

INVESTIGATIONS OF THE PHYSICAL, CHEMICAL AND MICROBIAL PARAMETERS OF COASTAL SEAWATER NEAR SEWAGE OUTLETS, KUWAIT

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ABSTRACT

A field study was carried out to investigate the physical, chemical and microbial parameters of coastal seawater effected by Sewage outlets. Coastal seawater samples were collected near two sewage manholes located in Kuwait bay during the period from April to May of 2019. The collected samples were analyzed for chemical parameters such as pH, dissolved oxygen (DO) and total dissolved solids (TDS), the physical parameter is Turbidity and microbial parameter such as faecal coliform. The laboratory results for all parameters were compared with Kuwait Environment Public Authority standards for discharging water to the sea. The laboratory analysis indicated alkaline, reduced oxidation and saline seawater that not suitable with Kuwait Environment Public Authority. On-site treatment system should be followed before discharging wastewater to the sea.

Keywords: Kuwait Bay, faecal coliform, turbidity, and microbial parameter.

1 INTRODUCTION

Coastal seawater contamination is known as worldwide problem for many countries. There are different sources for coastal seawater contamination such as discharging of the following man-made activities to the sea, untreated industrial wastewater, domestic sewage water, oil tankers leakage and brine water from water desalination plants, etc. Discharging treated or non-treated wastewater into the sea, with increase quantities of nutrients (nitrogen, phosphorus) to the coastal zones. These nutrients will be consumed by algae colonies, and their growth needs more dissolved oxygen from seawater. This will produce seawater zones of low oxygen which lead to negative impacts on marine life (fish, shrimps, oysters and other aquatic spices), and finally lead to fish kill problems.

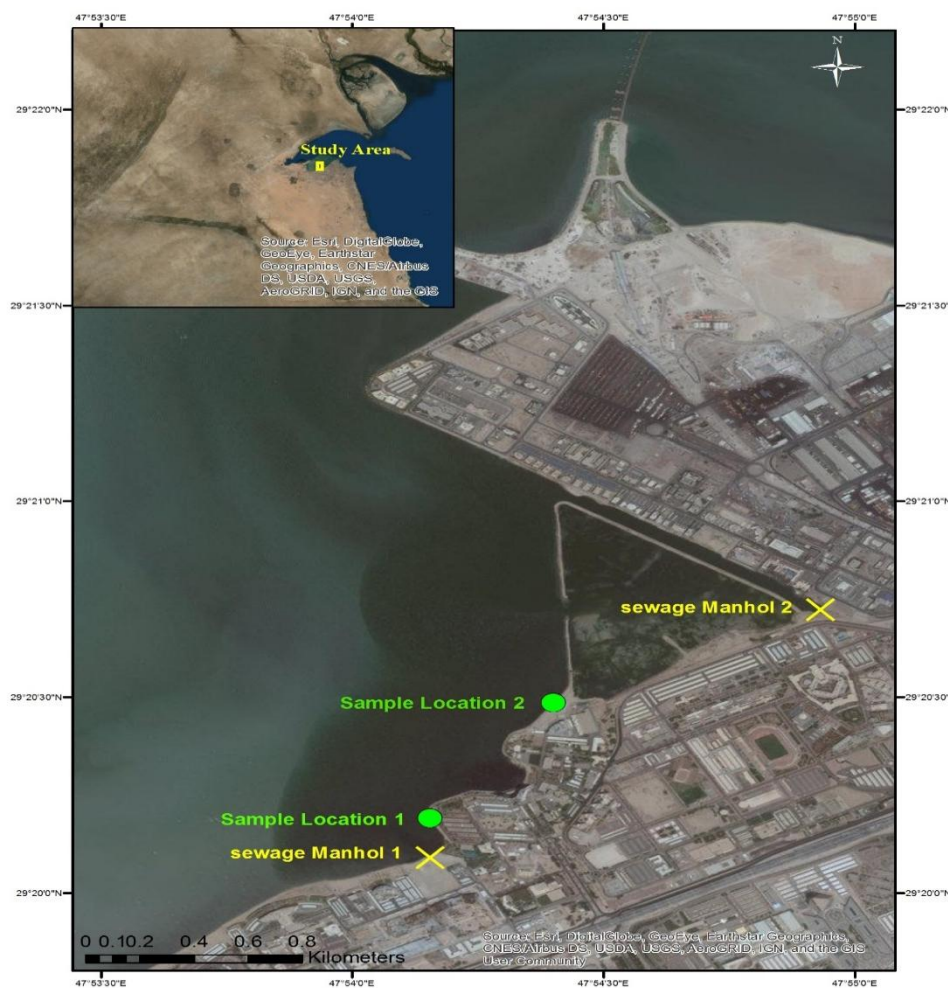


Figure 1. Location of the study area



Figure 2. Sewage Manhole 1.

