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ASSESSMENT OF SURFACE WATER QUALITY OF SUEZ GULF.

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Abstract

Suez gulf is the important region not only in Egypt but also around the world, because it is a vital location in connecting Red Sea with Mediterranean Sea through Suez Canal. Due to this nature in shipping ports, loading and unloading activities, gulf water is the most exposure to petrochemical pollution than other sea water. Not only petrochemical pollution can affect on gulf pollution but also chemical plants can be affected. Surface sea water samples at this study are collected from 7 sites from electricity location to hard steel company in attaqa road, including sewage co. The objective of this study is the monitoring of the contamination of water by petrochemical and chemical pollution from loading and unloading of ships in harbor and by different industrial chemical plants, navigation and recreation activities.

This study includes physical and chemical parameters of water such as pH, conductivity, salinity, TDS, TSS, TS, DO, BOD, COD and total alkalinity. These parameters were studied seasonally to ensure that the gulf water was contaminated by all these activities in the gulf region and the effect of these pollutants in biota. This analysis has been achieved by field and laboratory studies. and the data was collected from official and previous researches.

Introduction

General Information about the Suez gulf

Suez bay is the entrance of Red sea and is limited by latitudes 29˚ 54` and 29˚ 57` N, and longitudes 32˚ 28`and 32˚ 34` E. It is an important shipping route for oil tankers and other ships traveling through the Suez Canal.

The wastewater

The wastewater is a major cause of environmental and health problems if not treated well due to the presence of different kinds of viruses, bacteria, other organisms, and high concentrations of chemicals. The problem of contamination has attracted the attention of researchers in the last three decades. Heavy elements, which are present in the wastewater, may include Cd, Cu, Cr, Pb, Ni, Zn, Al, and Mg. The concentrations of these pollutants differ from place to another according to their surrounding conditions.

Situation of Water Pollution of Suez Gulf

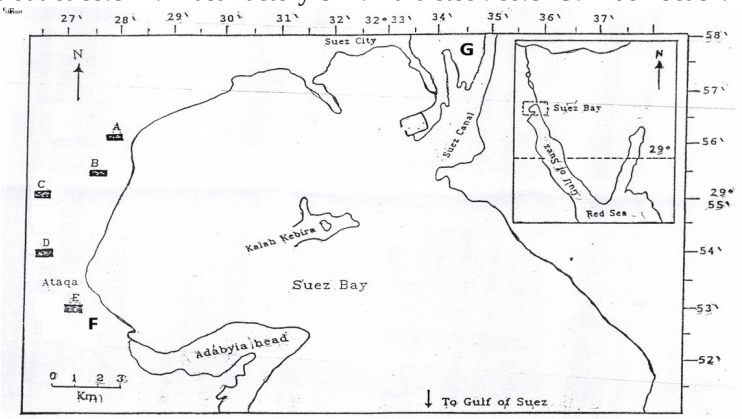
The sources and causes of water pollution in Suez Gulf Region can be categorized into: sewage, persistent organic solids, radioactive material, heavy metals, oils (hydrocarbons), nutrients, sediment mobilization, and discharge of domestic and Industrial wastewater. The marine environment of the bays in Suez

Gulf is subjected to mixed sources of pollution (industrial, agricultural and domestic sewage) through the direct discharge of El-Kabanon drain, which is considered as the main industrial and sanitary drain. Sewage of approximately 120,000 m3 /day is dumped through El-Kabanon drain into the bay in Suez Gulf. The sewage discharged contains 94 ton/year of ammonia, 0.31 ton/year of nitrite, 0.40 ton/year of nitrate, 53 ton/year of inorganic phosphate, 0.41 ton/year of copper, 3.7 ton/year of zinc and 0.12 ton/year of lead. Research was carried out on heavy metal pollution in the region, where the bay is subjected to industrial run-off from oil refineries, fertilizer plants, and power station in addition to sewage and garbage. The heavy metal concentrations ranged from 7.2 to 148 µg/l for Zn, 10 to 63 µg/l for Cu, 0.7 to 12 µg/l for Pb and 0.01 to 1.3 µg/l for Cd, respectively. Adabiya station showed the highest values, because of the various pollution sources discharged (i.e., harbors, sewage, and industrial drains), while in contrast the station of Moon beach showed the lowest concentrations. The moon beach area in the Suez Gulf was also found to suffer from extensive chronic petroleum pollution inputs, as it is evident in the vicinity of the SUMED pipeline company terminals, which include both floating and land-based receiving terminals.

