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ASSISTANCE IN WATER AND WASTEWATER TREATMENT IN THE FOOD INDUSTRY IN THE SYRIAN ARAB REPUBLIC

PART 1

GENERAL SECTION

FINAL REPORT

ZAGREB, JULY 1989.

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PART 1

G E N E R A L S E C T I O N

1. ABSTRACT WITH GENERAL CONCLUSIONS AND RECOMMENDATIONS

The Report based on the surveys made during the field missions reviews the production processes in three food factories from the aspect of water consumption and pollution outlines the possible methods of water and wastewater treatment, and recommends the necessary minimum for water and waste-water treatment in details. Finding out that in general in all the Syrian industry, a number of problems are caused by insufficient knowledge and water-pollution control, an outline of organization and staff training is given as well as some information about the available suppliers of necessary equipment and chemicals.

Bad quality of raw process water is an acute problem in all the factories surveyed in details as well as in all the others visited. In most cases bad quality is caused by ground water pollution due to non-adequate (or mostly non-existent) sewerage and waste-water treatment. Bad quality of raw water requires (especially for food industry) a high level of water treatment. That's why the following recommendations have been made:

- It is necessary to supplement the existing water-supplying systems with adequate equipment which will enable automatic disinfection and control of process waters. Ozonization has many advantages but it requires high investment and running costs, so we recommend chlorination but fully automatized. It should be performed on the level of the General Organization which will, on its part, have to select the same type of equipment for all the factories enabling proper maintenance and supply of spare parts.

- The existing water treatment in Drekish Factory has to be supplemented by chemical treatment if the mineral water surplus cannot be used for cola preparation.

- The effluent discharges of the factories in question do not create any visible problems for the time being, but everyone is aware of the fact that pollution exists. Because of that the following recommendations have been made:

- A simple aerated buffer tank has to be installed in Oil and Soap factory. It would serve for diluting alkaline shock loads and separating floating and settlable materials. A simple solution was recommended since there are many serious problems in the existing production. But some more sophisticated in-plant modifications as well as treatment methods are suggested for the future and they will have to be taken into consideration.

- Wastes from biscuit production, although biologically degradable can create clogging in the municipal sewerage and at least simple combination of a fat trap and a settling tank is recommended.

- Wastes from Drekish factory are highly alkaline and contain organic pollutants so neutralization folowed by a biological effluent treatment is recommended.

Once again we would like to point out that we are firmly of the opinion that technical assistance establishing a central water-pollution control laboratory and training an adequate team should be provided for GOFI as well as for the whole of Syrian process industry. In our opinion the easiest way of assistance in organizing the laboratory and in staff training would be through activities connected with practical needs in certain factories where the problems are particularly severe.

2. INTRODUCTION

2. INTRODUCTION

According to the Proposal Request and Terms of Reference No. P88/36 from 22 July 1988, the effluent discharge of Syrian food industries can no longer be tollerated without treatment.

The Drekish Soft Drink Factory, the Tartus Peanut Factory and the "Ghraoui" Biscuit Factory were marked as especially acute problems.

The immediate objective was to evaluate the present situation and provide advice on specific measures to be taken to minimize enviromental pollution caused by effluent discharge.

The development objective of the Report was to recommend modifications of the processes with a view to reduce pollution at its source and to prepare documentation which will serve as the basis for inviting offers for engineering of waste water treatment plants.

During the First Field Mission beetwen 9 th and 30 th of Dec. 1988. (see First Interim Report chap. 2.1.) we have found out that the most acute problems exist in the Drekish, the "Ghraoui" and the Arab Oil & Soap Factory - Jeremana and that they consist mainly of the contamination of water supplying systems.

The pollution of enviroment caused by effluents discharge does exist more or less in all the factories but for the time being does not cause major problems. However, this has to be seriously taken into consideration because Syria, as all the other countries, is facing problems of polluted surface and ground waters caused by inadequate sewerage systems and lack of wastewater treatment plants.

Because of that we decided to evaluate the problems on the basis of our investigations and the results of laboratory analyses which we initiate on sites, and to recommend modifications and/or installing new plants for water treatment as well as waste water treatment.

In general, food industry uses water as an ingredient in the finished product, as a buoyant transporting medium, as a cleaning agent, as a coolant and a source for obtaining steam for heating and power production. Quality requirements for industrial process waters vary greatly according to the type of industry and the function of water.