A field study was conducted in Kuwait indicated that the sewage nutrients led to death of 100-1000 fish/day in 2001 (Gilbert et al. 2002). Kuwait environmental public authority (KEPA) reported that more than 52 sewage manholes discharging untreated wastewater into the coastal area. Moreover, KEPA reported that the change in the sea water quality was due to anaerobic conditions at the coastal areas (Al-Anba Newspaper, 14 April 2019). In the current study, two sites were selected

near sewage manholes to determine the effects of the wastewater on the quality of the coastal seawater (Fig.1 and 2).

2 METHODOLOGY

Two sites of the coastline of Kuwait Institute for Scientific Research (KISR) were selected to determine the quality of seawater near relatively sewage manholes discharged to the sea (Figs. 1 and 2). Irregular seawater samples were collected from April to May. The collected samples were analyzed for chemical parameters such as pH, dissolved oxygen (DO) and total dissolved solids (TDS). The physical parameter is Turbidity and microbial parameter such as faecal coliform. All the sea water parameters were analyzed according to standard methods for the examination of water and wastewater (APHA, 2017). Total of two-liter samples were collected in sterilized glass bottles. All sea water samples were filtered by using Buchner funnel filtration system connected to vacuum to remove the clay particle and total suspended solids (TSS). All samples were analyzed without dilution except for the microbial parameter (faecal coliform bacteria) were one milliliter seawater sample diluted in one liter of distilled water.

3 RESULTS AND DISCUSSION

Laboratory results for all seawater samples presented in (Tables 1 and 2) and Figures (3-12). All the seawater samples were compared with Kuwait Environment Public Authority (KEPA, 2017) for discharging wastewater to the sea. The pH values of site1 ranged between 7.9 and 8.39 and those values for site 2 ranged between 8.0 and 8.6 (Figs. 3 and 4). The results indicated slightly alkaline water environment. The pH values for both sites within the range of KEPA, 2017 standard (Tables 1 and 2). The minimum and maximum values for dissolved oxygen was found to be 0.47 mg/l, 1.4 mg/l for site 1 (Fig. 5, Table 1), while the minimum and maximum values for dissolved oxygen was found to be 0.5 mg/l, 1.9 mg/l for site 2 (Fig. 6, Table 2). These data for both sites indicated anaerobic conditions and their values were below of KEPA standard (>4 mg/l). The total dissolved solids (TDS) values for sea water samples (31,747 mg/l - 44,270 mg/l, Figs. 7 and 8), for both sites were above KEPA standard (1650 mg/l-2250 mg/l).

Table 1. Laboratory chemical and Microbial Results for Coastal Sea Water Samples during April-May 2019, KISR, Kuwait
Site No. 1 Site Coordinates: 47.902623E - 29.336623 N

Parameters	pH			DO (mg/l)			TDS (mg/l)			Turbidity NTU			Faecal coliform (cfu/100 ml)		
	KEPA STD. (6-9)			KEPA STD. (>4)			KEPA STD. (1650-2250)			KEPA STD. (75)			KEPA STD. (500)		
Sampling Date	V. 1	V. 2	Mean	V. 1	V. 2	Mean	V. 1	V. 2	Mean	V. 1	V. 2	Mean	V. 1	V. 2	Mean
17/04/19	8.13	8.21	8.17	1.19	0.97	1.08	43,080	43,140	43,110	53	53	53	718000	756000	737000
23/04/19	8.39	8.10	8.25	0.57	0.47	0.52	42,940	43,050	42,990	48	50	49	466000	504000	485000

29/4/19	7.9 0	7.9 1	7.9 05	1.0 0	0.70	0.85	31,747	31,6 50	31,6 98	26	32	29	6930 00	7310 00	7120 00
1/5/19	7.9 3	7.9 2	7.9 25	0.6 3	0.81	0.72	32,160	31,9 20	32,0 40	48	47	47. 5	6260 00	3820 00	5040 00
2/5/19	8.1 2	8.1 0	8.1 1	0.4 8	0.71	0.59	37,162	37,1 85	37,1 73	42	42	42	3580 00	3900 00	3740 00
6/5/19	8.1 1	8.0 7	8.0 9	1.4	0.8	1.1	39,135	39,6 30	39,3 92	20	22	21	3090 00	3950 00	3520 00
7/5/19	8.0 6	8.0 8	8.0 7	1.3	0.8	1.05	37,237	37,2 67	37,2 52	25	26	25. 5	4650 00	3750 00	4200 00
8/5/19	8.0 4	8.0 1	8.0 3	1.2	0.7	0.95	37,830	37, 680	37,7 55	22	19	21	5070 00	3850 00	4460 00
Maximum Value	8.3 9	8.2 1	8.2 5	1.4	0.97	1.1	43,080	43,1 40	43,1 10	53	53	53	7180 00	7560 00	7370 00
Minimum Value	7.9 0	7.9 1	7.9 05	0.4 8	0.47	0.52	31,747	31,6 50	31,6 98	20	22	21	3090 00	3750 00	3520 00