Experimental

Sampling sites:

Figure (1): Map of Suez Bay showing position of the sources of pollution. A: Inlet of electricity. Co.& B: Electricity outlet Co.& C: Sewage inlet. Co. & D: Sewage outlet co.& E: Trust Factory & F: Hard steel. co.& G: Moon beach.



About 7 sampling sites were selected to represent Suez Gulf: as follows:

WA: Electricity inlet.
WB: Electricity outlet
WC: Sewage inlet.
WD: Sewage outlet.
WE: Trust co.
WF: Hard steel.
WG: Moon beach.

Surface water samples were collected from the Suez gulf from 7 different sites. The studied area lies from Electricity Co. to Hard and Trust Co. and includes Sewage Co., and another site is Moon beach to determine the hazards of this pollution to humans during rest time in beaches. These locations are about 18 km from Suez city. Along the coast to attaqa mountain, 7 water samples (3 litters) each were taken from onshore sites using the precleaned glass bottles to minimize contamination with component of ambient air during storage at the sampling site, and then the bottles were refrigerated until the time of analysis (immediately treated with 0.5% chloroform as preservative agent). This study was done to measure and determine the following tests:

1- pH values were determined using electrometric method Multimeter; WTW (Wissenshaftlich-Technische workstation GmbH) Iola Multi Level1, ba 12237de; (Germany). for measuring of pH, conductivity, salinity, total dissolved solids, dissolved oxygen.

2- Biochemical and chemical oxygen demand for sea water were determined according to standard methods.

3- Total alkalinity was calculated as CaCO3. (El-Sayed, et al,2012)

4- Total dissolved solids (TDS) were determined according to ASTMD 1888 (1992). (Omyma. et al, 2005). Determine the physical and chemical parameters also oil content Present in Misr Oil Company, (2005).

5- Chlorides, fluorides and nitrates were determined according to method of ASTM method D 512, D516 for ions spectrometrically.

Results and Discussion

Samples have been chosen for this study according to their location and activities. The main activities which may cause pollution are loading and unloading of ships in harbors, industrial activity which might affect the environmental pollution.

1- Hydrogen ion concentration (pH), Electrical conductivity (EC), and salinity measurements.

It is evident from the result of table (1) and figure (2) that the outflow of Trust Co. pH values ranged from 7.45 to 7.82 in summer and 7.66 to 8.04 in winter with average values of 7.726 and 7.786, respectively. This means that waters in general are slightly basic. The raise of pH in winter may be due to the high alkalinity content as recorded in tables (3). In general, the recorded pH values for the outflow are within the maximum permissible limits 6-9 according to the law 4/1994. Also table (1) explains the seasonal effect on conductivity values and summarizes the average values of all parameters. The conductivity of an electrolytic solution depends on the ions present and their concentrations. The conductivity reading reflects the level of

total dissolved solids (T.D.S) in wastewater. From this table one can observe the following: Conductivity is also the same except in certain locations such as inlet and outlet of Sewage station sites No. 5 and No. 6 where human drainage takes place. Conductivity values ranged from 32 ms/cm to 52 ms/cm in summer and 32.4 ms/cm to 52.4 ms/cm in winter with average values of 46.19 and 46.69 respectively. Seasonal variation of salinity which recorded high value of 33.9 in Sewage outlet and low value of 1.6 in Trust co. in summer and 33.3 in Electricity outlet and 1.5 in Hard Steel co. in winter season.

Table (1): The hydrogen ion concentration (pH), conductivity and salinity values for the water sample from Different sites in the studied area.