The literature contains numerous articles concerned with problems resulting from the presence of impurities in waters used for industrial purposes. Several of these publications contain recommendations pertaining to the amounts of certain impurities that may be present in water utilised by a given industry or industrial processes. The publication "Water Quality Criteria" which presents an extensive review of the subject, has been the principal source of information shown in Chapter: 3.1.1.

In some cases food industry may require water of biological quality exceeding that of drinking water.

Also, in Chapter 3.1.2. we present "Extracts from the Syrian National Standards for Drinking Water and Non-Alcoholic Beverages".

The ultimate disposal of waste water has been and continues to be one of the most difficult problems in the field of environment protection. Currently, the field of waste water engineering is in a dynamic period of development in the whole world. In Syria, as in many other Developing Countries regulations and standards for waste water treatment and discharge are not strictly defined but everyone is aware of the fact that something has to be done.

Searching for waste water standards in Syria we have found data and information in "Dissertation about pollution of the Barada River" in which some standards are recommended (see Chapter 3.2.2.). Although, GOFI agreed that those standards can be used as meritory we shall present a comparison with standards in other countries - see Chapter 3.2.1.

Being aware of the fact that in general a number of problems are the consequence of unsufficient knowledge and water-pollution control in all process industries, we shall give herein some recommendations for establishing a control laboratory as well as an outline of the programme for staff training (see Chapter 3.3.).

In Chapter 3.5. and throughout the intire text an attempt is made to inform the reader of many available suppliers of different types of equipment and chemicals. However, such listing does not constitute either endorsement or recommandation for use by the authors.

To make the Report more understendable, the problem of each factory is treated separately.

3. QUALITY STANDARDS FOR WATER AND WASTEWATER

3.1. WATER

3.1.1. GENERAL VIEW

RANGES IN RECOMMENDED LIMITING CONCENTRATIONS FOR FOOD INDUSTRY PROCESS WATERS

SOURCE: Mc Kee, J.E., and H.W.Wolf; WATER QUALITY CRITERIA, California State Water Quality Control Board Publication 3-A,1963.

USE / CONCENTRATION	FOOD EQUIPMENT, WASHING	FOOD PROCESSING, GENERAL	CARBONATED BEVERAGES	BAKING
Turbidity, units	1	1-10	1-2	10
Colour, units	5-20	5-10	5-10	10
Taste and oder threshold	none	low	none-low	none-low
Dissolved Solids	850	850	850	a
Hardness, as CaCO3 (o dH)	10 (0,6)	10-250 (0,6-14)	200-250 (11-14)	
pH-units				
Chlorides, as Cl	250		250	
Sulphates, as SO4			250	
Iron, as Fe		0,2	0,1-0,2	0,2
Manganese, as Mn		0,2	0,2	0,2
Mn + Fe	0,1	0 2-0,3	0,1-0,4	0,2
Fluoride, as F	1,0	1,0	0,2-1,0	
Other requirements	Potable, organic mater infinitesimal	Potable	Potable, COD 1,5, oranic matter, algae and protozoa none	Potable

(Except as noted, units are in mg/l)

3.1.2. SYRIAN STANDARDS

3.1.2.1. EXTRACTS FROM THE SNS STANDARDS No. 45/1973 REFERRING TO DRINKING WATER QUALITY

1. INTRODUCTION

This Standard refers to physical, chemical, bacteriological and toxic properties of drinking water as well as water used in food industry.

2. PHYSICAL PROPERTIES

2/1. Drinking water must be clear, colourless, odourless and tasteless.

If water is coloured and not clear, the following limits have been allowed:

	Permissible limit	Only in cases where there is no water of better quality
Colour	5 colour units Co/Pt Method	50 colour units
Turbidity	5 JTU Johnson turbidity units	25 JTU

2/2. Radioactivity

α - emitters < 10^{-9} μc/ml
β - emitters < 10^{-8} μc/ml

3. CHEMICHAL PROPERTIES

They refer to the contents of elements and salts in water which affect health and drinking water quality.

Substance	Symbol	Permissible limit mg/l	Only in cases where there is no water of better quality mg/l
Residue		500	1500
Hardness	as CaCO3	300	650
pH		7-8,5	6,5-9,2
Iron	Fe	0,3	1,0
Manganese	Mn	0,1	0,5
Copper	Cu	1,0	1,5
Zinc	Zn	5,0	15
Magnesium	Mg	50	150
Calcium	Ca	75	200
Sulphate	SO4	200	400
Chloride	Cl	200	600
Nitrate	NO3	15	40
Fluoride	F	0,6	1,5
Carbon dioxide, free	CO2	0,3-0,5	1 a)
Ammonia	NH3	None	
Nitrite	NO2	None	None

a) Can be of different value if approved by the Ministry of Health.

