (between 10:00 and 13:00 except in particular cases) during a rainless day.

When it is difficult to met these conditions, the weekly visit must still take place. The weather condition at the time of the visit must always be noted (S = dry; P = rain) and, if possible, one must indicate a recent rainfall by P24. i.e., rain within the last 24 hours. Appropriate comments for overflows, concerning their cause and importance, must be written on the monitoring chart.

Furthermore, when there is a mark, it must be noted whether or not it has moved. If so, the mark must be reset immediately or as soon as the overflow stops.

3.2 When There Is a Recorder

3.2.1 Autonomous Recorder

PERIOD: One year (from January 1 through December 31)
FREQUENCY: Once a week
CONDITIONS: Weekly visit and reading of the duration of operation of the overflow structure since the last visit

Whenever possible, add a mark to confirm the information on the recorder. The indication as to whether or not the mark has moved must be noted at each visit. If it has moved, it must be reset immediately or as soon as the overflow stops.

Furthermore, the outlet is observed to see whether there is an overflow or not during the visit. For this purpose, it is strongly that the visit be made at the time of peak flow (between 10:00 and 13:00) on a dry day if possible.

3.2.2 Telemetering (or last overflow structure before the treatment plant)

PERIOD: One year (from January 1 through December 31)
FREQUENCY: Once daily
CONDITIONS: Daily reading of the duration of the overflow structure and of the corresponding number of events

Furthermore, the overflow structure will be visited periodically to observe its operating condition and that of the metering device (sounding rod, float, etc.)

(For the last overflow structure before the treatment plant, the information is written on the plant's form).

REMARK: When the telemetering system is not working, the information must be entered on the form using the "without a recorder" method.

Annex G

Aerated Lagoon Treatment Plants

General
Determination of performance levels with respect to BOD_5
Determination of fecal coliforms effluent
Calculation of effluent requirements for aerated lagoons
Proposed effluent and operation requirements
Proposed monitoring program

1. General

The term "aerated lagoon" designates a type of treatment plant designed to treat wastewater whose concentration of organic matter (BOD_5) remains under 225 mg/l. The plant design's initial BOD_5 efficiency estimates are based on Eckenfelder equations, which determine the amount of organic matters (BOD_5) dissolved in each basin according to the concentration entering the basin and the length of time spent there. The air force applied to each basin is then calculated according to the load of organic matter in kg BOD_5 to be oxidized daily in each basin. Generally, 2.25 kgO_2 are needed to oxidize 1 kg BOD_5.

Since wastewater in Tunisia has an average BOD_5 concentration of around 350 mg/l, it must undergo a more intensive treatment initially to obtain effluent of a satisfactory quality; otherwise the number of "aerated lagoons" would need to be much higher, pushing construction costs of such a plant beyond those of other types of treatment. Thus, aeration in the first basin must be calculated similarly to that of "activated sludge" plants or "oxidation channels" in which organic loads are initially reduced by around 50%. The fact that the wastewater entering the second basin has a BOD_5 of concentration under 200 mg/l makes "aerated lagoon" treatment a promising method for improving effluent quality.

When it comes to evaluating the treatment plant's performance level in respect to BOD_5, we must keep in mind that the first basin, or at least a part of it, is not really a part of the so-called "aerated lagoon" system, but rather reduces by 50% the BOD_5 load carried in by raw wastewaters. Evaluation of performance levels thereby begins with the already reduced load and by subtracting the part used in the first stage to oxidize the raw wastewater from the total volume of the different basins.

Furthermore, certain lagoon treatment plants have an aeration system calculated in the same way as for an oxidation channel, and some even have sludge treatment systems. In this case, the treatment plants should be treated as an oxidation gutter whose performance is comparable to those treatment plants referred to more generally as "activated sludge." The calculation and formulation of BOD_5 effluent requirements should be done following the model suggested for that type of plant.

The water temperature in aerated lagoons — like the temperature in Tunisia — is, in general, relatively high and promotes the growth of algae. Thus, when it comes to testing BOD_5, it is preferable to specify filtered BOD_5 for lagoon effluent.

2. Determination of plant performance level with respect to BOD_5

The performance of an "aerated lagoon" treatment system depends heavily on average retention time in the lagoons and the number of series basins. The following table proposes a triple performance level classification of aerated lagoons according to the criteria enumerated above. The table, however, can be calibrated for the Tunisian system using actual results measured in each class.