Season	Summer			winter		
location	pH	Cond. ms/cm	salinity	pH	Cond. µs/cm	salinity
Inlet of electricity.	7.8	50.9	33.2	7.91	51.2	32.5
Outlet of electricity.	7.76	51	33.3	7.86	52.4	33.3
Trust company for fertilizer product.	7.78	51.9	1.6	8.04	52.1	1.8
Hard steel co.	7.82	52	1.7	7.66	51.6	1.5
Outlet of sewage.	7.71	34.5	33.9	7.51	32.4	33.1
Inlet of sewage.	7.45	32	29.5	7.64	36.8	31.7
Moon Beach.	7.76	51	30.1	7.88	50.3	32.3
Average	7.73	46.19	23.33	7.79	46.69	23.75

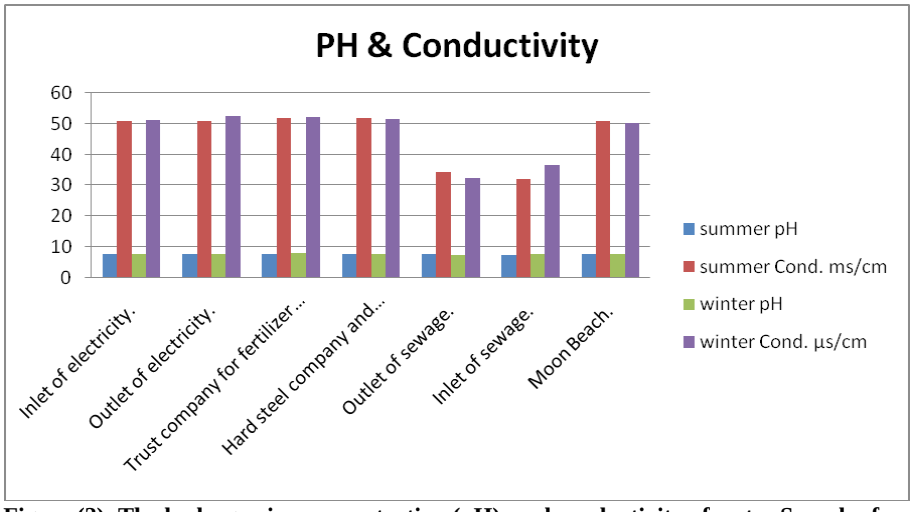


Figure (2): The hydrogen ion concentration (pH), and conductivity of water Samples for different sites in the studied area.

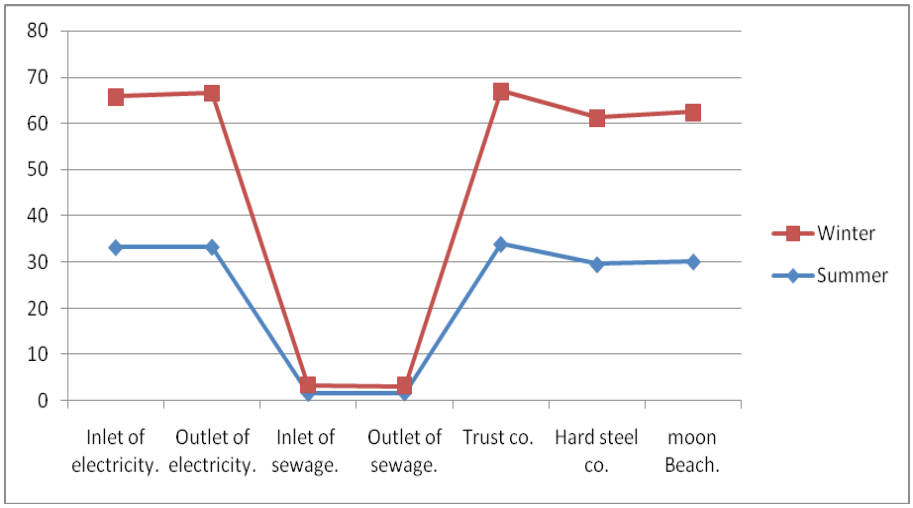


Figure (3): The salinity concentration of water samples for different sites in the studied area.