BOD5 - must be zero

COD - The maximum value 1-2 mg O2/l in drinking water

4. TOXIC PROPERTIES

The maximum allowed concentration of toxic substances is as follows:

Substance	Symbol	Permissible limit mg/l
Lead	Pb	0,05
Selenium	Se	0,01
Arsenic	As	0,05
Chromium (+6)	Cr	0,05
Cyanide	CN	0,01
Phenolic Compounds	(as Phenol)	0,001
Cadmium	Cd	0,01

5. BACTERIOLOGICAL PROPERTIES

5/1. Treated waters

5/1/1. The most probable number of coliform bacteria must not exceed 1/100 ml. This value refers to the tested sample, not to the spring.

Ninety percent of the total number of tested samples must have the maximum values mentioned above in the period of one year.

5/1/2. The total number of bacteria must not exceed 1000/ml.

5/1/3. Water must not contain bacteria or amoeba affecting diseases.

5/1/4. Echerichia coli must not be present.

5/1/5. Water must not contain fecal streptococcus.

5/1/6. Water must not contain W. Chlostride.

5/2. Untreated waters

The most probable number of coliform bacteria must not exceed 10/100 ml. This value refers to the tested sample and not to the spring. 90 % out of 100 samples must not exceed the values mentioned above, over the period of one year.

5/2/2. All regulations prescribed for treated waters (5/1/2. to 5/1/6.) are appliable to untreated waters.

3.1.2.2. EXTRACTS FROM THE SNS STANDARDS No. 47/1976 REFERRING TO THE QUALITY OF WATER USED IN CARBONATED BEVERAGES PRODUCTION

1. INTRODUCTION

This Standard refers to the quality of carbonated drinks - either artificially or naturally carbonated.

2. DEFINITION

2/1. Natural Carbonated drinks

Beverages are prepared by introducing CO2 under pressure in the natural fruit juice with addition of sucrose or any other additive, according to the Article 3.12. The quantity of the introduced gas must not be lower than the following ratio: volume of gas : volume of water = 2 : 1. It must be introduced under the specified temperature and pressure.

2/3. Fruit beverages carbonated artificially

These beverages are prepared by introducing CO2 under pressure into water, with the addition of sucrose, fruit flavour and other additives, regulated by the Article 3.12. The quantity of the introduced gas must not be lower than the following ratio - volume of gas:volume of water = 2:1.

2/4. Carbonated water

This water is prepared by introducing CO2 under pressure. The quantity of the introduced gas must not be lower than the ratio: volume of gas:volume of water = 3:1 the specified temperature and pressure. Na2CO3 can be added up to 1 g/l.

3. PROPERTIES AND CONDITIONS

3/1. Water used in the production line must correspond to the SNS Standard No 45/1973.

3/2. Sugar used in production of natural and artificial carbonated drinks must be sucrose, the quantity added must not be lower than 100 g/l.

3/3. CO2 must not contain any organic or anorganic substances (NO_2, SO_2, H_2S). It must be tasteless and odourless.

3/4. All the additives used must correspond to the Standards. They must be kept in stainless steel tanks, tightly closed, ensured in special warehouses, with labels noticeably attached to the tanks.

3/5. The final product must not exceed the quantity of:

AsO_3	0,1 ppm
Pb	0,1 ppm
Cu	1,5 ppm
Fe	0,5 ppm

3/6. The presence of caffeine (added directly or indirectly, within any of the additives) must not exceed 200 ppm.

3/7. The total number of bacteria in 1 ml of the product must not exceed 200 ppm (culture developed on the Agar colony at the temperature of 37 oC in 24 Hours).

3/8. The most probable number of coliform bacteria in the final product must not exceed 1/100 ml.

3/9. The amount of fungi and yeast must not exceed 2 per ml in the final product.

3/10. The final product must not contain Escherichia coli. These microorganisms do not reproduce in gaseous water if pH < 4 or if the volume of CO2:volume of water = 2:1.

3/11. Carbonated soft drinks must not contain:

3/11/1. Waste and suspended substances.

3/11/2. Soaps or substances containing soap.

3/11/3. Acids with the exception of H_3PO_4 and H_2CO_3.

3/11/4. Saccharin, dolcin and cyclic compounds.

3/12. Carbonated soft drinks can contain:

3/12/1. Natural fruit juice and industrial flavour, odour and colour additives.

