OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

UNIDO
A-1220 VIENNA
AUSTRIA

UNIDO CONTRACT NO. 88/94
PROJECT NO. SI/SYR/88/801
ACTIVITY CODE: J 13104

17866

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

PART 3

BISCUITES AND CHOCOLATE FACTORY ("GHRAOUI") DAMASCUS

FINAL REPORT

ZAGREB, JULY 1989.

TEH RIJEKA

Ordering Party: UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Waagramerstrasse 5
A-1220 VIENNA
AUSTRIA

The Contractor: "RINEX-TEH PROJEKT"
Fiorello la Guardia 13
51000 RIJEKA
YUGOSLAVIA

Contractors Personel:

SRDJAN SELANEC	-	Team Leader
RADOVAN GORJANOVIC	-	Effluent Treatment Specialist
ZORAN GOLOB	-	Food Technologist
PETAR BRUSIC	-	Civil Engineer
TOMISLAV KNEZEVIC	-	Mechanical Engineer
MIRJANA TURCIN	-	Droughtsman
LJILJANA VENIER	-	Typist
MAJA SELANEC	-	Editor

C O N T E N T S

PART 1

GENERAL SECTION

Page

1. ABSTRACT WITH GENERAL CONCLUSIONS AND RECOMMENDATIONS 2

2. INTRODUCTION 4

3. QUALITY STANDARS FOR WATER AND WASTEWATER 7

3.1. Water 8

3.2. Wastewater 16

4. AN OUTLINE OF WATER POLLUTION CONTROL, DEVELOPMENT AND STAFF TRAINING. 24

4.1. Introduction 25

4.2. Laboratory Facilities and Field Equipment. 28

4.3. Staff Training 28

5. GENERAL LIST OF EQUIPMENT SUPPLIERS 30

6. BIBLIOGRAPHY. 34

Page

PART 2

ARABIC OIL AND SOAP MANUFACTURING COMPANY

1. GENERAL DATA 1

2. DESCRIPTION OF THE PRODUCTION PROCESSES. 1

   2.1. Oil Production. 1

   2.2. Soap Production 4

3. WATER SUPPLY, TREATMENT AND DISTRIBUTION 5

   3.1. General Desription. 5

4. WASTEWATER FLOWS AND CHARACTERISTICS 7

   4.1. General Description 7

   4.2. Effluent Qualities and Quantities 8

5. WATER TREATMENT RECOMMENDATIONS. 11

   5.1. General Observations. 11

   5.2. Disinfection of Water which Retains the Existing Water Distribution System - - ALTERNATIVE A 11

   5.3. Disinfection of Water and New Water Distribution System - ALTERNATIVE B 15

   5.4. Boiler Feed-Water Treatment Unit. 17

   5.5. Bill of Quantities and Cost Estimations 21

   5.6. Running Costs 22

TEH PROJEKT - RIJEKA

Page

6. RECOMMENDATIONS FOR WASTEWATER TREATMENT AND DISPOSAL 25

6.1. General Possibilities 25

6.2. Tehnical Descriptions and Calculations. 27

6.3. Bill of Quantities and Cost Estimations 34

6.4. Running Costs 38

7. GENERAL CONCLUSIONS AND SUGGESTIONS. 39

8. DRAWINGS 41

PART 3

BISCUIT AND CHOCOLATE FACTORY ("GHRAOUI")

1. GENERAL DATA 2

2. DESRIPTION OF THE PRODUCTION PROCESSES 2

3. WATER SUPPLY, TREATMENT AND DISTRIBUTION 2

4. WASTEWATER FLOWS AND CHARACTERISTICS 6

4.1. General Desription. 6

4.2. Effluent Qcalitics and Quantities 6

5. WATER TREATMENT RECOMMENDATIONS. 8

5.1. General Observations. 8

5.2. Water Disinfection by Chlorine. 8

Page

5.3. Water Disinfection by Ozone 8

5.4. Boiler Feed-Water Treatment 13

5.5. Bill of Quantities and Cost Estimations 16

5.6. Running Costs 17

6. RECOMMENDATIONS FOR WASTEWATER TREATMENT AND DISPOSAL 20

6.1. Technical Description and Calculations. 20

6.2. Bill od Quantities and Cost Estimations 22

7. CONCLUSIONS AND SUGGESTIONS. 24

8. DRAWINGS 25

PART 4

THE DREKISH WATER FILLING FACTORY

1. GENERAL DATA 2

2. DESCRIPTION OF PRODUCTION PROCESSES. 2

2.1. Mineral Water Treatment and Production. 2

2.2. Cola Production 4

3. INDUSTRIAL WATER TREATMENT AND DISTRIBUTION. 4

3.1. General Desription. 4

3.2. The Ion Exchange Treatment Unit 7

3.3. Water Treatment for Cola Production 8

TEH PROJEKT - RIJEKA

Page

4. WASTEWATER FLOWS AND CHARACTERISTICS 8

4.1. General Desription. 8

4.2. Effluent Qualities and Quantities 9

5. WATER SUPPLY AND TREATMENT RECOMMENDATIONS 12

5.1. General Observations. 12

5.2. Industrial Water Supply and Disinfection. 13

5.3. Cola Water Treatment Line 18

5.4. Ions Exchange Treatment Line. 24

5.5. Mineral Water Surplus 25

5.6. Bill of Quantities and Cost Estimations 28

5.7. Running Costs 29

5.8. Laboratory Investigation Works. 31

6. WASTEWATER TREATMENT AND DISPOSAL RECOMMENDATIONS. 38

6.1. General Possibilities 38

6.2. Technical Desriptions and Calculations. 38

6.3. Bill of Quantities and Cost Estimations 44

6.4. Running Costs 47

7. GENERAL CONCLUSIONS AND SUGGESTIONS. 49

8. DRAWINGS 50

PART 3

B I S C U I T A N D C H O C O L A T E F A C T O R Y "G H R A O U I"

1. GENERAL DATA

The factory has been situated in Damascus. It manufactures approx. 8 tons of biscuits per diem, 70 % being plain biscuits (5,6 t/day), 20 % are so called stuffed biscuits (1,6 t/day), while 10 % of the manufactured goods are chocolate coated biscuits (0,8 t/day).

About 170 workers are employed in the factory. The plain biscuits production line works in triple shifts, while the stuffed and chocolate cotaed biscuits lines work one shift per day. The yearly production stretches to about 280-290 working days.

2. DESCRIPTION OF THE PRODUCTION PROCESSES

(See Block Flow Diagram, Fig. 2.1.)

As mentioned before, there are three basic production lines, the biggest and main line being the one for plain biscuits production.