Note: KEPA STD – Kuwait EPA standard, 2017, V.1- Primary sample, V.2 - Duplicate sample

Table 2. Laboratory chemical and Microbial Results for Coastal Sea Water Samples during April-May 2019, KISR, Kuwait
Site No. 2
Site Coordinates: 47.906859E - 29.341482 N

Parameters	pH			DO (mg/l)			TDS (mg/l)			Turbidity NTU			Faecal coliform (cfu/100 ml)		
	KEPA STD. (6-9)			KEPA STD. (>4)			KEPA STD. (1650-2250)			KEPA STD. (75)			KEPA STD. (500)		
Sampling Date	V. 1	V. 2	Mean	V. 1	V. 2	Mean	V. 1	V. 2	Mean	V. 1	V. 2	Mean	V. 1	V. 2	Mean
17/04/19	8.0 4	8.0 0	8.02	0.5 0	0.5 8	0.54	41,2 90	42,2 90	41,7 80	37	38	39	2150 00	2990 00	2570 00
23/04/19	8.3 8	8.6 0	8.49	1.7 3	1.6 4	1.68	44,2 70	42,4 33	43,3 51	71	74	72. 5	3950 00	4430 00	4190 00
29/4/19	8.2 3	8.2 4	8.23 5	1.6 0	1.7 0	1.65	34,9 87	34,6 50	34,8 18	49	37	43	6200 00	6680 00	6440 00
1/5/19	8.1 8	8.2 2	8.2	1.4 0	0.8 0	1.1	35,2 72	35,2 57	35,2 64	36	38	37	5120 00	3360 00	4240 00
2/5/19	8.3 7	8.3 6	8.36 5	1.9	1.2	1.55	38,6 85	39,1 57	38,9 21	66	68	67	6900 00	5420 00	6160 00
6/5/19	8.3 9	8.0 4	8.21 5	1.5	1.2	1.35	39,8 85	39,8 02	39,8 43	45	45	45	5000 00	3400 00	4200 00
7/5/19	8.2 8	8.2 7	8.27 5	1.9	1.5	1.7	39,7 57	39,5 92	39,6 74	30	31	30. 5	7400 00	6300 00	6850 00
8/5/19	8.4	8.4	8.42	1.3	1.7	1.5	37,9	37,5	37,7	38	43	40.	2910	3370	3140

	2	3	5				72	22	47			5	00	00	00
Maximum Value	8.42	8.60	8.49	1.9	1.7	1.7	44,270	42,433	43,351	71	74	72.5	7400	6680	6850
Minimum Value	8.04	8.00	8.02	0.50	0.58	0.54	34,987	34,650	34,818	30	31	30.5	2150	2990	2570

Note: KEPA STD – Kuwait EPA standard, 2017, V.1- Primary sample, V.2 - Duplicate sample

