RESULTS AND DISCUSSION

4. RESULTS AND DISCUSSION

4.1. Physical, chemical characteristics and heavy metals concentration of raw waste-water materials:

The chemical analysis and metals concentration of the raw waste-water produced from two sources of oil and soap industrial company at Kafr El-Zayat during the period from June to October 2000 are shown in Tables (1 and 2) and illustrated in Figs (1a-r and 2a-f).

The obtained results showed that the pH value ranged from 10.86 to 11.98 and the average value was 11.42, but the turbidity values of waste-water from two sources were 1220 and 1618 at the average of 1414 NTU.

Also, the raw waste-water contains a considerable concentration of total solids. The average of total dissolved solids and total suspended solids were 3114 mg/L and 23434 mg/L for two sources, respectively.

Oil and grease concentration ranged between 12537 and 4965 mg/L and the average value was 8751 mg/L.

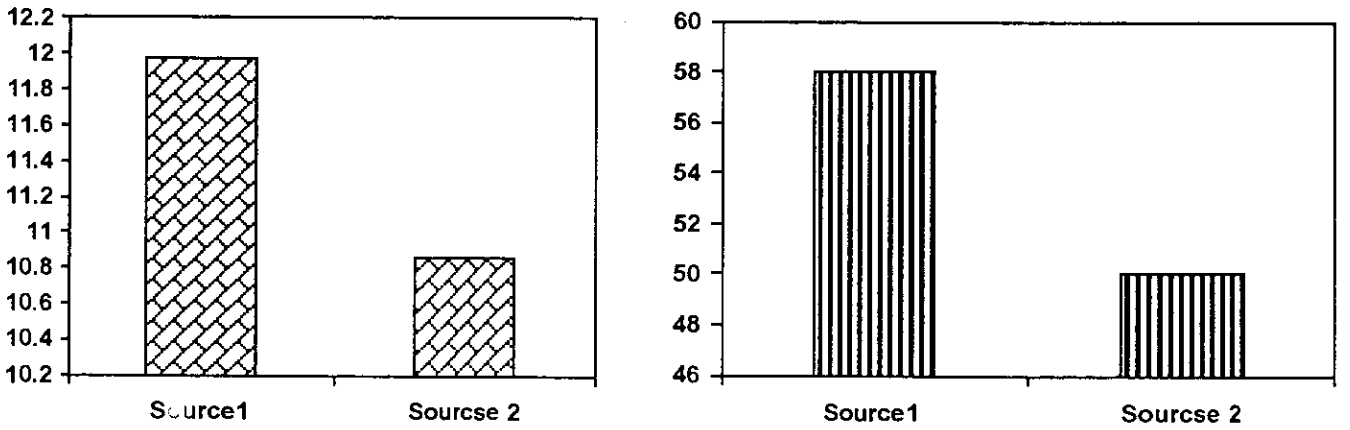
Moreover, the Biological Oxygen Demand (B.O.D.) and Chemical Oxygen Demand (C.O.D.) average for two sources were 2890 and 4594 mg O_2/L, respectively.

From the above mentioned results, it can be seen that the (C.O.D.) was much higher than its (B.O.D.).

Table (1): Physical and chemical characteristics of the raw waste water produced from two sources of the Oil and Soap Company, Kafr El-Zayat during June to October 2000.

Parameters	Before treatment		Standard
	Source (1)	Source (2)	
pH	11.98	10.86	6-9
Temperature (°C)	58	50	-
Turbidity (NTU)	1220	1618	50 NTU
Electerical conductivity (E.C., µmol/cm)	3422	5476	-
Biological Oxygen Demand (mg O_2/L)	3620	2160	60
Chemical Oxygen Demand (mg O_2/L)	5498	3690	100
Permanganate value (mg/L)	1448	874	25
Dissolved oxygen (mg O_2/L)	Nil	Nil	Up to 4 mg/L
Total dissolved solids (mg/L)	2395	3833	2000
Total suspended solids (mg/L)	21148	25720	60
Oil and grease (mg/L)	12537	4965	15
Total hardness	1421	1358	-
Calcium hardness (mg/L)	807.84	997.92	-
Magnesium hardness (mg/L)	416.16	514.08	-
Sodium (mg/L)	928	802	-
Sulphides (mg/L)	10.52	5.48	1.0
Inorganic phosphates (mg PO_4^{-3}/L)	45.60	36.80	5.0
Florides (mg/L)	5.20	8.24	1.0
Colon count/100 cm^3	18020	12318	5000

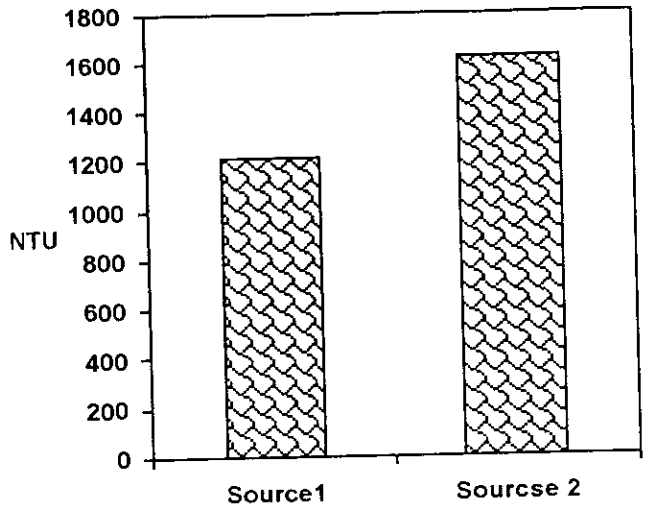
Source (1): Oil filing 1 & 2, refining, soap stock + FAS chloro alkali.
Source (2): Boiler house, silicate, detergents, cooling water.



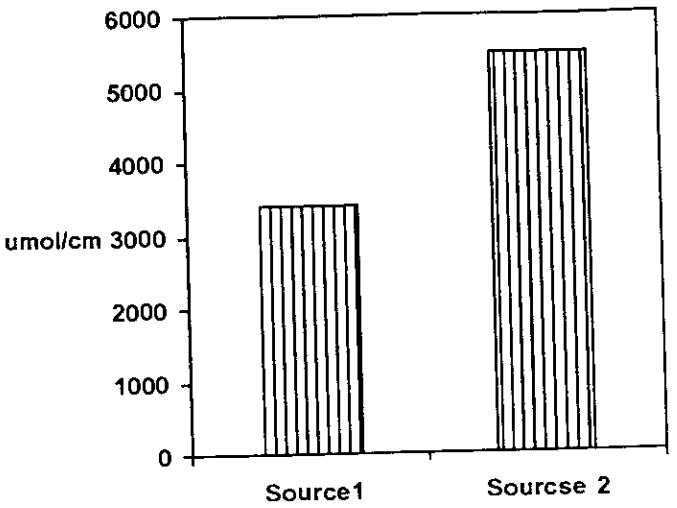
a) pH value

b) Temperature (°C)

Fig. (1): Mean values of physical and chemical characteristics of the raw waste water produced from two sources of the Oil and Soap Company, Kafr El-Zayat during June to October 2000

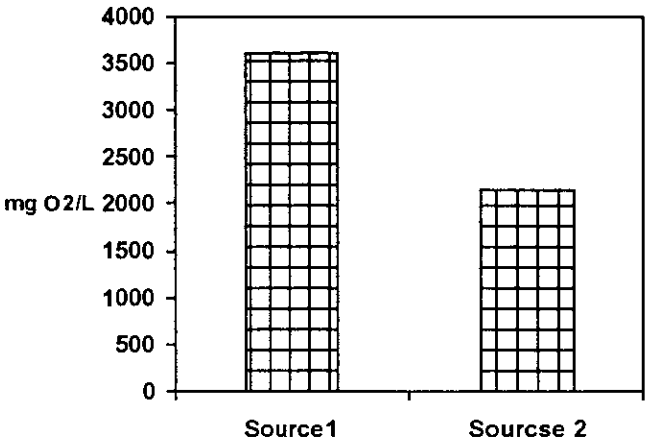


c) Turbidity

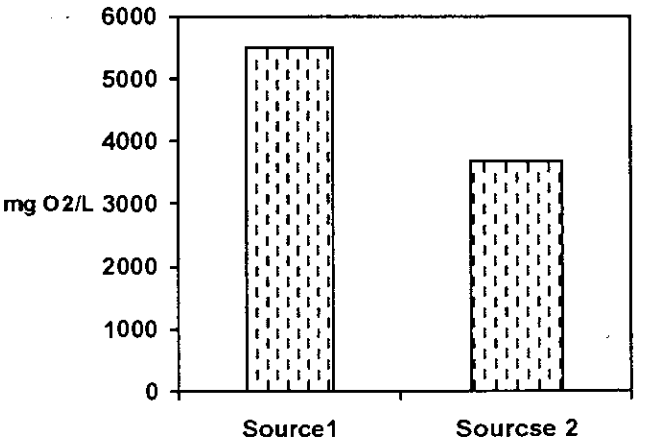


d) Electerical conductivity

Fig. (1): Cont.

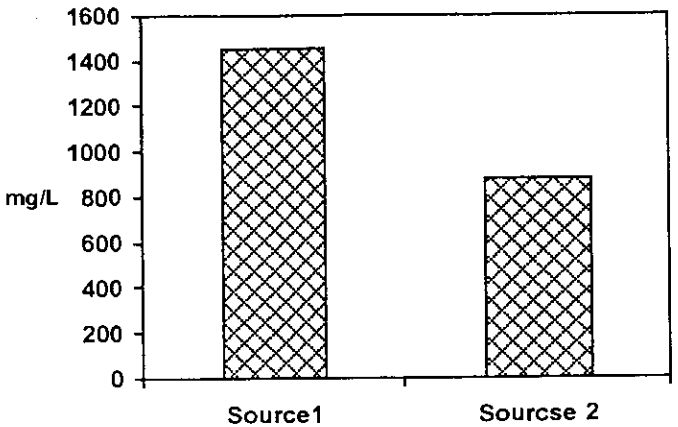


c) Biological Oxygen Demand

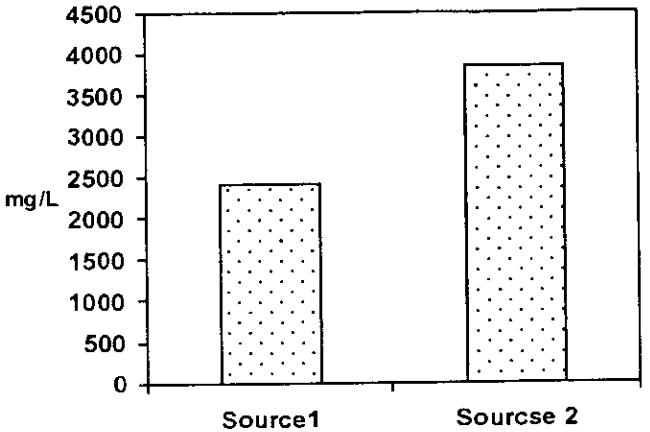


f) Chemical Oxygen Demand

Fig. (1): Cont.

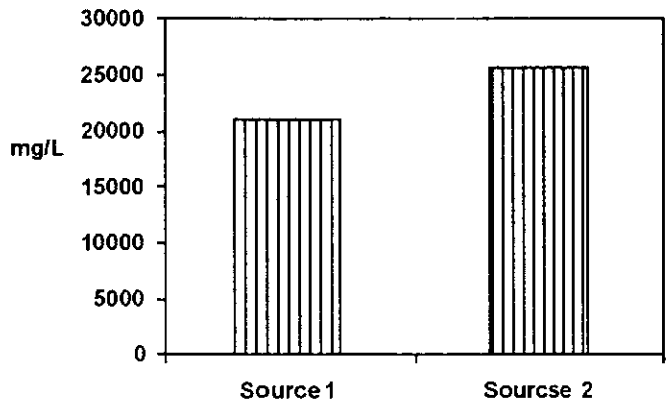


g) Permanganate value

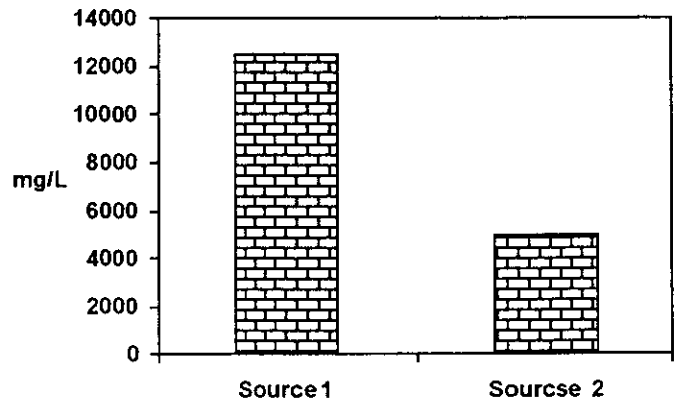


h) Total dissolved solids

Fig. (1): Cont.

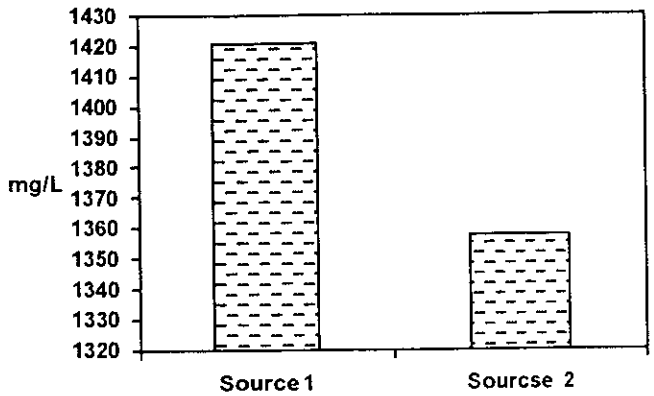


i) Total suspended solids

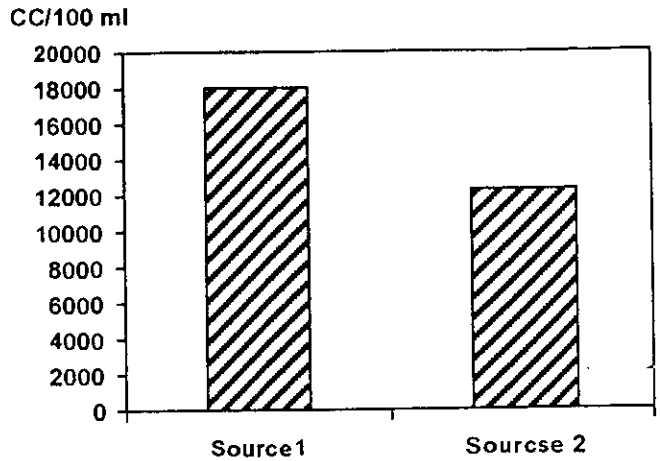


j) Oil and grease

Fig. (1): Cont.

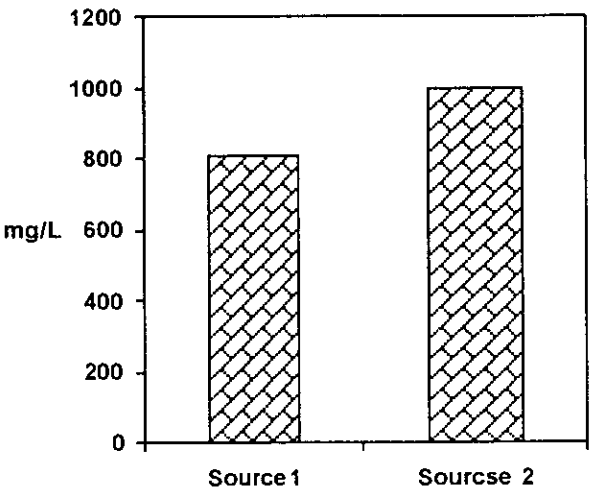


k) Total hardness

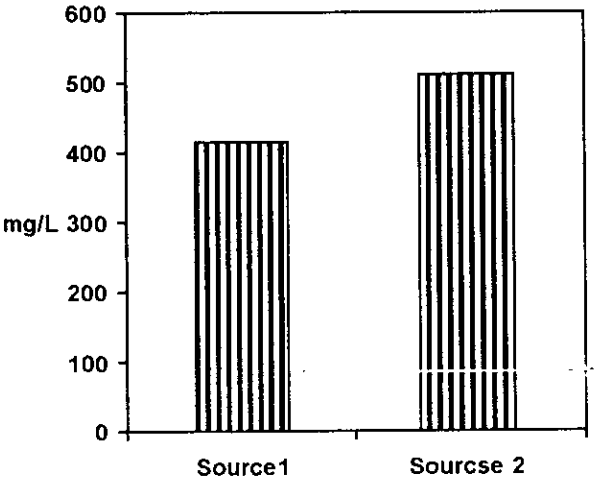


l) Colon count

Fig. (1): Cont.

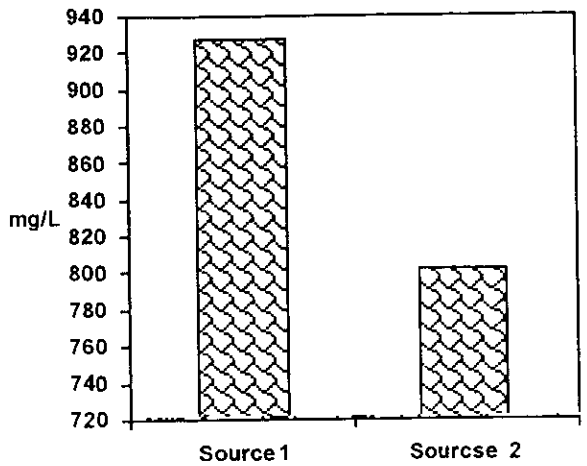


m) Calcium

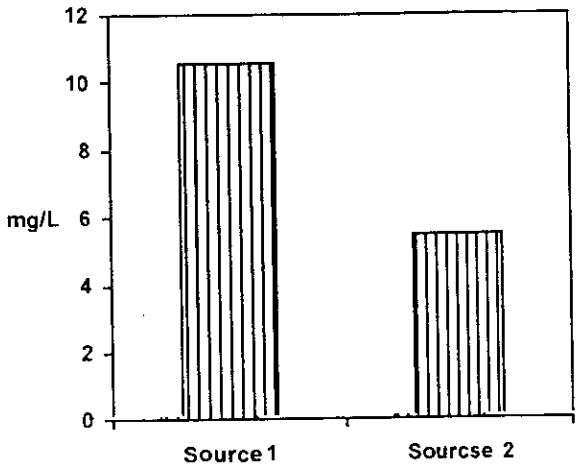


n) Magnesium

Fig. (1): Cont.