The biscuits production in this line starts with the preparation of dough in the mixer tank. The raw materials are: flour, sugar, fat, vitamin, sodium bicarbonate and warm water (35 oC). The prepared mixture goes into the baking machine where it is formed, branded and cut to its final forms and then flows through the baking tunnel (230 oC) where biscuits are baked, then cooled, and partialy packed in boxes, while one part of the production (30 %) is sent to the chocolate coat line and to the stuffed biscuits line.

3. WATER SUPPLY, TREATMENT AND DISTRIBUTION

(See Simplified Process Diagram, Fig. 2.2.)

Water is pumped from a well situated within the factory limits. The pump has a capacity of approx. 15 cu m/hr (P1). The daily needs of water are covered by 28-48 cu m.

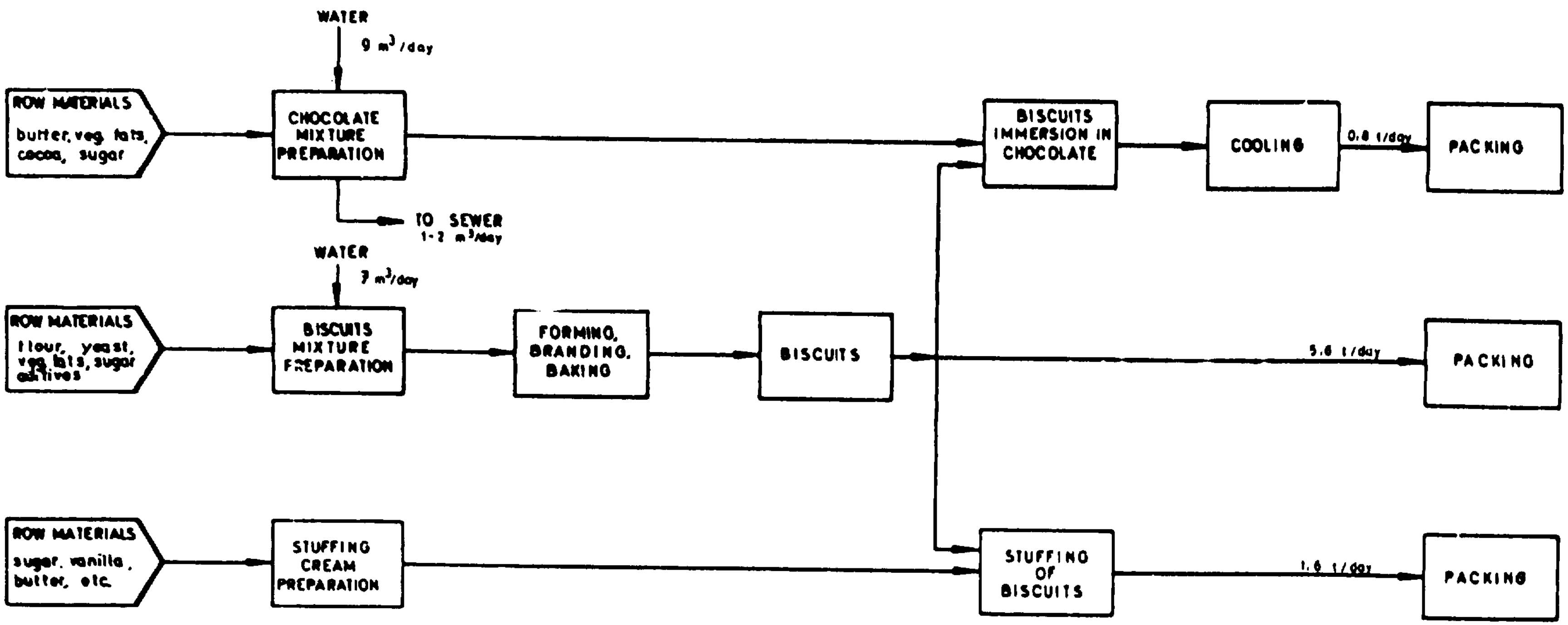

FIG. 2.1. BLOCK FLOW DIAGRAM OF BISCUITS PRODUCTION
Biscuits and Chocolate Factory - 'GHRAOUI'