2- Total dissolved solids (TDS), total suspended solides (TSS) and total solids (TS):

Total dissolved solids (T.D.S) comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides and sulfates) beside small amounts of organic matter that are dissolved in water. Concentrations of T.D.S in water vary considerably in different geological regions owing to differences in the solubilities of minerals. The data obtained are given in table (2) and figure (4, 5). The results show that the values of total dissolved solids in the Hard Steel Company are the highest value; this is due to the high conductivity value. T.D.S values ranged from 1123 mg/L to 37321 mg/L in summer and 2268 and 36680 in winter with average values of 25934 mg/L and 29063.29 mg/L, respectively.

To convert electric conductivity to an approximate value of TDS (APHA, 1995), we can use the following equation:

$$TDS\ (mg/L) = (EC\ \mu s/cm) * 0.7$$

Also average values of TS and TSS are 28545.43 mg/L and 2005.29 mg/L in summer and 41244 and 1140 in winter, respectively, as shown in table (2).

Table (2): The values of (T.D.S), (T.S) and (T.S.S) of water samples for the different sites in the studied area.

Season	Summer			winter		
location	T.D.S mg/L	TS mg/L	TSS mg/L	T.D.S mg/L	TS mg/L	TSS mg/L
Electricity Inlet.	36604	41084	2480	35840	52456	16616
Electricity Outlet.	33520	36592	2328	31215	50635	13955
Sewage Inlet.	1750	2450	644	25760	41755	15995
Sewage Outlet.	1123	2118	912	2268	2905	637
Trust co.	35870	38904	2574	36470	38895	2425
Hard steel Co.	37321	40525	2804	36680	45730	9050
Moon Beach.	35350	38145	2295	35210	56335	21126
Average	25934	28545.43	2005.29	29063.29	41244	1140

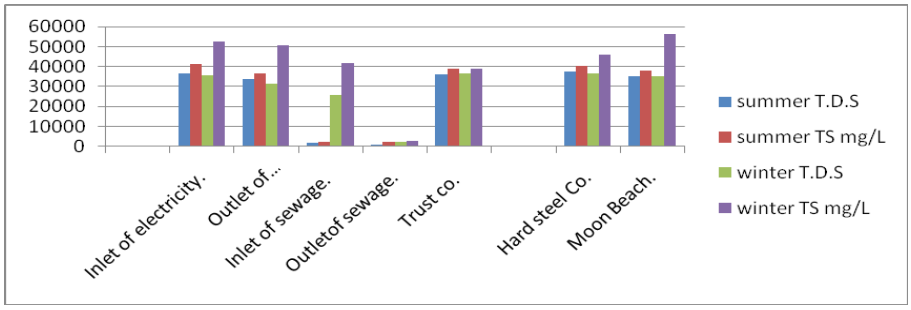


Figure (4): The TDS& TS values of water samples for different sites in the studied area.

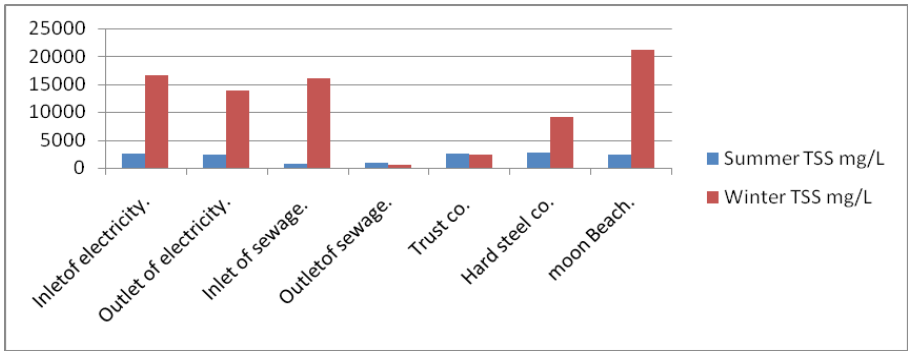


Figure (5): The TSS value of water samples for different sites in the studied

Total alkalinity contents*:*

The total alkalinity given in table (3) and figure (6).shows an idea about the content of alkalinity at all the seasons for the sites in the area under investigation. The high values recorded in sewage inlet are 238mg/L in winter and 315mg/L in summer while the average value in winter and summer are 161.2857and 182.1429 respectively.