3/12/2. Benzoic acid or benzoic acid salts can be added up to 100 ppm.

3/12/3. The following organic acids can be added:

- lactic acid
- citric acid
- tartronic acid
- ascorbic acid/vitamin C

Content of these acids is limited up to 200 mg/l.

3/12/4. Phosphoric acid up to 60 ppm is added to soft drinks of cola type or any other drinks containing caffeine.

3/13. Bottling carbonated drinks.

3/13/1. Carbonated soft drinks are bottled into glass bottles. The glass must undergo the following regulations:

- it must be colourless or coloured glass
- resistant to washing substances
- smooth and perfectly manufactured bottle brims.

3/13/2. The equipment and bottling lines must be automatic, well cleaned and washed. Bottles are to be washed in alkaline substances (concentration of 3 5 with at least 60 % of NaOH) for five minutes and at the temperature of 55 oC. In the next stage, bottles must be well rinsed with clean water until the neutral reaction to phenolphthalein paper appears.

3/13/3. Bottling must be carried away automatically in strictly hygienic conditions.

3/13/4. Bottles must be filled to the level 50 - 5 mm from the top of the bottle.

3/13/5. Bottles are automatically and hermetically closed with new, clean and stainless corks.

3/13/6. Corks are branded by a trade-mark.

3.2. WASTEWATER

3.2.1. GENERAL VIEW

3.2.1.1. CRITERIA FOR DISCHARGE INTO THE MUNICIPAL SEWERS

Prescriptions in mg/l except for temperature and pH value	Allemagne Germany	Australie Australia	Belgique Belgium	Danemark Denmark	France	Grande-Bretagne Great Britain	Hollande Netherlands	Hongrie Hungary	Italie Italy	Japon Japan	Pologne Poland	Suisse Switzerland
Temperature oC	< 35		< 45	< 35	< 30	40	30					< 40
pH value	6,5-10	> 6,8	6,0-9,5	6,0-9,0	6,5-9	6-10	6,5-10	6,5-10	6-10	5,7-8,7	6,5-9	6,5-9,0
BOD 5		< 600		< 125	< 500 - 1000	< 750 - 1000			< 500		< 700	
COD						3000 - 6000					< 1000	
Nitrogen				< 10	< 150				< 50			
Chrome Cr 3+	< 4			< 1		< 5-10	< 4 - 10	< 50	< 2		< 0,2 §	< 2
Sulphides 2-	0			< 10		< 5-10		< 1	< 2		< 3 §	< 1
Phenols				< 1				< 80			< 90 §	< 5
Oil and grease			< 500			< 0-500		< 60	< 50			
SS		< 600	< 1000 (1 cm in size)	< 150	< 500	500 - 1000			< 500	< 300	< 330	
Sulphate						1000 - 1200	300	400			300	300

§ After being mixed with domestic sewage

3.2.1.2. CRITERIA FOR DISCHARGE OF WASTE WATER INTO SURFACE WATERS

	Brazil	Denmark	France	W-Germany	Hungary	India	Italy	Netherlands	Switzerland	S-Africa	UK	USA
pH units	5,0-9,0	6,5-8,5	5,5-8,5	6,5-8,5	5,0-10,0	5,5-9,0	5,5-9,5	6,5-8,5	6,5-8,5	5,5-9,5	6,0-9,0	6.0-9,0
Temperature oC	40	30	30				30	25	30			
BOD 5 mg/l	60		40-200	20-25		30	250	5	20	10	20-130	40
COD mg/l				200-250	50-150	250	500					
Susp. solids mg/l		30	30-100			100	40	80	20	25	30-50	60
Sett. solids mg/l	1,0			0,3								
Sulphide mg/l	1,0	2,0	1,0	1,0	0,01-5	2,0	2,0		0,1	1,0		
Chrome (III) mg/l			0,1	2,0	2,0-5,0	2,0	4,0		2,0		2,0-5,0	
Chrome (VI) mg/l				0,5	0,5-1,0		0,2		0,1	0,05	0,1	
Chrome total mg/l		0,2						0,05		0,5		1,0
Chloride mg/l						1000	1200	200			4000	
Sulphate mg/l		300					1000	150				
Ammonia mg/l		2,0	15-18	5-10	2,0-3,0		15			10	100	
TKN mg/l		5,0	10-60					3,0				
Oil/grease mg/l	20	5			0-50		30		20	2,5		

3.2.2. SYRIAN STANDARDS

3.2.2.1. EXTRACTS FROM THE WASTE WATERS STANDARDS PRIOR TO THEIR DISPOSAL INTO RIVERS

SOURCE: A.Assad; DISSERTATION ABOUT POLLUTION OF THE BARADA RIVER, Damascus 1983.