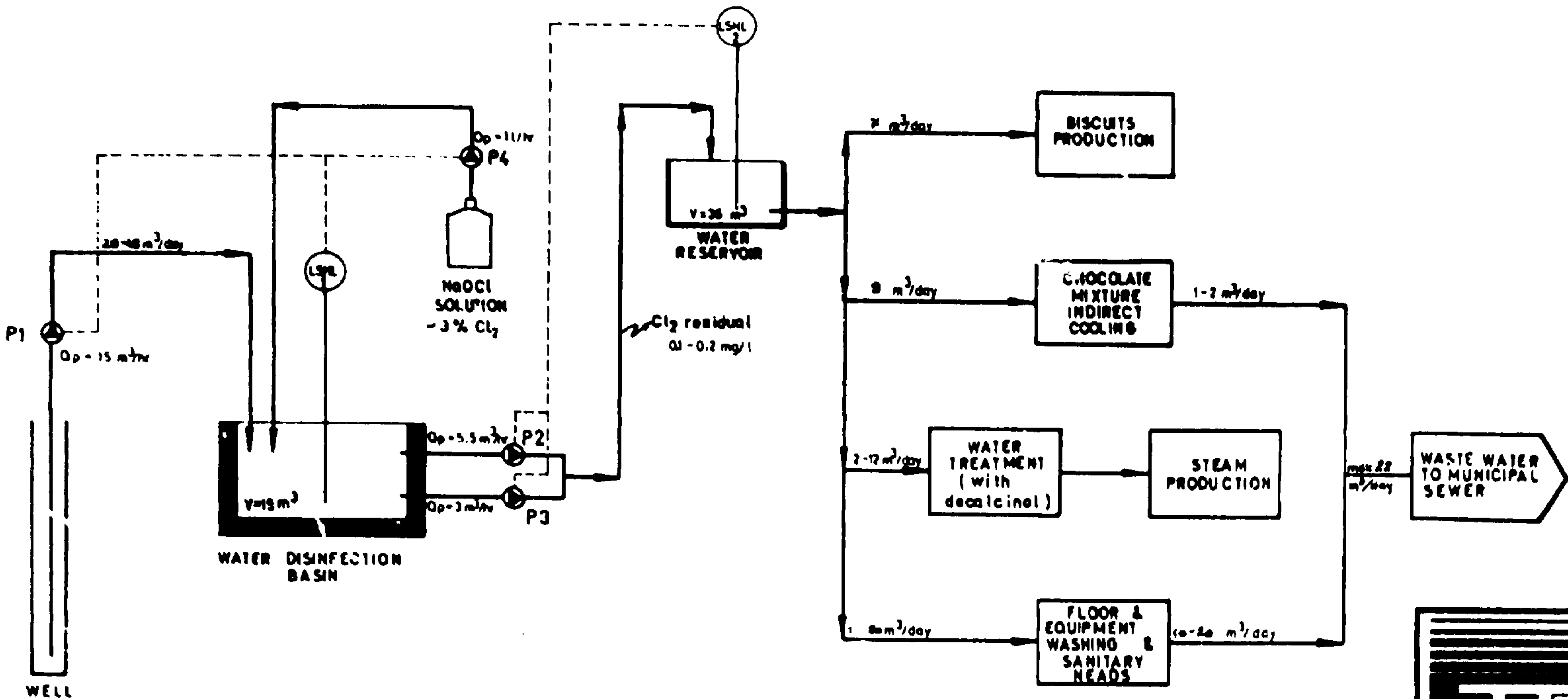

FIG. 2.2. SIMPLIFIED FLOW DIAGRAM OF WATER DISINFECTION AND DISTRIBUTION (existing)
Biscuits and Chocolate Factory - "GHRAOUI"

The water from the well is pumped into the concrete tank, 80 m away (its volume is 15 cu m) where it is disinfected by the NaOCl solution. The level control LSHL 1 switches on/off the electric motor at the dosing pump of the NaOCl solution (P4) and the well pump, and thus it regulates water pumping into the tank as well as Na hypochlorite dosing.

The disinfectant solution with approx. 3 % available chlorine has been dosed from the 30 liter container. The daily need is 8-9 liters of solution. It has been established by measuring that the dosing pump was adjusted to the cca 2,6 l/hr flow. What follows from these data is that the average dose concentration of chlorine in water is approx. 4,5- 5 mg/l.

From the data obtained by measuring in the factory it comes out that the residual chlorine in water is 0,3 mg/l

The water from the disinfection tank is pumped into the tank placed on the roof (its volume being 36 cu m). The tank is filled by means of the level control which switches on/off the supply pump from the disinfection tank (LSHL 2).

The water is distributed from the roof tank by a direct gravitational flow for the following purposes:

1) Preparation of dough
2) Chocolate mixture cooling
3) Steam production
4) Floor and equipment cleaning

Prior to the usage in the steam boiler, feed water is treated in a tank (V = 2 cu m) by a substance called decalcinol.
The boiler pressure is 5 bars and its capacity is 2000 kg of steam per hr.

An ion exchange water treatment facility is installed, but it is not used.

Some information is given concerning the water quality and its composition. From from the available data it was found out that the total hardness of water is approx. 400-500 mg/l $CaCO_3$ (22-29 odH) while the sulphate contents is approx. 140 mg SO_4/l. After being chlorinated, water contained no coliform bacteria or Escherichia coli.

4. WASTEWATER FLOWS AND CHARACTERISTICS

4.1. GENERAL DESCRIPTION

The factory has been built on the area of approx. 7000 sq m.

All the production processes, storages and administration facilities are settled inside the covered building occupying approx. 2200 sq m. The rest of the area is a paved manipulation area (cca 1000 sq m).

The main water consumers and waste water sources are shown on Flow Diagram (Fig. 2.2.). All the effluents and rainfall are collected by a combined sewerage system and discharged without any treatment into the municipal sewer.

Unfortunately, the lay-outs and the geodetical data about the sewerage were not available.

4.2. EFFLUENT QUALITIES AND QUANTITIES

During our visit to the site sampling and laboratory analyses for all the effluents were organised but unfortunately the results have not been received so far. Anyhow, in Table 2.1. we shall try to summarize the main characteristics on the basis of our investigation and experience.

The main sources of pollution are effluents from cleaning floors and equipment. They contain grease, sugar, flour and detergents which sometimes result in strong loads. Those effluents can be treated biologically with activated sludge giving good results but can cause cloggings in the sewers.

TABLE: 2.1. CHARACTERISTICS OF EFFLUENTS FROM THE BISCUIT PRODUCTION

SOURCE	QUANTITY m3/d	max l/sec	OIL & GREASE mg/l	SUSPENDED SOLIDS mg/l	BOD mg/l	pH
Floor and equipment cleaning	15	6	500-1500	2000-3000	1000-2000	8-9
Sanitary waste water	5	1	< 30	300-500	500-1000	7-8
Condensate & cooling water	2	0,5				
TOTAL DRY WEATHER EFFLUENTS	22	7,5	500-900	1500-2000	800-1500	7-9
RAIN FALL (max.10 min)		20				

5. WATER TREATMENT RECOMMENDATIONS

5.1. GENERAL OBSERVATIONS

As it has been already said, there is a unit in the factory which disinfects the well water with the NaOCl solution and it is in operation.

If this system of water disinfection is to be kept it should be reconstructed by adding the control of residual chlorine in water and the alarm system of the NaOCl solution low level in the dosing tank.

As food industry, whose final product consists of water, is in question, and at the same time answering the demands of the factory experts, we have anticipated the alternative of water disinfection by ozone as well.

5.2. WATER DISINFECTION BY CHLORINE

5.2.1. Description

(See Flow Diagram on Fig. 2.3.)

The processes of supply and disinfection of water are automatic. The decrease of water level in the roof tank T-2, turns on/off switch (LSHL-2) of the pump P-2 or P-3. In that way the tank is refilled with water. At the same time the water level of the disinfection tank is decreased, and the level switch (LSHL-1) automatically turns the well pump P 1 on/off.

The NaOCl solution is dosed automatically. The dosing pump P-4 is turned on/off depending upon the water level in the tank T-1 (LSHL-1). On the other hand, the operational power of the pump can be regulated depending upon the residual chlorine in water (chlorine analiser AIC-1 in the tank T-2).

5.3. WATER DISINFECTION BY OZONE

5.3.1. Description

(See Simplified Process Flow Diagram on Fig. 2.4.)

