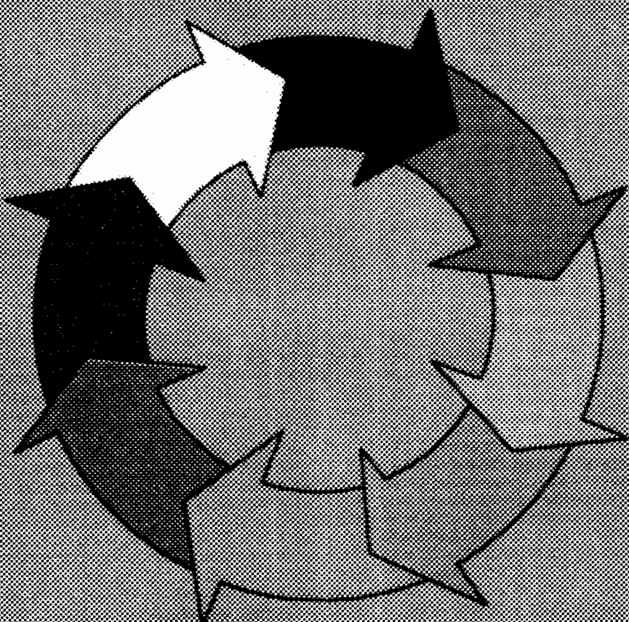
WATER, AIR, WASTE & ENERGY: PROTECTING THE ENVIRONMENT ECONOMICALLY



January 30 - 31, 2001

at the

ALEB Offices, 12 Dokki Street, Giza, Egypt

A Short Course Sponsored by Agriculture Led Export Businesses (ALEB) &

Center for Advanced Food Technology

Presented & Developed

by

Mr. Richard H. Meer

and

Dr. John Coburn

Energy Conservation Expert

USAID Contract No. 263-0264

Water, Air, Waste & Energy: Protecting the Environment Economically

Richard H. Meer
Energy Conservation Expert

Al Machlin, PE
Water Conservation Expert

Dr. John F. Coburn
Associate Director, CAFT

A Short Course Sponsored by the Agriculture Led Export Businesses (ALEB) Project

12 Dokki Street, Dokki, Cairo

January 30-31, 2001

USAID Contract No. 263-0264

الماء والهواء والفاقد والطاقة حماية البيئة من الناحية الاقتصادية

ريتشارد م. مير
خبير توفير الطاقة

آل ماكلين
خبير المحافظة على الماء

د. جون إف. كوبورن
مدير مساعد ، CAFT

دورة تدريبية قصيرة تحت رعاية مشروع دعم الاعمال الزراعية الموجهة للتصدير (ALEB)

١٢ شارع الدقي، الدقي، القاهرة

٣٠-٣١ يناير، ٢٠٠١

مشروع تموله الوكالة الامريكية للتنمية الدولية

رقم ٠٢٦٤ - ٢٦٣

WATER, AIR, WASTE & ENERGY: PROTECTING THE ENVIRONMENT ECONOMICALLY

INTRODUCTION

All businesses need to keep moving forward to assure that they remain healthy and viable. Understanding issues related to water, waste and energy, and their effects on the environment is an essential element in today's business world. There are many buyers who insist on working with companies who are committed to "***green***" production operations. Egypt's government officials also realize that protecting the environment is important, and have passed environmental laws mandating that processors move towards more environmentally friendly practices.

This one and one-half day program will provide attendees with information on how they can enhance environmental awareness and implement programs that will not only protect the environment, but will be cost effective.

PROGRAM OUTLINE

1. OBJECTIVES

- Reduce water usage
- Reuse water where possible
- Reduce wastewater discharges
- Reduce energy consumption
- Reuse available energy

2. WATER

- Pollution Prevention
- Initial Waste Survey
- Possible In-Plant Modifications
- Wastewater Treatment

3. ENERGY

- Energy Audit
- Fuel Sources
- Process Requirements
- System Maintenance
- Alternate Power Sources
- Energy Information System

4. CASE HISTORIES

- Campbell Soup Company (soup processor) – could not meet water quality standards, wanted to lower purchase costs.

- Wise Foods (potato chip manufacturer) – had to reduce waste clarifier solids in effluent under threat of heavy fines.

- Cascade Specialties (dehydrated vegetable manufacturer) – high cost of energy, conservation needed.

5. SOLAR ENERGY ALTERNATIVES

6. IMPLEMENTING AN ENERGY & WATER SAVING PROJECT

INSTRUCTORS

Dr. John Coburn
Director, CAFT/FMT Facility
Piscataway, NJ., USA

Mr. Richard Meer
Engineering & Management Consultants
Franklin Lakes, NJ, USA

MORE INFORMATION CONTACT:

Mr. Richard F. Stier
Director, Technical Services
Mr. Morad S. Ahmed
Co-Director, Technical Services
Agriculture Led Export Businesses
ALEB
12 Dokki Street, 6th Floor
Giza, Cairo
TEL 02-338-1445 (6 Lines)
FAX 02-348-0729
EMAIL rfstier4@egyptonline.com
Morad@egyptonline.com

January 30-31, 2001 at 10:00 at the ALEB offices on 12 Dokki Street, Cairo

EAGA MEMBER COMPANIES RECEIVE A 25% DISCOUNT ON REGISTRATION FEES

REGISTRATION INFORMATION
ENERGY & ENVIRONMENT

Name ....

Title ....

Company ....

Address ....

....

TEL ....

FAX ....

Email ....

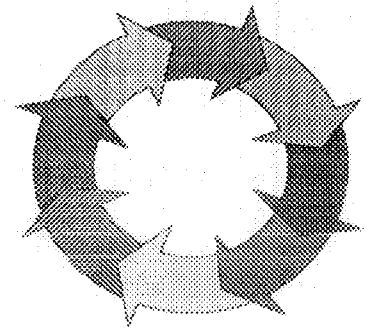
Attendees may register by calling in or faxing this registration to ALEB. They may also register on-site.

Registration Fee: There will be a 100LE registration fees for this program. Registrants will receive a course notebook, coffee breaks morning and afternoon and a certificate of participation following completion of evaluation forms.

For further details, contact:
Agriculture Led Export Businesses (ALEB)
12 Dokki Street
Giza, Cairo, EGYPT
TEL 02-338-1445 (6 Lines)
FAX 202-348-0729

WATER, AIR, WASTE & ENERGY: PROTECTING THE ENVIRONMENT ECONOMICALLY

A SHORT COURSE



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BY THE
AGRICULTURE LED EXPORT
BUSINESSES PROJECT (ALEB)
CAIRO, EGYPT

THE CENTER FOR ADVANCED
FOOD TECHNOLOGY
PISCATAWAY, NJ, USA

USAID Project No. 263-0264

January 30-31, 2001 at 10:00 at the ALEB Offices, Dokki, Cairo

RICHARD H. MEER,
PRINCIPAL CONSULTANT
ENGINEERING & MANAGEMENT CONSULTANTS
742 BUTTERNUT DRIVE
FRANKLIN LAKES, NJ 07417, USA
TEL/FAX: 201-847-0748
e-mail: RHMeerEMC@aol.com

EDUCATION

Bachelor of Chemical Engineering, Lafayette College, 1963
Master of Science, Chemical Engineering, Cornell University, 1965
Master of Business Administration, University of Delaware, 1968

PROFESSIONAL BACKGROUND

E. I. DUPONT DE NEMOURS & CO., DEEPWATER, NEW JERSEY, 1965 TO 1968

Jackson Laboratory, the Organic Chemicals Research and Development facility, specialized in "Freon" compounds and textile dyes. Position held was Research Engineer.

- Developed technical scale-up procedures for chemical compounds
- Supervised pilot plant operation

MEER CORPORATION, NORTH BERGEN, NEW JERSEY, 1968 TO 1993

The largest botanical extraction and water soluble gum company in the United States with sales of $ 25 million specializing in natural ingredients for the food and pharmaceutical industries. Positions included Project Engineer, Vice President, Executive Vice President, and President.

Production and Inventory Control

- Prepared manufacturing procedures, economic lot sizes and annual production plan.
- Installed plant extraction, distillation, spray drying, compounding, milling and blending equipment Prepared "what if" cost analysis on product formulations to remove unprofitable product inventory
- Developed state-of-the-art spray drying system requiring less labor and energy

Laboratory and Technical Activities

- Improved quality assurance by developing extensive product specifications with high customer satisfaction. Results confirmed by an independent market research firm.
- Compared raw material options for botanical ingredients based on cost and processing requirements.
- Coordinated development projects among flavor, stabilizer, and extraction laboratories

Corporate and Marketing Activities

- Prepared organizational plans and analysis for 1 to 3 year periods.
- Prepared detailed marketing plan by product line and profitability.
- Company delegate to industry trade associations including IFT, NAFFS, FEMA, ADS, and ASTA
- Product manager for spices, spice oleoresins, and pharmaceutical products.

- Targeted specific industry segments of beverage, baking, tobacco, dressings, spices and nutritional supplements to concentrate marketing, sales, and development efforts with growth potential.

ENGINEERING & MANAGEMENT CONSULTANTS, FRANKLIN LAKES, NEW JERSEY, 1993 TO PRESENT

Provide consulting services to organizations with botanical, food processing, flavor, and pharmaceutical applications. Position: Principal Consultant.

- Technology transfer of cell burst process for fruit, vegetable and grain products from South Africa to introduce the operation in the United States. Business plan prepared including marketing procedure outlined for full implementation.
- Prepared specifications, and selected equipment set-up a $0.5 million spray drying venture to manufacture health food ingredients. Prepared a Break Even Analysis for formulated nutritional supplements to operate the dryer efficiently.
- Provided botanical raw material ingredients, set up quality standards, and selected custom processing site for a pharmaceutical research firm. Identified over $250,000 of savings during brief assignment.
- Developed a process to remove moisture from a harvested engineered leafy crop without excess heat, followed by a cryogenic freezing process to maintain stability. Presented new product ideas for market expansion.
- Prepared venture analysis for flavoring ingredient. Potential sales $5 million
- Reduced bacteria, water and energy consumption during the manufacture of a mineral supplement
- Prepared marketing report for manufacturing standardized herbal products in North America
- Provided technical analysis for reactor damage in a manufacturing biological research laboratory for both equipment and research compounds. Supervised damaged equipment recovery process.
- Industry technical expert during merger negotiations of nutraceutical firms.
- Established equipment specifications and prepared a plant layout for manufacturing standardized botanical extracts.

PROFESSIONAL ENGAGEMENTS

- Seminar Speaker, "Cost Saving Wastewater Management Strategies for the Food and Flavor Industries," Rutgers, the State University of New Jersey, Center for Advanced Food Technology (CAFT)
- Industry Expert, Spice Oleoresins, Food Chemicals Codex, Specifications Committee
- Seminar Speaker, "Spice Oleoresin Marketing in the USA", Women in Flavor and Fragrance Industries
- Technical Review Presentation, Annual Convention, National Association of Fruits, Flavors, and Syrups

PROFESSIONAL AND COMMUNITY ACTIVITIES

President-Elect, National Association of Fruits, Flavors and Syrups (NAFFS)
Board Member, Consultants Association of the Natural Products Industry (CANI)
Consulting Associates Network, Rutgers University, Center for Advanced Food Technology (CAFT)

Industry Expert, Technical Advisory Service for Attorneys (TASA)
Professional Member, Institute of Food Technologists (IFT)
Former Member, Government Relations Committee, Flavor Extract Manufacturers Association (FEMA)
Former Member, Supplier Advisory Committee, Association of Dressings and Sauces (ADS)
Former Chairman, Extractors Committee, American Spice Trade Association (ASTA)
Member, Drug, Chemical, and Allied Trades Association (DCAT)
Executive Board, Northern New Jersey Council, Boy Scouts of America / Committee Chairman, Troop 34
Former Associate Director, United Jersey Bank, Hackensack, New Jersey

John F. Coburn

Associate Director, CAFT
Director, Advanced Manufacturing
Center for Advanced Food Technology (CAFT)
120 New England Avenue
Piscataway, NJ 08854
(732) 445-6132

Research Interests:

Research Management; Strategic Planning; Technology Assessment and Transfer; Research Evaluation; Productivity Analysis; Computing Applications; Manufacturing Engineering.

Education:

Ph.D., Chemistry, Yale University, 1964
B.S., Chemistry, University of Akron, 1958

Experience:

Rutgers University
- Associate Director, CAFT, Rutgers University 1991 – present
-Consultant, Rutgers University and Exxon, 1988-1991
-Associate Director, CAIP, Rutgers, 1986-88
Exxon Research and Engineering
-Senior Staff Advisor, Exxon Research & Engineering, 1981-86
-Project Head, Exxon Research & Engrg, 1971-76
-Chemist to Research Associate, 1965-1971
Exxon Enterprises
-Vice President-RD&E, Solar Thermal Systems, Exxon Enterprises, 1979-81
-Technology Manager, Solar Energy, Exxon Enterprises, 1976-79
United States Army
-Chief Chemical Officer, USArmy, Dugway Proving Grounds, 1963-67

Professional Activities:

Director, Combat Rations Network Projects, 1996-present
Director, Combat Rations Advanced Manufacturing Technology Demonstration, 1991-1996
Consultant, Computing Workstation Productivity, Exxon, 1987-88
Client Executive, Computing, Exxon Research & Engrg, 1981-86
Exxon Computing/Mathematics Technical Education Panel, 1982-86
Exxon Supercomputing Task Force, 1985
Technical Advisory Committees, Solar Energy Indus. Assoc, 1979-81
Board of Directors, Daystar Corporation, 1976-79

Coordinating Research Council (CRC) Fuel Quality, 1971-76
Exxon Aviation Technical Committee, 1971-76
CAPE-12 Panel, Industry-Government (CRC APRAC), 1971-73
CAPE-6 Panel, Industry-Government (CRC APRAC), 1969-71

American Chemical Society
American Association for the Advancement of Science
Institute of Food Technologists
Research & Development Associates for Military Food Feeding and Packaging Systems; Chairman Scientific Development and Member Board of Directors
Society of Automotive Engineers (1970-78)
International Solar Energy Society (1978-82)

Patents:

U.S. Patent 4,379,613 "Solar Energy Collector"
U.S. Patent 4,292,959 "Solar Energy Collection System"
U.S. Patent 3,873,271 "Method and Apparatus for Detecting Free Water in Hydrocarbon Fuels"
U.S. Patent 3,642,632 "Anthranilic Acid Esters as Lubricant Additives"

Recent Publications and Presentations:

"CORANET's Polymeric Tray Manufacturability Study", Research & Development Assoc. 1998 Spring Meeting, Lake Tahoe.
"Quality Process in Manufacturing", Research & Development Assoc. 1997 Spring Meeting, Tampa.
"Ideal Processing Line Setup", Defense Logistics Agency. 1997 MRE Quality Summit, Fort Mitchell, Kn.
"An Object-Oriented Environment for Chemical Process Simulation", AIChE 1990 National Meeting, Orlando

ALBERT MACHLIN, P.E
Consulting Engineer
212-675-5868 (Direct Phone)
212-924-8071 (Direct Fax)

SUMMARY

Consulting engineer with extensive experience in all aspects of environmental engineering with industry and government. Formerly Assistant Regional Director and Regional Engineer for Environmental Quality for Region I (Long Island) of the New York State Department of Environmental Conservation.

WORK HISTORY

Principal and Co-founder of the Environmental Technology Group, Inc., NY, Experts in Engineering, Science, and the Environment.

- *Provided expert environmental engineering assistance to various law, insurance and real estate firms, which included water supply, wastewater, flooding and stormwater, solid waste, and hazardous waste matters.*

Assistant Regional Director and Regional Engineer for Environmental Quality Region 1, New York State Department of Environmental Conservation, Stony Brook, NY.

- ***Second in command of Region 1 office covering all New York State environmental programs in Nassau and Suffolk Counties - including Air Pollution, Water Pollution, Solid and Hazardous Waste Programs.***

Director of Environmental Quality
Region 2, New York State Department of Environmental-Conservation, New York, NY.

- ***Responsible for carrying out all New York State programs for Air Pollution, Water Pollution, Solid Waste and Pesticide Control in New York City.***

Assistant Director for Environmental Health Services
Office of New York City Affairs, N Y S Department of Health, New York, NY

- ***Responsible for carrying out all New York State programs for Air Pollution, Water Pollution, Water Supply, Solid Waste, Hospital and Nursing Home Sanitation, Mosquito Control, Rodent Control, and Housing Code Enforcement in New York City.***

Vice President and Division Engineer
Hydrotechnic Corporation Consulting Engineers, New York, N Y

- ***Project Manager for preparation of engineering reports, designs, and specifications for various industrial and municipal wastewater treatment, water supply, storm drainage, and refuse disposal projects, both in the US and abroad. Served as Resident Manager of Pittsburgh and California offices, and Chief Sanitary Engineer of Lima, Peru office.***

Civil/Sanitary Engineer at the following Consulting Firms:

- **Alexander Potter Associates, New York, NY**
- **Parsons, Brinckerhoff, Hall and MacDonald, New York, NY**
- **Gibbs and Hill, Inc., New York, NY**

Prepared reports, designs, specifications, and supervised construction of sewerage, water supply, storm drainage and flood control works for above firms.

OTHER EXPERIENCE

Senior Technical Consultant
United Nations Development Program

- ***Proposed storm water, sanitary sewage, and solid waste facilities for the city of Sekondi-Takoradi, Ghana.***

Adjunct Associate Professor, Environmental Engineering
New York Institute of Technology, Old Westbury, NY

Lecturer, Environmental Engineering
Waste Management Institute, State University of New York, Stony Brook, NY

Lecturer, Environmental Engineering
School of Continuing Education, New York University, New York, New York

Assistant Professor, Waste Water and Water Supply Systems
Graduate Engineering School, State University of New York, Stony Brook, New York

Clinical Assistant Professor, Environmental Health
Division of Allied Health Services, State University of New York Stony Brook, New York

EDUCATION

College of the City of New York, B.C.E.
Polytechnic Institute of Brooklyn, M.C.E.
City University of New York, M.S. (Environmental Engineering)

LICENSES

Registered Professional Engineer in New York and New Jersey.

PROFESSIONAL

- **American Academy of Environmental Engineers (Diplomate)**
- **American Society of Civil Engineers (Fellow)**
- **Director of Metropolitan Section ASCE (1989-1992)**
- **President of Metropolitan Section ASCE (1997-1998)**
- **American Water Works Association**
- **New York Water Environment Federation**
- **Air and Waste Management Association**
- **Inter-American Association of Sanitary Engineers and Environmental Sciences (AIDIS) - Regional Director of Upper Mid-Atlantic Region**

PUBLICATIONS

- **Groundwater Contamination on Long Island, New York (co-authored with S. Smith), Third International Conference for Environmental Quality and Ecosystem Stability, Jerusalem, June 1988.**
- **Long Island Water Resource Problems, A Lesson for Developing Countries., International Conference on Resource Mobilization for Drinking Water Supply and Sanitation In Developing Nations, San Juan, P.R., May 1987.**
- **Uncertainty of Water Supply Demand Estimates (co-authored with A.S. Goodman and M. Karamouz), Symposium on Water-Use Data for Water Resources Management, Tucson, Arizona, August 1988.**
- **Multi-layered Sampling In Water Table Region of a Sandy Aquifer (co-authored with E. Kaplan, S. Banarjee, D.Ronen, M. Magaritz, M. Sosnow, and E. Koglin), Journal of Ground Water, May-June 1991.**

NOTEWORTHY

Recipient of World Health Organization Traveling Fellowship in 1985 to study and report on Reclamation and Reuse of Water in Israel and its applicability to Long Island.

Listed in Who's in the East (1985).

RECENT CONSULTING ASSIGNMENTS

- **Environmental Training for Venezuelan Oil Co. Staff, Maraicaibo, Centro Internacional de Educacion y Desarrollo**
- **Floodplain Management Plan, Village of Bayville, L.I., NY**
- **Local Waterfront Revitalization Plan, Village of Bayville, L.I., NY**
- **Leakage Testing of 2,000,000 Gallon Fuel Tank, Astoria Plant, Con Edison, ASTTest Co.**
- **Sanitary Sewer Overflow Handbook, USEPA, Citizens for the Environment, L.I., NY**
- **Structural Damage Evaluation for Garage, Northern Boulevard, Queens, NY, ConTech, NJ**
- **Pollution Prevention Seminar for Food Industry, Rutgers University, NJ**
- **Air Pollution Permit Program, Safety and Environmental Division, Brookhaven National Laboratory, Upton, NY**
- **Preparation of Proposal Documents for Sludge Chemical Fixation Plant for Wards Island - NYC, Metcalf and Eddy, Consulting Engineers, New York, NY**
- **Groundwater Monitoring Program, Safety and Environmental Division, Brookhaven National laboratory, Upton, NY**
- **Sewage Treatment Plant Operation,Plant Engineering, Brookhaven National Laboratory, Upton, NY**
- **Maybrook Lagoons, Hazardous Waste Site - Town of Hamptonburg, NY, Seevers Associates, New York, NY**
- **Environmental Site Study for Proposed Electrical Generation Facility Mission Energy Company, Smithtown, NY**
- **Peconic River Management Plan, Safety and Environmental Division, Brookhaven National Laboratory, Upton, NY**
- **Storm Drainage Project - Town of East Hampton, NY, Lewin & Laytin, Attorneys, New York, NY**
- **Water Treatment Plant, Oswego, NY, Mackenzie Smith Lewis Mitchell & Hughes, Attorneys, Syracuse, NY.**
- **Environmental Assessment, Eastern Star Products, Inc., Hicksville, NY, AKRF, Inc., Environmental Consultants, New York, NY**
- **Oil Spill - Private Residence, Westhampton Beach, NY, Pino & Associates, Attorneys, White Plains, NY**
- **Oil Spill - Gasoline Service Station, Garden City, NY Cooperman, Harding & Moore, Attorneys, Kew Gardens, NY**
- **Construction and Demolition Debris Facility, Queens, NY, Eder Associates, Consulting Engineers, Locust Valley, NY**
- **Sewage & Drainage System Private Residence, Plandome, NY Estate of Al Brackman, Plandome, NY**

- **Superfund Site, Caldwell Trucking Company, Caldwell, NJ Sive, Paget & Riesel, P.C., Attorneys, New York, NY**

- **Air Emission Permits Award Packaging Corp., Garden City, NY**
- **Environmental Education Consultant, School of Continuing Education, New York University, New York, NY**
- **Wood-Fired Waste-To-Energy Facility, Star Recycling, Inc., Brooklyn, NY**
- **Storm Drainage, Nassau County, NY, Pester, Goldberg, Schiff, Danzi & Feldman, Attorneys, Carle Place, NY**
- **Environmental Audit - Private Residence, Kenneth R. Singh, Attorney-At-Law, Richmond Hill, NY**
- **Fire Damage Evaluation, EcoSmart, New York, NY**
- **Legionnella Problem, Budget Motor Lodge, Woodbridge, NJ, Tell, Cheser & Breitbart, Attorneys, Mountainside, NJ**

M

Program Outline

- Objectives
- Water
- Energy
- Case Histories
- Solar Energy Alternatives
- Implementing an Energy & Water Project

نبذة عن البرنامج

- الاهداف
- الماء
- الطاقة
- خلفية تاريخية
- بدائل الطاقة الشمسية
- تنفيذ مشروع للطاقة والماء

Objectives

- Reduce Water Usage
- Reuse Water Where Possible
- Reduce Wastewater Discharges
- Reduce Energy Consumption
- Reuse Available Energy

- Energy and Water Reuse Project Check List

الأهداف

- خفض استهلاك الماء
- إعادة استخدام الماء كلما أمكن
- خفض تصريف المياه العادمة
- خفض استهلاك الطاقة
- إعادة استخدام الطاقة

- قائمـــة المراجعة الخاصة بمشروع إعادة استخدام الطاقة والماء

Energy And Water Reuse Project Plant Check List

- Major Products
- Plant Capacity
- Typical Work Week
- Plant Water Usage and Cost
- Plant Wastewater Discharge
- Electrical Energy Usage
- Fuel Usage
- Alternative Fuels
- Usefully Advance Information

قائمة المراجعة الخاصة بالمصنع لمشروع اعادة استخدام الطاقة والماء

- المنتجات الرئيسية
- سعة المصنع
- اسبوع العمل النموذجي
- استخدام مياه المصنع والتكلفة
- تصريف المياه العادمة بالمصنع
- استخدام الطاقة الكهربائية
- استخدام الوقود
- الوقود البديل
- المعلومات المفيدة في هذا الصدد

Energy and Water Reuse Project (ALEB)
Plant Check List

Firm: ________________ Contact Person: ________________

Major Products: ________________
Plant Capacity: ________________kilo/week
Typical Work Week: ________________hour/week

Plant Water Usage and Cost
a. Total Volume Used ________________liters/week
b. Major Water Requirement in Plant________________
c. Basic Water Cost ________________LE/liter
d. Quality of City Water Available ________________

Plant Wastewater Discharge
a. Discharge to City System ________________ liters/week
b. Wastewater Disposal Cost ________________ LE/liter
c: Cost Criteria (flow, BOD, etc) ________________

Electrical Energy Usage
a. Amount Used ________________ kwh/week
b. Basic Electrical Energy Cost ________________ LE/kwh
c. Peak Demand Charge Cost ________________ LE/kw
c. Quality of Electrical Energy (power factor, continuity, etc.) ________________

Fuel Usage
a. Amount of Fuel Used ________________ liters/week
b. Basic Fuel Cost ________________ LE/liter
c. Type of Fuel Used (#6 Oil, gas, propane, kerosene, etc)________________

Alternate Fuels Available
a. Fuels Availability (#6 Oil, gas, propane, kerosene, etc)________ liters/week
b. Alternate Fuel Cost ________________ LE/liter
c. Quality or Type of Fuel Available ________________

Useful Advance Information (process flow diagram, special situations, etc.)

