

"Study of the Wastewater Quality of Some Industries at Amriya District, Alexandria Governorate"

Fahmy EL-Sharkawy*, Olfat EL-Sebaei*, Manal Ahmed*, Mohamed Ramadan*

Abstract: The high increase of industrial development, especially in new industrial zones, will lead to increase the water demand and consequently the wastewater discharge. Amriya district was selected as a case study of the new industrial zones in Alexandria. According to Alexandria Comprehensive Plan for the year 2017, the area will be served by the sewerage network and a treatment plant. The aim is to determine the quality of the wastewater discharged from some selected industries [twenty industries] which represent different types of the industrial sectors and comparison will be made with law 93/1962 that govern the discharge of wastewater into public sewers. The physico-chemical results revealed that eleven industries are in compliance with the law and they can be connected directly with the future sewerage network. The other industries [nine industries] are not in compliance with the law and need pretreatment of their wastewater before connection into the public sewerage network. This study recommended some treatment methods for those industries to give a final treated effluent that is in compliance with the environmental laws.

INTRODUCTION

The high increase of industrial progress, especially in new industrial zones, will increase the water demand and consequently the wastewater discharge. Amriya district is one of the newest industrial complexes [AIC] in Alexandria. The complex is located in the south-west of Alexandria Governorate and it represents about tenth of the city area. Industrial development started in Amriya early of the eighties. The main industrial activities in the Amriya complex encompass: petroleum refining, petrochemical manufacturing, textile

spinning and finishing, pharmaceutical products, soft drinks, and medium scale plants for the manufacturing of carpets, ceramic, detergents,etc.

The industries in the eastern part of the AIC dispose off their effluents into EL-Tahrir drain which in turn leads to EL-Omoum drain; an agricultural drain; then to the Mediterranean sea at EL-Max Bay. Meanwhile, the industrial activities in the western part of the AIC dispose off their wastes into lateral drains which lead to EL-Amriya drain, and then into the north part of EL-Noubaria drain.¹ These industrial

*Environmental Health Dept., HIPH, Alex. Univ.

wastes affect the water quality of the drain. On the other hand, industrial activities in the Free Zone area discharge their wastes mainly into the western basin of Lake Mariut which add much more pollutants to the lake and consequently to EL-Max Bay.

According to Alexandria Comprehensive Plan for the year 2017, the area will be served by the sewerage network and a treatment plant. So, this study aimed to determine the quality of the wastewater discharged from some selected industries which represent different industrial sectors. Comparison will be made with standards of the Egyptian Law No 93/1962 [decree No. 9/1989] which govern the discharge of wastewater into public sewers.