PERFORMANCE LEVEL	Number of basins in series			
	1	2	3	4
	RETENTION TIME (1) IN DAYS BEGINNING WITH INITIAL PERFORMANCE LEVELS			
I	16	13	12	11
II	N/A	20	17	16
III	N/A	28	25	23

(1) RETENTION TIME = $\frac{\text{Total volume of liquid in the lagoons x 0.9}}{\text{Design flow or influent flow}}$

Round results off in the normal way: ($<0.5 = 0$) and ($\geq 0.5 = 1$)

3. Determination of fecal coliforms effluent

The determining factor when it comes to fecal coliform reduction is retention time coupled with the effect of solar ultraviolet rays. The following table proposes a conservative result for the quantity of fecal coliforms per 100 ml which can be found in the lagoon wastewater treatment effluent depending on the number of retention days and the number of series basins. It can, however, be calibrated for the Tunisian system using actual results measured at each one.

RETENTION TIME (1) (days)	Amount of fecal coliforms per 100 ml	
	2 series lagoons	More than 2 series lagoons
≤ 15.9	50 000	20 000
16.0 to 24.9	10 000	5 000
≥ 25.0	2 000	1 000

(1) RETENTION TIME = $\frac{\text{Total liquid volume of the lagoons x 0.9}}{\text{Design flow or influent flow}}$

4. Aerated lagoon effluent requirements calculation sheet

Plant: File no:

DATA USED TO CALCULATE AERATED LAGOON REQUIREMENTS

DESIGN DATA LO_{design}:__ kgBOD_5/d ⇒⇒ C: _ mg/l

$YEAR_{conc}$: __

$FLOW_{conc/infl.}$: __ m^3/d _ lagoons in series totaling __m^3

PERFORMANCE LEVEL - BOD_5

(Total volume x 0.9) ÷ $Q_{conc.}$ = _._d ⇒⇒⇒⇒ Level _

FECAL COLIFORMS Intermediary Period: half-yearly ☐

quarterly ☐

monthly ☐

"ECKENFELDER" THEORETICAL EFFICIENCIES - BOD_5 ⇒⇒⇒⇒ _% _mg/l

Basin no 1 = ___ m^3 Basin no 3 = ___ m^3

Basin no 2 = ___ m^3 Basin no 4 = ___ m^3

CALCULATION OF REQUIREMENTS

Type of requirement		BOD_5	Waste load assigned (kg/d)	
mg/l (1)	R_{rr} (1)		(A)	(B)
—	__%	YEAR	—	--
—	__%	Intermediary	—	—.

(1) RECOPY THE FIGURES THE TABLE PROVIDES FOR BOD_5 CONCENTRATIONS AND EFFICIENCIES ACCORDING TO THE PERFORMANCE LEVEL IN WHICH "mg/l" CORRESPONDS TO THE CONCENTRATION AND "R_{rr}" TO THE EFFICIENCY TO BE ATTAINED FOR THE PERIOD.

(A) Calculate: mg/l x $Q_{conc/infl.}$ ÷ 1000 = assigned waste load depending on the concentration to attain

(B) Calculate: (1-R_{rr}) x $LO_{conc/infl.}$ = assigned waste load depending on the average efficiency to attain

NOTE: Keep the highest load between (A) and (B).

FECAL COLIFORMS (see the TABLE which determines the amount of fecal coliforms per 100 ml depending on retention time and the number of series basins)

REQUIREMENT RETAINED: __org./100 ml (geometrical average for the period)

5. Proposed effluent and operation requirements

EFFLUENT AND OPERATION REQUIREMENTS OF THE TREATMENT PLANT (treatment plant name)

Given the flows and pollution loads anticipated for the above-mentioned treatment plant and its equipment, the following effluent and operation requirements have been established.

1. All wastewaters conveyed to the treatment plant must, at all times, be submitted to the complete treatment and must be discharged into the receiving environment through the outfall.

2. The quantities of organic matter, expressed in BOD_5 (mg/l and kg/d) and in fecal coliforms (number/100 ml), present in the treatment plant effluent should not exceed the values indicated on the attached chart, "Effluent requirements of an aerated lagoon treatment plant" and according to prescribed conditions therein.