____
____
____

Water

- What is the Ideal Situation?
  - Zero Discharge
- How Do We Move Toward That Goal?
  - Pollution Prevention
  - Waste minimization

الماء

- ما هي الحالة المثالية؟
  - تصريف صفر
- كيف يمكننا تحقيق هذا الهدف؟
  - منع التلوث
  - الاقلال من المياه العادمة

Pollution Prevention

- Maximum feasible reduction of wastes
- Judicious Use of Resources
  - Source reduction
  - Energy efficiency
  - Reuse of materials
  - Reduced water consumption
- Product changes and Process changes
  - Reduce volume and toxicity production wastes
  - End product life cycle and disposal

منع التلوث

أقصى حد مجدي للتخلص من الفاقد

الاستخدام الرشيد للموارد

خفض المصدر

كفاءة الطاقة

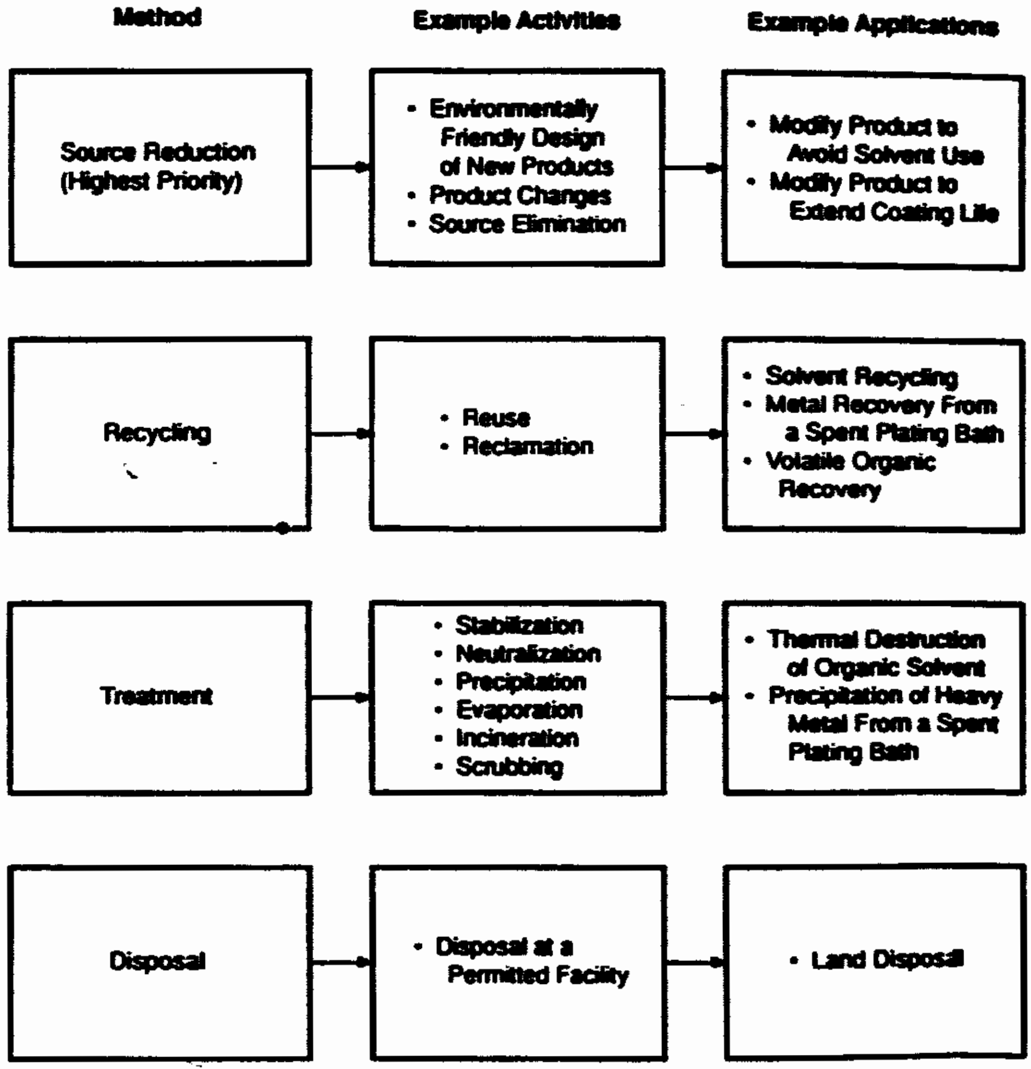
إعادة استخدام المواد

الاستهلاك المخفض للماء

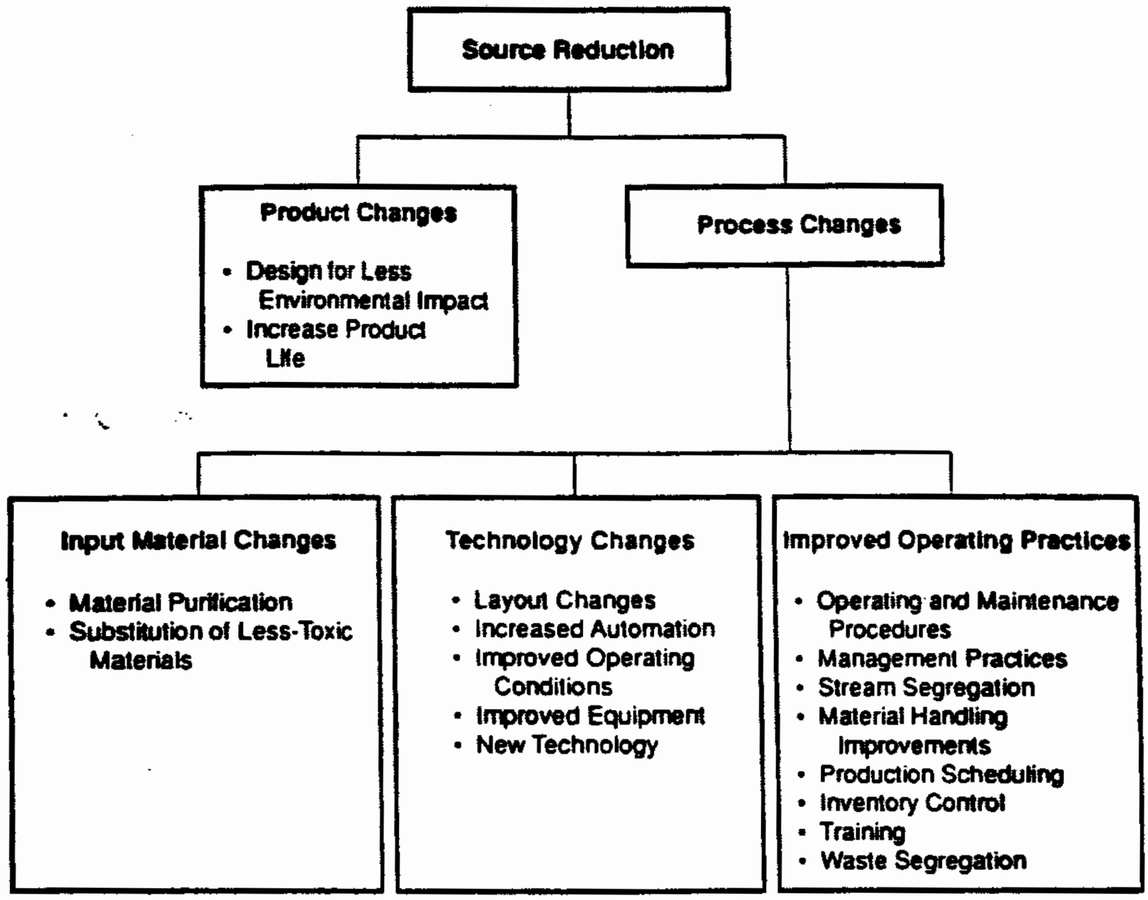
تغيرات المنتج والعملية

الاقلال من الحجم ومن الفاقد السام من المنتجات

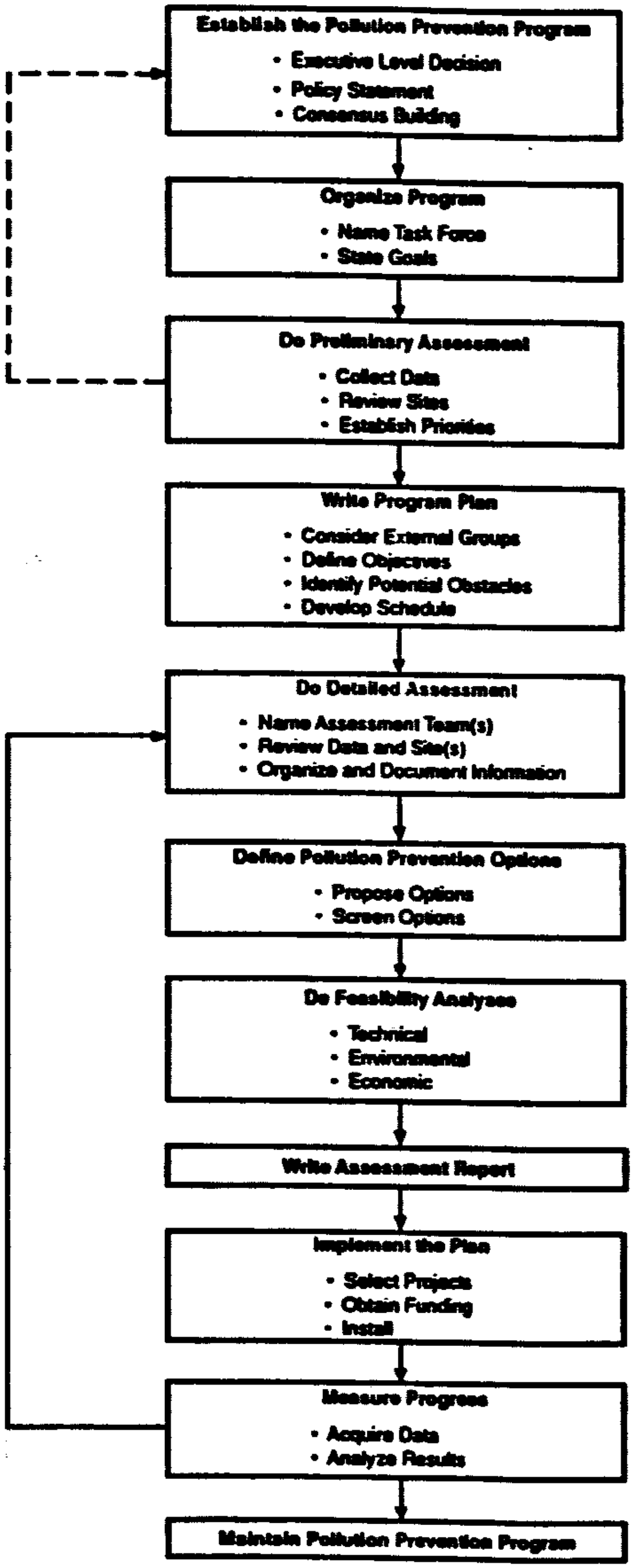
وقف دورة تصنيع المنتج والتخلص منه



Environmental Management Options Hierarchy



Source Reduction Methods



Pollution Prevention Program Overview

Defining The Problem

- The Initial Waste Survey
  - Evaluation of Existing Records
  - Determination of Characteristics, Quantities and Sources
  - Determination of Mass Balance (Water, Materials)
- Management Support Needed
  - Personnel and Service Use
  - Personnel Training
  - Laboratory Analyses

تحديد المشكلة

- التقييم المبدئي للفاقد
  - تقييم السجلات الحالية
  - تحديد الخواص والكميات والمصادر
  - تحديد موازنة الحجم (الماء والمواد)
- الدعم الاداري المطلوب
  - الاستفادة من العاملين والخدمات
  - تدريب العاملين
  - التحليل المعملي

Evaluation of Existing Records

- Discharge Permits
- Regulatory Violations
- Sewer Use Ordinances
- Flow Sheets
- Plans, Utilities
- Flow Measurements
- Water Pressure
- Seasonal and Product Variations
- Laboratory Analyses
- Costs of Treatment
- Process Procedures
- Energy Usage

تقييم السجلات الحالية

- تصاريح التصريف
- الانتهاكات التنظيمية
- القانون المحلي لاستخدام بالوعات المجاري
- مخططات لبيان تتابع العمليات
- الخطط والمرافق
- قياسات التدفق
- ضغط الماء
- التغيرات الموسمية والخاصة بالمنتج
- التحليل المعملي
- تكاليف المعالجة
- إجراءات الخاصة بالعمليات
- استخدام الطاقة

Waste Characteristics

- **Physical**
  - Solids
  - Color
  - Odor
  - Temperature
- **Chemical**
  - Organics (BOD, COD, TOC, FOG)
  - Inorganics (pH, Alkalinity, Nitrogen, Phosphorus)
  - Gases (Dissolved Oxygen)
- **Biological**
  - Total Coliform

خواص الفاقد

- **خواص فيزيائية**
  - المواد الصلبة
  - اللون
  - الرائحة
  - درجة الحرارة
- **خواص كيميائية**
  - المواد العضوية (مثل المتطلب الحيوي للاكسجين، والمتطلب الكيميائي للاكسجين، والكربون العضوي الكلي، والكربون العضوي الذائب)
  - المواد الغير عضوية (درجة الحموضة، القلوية، النيتروجين، الفوسفور)
  - الغازات (الاكسجين الذائب)
- **خواص حيوية**
  - اختبار العد الكلي لبكتيريا القولون

- Waste Quantities
  - Water Usage
  - Flow Measurements
  - Flow Variations (Minimum, Average, Peak)
- Waste Sources
  - Process
  - Sanitary
  - Cooling
  - Storm

– كمية الفاقد
– استخدام الماء
– قياسات التدفق
– تغيرات التدفق (الحد الادنى، المتوسط الذروة)
– مصادر الفاقد
– العمليات
– عمليات النظافة والتطهير
– التبريد
– العواصف

Mass Balance

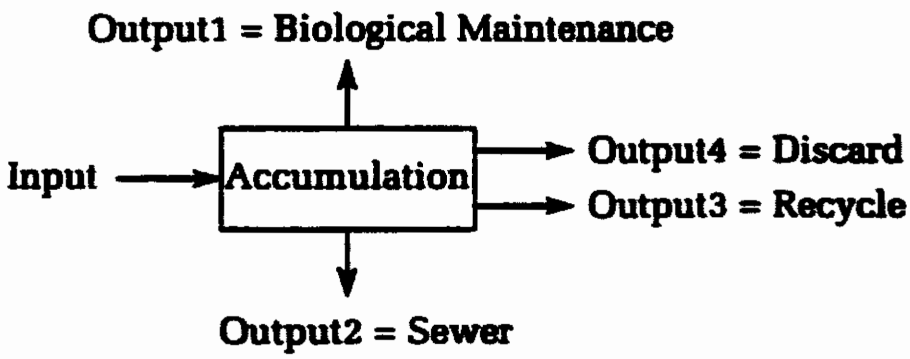
- Input
  - Water usage
  - Raw or processed ingredients
- Output
  - Retained in final product (water + ingredients)
  - Evaporation
  - Effluent flows and waste measurements
  - Miscellaneous

توا زن الحجم

- المدخلات
  - استخدام الماء
  - المواد الخام او المصنعة
- الناتج
  - يتم الابقاء عليه في المنتج النهائي (الماء + العناصر)
  - التبخر
  - تدفق الفاقد المنبعثة وقياسات المخلفات
  - خصائص مختلفة

ample 1-1. Mr. and Mrs. Konzzumer have no children. In an average week they :chase and bring into their house approximately 50 kg of consumer goods (food, gazines, newspapers, appliances, furniture, and associated packaging). Of this ount, 50 percent is consumed as food. Half of the food is used for biological intenance and ultimately released as CO_2 and the remainder is discharged to : sewer system. Approximately 1 kg accumulates in the house. The Konzzumers ycle approximately 25 percent of the solid waste that is generated. Estimate the iount of solid waste they place at the curb each week.

lution



rite the mass balance equation.

$$\text{Input} = \text{Output1} + \text{Output2} + \text{Output3} + \text{Output4} + \text{Accumulation}$$

ow we need to calculate known outputs.

One half of input is food = (0.5)(50 kg) = 25 kg

One half of food is used for biological maintenance = Output1 = (0.5)(25 kg) = 12.5 kg

One half of the food is lost to the sewer system = Output2 = (0.5)(25 kg) = 12.5 kg

The recycled amount is 25 percent of what remains of input after food and accumulation is removed = Output3 = .25(Input − Output1 − Output2 − Accumulation) = .25(50 − 12.5 −12.5 −1) = 6 kg

Now we can solve for Output4:

$$\begin{aligned}\text{Output4} &= \text{Input} - \text{Output1} - \text{Output2} - \text{Output3} - \text{Accumulation}\\ &= 50 - 12.5 - 12.5 - 6 - 1\\ &= 18 \text{ kg}\end{aligned}$$

Waste Survey Report

- Monitoring requirements
- Preventable material losses
- Low pollution impact processes
- Processes which require pretreatment
- Need for equalization
- All possible actions to reduce wastes
  - Short term, low cost
  - Interim to long term
- Possible by-product recovery
- Economics

تقرير خاص بمسح الفاقد

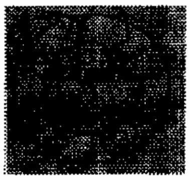
- مراقبة الاحتياجات
- خسائر المواد الممكن تفاديها
- العمليات التي ينتج عنها تأثير منخفض للتلوث
- العمليات التي تتطلب المعالجة المسبقة
- الحاجة الى التسوية
- كافة الاجراءات الممكنة للاقلال من المخلفات
  - قصيرة الأجل، تكاليف أقل
  - من متوسطة الى طويلة الاجل
- إمكانية استعادة المنتجات الثانوية
- الاقتصاديات

Possible In-Plant Modifications

- Process alterations
- Housekeeping practices
- Spillage Control
- Screening
- Residue disposal
- Non-food residue disposal
- Water conservation
- Recycling and reuse
- Dry cleaning
- Separation of wastes

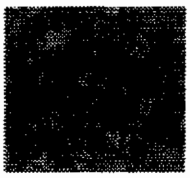
التعديلات الداخلية الممكنة

- تعديلات في العملية
- اساليب النظافة والتعقيم
- التحكم في الانسياب
- الغربلة
- التخلص من المخلفات
- التخلص من المخلفات غير الغذائية
- المحافظة على المياه
- إعادة التدوير والاستخدام
- التنظيف الجاف
- فصل الفاقد



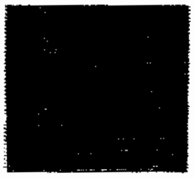
Top Ten Strategies to Conserve Water

1 Improve Maintenance
2 Alter Cleaning Methods
3 Separate Wastewater Streams
4 Monitor Process Flows
5 Conduct Plant-Wide Use Survey
6 Conduct Detailed Process Use Survey
7 Develop Water Use Budget
8 Reuse Water
9 Replace Older, Inefficient Equipment
0 Develop Employee Training



الإستراتيجيات العشر المثلى للمحافظة على الماء

١. تحسين عمليات الصيانة
٢. تغيير طرق النظافة
٣. فصل مجاري المياه العادمة
٤. مراقبة تدفق العملية
٥. إجـراء مسح على عمليات الاسـتخدام عـلى مستوى المصنع كله
٦. إجـراء مسح مفصل لاستخدام العملية
٧. عمل ميزانية لاستخدام الماء
٨. إعادة استخدام الماء
٩. استبدال المعدات القديمة والتي لا تعمل بكفاءة
١٠. وضع برامج تدريبية للعاملين



Hierarchy of Wastewater Management

1 Reduce-
- By Process changes

2 Reuse-
- By using "waste" again

3 Recycle-
- By reclaiming material and converting it

4 Treatment-
- By changing its nature

5 Disposal-

التدرج الخاص بالتحكم في المياه العادمة

☐ الاقلال منها –
- عن طريق التغيير الذي يجرى على العملية

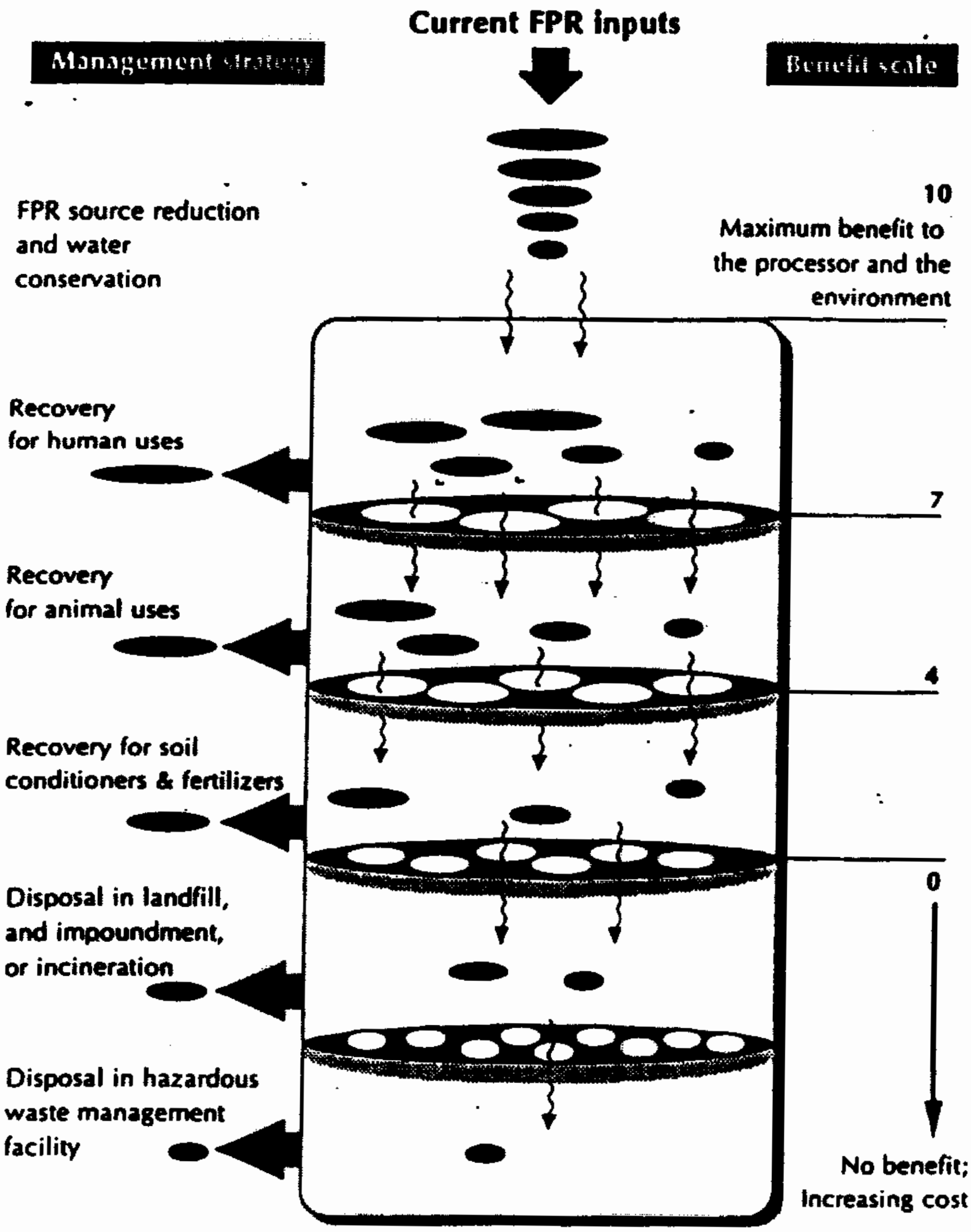
☐ إعادة الاستخدام –
- عن طريق استخدام المياه العادمة مرة اخرى