MATERIAL AND METHODS

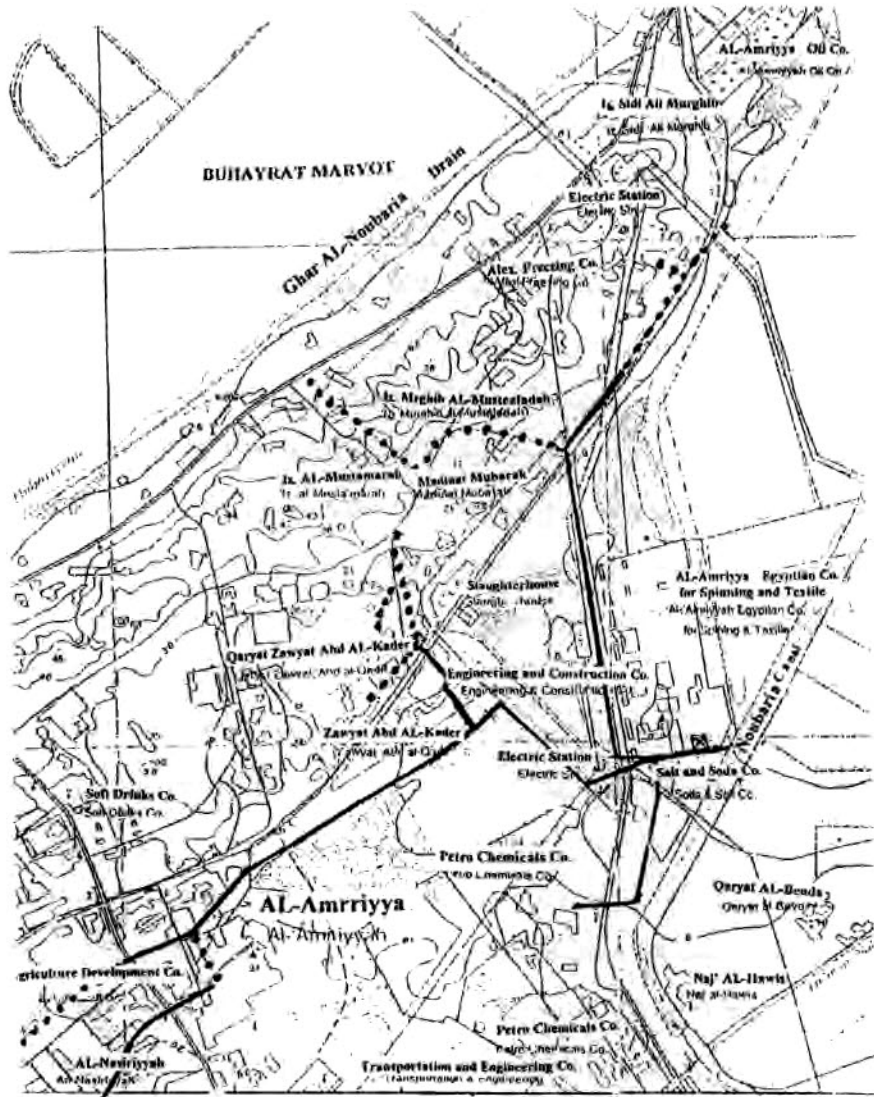
The proposed sewerage network at Amriya is shown on the map [1]. The industries reach about 80; which vary from small, medium, to large industries. From the field survey, it was obvious that, these categories of industry are different in nature and capacity. Therefore, twenty industries

have been selected to carry out comprehensive survey, where each industry represents certain industrial sector.

The detailed information on each selected industry were collected by a designed questionnaire sheet. This sheet includes information about location of the industry, description of the manufacturing process, the quantity of water supply, domestic and industrial wastewater discharges quantities, and analysis of the final wastewater which is generated by the industry.

Samples from the end-of-pipe of each selected industry were collected, preserved, and analyzed according to the Standard Methods for the Examination of Water and Wastewater.² The physico-chemical parameters determined include the following: pH, TDS, TSS, BOD, COD, Phosphate, Nitrate, Ammonia, Oil and Grease, Settleable Solids, and Heavy metals.

The results of the analyses of the final effluent from the selected industries were compared with the standards of the decree No. 9/1989³ to reveal its suitability for discharge into the sewerage network that will



Map (1). The proposed sewerage network at Amriya

Map [1]: The proposed seweragenetwork at amriya

be constructed in the area in the future development.

RESULTS AND DISCUSSION

A) The amount of water consumption and wastewater discharges from the selected industries

According to the field survey, twenty industries were selected to carry out the investigation. The list of industries were presented in table [1] including source of water, water uses, quantity of the daily water consumption and wastewater discharge, and presence of treatment unit for the final waste of each industry.

It is clear that most of the selected industries get their domestic and industrial water from Alexandria Water General Authority [AWGA]. While, EL-Amriya for spinning and weaving, and Amriya petroleum refining use raw water from Noubaria canal as another source of their domestic and industrial water. Also, it is noticed that the highest daily industrial water consumers were Alex. Beverage Industry [ABI], Petrochemical Egyptian Company, Alex. Carbon Black,

Crush, and Misr EL-Amriya for spinning and weaving company [ranged from 1200-1600m³/d]. Consequently, these industries discharge the highest amount of wastewater. The moderate daily industrial water consumers were Slaughter House "Automatic Butchery", British Egyptian Hatcheries, Amriya for synthetic detergents "salt and soda company", Alex for tyres company, and Amriya petroleum refining co. [ranged from 105-500m³/d]. The lowest daily industrial water consumption were those of Alex. paint and chemicals "VELVET", Eveready-Egypt company, Amriya feed factory, Arab Caps, and EL-Nasr casting company [ranged from 2-65m³/d]. Meanwhile, the other remaining industries have no industrial water uses because their manufacturing processes are dry process or the plant is used for the finishing and packaging of the final product only. So, these industries have no industrial wastewater discharge.