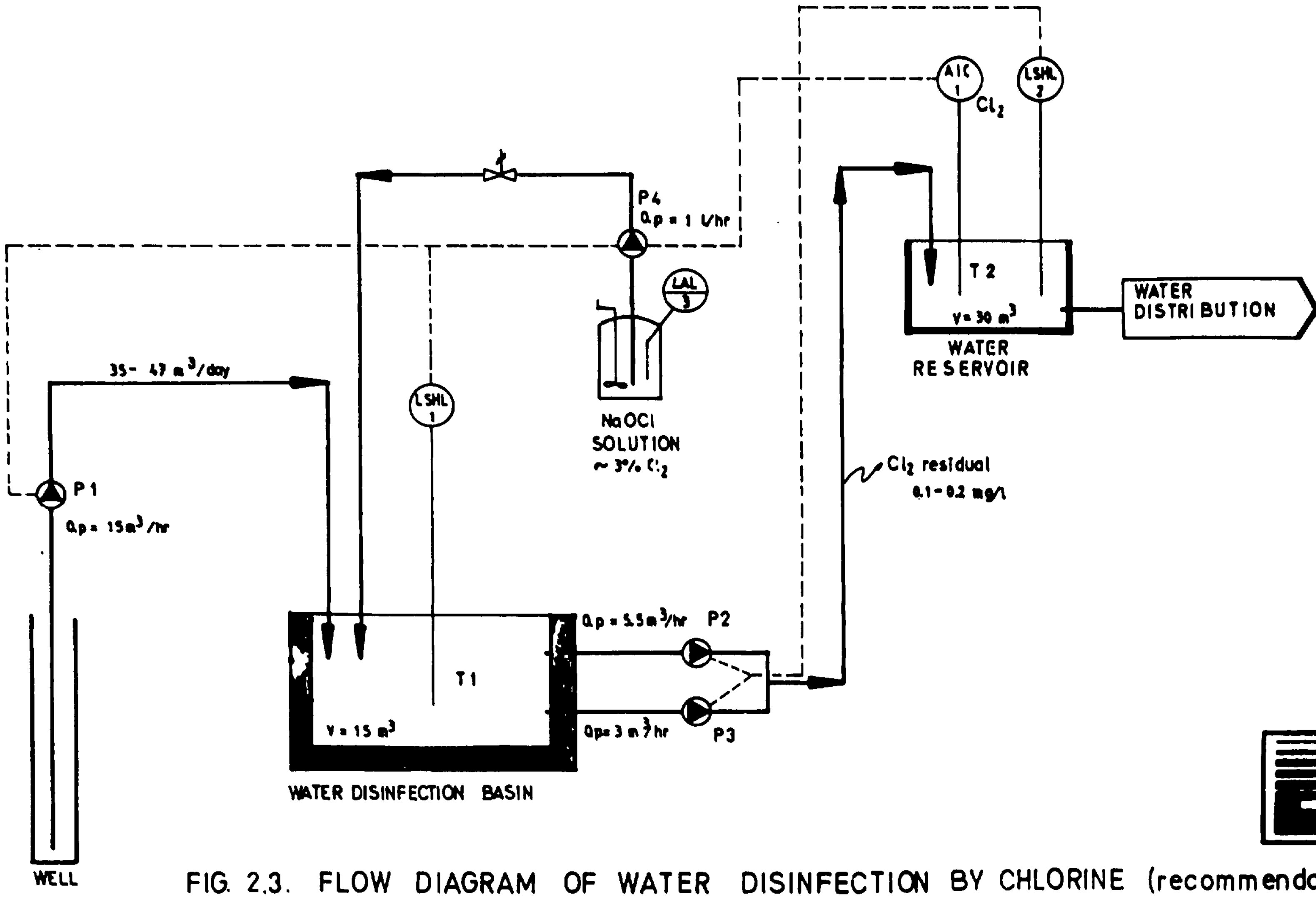

FIG. 2.3. FLOW DIAGRAM OF WATER DISINFECTION BY CHLORINE (recommendation)
Biscuits and Chocolate Factory - "GHRAOUI"

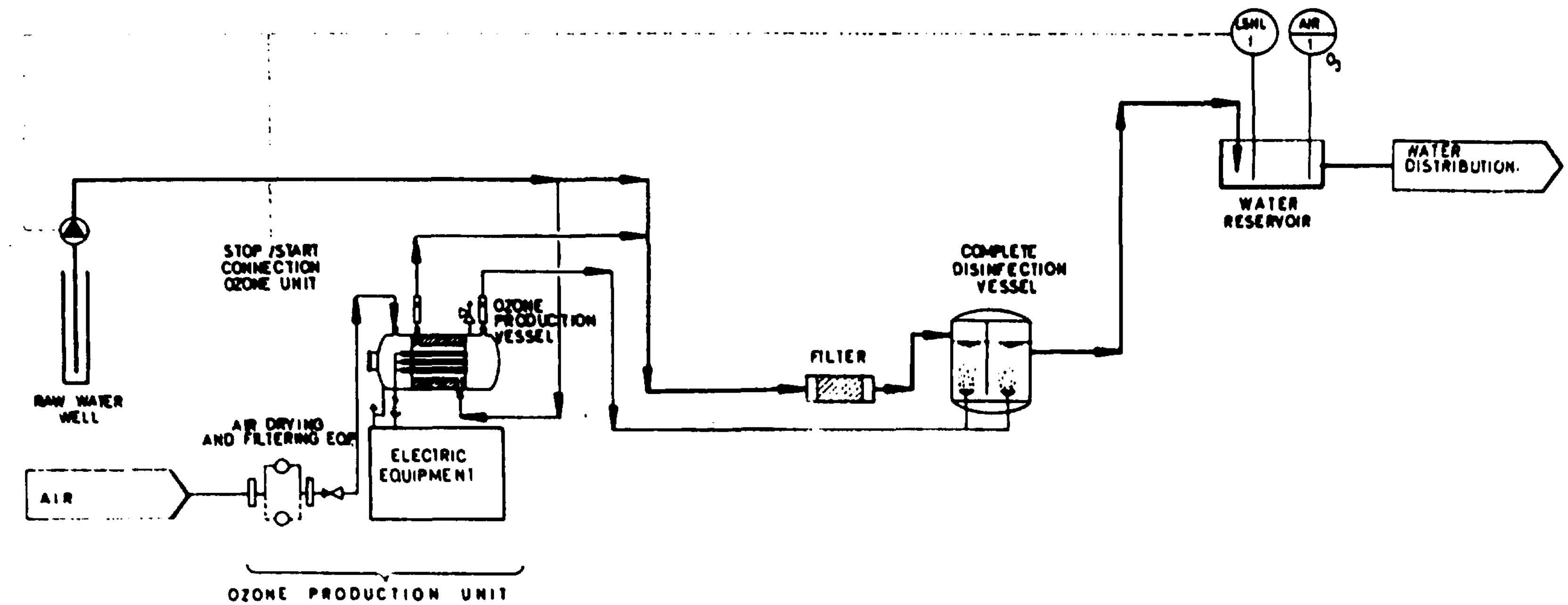

FIG. 2.4. SIMPLIFIED PROCESS FLOW DIAGRAM OF WATER DISINFECTION BY OZONE (recommendation) Biscuits and Chocolate Factory -"GHRAOUI"

Ozone, a faintly blue, pungent-smelling, unstable gas, is an allotropic form of oxygen in which three atoms of the element are combined to form a molecule, O3. Because of its instability and characteristics, it is generated almost invariably at the point of use. The resulting ozone-air mixture thus generated can be admitted to water by spraying water into an ozone-containing atmosphere, by discharging the ozonized air into a scrubber, or by applying the ozozne-air mixture through an injector or diffusing it upward into water in a well-baffled mixing chamber.