☐ إعادة التدوير –
- عن طريق معالجة المادة وتحويلها

☐ المعالجة –
- عن طريق تغيير طبيعتها

☐ التخلص منها –

Figure 1.2
FPR utilization and disposal hierarchy



Energy Audit
Electrical Usage Survey

Basic Terms

- Voltage (V) = Current (I) x Resistance (R)
- Configuration
  - Series
  - Parallel
- Phases - 60 Hertz (cycles) of alternating current
  - Single phase
  - Three phases
  - Power Factor

التفتيش على استخدام الطاقة
المسح الخاص بالاستخدام الكهربائي

المصطلحات الاساسية

- الفولت = التيار X المقاومة
- الهيئة
  - متتالية
  - متوازية
- الفاز (الاطوار) – ٦٠ هيرتز (دورات) للتيار المتناوب
  - فاز فردي
  - ثلاثة فاز
  - عامل القدرة

Energy Audit
Electrical Usage Survey

Power Factor concepts

- PF (power factor) = kw (power delivered)
  kvr (electrical energy)
- Inductive load motors and transformers
- Utilities and its capacity
- Capacitate components - current to lead voltage
- Turned Harmonic filters

التفتيش على استخدام الطاقة
المسح الخاص بالاستخدام الكهربائي

المفاهيم الخاصة بعامل القدرة

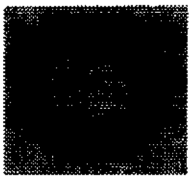
- عامل القدرة = كيلووات (الطاقة المستقبلة)
  كيلوفولت (الطاقة الكهربائية)
- موتورات التحميل المحفزة والمحولات
- المرافق وسعتها
- زيادة سعة المكونات – فلط تيار لفلط متقدم
- مرشحات متوافقة محولة

Energy Audit
Electrical Usage Survey

- Exterminating "Power Bugs"
  - Electronic equipment has a higher degree of sensitivity
  - Prevent load interaction
- Work Place Electrical Loads
  - Three Phases
  - Efficiency function of motor construction
- Electrical Consumption Survey
  - Identify each electrical use
  - Identify Electrical location
- Electrical Safety

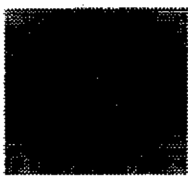
التفتيش على استخدام الطاقة
المسح الخاص بالاستخدام الكهربائي

- التخلص من أعطال التوصيلات الكهربائية
  - يكون للمعدات الالكترونية درجة عالية من الحساسية
  - منع تداخل الحمل
- الاحمال الكهربائية
  - ٣ فاز
  - الاداء الفعال لتركيب الموتور
- مسح الاستهلاك الكهربائي
  - تحديد كل استخدام كهربائي
  - تحديد الموقع الكهربائي
- السلامة الكهربائية



Monitoring Quality of Purchased Power

- Benefits of Monitoring Power
  - Fewer disruptions, quality parameters,
  - provides data for use in negotiation with power company
- Three Phase Monitors at Point of Entrance Cost Vs. Benefit
  - Monitor power supply, unit cost, regulation at entrance
- Monitoring entire plant
  - Problems occur within plant, alarm messages sent out



مراقبة جودة الطاقة المشتراه

– فوائد مراقبة الطاقة
- قلة انقطاع الطاقة الكهربائية الطاقة، العوامل المتغيرة الخاصة بالجودة
- توفير بيانات الاستخدام عند التفاوض مع الشركة التي تقوم بامداد الطاقة

– تكلفة وسائل مراقبة من ٣ فاز عند نقطة الدخول مقابل المنفعة
- مراقبة امداد الطاقة، وتكلفة الوحدة، وتنظيم الدخول

– مراقبة المصنع باكمله
- المشكلات التي تحدث داخل المصنع، صدور سائل تحذيرية

Electrical Transmission and Distribution (T&D) Conservation

- Basic Premise - Electricity cannot be stored
- T & D System Problems - power outages
- "Brownout" - utility reducing voltage by 5% or more
- Specialty circuits and equipment
- Energy conservation areas - within the plant distribution network

توفير نقل الطاقة الكهربائية و توزيعها

- المنشأة الرئيسية – يصعب تخزين الطاقة الكهربائية
- مشكلات نظام نقل الطاقة الكهربائية وتوزيعها – انقطاع واعطال في الطاقة الكهربائية
- وسيلة Brownout– وسيلة تقوم بخفض الفولت بنسبة ٥% أو أكثر
- دوائر ومعدات خاصة
- مناطق توفير الطاقة – داخل شبكة توزيع الطاقة الكهربائية بالمصنع

Fossil Fuel Sources

- Natural Gas
- Heavy Fuel Oil - #4 and #6
- Light Fuel Oil - #2 or Diesel Fuel
- Bottled Gas - Propane
- Gasoline or Kerosene
- Electricity - Generated by Public Utility
- Electricity - Generated by Plant Utility

مصادر وقود من الحفريات (بقايا الحيوانات المنقرضة)

- الغاز الطبيعي
- زيت وقود ثقيل - رقم ٤ ورقم ٦
- زيت وقود خفيف - رقم ٢ أو وقود الديزل
- غاز البروبين
- جازولين أو كيروسين
- الكهرباء – يتم توليدها بواسطة المرافق العامة
- الكهرباء – يتم توليدها بواسطة مرافق المصنع

Steam Power Systems

- Steam generation
  - Water is an inexpensive and effective heat transfer fluid
- Steam circuit - steam traps are a necessity
  - Condensed water contains heat value,
  - Mechanical, Thermostatic, Thermodynamic traps
- Energy Conservation Measures
  - Boiler operate below its max, remove scale from boilers
  - Correct fuel to air ratio for max efficiency
  - Keep steam traps working, insulation of all pipes

أنظمة الطاقة التي تعمل بالبخار

- توليد البخار
  - إن الماء غير مرتفع التكاليف وهو سائل فعال لنقل الحرارة
- دائرة البخار – تكون مصائد حبس البخار ضرورية
  - يحتوي الماء المكثف على مقدار من الحرارة
  - مصائد ميكانيكية واستاتيكية حرارية وديناميكية حرارية لحبس البخار
- إجراءات توفير الطاقة
  - تعمل الغلاية اقل من الحد الاقصى للتشغيل، يتم إزالة القشور والترسبات من الغلاية
  - يتم تصحيح نسبة الوقود الى الهواء للحصول على اعلى كفاءة
  - الإبقاء على مصائد البخار في حالة التشغيل، عزل كافة الانابيب

Hot Water and Steam Energy Recycling

- Heat Recovery Systems
  - Capture Waste heat and transfer to a liquid
  - Provide reserve energy capacity
- Thermodynamics
  - Transfer energy from one form to another
  - Waste heat, effectiveness of heat exchange
- Determining Value
  - F = Q x N/ E x H
  - Fuel saved equals the quantity of heat recovered times the number of hours per year system is on divided by efficiency of heat recovery system times heat value of fuel

إعادة تدوير الماء الساخن وطاقة البخار

- انظمة استعادة الحرارة
  - حجز الفاقد من الحرارة وتحويلها الى سائل
  - توفير احتياطي لسعة الطاقة
- الديناميكيات الحرارية
  - تحويل الطاقة من هيئة لاخرى
  - فاقد الحرارة، وفعالية التبادل الحراري
- تحديد القيمة
  - F = Q x N/ E x H
  - الوقود الموفر = كمية الحرارة المستعادة X عدد الساعات في السنة التي يكون فيها النظام تحت التشغيل مقسوما على كفاءة نظام الحرارة المستعادة X قيمة حرارة الوقود

Dryer Energy Efficiencies

- Improve Heat and Mass transfer area
- Safety considerations
- Drying Operations
- Energy Conservation

كفاءة طاقة المجفف

- تحسين منطقة نقل الحرارة الكلية
- اعتبارات للسلامة
- عمليات التجفيف
- توفير الطاقة

Refrigeration Efficiency Improvements

- Chiller Alternatives
- System Parts
- Plant Operation
- Plant Maintenance
- Energy Conservation

تحسين كفاءة التبريد

- بدائل جهاز التبريد
- أجزاء النظام
- تشغيل المصنع
- صيانة المصنع
- توفير الطاقة

Refrigerant Subcooling

- Applications
  - Chillers or packaged air conditioning systems to be replaced
  - Install smaller units
- System components and objectives
  - Increases cooling capacity, ground source water loop
- Maximum benefit
  - System has more refrigerant- greater density in cold liquid
  - long run- lower electrical costs
- Savings
  - Savings $5800 per year on electrical charges

انخفاض كفاءة سائل التبريد

- التطبيقات
  - ينبغي استبدال المبردات او انظمة التبريد المغلفة
  - تركيب وحدات تبريد اصغر
- مكونات النظام واغراضه
  - يزيد من سعة التبريد، دورة المياه السفلية
- اقصى فائدة
  - يكون لهذا النظام كفاءة اعلى للتبريد في السائل البارد
  - تكاليف كهربائية منخفضة بشكل طويل المدى
- الادخارات
  - يتم توفير ٥٨٠٠ دولارا امريكيا من فواتير الكهرباء

Energy Preventive Maintenance (PM)

- Basic Premise
- Economic of maintenance and energy
- Implement a maintenance program
- General suggestions for maintenance action
- Electric Motors
- Maintenance Summary

الصيانة الوقائية للطاقة

- المبنى الرئيسي
- التكلفة الاقتصادية للصيانة و الطاقة
- تنفيذ برنامج للصيانة
- مقترحات عامة لاجراءات الصيانة
- الموتورات الكهربائية
- موجز للصيانة

Energy Preventative Maintenance (PM)

1. Basic premise

a. Reactive management- "if it ain't broke, don't fix it"

b. Pro-active management- "if it ain't fixed, you might go broke"

2. Economics of maintenance and energy

a. After raw materials and labor, energy is the third largest component of production cost, maintenance is fourth

b. Budget cutting usually starts with deferred maintenance- strategy leads to additional energy use, reduced equipment life and plant reliability

c. Four ways to reduce energy cost- reduce price of purchased energy, reduce operating hours, reduce need for energy, increase operational efficiency

3. Implement a maintenance program

a. Assess existing conditions and correct deficiencies- first, complete audit of facilities, identify operation and maintenance (O&M) deficiencies

b. Compile documentation on existing equipment and facilities- building drawings, specifications, manuals, operating instructions, replacement and repair parts list, installation record, repair record history, etc.

c. Establish a preventative maintenance (PM) program- use manufacturers recommendations and past experience as primary guides

1. Identify frequency of maintenance trade-offs vs. benefit of more frequent maintenance actions

2. Use measurable parameters rather than calendar frequency
3. Software packages are available- lower cost of record keeping

d. Create and maintain well-trained staff- training awareness, operational knowledge, maintenance skills, repair of energy-using systems, energy accounting

e. Monitor and report maintenance progress for energy use- create reports for every level of management and O&M staff

4. General suggestions for maintenance actions

a. Primary utilities- electricity, fuel oil, natural gas, etc.

1. Check for voltage imbalance- loose connections or hot wires
2. Check piping and fix leaks promptly
3. Regularly clean heat transfer surfaces
4. Check buried pipes on a regular basis- look for pressure drops in liquid lines

b. Secondary utilities

1. Is steam system efficient?
2. Are leaks under control?
3. Are hot and cold pipes insulated?
4. Are steam traps working? Is condensate captured and returned?
5. Are dead-end steam lines eliminated?
6. Is piping properly sized to minimize restrictions?
7. Is steam treatment program planned to keep blow-down reasonable?
8. Does compressed air system use outside air to reduce temperature and increase efficiency

5. Electric motors

a. Motors count for 50% of all electricity in US, energy cost is 90% to 95% of life cycle cost of an electric motor

b. Inventory all motors 1 HP and larger- nameplate information, operating hours, age, drive system, etc.

c. Should be lubricated according to manufacturers recommendations

d. Drive system should be properly adjusted

e. Standard V-belts maybe replaced with grooved belts to reduce system losses

f. Optical tachometer or electrical tester should be available for operator use

g. Proper sizing of motors- designed to operate 65% to 100% of load, less than 40% of load should be replaced with a smaller motor

h. Older 40 HP motors with high operating hours should be replaced with energy efficient motors upon failure

i. If rewind costs 50% to 65% of motor cost, replace with new motor

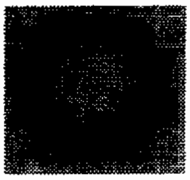
j. Motors of less than 15 HP should be replaced rather than repaired

6. Maintenance summary

a. Use information from energy audit to make educated decisions

b. Remove scales on all heat transfer surfaces like boiler tubes and heat exchangers tubes at least once a year, preferably twice

c. If you see leaks or hear noise around equipment, fix promptly before larger problem happens



Alternate Power Sources

- **Basic Premise**
  - Renewable energy capture directly: sun
  - Usually requires high installation cost and maintenance
- **Solar Energy**
  - Flat plate collectors filled with water and is pumped
  - Night time, stop pump and hot water flows in a reservoir
- **Day lighting- lighting naturally**
  - Reduced energy consumption during peak power uses
  - Requires little maintenance

المصادر البديلة للطاقة

- **المبنى الرئيسي**
  - الطاقة المتجددة المباشرة: الشمس
  - دائما ما يتطلب الامر تكلفة عالية للتركيب والصيانة
- **الطاقة الشمسية**
  - ألواح مسطحة لتجميع الطاقة الشمسية تكون مملوءة بالماء يتم تفريغها
  - اثناء فترة الليل، يتم ايقاف الطلمبة ويتدفق الماء الساخن داخل الخزان
- **ضوء النهار – ضوء طبيعي**
  - استهلاك منخفض للطاقة اثناء فترات الذروة لاستخدام الطاقة
  - تتطلب صيانة اقل

Steam Turbine Cogeneration

- Basic Premise
  - Basic process of producing electrical power from existing steam production
- Potential for cogeneration
  - Steam turbines are 50% to 70% efficient and oil generators are 90 to 95% efficient
- Evaluation of electrical rates
  - Consideration of downtime occurrences
- Project pitfalls
  - Manpower? Technical assistance?
- Summary

التوليد التربيني المشترك للبخار

- المبنى الرئيسي
  - العملية الرئيسية لانتاج الطاقة الكهربائية من البخار المنتج الموجود بالفعل
- احتمالية التوليد المشترك للبخار
  - تبلغ كفاءة تربينات البخار من ٥٠% الى ٧٠% وتبلغ كفاءة المولدات الزيتية من ٩٠% الى ٩٥%
- تقييم المعدلات الكهربائية
  - الاعتبار الخاص بتكرار حدوث اوقات التوقف (للتصليح او للصيانة)
- المشكلات التي تواجه المشروع
  - الايدي العاملة؟ المساعدة الفنية؟
- موجز

Information Needed For Energy Management (EM)

Knowledge about Power

- Basic Factors
- On Site Generation- Classic Make or Buy Decision
- Ability to evaluate alternative energy choices
  - "What if" questions
- Elements of an Ideal System
- Advantage of EM System

المعلومات المتطلبة للتحكم في الطاقة

المعرفة الخاصة بالطاقة

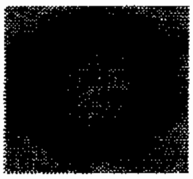
- عوامل اساسية
- توليد الطاقة في نفي المكان بشكل لحظي – القرار التقليدي للعمل او للشراء
- القدرة على تقييم الخيارات البديلة للطاقة
  - التساؤلات التي تدور حول "ماذا إذا..."
- عناصر النظام النموذجي
- مميزات نظام التحكم في الطاقة

Case Studies

- Campbell Soup Company
- Wise Foods - Subsidiary of Borden
- Cascade Specialties
- Rutgers University - Food Manufacturing Facility

دراسات الحالة

- شركة Campbell Soup
- شركة Wise Foods -شركة تابعة لـ Borden
- شركة Cascade Specialties
- جامعة روتجرز – مصنع تصنيع الاغذية



"Reduce" - Water Conservation

Campbell Soup Company Plants

- Problem- lowering costs of water supply, wastewater treatment, and solid waste removal
- Issues- State EPA regulation, lower disposal lead to less production, wastewater treatment needed
- Process
  - Task Force manager, wastewater audit performed, employee awareness made, approached each unit process separately
- Results
  - Saved company $950,000 in purchase water costs alone
  - reduced environmental liability

"الخفض" – المحافظة على الماء

مصانع شركة Campbell Soup

– المشـــكلة هـــي: خفض تكلفة امداد الماء، ومعالجة المياه العادمة، والتخلص من الفاقد من المواد الصلبة

– العواقـــب: الـــلوائح الخاصـــة بوكالة المحافظة على البيئة، وادى انخفاض عملية التخلص من الفاقد الى خفض الانتاج، وتطلب الامر معالجة المياه العادمة

– العملية

- تم تعيين مدير للقوى العاملة ، تم التفتيش على المياه العادمة ، وتم توعية العاملين، النتائج
- تم توفير ٩٥٠,٠٠٠ ألف دولارا من تكاليف شراء الماء فقط
- تم الاقلال من التأثير السلبي على البيئة

"Recycle" - Land Application

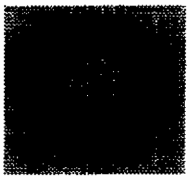
Wise Foods- Subsidiary of Borden

- Problem- disposal of potato waste solids
- Issues
  - Strict State land applications regulations
  - Desire to optimize recycling benefits
- Process
  - Designed the process to meet municipal sludge land standards
  - Eliminated chemical cleaning of raw potatoes
- Economic Evaluation
  - Annual Savings = $5000 per week x 52 weeks= $221,000
- Results

"اعادة التدوير" – التطبيق الارضية

شركة Wise Foods -شركة تابعة لــ Borden

– المشكلة: التخلص من الفاقد من المواد الصلبة للبطاطس
– العواقب
  - لوائح صارمة بالولاية تجاه التطبيقات الارضية
  - الرغبة في زيادة الاستفادة من اعادة التدوير
– العملية
  - تم تصميم عملية معينة للوفاء بالمعايير المحلية للتخلص من الفاقد
  - تم الحد من التنظيف الكيميائي للبطاطس غير المصنعة
– التقييم الاقتصادي
  - الادخارات السنوية = ٥٠٠٠ دولار في الاسبوع x ٥٢ أسبوع = ٢٢١,٠٠٠ دولارا
– النتائج



Cascade Specialties – Wise Energy Use

Dehydrated Onion Producer

- Basic System
  - Multi-stage, gas fired, mixed flow hot air system
- Energy Techniques Used
  - Dry outside air employed, 3 inch insulation, filtered air
  - automatic slicing machine, product preparation
- Energy Techniques <u>Not Used</u>
  - No waste heat recovery employed
  - Used standard electric instrumentations
  - Used direct, open flame natural gas in 1st stage

Cascade Specialties شركة الاستخدام الرشيد للطاقة

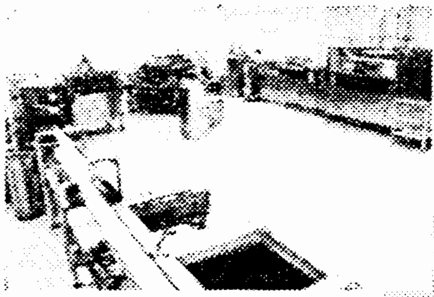
شركة منتجة للبصل المجفف

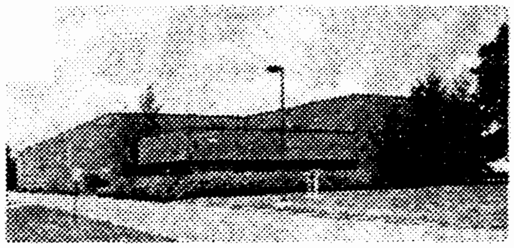
– النظام الرئيسي
- متعدد المراحل، اطلاق الغاز، نظام للتدفق المختلط للهواء الساخن

– تقنيات الطاقة المستخدمة
- استخدام الهواء الخارجي البارد، العزل بحوالي ٣ بوصة، هواء مرشح
- ماكينة اوتوماتيكية لتقطيع البصل الى شرائح، تجهيز المنتج

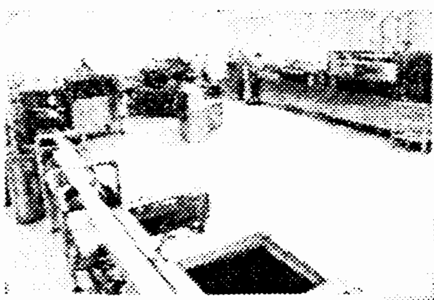
– تقنيات الطاقة غير المستخدمة
- لم يتم استخدام أي نظام لاستعادة الفاقد من الحرارة
- تم استخدام معدات كهربائية تقليدية
- تم استخدام لهب مكشوف مباشر من الغاز طبيعي في المرحلة الاولى

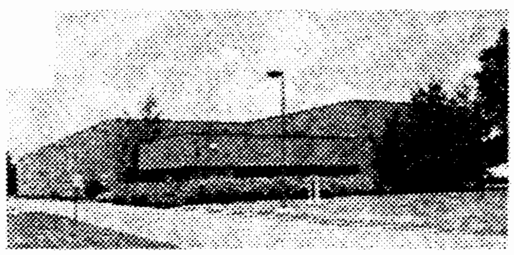
Rutgers, Food Manufacturing Facility



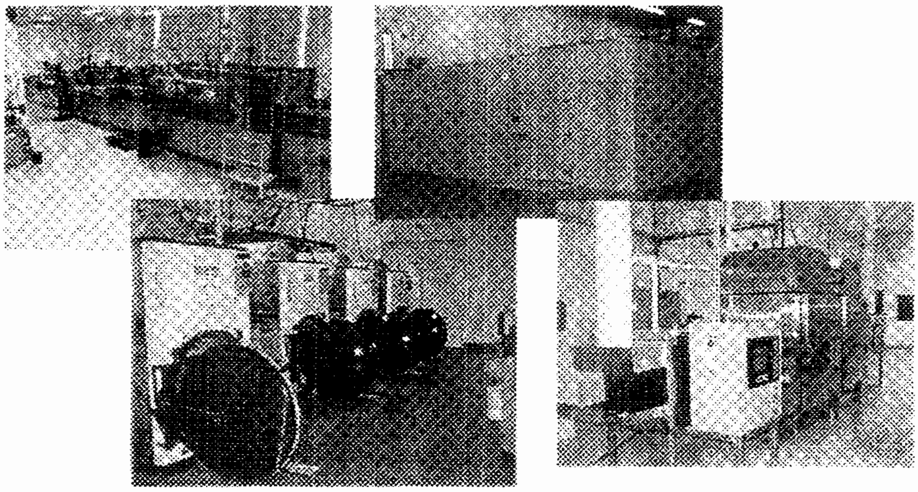


جامعة روتجرز – مصنع لتصنيع الاغذية





Rutgers, Food Manufacturing Facility - Energy Users



جامعة روتجرز – مصنع لتصنيع الاغذية – مستخدمي الطاقة

Photo of
Raque Heat Sealer

صورة للاصقة
حرارية

Photo of
Blast Freezer

صورة لفريزر
هوائي

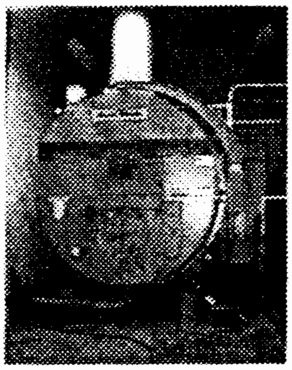
Photo of
Stock AG
Retorts

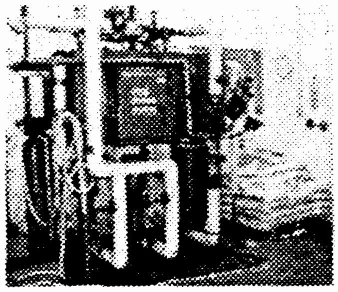
صورة لاجهزة تعقيم

Photo of
Enersyst
Jet Sweep Oven

صورة لفرن نفاث

Rutgers, Food Manufacturing Facility - Steam/Hot Water





جامعة روتجرز – مصنع لتصنيع الاغذية – بخار/ماء ساخن

Photo of
Cleaver-Brooks
Boiler

صورة لغلاية

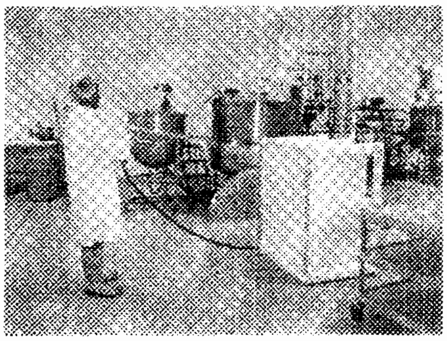
Photo of
Condensate Receiver
and
Water Softener

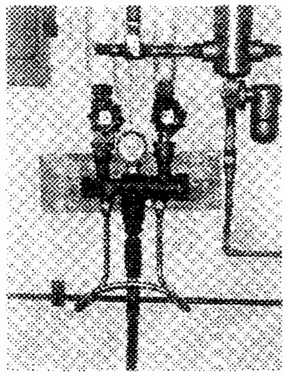
صورة لجهاز تلقي المياه المكثفة وجهاز معالجة المياه