It is evident that, most of the selected industries discharge their wastewater into septic tanks which they are evacuated except

Table 1: Water sources, daily water consumption, and wastewater discharge of studied industries at Amriya District(AIC)

Industry Name	Source of water	Wastewater consumption m ³ /d		Wastewater discharge m ³ /d		Presence of treatment unit for the final waste
		Domestic	Industrial	Domestic	Industrial	
1- Alexandria Beverage Industry [ABI]	AWGA	15	1600	15	1100	Present
2- Alexandria Carbon Black [ACB]	AWGA	50	1400	50	970	Not Present
3- EL-Nile Company for Soft Drinks [Crush]	AWGA	7.5	1200	7	1000	Present
4- Misr EL-Amriya for Spinning and Weaving Company	AWGA, Noubaria canal	100	1500	100	1260	Present
5- Slaughter House [Automatic Butchery]	AWGA	30	300	30	300	Not Present
6- Amriya for Synthetic Detergents, Salt, and Soda Company	AWGA	75	360	75	360	Present
7- Amriya Petroleum Refining Company	AWGA, Noubaria canal	75	500	75	500	Not Present
8- British Egyptian Hatcheries	AWGA	25	105	25	30	Not Present
9- Eveready-Egypt Company	AWGA	15	23	15	23	Not Present
10- Amriya Feed Factory	AWGA	9	19	9	19	Not Present
11- Arab Caps	AWGA	20	65	20	65	Not Present
12- EL-Nasr Casting Company	AWGA	100	40	100	40	Not Present
13- Alex. Paints and Chemicals [VELVET]	AWGA	5	3	5	1.3	Not Present
14- Amriya Industry and Trading Paper	AWGA	10	NO	10	NO	Not Present
15- EL-Nile for Pharmaceutical and Chemical Industry	AWGA	1.5	NO	1.5	NO	Not Present
16- EL-Nasr Clothes and Woven Company	AWGA	3	NO	3	NO	Not Present
17- Misr Cables Company	AWGA	0.5	NO	5	NO	Not Present
18- Petroject Company	AWGA	15	NO	15	NO	Not Present
19- Alex. for Tyres Company	AWGA	40	160	40	160	Not Present
20- Petrochemical Egyptian Company	AWGA	160	1600	160	1600	Not Present

NB NO= It means no consumption of industrial water as these industries have dry processes

Slaughter house which discharges its wastewater into Amriya drain; ABI, Misr EL-Amriya for spinning and weaving company, and Amriya for synthetic detergents discharge their wastewater into Noubaria drain; and Amriya petroleum refining company discharges its wastewater into Lake Mariut. It is also noticed that there is no water re-circulation system in most industries and there are four industries applying biological treatment process for the effluents [ABI, Misr EL-Amriya for spinning and weaving company, Amriya petroleum refining company, and slaughter house].

The questionnaire results revealed that all industries do not keep any record of their wastewaters analyses results.

B) Physico-chemical analyses of the final effluent from the twenty selected industries

The physico-chemical characteristics of the final effluents of the selected industries carried out in this study are presented in tables [2&3]. The results of the industrial wastewater analysis which are in compliance with the standards of decree No. 9/1989, are

presented in tables [2[A&B]]. These were due to the following reasons :

- 1- EL-Nasr clothes and woven company, where this site is used only as storing house for the main factory and the waste generated is only domestic waste.
- 2- VELVET plant, where there is no spills or entrapping of any raw materials paste into sewage, and it has a good control system in preparing their products.
- 3- EL-Nile for pharmaceutical and chemical industries since it is used as a marketing branch for the products delivered from the main branch which is located in Cairo.
- 4- Petrochemical Egyptian Company that produces a variety of chemicals as PVC, Cl_2 , ...etc. Each production unit has a separate treatment unit [separation or settling unit] and the overflow from each unit is collected to a final septic tank. This is in agreement with that finding by Yakan.⁴
- 5- Alexandria Carbon Black produces carbon black, steam, and electricity. There is a separation drainage line of industrial wastewater from that of domestic waste and the wastewater is well managed inside the company.