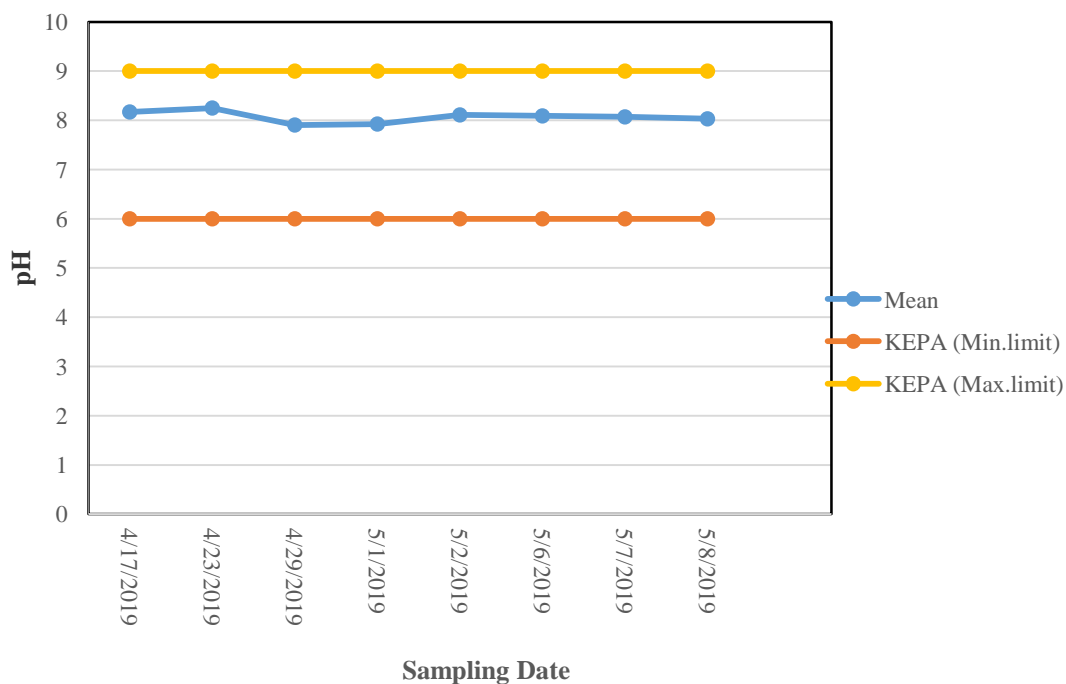


Figure 3. pH mean values for coastal seawater samples for site 1.

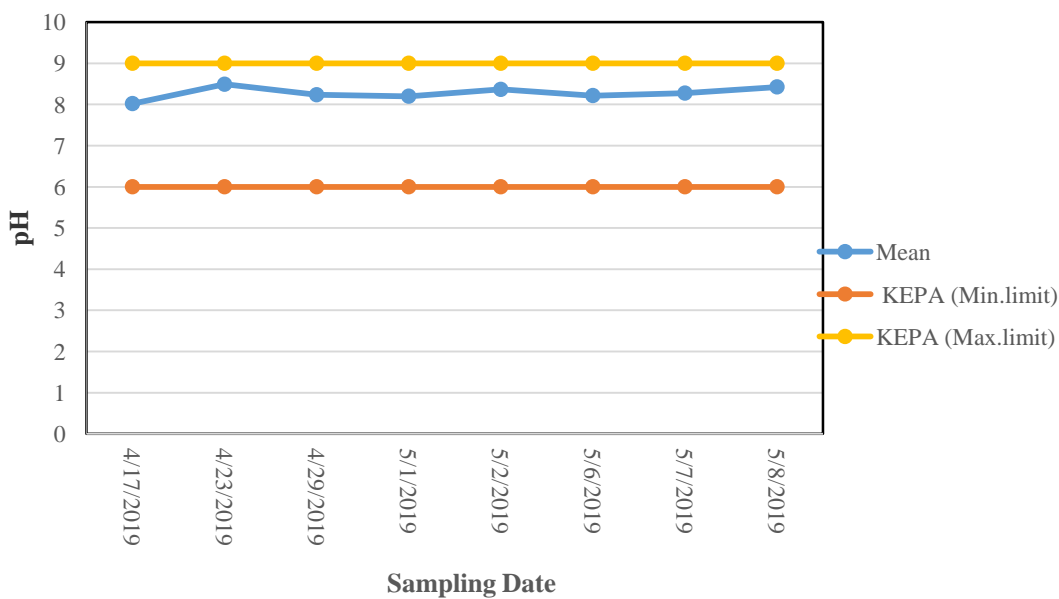


Figure4. pH mean values for coastal seawater samples for site 2.

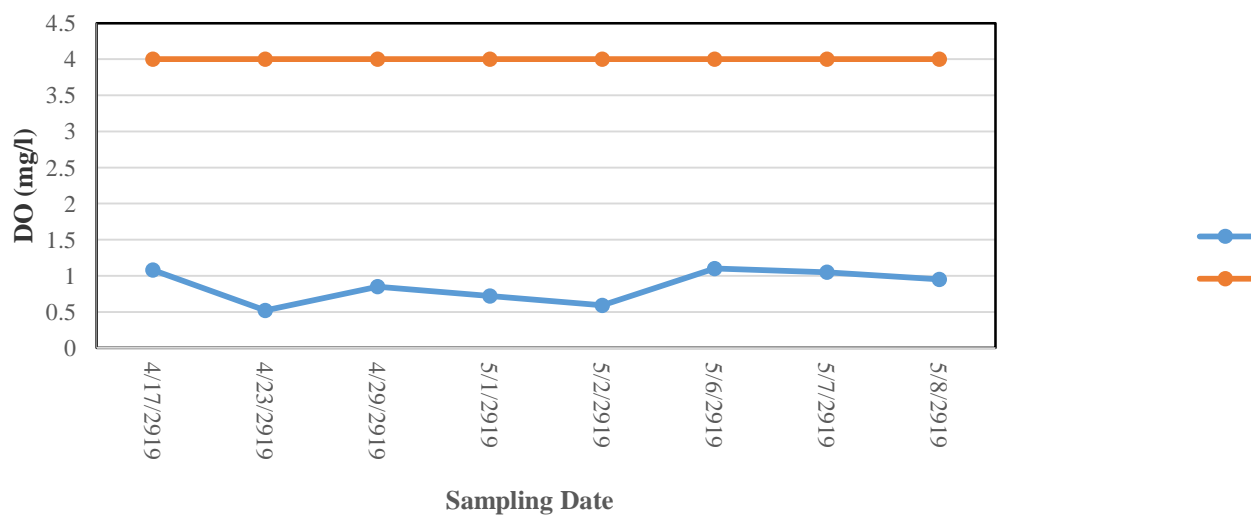


Figure 5. DO mean values for coastal seawater samples for site1.