Photo of
High Efficiency (94%)
Water Heater

صورة لسخان للمياه

Rutgers, Food Manufacturing Facility - Sanitation





جامعة روتجرز – مصنع لتصنيع الاغذية – عمليات النظافة و التعقيم

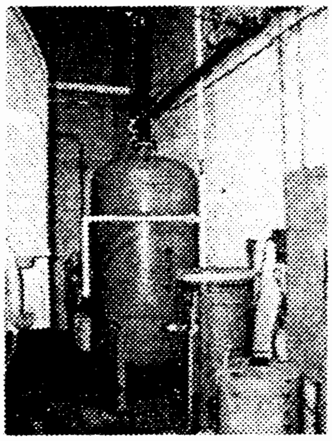
Photo of Hot Water (Mixed Steam) Washing

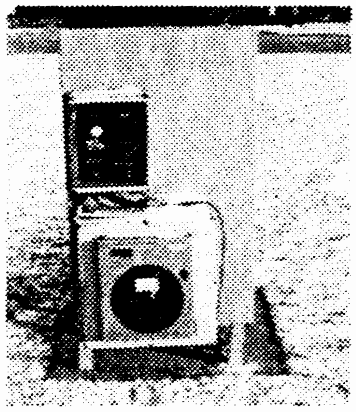
صورة للغسل بالماء الساخن (البخار المختلط)

Photo of Strahman Mixing Valve

صورة لصمام الخلط

Rutgers, Food Manufacturing Facility - Waste Water





جامعة روتجرز – مصنع لتصنيع الاغذية – المياه العادمة

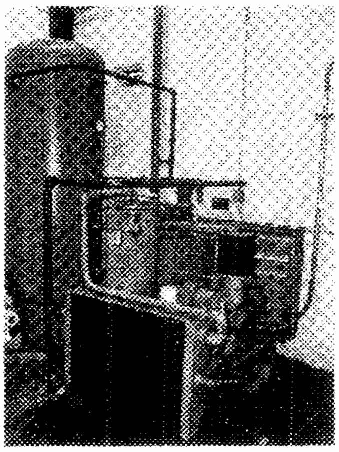
Photo of
Waste Water
Tempering

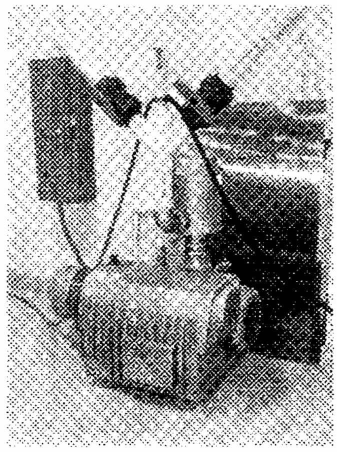
Photo of
Waste Water
Sampling Station

صورة لجهاز ضبط
المياه العادمة

صورة لمحطة اخذ
عينات من المياه
العادمة

Rutgers, Food Manufacturing Facility - Air/Vacuum





جامعة روتجرز – مصنع لتصنيع الاغذية – الهواء/التفريغ

Photo of Air Compressor	Photo of Vacuum Pump
صورة لجهاز ضغط الهواء	صورة لمضخة تعمل بالتفريغ

Solar Energy Alternatives

John F. Coburn, Ph.D.
Director, Advanced Manufacturing
Center for Advanced Food Technology (CAFT)
Rutgers, The State University of New Jersey

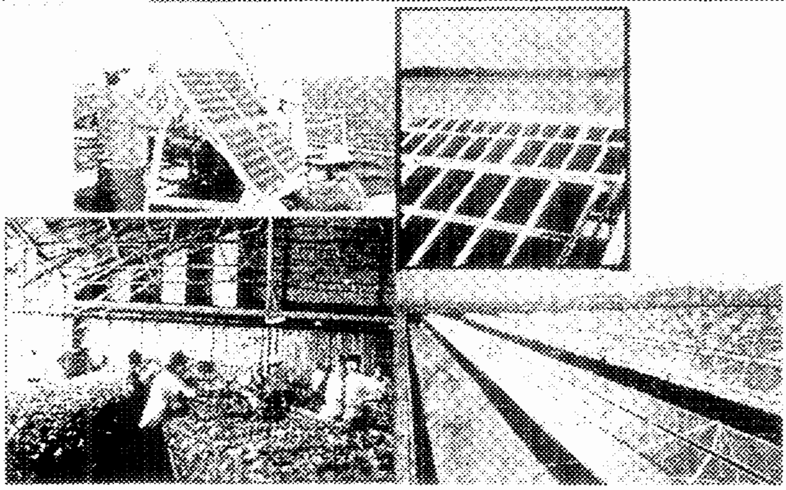
Former Officer and Member of Boards of:
Solar Power Corporation
Daystar Corporation
Solar Thermal Systems, Inc
Exxon Enterprises, Inc

الطاقة الشمسية كبديل

د. جون إف كوبورن
مدير بمركز تكنولوجيا تصنيع الاغذية المتقدمة (CAFT)
روتجرز ، جامعة ولاية نيوجيرسي

مسئول وعضو سابق بالمؤسسات التالية:
Solar Power Corporation
Daystar Corporation
Solar Thermal Systems, Inc
Exxon Enterprises, Inc

Solar Energy Collection



جمع الطاقة الشمسية

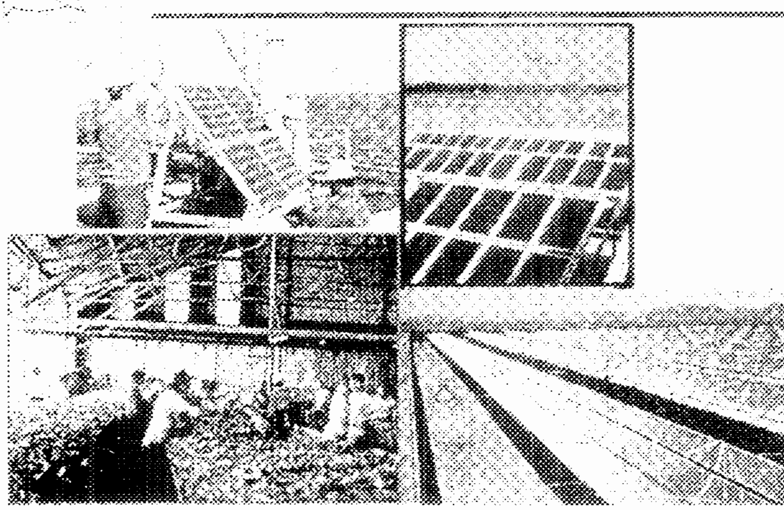
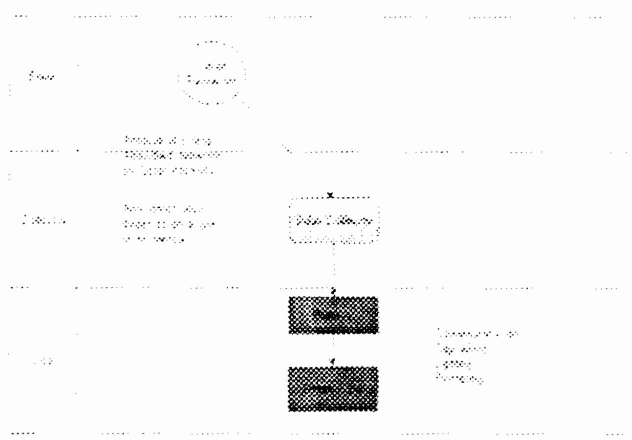
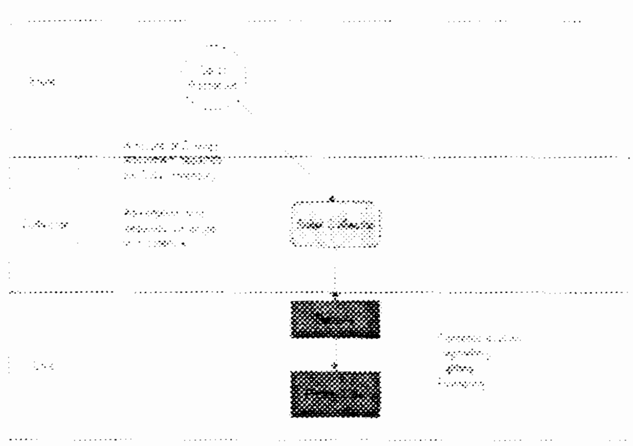


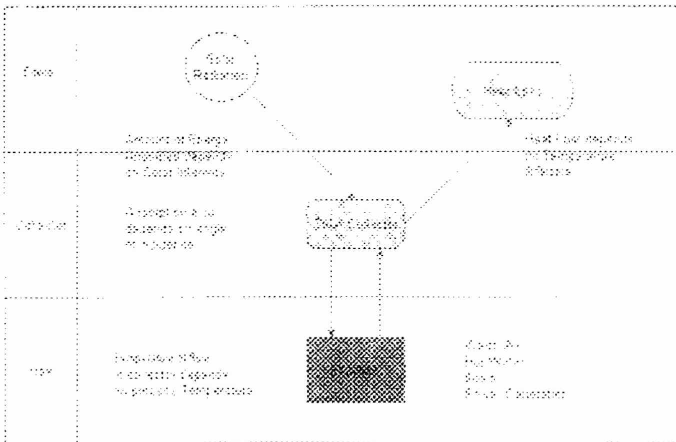
Photo Voltaic Diagram



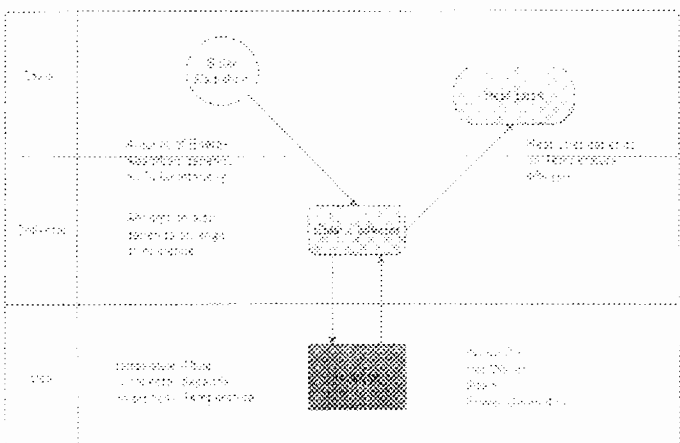
رسم تخطيطي للخلية الضوئية



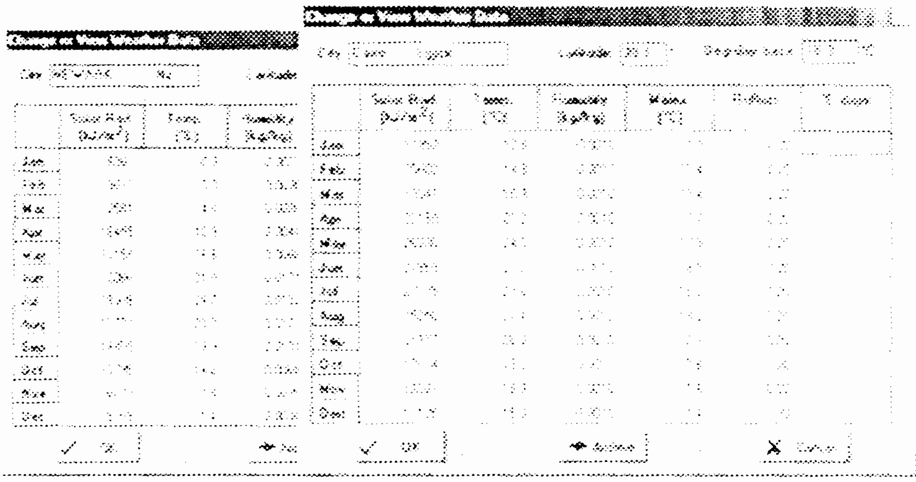
Solar Thermal Diagram



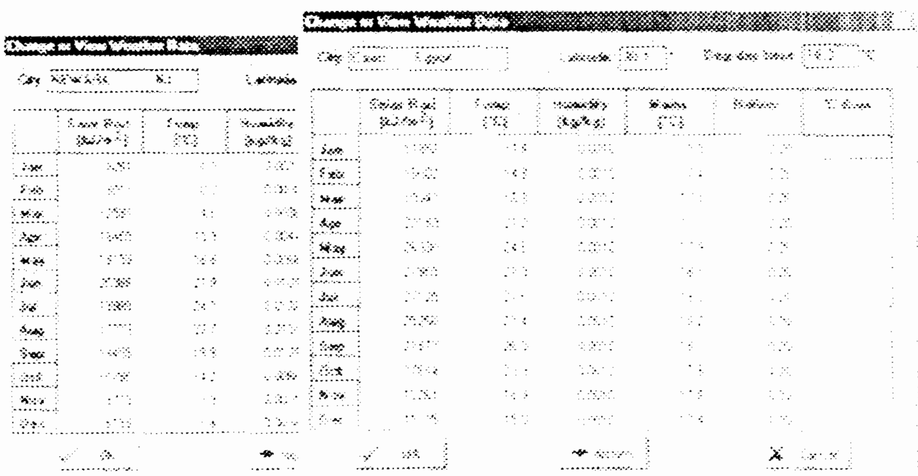
رسم تخطيطي لتجميع الطاقة الحرارية الشمسية



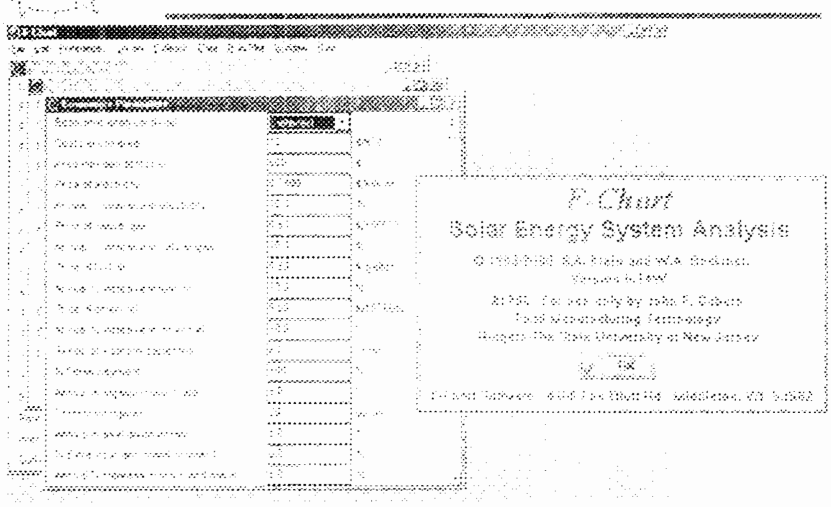
Weather Data - Cairo



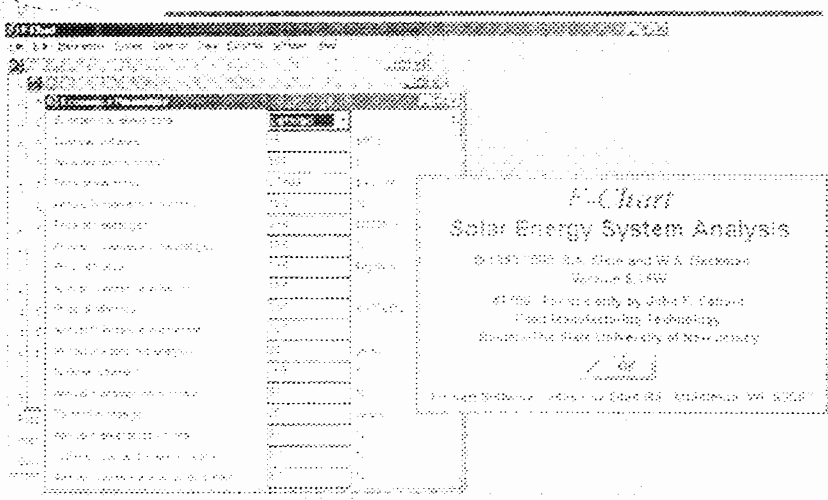
بيانات عن حالة الطقس في القاهرة



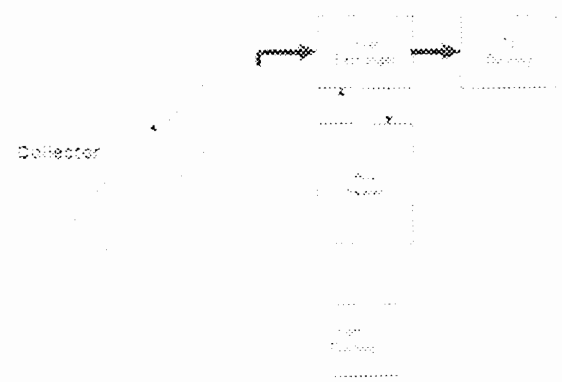
Predicting Solar Performance



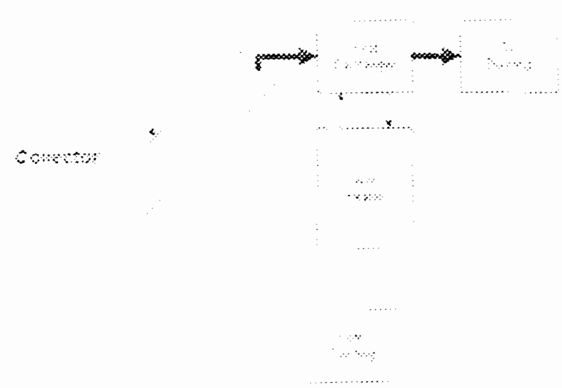
التنبؤ بالاداء الشمسي



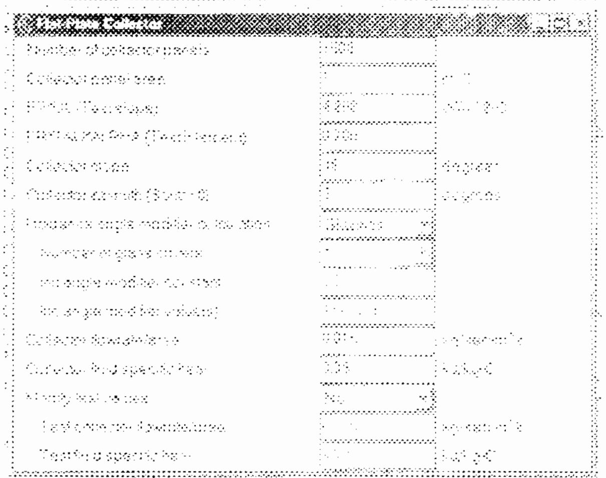
Solar Heated Air Collector



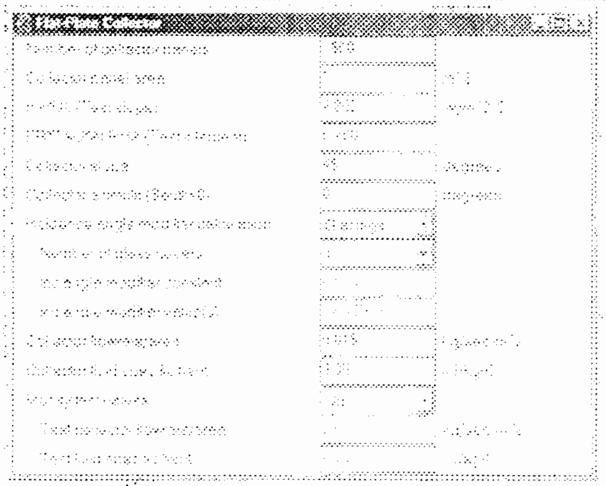
مجمع الهواء المسخن بالطاقة الشمسية



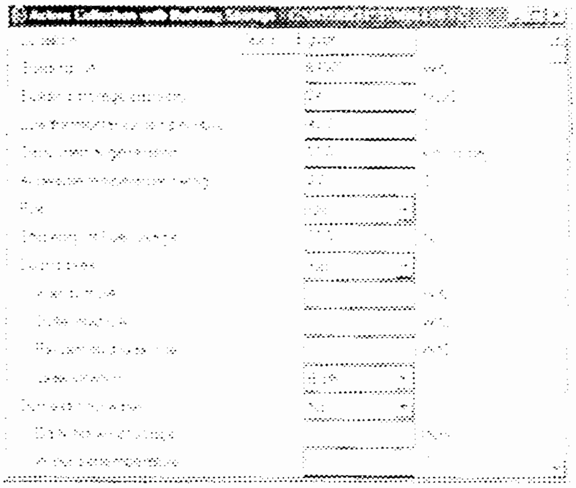
Air - Collector Parameters



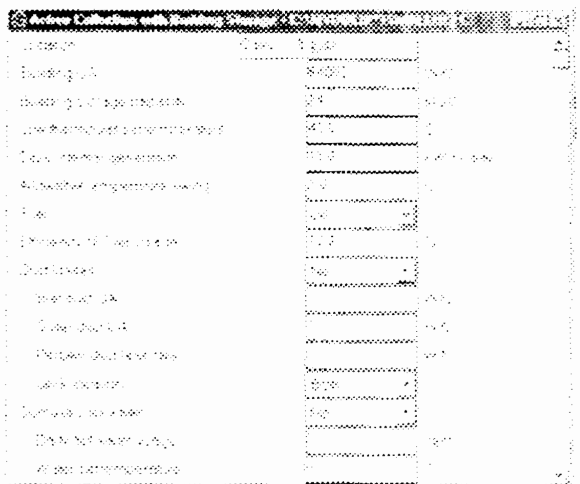
المقادير متغيرة القيمة لمجمع الهواء



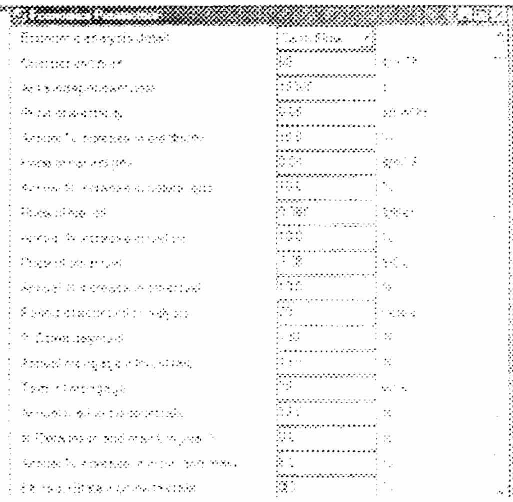
Air - System Parameters



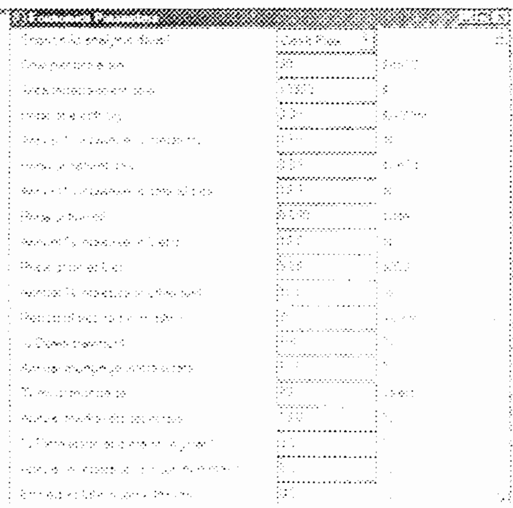
الهواء – المقادير متغيرة القيمة للنظام



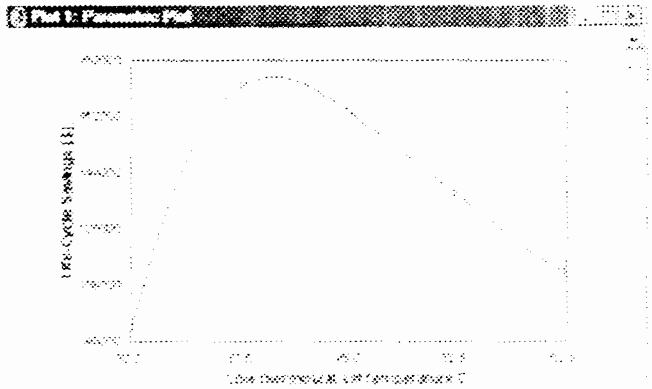
Air - Economic Assumptions



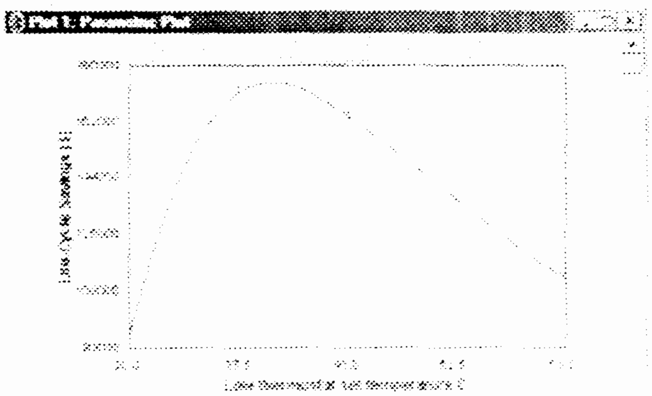
الهواء – الافتراضات الاقتصادية



Air Temp vs Performance



درجة حرارة الهواء مقابل الأداء



Air - Thermal Output

Thermal Output

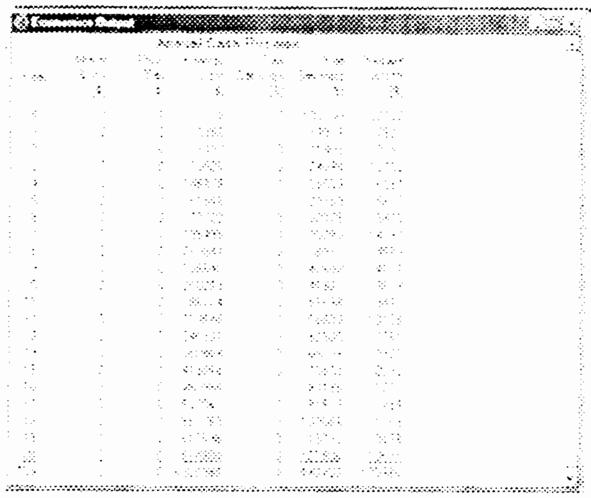
	Solar	Heat	Dhw	Aux	f
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Year	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