3. The monitoring program specially prepared for the above-mentioned treatment plant must be carried out entirely and the required monthly reports must reach ONAS at the latest six weeks following the month concerned. Test results from an independent laboratory must be attached to each report.

4. Monthly reports summarizing interventions carried out as part of the maintenance program must be attached to the monthly monitoring reports. They are thus subject to the same deadlines.

EFFLUENT REQUIREMENTS OF THE AERATED LAGOON TREATMENT PLANTS

PARAMETER	PERIOD	CONCENTRATION mg/l	WASTE LOAD ASSIGNED* kg/d
		average for the period	
BOD_5	YEAR	(1)	
	Intermediary Period (2)	(1)	
Fecal Coliforms	Intermediary Period (2)	Geometric Average 000 org./100 ml	

✓✓ The assigned waste load should never be exceeded.

✓✓✓ (1) If the measured concentration exceeds the required concentration, it is still acceptable provided the influent BOD_5 load is reduced by at least _% over the year, and _% over the intermediary period.

(2) The intermediary period is determined by the plant category (size) as defined in the monitoring program.

These requirements apply to the effluent in the final lagoon.

Data used to determine compliance with the requirements are those provided by the operator in accordance with the monitoring program required by ONAS as well as any data collected at ONAS' request or by the operator.

NOTE: The yearly and intermediary BOD_5 concentrations and efficiencies for the year and for the intermediary period must be transcribed using the table proposed below.

PERFORMANCE LEVEL	PERIOD	CONCENTRATION (mg/l)	EFFICIENCY (%)
I	Annual Intermediary	40 60	80 70
II	Annual Intermediary	30 50	85 75
III	Annual Intermediary	20 30	90 85

As earlier stated, the proposed concentrations and efficiencies can be revised according to the actual concentrations and efficiencies measured in Tunisian aerated lagoons. The proposed values, however, are sufficiently realistic to be used integrally initially.

The intermediary period is **biannual** for Category 1 plants, **quarterly** for Categories 2 and 3, and **monthly** for Category 4.

6. Proposed monitoring program

One of the primary objectives of a treatment plant monitoring program is to verify compliance with effluent requirements established for the plant.

In the case of aerated lagoon treatment plants, these requirements are set up with performance variations for the intermediary periods, as well as with an annual basis.

ONAS requires both regular monitoring of effluent quality throughout the year and periodic control of the influent in order to assess the performance of the treatment process.

In the case of irregularities (for example, non-compliance with requirements or abnormal odors), ONAS should be able to formulate a diagnosis rapidly. Information is therefore required on those operational parameters most likely to vary, such as aeration parameters. In addition, effluent load evaluations also serve to verify compliance with the design basis and to establish treatment plant efficiencies.

The list of parameters subject to monitoring as well as the frequencies and how to achieve them are outlined in the following section, "Monitoring Program for Aerated Lagoons." Since certain aspects vary with a treatment plant's size or the nature of the requirements, **certain parameters may not be applicable to a given plant**.

It should be noted that certain parameters may be omitted upon approval from ONAS when the equipment required to collect certain data has not been installed. The monitoring program presented here, however, is a minimal program, so particular conditions may require additional parameters or higher reading frequencies; for example, readings will be required when particular conditions exist (e.g., the presence of industry(ies) whose load represents more than 30% of the total load, or whose effluent contains toxic substances, etc.).

ONAS has also defined the form in which it wants this information to be provided. A standardized form is to be sent to ONAS monthly.

MONITORING PROGRAM FOR AERATED LAGOONS

Section 1. Definition of Quarterly Periods

IDENTIFICATION OF QUARTERLY PERIODS	CORRESPONDING MONTHS
1st	January, February, March
2nd	April, May, June
3rd	July, August, September
4th	October, November, December

Section 2. Definition of Treatment Plant Categories

CATEGORY	CAPACITY	
	m^3/d	Population equivalent
1	< 500	< 5 000
2	≥ 500 to < 5 000	≥ 5 000 to < 50 000
3	≥ 5 000 to < 15 000	≥ 50 000 to < 150 000
4	≥ 15 000 to < 50 000	≥ 150 000 to < 500 000
5*	≥ 50 000	≥ 500 000

* It is highly unlikely that aerated lagoons will be chosen to treat such a flow and/or population. We will therefore not refer to Category 5 in the rest of this document.