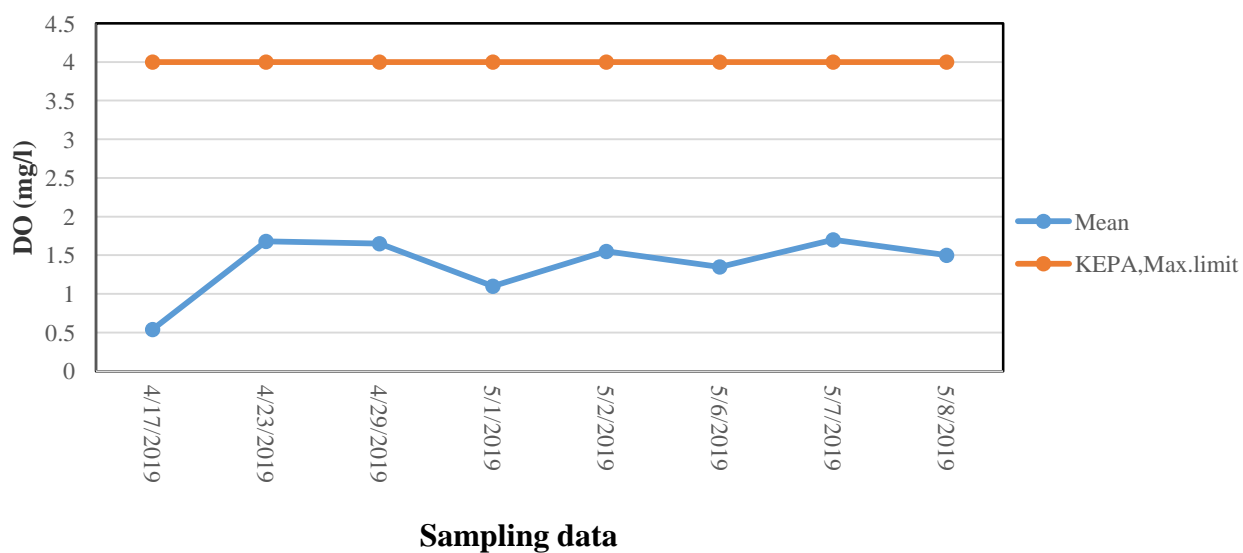


Figure 6. DO mean values for coastal seawater samples for site 2.

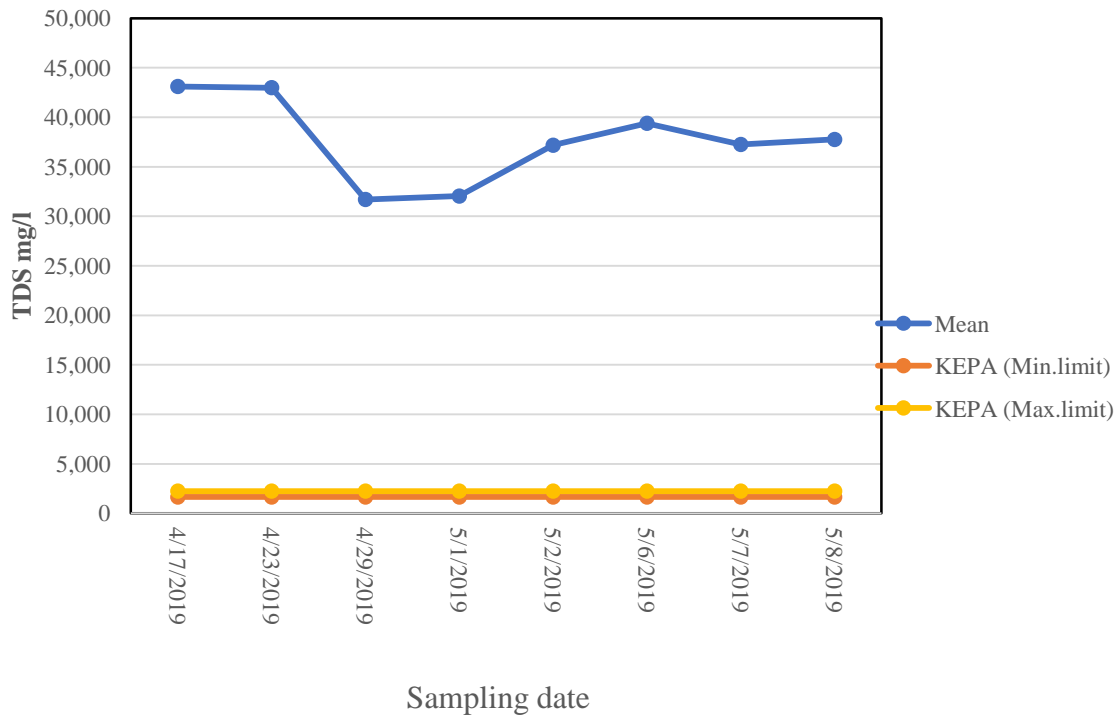


Figure7. TDS mean values for coastal seawater samples for site 1.