1. The waste waters temperature must not exceed 35 oC.

2. pH value must not be lower than 6, nor may it exceed 9,5.

3. The total amount of soluble substance must not exceed 200 mg/l, on condition that the quantity of SO4 and Cl does not exceed 400 mg/l.

4. H2S must not exceed 1 mg/l, while the quantity of oil and fats must not exceed 10 mg/l.

5. At temperature of 20 oC BOD5 must not exceed 40 mg O2/l.

6. Cyanides must not exceed 0,1 mg/l, ammonia (NH3) must not exceed 10 mg/l.

7. Hydrogen phosphate (HPO4) must not exceed 40 mg/l, while the floating substance must not exceed 80 mg/l.

8. The effluent must not contain any substances harmful to the river fauna, or radioactive substances.

9. Waste waters from infectious hospitals, medical institutions, slaughter-houses, veterinary stations and similar institutions must not be disposed of into rivers without previous disinfection.

10. If waste waters have been disinfected before being disposed of, the highest content of the residual chlorine can be 0,5 mg/l twenty minutes after it has been disinfected.

NOTE 1 Waste waters exceeding the above mentioned limits must not be disposed of into rivers.

NOTE 2 Waste waters disposed of into rivers must not result in the quality lower than that one prescribed by Standards for rivers, 100 m diwnstream from the place where the waste waters are disposed of.

3.2.2.2. EXTRACTS FROM THE STANDARDS ON RIVER WATER QUALITY 100 M. DOWNSTREAM FROM THE LOCATION OF WASTE WATERS

SOURCE: D.Assad; DISERTATION ABOUT POLLUTION OF BARADA RIVER, Damascuc 1983.

1. The river water temperature must not exceed 4 oC provided that the river water temperature does not exceed 30 oC during summer.
2. pH values must not be lower than 6,5 and must not exceed 9.
3. Oil stains of floating substances must not be present.
4. The total amount of soluble substances must not exceed 1000 mg/l (on condition that sulphates do not exceed half of the mentioned value and chlorides one third of the value).
5. No chlorine odour must be felt (if the effluent before disposal has been disinfected by chlorine or chlorine compounds).
6. Dissolved oxygen must not be lower than 5 mg/l.
7. BOD5 must not exceed 5 mg O2/l.
8. The maximum allowed quantity of elements or compounds that makes the river water unsuitable for drinking, industrial use, irrigation or fish life, has beer given in the following table:

Substance:	Permissible limit mg/l
Iron (Fe)	10
Copper (Cu)	1

Substance:	Permissible limit mg/l
Magnesium (Mg)	150
Zinc (Zn)	3
Organic solvents and easily volatile petroleum derivatives	1
H2S	None

10. Maximum alloved concentration of substances affecting the health of children

Substance:	Permissible limit mg/l
Nitrate (NO3)	30
Fluoride (F)	1,5

11. Maximum allowed concentration of toxic substances affecting the health of adults

Substance:	Permissible limit mg/l
Phenol	0,01
Arsenic (As)	0,05
Cadmium (Col)	0,01
Chromium (Cr 6+)	0,05
Cyanide (CN)	0,1
Lead (Pb)	0,05
Selenium (Se)	0,01
D.D.T.	None
Hydrazine	None
Insecticides	None

3.2.2.3. WATER STANDARDS FOR:

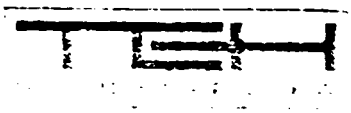
A. Irrigation Water
B. Bathing Water
C. Fishing Water

NOTE: Except as noted, units are in mg/l

SOURCE: D, Assad; DISSERTATION ABOUT POLLUTION OF THE BARADA RIVER, Damascuc 1983.