The development of breakpoint chlorination and its wide success for handling most taste and odour problems, the introduction and development of chlorine dioxide treatment, the inability of ozone to exist as a residual in distribution systems, and the generally high electric energy requirements and cost are among the factors contributing to the greater popularity of materials other than ozone for disinfection and taste, odour, and colour control.

Some of the advantages and disadvantages of ozone as a disinfectant are:

Advantages:

1. Complex taste, odour, and colour problems are effectively reduced or eliminated.

2. It is a powerful oxidant that rapidly oxidizes organic impurities.

3. Disinfecting action is effective over a wide temperature and pH range.

4. Bactericidal and sporicidal action is rapid (said to be from 300 to 3000 times quicker than chlorine), and only short contact periods are required.

5. Odours are not created or intensified through formation of addition or substitution complexes.

6. There is no possibility of danger or harm from overtreating.

Disadvantages:

1. No lasting residual disinfecting action is provided.
2. Electric energy requirements and capital and the operating costs are high (about 10 to 15 times higher that chlorine).
3. The ozone-air mixture produced by necessary on-site generation is only slightly soluble in water, and the production is complicated when the temperature and humidity are high.
4. The process is less flexible than chlorination in adjusting to the flow rate and water quality variations.
5. Analytic techniques are not sufficiently specific or sensitive for ready and efficient control of the process.
6. Waters of high organic and algal content usually require thorough pretreatment to satisfy the ozone demand.

The dosing concentration of ozone in raw water is supposed to be 5 mg O_3/l of water (5 g/cu m). If the existing well pump is to be used (Q = 15 cu m/hr), the ozone production unit of 75-100 g/hr capacity should be required.

The contact time of water and ozone is supposed to be 5-8 minutes at maximum, while the residual ozone in water will be within limits of 0,2-0,4 mg O_3/l.

The ozonization unit operates automatically, depending upon the water level in the distribution tank (LSHL 1). The contents of the ozone in water are measured in the tank as well. The ozonization unit is of compact manufacture.

Electrical energy consuption is 18-30 W/g ozone, which means 3 kW/hr, or about max. 10 kW hr/day.

5.4. BOILER-FEED WATER TREATMENT

5.4.1. Description

Considering the mentioned problems with scaling, which is connected to the fact that lines for softening water by ion exchange are installed, we think that the line should be repaired and used for preparation of boiler-feed water.
(Fig. 2.5.)

To achieve this it is necessary to:

- clean and paint the vessel for preparation of the regeneration substance (NaCl-solution) with the epoxi coat - Tank T 1.

- install the mixer M1 into the vessel,

- install the pump P1 for regeneration solution,

- purchase ionic resin (cationic, for neutral exchange)

Dimensions of the ion exchanger V-1

diameter	0,4 m
height	1,8 m
volume	0,9 cu m

Dimensions of the vessel for preparation of the NaCl solution (T-1)

diameter	0,8 m
height	1,0 m
volume	0,5 cu m

The ion exchange column is usually filled with ionic resin up to 50-percent of its volume

(Vm = 0,9 x 0,5 = 0,450 cu m)

The flow of water: Q = 1,5 cu m/hr,

Maximum total hardness: TH = 29 o dH

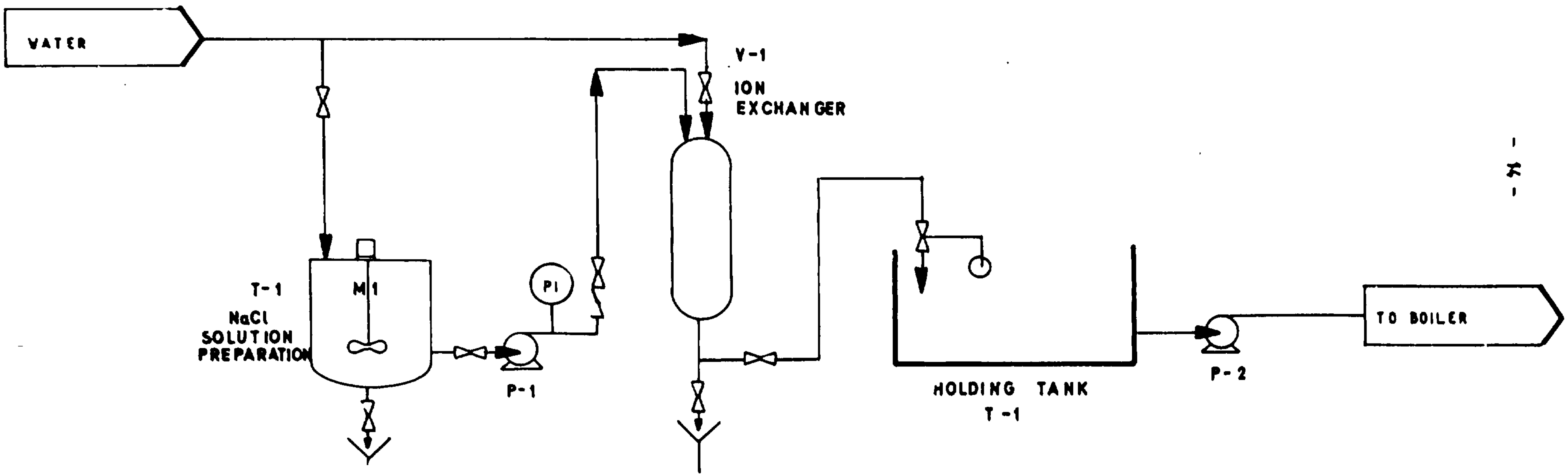

FIG 2.5. PROCESS-FLOW DIAGRAM OF BOILER FEED WATER TREATMENT (recommendation)
GHRAOUI Factory

Useful capacity of the ion-exchange resin:

Kk = 30 g CaO/l

From these data a number of hours of continuous work of ion exchange can be calculated:

$$t = \frac{Vm \times Kk}{10\ TH\ Q}$$

$$t = \frac{450 \times 30}{10 \times 29 \times 1,5} = 31\ hr$$

As the maximum flow water is 12 cu m per day, it comes out that the ion exchanger will operate: 12/1,5 = 8 hr/day.

Again, it comes out that the ion exchange can be used until regenerated for 31/8 = 3,9 days.

