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AN ASSESSMENT OF POLLUTION IN MAJOR CREEKS AROUND PORT QASIM

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ABSTRACT: Discharge of industrial and domestic wastes in sea alter the physical and chemical properties of sea water, which may affect the marine ecosystem. This study was aimed to measure the water quality of eight different creeks around Port Qasim. Samples were collected and analyzed using standard procedures during February and March, 2009. The parameters including pH, Conductivity, Total Dissolved Solids, Salinity, Dissolved Oxygen, Nitrate, Phosphate, Sulphate, Chloride, Calcium, Potassium, Zinc, Iron, Cobalt, Chromium, Manganese and Cadmium were determined. The result shows that Bakran creek and Gharo-Phitti creeks are heavily polluted compared to other creeks. This study recommends that wastes from the industries or sewerage should be treated before being discharge into the creek system.

Key words: Creeks, Port Qasim, nutrients, Gharo-Phitti, Bakran

INTRODUCTION

Pollution of water bodies is a major concern in the developing nations. According to various workers (Fakayode, 2005; Emongor *et al*., 2005; Furtado *et al*., 1998; Ugochukwu, 2004; Altman and Parizek, 1995**)** anthropogenic activities i.e. industrial effluents, direct disposal of wastes into the water bodies, agricultural fertilizer and animal waste are responsible for metal toxicity on both aquatic and terrestrial life. These activities often lead to alteration of water quality by raising the physico-chemical parameters above the permissible limits (Fakayode, 2005; Adekunle *et al*., 2008). Sometimes these physical and biological factors act as pollutants (Goel, 1997).

Like other populated and industrialized coastal regions of the world, seawater quality of Pakistan is also severely affected by the discharge of pollutants into marine environment (Furyal and Hameed, 2005). It was estimated that the resident, living in or around the coast are under the stress of chronic pollution which may not only threatening their lives but also causes metal toxicity both aquatic and terrestrial life (Sarnaik and Kanekar, 1995). Karachi is located on the northern border of the Arabian sea and its population is over thirteen million. It generates approximately 262 MGD domestic and industrial waste water which is discharged into Malir river and Lyari river. Qureshi, (1975); Ahmed, (1977); Saleem and Kazi (1995) reviewed that urban industrial discharge is mainly responsible for high level of pollution. The Indus delta lies in the South-East of

Karachi, covers an area of 5,000 square kilometers. The delta is characterized by a network of 17 major creeks and innumerable minor creeks which constituted the tributaries of river Indus. The environment of the creeks is under serious stress (Hamid *et al*., 2000) because they receive a very large amount of pollutant from three major zones steel mills, shipping routes and power plant. So, the aim of this research was to study the current status of the physico-chemical characteristics in major creek system.

MATERIAL S AND METHODS

Water samples were collected from eight stations i.e. Jetty, Phitti creek, Chara creek, Korangi creek, Bakran creek, Rakhal creek, Saudagar creek and light house located between 24º37′ and 25º49′E and 66º53′ and 67º20′ N (Table 1).

Sampling and analysis:

The study was conducted during February to March (2009); water samples were collected from eight different stations along Port Qasim. Three replicates were sampled from 0-4, 4-8 and 8-12 feet in acid pre-cleaned polyethylene bottles. The samples were mixed in equal proportion to make composite sample and all the samples were labeled properly. The samples were brought into the laboratory for physical and chemical analysis. Physical parameters i.e. pH, salinity, conductivity, total dissolved solids, dissolved oxygen and temperature were determined by Sension multiparameter meter (Hach Tm^{105}). Nitrate, Phosphate, Sulphate, Chloride, Calcium and Potassium were analyzed using spectrophotometer. The samples were then filtered with whatman filter paper No. 1 for heavy metal analysis. After filtering, the samples were gently boiled and 1 ml HNO_3 was added (Van Loon, 1982). Six metals including Fe, Zn, Co, Cr, Mn and Cd were determined by using an atomic absorption spectrophotometer model PG 990.

RESULTS

Table 1. Ecological parameters of the sampling stations.

Sites	**Creeks**	**Longitude** (Nº)	**Latitude** (Eº)	**Distance** (m)	**Elevation** (m)	**Bearing**
Station1	Gharo-Phitti	24° 46.642	067° 17.504	52	394.66	NE
Station2	Chara	24° 43.695	067° 13.659	57	3.5	W
Station3	Rakhal	24° 45.817	067° 19.401	25	34.7	NW
Station4	Jetti	24° 46.552	067° 20.847	22	7.03	NW
Station5	Korangi	24° 40.937	067° 14.448	46	6.62	SE
Station6	Bakran	24° 37.805	067° 17.299	42	7.6	SE
Station7	Light house	24° 40.211	067° 14.715	27	24.68	S
Station8	Saudagar	25° 49295	066° 53493	--------	--------	NE

Table 2. Mean values of physical parameters of sample water recorded from all stations.