STANDARD FOR SUBSTANCES	IRRIGATION WATER	BATHING WATER	FISHING WATER
	Permissible limit		
Temperature, oC			25
pH	6,8-8,5	6-9	5,5-8,6
BOD5	4	4	4
Dissolved oxygen	4-6	6	4-6
Organics, above 650 oC	10		
Dissolved solids	900		
Conductivity, mhos/cm	1200		
Organic nitrogen	0,45		0.45
Ammonia	1,2		1,2
Mg	10		
K	7		
Al	5		
As	0,1	0,2	
Be	0,1		

STANDARD FOR SUBSTANCES	IRRIGATION WATER	BATHING WATER	FISHING WATER
	Permissible limit		
B	0,75		
Cd	0,01		
Cr	0,1	0,05	
Co	0,25		
Cu	0,2		
Fe	5		
Pb	5	0,1	
Li	2,5		
Mn	0,2		
Hg		0,001	0,01
Mo	0,01		
Ni	0,2		
Se	0,02	0,5	
Ag			0,04
U	0,1		
Sn	2		0,3
SO4	250		
Cl	150		
NO3	13		13
S 2-			0,5
CN		0,05	0,02
Chlorine	1		
Phenol		0,01	2
Coliform bacteria numbers per ml		100	



4. AN OUTLINE OF WATER-POLLUTION CONTROL, DEVELOPMENT AND STAFF TRAINING

4. AN OUTLINE OF WATER-POLLUTION CONTROL DEVELOPMENT AND STAFF TRAINING

4.1. INTRODUCTION

It is obvious that many problems in water and waste-water treatment are generated from the fact that existing staff in food industry is not trained enough in water pollution control and operation of treatment plants. In the same time it woud be very difficult to establish a capable multidisciplinary team in every factory.

Because of that we woud like to suggest the establishment of a team on the level of GOFI or even Ministry for Industry which would be able to cope with all the problems of water and waste-water treatment.

The team would have to be able to do the following:

1. Interprete ordinances and regulations.
2. Establish monitoring programs for recording of water and wastewater characteristics.
3. Interpret data and report emission levels of specified pollutions to regulatory agencies.
4. Direct in-plant pollution abatement programs and obtain the necessary permits.
5. Coordinate plant activities with consulting engineers or the company engineering department.
6. Coordinate evaluations of plans for treatment systems, process changes, or product recovery systems.
7. Gather data for design of water and waste water treatment or reuse systems.

8. Keep operating departments and management informed of possible or a probable economic effect of new or proposed regulations for effluent discharges.

9. Prepare statements for various government agencies on the enviromental impact of present or proposed plant operations.

10. Handle company public relations work on enviromental issues.

11. Instruct the operating staff of a particular plant in every possible aspect of practical operation.

To perform the mentioned tasks the team will need to have a thorough understanding of the technology of particular industry as well as basic working knowledge (or support from consultants) in the following subjects:

1. Chemistry

   - Interaction of various waste constituents
   - Chemical equilibria and kinetics
   - Qualitative and quantitative analytical methods for inorganic and organic compounds in water
   - Measurement of water physical characteristics

2. Environmental health

   Acute and chronic toxicity effects of elements and compounds on various forms of flora and fauna including man and knowledge of which compounds may be classified as carcinogens, mutagens, or teratogens.

3. Aquatic biology

   The significance of various forms of aquatic life as characteristic of certain types of impurities in water.

4. Water quality requirements

   Water quality need for various beneficial uses.

5. Hydrology and geology

   Surface and groundwater resources - use and contamination.

6. Monitoring techniques and technology

   - Hydraulics - flow measurement
   - Sampling techniques
   - Sample preservation and handling
   - Automatic instrumental or laboratory analyses
   - Data management

7. Water and wastewater treatment technology and economics

   Conditioning or renovating water for specific process needs, reuse or discharge

8. Environmental laws

   Local, state, and federal.

9. Management skills

   Optimum utilization of company personel, consultants, and government services.

Besides knowledge the team will need adequate laboratory facilities and field equipment.

4.2. LABORATORY FACILITIES AND FIELD EQUIPMENT

Because of space limitations it is not possible to list here all the neccesary laboratory equipment and analitical methods.
During our Field Mission we visited Water Laboratory in "BOUKEIN Mineral Water Filing Factory" which is capable to perform all the necessary water and waste-water analyses, so our suggestion is to use it (or a similar lab.) for detailed and precise analyses in accordance with internationally accepted methods (for example: "STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, (17 th Edition 1989), Publication Office APHA, AWWA, WPSF, New York).