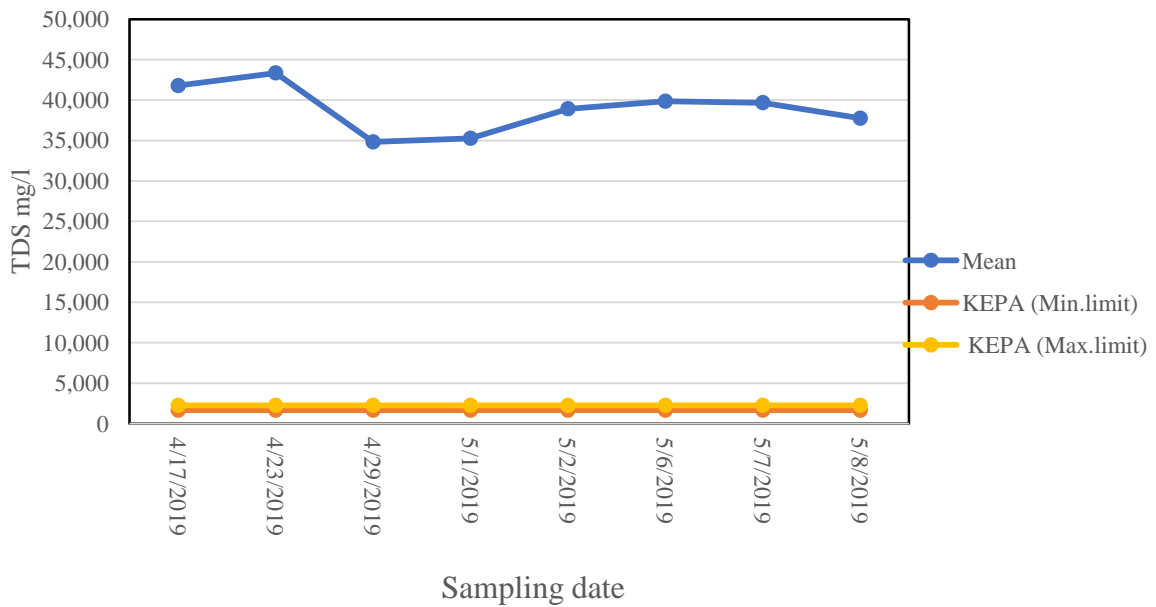


Figure 8. TDS mean values for coastal seawater samples for site 2.

The turbidity values for sea water samples ranged (20 NTU - 74 NTU, Figs. 9 and 10) for both sites and they were below KEPA standard (75 NTU). These data indicated that turbidity values for site 2 were higher than those at site 1 (Figs. 9 and 10). Faecal coliform bacteria counts indicated that sea water samples counts (215000 cfu/100ml-756000 cfu/100ml, Figs. 11 and 12), for both sites were above KEPA standard (500 cfu/100ml). The seawater samples results for both sites meets KEPA

standard for discharging wastewater into the sea, except parameters such as dissolved oxygen, total dissolved solids and faecal coliform counts. These data indicated seawater samples contamination with bacteria and low dissolved oxygen values. This conclusion was supported by presence of anaerobic environment with high counts of bacteria.