الهواء – الناتج الحراري

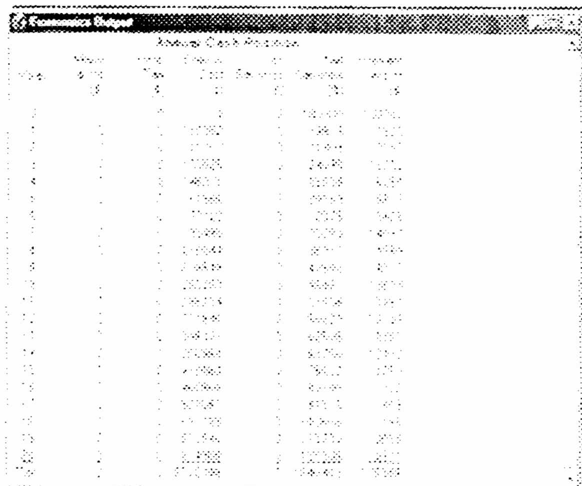
Thermal Output

	Solar	Heat	Dhw	Aux	f
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Year	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

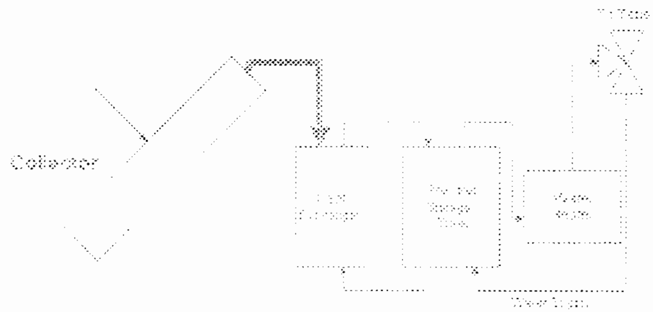
Air - Economic Output



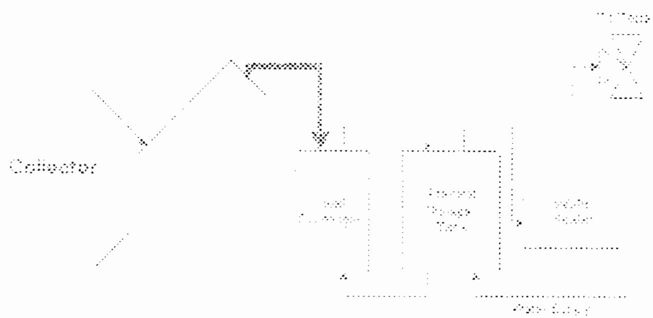
الـهواء – الناتـج الاقـتصادي



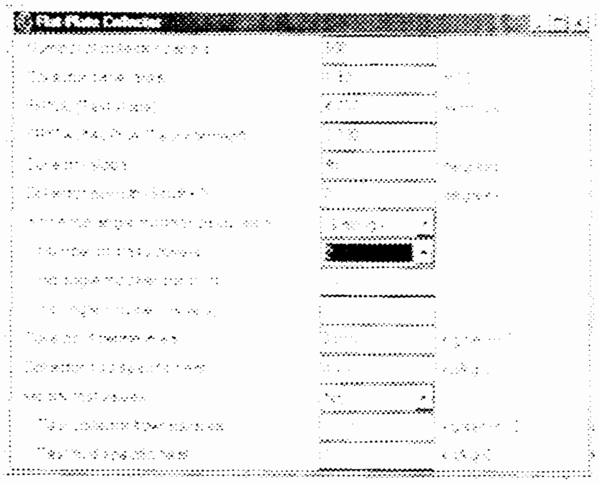
Hot Water Flat Plate Collector



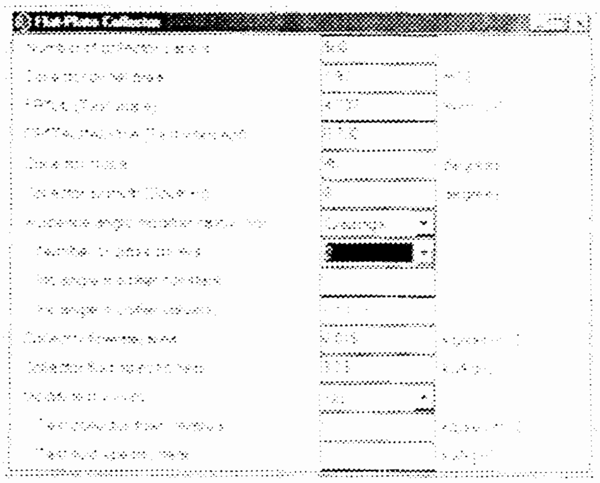
مجمع الماء الساخن المصنوع من ألواح مسطحة



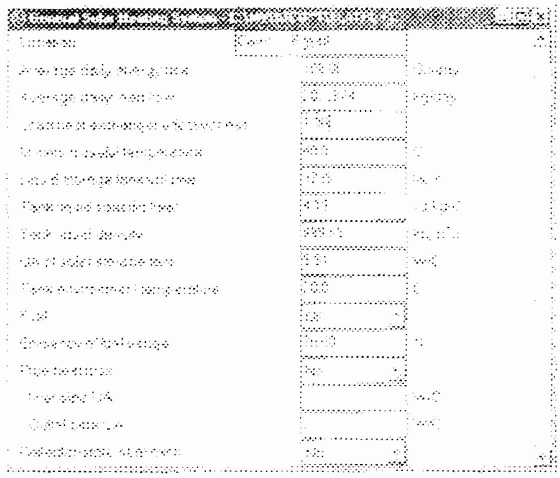
HW - Collector Parameters



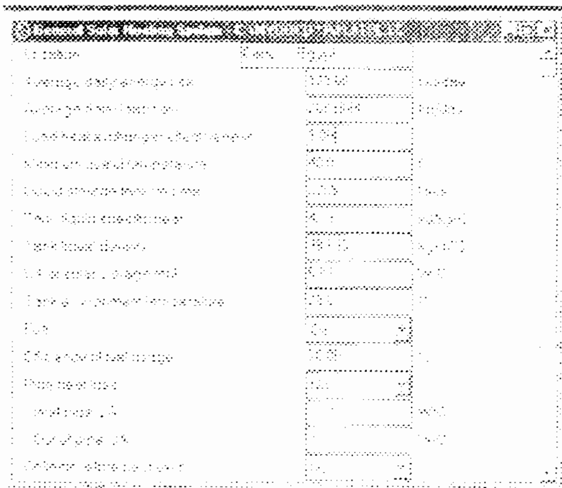
الماء الساخن – المقادير متغيرة القيمة لجهاز التجميع



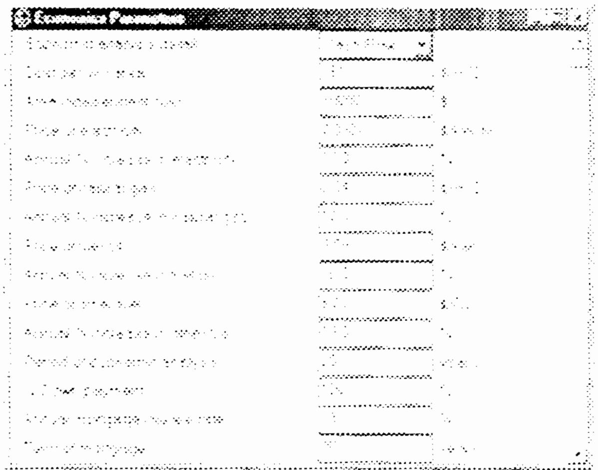
HW - System Parameters



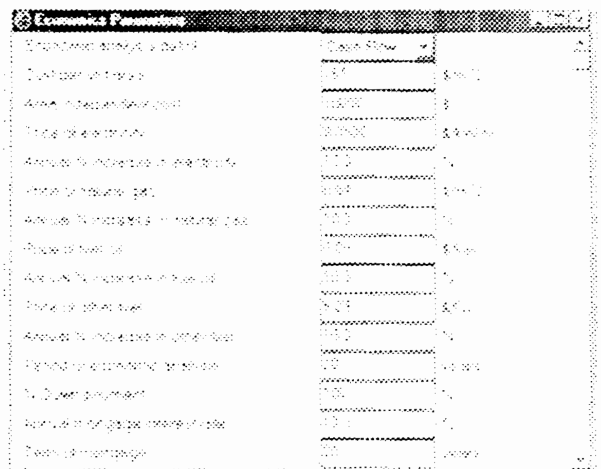
الماء الساخن – المقادير متغيرة القيمة للنظام



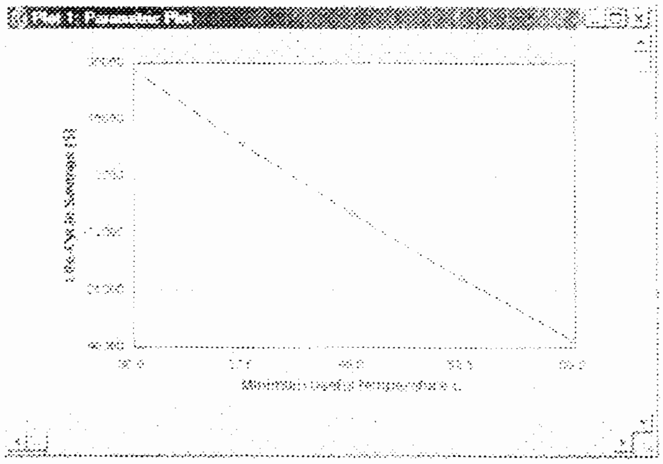
HW - Economic Assumptions



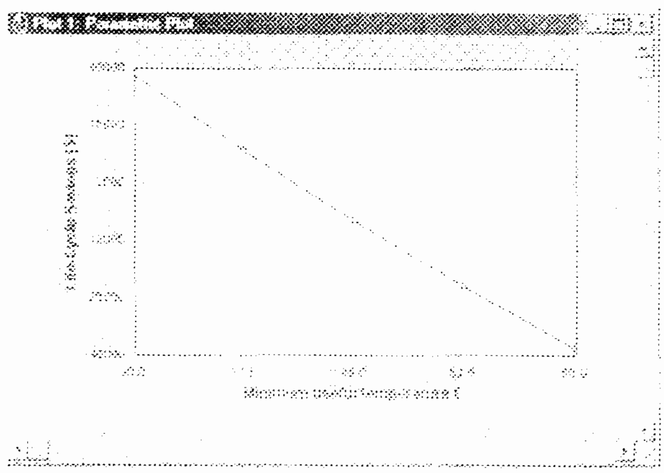
الماء الساخن – الافتراضات الاقتصادية



HW - Temp vs Performance



الماء الساخن – درجة حرارة الماء الساخن مقابل الأداء



HW - Thermal Performance

Thermal Output

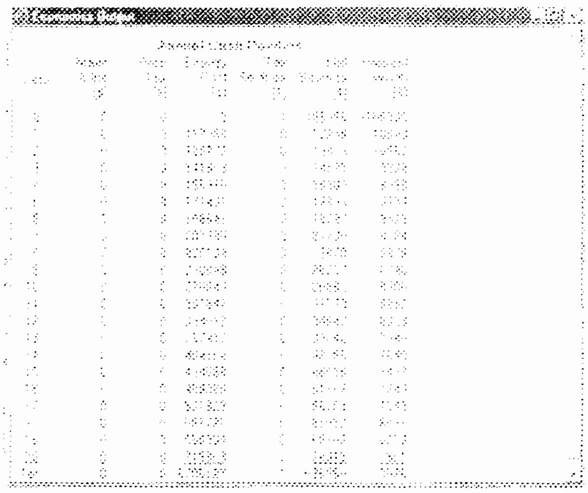
	Solar	Load	QTank	Aux	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	
Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Year	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

الماء الساخن – الاداء الحراري

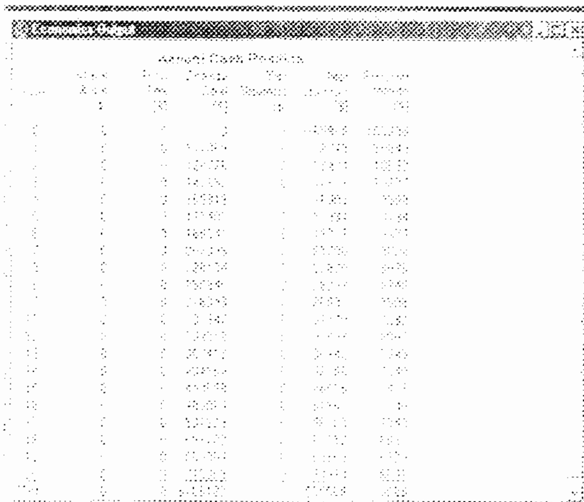
Thermal Output

	Solar	Load	QTank	Aux	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	
Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Year	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

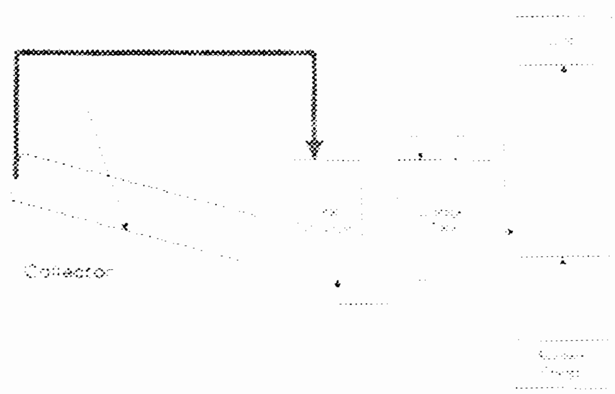
HW - Economic Output



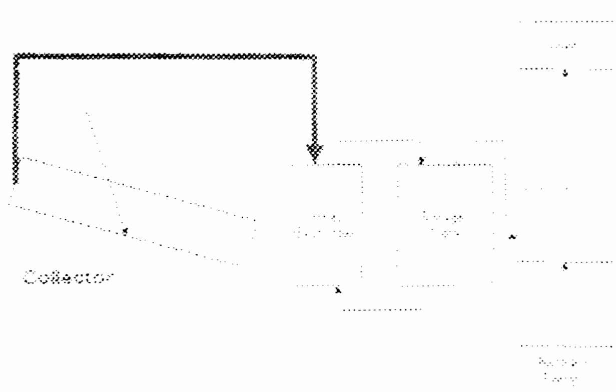
الماء الساخن – الناتج الاقتصادي



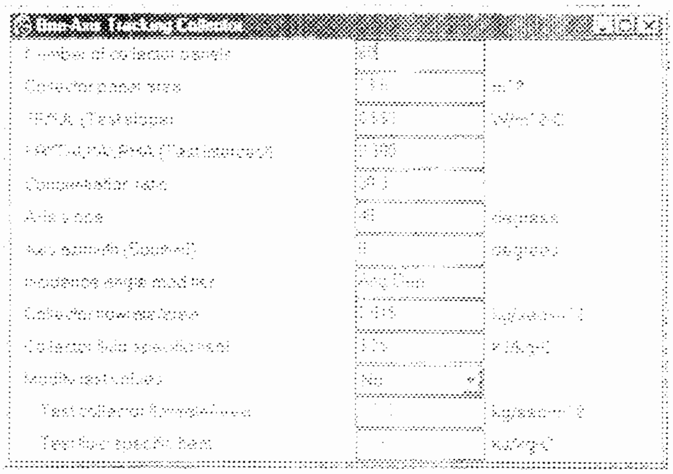
Steam Parabolic Collector



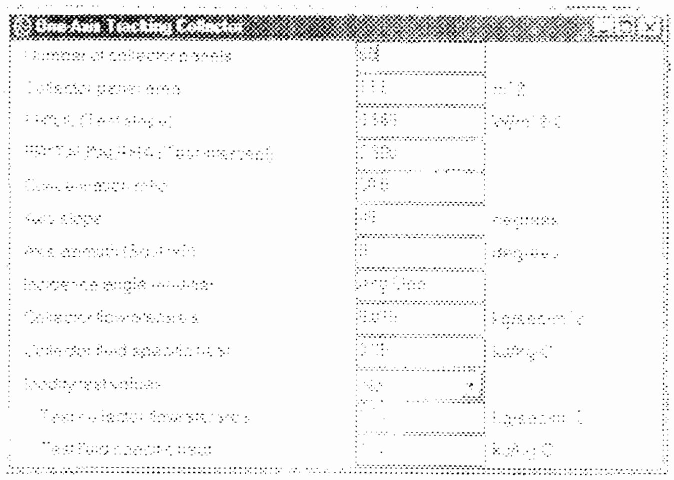
مجمع بخار مكافئ المقطع



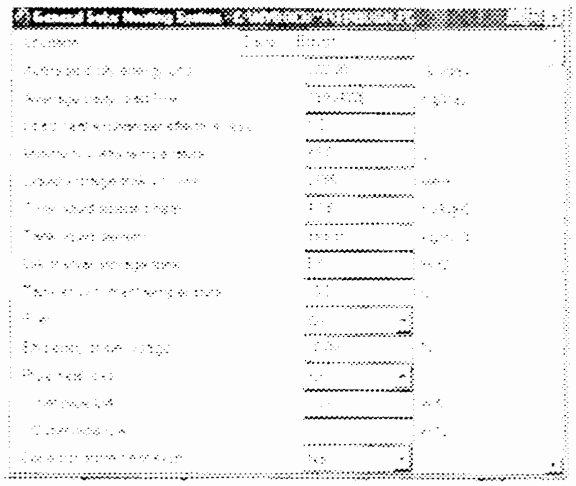
Parabolic-Collector Parameters



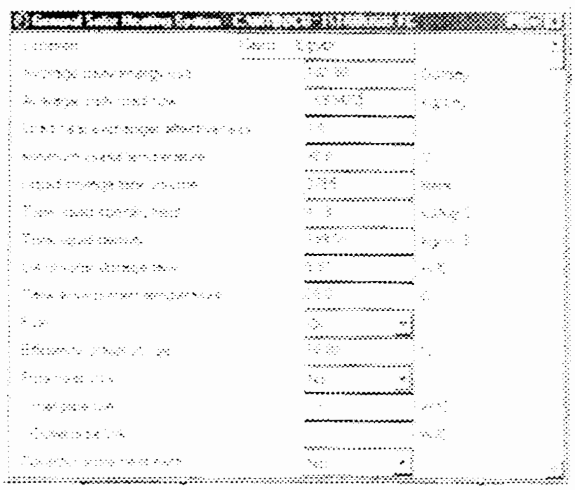
المقادير متغيرة القيمة للمجمع المكافئ



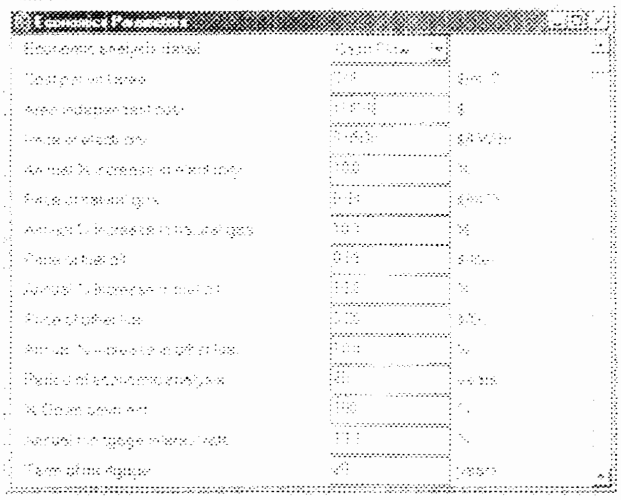
Parabolic-System Parameters



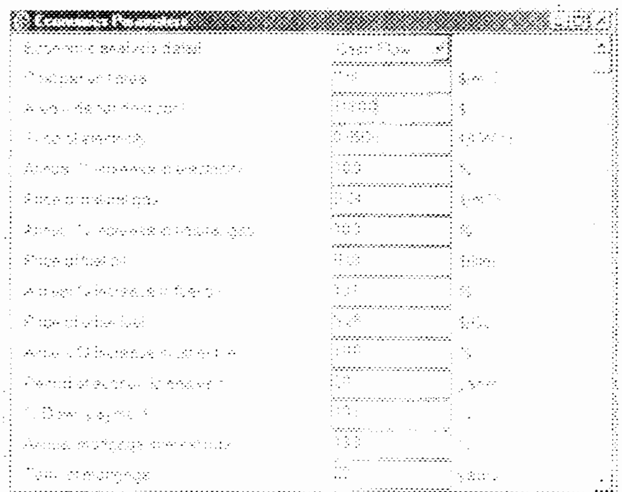
المقادير متغيرة القيمة للنظام المكافئ



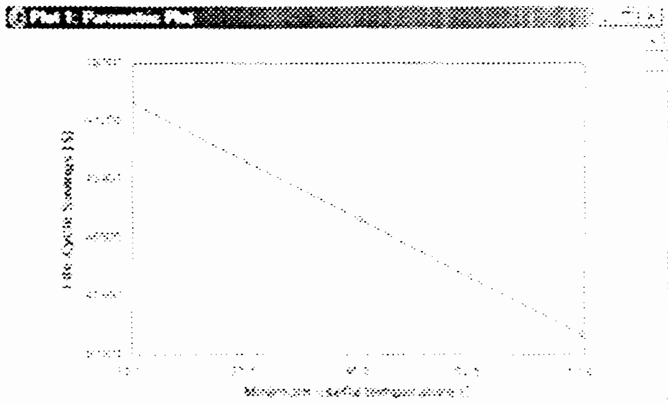
Parabolic-Economic Assumptions



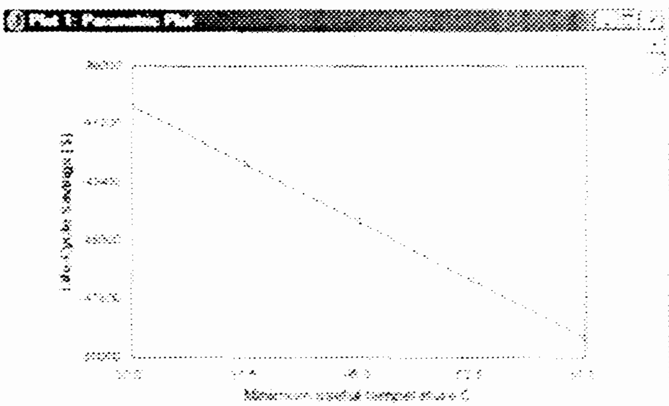
النظام المكافئ – الافتراضات الاقتصادية



Parabolic-Temp vs Performance



النظام المكافئ المقطع – درجة الحرارة مقابل الاداء



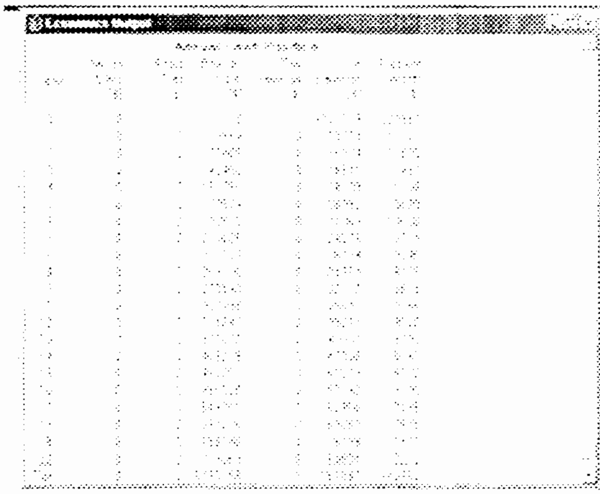
Parabolic-Thermal Output

	Solar	Load	QTank	Aux	f
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Year	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