Parameters	Sta 1	Sta 2	Sta 3	Sta 4	Sta 5	Sta 6	Sta 7	Sta 8
Sal‰	37.97±0.57	38.50±0.06	39.03±0.07	39.70±0.1	37.60±0.06	38.97±0.03	38.53±0.09	41.93±0.47
Con mS/cm	58.97±0.82	59.77±0.09	60.50±0.15	61.53±0.07	62.70±0.20	64.57±0.15	64.40±0.32	61.80±0.46
TDS g/L	36.10±0.06	37.07±0.03	37.53±0.07	38.20±0.01	36.53±0.53	42.17±0.07	37.00±0.10	37.4±0
DO mg/L	1.71±0.15	3.13±0.41	1.38±1.0	1.87±0.86	3.15±0.36	3.26±0.99	2.95±0.34	3.32±0.15
Temp°C	26.50±0.06	26.47±0.03	26.47±0.07	24.90±1.04	28.37±1.98	30.17±0.09	24.67±0.23	24.03±0.03
pH	7.00±0.06	7.33±0.12	5.70±0.93	6.77±0.34	6.77±0.29	6.90±0.36	6.57±0.32	7.15±0.03

Note: Sta= stand, Sal= Salinity, Con= Conductivity, TDS=total dissolved solids, DO=dissolved oxygen, Temp=temperature.

Physical parameters of sample water:

The Physical parameters of sample water is given in Table 2. The range of salinity recorded in sea water varied from 37.4-42.5‰. The maximum mean value of sea water salinity (41.93±0.47‰) and dissolved oxygen (3.32±0.15mg/l) were found at Saudagar creek (station 8) while minimum value of salinity (37.60±0.06‰) was recorded from Korangi creek (station 5). The highest value of conductivity (64.57±0.15 mS/cm), total dissolved solids (42.17±0.07 g/l) and temperature (30.20±0.23 ˚C) were recorded from Bakran creek (station 6). The pH values at different stations ranged between 6.10 to 7.50. The highest average value of pH (7.33 ± 0.12) was recorded from Chara creek (station 2) whereas least pH (5.70±0.93) and the lowest dissolved oxygen (1.38±1.0mg/l) were found at Rakhal creek (station 3).

Nutrient concentration of sample water:

The nutrient concentration in seawater is given in Table 3. Six important nutrients including phosphate, nitrate, sulphate, chloride, potassium and calcium were analyzed and discussed separately. The highest average concentration of phosphate was observed from station1 (26.46±0.29ppm) whereas least was found at station 7 (7.8±0.09 ppm). The range of the concentration of phosphate recorded in sea water was between 7.2 to 27.8 ppm. The highest average concentration of nitrate was observed from station6 (369.33±10.99 ppm) whereas least was found at station5 (118.93±3.27 ppm). The maximum concentration of sulphate was observed from station 2(4250.0±76.38 ppm) whereas minimum was found at station 8(761.42±3.29 ppm). The highest average concentration of chloride (23.29±0.26 ppm) and potassium (39.10±0.39 ppm) were recorded from station8 whereas least amount of chloride (20.88±0.03 ppm) and potassium (24.99±2.32 ppm) were found at station5 and station 1 respectively. The highest average concentration of calcium was observed from station6 (18±0.57 ppm) whereas least was found at station1 (14.66±1.45 ppm).

Table 3. Mean nutrient concentration of seawater recorded from all stations.

Para	Sta 1	Sta 2	Sta 3	Sta 4	Sta 5	Sta 6	Sta 7	Sta 8
PO_4 (ppm)	26.46±0.29	18.40±0.32	17.1±0.21	8.5±0.58	9.53±0.15	8.8±0.24	6.9±0.24	7.8±0.09
NO_3 (ppm)	254.33±8.37	177.67±3.71	224.67±7.75	248.33±9.39	118.93±3.27	369.33±10.99	347.33±18.48	275.75±17.75
SO_4 (ppm)	3580.67±43.24	4250.00±76.38	4016.67±72.65	1653.00±29.26	2178.33±43.43	1373.33±93.33	931.17±40.61	761.42±3.29
Cl (ppm)	21.09±0.31	21.38±0.03	21.68±0.03	22.06±0	20.88±0.03	21.65±0.02	21.40±0.04	23.29±0.26
K (ppm)	24.99±2.32	25.07±0.92	29.40±1.50	26.36±2.62	29.91±1.51	30.98±2.20	33.81±1.74	39.10±0.39
Ca (ppm)	14.66±1.45	15±0.57	17±3.60	16.33±0.88	15.33±0.33	18±0.57	15.43±0.33	15.66±1.45