Table [2-A]: Average physico-chemical analysis of the final effluent of the selected industries which are in compliance with the standards

Parameter	pH	TDS	TSS	COD	BOD	PO ₄ -P	NO ₃ -N	NH ₃ -N	NG & O	Settleable Solids [ml/l]	COD/BOD	
Industry Name	[units]	[mg/l]	[mg/l]	[mg/l]	[mg/l]	[mg/l]	[mg/l]	[mg/l]	[mg/l]	10'	30'	
1- EL-Naar Clothes and Woven Company	7.8	573	129	520	300	3.5	<0.05	18	10	2.5	3	1.73
2- Alex. Paints and Chemicals [VELVET]	7	449	270	480	280	3	<0.05	0.08	16	3	3.5	1.7
3- EL-Nile for Pharmaceutical and Chemical Industry	7.5	696	36	320	220	4.5	<0.05	32	19	0.02	2	1.5
4- Petrochemical Egyptian Company	7	732	47	240	180	2.5	0.08	8	30	ND	ND	1.33
5- Alex. Carbon Black [ACB]	7	835	33	420	300	4	<0.05	30	ND	ND	ND	1.4
6- Misr for Cables Company	There is no industrial wastewater											
7- Amriya Feed Factory	6.4	305	203	400	370	1.6	0.12	1.04	ND	ND	ND	1.08
8- Slaughter House [Automatic Butchery]	7.5	500	20	220	180	0.5	0.05	0.28	ND	0.1	0.2	1.22
9- Alexandria Beverage Industry [ABI]	7.9	1993	55	80	60	0.45	0.05	0.14	9.2	ND	ND	1.33
10- Eveready-Egypt Company	7.4	695	522	400	280	0.5	<0.05	12	48	1	1.2	1.43
11- EL-Naar Coating Company	7.5	1726	358	58	38	0.4	<0.05	0.08	41	0.1	0.1	1.53
Standards of Decree No. 9/1989	6 to 10	2000	500	700	400	5	30	100	100	5	10	

NB ND: Not Detected

Table [2-B]: Analysis of the heavy metals of the final effluent of the selected industries which are in compliance with the standards

Parameter	Cd	Cr	Cu	Ni	Pb	Zn	Total
Industry Name	[mg/l]	[mg/l]	[mg/l]	[mg/l]	[mg/l]	[mg/l]	[mg/l]
1- EL-Naar Clothes and Woven Company	0.001	0.005	0.005	0.003	0.012	0.042	0.068<1
2- Alex. Paints and Chemicals [VELVET]	0.002	0.017	0.014	0.02	0.02	0.016	0.089<1
3- EL-Nile for Pharmaceutical and Chemical Industry	0.001	0.002	0.02	0.08	0.028	0.095	0.208<1
4- Alexandria Carbon Black [ACB]Petrochemical Egyptian Company	0.003	0.006	0.051	0.043	0.026	0.231	0.36<1
5- Eveready-Egypt Company EL-Naar Coating Company	ND	0.002	ND	0.005	0.23	0.344	0.644<1
6- Alexandria Beverage Industry [ABI]	0.066	0.012	0.317	ND	0.071	0.255	0.721<1

NB ND: Not Detected. Limits of the decree No. 9/1989 for total heavy metals = 1mg/l

- 6- Misr for cables company has no wastewater because this site is used as a storage site and if there is a waste it will be a domestic waste from the security people.
- 7- Amriya food factory produces animal feed. The main source of wastewater is cooling water. The combination of cooling water and domestic wastewater are discharged into septic tank.
- 8- Slaughter House "Automatic Butchery" uses animals as a raw material and there is no addition of chemicals in the production process. The plant has biological treatment unit [Activated Sludge] used for treatment of mixed domestic and industrial wastes before discharge into west Noubaria drain. The results of the analyses of the treated effluent are in agreement with decree No. 9/1989, but they are not in compliance with article 66 of law 48/1982⁵ which governs the discharge of the waste into drains especially for the BOD and COD [220 & 180 mg/l, respectively]. The biological unit is not highly efficient in removing all the organic load. So, the treated effluent must be connected to the future public sewers or the efficiency of the biological unit must be improved before discharge of the waste into the drain.
- 9- Alexandria Beverage Industry [ABI] produces five kinds of soft drinks named, Cola, Sprite, Fanta Orange, Fanta Apple, and diet cola. The industrial waste is treated separately from domestic waste by screening, oil and grease removal, pH adjustment, and biological treatment using Uni-tank technology. The final treated effluent is discharged into Amriya drain which is in compliance with the standards of 48/1982 [article 66] and Decree No. 9/1989. Meanwhile, the analysis of the raw waste of ABI before treatment carried out by Shawky⁵ revealed that the raw waste can be connected into public sewerage network if neutralized before discharge.
- 10- Eveready-Egypt company produces dry batteries. The process of production includes manufacturing of batteries parts,