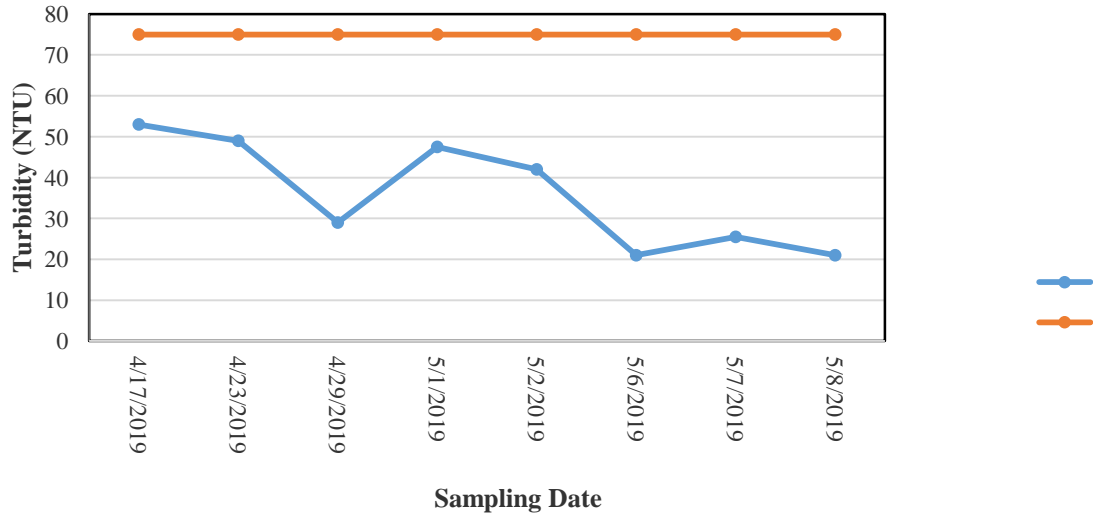


Figure 9. Turbidity mean values for coastal seawater samples for site 1.

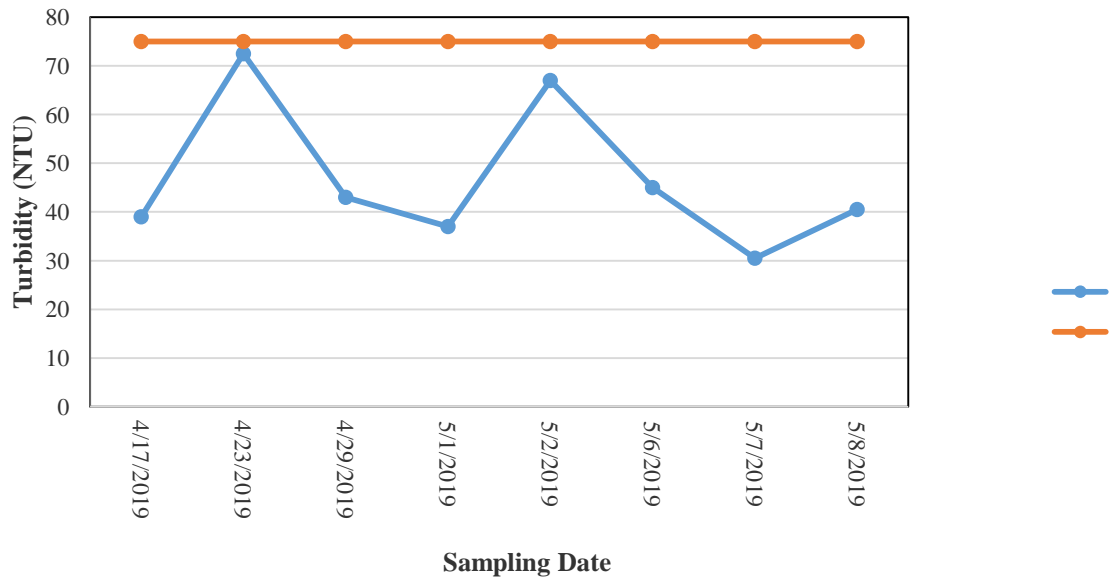


Figure 10. Turbidity mean values for coastal seawater samples for site 2.