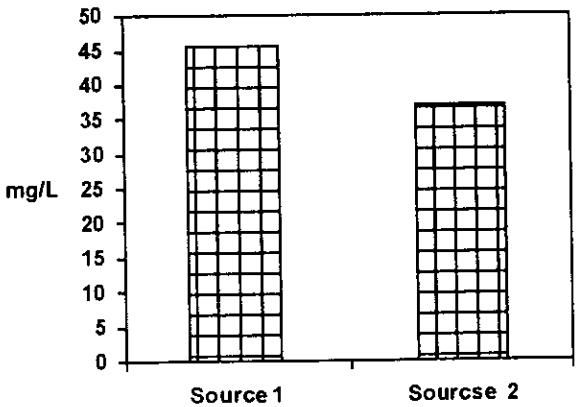


o) Sodium

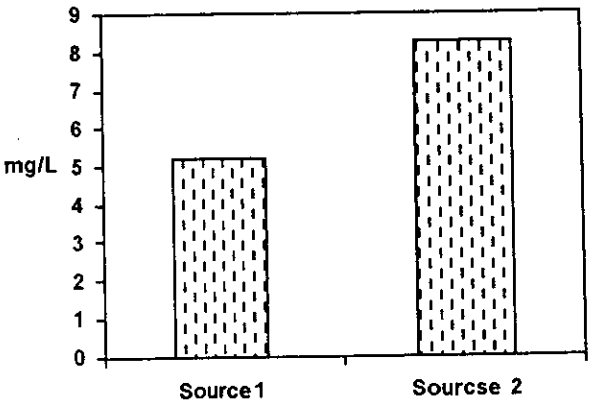


p) Sulphides

Fig. (1): Cont.



q) Inorganic phosphate



r) Florides

Fig. (1): Cont.

These values are in agreement with those obtained by Abou-Elela *et al.* (1990). However, the permangnate value, calcium hardness, Magnisum hardness, sodium, sulphides, inorganic phosphate and florides concentration were recorded to be 1161.0. 902.88, 465.12, 865, 8.0, 41.2 and 6.72 mg/L, respectively.

From the overall results which tabulated in Table (1) it has been observed that the final effluent from oil and soap industry was highly contaminants with organic as well as inorganic pollutants, Mahrous (1992). Also, the raw waste-water under investigation contains several heavy metals i.e. iron, manganese, zinc, nickel, lead and copper were determined. The heavy metals concentration were 3.31, 3.15, 7.94, 2.38, 2.25 and 3.22 mg/L, respectively (Table 2 and Figure 2a-f).

The above results indicated that the heavy metals concentration were slightly higher than that of Abdel-Shafy (1992).

4.2. Treatments of industrial raw waste-water from Oil and Soap Company.

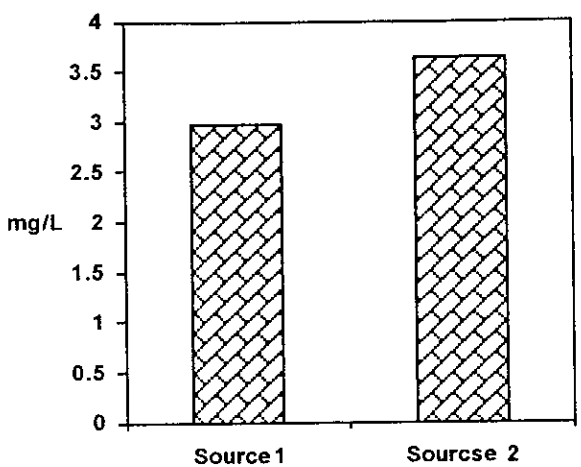
4.2.1. Effect of dilution of waste-water by artesian water on the chemical characteristics and heavy metals concentration of wastes during November 2000 to January 2001.

Industrial waste water treatment may be required for a variety of reasons, depending on the location of the industrial plan, the regulations governing the discharge of effluents and the

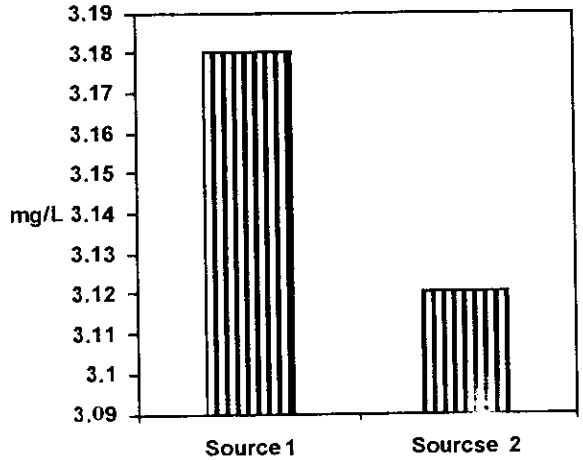
Table (2): Heavy metals concentrations of the raw waste water produced from two sources of the Oil and Soap Company, Kafr El-Zayat during June to Octoher 2000.

Element (mg/L)	Before treatment		Standard
	Source (1)	Source (2)	
Iron	2.98	3.64	1.5
Manganese	3.18	3.12	1.0
Zinc	7.90	7.98	5.0
Nickel	2.28	2.48	0.1
Lead	2.20	2.30	0.5
Copper	3.18	3.26	1.5

Source (1): Oil filing 1 & 2, refining, soap stock + FAS chloro alkali.
Source (2): Boiler house, silicate, detergents, cooling water.

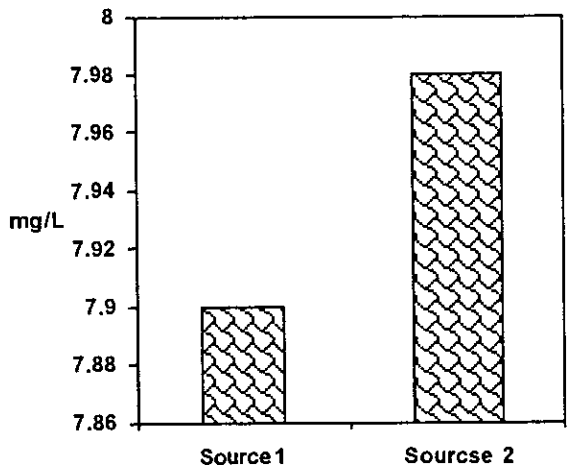


a) Iron

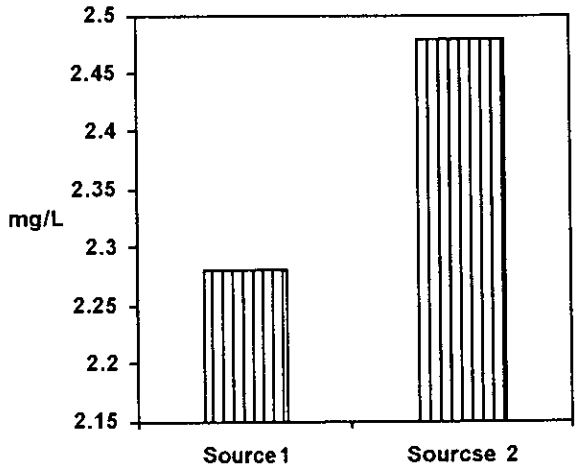


b) Mangnese

Fig. (2): Mean values of heavy metals concentrations of the r(raw waste water produced from two sources of the Oil and Soap Company, Kafr El-Zayat during June to October 2000

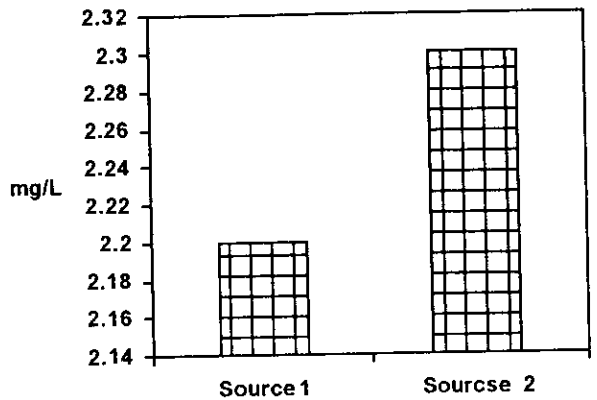


c) Zinc

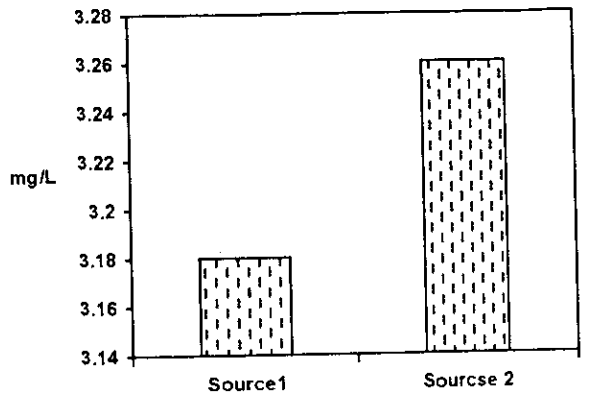


d) Nickel

Fig. (2): Cont.



e) Lead



f) Copper

Fig. (2): Cont.

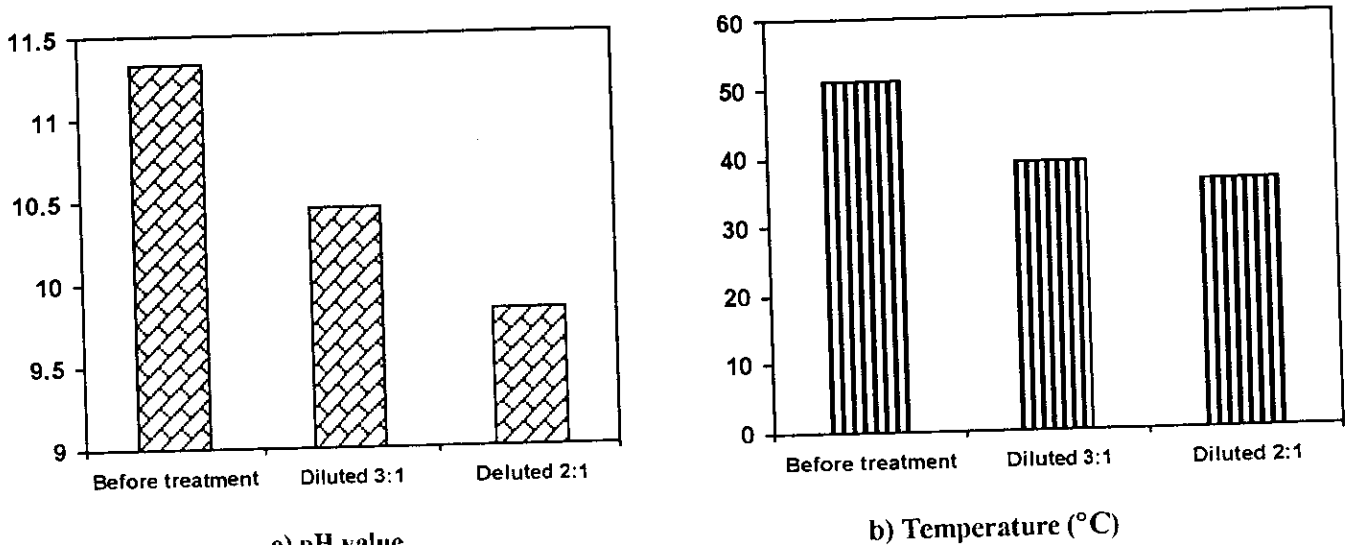
availability and economics of process water. Various waste constituents may have to be removed before discharge, Katsuyama (1980). Some of these constituents are soluble organics, suspended and dissolved solids, heavy metals, toxic organics, color and turbidity, oil and grease and floating material. The two considerations of primary very significance in planning waste-water re-use projects are public health and economics. Considerable water economy, however, can be achieved if the waste water is treated in such a manner as to render it suitable for reuse, Salvato (1982).

One of the main problems in the treatment of oil and soap industry waste water was its high content of solids and foam. The design of systems for dissolving solid are remove of varies widely with the technical method. Most systems require the removal of both suspended solids and dissolved organic solids prior to industrial waste water treatment. First treatment process was carried out by dilution of industrial waste water resulting from Oil and Soap Company at Kafr El-Zayat with fresh water from artesian water at the ratio of 3 : 1 and 2 : 1 i.e. three and two volumes of waste-water to one volume of fresh artesian water.

Tables (3 and 4) and Figures (3a-r and 4a-f) shows the data related to the chemical analysis characteristics of the waste-water before and after dilution with fresh artesian water. The obtained results indicated that the oil and grease reduce efficiency was 23.19% and 26.85% after diluted at the ratio 3 : 1 and 2 : 1, respectively.

Table (3): Effect of dilution by artesian water on physical and chemical characteristics of waste-water during November 2000 to January 2001.

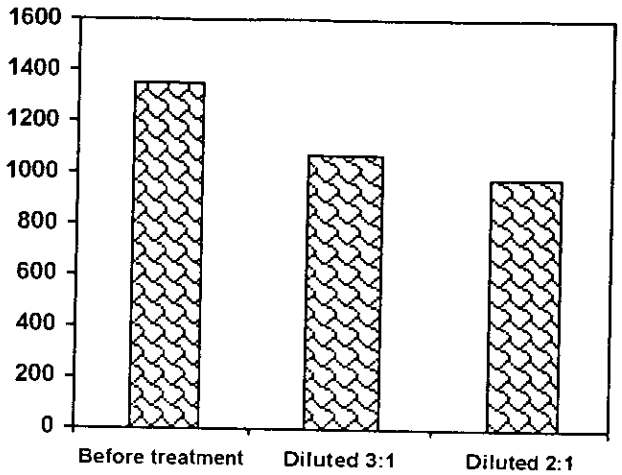
Parameters	Before treatment	Waste: water 3 : 1	Efficiency %	Waste: water 2 : 1	Efficiency %	L.S.D. at 0.05
pH	11.33	10.46	7.76	9.83	18.79	0.15
Temperature (°C)	51	39	22.58	36	28.99	1.15
Turbidity (NTU)	1353	1068	19.67	982	27.36	20.85
Electerical conductivity (E.C., µmol/cm)	4491	4310	4.05	4009	10.75	17.50
Biological oxygen demand (mg O_2/L)	2875	2372	17.50	2129	25.95	59.09
Chemical oxygen demand (mg O_2/L)	4689	4078	13.05	3865	17.57	79.57
Permanganate value (mg/L)	1172	994	15.11	948	19.12	54.25
Dissolved oxygen (mg O_2/L)	-	0.29	-	0.43	-	0.03
Total dissolved solids (mg/L)	3144	3017	4.04	2806	10.75	11.92
Total suspended solids (mg/L)	23398	22134	5.36	21060	9.99	82.61
Oil and grease (mg/L)	8792	6753	23.19	6430	26.85	818.42
Total hardness	1373	1195	12.19	1096	20.17	23.88
Calcium hardness (mg/L)	907	789		723		15.76
Magnesium hardness (mg/L)	467	406		373		8.12
Sodium (mg/L)	843	787	6.53	701	16.74	4.28
Sulphides (mg/L)	7.96	6.34	20.35	5.93	25.50	0.03
Inorganic phosphates (mg PO_4^{-3}/L)	40.92	36.63	10.46	32.41	20.77	1.11
Florides (mg/L)	6.16	5.74	6.98	4.99	19.15	0.22
Colon count/100 cm^3	15464	13883	12.20	13038	15.68	622.59



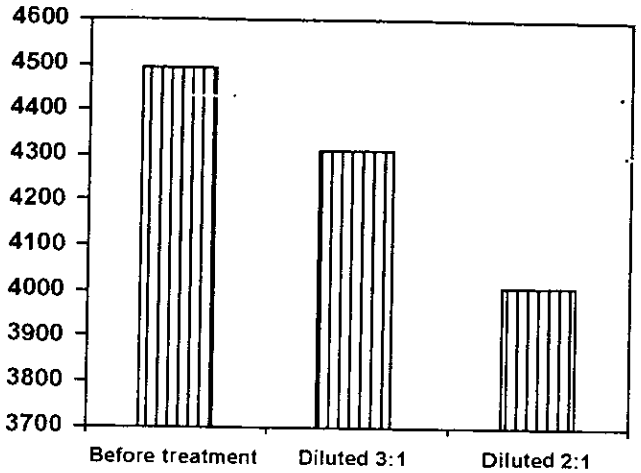
a) pH value

b) Temperature (°C)

Fig. (3): Effect of dilution by artesian water on physical and chemical characteristics of waste-water during November to January 2001.

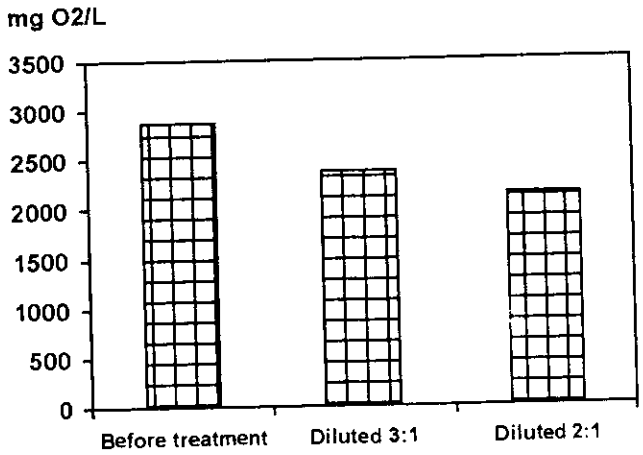


c) Turbidity

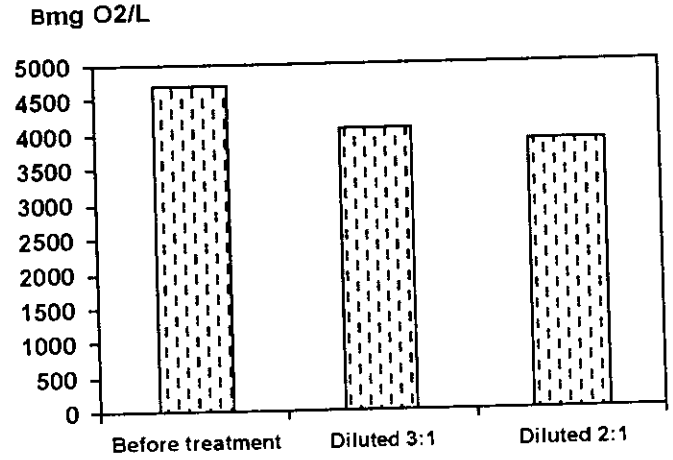


d) Electerical conductivity

Fig. (3): Cont.