assembling, and packaging. The wastewater analysis was done only for domestic waste where they re-circulate the industrial wastewater after filtration into the production processes. As, industrial waste of this company was difficult to collect and analyses during this study, it is expected that the waste after certain time of re-circulation will contain toxic heavy metals [especially zinc and lead] which are used in the production process. The heavy metals should be removed before connection into public sewers.

11- EL-Nasr casting company produces ductile cast iron, fitting flanges, and valves. The wastewater is drained into settling tank to remove settleable solids and then into a septic tank. The analyses of the waste are within the limits of the decree 9/1989. So, it can be easily connected with public sewer.

Also, it is clear that the heavy metals analysis of the final effluent of the previous eleven industries are less than the limits of the decree No. 9/1989. So, they can be

connected directly into the sewerage network which will be implemented in the future.

The results of the physico-chemical analyses of the final effluent of the industries that are not in compliance with the standards of decree No. 9/1989 are presented in table [3[A&B]] and figure [2].

These industries are:

- 1- The British Egyptian Hatcheries which produces different types of products as Breeder, Hatchery, concentrated feed, and feed meal. The analysis of the final wastewater which is discharged into septic tanks shows that most of the measured parameters are in compliance with decree No. 9/1989, except TSS. The high value of TSS [1046 mg/l] need to be treated by physical and/or chemical processes to remove SS before discharging into the sewerage network.
- 2- EL-Amriya for trading paper is used only for paper finishing. The measured parameters of the wastewater are not in compliance with the decree for TSS, COD, and BOD [2837, 1960, and 1000mg/l, respectively]. The high value of

Table [3-A] : Average physico-chemical analysis of the final effluent of the selected industries which are not in compliance with the standards