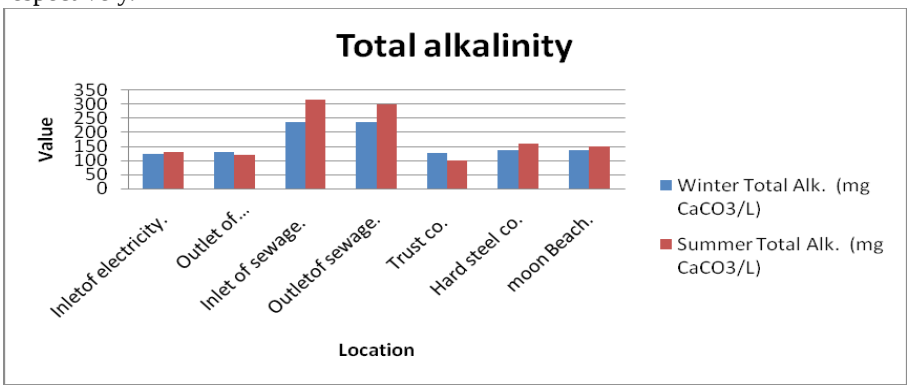


Figure (6): The values of alkalinity of water samples for the different sites in the studied area.

Table (3): The seasonal variation of total alkalinity of different sites in stududied areas . (partial and total alkalinity) (as mg$CaCO_3$/L) and carbonate, bicarbonate and hydroxide contents of Different sites in the studied areas.

Site No.	Winter	Summer
	Total Alk.(mg $CaCO_3$/L)	Total Alk. (mg $CaCO_3$/L)
Inlet of electricity.	124	130
Outlet of electricity.	130	120
Inlet of sewage.	238	315
Outlet of sewage.	237	300
Trust co.	127	100
Hard steel co.	135	160
Moon Beach.	138	150
Average	161.2857	182.1429

The content of Dissolved oxygen content (DO), chemical oxygen demand (COD) and biochemical oxygen demand (BOD):

Seven Locations were collected and the results are given in table (4), and fig (7,8,9). The results of DO, COD and BOD obtained from seven locations varied from 30.8 mgO2/L to 80.24 mgO2/L in summer season and from 30.21 mgO2/L to 120.36 mgO2/L in winter. while COD values

are varied from 34.22mgO2/L to 150.85mgO2/L in summer and from 20.02mgO2/L to 96.95mgO2/L in winter season.

Table (4): The content of DO, BOD and COD (mgO_2/L) of the different sites in the studied areas.

Season	**Summer**			**winter**		
Location	DO (mgO2/L)	BOD (mgO2/L)	COD (mgO2/L)	DO (mgO2/L)	BOD (mgO2/L)	COD (mgO2/L)
Elect. Inlet	1.49	70.09	61.63	1.88	50.32	80.8
Elect. Outlet	1.52	62.92	51.36	1.85	70.39	96.5
Sewage inlet	0.72	33.21	36.96	0.62	40.35	28.52
Sewage outlet	0.35	30.80	68.48	0.86	30.21	20.02
Trust co.	1.72	55.84	34.24	1.85	120.36	64.08
Hard steel	1.86	70.28	150.85	1.26	95.3	60.26
Moon beach	1.89	80.42	120.56	1.88	77.32	96.95

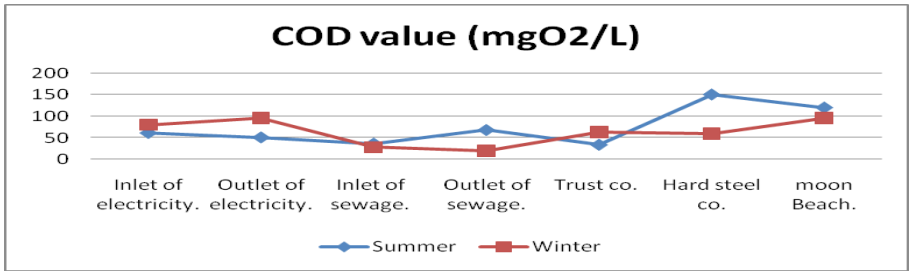


Figure (7): The values of COD of water samples for the different sites in the studied area.