In addition, it will be necessary to purchase an adequate vehicle equiped with sampling equipment, a refrigerator, instruments and test-kits for field measurements. Possible suppliers for such equipment:

- Samplers: - "Quality Control Equipment Co"
  P.O. Box 2706, Des Moines, Iowa 50315, USA
  - "Sirco Controls Limited", Seatle, Wash 98119
  - "Sanford Products Corp.", Mineapolis, Min. 55402, USA
  - RIZ, 41000 Zagreb, Bozidareviceva 13, YUGOSLAVIA
- Instruments and test-kits:
  - "E. Merck" Frankfurterstr. 250, D-6100 Darmstat 1
  - "HACH", B.P. 51, 5000 Nammur 1, Belgium
  - "Strohleim GmbH" P.O. Box 1460, D-4044 Kaarst 1

4.3. STAFF TRAINING

After our collecting information during two Field Missions we are firmly of the opinion that technical assistance in the establishment of a control laboratory and staff training in water pollution control should be provided for Syrian industry.

In our opinion, the easiest way to train staff could be through expert assistance in the following practical activities:

1. The establishment of a small team (3-5 chemical, biological, mechanical and civil-sanitary engineers) who will later spread their knowledge to the others involved in water-pollution problems.

2. The establishment of a new specialized water-pollution control laboratory or as recommended under 4.2.

3. Training of the team in conducting analyses and tests of parameters pertaining to factories in question.

4. Chosing of a certain number of factories which can serve as a representative example for water and waste-water treatment.

5. Collecting necessary data about water pollution through field and laboratory tests, and interpreting them in accordance with needs for water and waste-water treatment.

6. Preparing Case Studies (or Preliminary Designs) for water and wastewater treatment in the particular factories which would serve as a basis for tender documents.

7. Practical training of the team on the existing treatment plants (in Syria or abroad).

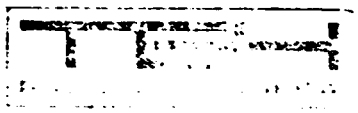
8. Together with the team, organizing and conducting a short (3-5 days) course in water-pollution for participants from factories and enviroment protection agencies.

5. GENERAL LIST OF EQUIPMENT SUPPLIERS

SUPPLIER	REF. No.	SCREENS	PUMPS - Effluent	PUMPS - Sludge	PUMPS - Dosing	BLOWERS/COMPRESSORS	LEVEL CONTROLS	pH-CONTROLLERS	FLOW METERS/RECORD	AGITATORS	SEDIMENTATION UNITS	FLOTATION UNITS	BIO DISCS	ION RESIN	ACT. CARBON	OZONIZATORS	CHLORINATION UNITS	DOSING UNITS
A.B.S.	1		*	*														
ALLDOS	2				*			*	*	*							*	*
ALLWEILER	3			*														
AMES CROSTA	4												*					
AQUAPURE	5											*						
AUTOROL	6																	*
BAYER	7													*				
BRAN & LUBBE	8				*													
CALGON	9														*			
CHEMVIRON	10														*			
CHRIST	11															*		
CLAESSEN	12		*	*			*											
CLOW	13		*		*						*	*						
COMPAIR	14					*												
COS. ME	15	*																
DE CARDENAS	16	*									*							
DEL MONTE	17			*														
DONKIN	18					*												
DORR-OLIVER	19	*	*	*							*							
DOW CHEMICAL	20													*				
EKATO	21									*								
EMU	22		*	*														
ENV. ENG.	23	*									*	*						
ENVIROTECH	24		*	*					*		*	*						
FENVICK	25	*									*							
H.D.W.	26									*								
HIDROMETAL	27	*	*	*						*								
HURNER	28															*		
JEKLO	29															*		
JENSEN	30									*								
MONO	31			*														
NETZSCH	32			*														
PRO MINENT	33				*			*								*	*	*
ROBUSCHI	34		*	*		*												
ROHM AND HAAS	35													*				
TEH-PROJEKT	36	*					*					*						
T.M.R.	37									*								
TRAILIGAZ	38															*		
WALLACE & TIER	39																*	*
WHITEHEAD	40	*		*		*					*							