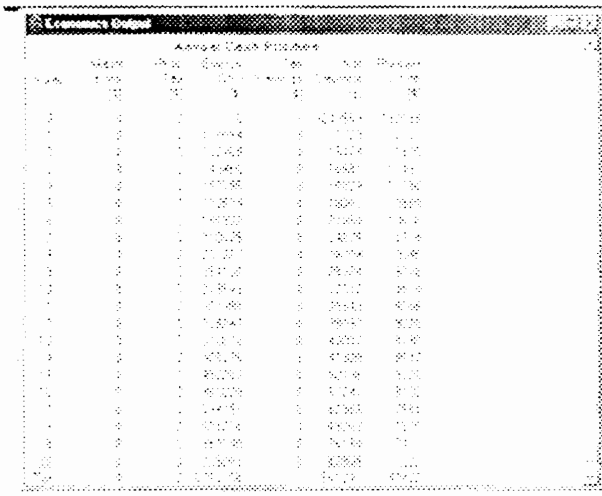
النظام المكافئ المقطع – الناتج الحراري

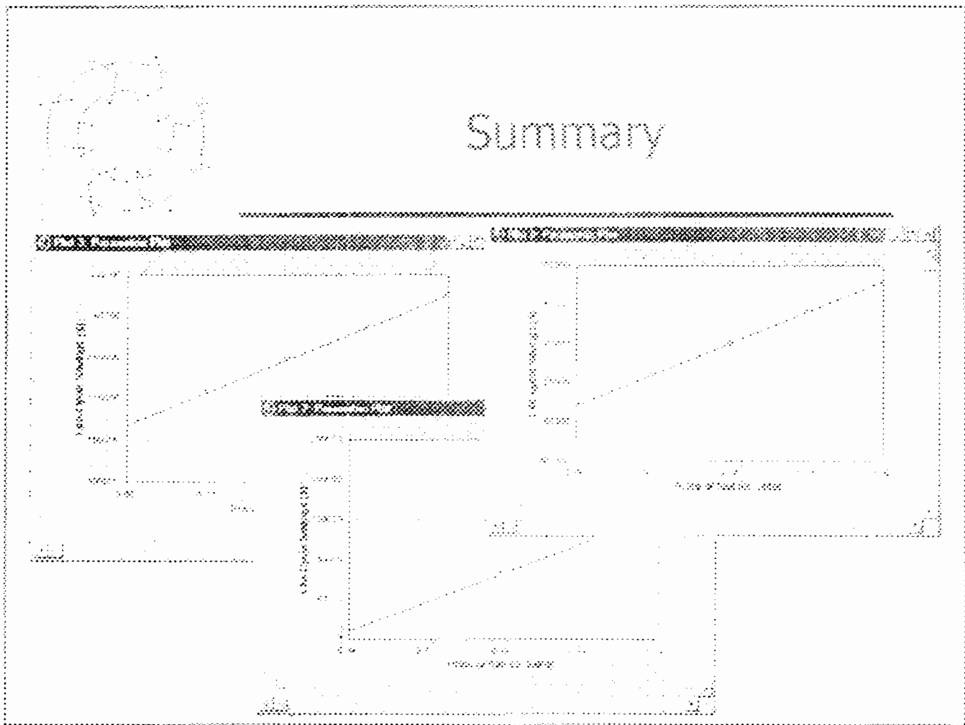
	Solar	Load	QTank	Aux	f
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jan	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Feb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Apr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jun	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Oct	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Nov	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dec	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Year	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

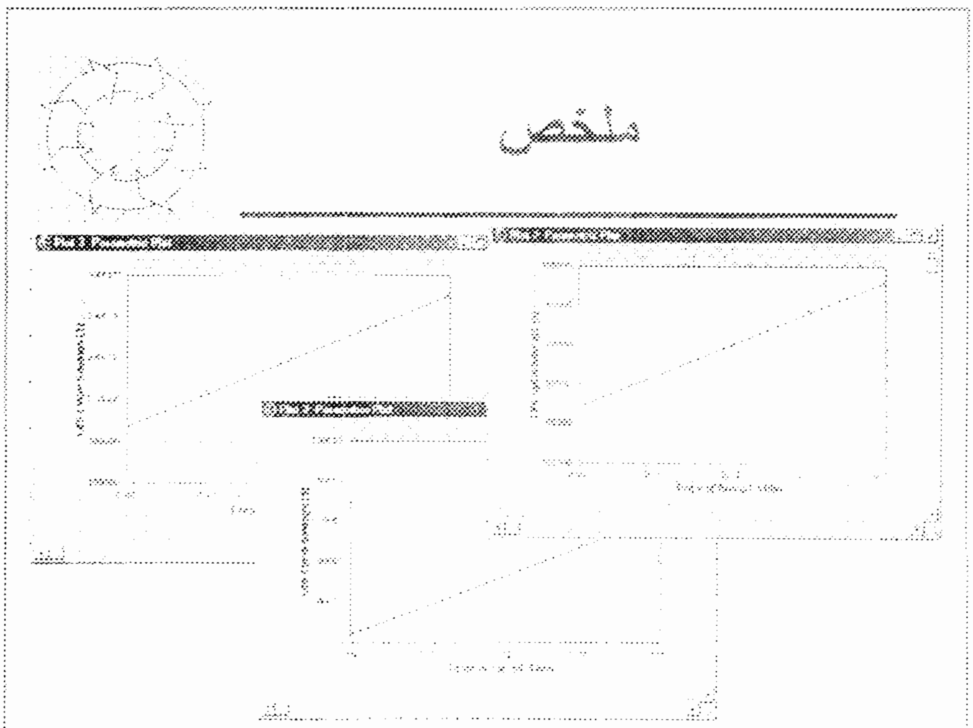
Parabolic-Economic Output



النظام المكافئ المقطع – الناتج الاقتصادي




Summary


ملخص

Solar Proposal Examples

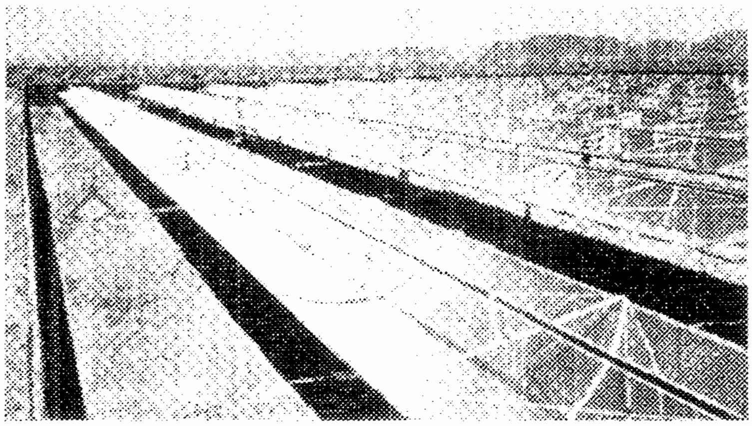
- Conserval Engineering - SOLARWALL
- Capital Sun Group - IST Parabolic Trough

أمثلة للمقترحات الخاصة باستخدام نظام الطاقة الشمسية

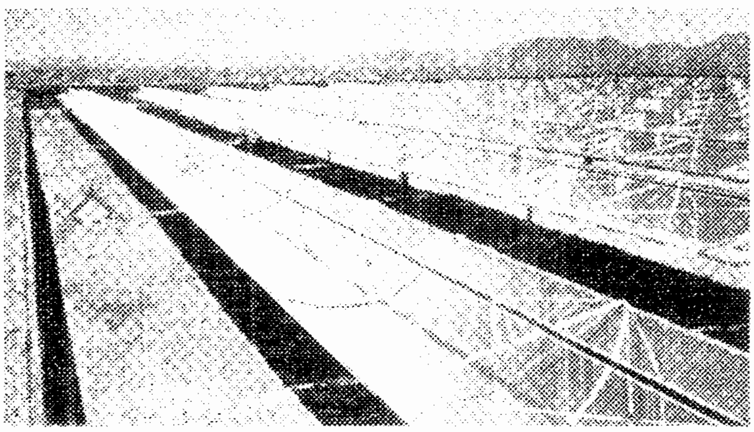
هندسة توفير الطاقة – SOLARWALL

قناة مكافئية المقطع طبقا للتكنولوجيا الصناعية للطاقة الشمسية – Capital Sun Group

Capital Sun Group Analysis of IST Parabolic Trough System



تحليل شركة Sun Group – Capital لنظام القناة مكافئية المقطع طبقا للتكنولوجيا الصناعية للطاقة الشمسية



System Characteristics

- Concentration of sun's heat rays
- Requires -
  - Collecting surface
  - Absorbing surface
  - Heat transfer fluid
- Tracking system with sensors
- Can operate at 175 °C for onion dehydration

خواص النظام

- تركيز الأشعة الحرارية للشمس
- يتطلب الامر
  - سطح تجميع
  - سطح ماص
  - سائل نقل الحرارة
- نظام التعقب المزود بأجهزة استشعار
- يمكن تشغيله عند ١٧٥°م لتجفيف البصل

Built from Local Materials

- Constructed mostly from aluminum
- 40-60% from local materials & labor
- Routine maintenance - once/week operator washing
- Data monitoring by telephone
- Industrial Solar Technology (IST) has 15 years of improvement

يتم تشييده من مواد محلية

- يتم تشييد معظمه من الألومنيوم
- ٤٠ – ٦٠% من المواد والعمالة المحلية
- عمليات الصيانة الروتينية – التنظيف والغسل مرة في الأسبوع
- مراقبة البيانات عن طريق الهواتف
- التكنولوجيا الصناعية للطاقة الشمسية في تحسن مستمر على مدى ١٥ عاما

System Parts

- Light weight and high strength - wind protect
- Special reflective surface 87-88% efficient
- Standard motors and controls
- Trough efficiency - 55% of available heat
- Operation - balance of collection/application
  - Solar system feeds steam available
  - Conventional system feeds make-up steam

أجزاء النظام

- تتميز بخفة الوزن والقوة الفائقة – محمية ضد الرياح
- سطح عاكس يعمل بكفاءة تتراوح ما بين ٨٧ – ٨٨%
- موتورات ولجهزة تحكم تقليدية
- كفاءة القناة – ٥٥% من الحرارة المتوافرة
- التشغيل – توا زن الجمع/التطبيق
  – يقوم النظام الشمسي بتغذية البخار المتوفر
  – يقوم النظام التقليدي بتغذية النظام التعويضي

Onion Drying Solar Thermal System

- Plant capacity - 3.7 tons/day of dehydrated onions
- Operation - 10 months/year
- Temperature - 115 - 130 °C by National Drying & Wolverine P&S
- Design - 20 million BTU/hr energy
- Field area required - 13,378 square meters
- System Cost = $3,600,000

النظام الحراري الشمسي المستخدم في تجفيف البصل

- سعة المصنع – ٣,٧ طن/اليوم من البصل المجفف
- التشغيل – ١٠ أشهر/السنة
- درجة الحرارة – ١١٥ – ١٣٠°م بواسطة National Drying & Wolverne P&S
- التصميم – ٢٠ مليون وحدة حرارية بريطانية/الساعة من الطاقة
- المساحة المتطلبة – ١٣,٣٧٨ م٢
- تكلفة النظام = ٣,٦٠٠,٠٠ دولارا امريكيا

Payback Period

- Mazoot cost at $25/barrel
- Current Fuel Cost = $310,500 per year
- Maintenance cost = $3.32/M^2/yr or $43,200
- Net Savings $267,300
- Simple Payback = 13.5 years
- Assuming oil cost increase of 5% annual
  - Simple Payback = 11.2 years

فترة الاسترداد

- تبلغ تكلفة المازوت ٢٥ دولارا للبرميل
- التكلفة الحالية للوقود = ٣١٠,٥٠٠ دولارا في السنة
- تكلفة الصيانة = ٣,٣٢ دولارا/م^{٢}/السنة أو ٤٣,٢٠٠ دولارا
- صافي الادخارات ٢٦٧,٣٠٠ دولارا
- الاسترداد البسيط = ١٣,٥ عاما
- بافتراض زيادة تكلفة النفط بحوالي ٥% سنويا
  - يكون الاسترداد البسيط = ١١,٢ عاما

Issues for Study

- Accurate solar plant sizing
  - Dehydration plant requirements
  - Secure accurate solar data
- Optimum mix of solar energy and conventional fuel
- Detailed economic analysis - interest, discounted cash flow
- GATT treaty to remove energy subsidies in 2004

موضوعات للدراسة

- التحديد الدقيق لحجم المصنع الذي يعمل بالطاقة الشمسية
  - متطلبات مصنع التجفيف
  - تأمين البيانات الدقيقة للطاقة الشمسية
- الخلط الامثل للطاقة الشمسية بالوقود التقليدي
- التحليل الاقتصادي التفصيلي – الفائدة، التدفق النقدي المخفض
- اتفاقية الجات للحد من الدعم على الطاقة في عام ٢٠٠٤

Conserval Analysis for Solarwall Hot Air Drying

تحليل توفير الطاقة لعملية التجفيف بالهواء الساخن بواسطة الجدار الشمسي

Application and Advantages

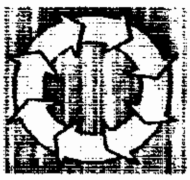
- Provides "free" solar energy to dry crops
- Non-polluting system
- Wall or roof mounted on existing structures
- Highest solar efficiency up to 70%
- Low cost and easy installation

التطبيق والمزايا

- توفير الطاقة الشمسية "المجانية" لتجفيف المحاصيل
- نظام غير ملوث
- يركب على الجدران او الاسطح الخاصة بالمباني القائمة
- أعلى كفاءة للطاقة الشمسية حتى ٧٠%
- تكلفة منخفضة وتركيب سهل

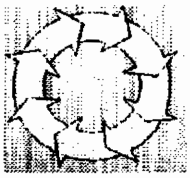
System Operation

- Dark metal cladding surface to absorb heat
- Contains holes to pick up outside air - drawn in by ventilation fan
- Distributed in plenum chamber to crops where needed
- Can raise drying temperature to 60 °C



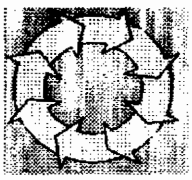
تشغيل النظام

- سطح معدني مصفح داكن لامتصاص الحرارة
- يحتوى على ثقوب لالتقاط الهواء الخارجي – يتم سحب الهواء بواسطة مروحة التهوية
- يتم توزيع الهواء في حجرة نفاخة على المحاصيل كلما اقتضت الضرورة
- يمكن ان يرفع درجة حرارة التجفيف لحولي ٦٠°م



Conserval Proposal

- Floor area - 1,200 m^2
- Collector area - 1,500 m^2
- Temperature rise - 24.5 °C
- Installed cost - $123,300
- Annual savings - $31,100
- Simple Payback = 4.0 years



اقتراح توفير الطاقة

- مساحة الارضية – ١,٢٠٠م^{٢}
- مساحة المجمع – ١,٥٠٠م^{٢}
- رفع درجة الحرارة الى – ٢٤,٥°م
- تكلفة التركيب – ١٢٣,٣٠٠ دولارا
- الادخارات السنوية – ٣١,١٠٠ دولارا
- الاسترداد البسيط _ ٤,٠ عاما

Implementing An Energy &Water Saving Project

- Establish the Program
- Organize program
- Do preliminary assessment
- Write program plan
- Do detailed assessment
- Define pollution prevention options
- Do feasibility analysis
- Write assessment report
- Implement the plan
- Measure progress
- Maintain pollution prevention program

تنفيذ برنامج لتوفير الطاقة والماء

- وضع البرنامج
- تنظيم البرنامج
- إجراء تقييماً مبدئياً
- كتابة خطة البرنامج
- إجراء تقييماً تفصيلياً
- تحديد خيارات الحد من التلوث
- إجراء تحليل جدوى
- كتابة تقرير عن التقييم
- تنفيذ الخطة
- قياس درجة التقدم والنجاح
- وضع برنامج للحد من التلوث

Involving Employees in Pollution Prevention Program

- Help define company goals
- Review processes and operations
- Recommend ways to eliminate or reduce waste
- Design and modify forms and records
- Acknowledge and reward employee contributions

إشراك العاملين في برنامج الحد من التلوث

- المساعدة في تحديد أهداف الشركة
- مراجعة الاجراءات والعمليات
- اقتراح بعض الطرق للتخلص من الفاقد أو منعه
- تصميم وتعديل النماذج والسجلات
- إدراك اسهامات العاملين ومكافئتهم على ذلك

- Data Sources For Facility Information
- Policy statement
- Name pollution prevention task force

- مصادر بيانات خاصة بمعلومات عن المنشأة
- البيان الخاص بالسياسة
- تحديد القائمين بمهمة الحد من التلوث

DATA SOURCES FOR FACILITY INFORMATION

- Water and Wastewater Analyses
- Process Flow Diagrams
- Operation Manuals and Process Descriptions
- Equipment Lists
- Equipment Specification and Data Sheets
- Piping and Instrument Diagrams
- Plot and Elevation Plans
- Equipment Layouts and Logistics
- Product Composition and Batch Sheets
- Operator Data Logs
- Operating Procedures
- Production Schedules
- Wastewater Treatment and/or Disposal Costs
- Water and Sewer Costs, Including Surcharges
- Energy Costs
- Fuel Costs
- Operating and Maintenance Costs
- Department Cost Accounting Reports
- Standard Procedures
- Organization Charts

POLICY STATEMENT

Should answer three key questions:

1. Why are we implementing pollution prevention?

   We want to cut costs.

2. What will be done to implement pollution? prevention?

   We will reduce or eliminate the amounts of all types of waste, and we will improve energy efficiency.

3. Who will implement pollution prevention?

   Everyone will be involved with assigned tasks.

NAME POLLUTION PREVENTION TASK FORCE

Program Leader

Should be named from the highest level practicable.

Must have authority and influence to keep the program on track and ensure that this program becomes part of overall corporate plan.

Should possess personal qualities needed to obtain broad-based support from the company's employees.

Other Team Members

Should be selected for their specific technical or business expertise.

Environmental and plant process engineers, production supervisors, and experienced line-workers are good candidates. Other potential sources include purchasing and quality-assurance staff.

Once team is set up and working, they can be used to review plans for expansion to determine whether pollution prevention and waste generation have been thoroughly evaluated.

Establish Goals

Goals should be

- Well-defined
- Meaningful to all employees
- Challenging yet achievable
- Flexible
- Part of a program planning document

وضع الاهداف

ينبغي أن تكون الاهداف على النحو التالي:

- شديدة الدقة والوضوح
- يفهمها كافة العاملين
- من الممكن تحقيقها بالرغم صعوبتها
- مرنة
- أن تكون جزءاً من المستند الخاص بتخطيط البرنامج

Do Preliminary Assessment

- Collect Data
- Visit Sites
- Establish priorities

إجراء تقييما مبدئيا

- جمع البيانات
- زيارة المواقع
- وضع الاولويات وتحديدها

Write Program Plan

- Define Objectives
- Identify Potential Obstacles
- Develop Schedule

كتابة خطة البرنامج

- تحديد الاهداف
- تحديد العراقيل المحتمل حدوثها
- عمل جدول زمني لها

Do Detailed Assessment

- Name Assessment Teams
- Review data and sites
- Organize and document information

إجراء تقييما تفصيليا

- تحديد فرق التقييم
- مراجعة البيانات والمواقع
- تنظيم المعلومات وحفظها في سجلات

DO DETAILED ASSESSMENT

Name assessment teams

- **Areas of expertise to consider for detailed assessment teams:**
  - **Management**
  - **Engineering**
  - **Quality control**
  - **Production and maintenance**
  - **Accounting and purchasing**
  - **Legal**
  - **Health and safety**
  - **Research and development**

Example of Detailed Assessment Team:

- **Production supervisor (Team leader)**
- **Facilities engineer**
- **Maintenance engineer**
- **Accounting and purchasing**

Review data and sites

- Review existing documentation
- Prepare agenda for site review
- Provide staff contacts in advance of site review
- Schedule inspection to coincide with operation of particular interest
- Monitor operation at different times
- Interview operators and supervisors
- Take photographs, if warranted
- Observe housekeeping aspects – check for signs of spills or leaks
- Make follow-up visits
- Assess organizational structure and coordination between departments
- Assess administrative controls

Organize and document information

- Perform materials and energy balance on each process or component

Define Pollution Prevention Options

- Propose Options
- Screen Options

تحديد خيارات الحد من التلوث

- اقتراح الخيارات
- تقييم الخيارات وانتقاء ما يلائم منها

Do Feasibility Analysis

- Technical
- Environmental
- Economic

إجراء تحليل جدوى

- فني
- بيئي
- اقتصادي

Economic

Payback method:

Payback =
(Capital cost of project)/(annual net operating cost savings)

PBP (Payback Period) = ($ 160,000)/($ 50,000) = 3.2 years

Net Present Value (NPV) Method:

NPV = (savings – costs)/(1 + MARR) t

(Savings – costs) for year t

MARR = the minimum attractive rate of return, the average cost of capital for the firm

(1 + MARR)t = (1 + the rate of return) to the power of t

EXAMPLE -- NET PRESENT VALUE METHOD

In this example, a company buys a solvent recovery system.

- The total capital outlay for the system is $7500.
- The total ongoing average annual operating costs will be $500/year.
- The system will last for five years, then be discarded as scrap.
- The total estimated average annual savings will be $2800/yr in avoided waste disposal and reduced raw material costs.
- The company's MARR is 10%.

The net present value of the proposed project is then calculated as follows:

Year	Savings(t)	Costs(t)	Savings Minus Costs(t)	Savings - Cost(t) / (1+MARR)^t
0	$ 0	$7500	-$7500	-$7500
1	$2800	$ 500	$2300	$2090
2	$2800	$ 500	$2300	$1900
3	$2800	$ 500	$2300	$1730
4	$2800	$ 500	$2300	$1570
5	$2800	$ 500	$2300	$1430
	TOTAL PROJECT NPV			$1220

Therefore, the total profit from this project would be $1220. The initial cost is felt right away and is not affected by discounting. Each of the following years savings must be discounted.

The numbers in the last column are calculated by the formula given at the beginning of this section. For example, in the fourth year, the years savings minus the years costs are divided by one plus the MARR raised to the fourth power, or

$$\frac{\text{SAVINGS - COSTS (year 4)}}{(1+\text{MARR})^4} = \frac{2300}{(1.1)^4} = 1570$$

The total NPV for years 0 through 5 are added together, resulting in a total project NPV of $1220. Any other project's NPV would be calculated in the same way, and the result compared to the $1220. A larger NPV would imply greater profitability. Always implicit in this comparison is the "do nothing" alternative. If all project NPVs are less than zero, the least negative is the best, but is still not economically profitable. In that situation, if profits were the only consideration, then the best alternative would be to "do nothing."

- Write Assessment Report
- Implement the Plan
- Measure Progress
- Maintain Pollution Prevention Program

- كتابة تقرير خاص بالتقييم
- تنفيذ الخطة
- قياس درجة التقدم والنجاح
- وضع برنامج للحد من التلوث

WRITE ASSESSMENT REPORT

Each Assessment Team summarizes:

- **Results of assessment effort**
- **Options proposed**
- **Results of option screening**
- **Project personnel for each selected option**

The Report on each proposed project should discuss:

- **Its pollution prevention potential**
- **The maturity of the technology and a discussion of successful applications**
- **The required resources and how they will be obtained**
- **The estimated time for installation and startup**
- **Possible performance measures to allow the project to be evaluated after it is implemented**

The Summary Assessment Report is used for:

- **QA of implementation plan**
- **Funding decisions**
- **Building support for plan**

The formal written pollution prevention plan will include the following elements:

- Corporate policy statement of support for pollution prevention
- Description of your pollution prevention planning team(s) makeup, authority, and responsibility
- Description of how all of the groups (production, laboratory, maintenance, shipping, marketing, engineering, and others) will work together to reduce waste production and energy consumption
- Plan for publicizing and gaining company-wide support for the pollution prevention program
- Plan for communicating the successes and failures of pollution prevention programs within your company
- Description of the processes that produce, use, or release hazardous or toxic materials, including clear definition of the amounts and types of substances, materials, and products under consideration
- List of treatment, disposal, and recycling facilities and transporters currently used
- Preliminary review of the cost of pollution control and waste disposal
- Description of current and past pollution prevention activities at your facility
- Evaluation of the effectiveness of past and ongoing pollution prevention activities
- Criteria for prioritizing candidate facilities, processes, and streams for pollution prevention projects.