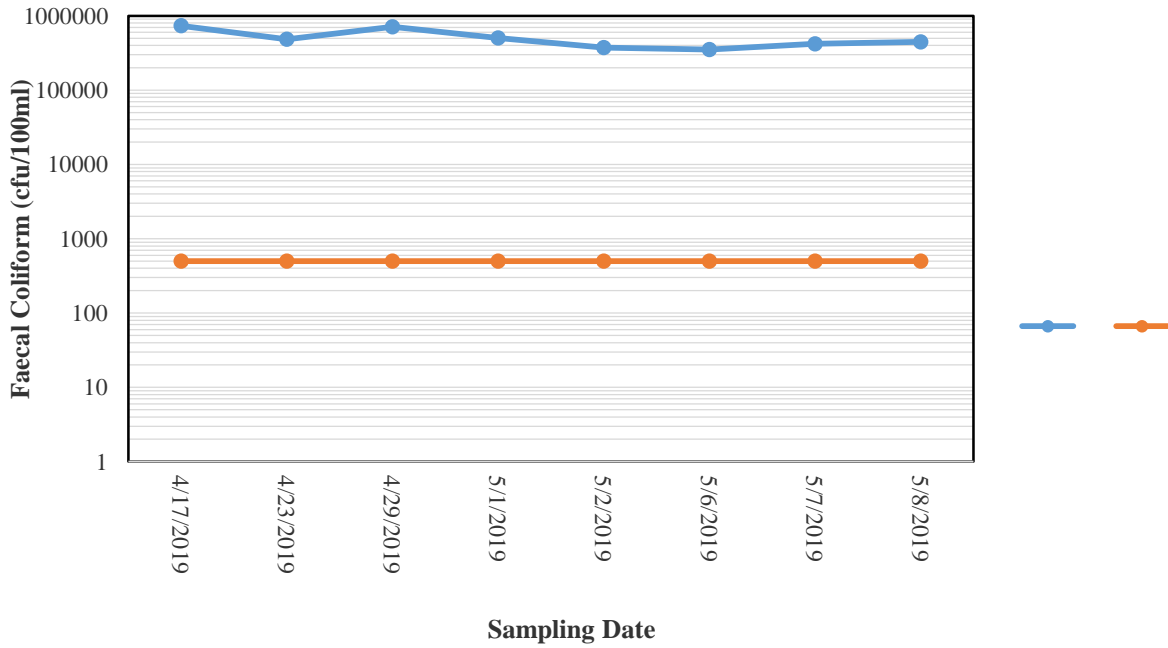


Figure 11. Faecal coliform mean counts for coastal seawater samples for site 1.

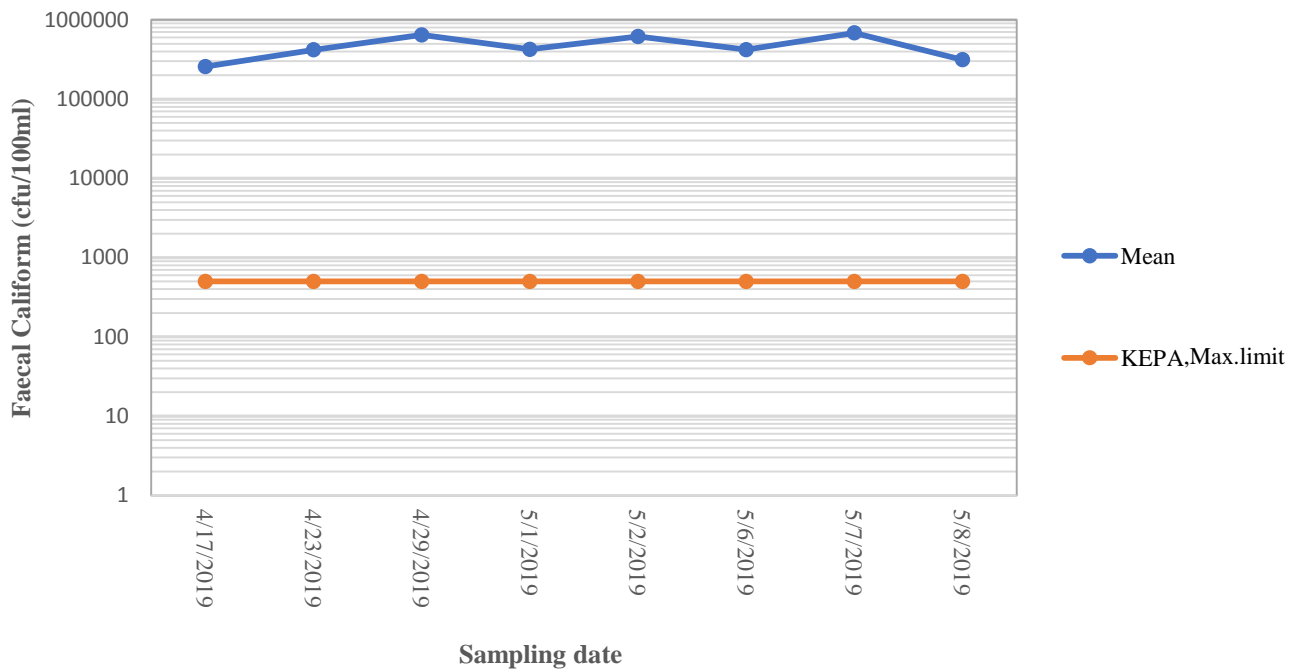


Figure 12. Faecal coliform mean counts for coastal seawater samples for site 2.

4 CONCLUSIONS

Field study was carried out to determine the effects of wastewater from two sewage manholes on the quality of coastal seawater. The obtained results were compared with KEPA standard, for discharging wastewater into the sea. Two sites were selected along with coordinates near relatively sewage manholes and the quality of seawater samples were evaluated. The collected samples were analyzed for the following parameters pH, EC, DO, total dissolved solids, turbidity and faecal

coliform bacteria. The laboratory results indicated that alkaline, low oxidized environment with high faecal coliform bacteria counts were found near both sites. The parameters of the coastal seawater samples meet KEPA standard except parameters DO, TDS and bacteria.

RECOMMENDATIONS

The following are suggested for any future studies:

1. Continuous monitoring programs should be conducted on seasonal and yearly basis with respect to the coastal quality seawater in Kuwait bay as suggested by (Al-Mutairi et al., 2014).
2. The coastal seawater samples should be analyzed for physical, chemical, organic, bacteria and radiation parameters.
3. On site wastewater treatment system should be applied to the sewage water before discharging into the sea.

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