PARAMETERS	FREQUENCY OF READINGS BY CATEGORY 1-2	3-4
Section 3. Flows		
Daily influent flow (m^3/d)	1/d	1/d
Instantaneous effluent flow (m^3/d)	1/w	1/w
Section 4. Influent Outlet		
Duration of operation (hours/d)	1/d	1/d
Section 5. Meteorology		
Rainfall (mm of water/d)	1/d	1/d
Section 6. Treatment		
Operation time of each booster (hours/d)	1/d	1/d
Air flow (m^3/min)	1/d	1/d
D.O. in the effluent (mg/l)	1/w	1/w
Effluent temperature (°C)	1/w	1/w
D.O. in each basin (mg/l)	1/m	1/w
Temperature in each basin (°C)	1/m	1/w
Aerator out of service	1/m	1/m
Aeration modifications	1/m	1/m
Abnormal odors	1/m	1/m
Floating debris	1/m	1/m
Basis deviations	1/m	1/m
Section 7. Chemical feed		
Chemicals used	1/m	1/m
Quantity used monthly	1/m	1/m
Usage objective	1/m	1/m
Injection sites	1/m	1/m
End of feed	1/m	1/m

1/d = once daily; 2/w = twice every week;
1/w = once weekly; 1/2w = once every two weeks;
1/m = once monthly.

Section 8. Regular Effluent Monitoring

A. CATEGORY 1

PARAMETERS (In mg/l except for amt of fecal coliforms per/100 ml)	FREQUENCY	
	Independent lab	On site
BOD_5, SS, NH_4 (mg/l N)	1/m	---
COD	1/m *	1/m *
P_{tot} (mg/l P)	1/m	---
Fecal Coliforms	1/m	---

* EVENLY SPACE THE TESTS (once by an independent laboratory, and then on site)

B. CATEGORY 2

PARAMETERS (in mg/l, except for amt of fecal coliforms per/100 ml)	FREQUENCY	
	Independent laboratory	On site
BOD_5, SS, NH_4 (mg/l N)	1/2w	---
COD	1/2w *	1/2w *
P_{tot} (mg/l P)	1/m	---
Fecal Coliforms	1/2w	---

* EVENLY SPACE THE TESTS (once by an independent laboratory, and then on site)

C. CATEGORY 3

PARAMETERS (in mg/l, except for amt of fecal coliforms per/100 ml)	FREQUENCY	
	Independent lab	On site
BOD_5, SS, NH_4 (mg/l N)	1/w	---
COD	1/w**	1/w
P_{tot} (mg/l P)	1/2w	---
Fecal Coliforms	1/w	---

** DOUBLE TEST (the same sample divided into two fractions)

D. CATEGORY 4

PARAMETERS (in mg/l, except for amt of fecal coliforms per/100 ml)	FREQUENCY	
	Independent lab	On site
BOD_5, COD, SS	2/w **	1/w
NH_4 (mg/l N)	2/w	---
$O\text{-}PO_4$ (mg/l P)	1/w **	1/w
P_{tot} (mg/l P)	1/w	---
Fecal coliforms	2/w	---

** DOUBLE TEST (the same sample divided into two fractions)

Section 9. Regular Influent Monitoring

APPLIES ONLY TO CATEGORY 4 AERATED LAGOONS excluding those months in which there is a periodical control

PARAMETERS (in mg/l)	FREQUENCY	
	Independent lab	On site
BOD_5, COD, SS	---	1/m
P_{tot} (mg/l P)	---	1/m

Section 10. Periodical Influent Monitoring

PARAMETERS (in mg/l)	CATEGORY		
	1	2	3 and 4
BOD_5, COD, SS	twice (2)/year **	3 times/year **	once (1)/quart **
TKN and NH_4 (mg/l N)	(3 consecutive days)		
P_{tot} (mg/l P)			

** Intervals evenly spaced throughout the year.
Same days as effluent

Section 11. Periodical Effluent Monitoring

PARAMETERS (in mg/l)	CATEGORY		
	1	2	3 and 4
BOD_5, COD, SS	twice (2)/year **	3 times/year **	once(1)/quarter **
TKN and NH_4 (mg/l N)	(3 consecutive days)		
P_{tot} (mg/l P)			