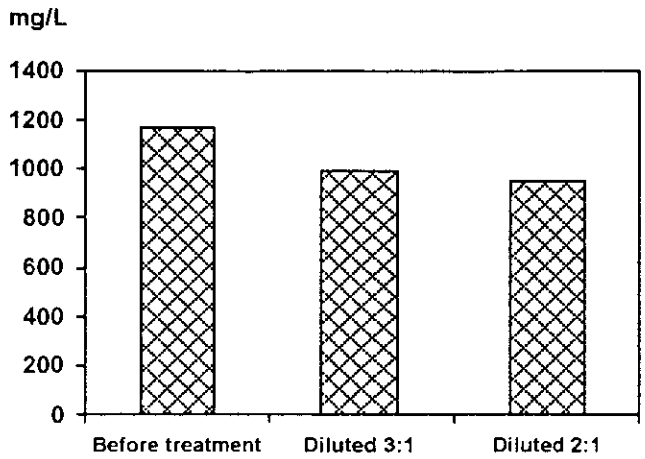


e) Biological Oxygen Demand

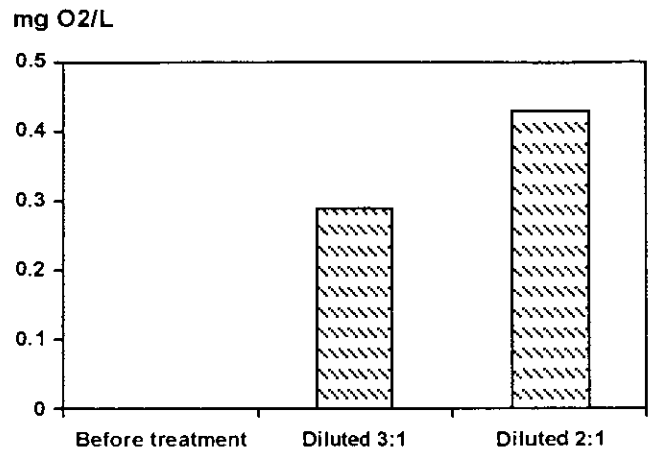


f) Chemical Oxygen Demand

Fig. (3): Cont.

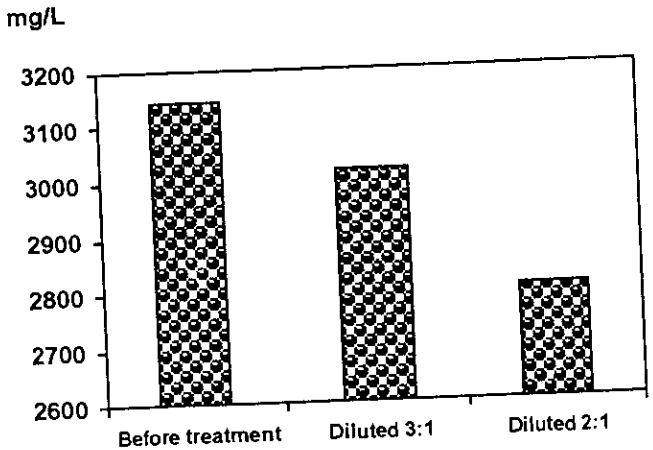


g) Permanganate value

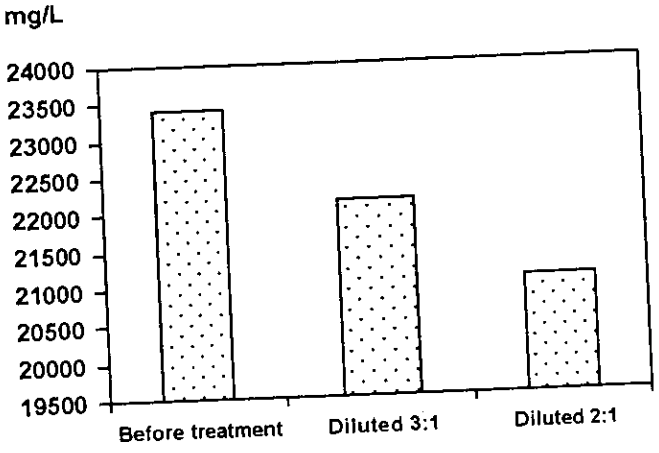


h) Dissolved oxygen

Fig. (3): Cont.

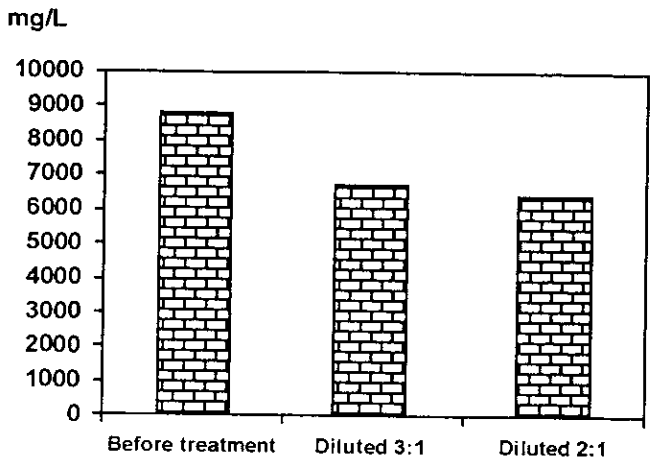


i) Total dissolved solids

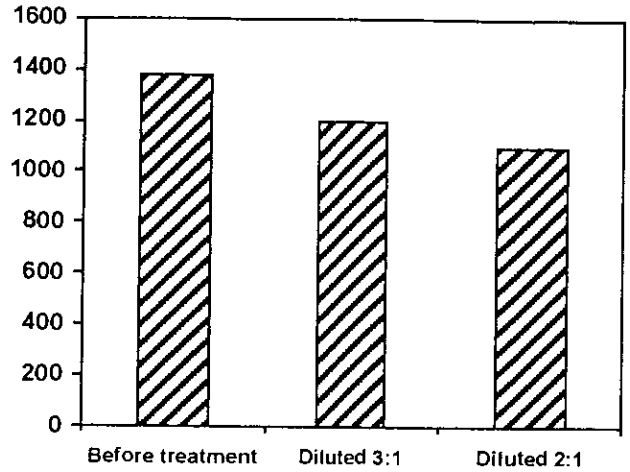


j) Total suspended solids

Fig. (3): Cont.

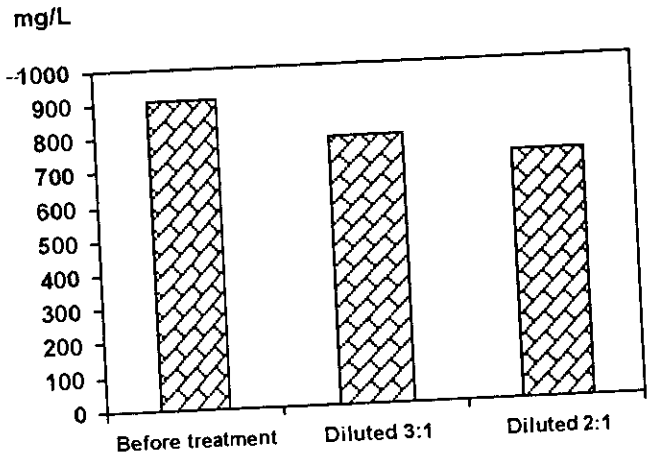


k) Oil and grease

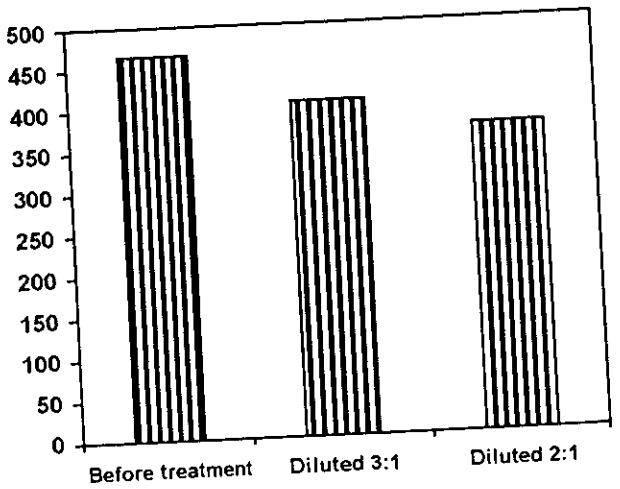


l) Total hardness

Fig. (3): Cont.

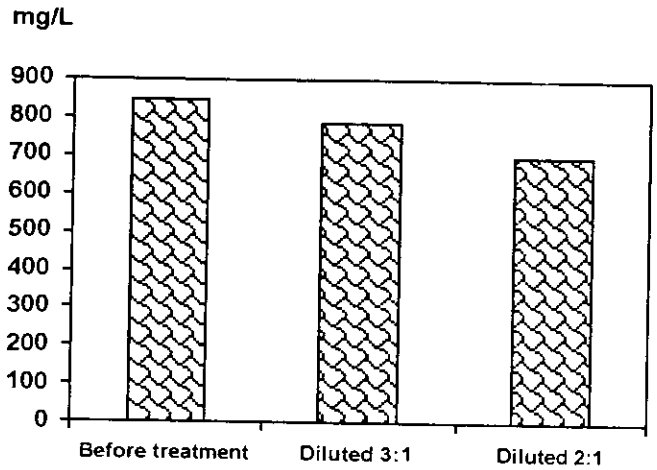


m) Calcium

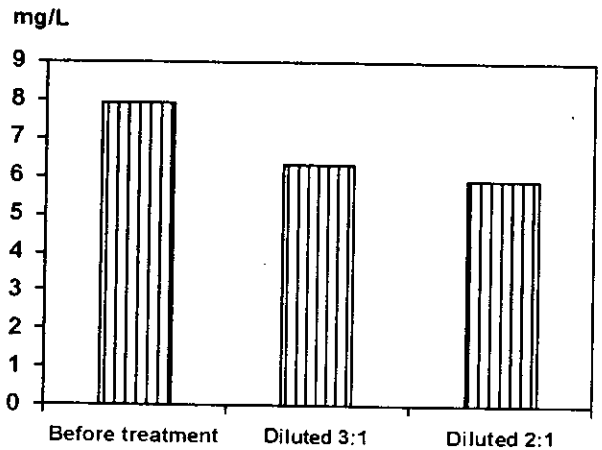


n) Magnesium

Fig. (3): Cont.

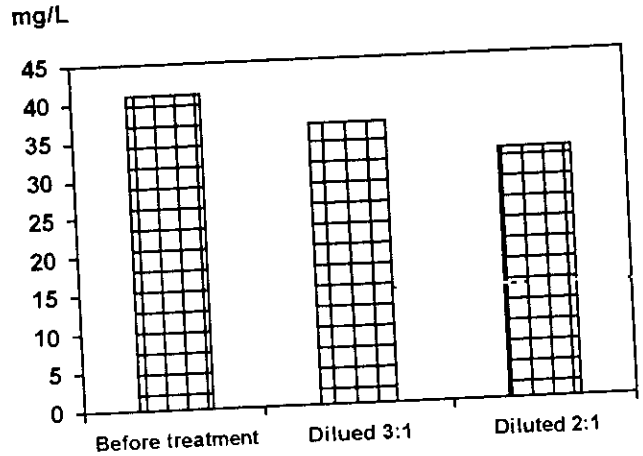


o) Sodium

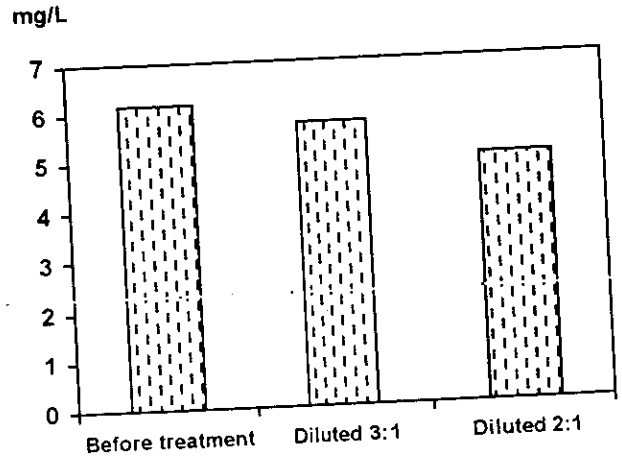


p) Sulphides

Fig. (3): Cont.



q) Inorganic phosphate



r) Florides

Fig. (3): Cont.

But, these values at the ratio of 3 : 1 were 11.55%, 5.8%, 13.87%, 20.40%, 14.35% and 21.66% for the above-mentioned heavy metals. From the above results it has been observed that the dilution of waste-water process by using fresh artesian water gave differentiation the efficiency percentage under the different ratios with all parameters of waste water diluted.

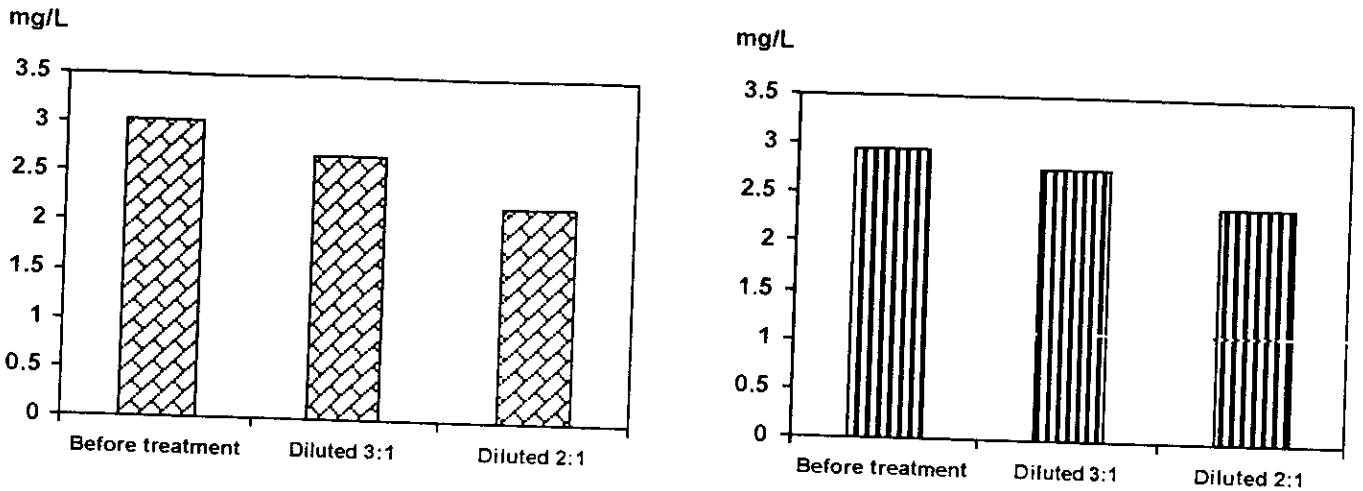
From these results, it has observed that the total dissolved and suspended solids were reduced to 10.75% and 9.99% after treatment at the ratio of 2 : 1, respectively. The efficiency of turbidity, Biological Oxygen Demand (B.O.D.), Chemical Oxygen Demand (C.O.D.), permanganate value and total hardness were 27.36%, 25.95%, 17.57%, 19.12% and 20.17% after the dilution of waste water at the ratio 2 : 1. However, the efficiency for sodium, sulphides, inorganic phosphate and phlorides were recorded to 16.74%, 25.5%, 20.77% and 19.15%, respectively.

While, the efficiency percentage of heavy metals after the above treatment process were 28.05%, 22.18%, 15.88%, 27.04%, 29.18% and 28.88% for Iron, manganese, zinc, nickel, lead and copper, respectively, at the ratio 2 : 1 (Table 4 and Fig. 4a-f).

These results are in agreement with those obtained by Somaya *et al.* (1992) and Zaid (1996).

Table (4): Effect of dilution by artesian water on heavy metals concentrations of waste-water during November 2000 to January 2001.

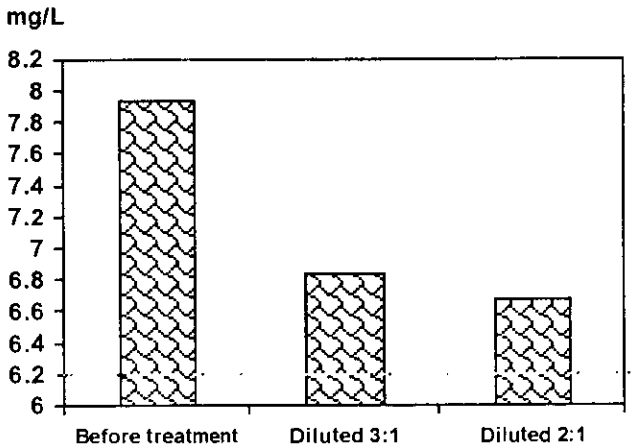
Elements (mg/L)	Before treatment	Waste: water 3 : 1	Efficiency %	Waste: water 2 : 1	Efficiency %	L.S.D. at 0.05
Iron	3.03	2.68	11.55	2.19	28.05	0.19
Manganese	2.94	2.76	5.80	2.40	22.18	0.18
Zinc	7.93	6.84	13.87	6.67	15.88	0.10
Nickel	1.96	1.57	20.40	1.43	27.04	0.32
Lead	2.09	1.79	14.35	1.49	29.18	0.40
Copper	2.78	2.18	21.66	1.98	28.88	0.36



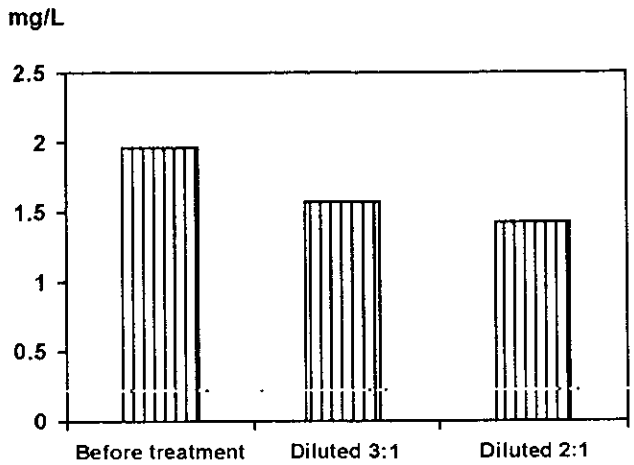
a) Iron

b) Mangnese

Fig. (4): Effect of dilution by artesian water on heavy metals concentrations of waste-water during November to January 2001.

