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Feature of Industrial Wastewater Discharged to the Sewerage System

" Case Study Northern Governorate - Gaza Strip"

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1- Introduction

Industrial wastewater generation is considered as an environmental problem in all Palestinian Governorates. The connection of industrial wastewater to the treatment plant (TP) is always a matter of a case evaluation. The first concern is whether the industrial wastewater is possible to be treated at the TP, without any disturbances in operating of the plant or deterioration of the quality of the effluent or sludge. The second concern is the size of industrial wastewater flow in relation to the plant capacity.

The final disposal of the industrial effluent has to be defined to avoid the damage of the treatment process and to protect public health and ecological system. Furthermore, it is important for the possible reuse of treated effluent in agriculture or recharge to the groundwater aquifer.

The Northern Governorate of Gaza will be given as a case study for the management of the industrial wastewater and will suggest regulations concerning the discharge of industrial wastes to the sewerage system.

2- Existing Situation

2.1- Sewerage System and Treatment Plant:

The Northern Governorate consists of three municipalities: Jabalia, Beit Lahia and Beit Hanun, with a population of about 150 000 persons. The sewage plant, which serves these municipalities, is located in Beit Lahia. About 60% of the households are connected to the community sewerage system.

Beit Lahia treatment plant was originally built by the Israeli Civil Administration in 1976 to treat the sewage from Jabalia and Nazla villages. The system was designed as aerated ponds (4 ponds) of 5000 m^2 surface area each, with a capacity of 29,000 m^3. Two more lagoons were added in 1985 with a surface area of 10,000 m^2 each and with a capacity of 34,000 m^2 for the first pond and 12,000 m^3 for the second pond. In 1993 another 34,000 m^3 pond was added to the system.

The sewage flow to the treatment plant, as reported by the village council engineer, is estimated at approximately 7000 m^3/day with a possible increase to 15,000 m^3/day in winter. The original project was constructed for reuse purposes. The irrigation part of the project was not completed; farmers refused to use the effluent, as they were worried about the sociocultural acceptability of their products. In addition, the effluent quality does not fulfill the reuse requirements recommended by the World Health Organization or the Israeli standards that require effluent with BOD_5 less than 20 mg/l and SS less than 30 mg/l. The final disposal from pond is discharged directly to the sand dunes where it is infiltrated into the ground. The sludge removed from the ponds

is deposited in the adjacent areas to the treatment plant without any type of treatment. This plant, as in the case of other plants does not operate properly.

According to the terms of reference of the Swedish project "Upgrading of Beit Lahia Treatment Plant", the large objectives are to improve the environmental situation and to treat wastewater to be reused for agriculture or recharged to the aquifer. Therefor the future connection of industrial wastewater to the treatment plant should consider the quantity and the quality of generated wastewater. The first concern in this matter would be whether the industrial wastewater is possible to be treated at the plant without any disturbances in operation or deterioration of the effluent quality or the sludge. The second is the total flow in relation to the plant capacity.

2.2- Industrial Wastewater Quantity:

The Northern Governorate counts a number of industries, but very few of them can be considered as potentially harmful for the biological process in the treatment plant or for the final effluent.

In the year 1996, 287 industrial establishments were registered in the concerned area; most of them (83%) belong to the clothing branch. Through field visits conducted by DRC Gaza-team in the period of 19-28 June 1997, a list of 16 firms was found which has the major relationship to wastewater discharge. The other firms discharge no or negligible amount of wastewater.

Table 1 summarized the relative water demand and possible wastewater generation of different types of industrial activities in Northern Gavernorate. Sector like garment and woodwork were excluded because no significant water or wastewater is consumed or generated. In the plastic firms, water is being used for cooling and 100% recycled. The construction industry is excluded because of low wastewater is being generated. All types of metal work were also excluded for the same sound except for iron galvanization.

Table 1: Relation between water demand and wastewater generation of different types of industrial activities in Northern Gavernorate of Gaza Strip (DRC Study, June 1997).

Type of Industrial Activities	Water Demand	Wastewater Generation	Recycling
Garment , Wood work and Metal work	not significant	negligible amount	
Plastic firms		negligible amount	100%
Construction	High	negligible amount	
Jeans washing and laundries	High	High	
Tiles Industry		law	
Textile dyeing	High	High	
Soft drink filling	High	law	
Iron Galvanization	High	High	

The daily industrial wastewater generation is limited according to the data provided by DRC study. The total water demand and wastewater generated quantity of the five industrial types is given in table 2. The discharge quantity is about 250- 300 m^3 daily and this make less than 5% of the total wastewater amount connected to the sewer system in the existing situation in the northern area.

Table 2: Water consumption and Wastewater Generation of the Main Industrial Type produced wastewater (DRC Study, June 1997).

Type	Number of factories	water Demand m^3/year	% wastewater Generation	Total wastewater Generation m^3/year
Jeans washing and laundries	8	28,850	100	28,850
Tiles Industry	4 *	19,800	10	1,980
Textile dyeing	2	16,800	92.3	15,600
Soft drink filling	1	24,000	7	1,680
Iron Galvanization	1	1,800	100	1,800
Total	16	91,250	54.70	49,910

* Three Factors only working

The generated wastewater is discharged directly, in the most cases, from these factories to the sewer system without any treatment.

2.3- Industrial Wastewater Quality:

Table 3 shows the results of the analysis program, which were carried out in October 1996 in the Environmental and Rural Research Center at the Islamic University. The results showed that the quality of the treatment plant influent (industrial and municipal wastewater) has the typical character of communal wastewater. The COD/BOD - Ratio is less than 3 and this indicate that the biological activities of treatment process will be not effected.