MAINTAIN POLLUTION PREVENTION PROGRAM

Integrate Pollution Prevention into corporate plan

- Assign accountability for wastes
- Tracking and reporting
- Annual program evaluation

Staff Education

- New employee orientation
- Retraining

Maintain Internal Communication

- Two-way communication (manager/employee)
- Solicit and follow up on employees' suggestions

Employee Reward Program

- Performance reviews
- Recognition among peers
- Material rewards

APPENDICES

Pollution Prevention

APPENDIX I- Employee Involvement
- a. Employee Orientation
- b. Employee Motivation

APPENDIX II- Good Operating Practices

APPENDIX III- Checklist for Prevention and Recycling

APPENDIX IV- Energy Saving Suggestions
- a. Absorption Cooling
- b. Transmission Losses

APPENDIX V- Typical Worksheets
- a. Process Information
- b. Input Materials Survey
- c. Waste Stream Summary
- d. Option Generation
- e. Option Generation
- f. Profitability

APPENDIX VI- Pollution Control

APPENDIX I

Employee Involvement

a. Employee Orientation
b. Employee Motivation

Ia.

Example Pollution Prevention Employee Orientation

Course: "Pollution Prevention — Description, Motivation, and Practice"

Description: This training course emphasizes your company's commitment to pollution prevention. It gives instruction and practice in techniques for promotion, persuasion, and encouragement of pollution prevention.

Goal: The goal of the training program is to explain:

- What is pollution prevention?
- What leads to successful implementation of pollution prevention?
- What role can the individual play in promoting pollution prevention?

Lesson Plan for One-Day Orientation

Activities	Objectives
Get acquainted	Outline activities
Define terms and introduce objectives	Begin definition of pollution prevention as a concept and an activity
Group discussion	Perform and discuss a pollution prevention assessment of a simple process Outline pollution prevention opportunities Analyze implementation, possible barriers, and how to overcome
Hands-on exercise (1st half)	Perform and discuss pollution prevention assessment of a complex process
Form teams	Experience pressures of business
Individuals assigned roles	Experience importance of communication
Hands-on exercise (2nd half)	Refine application
Reassign roles	Develop teamwork
Repeat hands-on exercise (1st half)	Experience putting opportunities into priority list Discuss implementation, possible barriers, and how to overcome
Discussion	Reinforce need for pollution prevention Explain significance of individual contribution to pollution prevention

To motivate employees, managers can:

- Provide feedback and reinforcement of employees' pollution prevention performance.
- Set an example by adhering to the pollution prevention program and actively considering employee ideas.
- Convey enthusiasm about meeting pollution prevention objectives.
- When new pollution prevention measures are implemented, explain how they fit in with the overall objectives.
- Regularly reinforce the importance of each individual's contributions to pollution prevention and their value to the overall objectives.
- Demonstrate personal commitment to the objectives and praise the commitment demonstrated by employees.
- Announce pollution prevention innovations by calling a meeting for all individuals who will be affected to discuss the change.
    - Open meeting to questions and comments.
    - Pay attention to signs of animosity or resistance and address these immediately.
    - Gain cooperation by showing that you know and care how the employees feel.
- Establish a "group identity" and work at building pride in adapting to the pollution prevention innovation.
- "Go to bat" for employees who have good pollution prevention ideas that have been rejected or overlooked.
- Establish quantifiable annual pollution prevention objectives:
    - On a monthly basis, have employees chart their personal and the company's progress against these objectives.
    - Incorporate pollution prevention goals, objectives, and accomplishments into annual job performance evaluations for people with direct process pollution prevention responsibilities.
    - Readjust objectives if they prove to be unattainable.

APPENDIX II GOOD OPERATING PRACTICES

Table 1. Pollution Prevention Through Good Operating Practices

Good Operating Practice	Program Ingredients
Waste Segregation	Prevent mixing of hazardous wastes with nonhazardous wastes
	Store materials in compatible groups
	Segregate different solvents
	Isolate liquid wastes from solid wastes
Preventive Maintenance Programs	Maintain equipment history cards on equipment location, characteristics, and maintenance
	Maintain a master preventive maintenance (PM) schedule
	Keep vendor maintenance manuals handy
	Maintain a manual or computerized repair history file
Training/Awareness-Building Programs	Provide training for
	- Operation of the equipment to minimize energy use and mate waste
	- Proper materials handling to reduce waste and spills
	- Emphasize importance of pollution prevention by explaining t economic and environmental ramifications of hazardous waste generation and disposal
	- Detecting and minimizing material loss to air, land, or water
	- Emergency procedures to minimize lost materials during accidents
Effective Supervision	Closer supervision may improve production efficiency and reduce inadvertent waste generation
	Centralize waste management. Appoint a safety/waste management officer for each department. Educate staff on the benefits of pollutic prevention. Establish pollution prevention goals. Perform pollution prevention assessments.
Employee Participation	"Quality circles" (free forums between employees and supervisors) c identify ways to reduce waste
	Solicit and reward employee suggestions for waste reduction ideas

Table 1. (Continued)

Good Operating Practice	Program Ingredients
Production Scheduling/Planning	Maximize batch size to reduce clean out waste
	Dedicate equipment to a single product
	Alter batch sequencing to minimize cleaning frequency (light-to-dark batch sequence, for example)
Cost accounting/ Allocation	Charge direct and indirect costs of all air, land, and water discharges to specific processes or products
	Allocate waste treatment and disposal costs to the operations that generate the waste
	Allocate utility costs to specific processes or products

APPENDIX III CHECKLIST FOR PREVENTION & RECYCLING

Table 2. Checklist for All Industries

Waste Origin/Type	Pollution Prevention and Recycling Methods
terial Receiving/ Packaging materials, off-spec materials, damaged container, inadvertent spills, transfer hose emptying	Use "Just-in-Time" ordering system. Establish a centralized purchasing program. Select quantity and package type to minimize packing waste. Order reagent chemicals in exact amounts. Encourage chemical suppliers to become responsible partners (e.g., accept outdated supplies). Establish an inventory control program to trace chemical from cradle to grave. Rotate chemical stock. Develop a running inventory of unused chemicals for other departments' use. Inspect material before accepting a shipment. Review material procurement specifications. Validate shelf-life expiration dates. Test effectiveness of outdated material. Eliminate shelf-life requirements for stable compounds. Conduct frequent inventory checks. Use computer-assisted plant inventory system. Conduct periodic materials tracking. Properly label all containers. Set up staffed control points to dispense chemicals and collect wastes. Buy pure feeds. Find less critical uses for off-spec material (that would otherwise be disposed). Change to reusable shipping containers. Switch to less hazardous raw material. Use rinsable/recyclable drums.
w Material and Product Storage/ Tank bottoms; off-spec and excess materials; spill residues; leaking pumps, valves, tanks, and pipes; damaged containers; empty containers	Establish Spill Prevention, Control, and Countermeasures (SPCC) plans. Use properly designed tanks and vessels only for their intended purposes. Install overflow alarms for all tanks and vessels. Maintain physical integrity of all tanks and vessels. Set up written procedures for all loading/unloading and transfer operations. Install secondary containment areas. Instruct operators to not bypass interlocks, alarms, or significantly alter setpoints without authorization. Isolate equipment or process lines that leak or are not in service. Use sealless pumps.

Table 2. (Continued)

Waste Origin/Type	Pollution Prevention and Recycling Methods
Raw Material and Product Storage/ (Continued)	Use bellows-seal valves. Document all spillage. Perform overall materials balances and estimate the quantity and dollar value of all losses. Use floating-roof tanks for VOC control. Use conservation vents on fixed roof tanks. Use vapor recovery systems. Store containers in such a way as to allow for visual inspection for corrosion and leaks. Stack containers in a way to minimize the chance of tipping, puncturing, or breaking. Prevent concrete "sweating" by raising the drum off storage pads. Maintain Material Safety Data Sheets to ensure correct handling of spills. Provide adequate lighting in the storage area. Maintain a clean, even surface in transportation areas. Keep aisles clear of obstruction. Maintain distance between incompatible chemicals. Maintain distance between different types of chemicals to prevent cross-contamination. Avoid stacking containers against process equipment. Follow manufacturers' suggestions on the storage and handling of all raw materials. Use proper insulation of electric circuitry and inspect regularly for corrosion and potential sparking. Use large containers for bulk storage whenever possible. Use containers with height-to-diameter ratio equal to one to minimize wetted area. Empty drums and containers thoroughly before cleaning or disposal. Reuse scrap paper for note pads; recycle paper.
Laboratories/ Reagents, off-spec chemicals, samples, empty sample and chemical containers	Use micro or semi-micro analytical techniques. Increase use of instrumentation. Reduce or eliminate the use of highly toxic chemicals in laboratory experiments. Reuse/recycle spent solvents. Recover metal from catalyst.

Table 2. (Continued)

Waste Origin/Type	Pollution Prevention and Recycling Methods
oratories (Continued)	Treat or destroy hazardous waste products as the last step in experiments. Keep individual hazardous waste streams segregated, segregate hazardous waste from nonhazardous waste, segregate recyclable waste from non-recyclable waste. Assure that the identity of all chemicals and wastes is clearly marked on all containers. Investigate mercury recovery and recycling.
eration and Process Changes Solvents, cleaning agents, degreasing sludges, sandblasting waste, caustic, scrap metal, oils, greases from equipment cleaning	Maximize dedication of process equipment. Use squeegees to recover residual fluid on product prior to rinsing. Use closed storage and transfer systems. Provide sufficient drain time for liquids. Line equipment to reduce fluid holdup. Use cleaning system that avoid or minimize solvents and clean only when needed. Use countercurrent rinsing. Use clean-in-place systems. Clean equipment immediately after use. Reuse cleanup solvent. Reprocess cleanup solvent into useful products. Segregate wastes by solvent type. Standardize solvent usage. Reclaim solvent by distillation. Schedule production to lower cleaning frequency. Use mechanical wipers on mixing tanks.
peration and Process Changes Sludge and spent acid from heat exchanger cleaning	Use bypass control or pumped recycle to maintain turbulence during turndown. Use smooth heat exchange surfaces. Use on-stream cleaning techniques. Use high pressure water cleaning to replace chemical cleaning where possible. Use lower pressure steam.

APPENDIX IV ENERGY CONSERVATION SUGGESTIONS

IV a.

CONSERVING ENERGY

Wastes Produced by Energy Generation

- **Residue**
- **Wastewater**
- **Gases**

Ways to Conserve Electrical and Thermal Energy:

- **Turning off equipment and lights when not in use**
- **Placing cool air intakes and air-conditioning units in cool, shaded area**
- **Using more efficient heating and refrigeration units**
- **Using more efficient motors**
- **Eliminating leaks in compressed air supply lines**
- **Improving lubrication practices for motor-driven equipment**
- **Using energy-efficient power transfer belts**
- **Using fluorescent lights and lower wattage lamp or ballasts**
- **Installing timers and/or thermostats to better control heating and cooling**

Ways to Reduce Loss of Thermal Energy:

- **Adjusting burners for optimal air/fuel ratio**
- **Improving or increasing insulation on heating or cooling lines**
- **Instituting regular maintenance to reduce leakage and stop steam trap bypass**
- **Improving the thermodynamic efficiency of the process by options such as:**
  - **Using condensers or regenerative heat exchanger to recapture heat**
  - **Using heat pumps or similar equipment to recover heat at distillation columns**
  - **Using more efficient heat exchangers**
  - **Using cogeneration of electricity and steam (or hot water)**

Conserving Energy through Pollution Prevention:

- **Treating and transporting pollutants wastes energy**

APPENDIX V

1. Process Information
2. Input Materials Summary
3. Waste Stream Summary
4. Option Generation
5. Option Description
6. Profitability

IZ

Firm ______ Site ______ Date ______	Pollution Prevention Assessment Worksheets Proj. No. ______	Prepared By ______ Checked By ______ Sheet ___ of ___ Page ___ of ___

PROCESS INFORMATION

Process Unit/Operation: ______

Operation Type: ☐ Continuous ☐ Discrete ☐ Batch or Semi-Batch ☐ Other ______

Document	Status					
	Complete? (Y/N)	Current? (Y/N)	Last Revision	Used in this Report (Y/N)	Document Number	Location
Process Flow Diagram						
Material/Energy Balance						
Design						
Operating						
Flow/Amount Measurements						
Stream						
Analyses/Assays						
Stream						
Process Description						
Operating Manuals						
Equipment List						
Equipment Specifications						
Piping and Instrument Diagrams						
Plot and Elevation Plan(s)						
Work Flow Diagrams						
Hazardous Waste Manifests						
Emission Inventories						
Annual/Biennial Reports						
Environmental Audit Reports						
Permit/Permit Applications						
Batch Sheet(s)						
Materials Application Diagrams						
Product Composition Sheets						
Material Safety Data Sheets						
Inventory Records						
Operator Logs						
Production Schedules						

IV 6

Firm ______	Pollution Prevention Assessment Worksheets	Prepared By ______
Site ______		Checked By ______
Date ______	Proj. No. ______	Sheet ___ of ___ Page ___ of ___

INPUT MATERIALS SUMMARY

Attribute	Description		
	Stream No. ___	Stream No. ___	Stream No. ___
Name/ID			
Source/Supplier			
Component/Attribute of Concern			
Annual Consumption Rate			
Overall			
Component(s) of Concern			
Purchase Price, $ per ______			
Overall Annual Cost			
Delivery Mode[1]			
Shipping Container Size & Type[2]			
Storage Mode[3]			
Transfer Mode[4]			
Empty Container Disposal Management[5]			
Shelf Life			
Supplier Would			
— accept expired material? (Y/N)			
— accept shipping containers? (Y/N)			
— revise expiration date? (Y/N)			
Acceptable Substitute(s), if any			
Alternate Supplier(s)			

Notes:
1. e.g., pipeline, tank car, 100 bbl tank truck, truck, etc.
2. e.g., 55 gal drum 100 lb paper bag, tank, etc.
3. e.g., outdoor, warehouse, underground, aboveground, etc.
4. e.g., pump, forklift, pneumatic transport, conveyor, etc.
5. e.g., crush and landfill, clean and recycle, return to supplier, etc.

IV

Firm ____	Pollution Prevention Assessment Worksheets	Prepared By ____
Site ____		Checked By ____
Date ____	Proj. No. ____	Sheet ___ of ___ Page ___ of ___

WASTE STREAM SUMMARY

Attribute	Description		
	Stream No. ____	Stream No. ____	Stream No. ____
Waste ID/Name:			
Source/Origin			
Component or Property of Concern			
Annual Generation Rate (units ________)			
Overall			
Component(s) of Concern			
Cost of Disposal			
Unit Cost ($ per: ________)			
Overall (per year)			
Method of Management[1]			

Priority Rating Criteria[2]	Relative Wt. (W)	Rating (R)	R x W	Rating (R)	R x W	Rating (R)	R x W
Regulatory Compliance							
Treatment/Disposal Cost							
Potential Liability							
Waste Quantity Generated							
Waste Hazard							
Safety Hazard							
Minimization Potential							
Potential to Remove Bottleneck							
Potential By-product Recovery							
Sum of Priority Rating Scores		Σ(RxW)		Σ(RxW)		Σ(RxW)	
Priority Rank							

Notes:
1. For example, sanitary landfill, hazardous waste landfill, on-site recycle, incineration, combustion with heat recovery, distillation, dewatering, etc.
2. Rate each stream in each category on a scale from 0 (none) to 10 (high).

	Pollution Prevention Assessment Worksheets	Prepared By ______
		Checked By ______
	Proj. No. ______	Sheet ___ of ___ Page ___ of ___

OPTION GENERATION

:ing format (e.g., brainstorming, nominal group technique) ______

:ing Coordinator ______

:ing Participants ______

List Suggestion Options	Rationale/Remarks on Option

V

Firm ____________	Pollution Prevention Assessment Worksheets	Prepared By ____________
Site ____________		Checked By ____________
Date ____________	Proj. No. ____________	Sheet ___ of ___ Page ___ of ___

OPTION DESCRIPTION

Option Name: ____

Briefly describe the option: ____

____

____

____

____

____

____

____

Waste Stream(s) Affected: ____

____

Input Material(s) Affected: ____

____

Product(s) Affected: ____

____

Indicate Type:

☐ Source Reduction
- _____ Equipment-Related Change
- _____ Personnel/Procedure-Related Change
- _____ Materials-Related Change

☐ Recycling/Reuse
- _____ Onsite
- _____ Offsite
- _____ Material reused for original purpose
- _____ Material used for a lower-quality purpose
- _____ Material sold

Originally proposed by: ______________________ Date: ____________

Reviewed by: ______________________ Date: ____________

Approved for study? _________ yes _________ no By: ____________

Reason for Acceptance or Rejection ____

V f.

Firm ______	Pollution Prevention Assessment Worksheets	Prepared By ______
Site ______		Checked By ______
Date ______	Proj. No. ______	Sheet ___ of ___ Page ___ of ___

PROFITABILITY

Capital Costs

Purchased Equipment ______

Materials ______

Installation ______

Utility Connections ______

Engineering ______

Start-up and Training ______

Other Capital Costs ______

Total Capital Costs ______

Incremental Annual Operating Costs

Change in Disposal Costs ______

Change in Raw Material Costs ______

Change in Other Costs ______

Annual Net Operating Cost Savings ______

$$\text{Payback Period (in years)} = \frac{\text{Total Capital Costs}}{\text{Annual Net Operating Cost Savings}} = \_\_\_\_\_\_$$

MEASUREMENT OF ORGANIC CONTENT

Biochemical oxygen demand (BOD) - measures the dissolved oxygen used by microorganisms in the biological oxidation of organic matter (5-day at 20 deg. C).

Chemical oxygen demand (COD) – gives a reasonably close approximation of the total chemically oxidizable carbonaceous content. The COD of a waste is generally higher than the BOD because more compounds can be chemically oxidized. For many types of wastes, it is possible to correlate COD with BOD. COD takes only 3 hours as compared to BOD, which takes 5 days. It is useful in testing of industrial wastes. For typical untreated domestic wastes, the BOD5/COD ratio varies from 0.4 to 0.8.

Total organic carbon (TOC) – measures the organic carbon. Possible correlation with BOD. For typical untreated domestic wastes, the BOD5/TOC ratio varies from 1.0 to 1.6.

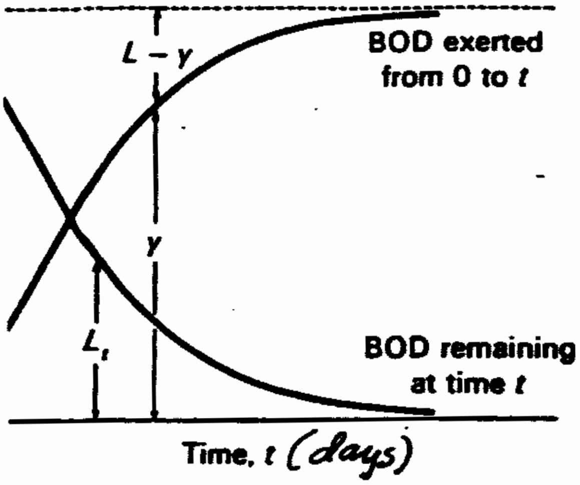


Figure 3-11 Formulation of the first-stage BOD curve.

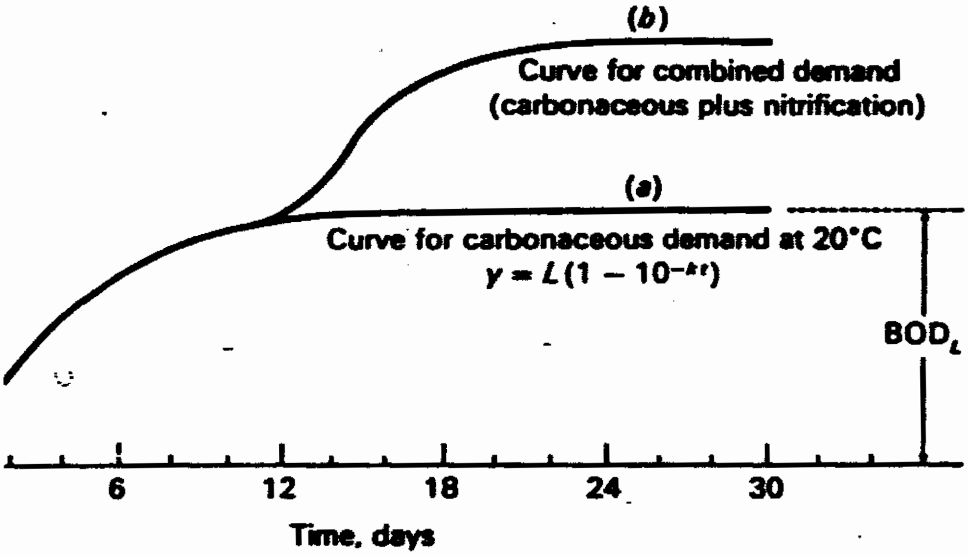
$y = L(1 - 10^{-kt})$

Typical value of K (base 10, 20°C) is 0.10 d⁻¹.

$K_T = K_{20}\,\theta^{(T-20°)}$

Typical value of θ = 1.047.

K = rate constant.



3-13 The BOD curve [32]. (*a*) Normal curve for oxidation of organic matter; (*b*) influence ication. Note: mg/L = g/m^3.

TOTAL SOLIDS

Total solids- all matter that remains as residue upon evaporation at 103 to 105 deg C.

1. Filterable solids- matter passing through a 1 micron filter.
   a. Colloidal
      (1) Organic
      (2) Mineral
   b. Dissolved
      (1) Organic
      (2) Mineral
2. Suspended solids- larger than 1 micron.
   a. Settleable solids- will settle to the bottom of an Imhoff cone in 60 minutes.
      (1) Organic
      (2) Mineral
   b. Non-settleable.
      (1) Organic
      (2) Mineral

Organic- volatile suspended solids(will volatilize at 600 deg C).
Mineral- fixed suspended solids(will remain behind as ash).

ORGANIC MATTER

1. Proteins(40 to 60%)
2. Carbohydrates(25 to 50%)
3. Fats and oils(10%)
4. Urea
5. Synthetic organics(includes surfactants, phenols, pesticides and agricultural chemicals)

HS

ble 3-5 Typical composition of untreated domestic wastewater

. values except settleable solids are expressed in mg/L)[a]

'onstituent	Concentration		
	Strong	Medium	Weak
olids, total:	1200	720	350
Dissolved, total	850	500	250
Fixed	525	300	145
Volatile	325	200	105
Suspended, total	350	220	100
Fixed	75	55	20
Volatile	275	165	80
ettleable solids, mL/L	20	10	5
iochemical oxygen demand, 5-day, 20°C (BOD_5, 20°C)	400	220	110
otal organic carbon (TOC)	290	160	80
hemical oxygen demand (COD)	1000	500	250
itrogen (total as N):	85	40	20
Organic	35	15	8
Free ammonia	50	25	12
Nitrites	0	0	0
Nitrates	0	0	0
osphorus (total as P):	15	8	4
Organic	5	3	1
Inorganic	10	5	3
Chlorides[b]	100	50	30
kalinity (as $CaCO_3$)[b]	200	100	50
'ease	150	100	50

mg/L = g/m^3.

Values should be increased by amount in domestic water supply.

Note: 1.8(°C) + 32 = °F.

THE WASTEWATER TREATMENT PROCESS

Pretreatment

- Screening
- Grit Removal
- Flow Equalization

Primary Treatment

- Primary Sedimentation
- Dissolved Air Flotation

Secondary Treatment

- Biological Treatment
  - Trickling Filter
  - Activated Sludge
  - Anaerobic + Aerobic
- Final Clarification
- Disinfection

Tertiary Treatment

- Nitrogen Removal
- Phosphorus Removal
- Reverse Osmosis
- Ion Exchange
- Activated Carbon Adsorption

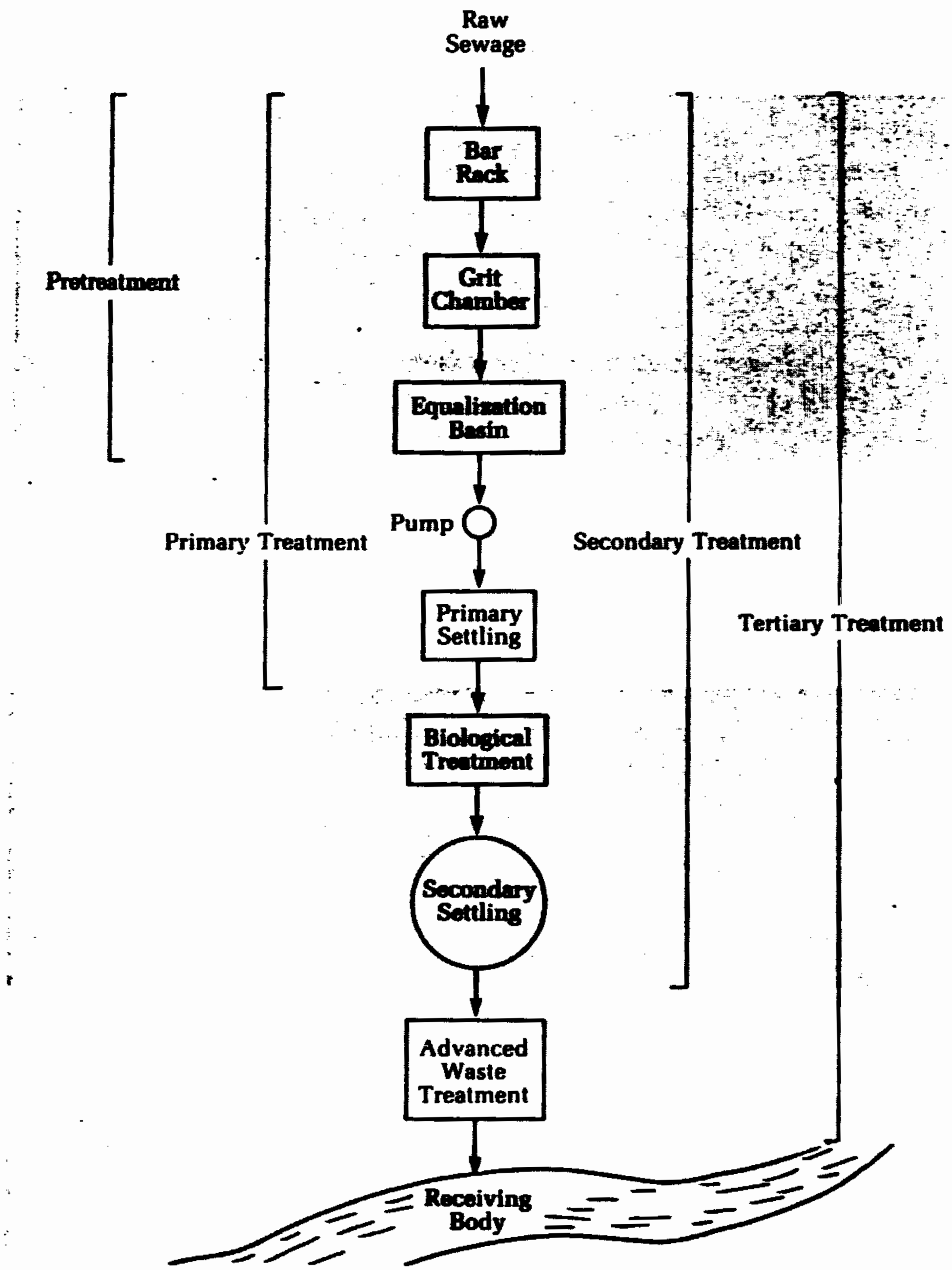


FIGURE 5-10
Degrees of treatment.