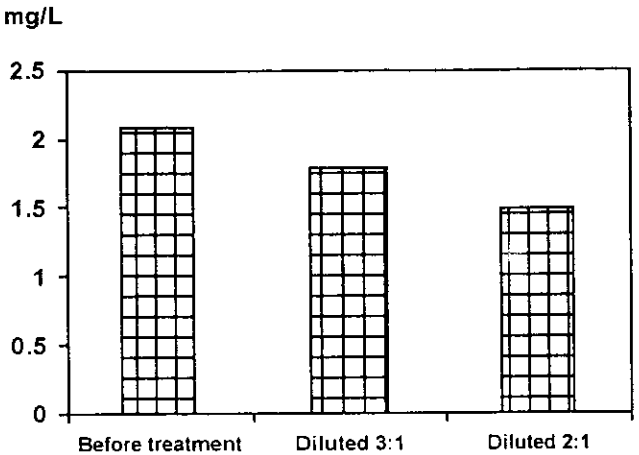


c) Zinc

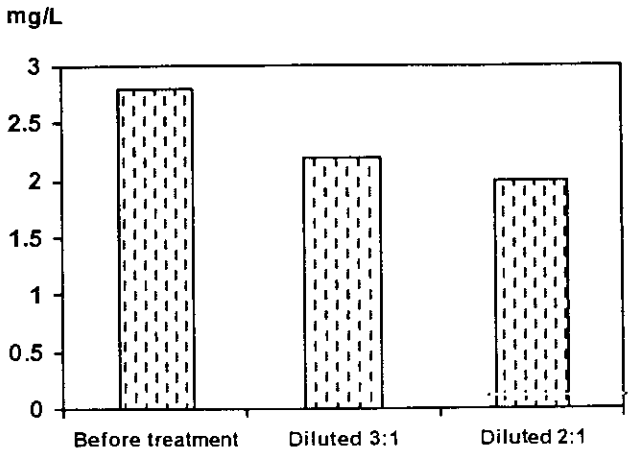


d) Nickel

Fig. (4): Cont.



e) Lead



f) Copper

Fig. (4): Cont.

4.2.2. Effect of chemical treatment on the physical and chemical characteristics of waste-water produced from Oil and Soap Company during February to May 2001:

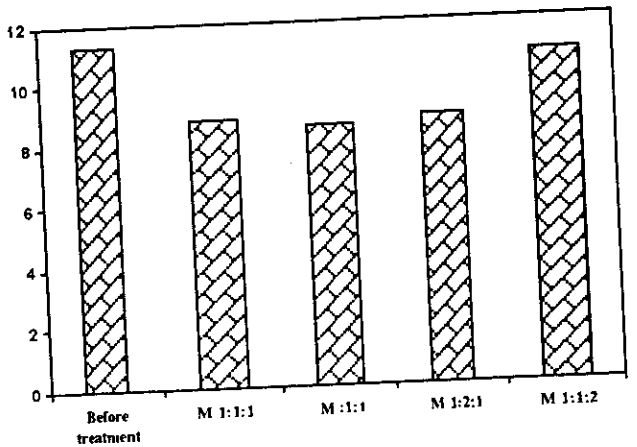
The discharge of such wastes without adequate treatment into water bodies can cause destruction to the aquatic life and impair the beneficial use of water for different purposes.

Furthermore, if these wastes are discharged without pretreatment into River Nile it may cause a severe problem and exert negative impact on the sewage treatment facilities. The different treatments such as physical, chemical and biological techniques have been applied successfully for oil and soap waste-water in Kafer El-Zayat. Most all treatments achiene the removal of both organic, inorganic, oil and grease pollutants before discharged into the River Nile.

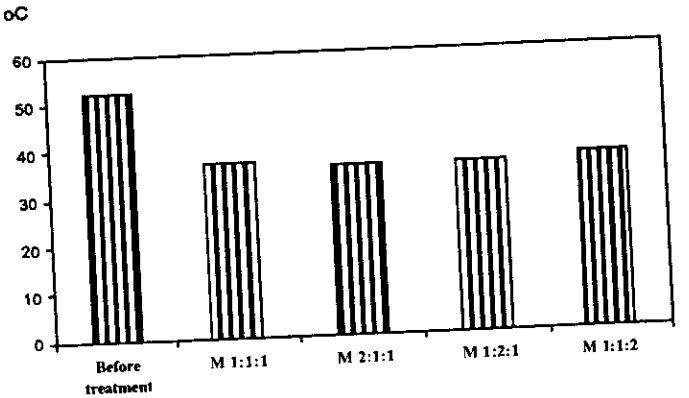
Chemical treatment can be effective for oil and soap waste-waters. This process was carried out by using different chemical reagents i.e. activated charcoal, potassium dihydrogen phosphate (KH_2PO_4) and calcium carbonate ($CaCO_3$) as a second treatment. Activated charcoal was tested as absorbent in the present work because it is one of the absorbents widely used in many purification processes, Huang and Blanenship (1984) and Peters *et al.* (1985). In addition charcoal was the best absorbent for inorganic matters from waste-water as well as (C.O.D.). On the other hand, potassium dihydrogen phosphate (KH_2PO_4) was the reagent for decreasing pH value, but calcium carbonate ($CaCO_3$) was used as chelated reagent. The above reagents were mixed together by weight at the following different ratios 1 : 1 : 1, 2 : 1 : 1, 1 : 2 : 1 and 1 : 1 : 2, respectively. The efficiency of

Table (5): Effect of chemical treatment on the physical and chemical components of waste-water from Oil and Soap Company during February to May 2001.

Parameters	Before treatment	After chemical treatment								L.S.D. at 0.05
		1:1:1	Efficiency %	2:1:1	Efficiency %	1:2:1	Efficiency %	1:1:2	Efficiency %	
pH	11.33	8.80	22.33	8.60	24.09	8.87	21.71	10.85	4.23	0.06
Temperature (°C)	52.0	37.0	28.84	36.0	30.76	36.0	30.76	37.0	28.84	0.73
Turbidity (NTU)	1370	424	69.05	393	71.31	315	77.00	422	69.19	17.85
Electerical conductivity (E.C., µmol/cm)	4497	3436	23.59	3347	25.68	3205	28.73	3352	25.46	6.58
Biological oxygen demand (mg O_2/L)	2820	965	65.72	888	68.51	806	71.41	896	68.22	10.11
Chemical oxygen demand (mg O_2/L)	4614	1863	59.62	1788	61.24	1680	63.58	1801	60.96	10.01
Permanganate value (mg/L)	1130	587	48.05	562	50.26	498	55.92	579	48.79	7.31
Dissolved oxygen (mg O_2/L)	Nil	1.15	-	1.93	-	2.20	-	1.73	-	0.12
Total dissolved solids (mg/L)	3148	2405	23.60	2342	25.60	2243	28.74	2346	25.47	4.57
Total suspended solids (mg/L)	23252	1978	91.49	1758	92.34	1664	92.84	1812	92.20	25.67
Oil and grease (mg/L)	8717	987	88.67	784	91.00	752	91.37	825	90.53	18.98
Total hardness	1378	986	28.44	817	40.71	766	44.41	844	38.75	18.29
Calcium hardness (mg/L)	909	650.67	28.44	539.22	40.71	505.56	44.41	557.04	38.75	12.07
Magnesium hardness (mg/L)	468	335.24	28.44	277.78	40.71	260.44	44.41	286.96	38.75	6.22
Sodium (mg/L)	848	521	39.56	486	42.68	414	51.17	471	44.45	10.99
Sulphides (mg/L)	7.86	4.55	42.11	4.07	48.21	3.58	54.45	3.89	50.50	0.08
Inorganic phosphates (mg PO_4^{-3}/L)	40.25	30.17	25.40	28.41	29.41	24.15	40.00	29.60	26.45	0.43
Florides (mg/L)	6.53	4.20	35.68	2.88	55.89	2.12	67.53	2.87	56.04	0.16
Colon count/100 cm^3	15290	9935	35.02	9806	35.86	9631	37.01	9807	35.86	73.12

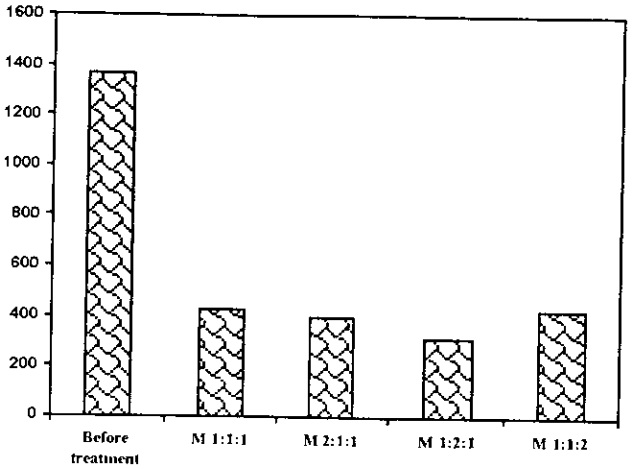


a) pH value

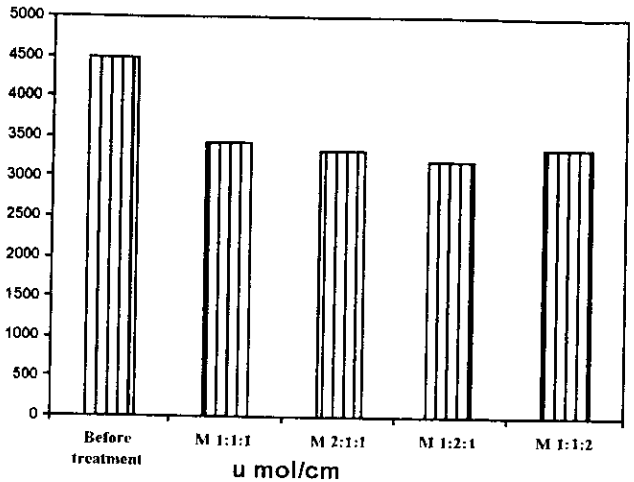


b) Temperature (°C)

Fig. (5): Effect of chemical treatment on physical and chemical characteristics of waste water produced from Oil and Soap Company, Kafr El-Zayat during February 2001.

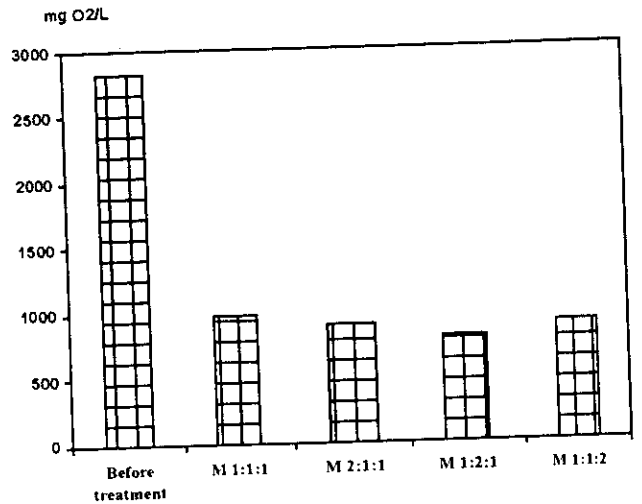


c) Turbidity

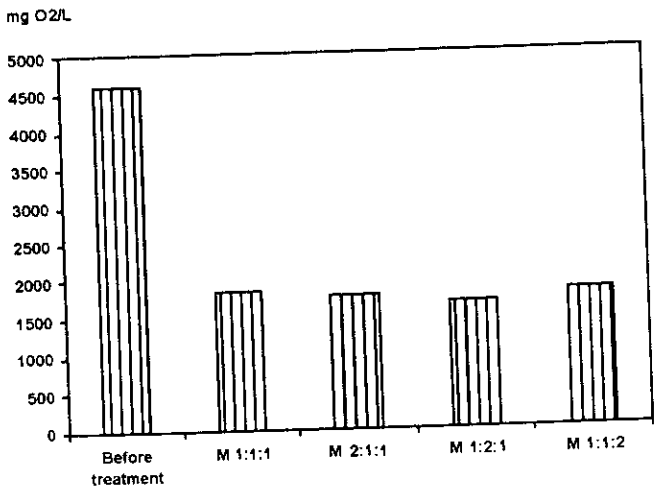


d) Electerical conductivity

Fig. (5): Cont.

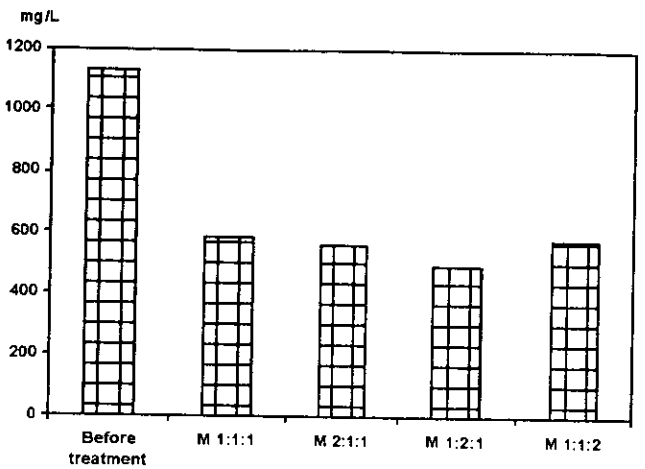


c) Biological Oxygen Demand

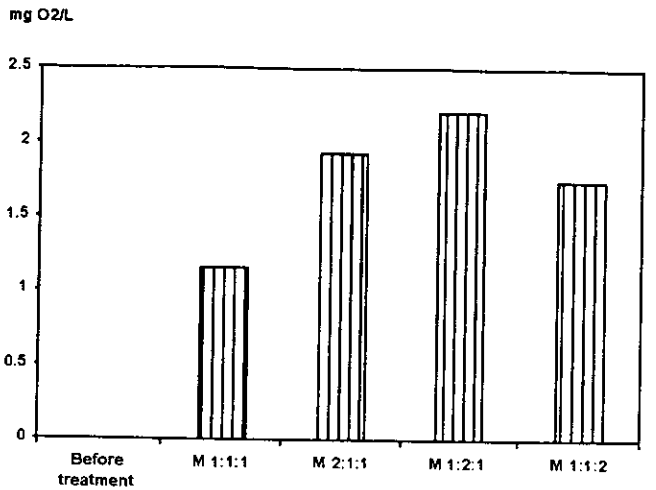


f) Chemical Oxygen Demand

Fig. (5): Cont.

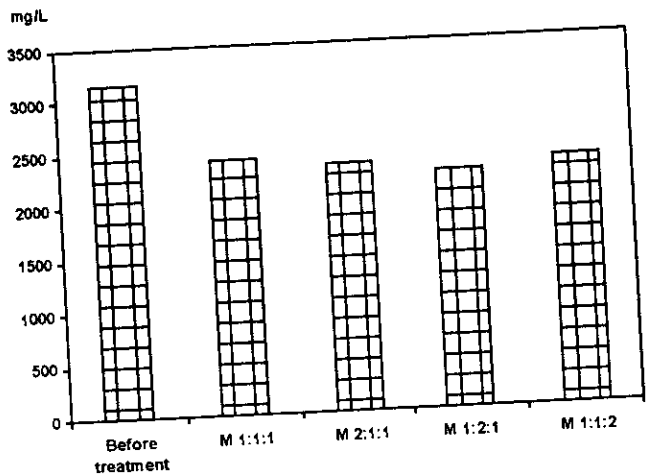


g) Permanganate value

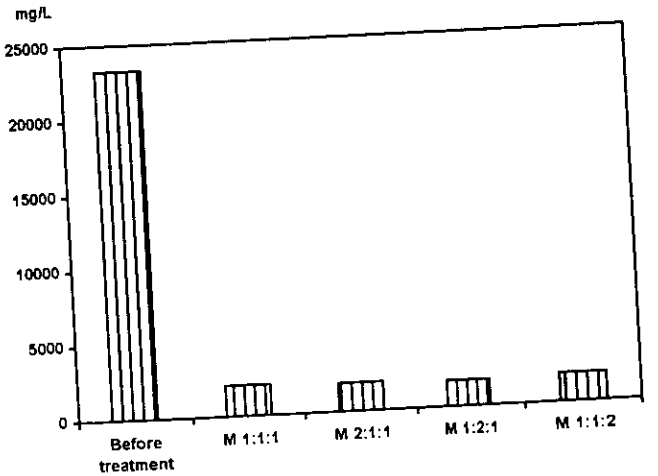


h) Dissolved oxygen

Fig. (5): Cont.

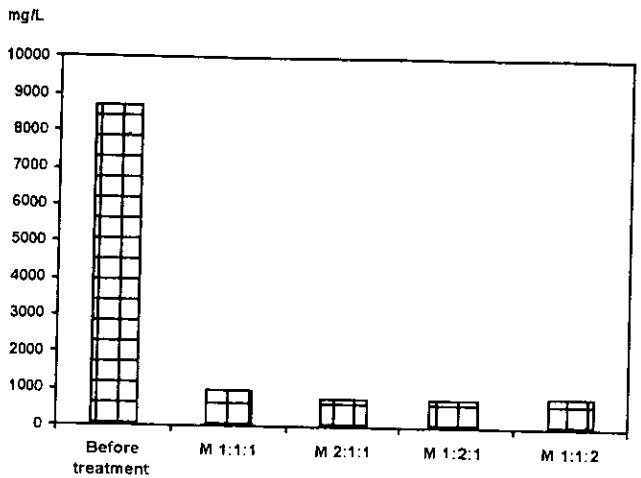


i) Total dissolved solids

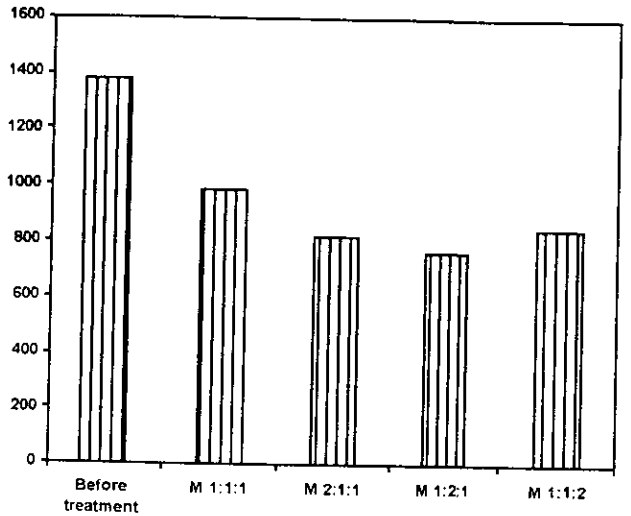


j) Total suspended solids

Fig. (5): Cont.

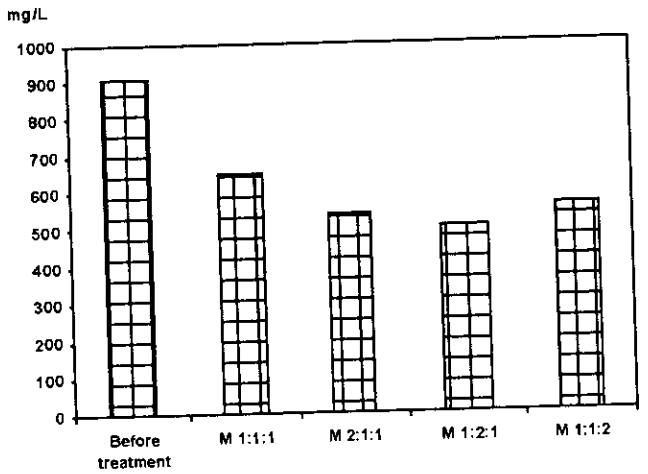


k) Oil and grease

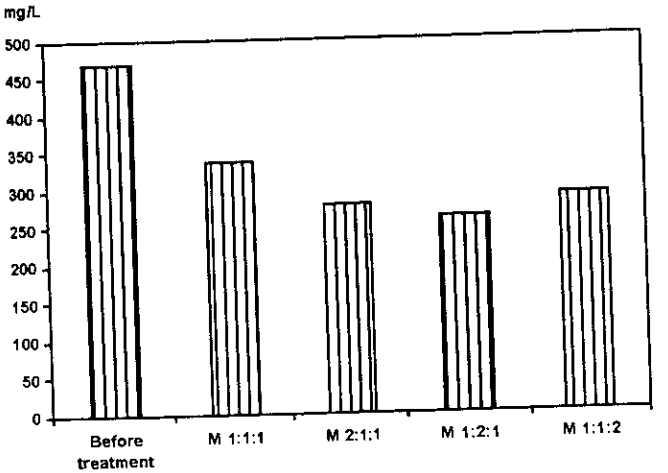


l) Total hardness

Fig. (5): Cont.