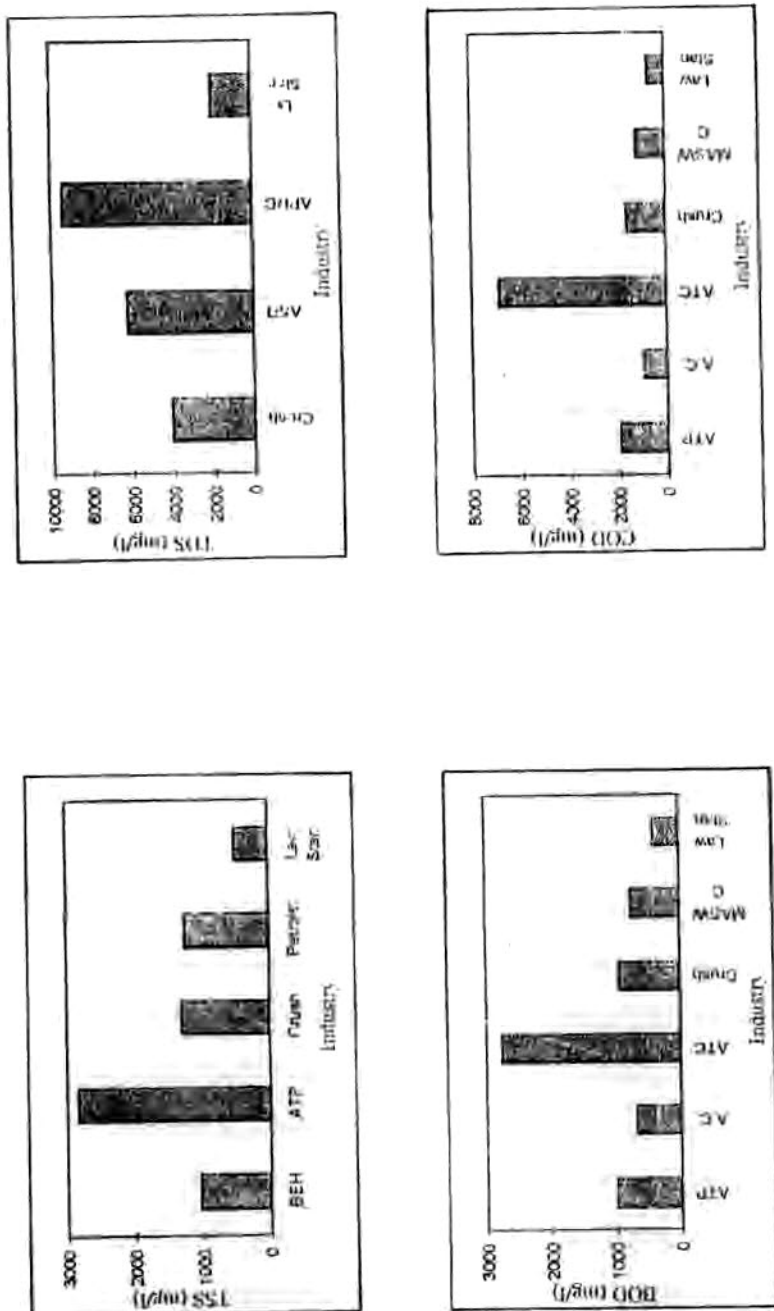
Parameter	pH	TDS	YSS	COD	BOD	PO ₄ -P	NO ₃ -N	NH ₃ -N	G & O	Settleable Solids [ml/l]	COD/BOD	
Industry Name	[units]	[mg/l]	[mg/l]	[mg/l]	[mg/l]	[mg/l]	[mg/l]	[mg/l]	[mg/l]	10'	30'	
1- British Egyptian Hatcheries	7.7	561	1046	640	450	0.7	0.1	60	6.8	ND	ND	1.42
2- EL-Amriya for Trading Paper	6.9	785	2837	1960	1000	11.5	0.05	28	12	49	50	1.96
3- Arab Caps	6.8	823	475	960	690	0.55	0.12	12	20.4	ND	ND	1.39
4- Alex. for Tyrese Company	5.1	1197	ND	6912	2760	ND	ND	ND	145	ND	ND	2.5
5- EL-Nile for Soft Drinks Company [Crush]	11.8	4084	1309	1600	940	0.51	<0.05	ND	0.2	6.5	9	1.7
6- Misr EL-Amriya for Spinning and Weaving Co.	11.1	1240	350	1200	750	6.25	0.16	0.36	51	4	5	1.6
7- Amriya for Synthetic Detergents	7.6	6249	203	290	120	1.8	0.5	1.2	30	0.05	1.3	2.4
8- Amriya for Petroleum Refining Company	7.7	9380	15	70	35	2	0.5	0.8	ND	0.1	0.1	2
9- Petrojet Company	7	401	1256	260	200	5	0.05	4	25	1	1.5	1.3
Standards of Decree No. 9/1989	6 to 10	2000	500	700	400	5	30	100	100	5	10	

NB ND: Not Detected

Table [3-B] : Analysis of the heavy metals of the final effluent of the selected industries which are not in compliance with the standards

Parameter	Cd	Cr	Cu	Ni	Pb	Zn	Total
Industry Name	[mg/l]	[mg/l]	[mg/l]	[mg/l]	[mg/l]	[mg/l]	[mg/l]
1- British Egyptian Hatcheries	0.001	0.026	0.011	0.001	0.094	0.608	0.741<1
2- EL-Amriya for Trading Paper	0.002	0.016	0.085	0.023	0.078	0.113	0.317<1
3- Arab Caps	0.001	0.007	0.019	ND	0.003	0.381	0.411<1
4- EL-Nile for Soft Drinks Co. [Crush]	0.001	0.011	0.013	0.004	0.024	0.78	0.833<1
5- Amriya for Synthetic Detergents	0.001	0.016	0.01	0.011	0.01	0.007	0.055<1

NB ND: Not Detected. Limits of the decree No. 9/1989 for total heavy metals = 1mg/l



AE: BEH: British Egyptian Helium — ATP: El-Amra (el Trading) — A.C.: Also Coat — ATC: Avestal (el Trading) — MARIN: M.V. El-Amra (el Spinning and Weaving) Co.
 ASD: Amra (el Synthetic Detergent) — APIC: Amra (el Petroleum Refining) Co. —

Figure 2: Comparison between the industries which are not in compliance with decree no. 9/1989 of law 93/1962 for Tss, TDS, BOD and COD parameters with the standard law limits.