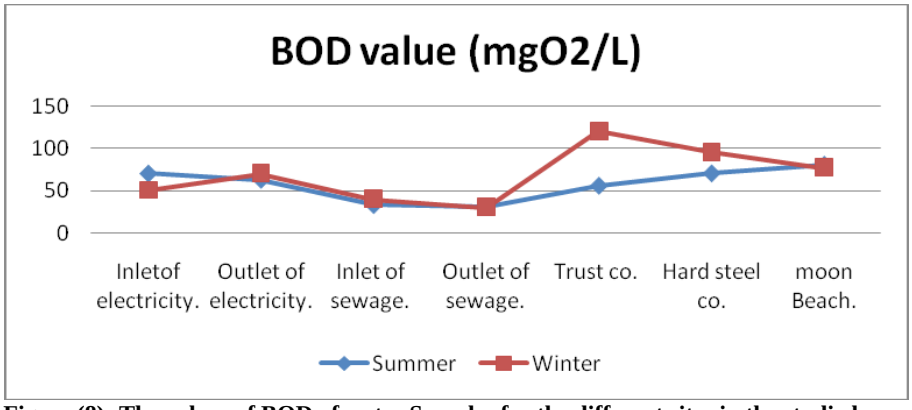


Figure (8): The values of BOD of water Samples for the different sites in the studied area.

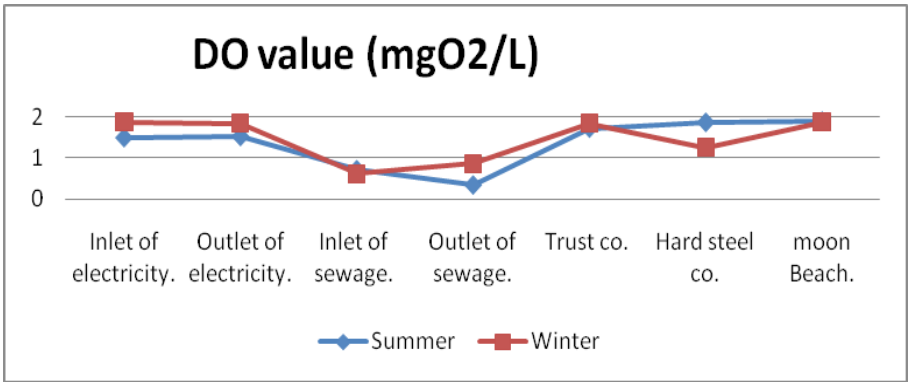


Figure (9): The values of DO of water Samples for the different sites in the studied area.

Chloride, fluorides and nitrates contents:

Table(5): Contents of NO3,F and chloride concentration in surface sea water.

Season	Summer			winter		
Location	Cl^-	$NO3^-$	F^-	Cl^-	$NO3^-$	F^-
Elect. Inlet	267.7	0.17	1.17	407.8	0.11	1.11
Elect. Outlet	272.9	1.02	0.43	351.5	3	0.38
Sewage inlet	125	0.11	0	230.96	0.2	0
Sewage outlet	225	0.02	0	357.41	0.05	0
Trust co.	268.3	6.98	0.17	373.5	9.58	0.10
Hard steel	105.1	3.12	0.54	93.1	1.25	0.28
Moon beach	245.5	1.25	4.25	130	1.01	7.96

This table shows the chloride content which varies from 105.1 ppm to 272.9ppm in summer and 93.1ppm to 407.8ppm in winter. Nitrate content is varied from 0.11ppm to 6.98ppm in summer and 0.05ppm to 9.58ppm in winter, while the flouride content is varied from 0 to 4.25ppm in summer and from 0 to 7.96ppm in winter.