On the other hand, the solution of the regeneration substance (NaCl) must have the concrentation of 10 w/w %, while the volume of the needed solution is at least 1,5 volume of the ionic mass (1,5 x 450 = 680 l). The useful volume of the vessel for NaCl solution is 500 l.

The quantity of the needed regeneration substance is (on condition that ion exchange is 31 hr on):

TH = 29 o dH max.

t = 31 hr

Q = 1,5 cu m

NaCl = 70 x TH x t x Q

NaCl = 70 x 29 x 31 x 1,5

NaCl = 94,395 g of NaCl/regeneration

It means approx. 94 kg of NaCl dry is needed for a single regeneration of the ionic resin.

It can be concluded from the above mentioned that on conditions of max. loading of raw water by total hardness of 29 o dH and max. flow of water up to 12 cu m/day, the ion exchange line can work without regeneration for 3,9 days. It should be regenerated by dissolving 100 kg of NaCl in 1000 l of water. It practically means that the regeneration will be carried out with two volumes of the vessel for preparation of the NaCl solution (2 x 500 l), and each time 50 kg of NaCl will be dissolved.

5.4.2. Specifications and Dimensions

- Mixer in the vessel for preparation of NaCl solution

  Type: prop-driven
  Electric motor power: 0,55 kW

  1 pc

- Pump for the NaCl solution

  Type: centifugal horizontal
  Electric motor power: 3 kW
  H : 20 m WC
  Capacity (Q) : 1 l/sec

  1 pc

- Ionic resin

  Type: ROHM & HAAS IR 120 (neutral exchange)

  600 kg (for two fillings of column)

5.5. BILL OF QUANTITIES AND COST ESTIMATIONS

5.5.1. Water Disinfection by Chlorine

- NaOCl solution dosing equipment with accessories

  Consists of: one dosing pump (P4), pump section line system, back pressure valve, PVC chemical tank, signal horn for law level alarm (LAL-3) and signal lamp-alarm, manual stirrer, measurement and recording of chlorine residual (AIRC Cl2-1).

1 complete set with mounting	4.250 USD
TOTAL (capital costs):	4.250 USD

5.5.2. Water Disinfection by Ozone

This unit consists of the following main components: ozone generator, air dryer and filter, water filter, reaction column.

The price includes mounting of the unit	93.000 USD
TOTAL (capital costs):	93.000 USD

5.5.3. Boiler-feed water Treatment Unit

The equipment which is missing now, but must be procured to complete the line:

- Mixer in NaCl solution vessel		
	1 pc	1.500 USD
- NaCl solution pump	1 pc	1.600 USD
- Ion resin IR 120 (RHOM & HAAS)		
	1000 l a´ 1,5 USD/l =	1.500 USD
- Mounting (lump sum)		180 USD
TOTAL (capital costs):		4,780 USD

5.6. RUNNING COSTS

Basically, the running costs (CR) consist of the following:

- maintenance costs (CM)
- energy costs (CE)
- costs for chemicals (CC)
- labour costs (CL)
- depreciation costs (charges) (CA)

The maintenance costs (CM) are usually about 1,5 % of the capital costs.

The energy costs (CE) consist of the electrical power and steam costs. The labour costs (CL) are applied according to the number of employed as well as the costs that are to be ensured for each employee.

The depreciation costs (CA) are applied with 6,7 % per annum of the capital costs (based on the 15 year period exploitation).

NOTE: The running costs are computed only through newly suggested equipment. Working days per year 285.

5.6.1. Water Disinfection by Chlorine

- Chemicals costs (CC)

NaOCl with 13 % available chlorine

1,9 kg/day x 285 day/year = 542 kg/year

- Maintenance costs (CM)

CM = 4250 USD x 0,015 = 64 USD/year

- Energy costs (CE)

P4: 0,06 kW x 3 kr/day x 285 day/year =51,3 kW hr/day

- Labour costs (CL)

1 hr/day qualified worker

CL = 1 hr/day x 285 day/year = 285 man hr/year

- Depreciation costs (CA)

CA = 4250 USD x 0,067 = 285 USD/year

5.6.2. Water Disinfection by Ozone

- Maintenance costs (CM)

CM = 93000 USD x 0,015 = 1395 USD/year

- Energy costs (CE)

  10 kW hr/day x 285 day/year = 2850 kW hr/day

- Labour Cost (CL)

  No need for additional labour

  Cl = 0

- Depreciation costs (CA)

  CA = 93000 USD x 0,067 = 6321 USD/year

5.6.3. Boiler-feed water treatment Unit

- Chemical costs (CC)

  NaCl dry

  100 kg/reg x 95 reg/year = 9500 kg/year

- Maintenance costs (CM)

  CM = 4780 USD x 0,015 = 72 USD/year

- Energy costs (CE)

  P-1 3 kW x 1 hr/day x 285 day/year = 855 kWhr/year

  P-2 3 kW x 3 hr/day x 285 day/year = 2565 kWhr/year

  P-3 0,55 kW x 1 hr/day x 285 day/year= 157 kWhr/year

  TOTAL: 3577 kW hr/year

  CE = 3577 kW hr/year

- Labour costs (CL)

  2 hr/day qualified worker

  CL = 2 hr/day x 285 day/year = 570 man hr/year

  CL = 570 man hr/year

- Depreciation costs (CA)

  CA = 4780 USD x 0,067 = 320 USD/year

6. RECOMMENDATIONS FOR WASTE WATER TREATMENT AND DISPOSAL

Although biologically degradable, effluents from floor and equipment cleaning cannot be discharged into the municipal sewerage because of high concentrations of grease and suspended solids. In bigger factories those materials can be sufficiently removed by physical-chemical treatment processes such as:

- breaking of emulsions by acidification
- coagulation with metal-salts and
- flotation (air-, disolved-air- or electro-)

In smaller factories like the "Ghraoui" it is advisable and economical to use simple methods of pretreatment such as grease or gravity separators which should be installed as near as possible to the source of pollution. That is necessary not only to protect the municipal sewerage from clogging but the internal factory drainage, as well.

6.1. TEHNICAL DESCRIPTION AND CALCULATIONS

(See Fig. 2.6. Scheme of the wastewater pretreatment)

It will be advisable to collect all the effluents from the polluted areas in a new shallow sewer which will be connected directly to the separator, because the existing sewerage is (in our opinion) unnecessarily deep.

All the effluents will enter the three-chamber concrete tank which serves as a gravity separator for settling and floating matters. Settling solids will be collected in conical bottoms and emptied frequently by municipal sanitary trucks. Grease and other floating materials will rise and be held by submerged partitions (deep scum boards) at the surface, while the purified water flows out continuously under the partitions. Scum has to be frequently shovelled from the surface and transported by containers to the rendering house or to the municipal dump.