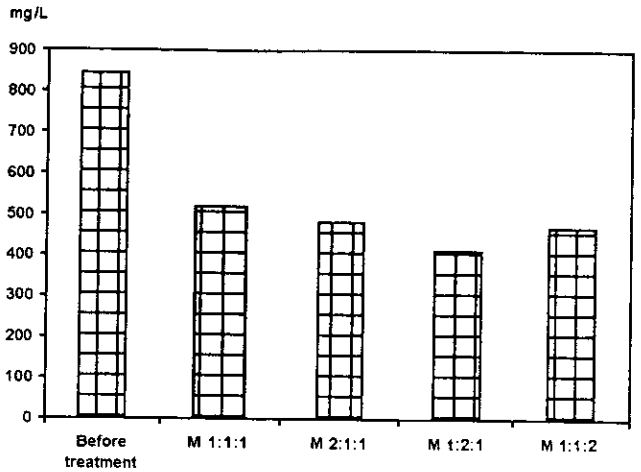


m) Calcium

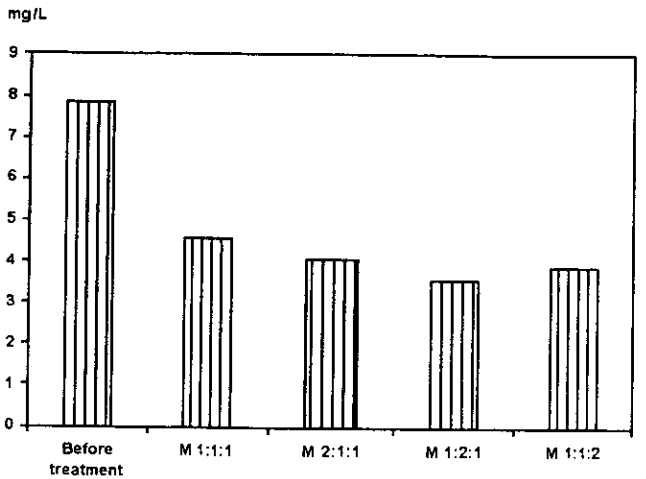


n) Magnesium

Fig. (5): Cont.

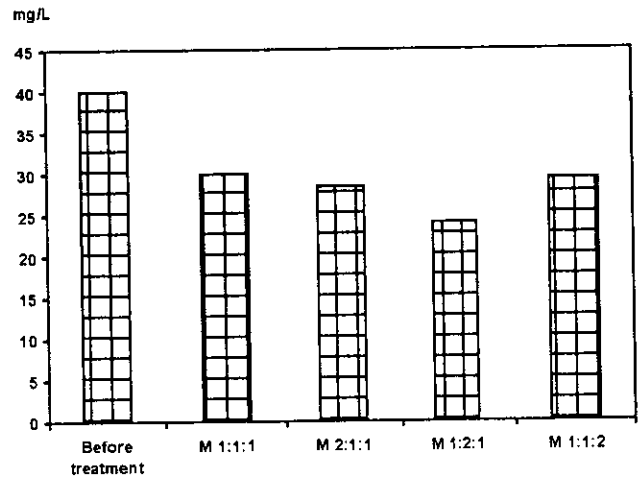


o) Sodium

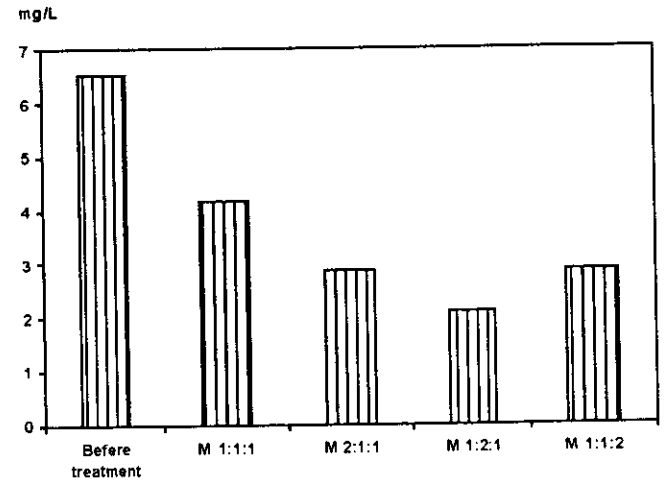


p) Sulphides

Fig. (5): Cont.



q) Inorganic phosphate



r) Florides

Fig. (5): Cont.

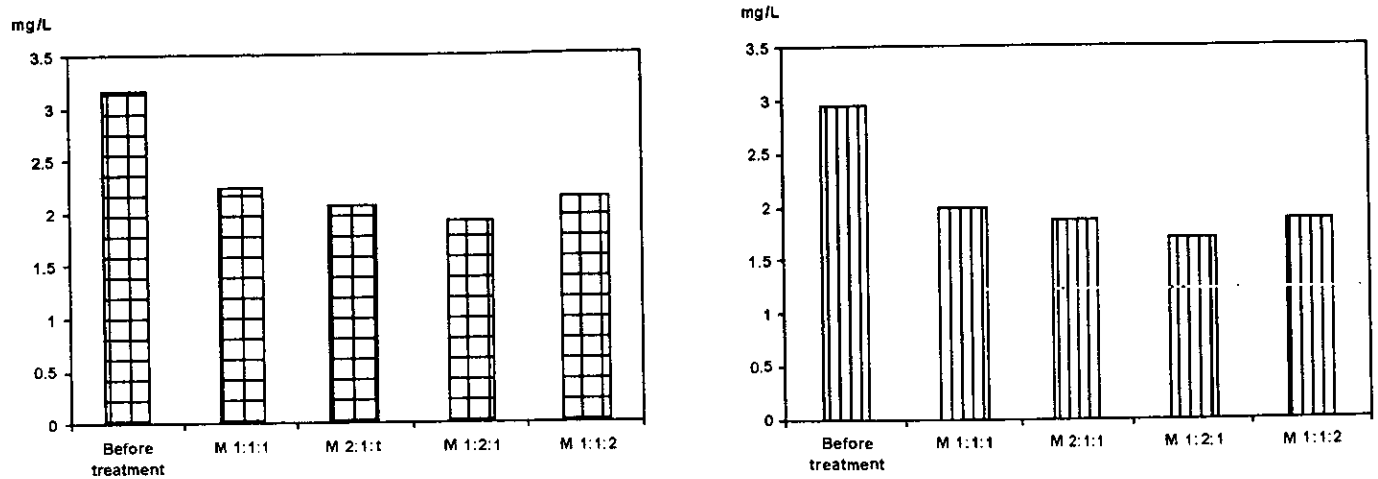
chemical treatment process for oil and soap waste-water are recorded in Table (5) and Figure (5a-r). The obtained results showed that the efficiency of the chemical treatment by using the above-mentioned reagents at different ratios were reduced and removed the main pollutants. The above results indicated that the chemical treatment of industrial waste-water, led to decrease the percentage removal of oil and grease to 88.67, 91.0, 91.37 and 90.53% at the above-mentioned different ratios, respectively, but the total dissolved and suspended solids reduced to 28.74% and 92.84% when using chemical reagents at ratio 1 : 2 : 1, respectively.

On the other hand, the removal efficiency of Biological and Chemical Oxygen Demand (B.O.D. & C.O.D.) were 71.41 and 63.58% after chemical treatment at the same ratio of chemical reagents. Also, the removal efficiency of this treatment towards turbidity, sodium, sulphids, inorganic phosphate and phlorides were found to be 77.00, 51.17, 54.45, 40.00 and 67.53%, respectively.

The overall efficiency of such process on heavy metals is shown also in Table (6) and Figure (6a-f), the heavy metals values reached 39.11, 42.56, 26.96, 29.64, 29.51 and 34.34% for iron, manganese, zinc, nickel, led and copper, respectively, at the ratio 1 : 2 : 1. The sepative mechanism of inorganic ions by charcoal may be due to the physical process which depends on the electrostatic force and porous character of this material. In the physicochemical process, chemical interaction of the functional group is paramount, whilest the electrostatic force and the parous character of the materials plays a minor role, Etzer and Hughes (1984).

Table (6): Effect of chemical treatment on heavy metals concentrations of waste-water from Oil and Soap Company during February to May 2001.

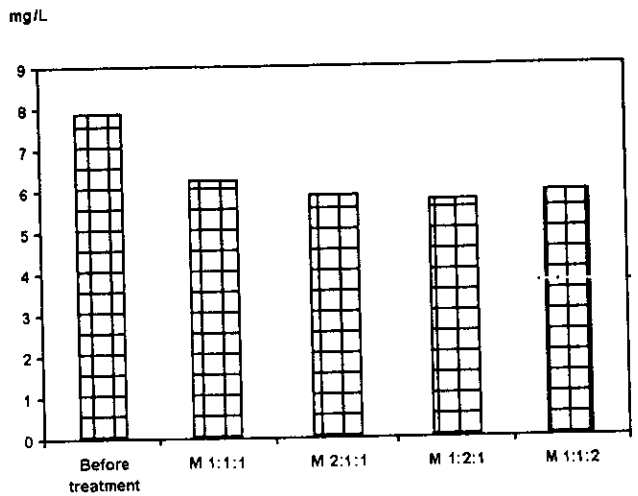
Elements (mg/L)	Before treatment	After chemical treatment								L.S.D. at 0.05
		1:1:1	Efficiency %	2:1:1	Effieiency %	1:2:1	Efficiency %	1:1:2	Efficiency %	
Iron	3.17	2.24	29.33	2.07	34.70	1.93	39.11	2.15	32.17	0.09
Manganese	2.96	1.98	32.88	1.88	36.48	1.70	42.56	1.88	36.48	0.05
Zinc	7.90	6.26	20.75	5.91	25.18	5.77	26.96	5.93	24.93	0.06
Nickel	2.26	1.75	22.56	1.67	26.10	1.59	29.64	1.71	24.33	0.04
Lead	2.27	1.74	23.34	1.67	26.43	1.60	29.51	1.66	26.87	0.04
Copper	2.97	2.83	4.71	2.55	14.14	1.95	34.34	2.49	16.16	0.09



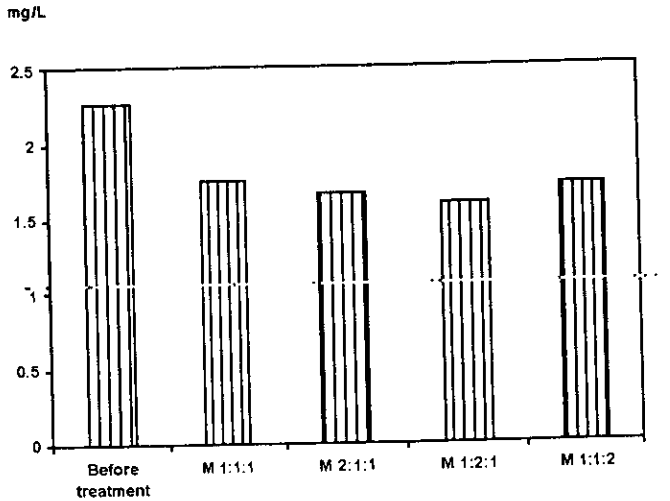
a) Iron

b) Mangnese

Fig. (6): Effect of chemical treatment on heavy metals concentration of waste water produced from Oil and Soap Company, Kafr El-Zayat during February 2001.

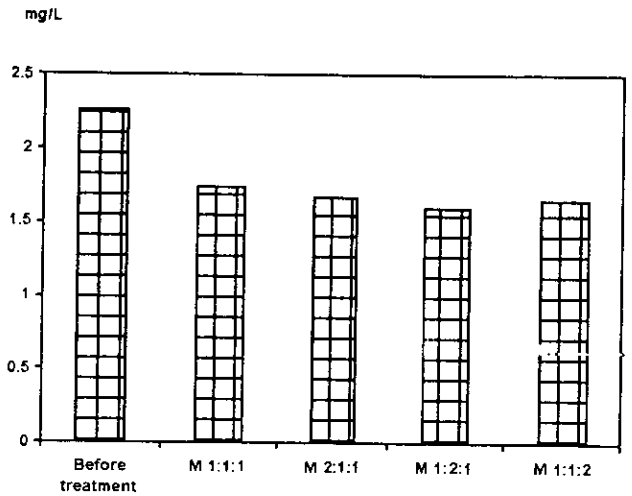


c) Zinc

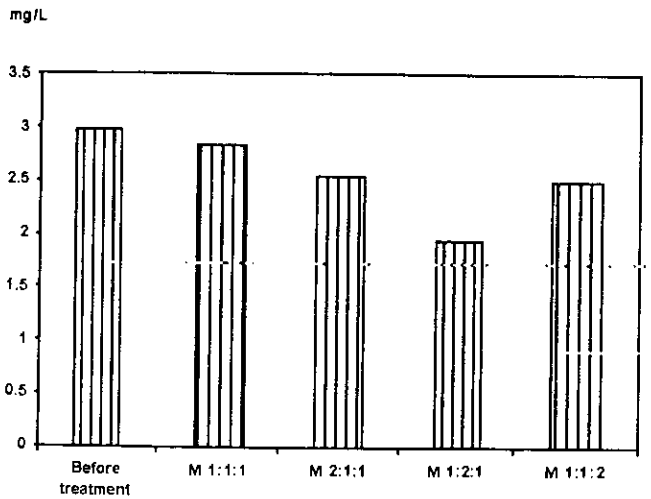


d) Nickel

Fig. (6): Cont.



e) Lead



f) Copper

Fig. (6): Cont.

From the above-mentioned results it has been indicated that the chemical treatment by above reagents at different ratios may reduce both oil and grease, organic and inorganic pollutants before discharged into the Rive Nile. The obtained results are in agreement with those obtained by Nawar *et al.* (1990), Ahmed (1992) and El-Sarwi *et al.* (1997).

This observation may be due to that such heavy metals has been absorbed by the charcoal, monobasic phosphate and calcium carbonate salts.

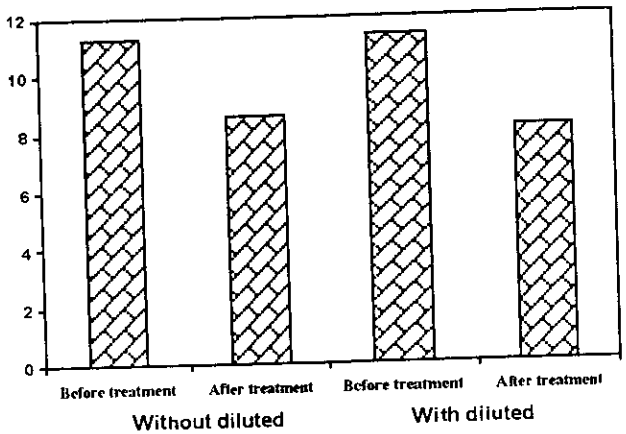
4.2.3. Effect of biological treatment on the characterization of raw and treated waste-water from Oil and Soap Company during June to September 2001:

These experiments were carried out to identify the best operating conditions for continuous treatment using the mixture of microorganisms i.e. sarcodina, alga, rotifers and ciliated protozoa. This process was carried out before and after dilution of waste-water by artesian water at the ratio 3 : 1.

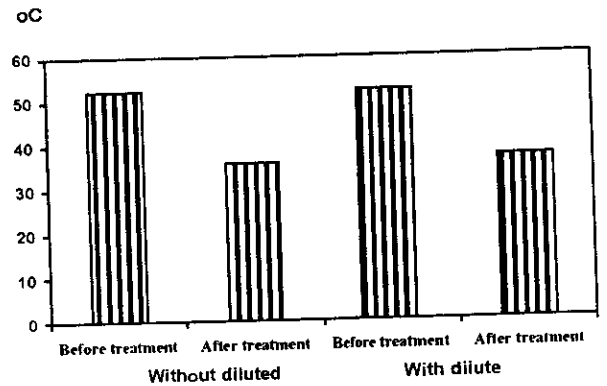
The results obtained are illustrated in Table (7) and Figure (7a-r). The achieved results indicate that the removal efficiency of different pollutants was improved. The turbidity, B.O.D. and C.O.D. removal values reached 78.9%, 73.2% and 68.3%, respectively, with diluted of waste-water at the ratio 3 : 1 if compared with that values which obtained without any dilution (Table, 5). This process proved that the best removal percentage of total suspended solids (T.S.S.), oil and grease was obtained. The percentage reduction of T.S.S., oil and grease achieved to 93.5% and 91.7%.

Table (7): Characterization of raw and biologically treated of waste-water during June to September 2001.