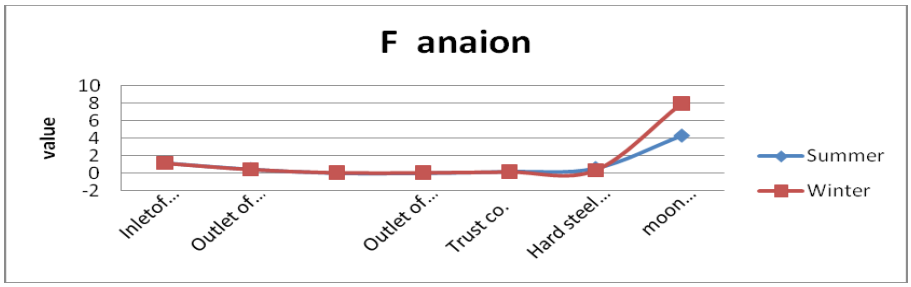


Figure (10): The seasonal variations of fluoride content (ppm).

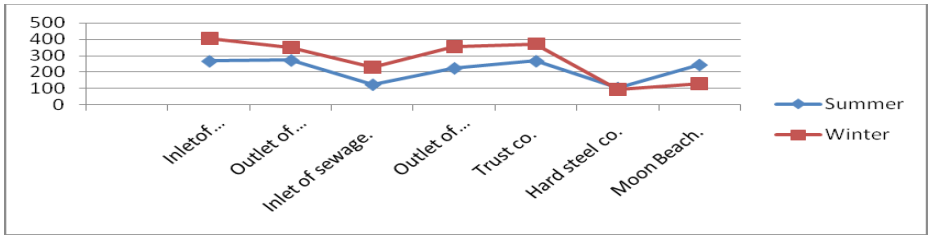


Figure (11): The seasonal variations of chloride content (ppm).

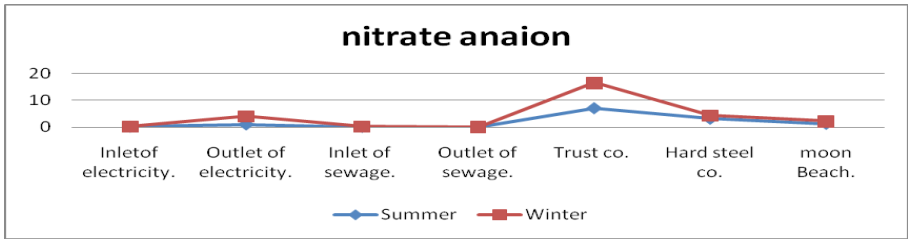


Figure (12): The seasonal variations of nitrate content (ppm).

Conclusion

This study demonstrates the following physico- chemical properties of water such as pH,conductivity, salinity, alkalinity, TDS,TS, TSS, BOD,DO,COD and trace metal compounds.

1- Water samples were analyzed for pH, alkalinity, salinity and conductivity. it was found that the water samples are slightly basic and the seasonal variations are slightly different. While the alkalinity in summer is higher than that in winter season.

2- Trace anions like chloride, flouride and nitrate can be explained as follow; Chloride content varied from 105.1 ppm to 272.9ppm in summer and 93.1ppm to 407.8ppm in winter seasons. Nitrate varied from 0.11ppm to 6.98ppm in summer and 0.05ppm to 9.58ppm in winter, also the flouride content varied from 0 to 4.25ppm in summer and from 0 to 7.96ppm in winter.

3- The results of BOD,DO and COD table showed that BOD varied from 30.8 mgO2/L to 80.24 mgO2/L in summer and from 30.21 mgO2/L to 120.36mgO2/L in winter. Also COD varied from 34.22mgO2/L to 150.85mgO2/L in summer and from 20.02mgO2/L to 96.95mgO2/L in winter.

4- TDS,TS and TSS, Tss values in winter are higher than those reported in summer season, while the TDS values in summer are higher than those reported in winter season.

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