Note: PO_4 = Phosphate ion, NO_3= Nitrate ion, SO_4 = Sulphate ion, Cl= Chloride ion, K= Potassium ion, Ca= Calcium ion

Table4. Mean ppm values of heavy metal in seawater recorded from all stations.

Para	Sta 1	Sta 2	Sta 3	Sta 4	Sta 5	Sta 6	Sta 7	Sta 8
Cr	1.20±0.09	1.13±0.006	1.164±0.01	1.098±0.019	1.100±0.017	1.121±0.02	1.001±0.02	1.0066±0
Fe	1.08±0.008	1.075±0.017	1.051±0.03	1.137±0.06	1.047±0.011	1.021±0.019	1.017±0.01	1.143±0.03
Zn	0.04±0.005	0.074±0.004	0.167±0.04	ND	ND	0.506±0.021	0.00034±0	0.101±0.07
Co	0.28±0.01	0.669±0.052	0.474±0.022	0.288±0.01	0.234±0.013	0.220±0.011	0.166±0.006	0.190±0.005
Mn	0.00001±0	ND	0.0000026±0	ND	0.0003±0	0.003±0.001	ND	ND
Cd	0.0004±0	0.0005±0	ND	ND	ND	0.0006±0	ND	ND

Note: Sta= station, ND= not detected

Heavy metal analysis of sample water:

Table 4 presents the heavy metal analysis of seawater from different locations of Port Qasim. Six heavy metals i.e. Iron (Fe), Zinc (Zn), Cadmium (Cd), Chromium (Cr), Cobalt (Co) and Manganese (Mn) were analyzed. The range of the concentration of chromium recorded in sea water was between 0.952 to 1.342 ppm. The highest average concentration of chromium was observed from station1 (1.20±0.09ppm) whereas least was found at station 8 (1.006±0 ppm). Chromium was present in the maximum concentration ranked first among all the heavy metals.

The range of the concentration of iron recorded in seawater was between 1.003 ppm to 1.214 ppm. Iron was present in the maximum concentration ranked second among all the heavy metals. The highest concentration of iron in seawater was recorded from station6 (1.143±0.03 ppm) whereas least average value was found at station7 (1.017 ± 0.01 ppm). The highest average concentration of zinc was observed at station6 (0.506±0.021ppm) whereas no record was found from station4 and station5. Zinc was present in the maximum concentration ranked third among all the heavy metals. The range of the concentration of zinc recorded in seawater was between 0.00012 to 0.548ppm. Cobalt was present in the maximum concentration ranked fourth among all the heavy metals. The range of the concentration of cobalt recorded was between 0.18 to 0.84ppm. The highest average concentration of cobalt was observed at station2 (0.669±0.052ppm) whereas least was found at station7 (0.166±0.006ppm). The range of the concentration of manganese recorded was between 0.0000026 to 0.0058 ppm. The highest average concentration of manganese was observed at station6 (0.003±0.0001ppm) whereas no records were found from four stations (2, 4, 7 and 8). Manganese was present in the maximum concentration ranked fifth among analyzed metals. The range of the concentration of cadmium recorded in seawater was between 0.0004 to 0.006ppm. The highest values were recorded from station 6 (0.006±0 ppm) whereas no traces were found from station 3, 4, 5, 7 and 8. Cadmium was ranked sixth among all heavy metals.