Parameters	Without diluted			With diluted			L.S.D. at 0.05
	Before treatment	After treatment	Efficiency %	Before treatment	After treatment	Efficiency %	
pH	11.29	8.62	23.64	11.36	8.11	28.60	0.12
Temperature (°C)	52.0	36.0	28.00	52.0	37	28.84	1.44
Turbidity (NTU)	1381	390	71.75	1391	294	78.86	6.13
Electerical conductivity (E.C., µmol/cm)	4506	3450	23.43	4540	3185	29.84	48.92
Biological oxygen demand (mg O_2/L)	2850	900	68.42	2868	770	73.15	11.40
Chemical oxygen demand (mg O_2/L)	4675	1832	60.00	4677	1481	68.33	29.45
Permanganate value (mg/L)	1178	585	48.00	1166	472	59.48	5.91
Dissolved oxygen (mg O_2/L)	Nil	0.92	-	Nil	2.08	-	0.21
Total dissolved solids (mg/L)	3154	2415	23.43	3178	2230	29.86	35.37
Total suspended solids (mg/L)	23363	1981	91.52	23352	1590	93.51	54.03
Oil and grease (mg/L)	8679	982	88.68	8640	721	91.65	37.89
Total hardness	1381	991	28.24	1352	688	49.18	14.64
Calcium hardness (mg/L)	911.46	654.06	28.24	892.32	454	49.18	9.66
Magnesium hardness (mg/L)	469.54	336.94	28.24	459.68	234	49.18	5.46
Sodium (mg/L)	844	517	38.74	868	363	58.17	18.17
Sulphides (mg/L)	7.83	4.05	48.27	7.94	3.85	51.63	0.11
Inorganic phosphates (mg PO_4^{-3}/L)	40.80	30.89	24.28	41.00	25.65	37.34	1.35
Florides (mg/L)	4.47	4.21	34.93	6.84	3.80	44.44	0.18
Colon count/100 cm^3	15020	9492	37.27	15170	7820	48.45	106.93

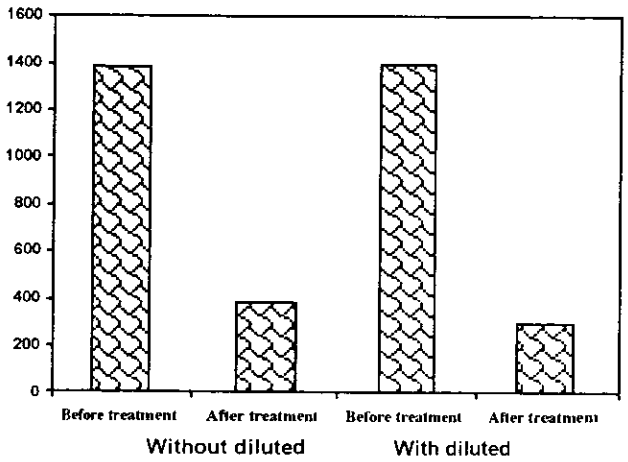


a) pH value

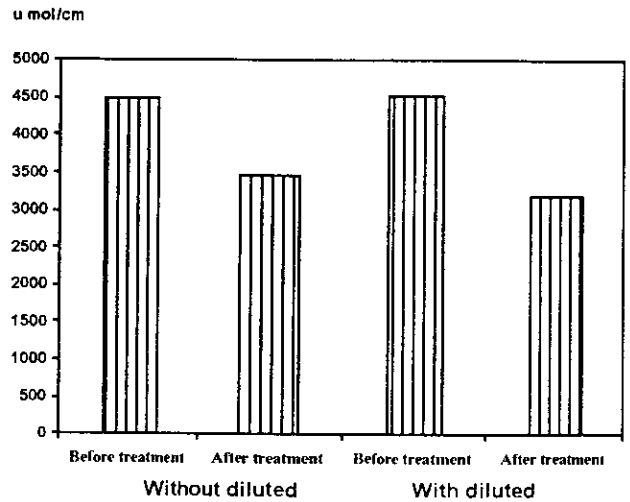


b) Temperature (°C)

Fig. (7): Physical and chemical characteristics of raw and biologically treated of waste-water produced from Oil and Soap Company, Kafr El-Zayat during February 2001.

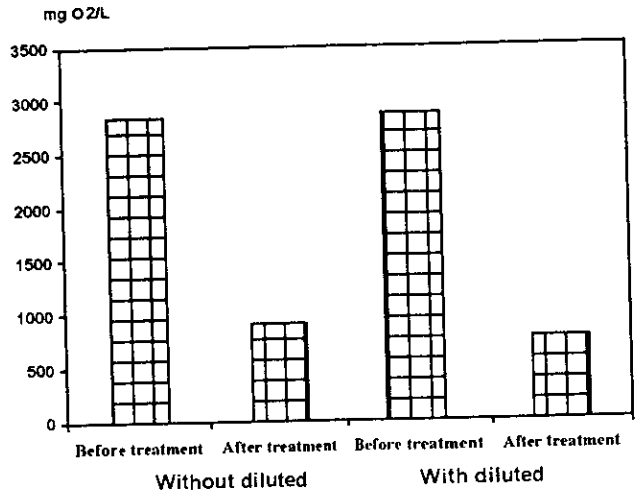


c) Turbidity

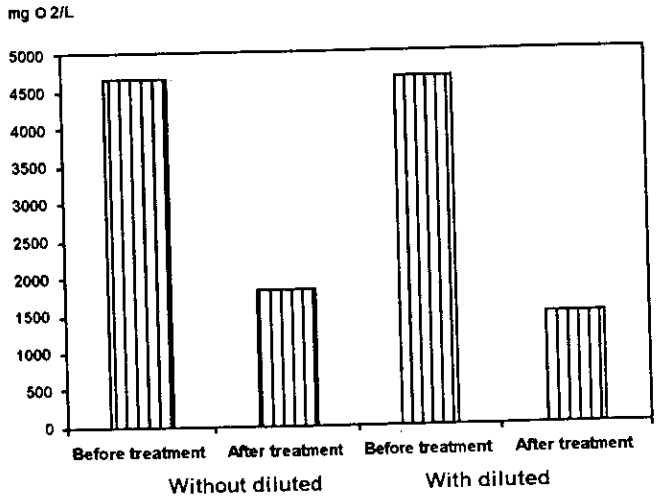


d) Electerical conductivity

Fig. (7): Cont.

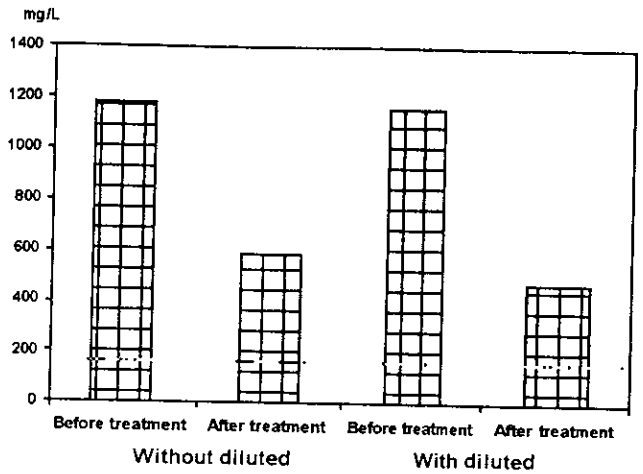


e) Biological Oxygen Demand

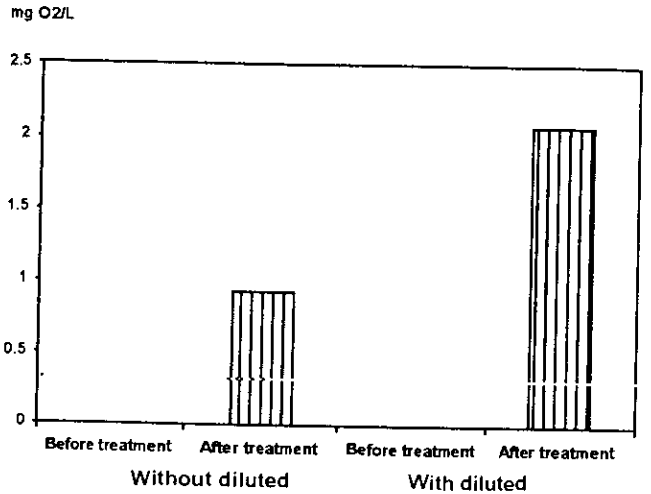


f) Chemical Oxygen Demand

Fig. (7): Cont.

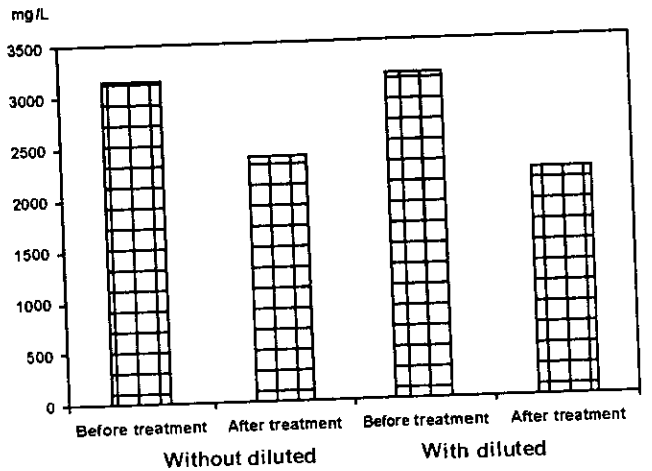


g) Permanganate value

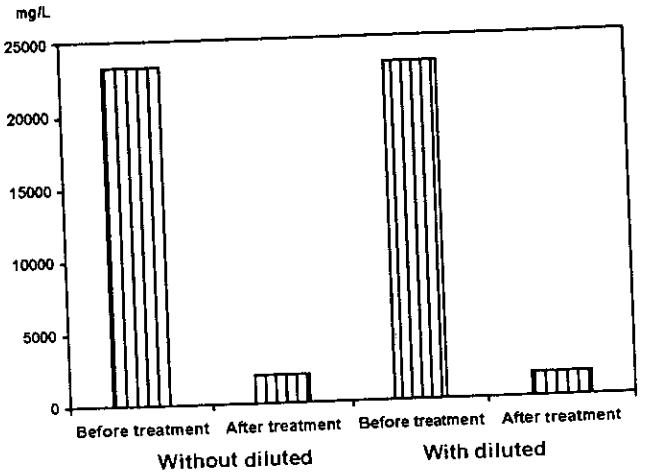


h) Dissolved oxygen

Fig. (7): Cont.

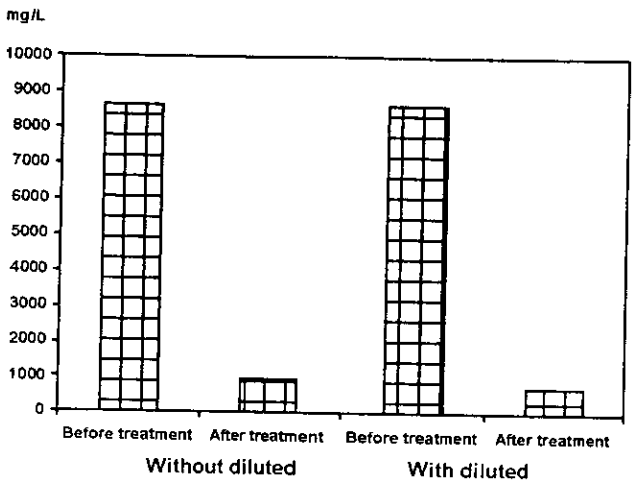


i) Total dissolved solids

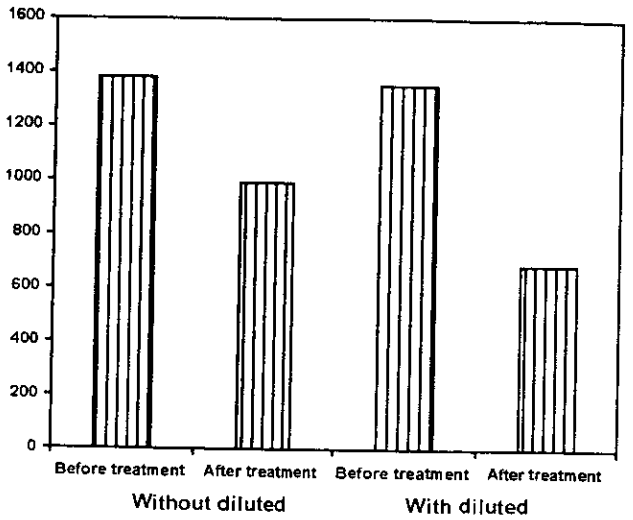


j) Total suspended solids

Fig. (7): Cont.

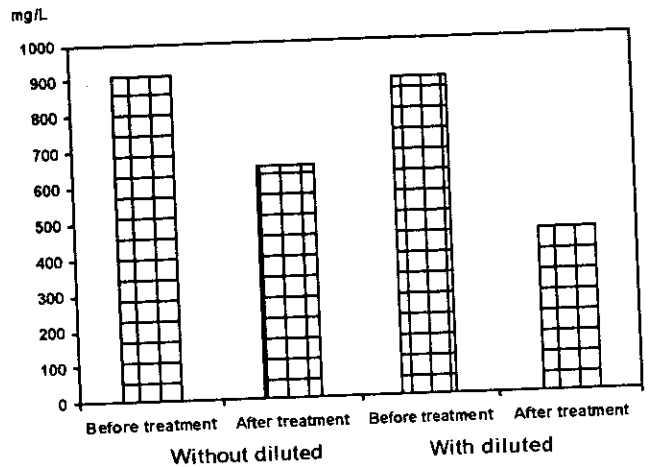


k) Oil and grease

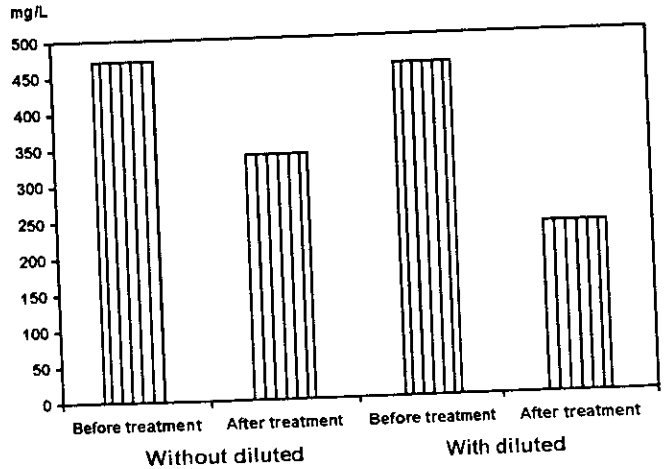


l) Total hardness

Fig. (7): Cont.

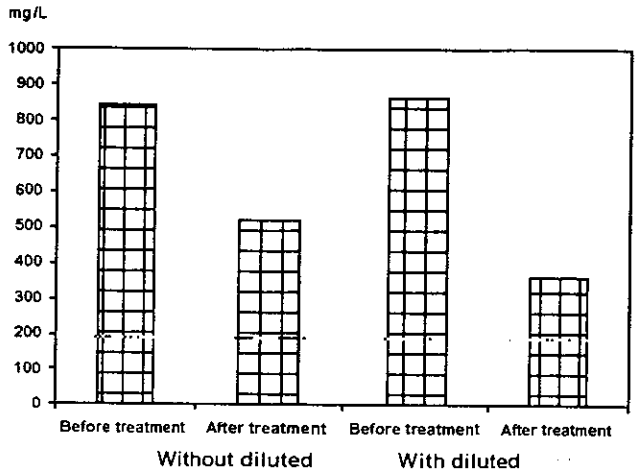


m) Calcium

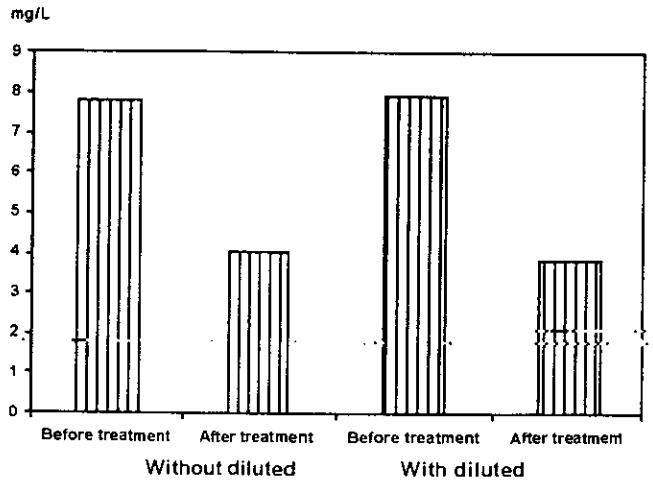


n) Magnesium

Fig. (7): Cont.

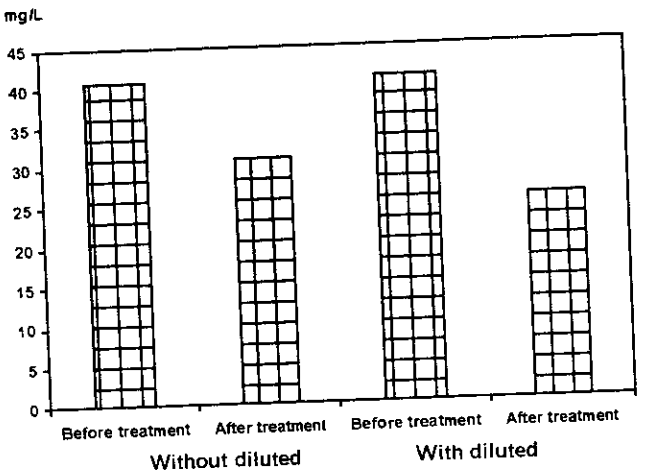


o) Sodium

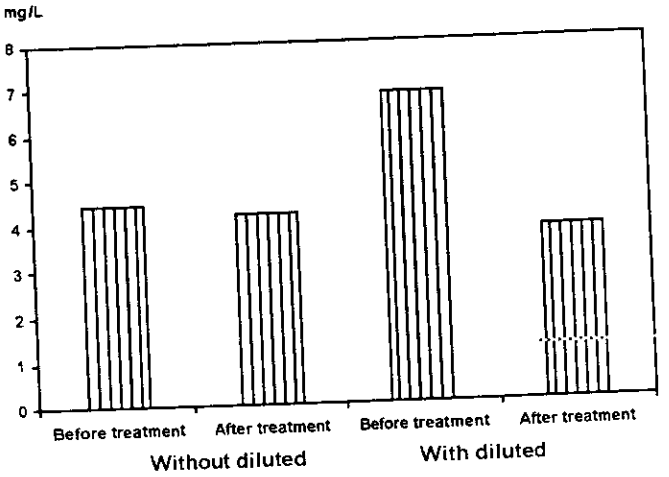


p) Sulphides

Fig. (7): Cont.



q) Inorganic phosphate



r) Florides

Fig. (7): Cont.

From the above-mentioned results which recorded in Table (7) and Figure (7a-r), it has been indicated that the dissolved oxygen increased to 0.92 mg O_2/L and 2.07 mg O_2/L before and after dilution, respectively. While, total hardness, sodium, sluphides, inorganic phosphate, florides and colon count reduced to 49.2%, 58.2%, 51.6%, 37.3%, 44.5% and 48.5%, respectively.