** Intervals evenly spaced throughout the year
Same days as influent

Section 12. Sludge Management — CATEGORIES 1, 2, 3, and 4

A. Sludge Accumulation Measurements

TYPE OF BASIN	FREQUENCY
Entry of raw wastewaters (influent) and/or secondary basins	once (1)/3 years **AND** once (1)/year when the sludge volume represents 10% of the lagoon's volume
Exit of treated wastewaters (effluent) and/or with phosphate removal	once (1)/3 years AND once (1)/year when the sludge volume represents 10% of the lagoon's volume **and/or** when the sludge level falls to one meter under the influent pipe radier

B. Sludge Sampling and Testing

TYPE OF BASIN	FREQUENCY
Entry of raw wastewaters (influent) and/or Secondary Basins	once (1)/3 years
Exit of treated wastewaters (effluent) and/or with chemical phosphate removal	once (1)/3 years

When agricultural or forestry use is planned, there should be 2 sludge samplings and testings in the year preceding the basin draining.
When burial of decontaminated sludge is planned, one single test is required in the year preceding the draining.

C. Parameters Subject to Testing (by an independent ONAS approved laboratory)

TS	(mg/l)		Aluminum	(mg/kg solids) (1)
TVS	(mg/l)		Arsenic	(mg/kg solids)
TKN	(mg/kg solids)		Boron	(mg/kg solids)
HN_4	(mg/kg solids)		Cadmium	(mg/kg solids)
$NO_2 + NO_3$	(mg/kg solids)		Cobalt	(mg/kg solids)
P_{tot}	(mg/kg solids)		Chromium	(mg/kg solids)
K	(mg/kg solids)		Copper	(mg/kg solids)
Ca	(mg/kg solids)		Iron	(mg/kg solids) (1)
Mg	(mg/kg solids)		Manganese	(mg/kg solids)
pH			Mercury	(mg/kg solids)
			Molybdenum	(mg/kg solids)
			Nickel	(mg/kg solids)
			Lead	(mg/kg solids)
			Selenium	(mg/kg solids)
			Zinc	(mg/kg solids)
			BPC	(mg/kg solids)

(1) Aluminum (Al) or iron (Fe) concentrations must be measured in the basin(s) where the phosphate removal takes place according to whether alum or an iron compound is used to remove phosphate.

D. Information on Evacuated Sludge

ELEMENT	FREQUENCY
Volume [m^3]	1/d
Dryness [%] (1)	1/d
Elimination site and name of transporter	1/d

(1) Only when the sludge must be dried and conveyed to a sanitary burial site

DETAILS ON THE IMPLEMENTATION OF THE AERATED LAGOON MONITORING PROGRAM

Section 1. Definition of the Quarterly Periods

As part of the monitoring program of municipal liquid treatment facilities, the quarterly periods have been defined as indicated in Section 1. This definition is the one that is used to verify the effluent requirement carried out during the annual performance testing.

Section 2. Definition of Plant Categories

The plant category is defined according to its designed hydraulic capacity or **the reference** capacity that is used to calculate its effluent requirements.

Section 3. Flows

The daily **influent** flow corresponds to the volume of wastewater let into the plant every 24 hours, which is determined through daily readings of the influent flow totalizing system at a fixed time.

The instantaneous **effluent** flow corresponds to the flow obtained by selective measurements of the effluent overflow water levels that are converted into flow using the appropriate chart.

Section 4. Influent Outlet

Readings of the operation duration of the final outlet before the plant entrance should be done the same number of times as the influent flow, that is, daily. If other derivation(s) likely to function on a regular basis exist inside the plant, it (they) should be similarly monitored. Furthermore, if a device allowing for a continuous measuring of derived flow exists, the daily derived volume (m^3/d) should be noted daily.

Section 5. Meteorology

Readings of the quantity of rainfall are done using the pluviometer, which is generally present at the plant site. This reading should be done once a day at the same time as the influent flow reading. When there is no pluviometer, the letter "R" should be inscribed when there is rainfall during the day.

Section 6. Treatment

Daily readings of the air flow injected into the basins is required even when a flowmeter is installed.

Measurement of dissolved oxygen (D.O) in the basins takes place at the exit or near the exit of each basin: the sampling site should be the most representative possible. The measurement of dissolved oxygen in the effluent is required every week of the year.