TSS was due to washing of the floors carrying with it suspended solids resulting from cutting process of the paper which are cellulosic and lignocellulosic materials. They affect the values of both BOD and COD. These results are similar to those found by Saad and Hamza.⁷ Hence, the waste must be pretreated by coagulation and settling to remove suspended solids before connection to public sewer.

- 3- Arab Caps produces hard capsules, where the main raw materials used are gelatin and food colors. The characteristics of its wastewater for BOD and COD values are 690 & 960 mg/l, respectively which were higher than the limits of decree No. 9/1989. This may be due to seepage of raw materials during manufacturing process. Therefore, the company needs proper housekeeping for in-plant control and/or biological treatment of the waste before connection into the public sewers.
- 4- Alexandria for tyres company produces large sized tyres. It has five collection septic tanks. The heavily polluted tank

was at the kitchen site, which is attributed to the high oil and grease content [145 mg/l] that are accumulated for several months. The grease coats the sewer, thus reducing its flow capacity and causes troubles in the pumping station as it forms heavy scum blanket with the resulting disposal nuisance. So, the floating matter can be recovered using efficient traps at the source of generation. Then, the company must install internal sewerage network. The mixing of the wastewater from the different buildings will equalize the wastewater characteristics. The finally equalized waste can be discharged into the public sewer.

- 5- EL-Nile company [Crush] produces four types of soft drinks which are namely Sport Cola, Canada Dry, Lemon Crush, and Orange Crush. The physico-chemical characteristics of the final wastewater are higher for pH, TDS, TSS, BOD, and COD than the limits. This is due to seepage of the raw material [especially sugar] during manufacturing process that increase BOD, COD, and TDS. Also, the use of

sodium carbonate in the production process increase pH and the washing of the bottle from dirt increase TSS. Therefore, good housekeeping is necessary, then the waste must be treated biologically to comply with the limits of decree No. 9/1989.

- 6- Misr EL-Amriya for spinning and weaving company produces yarns, cotton products, different kinds of cloths, bed sheets, beach towels, and table cloths. The wastewater is discharged into an open pit then into the down stream of west Noubaria drain. The characteristics of the final waste show that the COD, BOD, pH, and TDS values are exceeding both the limits of the law 48/1982 [article 66] and decree 9/1989. The high values of COD and BOD are due to the use of dyes and printing materials during the finishing process. Also, the desizing and scouring processes are the main sources of the organic load. The high TDS is due to use of slightly brackish water of Noubaria canal as a source of process water which is softened to remove TDS. The results of

COD and BOD values are in agreement with that found by Saad et.al.⁸ They characterized textile wastes from UNIRAP [United Arab for spinning and weaving co.] [COD/BOD=1728/760] and EL-Siouf spinning and weaving co. [COD/BOD=1689/735]. They stated also that the high phosphate content originated from the surface active agent used in the kier boiling of the cotton to remove part of the natural impurities of the fiber. Although, the company has biological treatment unit but it is not operated due to failure of some parts of it. So, it must be rehabilitated and re-operated to give a treated effluent that is in compliance with standards of article 66 of law 48/1982 and decree 9/1989.