DISCUSSION

Physico-chemical properties were discussed to evaluate the current status of seawater in major creeks of Port Qasim. The result shows considerable variations from station to station. Our results describes that the salinity ranged between 37.4 to 42.5‰ which was inline of the previous finding. According to UNEP (1986) the salinity ranges from 35.5 to 36.90‰ in the inshore water of Karachi may rise as 41 to 42‰ in the back water and intertidal creeks. Zaqoot (2000) also reported salinity values ranged between 25 to 34‰ from inside Karachi harbour. Small change in salinity may correspond to temperature and dissolved oxygen, though, dissolved oxygen is not considered to be the pollutant parameter but its contribution represents the level of pollution (Khan and Shaukat, 2008). The results indicated that all the sites are under stress because as dissolved oxygen levels in water drop below 5.0 mg/l, aquatic life is put under stress, it means the lower the concentration, the greater the stress. However, the level of oxygen is not below 1mg/L in our results because below level (1 mg/L) for a few hours can result in large fish kills (Khan and Shaukat, 2008). The recorded values of dissolved oxygen (DO) would not be

enough to efficiently control the natural purification system of water which may cause reduction in biodiversity in creeks. The pH values of five seawater at stations (3 to 7) were acidic while the other stations were alkaline in nature. The range of temperature is a universally important factor governing the existence and behaviour of living organisms. In seawater temperature influences on various other parameters because hydrogen bonding between adjacent water molecules depends on this factor either to resist or accept external forces that would separate these molecules.

Nutrients play important role in the physiology of marine algae, seaweeds and cynobacteria by providing energy. The nutrients like phosphate, nitrate, sulphate, sodium, potassium, magnesium and calcium are known as the fertilizers of the sea and play an important role in primary production of coastal and oceanic waters. The maximum value of phosphate at station 1 showed that this area is comprised with high energy in the form of ADP and ATP.

All the metals showed considerable variations in concentration at different stations. The results of the present study suggested that Chromium ranked first in seawater which is higher than the values reported by other workers **(**Tariq *et al*., 1993 and Ismail 2002**)** from the offshore clear water of Pakistan and India. The maximum concentration of Cr was recorded from Gharo-Phitti creek obviously due to the discharge of sewage, agro chemical industrial waste water and Tannery effluents into nearby water. Iron was the second most abundant metal as reported by Saifullah *et al* (2002). The present study also agreed with Saifullah *et al* (2002) the concentration of iron was almost similar in all stations. This may be explained by the fact that the reduction of Fe^{+3} to Fe^{+2}, which were then transported upward in water column. Iron in natural water, may remains present either in ferrous or ferric forms ferric hydroxide. Secondly, corrosion of underground pipes and pumps which discharge waste in water also raised the concentration of iron in sea water. The high value of iron was found at Gharo-Phitti creek, may be possible due to fact that the study site is closed to the Steel mill which is the major source of iron pollution. The presence of iron ore, coal terminal and the conveyor belt also influences the water quality.

Zn, Mn and Cd were present at Bakran creek due to the fact that the outlet of steel mill discharges its heated water about 200 MGD and waste into Bakran creek. Ismail (2002) also reported the highest concentration of zinc from Port Qasim. According to Saleem *et al*., (2005) the highest concentration of Zn is associated with the industrial waste from Landhi and Korangi industrial areas. In addition, dissolution of anode from the ships may also aggravate zinc concentration.

The main source of water pollution in the Port Qasim area are steel mill, movement of ships, industries and domestic source discharging into the Korangi and Bakran creeks. Besides, the discharges of domestic sewage and industrial wastes from the Korangi Industrial area including tannery wastes and two outfalls from the National Oil Refinery and Pakistan Oil Refinery, the fish harbour at Korangi has become a major source of pollution ranging from sewage, fish offal and spilt oil and grease. Similarly the oil terminal built across Bakran and Ganglaro creeks is a potential source of oil pollution. The pure zinc metal always has some cadmium as impurity and it may lead to cadmium pollution. Cadmium acts synergistically with zinc to increase toxicity, a large number of marine organisms accumulate Cd several times higher than ambient environment (Goel,

1997). Manganese like iron is also a naturally derived metallic pollutant. The pH value is not highly acidic which might be responsible to maintain low concentration of Mn in this station because it was reported by Goel (1997) that acidic value of pH enhance the concentration of Mn. Cadmium in nature exists mainly in the form of sulphide. Cadmium is majorly found in paints and plastic industries. It may also occur in oil and gasoline and largely used in the electroplating industries.

From the present study it was concluded that the creek system in/or around Port Qasim is polluted due to land based activities including port operations, sea cargo traffic, thermal effluent from Pakistan Steel mill and KESC Power Stations, cattle colony, other industrial and domestic wastes. Especially Gharo-Phitti and Bakran creeks have high rate of pollution compared to other sites. It is obvious that the industries located in these areas generate large volume of effluents which directly discharge into these two creeks and its surrounding. If the ongoing practice of dumping/disposing untreated waste continues in the creek systems of Port Qasim will badly damage the sustainability of mangrove vegetation besides damaging the ecological processes and biota.

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