Table 3: Average of Effluent and Influent quality in the Beit - Lahia Treatment plant in October 1996.

Parameter	**Unit**	**Influent**	**Effluent**
Electrical Conductivity	mS/cm	1.55	1.90
pH	-	7.82	8.15
Total Solids	g/l	2.104	1.244
Dissolved Solids	g/l	1.114	0.996
Suspended Solids	g/l	0.990	0.074
Volatile Solids	g/l	1.00	0.27
Fixed Solids	g/l	1.104	0.974
Biochemical Oxygen Demand (BOD_5)	mg/l	590	140
Chemical Oxygen Demand (COD)	mg/l	1570	272
lmhaff	ml/l	18	<0.1
Total Kjeldahl Nitrogen (TKN)	mg/l	115.2	76.0
Fecal Coliform	per 100 ml	10^8	10^5
Chloride	mg/l	285	275

Concerning the industrial effluent in the northern area, there is a limit information about possible contamination compounds (organics and heavy metals) which may be

founded in the wastewater of industrial units. However, a previous wastewater analysis program is done for industrial units in Khan Yunis area in the southern part of Gaza Strip by JAPAN INTERNATIONAL COOPERATION AGENCY (JICA). And since the industry in all Gaza Strip is similar, this data could be enough to give an impression on the industrial wastewater characteristics in the region of Gaza.

The JICA-survey results indicated that the concentration of cyanide and heavy metals, such as zinc and chromium were relatively high in wastewater. Although the wastewater quantities generated from industrial unit are still small. In the other hand this toxic compound may limited the effluent reuse for irrigation or groundwater recharge.

3- Future guide lines

Generally, attention has to be paid to the quality of wastewater discharged to the network, as the quality of raw sewage will effect the biological activities of treatment plants. At the same time, industrial effluent may contain heavy and toxic elements which do not get any treatment in conventional wastewater treatment process and will finally reach the environment and disturb any applicable use of treated wastewater and sludge.

As part of the Swedish project for the upgrading of the Beit Lahia treatment plant in the Northern Governorate, the wastewater treatment plant should be operated in the future to treat the effluent for both sectors, municipal and industrial sewage. For industrial that may be established within the northern area in the future the regional guide lines (Egyptian and Israeli) were recommended for the connection of the industrial effluent to the network and treatment plant:

I- Basic requirements

The industrial waste should meet the following basic requirements:

1- The total amount of industrial wastewater must not exceed 10% of the design flow of the northern TP.

2- The daily total organic pollution, expressed as BOD_5 must not exceed 10% of the plant load and the concentration must not exceed 500 ppm BOD_5.

3- The wastewater should be as easy to treat as the municipal wastewater. This is expressed as a ratio of COD: BOD_5, that should be < 3:1 and the total amount of SS must not exceed 10% of the design amount.

4- Liquid wastes containing pH less than 6.0 or greater than 9.0. and the temperature of the wastewater shall be within the range 5 - 40 oC.

5- The total heavy metals should be limited to less than 10 ppm.

II- Industrial waste should not include:

1. Gasoline; benzene (C_6H_6); oil; solvents such as carbon tetrachloride, chloroform, methyl chloride, tri-chloro-ethylene, halogenic ethane's and their kink; and combustible oils or any liquid, solid or gas that may cause flammable conditions or explode in the sewerage system.

2- Solids of viscous matter in size and quantities likely not to flow smoothly and in so doing cause problems in the purification process, such as: residuals of filter cakes, asphalt, animal carcasses, rubbish, ashes, sand, mud, straw, remnants of industrial

chiseling, tree trunk residue, metal parts, glass, rags, feathers, plastic, wood, plastic bags and other disposable paper or plastic goods, either complete or after scraping or cutting.

3- Cooking oils with a concentration of greater than milligrams per litter (hexane extraction), fats and greasy material such as animal oils, milk, vegetable oils, any kink of mineral oil, and wastes with a concentration below 100 milligrams per litter likely to cause damage to the sewerage system.

4- Mineral oil or oils with a mineral base for cutting machines known as "soluble oil", creating stable suspension in water, or any other kind of oil that is not biodegradable, or any other distillates constituting oil products over 20 milligrams per litter.

5- Cyanides such as CN and other compounds likely to produce hydrogen cyanide in acidic solution in a concentration greater that 20.0 milligrams per litter.

6- Total inorganic and mineral solids dissolved or not dissolved with concentrations greater that 3,500 milligrams per litter and wastes in concentrations less than 3,500 milligrams per litter likely to cause damage to the sewerage system.

7- Dissolved sulfides in concentrations greater than 0.1 milligrams per litter.

8- Chlorohydrocarbon compounds or organophosphorus compounds in concentrations greater than 0.02 milligrams per litter.

9- Chlorine or other active halogen in concentrations greater than 3.0 milligrams per litters.

10- Phenols and cresols in concentrations greater than 3 milligrams per litter.

11- In addition to the above, waste should not include the following stated substances in concentrations greater than those indicated below.

Table 3: Threshold Level of Heavy Metal Concentrations in Industrial Wastewater (Based on Israeli recommendations).

Substance	Maximum Concentration (mg/1)	Substance	Maximum Concentration (mg/1)
Zinc	5.00	Arsenic	0.25
Boron	3.00	Beryllium	0.50
Vanadium	0.50	Aluminum	25.00
Silver	0.05	Mercury	0.005
Chromium	0.25	Lithium	0.30
Molybdenum	0.05	Manganese	1.00
Copper	1.00	Nickel	1.00
Selenium	0.05	Lead	0.25
Cadmium	0.05	Cobalt	0.25

Pretreatment

Depending on the nature of production and quality of the effluent generated from industrial units, a pretreatment (in side treatment) might be required.

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