Section 7. Chemical Feed

Each monthly report must indicate if chemical feed has been used in the treatment chain. If yes, all the information requested in Section 5 must be provided.

Section 8. Regular Effluent Monitoring of Effluent

Section 8 of the monitoring program sets forth the required frequencies for the regular monitoring of effluent quality.

The effluent sample is an instantaneous sample, that is, a single sampling done manually.

The test referred to as "independent lab" must be carried out by an **ONAS approved laboratory** and in accordance with the most recent standards indicated in Standard Methods for the Examination of Water and Wastewater. The operator must follow the instructions on preserving and transporting the samples furnished by the laboratory. The operator is advised to keep in mind, when making arrangements with the laboratory, the constraints associated with BOD_5 testing. Except in particular cases, it is preferable that the laboratory begin testing on a Wednesday, a Thursday, or a Friday. The operator must **keep all laboratory test results** and send ONAS a copy with the corresponding monthly report.

Moreover, some of the testing should be conducted "on site" using the laboratory equipment available at the plant.

For Categories 1 and 2 plants, an interval left between "independent" and "on site" COD and O-PO_4 testing will produce more information. This process allows Category 1 to obtain one result every two weeks, and one weekly result for Category 2.

For Categories 3 and 4, the parameters tested on site should be verified by an ONAS-approved laboratory on those days when the samples are sent to ONAS. This increases the amount of information collected as well as regularly validating the on-site testing. This monitoring should be done at least **twice (2) a year** for Categories 1 and 2.

In order to minimize the annual number of tests conducted by an independent laboratory, the regular effluent control can be omitted those months when a periodical effluent control is done (see Section 11).

Section 9. Regular Influent Monitoring

Regular control of Category 4 lagoon influent should be conducted once a month.

Sampling should be done every 24 hours and according to the conditions specified for the periodical influent verification.

Testing should be done on site using available equipment. Test results will then be recopied onto the ONAS-stipulated forms (see Section "Influent") and sent with the monthly report.

Section 10. Periodical Influent Monitoring

Section 11. Periodical Effluent Monitoring

Periodical monitoring of the plant's **INFLUENT** and **EFFLUENT** is conducted during two (2), three (3), or four (4) sampling campaigns per year, or:

- for Category 1 lagoons, **TWO (2)** campaigns of three (3) days each set up at approximately six-month intervals respectively;
- for category 2 lagoons, **THREE (3)** campaigns of three (3) days each set up at approximately four-month intervals respectively;
- for Categories 3 and 4 lagoons, **FOUR (4)** campaigns of three (3) days each set up at approximately three-month intervals respectively;
- in some cases, such as when the BOD_5 waste load that comes from industrial use represents more than 30% of the treatment plant's total design capacity, each sampling campaigns should be increased in duration to five days — three days when industrial activity takes place and two when there is none. ONAS strongly recommends if this is the case that the operator increase the control campaign to seven days. This allows calculation of the organic load, as well as a better differentiation of the proportion of industrial to residential waste load.

Each campaign should take place in the following way:

- **INFLUENT** sampling is conducted on three (3) consecutive days providing the weather is dry. If significant rainfall occurs (normally more than 10 mm of rain; this value can vary according to the actual reaction of the sewerage network to rainfall) during the sampling, the sample should be discarded and another sample taken the following day or during the following week.
- **EFFLUENT** sampling is conducted at the same time as the influent provided that the latter is not discarded.

INFLUENT samples should be **24-hour composite samples**.

- Categories 1 and 2 lagoon sample should be made up proportionally to the **time** with a minimum of four samples per hour.
- Categories 3 and 4 lagoon samples should be made up proportionally to the **flow** with at least four samples per hour at the time of minimum hourly flow; sampling proportional to time is acceptable if it is too difficult to do it proportional to the flow;
- the volume of wastewater received during each sampling day should be read and should correspond to the period that covers the beginning and the end of the sampling.

EFFLUENT samples should be taken manually once a day in one single procedure.

Testing required during an annual periodical sampling campaign should be conducted by an ONAS-approved laboratory and in compliance with the most recent standards indicated in Standard Methods for the Examination of Water and Wastewater. The operator must follow the instructions provided by the laboratory on preserving and transporting the samples. The operator must keep all the laboratory test results and transmit a copy to ONAS with the corresponding monthly report.