It is enough to design a gravity separator for max. dry weather flow because during heavy rainfalls the velocities of the flow will be sufficient to prevent settlings and cloggings of the sewerage.

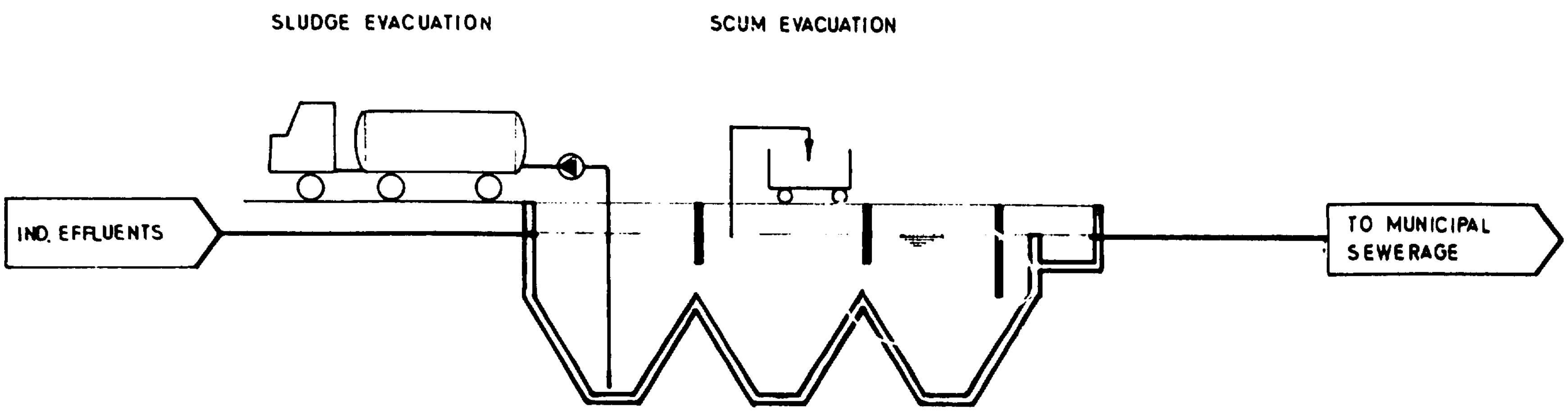

FIG. 2.6. SCHEMATIC OF "GHRAOUI" - BISCUIT FACTORY EFFLUENT PRETREATMENT (recommendation)

Dimensions of the separator:

Lenght: 7,5 m
Width: 2,5 m
Water depth in
the straight part: 1,0 m
Depth of the
conical parts: 1,5 m
Total volume: 25,5 m
Retention in
dry weather: about 1 hr
Depth of the
last partition: 1,0 m

6.2. BILL OF QUANTITIES AND COST ESTIMATION

1. Excavation of the surface layer, 30 cm thick

   10 x 3 x 0,30 = 9 m3

   m3 9 x 32 = 288 SP

2. Soil Excavation of the first, second, third and fourth category. It has been represented by 35, 35, 15 and 15 %. Total quantity is:

   11 x 4 x 3 = 132 m3

   1. ctg m3 46,20 x 50 = 2.310 SP

   2. ctg m3 46,20 x 57 = 2.633 SP

   3. ctg m3 19,80 x 76 = 1.505 SP

   4. ctg m3 19,80 x137 = 2.713 SP

3. Depositing of gravel screed beneath the concrete base

   m2 10 x 70 = 700 SP

4. Casting of concrete MB-10, 10 cm thick

   m3 0,60 x 1000 = 600 SP

5. Casting of the flotation basin by MB-30 concrete with addition of waterimpermeability admixtures. Casting should be carried out in smooth oil formwork with vibrating. Interruptions of casting and dilatations should be ensured by dilatation lines (Water Sto Couplings). Double formwork is included in the unit price.

   3 x 0,40 + 3 x 2,50 x 4 x 1,50 x 0,50 x 0,50 x 1,41 x

   x 0,30 + (8,80 x 2 + 2,80 x 2) x 2 x 0,30 + 2,80 x

   x 0,20 x 1,20 = 25,32 m3

   m3 25,30 x 2000 = 50.600 SP

6. Filling up of the flotation basin area with the excavation material

   132 + 9 - 9 x 3 x 3 = 60

   m3 60 x 40 = 2.400 SP

7. Carting off the excavation material

   5 x 3 x 3 x 1,25 + 60 x 0,05 = 104,25

   m3 104,25 x 50 = 5.213 SP

8. Reinforcing of the concrete basin with ribbed bars according to static calculations and drawing of bending.

   25,30 x 80 = 2024

   kg 2024 x 10,50 = 21.252 SP

9. Rainforced concret slab

   9,10 x 2,50 x 0,10 x 2500 = 5.687 SP

   Covers, 4 pcs

   4 x 150 x 10,50 = 6.300 SP

   TOTAL (6.2.): 102.201 SP

   or (1 USD=22 SP) 4.645 USD

7. CONCLUSIONS AND SUGGESTIONS

As food industry, whose final product contain water, is in questions, it is of crucial importance that high quality water is used. Besides the required physical and chemical properties water has to be disinfected to reach the required bacteriological properties.

No matter which disinfection method is used it has to be effective and safe in operation.

Ozonization has many advantages but it requires high investment and running costs, so we **recommend chlorination but fully automatized.**

We are of the opinion that GOFI should install the same type of fully automatized systems in all of their factories, which will enable permanent and safe operations as well as proper maintenance and supply of spare parts.

Although biologicaly degradable wastes cannot be directly discharged into the municipal sewerage and at least simple separation of fats and suspended solids have to be provided.