- 7- Amriya for synthetic detergents "Salt and Soda Company" discharges its wastewater into separate drain which is finally pumped to west Noubaria drain. The physico-chemical characteristics of the final waste are not in compliance with law 48/1982 but they are in compliance with decree No. 9/1989 except for the

- TDS. These results agree with a study carried out by EL-Shall⁹ who reported that the effluent of Alexandria oil and soap company had high TDS.
- 8- Amriya for petroleum refining company produces various types of petroleum products. Its waste is treated by lime, then discharged to the sedimentation unit to be settled, and finally to the secondary treatment unit [Activated Sludge]. The final treated effluent is discharged into Lake Mariut. The analysis results of this waste are within the limits of both article 66 of law 48/1982 and decree 9/1989 except for TDS which is due to the use of brackish water from Noubaria canal as a source of water supply. So, the waste must be treated to remove TDS before discharge into Lake Mariut or even if connected into public sewer.
- 9- Petrojet company is a contractor company for manufacturing of pipes, connections, and installation of pipe lines. There is no industrial waste generated and the only waste is domestic which discharged into a septic tank. The analysis of this waste are

within the limit of decree No. 9/1989 except for SS which results from cleaning of the floor which contain some fine scraps from manufacturing of pipes. Therefore, the waste must be treated to remove SS by coagulation and sedimentation before connection to the public sewer.

The heavy metal results presented in table [3-B] are within the permissible limits of decree 9/1989.

CONCLUSION AND RECOMMENDATIONS:

The survey includes twenty industries in Amriya region. According to the results of the analysis of domestic and industrial waste samples, it can be classified into two categories:

The first category includes those industries [eleven] which their wastes are in compliance with the limits of decree No. 9/1989 and allow them to be connected into the public sewer network. The second category includes industries [nine] which their wastes are not in compliance with the limits of decree No. 9/1989 and need to be treated before discharge into public sewers.

It was found that there are four industries with higher BOD and COD than the limits [Amriya industry for trading paper, Arab-Caps, Alex. for tyres, and Misr EL-Amriya for spinning and weaving]. One industry has a high TDS in addition to BOD and COD [Crush]. Two industries have high TDS than the limits [Amriya for synthetic detergents and Amriya for petroleum refining co.]. The last two industries have high TSS [British Egyptian Hatcheries and Petrojet]. Therefore, these industries need to be pretreated before connection to the public sewerage system.

Finally, it is recommended to separate the industries which generate wastewater containing harmful substances as Everready company [heavy metals], Amriya petroleum refining, and Petrochemical Egyptian company [toxic substances]. While, the other industries must be pretreated physically, chemically, and/or biologically to remove suspended solids, dissolved organics before connection into sewerage network. The following are recommended treatment methods for the industries which are not in compliance with the law limits.

Industry Name	Recommended treatment method
- Petrojet	Coagulation and sedimentation for suspended solid removal
- British Egyptian Hatchery	Biological treatment for BOD and COD removal
- EL-Nile for Soft Drinks	
- Arab Caps	
- Alexandria for tyres company	
- Amriya for trading paper	
- Misr EL-Amriya for spinning and weaving co.	
- Amriya Petroleum Refining Co. - Amriya for Synthetic Detergents [Salt and Soda Factory]	Advanced treatment for TDS removal [Ion exchange, reverse osmosis, ...etc.

REFERENCES

- 1- Shawky SM. Environmental Impact Assessment for Amriya Industrial Complex. Ph.D. thesis, HIPH, Alexandria University 1997.
- 2- APHA, AWWA, WEF. Standard Methods for the Examination of Water and Wastewater. 1995, 19th Ed. American Public Health Association, Washington, Dc. 20005.
- 3- Law 93/1982, Decree 9/1989. Related to wastewater disposal into sewerage system, Ministry of Housing and development.
- 4- Yakan MA. Partial treatment of raw water and wastewater of Egyptian Petrochemical Company at Amriya. Master thesis, Institute of Graduate Studies and Research, Alexandria University 1993.
- 5- Law 48/1982 Related to Protection of River Nile and Water Streams from Pollution, Ministry of Irrigation.
- 6- Shawky SM. Wastewater treatment and optimization of Beverage Industrial Waste. Master Thesis. HIPH, Alexandria University 1990.
- 7- Saad S, Hamza A. Pilot studies for removal of trace metals of Alexandria. The Bulletin of High Institute of Public Health. 1985, XV, 2, 219.
- 8- Saad S, Taha S, Masry A, Zaki M, Maksoud A. Biotoxicity evaluation of textile industrial waste. The Bulletin of High Institute of Public Health. 1982, XII, 4, 69.
- 9- EL-Shall W. Reuse of dissolved solids wastewater in Edible Oil Industry. The Bulletin of the High Institute of Public Health. 1994, XXIV, 4, 1001.