Ref. No.	ADDRESS
1.	ABS PUMPS LIMITED Devereux Works/Station Rd/ Coleshill/BIRMINGHAM B46 1 JT U.K.
2.	ALLDOS Rertzstrasse 85 D-7507 PFINZTAL-SöLLINGEN W. GERMANY
3.	ALLWEILER SEEBERG PUMPEN GMBH Kirchhellner Ring 77-79 Postfach 1220 D-4272 KIRCHHELLEN W. GERMANY
4.	AMES CROSTA BABCOCK LTD. Heywood/Lancashire OL10 2DX U.K.
5.	AQUAPURE SYSTEMS LIMITED 14 Holton Heath Industrial Estate/Holton Heath POOLE/Dorset BH16 6LG U.K.
6.	AUTOROL BIO-SYSTEM DIVISION 5855 N.Glen Park Road MILWAUKEE, WISCONSION 53209 U.S.A.
7.	BAYER Lewatit LEVERKUSEN W. GERMANY
8.	BRAN & LUBBE LIMITED Scaldwell Road/BRIXWORTH/ Northants NN6 9EN U.K.
9.	CALGON P.O. Box 717 PITTSBURG, PA 15230 U.S.A.
10.	CHEMVIRON CARBON Via G.Pacini 20 20131 MILANO ITALY
11.	CHRIST AG CH-4147 AESCH/BL Hauptstrasse 192 SWITZERLAND
12.	CLAESSEN & CO. LTD. Ironbridge Road/West Drayton Middlesex UB7 8JA U.K.
13.	CLON CORPORATION W.T.D. P.O. Box 03/ 56 Industrial Road FLORENCE, KY 41042 U.S.A.
14.	COMPAIR INDUSTRIAL LTD. P.O.Box 44/Reavell Works/ Ranelagh Road/IPSWICH 1 P2 0AE U.K.
15.	COS. ME S.N.C. Via G.Maurisio 36 36100 VICENZA ITALY
16.	DE CARDENAS S.P.A. Via Melchiorre Gioia 72 20125 MILAN ITALY
17.	DEL MONTE (ANGELO DEL MONTE) Via Langhirano 134 43100 PARMA ITALY
18.	DONKIN BRYAN DONKIN COMPANY LIMITED Derby Road CHESTERFIELD S40 2EB U.K.
19.	DORR-OLIVER COMPANY LTD. Norfolk House/ Wellesley Road/ CROYDON CR9 2DS U.K.
20.	DOW CHEMICAL USA MIDLAND, MICHIGAN 48640 U.S.A.
21.	EKATO P.O. Box 1110/20 D-7860 SCHOPFHEIM W. GERMANY
22.	ENU PUMPS (U.K.) LTD Fairfield Estate/ Reading Road/ HENLEY - ON - THAMES OXON RG9 1DX U.K.
23.	ENVIRONMENTAL ENG. LTD. Little London Spalding Lincolnshire PE11 2JE U.K.
24.	ENVIROTECH CORPORATION (EIMCO PROCESSING MACHINERY DIVISION) 669 West 2nd South SALT LAKE CITY UTAH 84110 U.S.A.
25.	FENWICK Strada nuova Valassina 324 20035 LISSONE (MI) ITALY
26.	H.D.W. P.O.Box 111480 D-2000 HAMBURG W. GERMANY
27.	HIDROMETAL Gorenjska cesta 61234 MENGES YUGOSLAVIA
28.	HURNER ITALIA Corso Buenos Ayres 64 20124 MILANO ITALY
29.	JEKLO Pogacnikova 13 62342 RUSE YUGOSLAVIA

Ref. No.	ADDRESS
30.	JENSEN Box 45368 TULSA Oklahoma 74145 U.S.A.
31.	MONO PUMPS LIMITED Arnfield Works/ Martin Street/Audenshaw/ MANCHESTER M34 5JA U.K.
32.	NETZSCH Liebigstrasse 28 D-8264 WALDKRAIBURG W. GERMANY
33.	PRO MINENT Im Schuhmachergewann 7-11 Postfach 101760 D-6900 HEIDELBERG W. GERMANY
34.	ROBUSCHI & C. S.p.a. Via S.Leonardo n. 71/A 43100 PARMA ITALY
35.	ROHM AND HAAS Co. PHILADELPHIA PENNSYLVANIA 19105 U.S.A.
36.	TEH-PROJEKT Fiorello la Guardia 13 51000 RIJEKA YUGOSLAVIA
37.	T.M.R. Eulenspiegelstrasse 53 D-8000 MUNCHEN 83 W. GERMANY
38.	TRAILIGAZ 29/31 Boulevard de la Muette 95140 GARGES-LES-GONESSE FRANCE
39.	WALLACE & TIERNAN GMBH Postfach 1563 D-8870 GUNZBURG W. GERMANY
40.	WHITEHEAD & POOLE LTD. P.O.Box 9 Milltown Street/ RADCLIFFE/MANCHESTER/ M26 9NU U.K.



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13. N.N. Abramov; SNABDEVANJE VODOM, Gradjevinska knjiga, Beograd 1974.

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15. STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER 14 th Edition, APHA, AWWA, WPCF 1976.

16. GOFI Commercial Booklet

17. Tehnical Brochures of various equipment producers