8. DRAWINGS

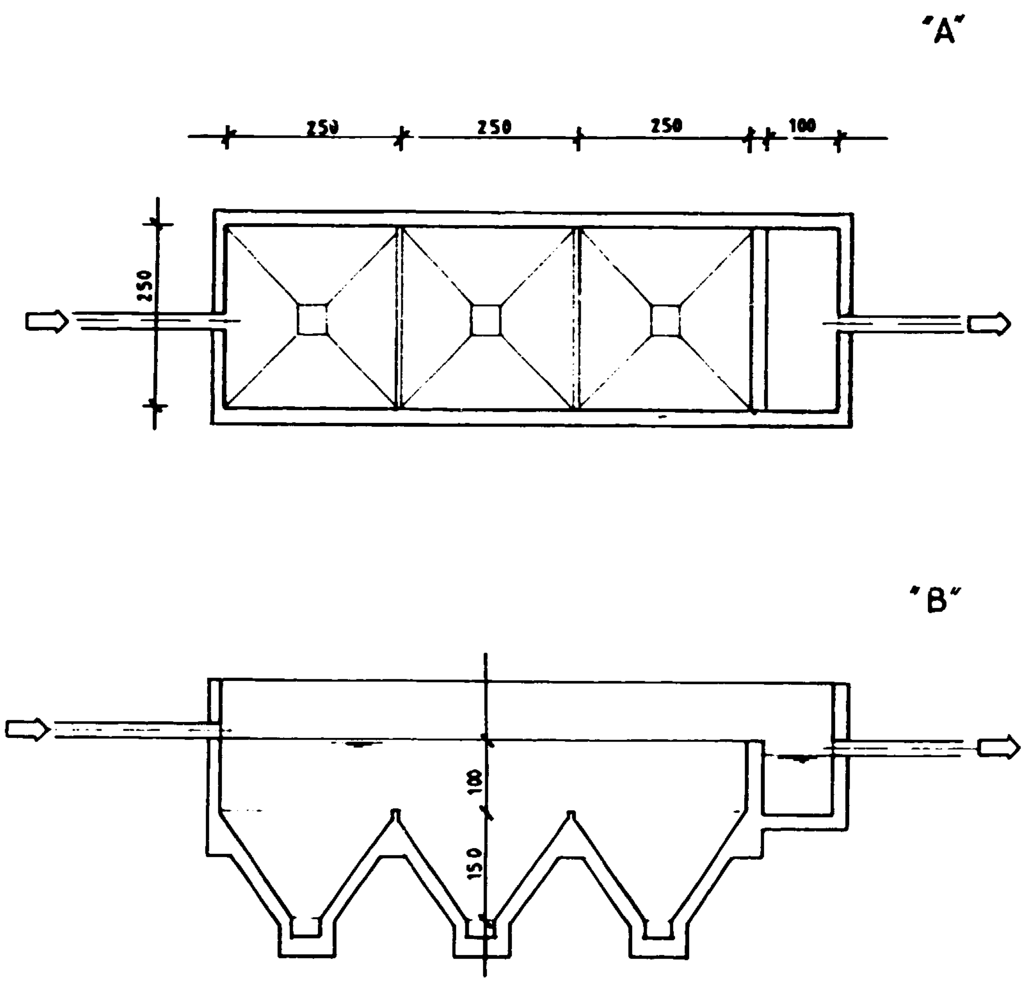

FIG. 2.7. COMBINED WASTE WATER PRETREATMENT UNIT
Plan (A) and Cross-sectional (B) View
" GHRAOUI" Biscuits Factory

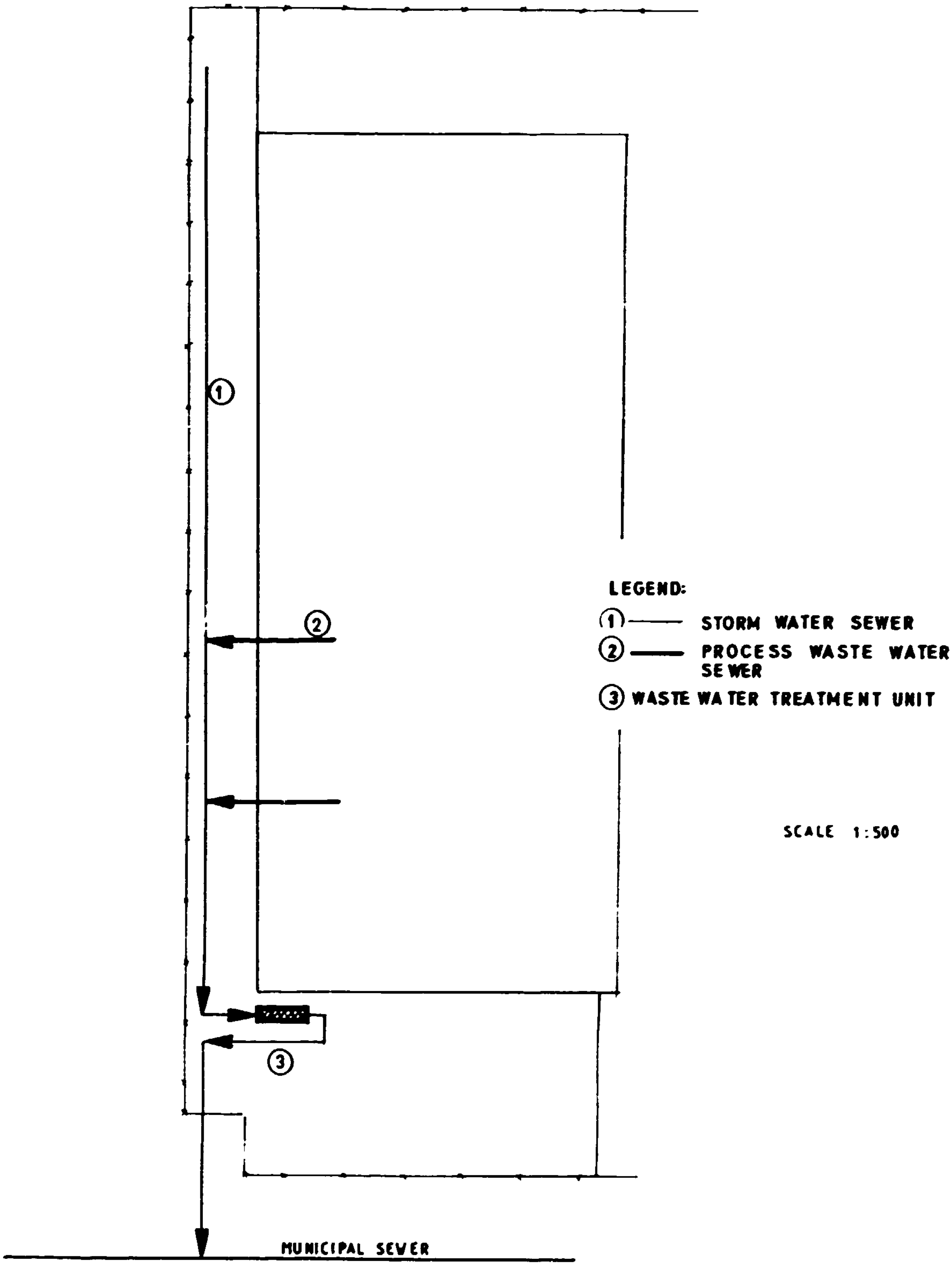

FIG. 2.8. WASTE WATER TREATMENT UNIT
Lay Out (preliminary)
"GHRAOUI" Biscuits Factory