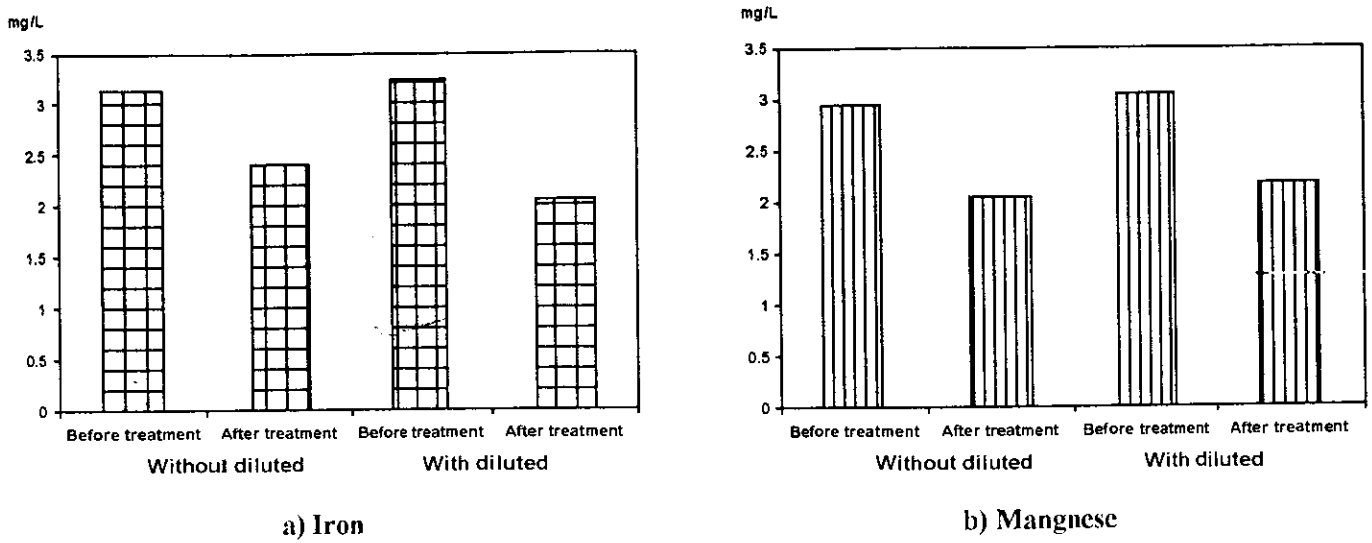
On the other hand, the removal efficiency of heavy metals (Fe, Mn, Zn, Ni, Pb and Cu) reduced to 36.1%, 30.3%, 17.0%, 18.5%, 25.7% and 33.7%, respectively, after dilution of waste-water by artesian water at the ratio 3 : 1. According to the acquired results, it may suggest a great possibility of using the treated waste water for the processes.

Also, the removal of pollutants from the waste water could be an economic significance and could be considered as a potential remedy in the solution of some global environmental problems (Table, 8) and Figure (8a-f).

These results are corresponding with those obtained by Abou-El-Aula *et al.* (1994b) and El-Gouhari *et al.* (1995). Also, the obtained results indicated that the residual of B.O.D., C.O.D., oil and grease concentrations in the treated effluent were complying with National Regularity Standards (1982).

Table (8): Heavy metals concentration of raw and biologically treated of waste-water during June to September 2001.

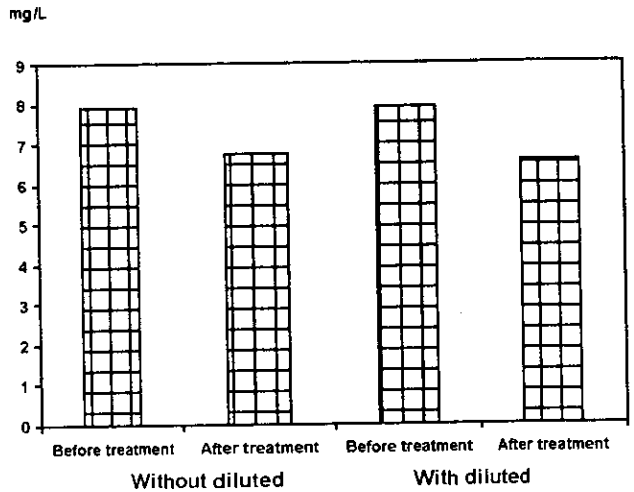
Elements (mg/L)	Without diluted			With diluted			L.S.D. at 0.05
	Before treatment	After treatment	Efficiency %	Before treatment	After treatment	Efficiency %	
Iron	3.13	2.41	23.00	3.24	2.07	36.11	0.11
Manganese	2.95	2.06	30.16	3.04	2.17	30.26	0.08
Zinc	7.95	6.75	15.09	7.94	6.60	17.00	0.07
Nickel	2.22	1.92	15.31	2.32	1.90	18.53	0.05
Lead	2.31	1.88	61.88	2.41	1.80	25.72	0.10
Copper	3.17	2.89	9.14	3.32	2.21	33.73	0.10



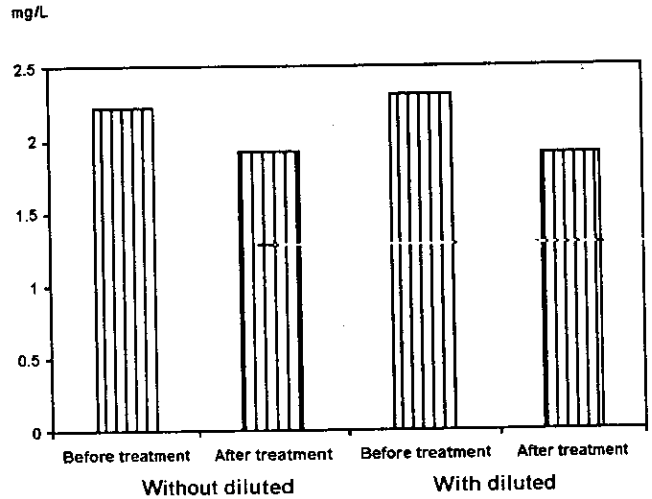
a) Iron

b) Mangnese

Fig. (8): Heavy metals concentrations of raw and biologically treated of waste-water produced from Oil and Soap Company, Kafr El-Zayat during February 2001.

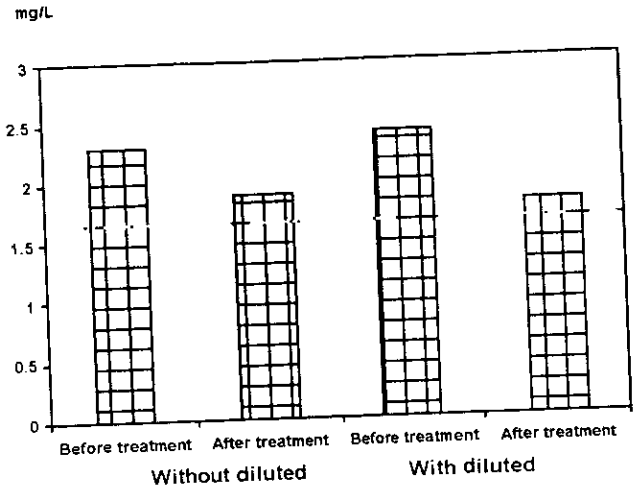


c) Zinc

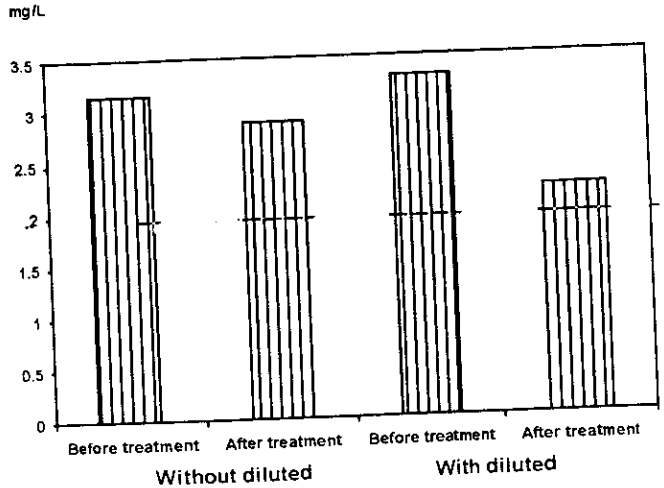


d) Nickel

Fig. (8): Cont.



e) Lead



f) Copper

Fig. (8): Cont.

4.2.4. Effect of the combined chemical and biological treatment after dilution by artesian water on physical and chemical charaterization of waste-water during October 2001 to March 2002:

Chemical treatment can be achieved by using different reagents, i.e. activated charcoal, potassium dihydrogen phosphate and calcium carbonate, followed by directly biological treatment with microorganisms at the obtained conditions for suitable system for treatment of the oil and soap waste-water to comply with the law, because the waste-water is characterized by very high (B.O.D.), (C.O.D.), suspended solids (S.S.), dissolved solids (D.S.), oil and grease concentrations.

The waste-water was treated primarily by chemical followed by biological as secondary treatment because the individual treatments did not succeed by using chemical or biological treatment. Therefore, the treatment of this waste is difficult and many treatment processes failed in reasonable reduction of the pollution parameters to comply with the specifications of the law.

The obtained results showed that the combined of chemical and biological technique were proved to be very efficient in removing the organic contaminants and other pollutants parameters to complying with the National Regularity Standards (1982).

From the above-mentioned results the combined treatment, the achieved removal value equaled to 99.8% and the Biological and Chemical Oxygen Demand (B.O.D. & C.O.D.) reached 98.14% and 98.10%, respectively. The quality of the

treated effluent is much complying with National Regularity Standards for waste-water disposal into surface water (Table, 9) and Figure (9a-r).

Similar results were obtained by Mahrous (1992) and Suhail (1995). While, the dissolved oxygen concentration increased to 4.23 mg O_2/L compared to standard (up to 4.0 mf O_2/L).

On the other hand, total dissolved solids (T.D.S.), total suspended solids (T.S.S.) and total hardness (calcium and magnesium) reduced to 37.2%, 99.76% and 86.9%, respectively. Corresponding sodium, sulphides, inorganic phosphate, florides and colon count values were 81.75, 89.46, 89.25, 87.31 and 68.59%, respectively.

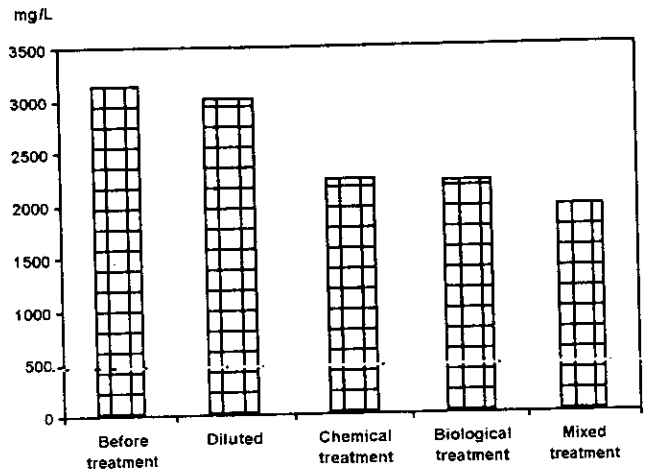
According to the acquired results, it became essential to evaluate the efficiency of the combined chemical and biological process for reduction of the heavy metals.

The results in Table (10) and Figure (10a-f) indicate that a significant decrement in the heavy metals value had been occurred. Removal values of Fe, Mn, Zn, Ni, Pb and Cu were 68.74, 77.8, 48.2, 96.5, 83.88 and 67.73%, respectively.

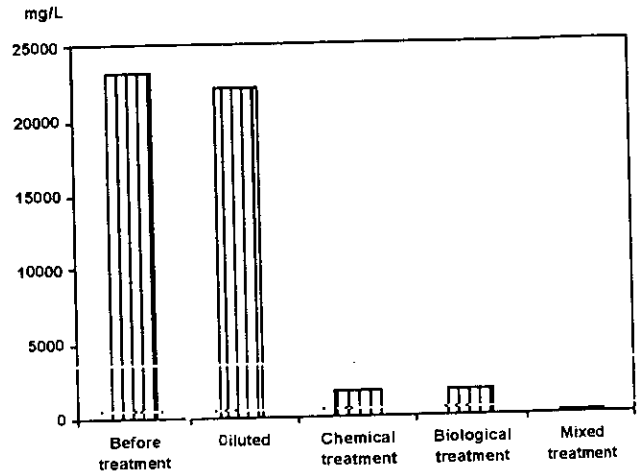
These values are similar with those obtained by Abdel-Shafy (1992) and Azab *et al.* (1995).

Table (9): Effect of the combined chemical and biological treatments after diluted by artesian water on physical and chemical characterization of waste-water.

Parameters	Before treatment	Diluted	Chemical treatment	Biolological treatment	Mixed treatment	Efficiency by mixed treatment %	L.S.D. at 0.05
pH	11.29	10.46	8.48	8.11	7.60	32.68	0.17
Temperature (°C)	50.0	39.3	36.0	37.0	33.8	34.00	1.44
Turbidity (NTU)	1391	1068	315	295	46	96.76	10.85
Electerical conductivity (E.C., µmol/cm)	4497	4310	3205	3185	2824	37.20	42.73
Biological oxygen demand (mg O_2/L)	2878	2372	807	770	54	98.14	42.34
Chemical oxygen demand (mg O_2/L)	4691	4078	1680	1481	89	98.10	59.25
Permanganate value (mg/L)	1182	994	499	472	23	98.03	7.28
Dissolved oxygen (mg O_2/L)	–	0.29	2.20	2.08	4.24		0.35
Total dissolved solids (mg/L)	3147	3017	2243	2230	1977	37.21	30.38
Total suspended solids (mg/L)	23250	22134	1665	1591	56	99.76	34.55
Oil and grease (mg/L)	8720	6753	753	721	14	99.84	349.73
Total hardness	1420	1196	767	688	186	86.90	29.61
Calcium hardness (mg/L)	937.2	789	506	462	123	86.90	20.68
Magnesium hardness (mg/L)	482.8	406	261	234	63	86.90	10.07
Sodium (mg/L)	844	787	414	363	154	81.75	15.66
Sulphides (mg/L)	7.88	6.34	3.58	3.85	0.84	89.46	0.08
Inorganic phosphates (mg PO_4^{-3}/L)	40.20	36.63	24.16	25.65	4.51	89.25	0.82
Florides (mg/L)	6.62	5.74	2.13	3.80	0.84	87.31	0.16
Colon count/100 cm^3	15060	13883	9631	7820	4729	68.59	262.19

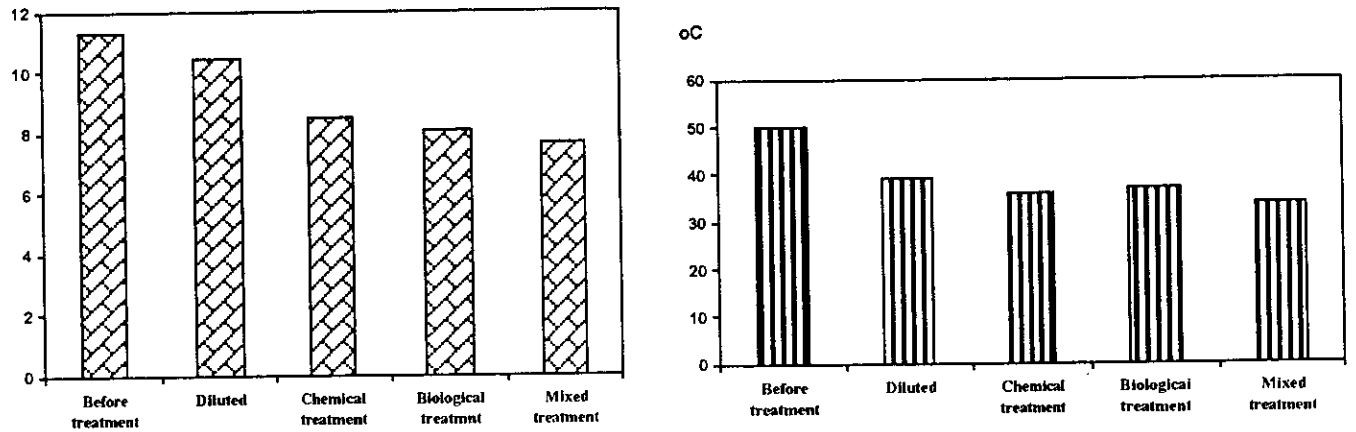


i) Total dissolved solids



j) Total suspended solids

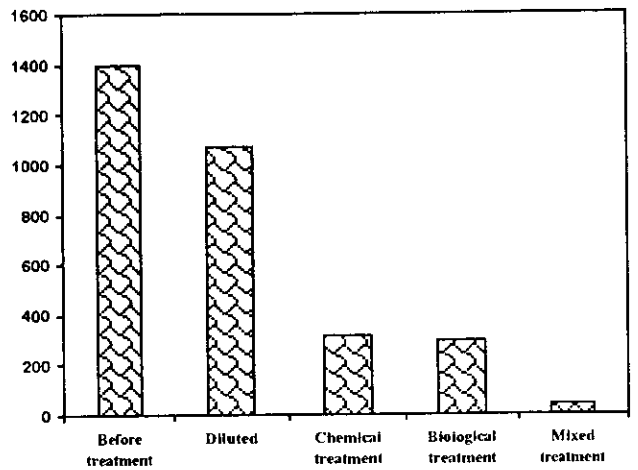
Fig. (9): Cont.



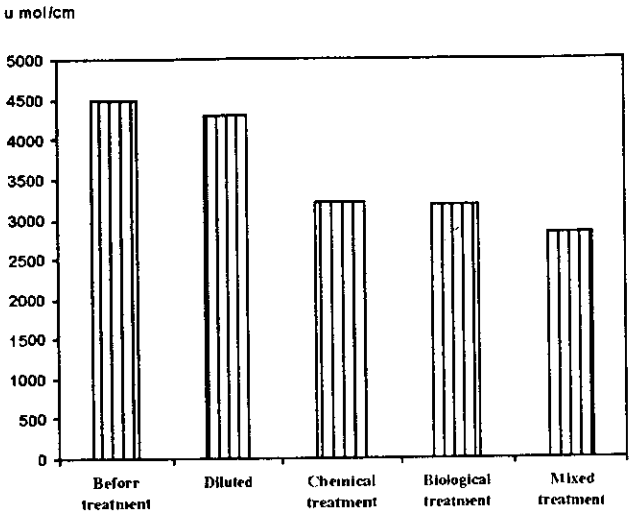
a) pH value

b) Temperature (°C)

Fig. (9): Effect of combined chemical and biological treatment after diluted by artesian water on physical and chemical characteristics of waste water produced from Oil and Soap Company, Kafr El-Zayat during February 2001.

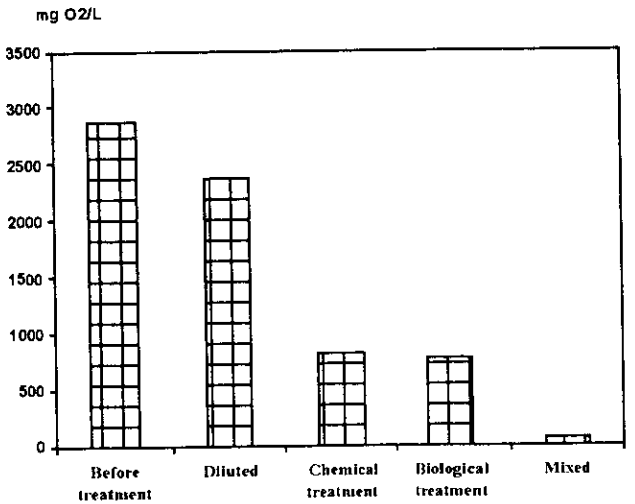


c) Turbidity

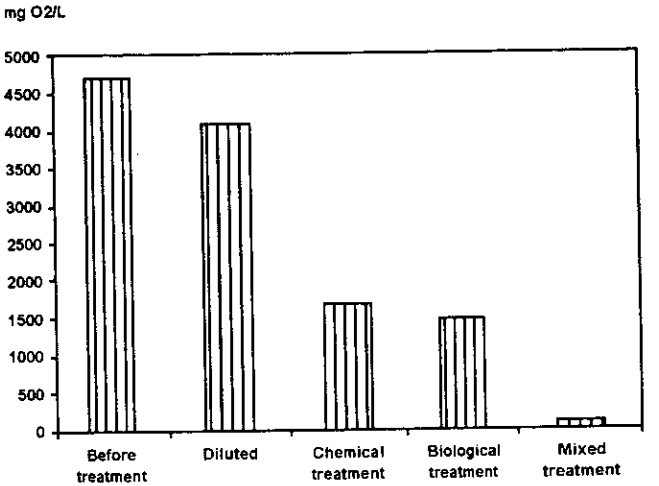


d) Electerical conductivity

Fig. (9): Cont.