Section 12. Sludge Management

A. Sludge Accumulation Measurements

The monitoring program requires the treatment plant operator to measure sludge accumulation according to the frequencies indicated in Section 12 A.

The measurement results should be compiled on the form stipulated by ONAS.

To obtain a result representative of the sludge volume accumulated at the bottom of the basin, uniformly space the measurement sites according to a grid and limit the measurements to the lagoon's bottom surface, avoiding the banks. In the treated wastewater exit basin (effluent), however, there is generally a zone without aeration in the last part of the basin near the exit pipes toward which the sludge tends to move and settle. A higher number of measurement sites should therefore be anticipated in this area and, in particular, in the 10 meters immediately upstream of the exit pipes. The final basin's exit manhole upstream of the overflow should also be measured in order to verify whether sludge has accumulated, an indication that there is sludge loss through the effluent.

Since the dimensions of the aerated lagoons will vary widely, some measurement sites have been set according to the basin's bottom surface for informational purposes.

BOTTOM SURFACE (m^2)	NUMBER OF MEASUREMENT SITES
< 2 000	12 (6)
2 000 to 5 000	15 (6)
> 5 000	24 (8)

The figures in parentheses represent the number of measurement sites to set in the 10 meters upstream of the final basin's treated water (effluent) exit pipes.

Sludge accumulation measurements can be conducted with a mud gauge, an infrared detector, Sonar equipment, etc.

B. Sludge Sampling and Testing

The sludge sampling and testing frequencies required by the monitoring program are those required if agricultural use is planned. If, however, burial of decontaminated sludge proves to be the only possible solution, a single test result is sufficient before draining.

Generally, regardless of the basin to be drained, at least two (2) sludge test results taken at different intervals are required one year before draining. If the two reports differ greatly from one another and present a problem in relation to the standards fixed for metals, a supplementary test for the concerned parameters is necessary.

When sludge sampling is conducted in one of the basins, five samples should be taken during the sampling and homogenized to obtain a single sample representative of the basin. The sludge quality test report must be sent to ONAS on the stipulated form.

These sludge tests permit ONAS:

- to know the quality of the sludge;
- to observe variations in sludge quality from one sample to another;
- to provide advice on the possible future elimination methods to be used.

When the sludge is transferred to the basins for long-term storage or treatment (thickening or other) before being put to agricultural use, tests of this sludge should be conducted to evaluate the quality and to calculate the amount of sludge being used. The sludge volume must be precisely assessed and the tests must be representative of the sludge quality.

C. Parameters Subject to Testing

The parameters subject to testing can found in section 12.C. They should all be tested by an ONAS-recognized laboratory. When two sets of test results differ greatly for some of the parameters, a new sampling that tests the differing parameters is advised.

D. Information on the Evacuated Sludge

When the basin is drained, ONAS requires a daily reading of the quantity of evacuated sludge (in m^3), the degree of dryness in percentage (only for burial), the elimination sites, and the name of the transporter who carried out the elimination work.

Annex H

Non-Aerated Lagoon Treatment Plants

Both the operation and efficiency requirements and the monitoring program resemble that of Category 1 aerated lagoons. The efficiency requirements applicable to this type of plant, however, apply to fecal coliform as defined for aerated lagoons. Operation requirements should be modified as a consequence. It is useful, however, to specify a maximum BOD_5 load per hectare (total water surface area) for the first basin. Verification of this load lets the operator know when the lagoons need to be enlarged.

The operator must produce a quarterly report instead of a monthly one. Category definitions are not necessary since this type of treatment only applies to a restricted number of clients.

Influent flow measurement is generally done manually on an overflow. It is preferable, however, to average three measurements taken during each day in which samples are taken for testing. The sample should be taken manually and made from three samplings done during the day. Effluent measurements can be taken monthly.

Verification of the influent outlet must be done every day a flow measurement is taken; the same is true for the meteorological conditions.

The data relative to the treatment (section 6 of the aerated lagoon monitoring program) is limited to noting abnormal odors and floating debris, as well as any deviation of a basin. No on-site testing is required.

Both the regular effluent monitoring and the periodical influent and effluent monitoring should be identical to those of Category 1 aerated lagoons.

Sludge management can be done in the same manner as for aerated lagoons, but the frequencies for accumulation measurement, sampling, and testing should be halved.