BACTERIAL DECOMPOSITION OF WASTE

Aerobic Decomposition

Molecular oxygen (O2) must be present for decomposition to proceed by aerobic oxidation. The chemical end products of bacterial decomposition are primarily carbon dioxide, water, and new cell material.
Wide spectrum of organic material can be oxidized aerobically - final end products oxidized to very low energy level - more stable end product.
High growth rate - high amounts of biological sludge generated.

Anoxic Decomposition

Some organisms will use nitrate (NO3) in the absence of molecular oxygen. This is called denitrification.
End products are nitrogen gas, carbon dioxide, water, and new cells.
High growth rate - production of sludge almost as high as in aerobic process.

Anaerobic Decomposition

Molecular oxygen and nitrate must not be present.

Two-step Process:

1. Fermentation - complex organic compounds are fermented to low molecular weight fatty acids (volatile acids).
2. Organic acids are converted to methane.

Carbon dioxide, methane, and water are major end products.
Ammonia, hydrogen sulfide, and mercaptans are also formed (odoriferous compounds).
Low growth rate - low amounts of sludge generated.

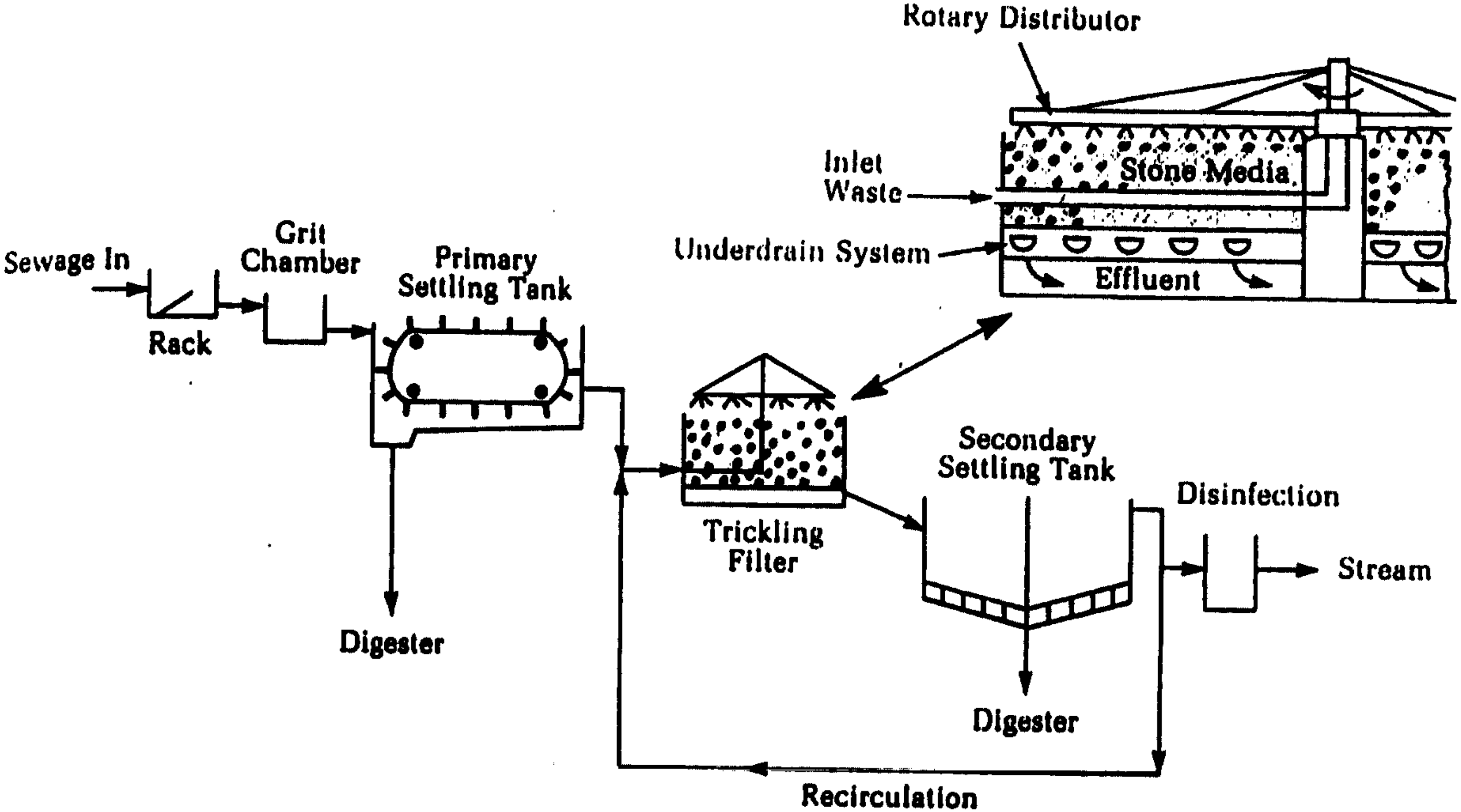


FIGURE 5-15
Trickling filter plant with enlargement of trickling filter.

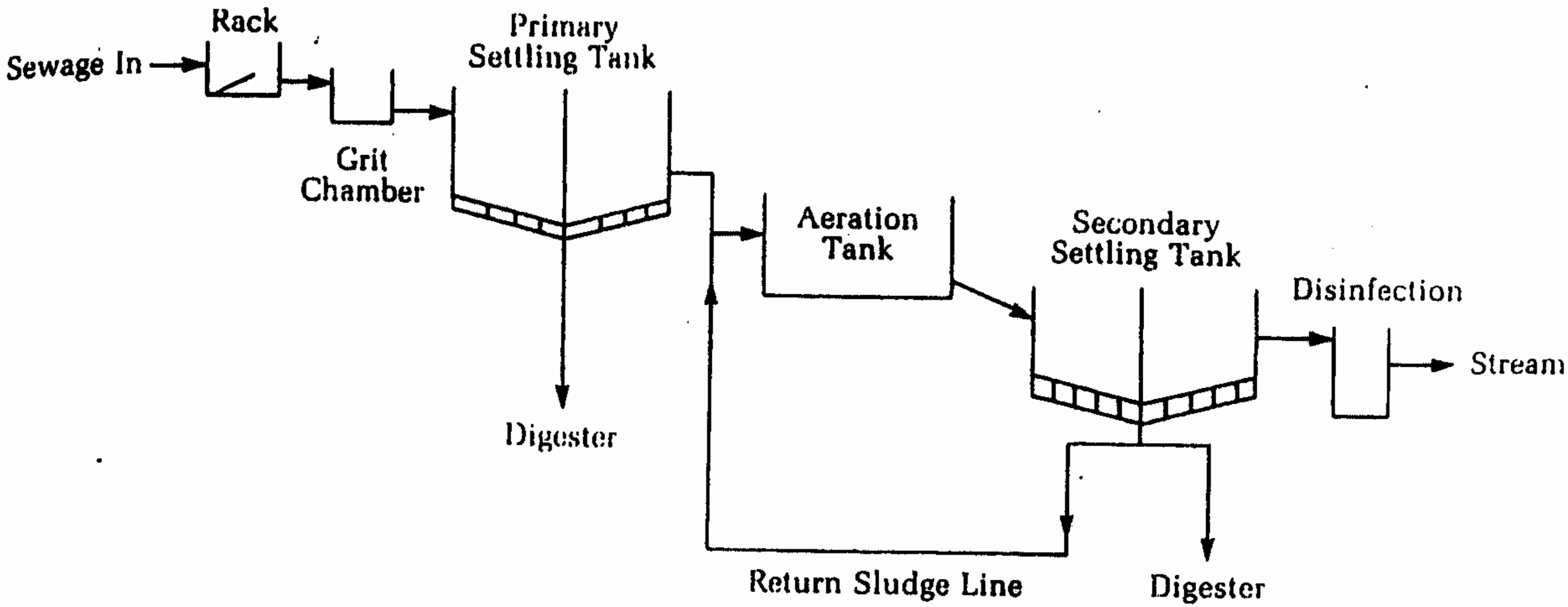
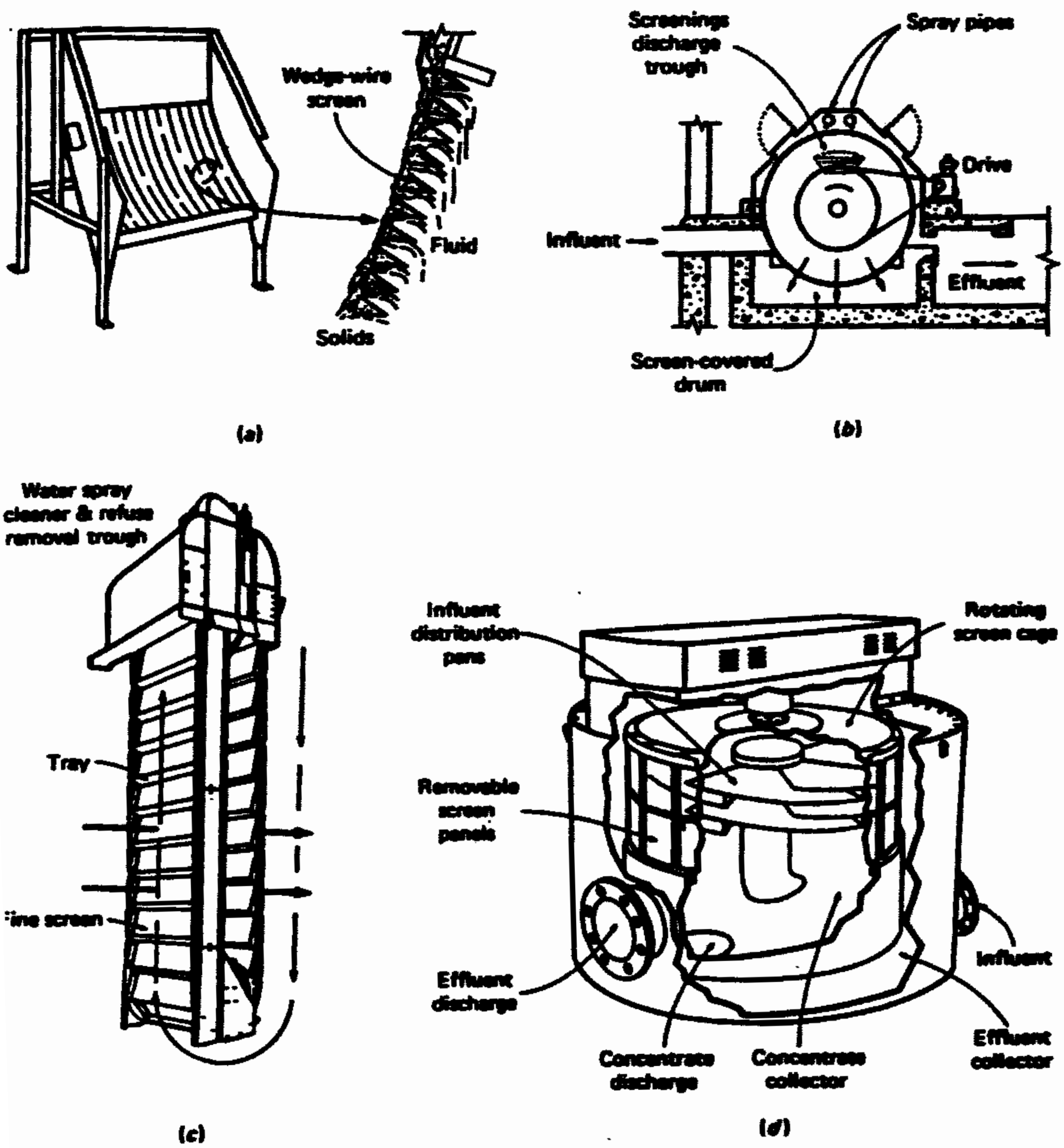


FIGURE 5-18
Conventional activated sludge plant.



gure 6-3 Typical screening devices used for wastewater treatment. (*a*) Inclined fixed screen.) Rotary drum screen. (*c*) Traveling screen. (*From FMC, Link-Belt.*) (*d*) Centrifugal screen. *rom SWECO, Inc.*)

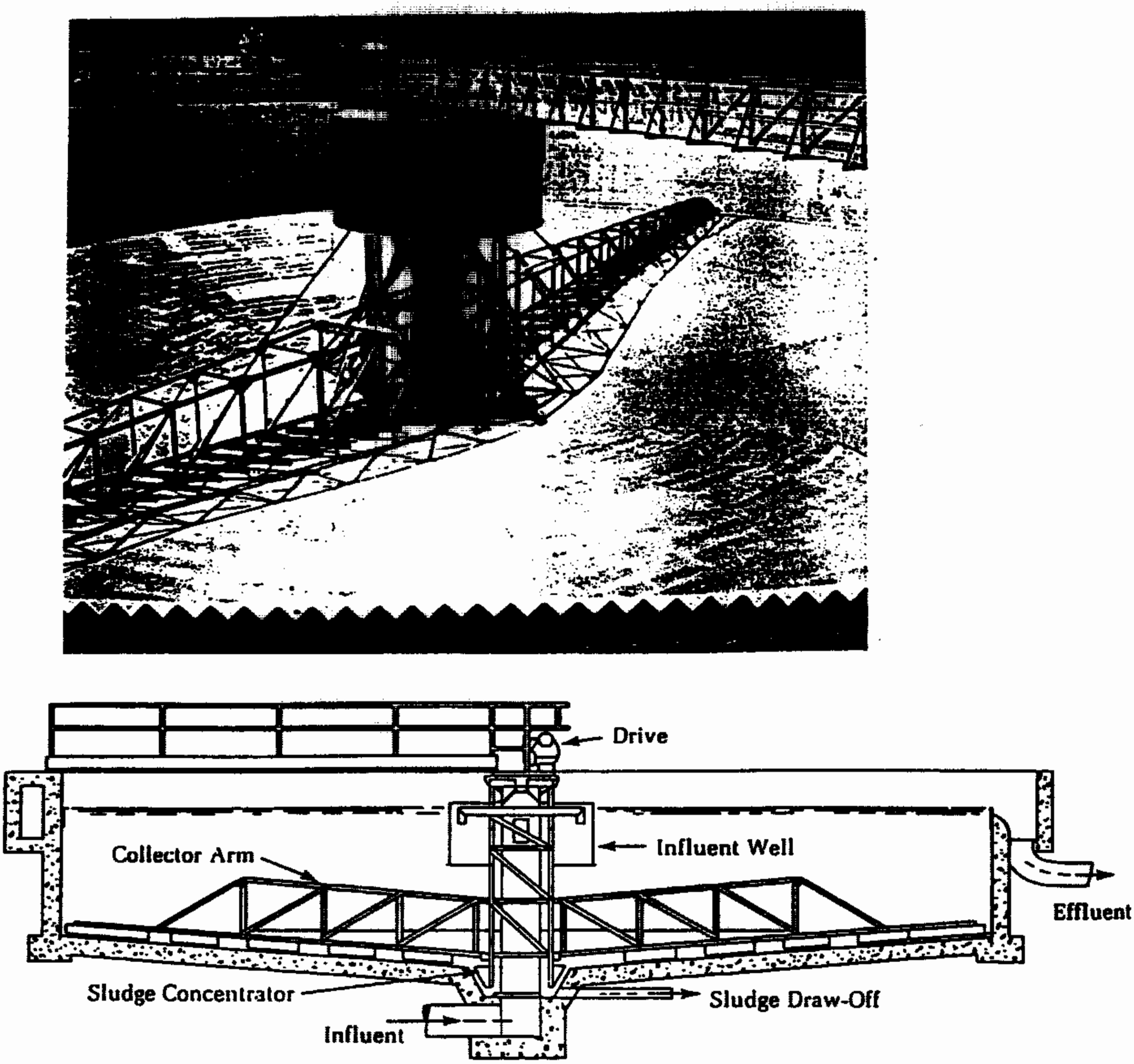
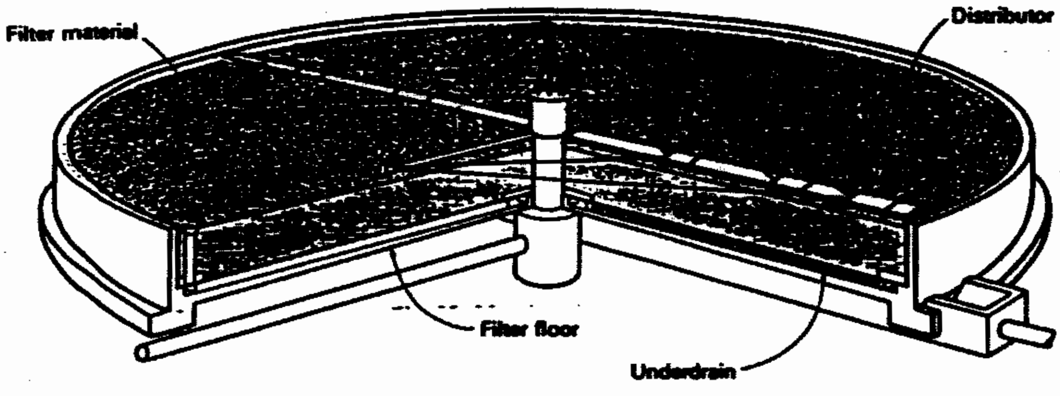
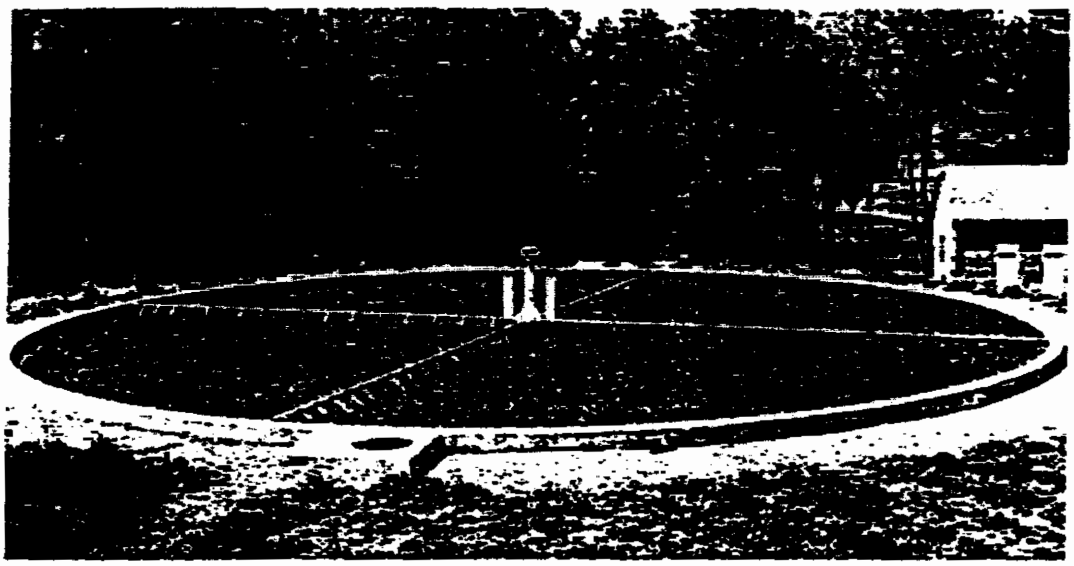


FIGURE 3-22
Photograph and schematic diagram of sludge collector for circular sedimentation basins. [*Source:* Walker Process Equipment, Inc., Division of Chicago Bridge and Iron Company (Bulletin Number 9-W-65, 1973) Aurora, Illinois.]



(a)



(b)

Figure 9-22 Trickling filters. (*a*) Cutaway view of a trickling filter. (*From Dorr-Oliver.*) (*b*) Conventional rock-filled type of filter.

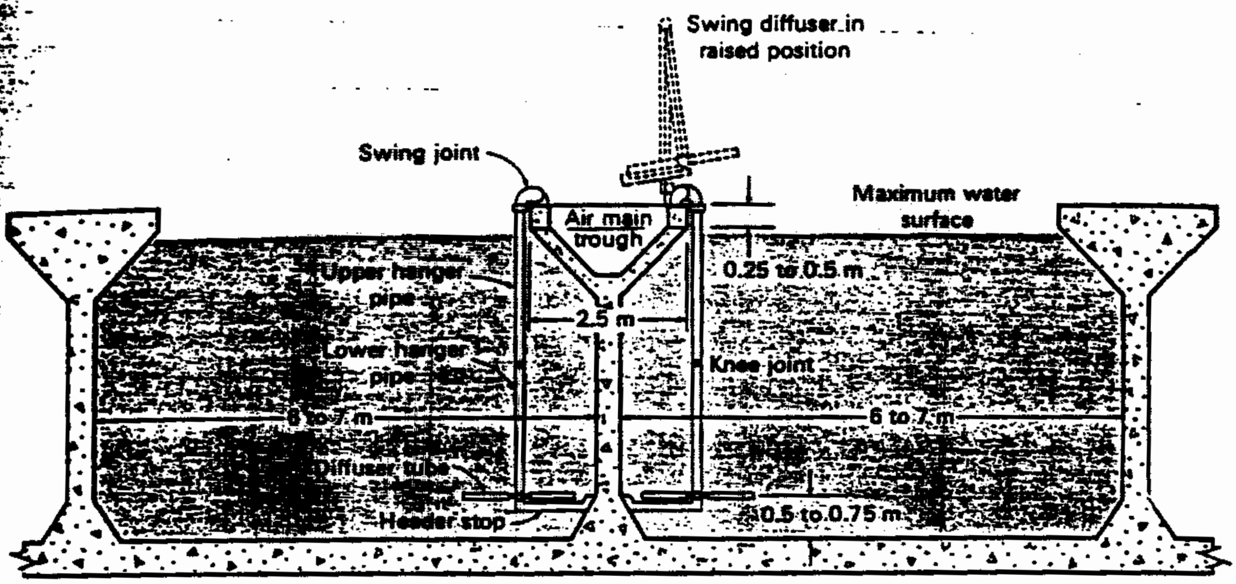


Figure 10-16 Cross section of a typical activated-sludge aeration tank with fine-bubble diffuser aeration system. Note: m × 3.2808 = ft.

SOLIDS

- Screenings
- Grit
- Primary Sedimentation Sludge
- Final Clarifier Sludge

SLUDGE HANDLING

- Thickening
  - Gravity
  - Flotation
- Anaerobic Digestion
- Aerobic Digestion
- Dewatering
  - Vacuum Filters
  - Filter Press
  - Centrifuge
  - Sand Bed Drying
  - Thermal Processing
- Disposal
  - Beneficial Reuse (Composting, etc.)
  - Land
  - Incineration
- Biogas Use

SUMMARY

1. DEFINITION OF PROBLEM

2. AVOIDANCE OF WASTE
   - POLLUTION PREVENTION
   - WASTE MINIMIZATION

3. TREATMENT OF DISCHARGES