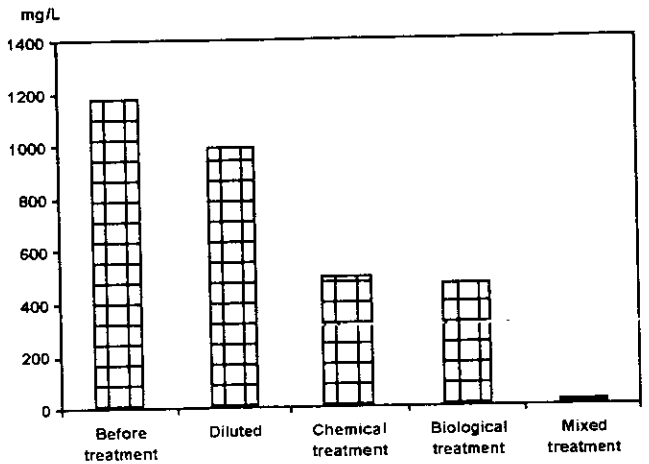


c) Biological Oxygen Demand

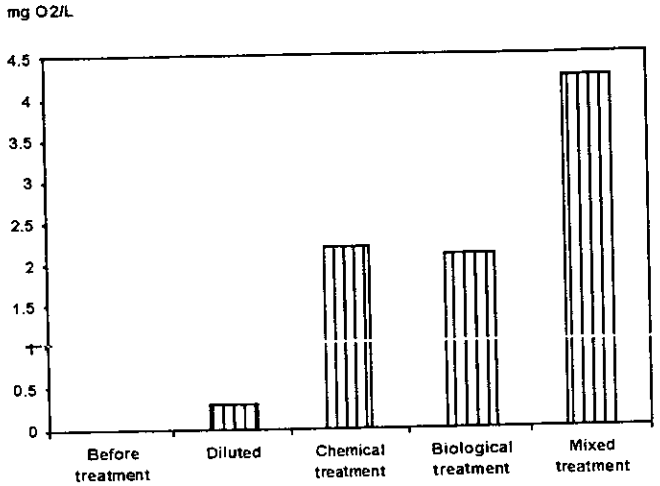


f) Chemical Oxygen Demand

Fig. (9): Cont.

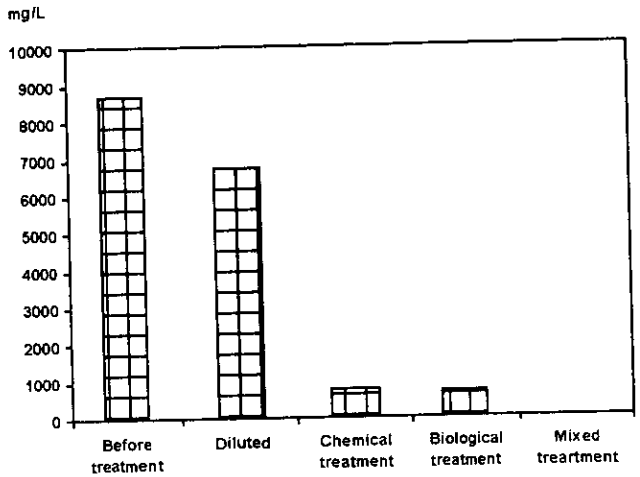


g) Permanganate value

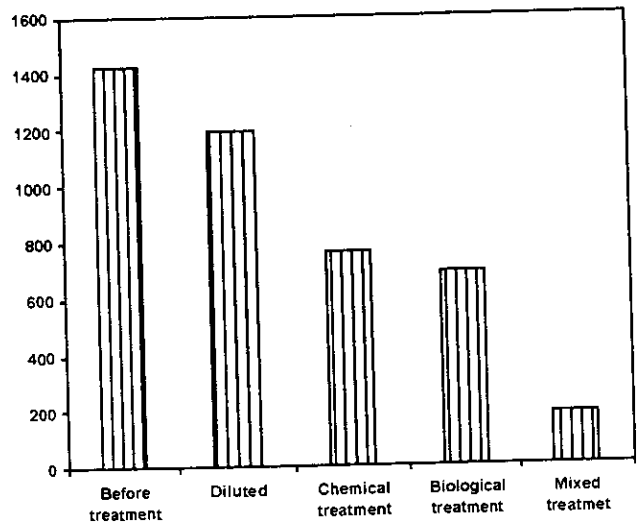


h) Dissolved oxygen

Fig. (9): Cont.

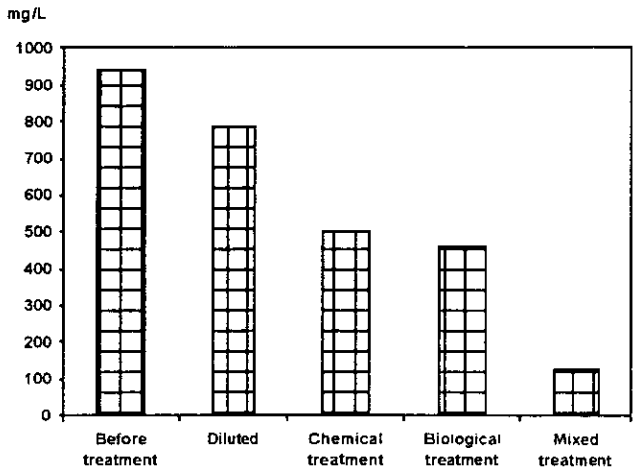


k) Oil and grease

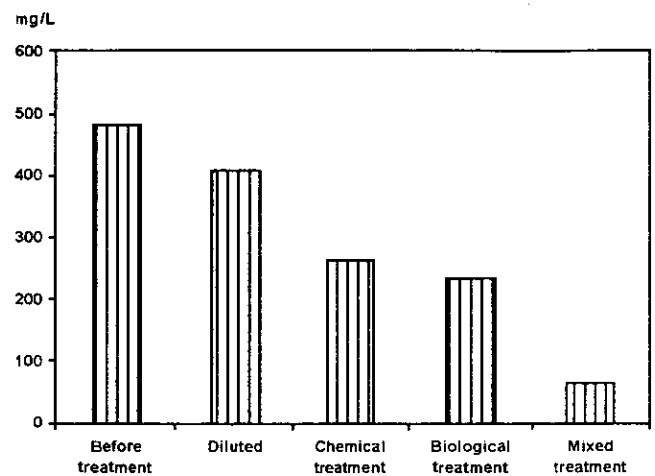


l) Total hardness

Fig. (9): Cont.

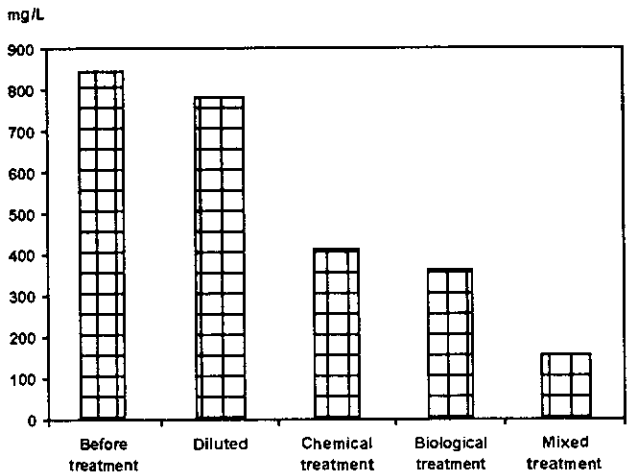


m) Calcium

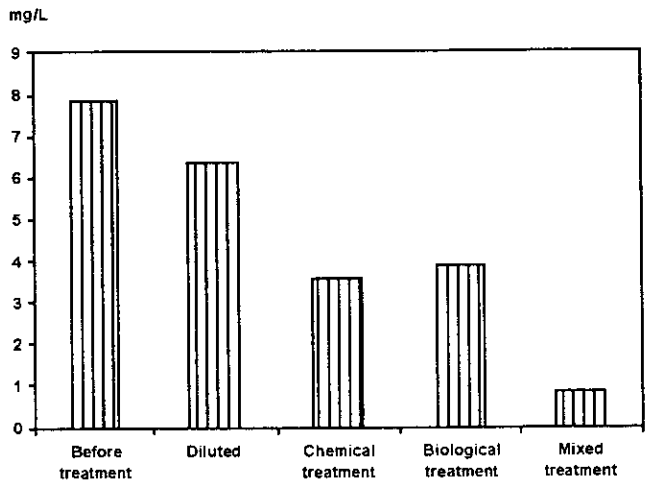


n) Magnesium

Fig. (9): Cont.

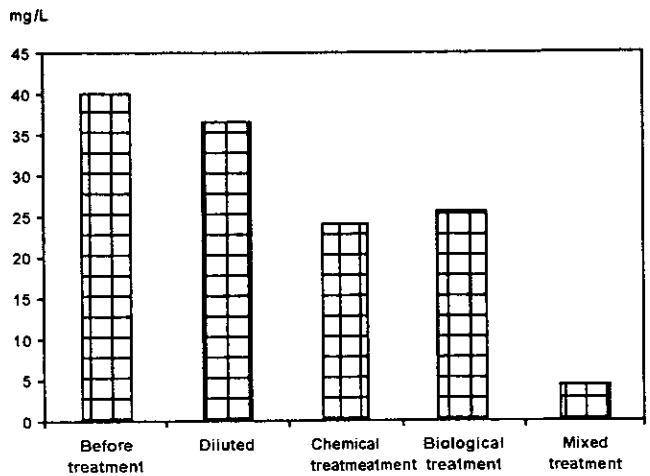


o) Sodium

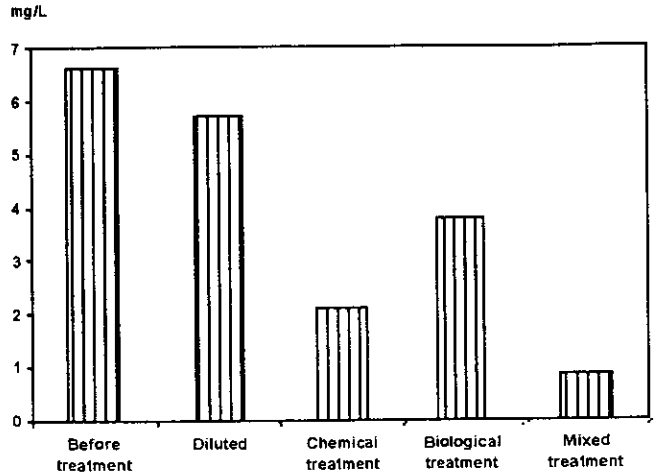


p) Sulphides

Fig. (9): Cont.



q) Inorganic phosphate

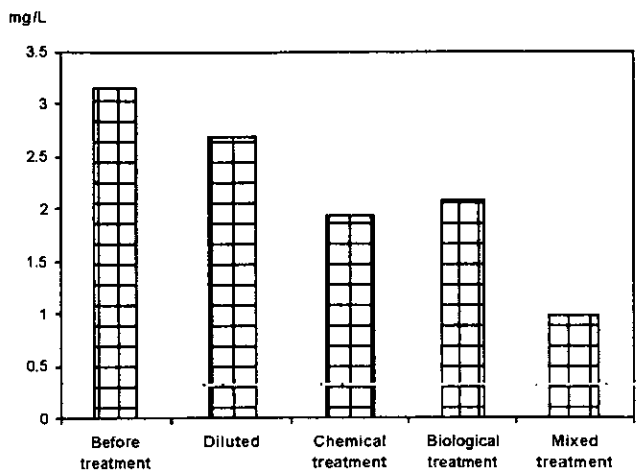


r) Florides

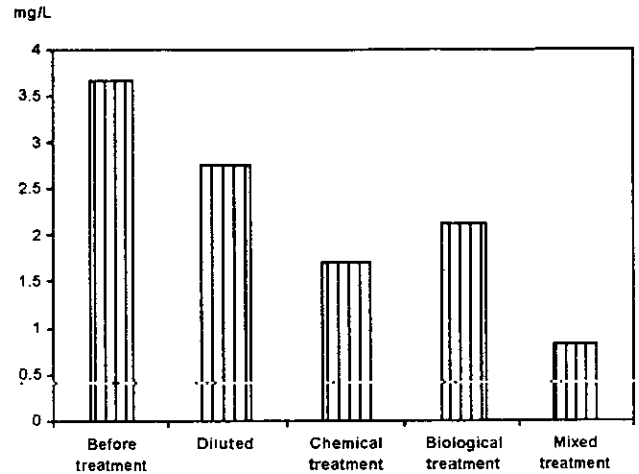
Fig. (9): Cont.

Table (10): Effect of the combined chemical and biological treatments after diluted by artesian water on heavy metals concentration of waste-water.

Elements (mg/L)	Before treatment	Diluted	Chemical treatment	Biolological treatment	Mixed treatment	Efficiency by mixed treatment %	L.S.D. at 0.05
Iron	3.14	2.68	1.93	2.07	0.99	68.47	0.20
Manganese	3.65	2.76	1.71	2.12	0.82	77.80	0.10
Zinc	7.83	6.84	5.77	6.60	4.08	48.02	0.15
Nickel	2.35	1.57	1.60	1.90	0.08	96.50	0.12
Lead	2.42	1.79	1.60	1.80	0.39	83.88	0.07
Copper	3.13	2.18	1.96	2.01	1.02	67.73	0.12

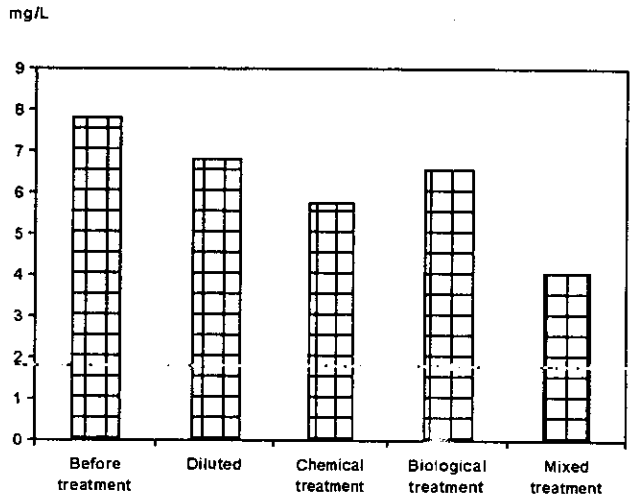


a) Iron

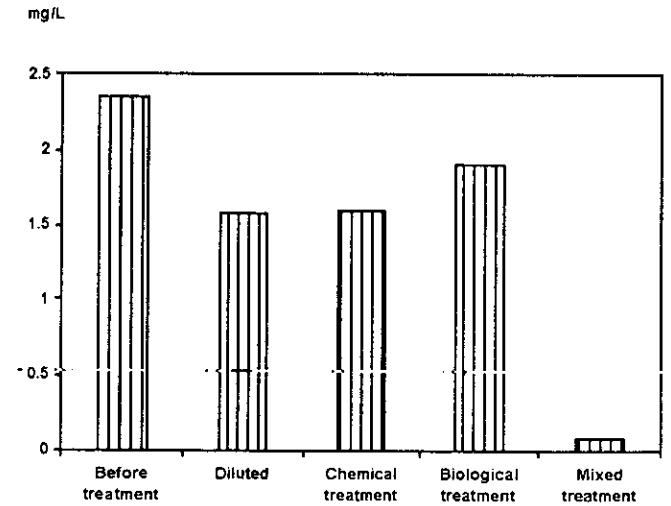


b) Mangnese

Fig. (10): Effect of combined chemical and biological treatment after diluted by artesian water on heavy metals concentration of waste-water produced from Oil and Soap Company, Kafr El-Zayat during February 2001.

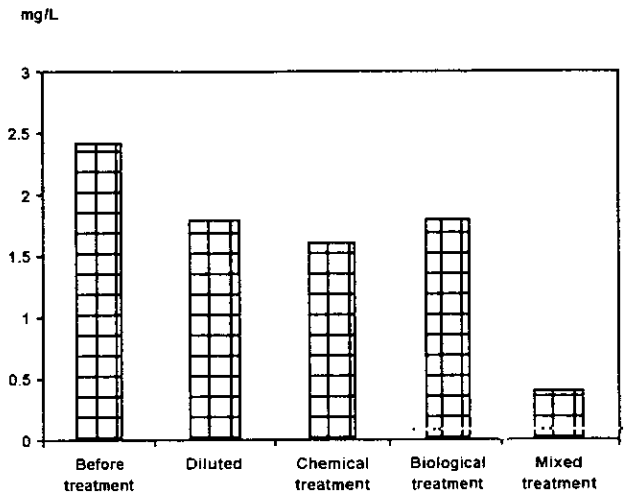


c) Zinc

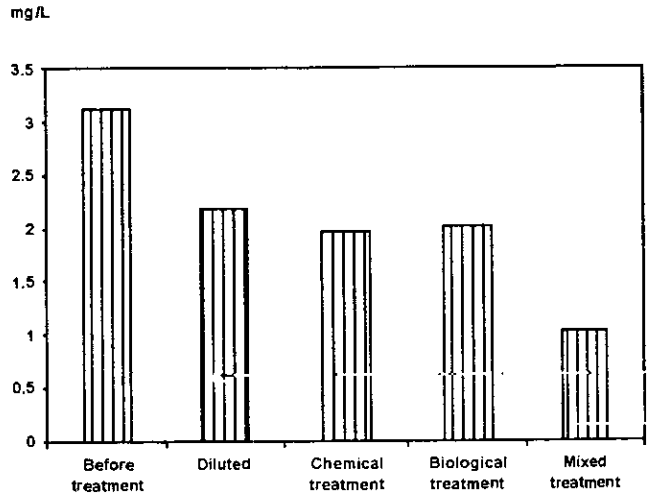


d) Nickel

Fig. (10): Cont.



e) Lead



f) Copper

Fig. (10): Cont.