SPECTROPHOTOMETRIC STUDIES OF SEA WATER SAMPLES OF UNITED ARAB EMIRATES

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Abstract- Sea water is chemically complicated mixture as many types of organic and inorganic chemical species are dissolved in the solution in high concentration. It is the main water body used by mankind as the major dustbin for dumping all kinds of waste materials. As a result, the heavy metals such as Cadmium, Mercury etc. show their presence in this water body. In this research, an attempt is made to analyze the presence of these heavy metal contaminations and dissolved salts in various sea water samples from Abu Dhabi and Dubai. After the collection of samples. analysis weredone using Spectrophotometry and electro-chemical analysis for the speciation studies of these heavy metals and dissolved salts.

Key words- Spectrophotometry, seawater, dissolved salts, Electro-chemical analysis, Heavy metals

I. INTRODUCTION

The Rapid urbanization and industrial development in UAE in the past years have triggered, many significant issues to the environment, and water pollution is one of these issues. UAE lies in the Arabian Gulf and this area has witnessed industrial, social, and economic developments (Sheppard et al., 2010) [1]. Although urbanization improves the economy of the country it also has a negative impact on its environment. Water pollution occurs in two ways, by nature and by human activities. Anthropogenic pollution can be classified into point and non-point sources. Point sources pollutants are released into the environment from a specific source like pipes, factories, outfalls, and these sources can be easily monitored and regulated. Non-point sources pollutants are discharged from unknown location such as agriculture runoff, and there are difficult to be monitored.Heavy metal is a term which is given to metals or metalloids that have a toxic effect on both living organisms and environment [2]. They are divided into two categories: essential and non-essential. Essential heavy metals are elements that are important for health and growth; however, if they are found in high concentrations, they are considered as toxic such as Cu, Co, Mn, Zn, and Fe. Non-essential heavy metals are toxic even at low concentration such as Pb, and Cd [3]. These heavy metals reach to human through consumption of marine resources contaminated with heavy metals. They tend to accumulate in the marine resources tissues. The amount of heavy metals to be available for uptake by the fish depends on several factor. chemistry of the water, speciation of the metal and the binding state of the metals were the main factors. Metals can enter the fish from three major routes the gills, body surface and digestive tract were the three main routes that can metal enter to fish body. Digestive tract was the most route that play a major role in the accumulation process. This accumulated amount biomagnifies and increases from the lowest trophic level to the highest in the food chain, and reaches to human through dietary exposure (Fleming et al., 2006) [4].The consumption of heavy metals leads to severe health consequences to human. Neurological effects, cancers, cardiovascular diseases are health effects resulted from mercury, cadmium, and arsenic respectively (U.S. Environmental Protection Agency, 2009) [5]. Heavy metals are discharged in the Arabian Gulf from different anthropogenically sources, such as industrial effluent, sewage discharge, desalination plants, oil spills, and reclamation. These sources are considered as the highest anthropogenically in the world, as it increases the concentrations of heavy metals in the Arabian Gulf (Halpern et al., 2008). [6]

The other water pollutants that were measured in this study were dissolved salts like sulfates and chlorides. Sulfate is anion found in sea water and it is formed by biological oxidation of sulfur compounds (Khopkar, 2004)[7]. Chloride concentration can be introduced in sea water from different sources like industrial discharges, fertilizers and human and animal wastes. [8] In addition Total dissolved solid, Alkalinity as well conductivity was measured in this project.

Studying the concentration of heavy metal in this area should be given more attention for several reasons. Firstly, UAE citizens depend on the marine resources for food and about 90 percent of them eat fish at least one meal a week (Buggiani and Vannucchi, 1980) [9]. This area also is described as a semi-enclosed sea which faces fluctuations in temperature and high salinity (Sheppard et al., 2010) [1]. Also, this Gulf has many characteristics that lead to weaken its marine ecosystem such as: poor flushing, high evaporation rate, shallow and warm water, and slow surface current. All these properties contribute in concentrating the amount of water contaminants (De More, Fowler, Wyse and Azemard, 2004)[10].
In this work, two locations in UAE were selected to have samples to be analyzed. Sample No. 1 was taken from the Jebel Ali Port. This port is located in Dubai, UAE and it is the world's largest man-made port

(Jebel Ali Port overview) [11]. It has more than 170 shipping lines which give it a vital role in the world market and in connecting this port to over 100 ports worldwide (Dubai-Jebel Ali) [12]. The second sample was taken from Mussafah Industrial Area, which is located in Abu Dhabi, UAE.

The present investigation was done to measure the levels of eight heavy metals (Al, Cd, Pb, Mg, Cr, Zn, Cu, Ni), and to measure the amount of sulfates and chlorides in samples, from Jebel Ali Port and the other from Mussafah Industrial Area.

II. OBJECTIVES

The objective of this study is to evaluate the sea water samples of Abu Dhabi and Dubaiand to know whether any Chemical hazard or health hazard threat is there in the costal sea water. sea water is collected from different locations and is analyzed to know the presence of various heavy metals like (Al, Cd, Pb, Mg, Cr, Zn, Cu, Ni), and the ion concentrations of Sulfates and Chlorides.

III. REVIEW OF LITERATURE

An investigation was done on the water sediment taken from different locations in the coastal area of Dubai to measure various heavy metals concentrations. The results showed that the northeastern part was heavily or moderately polluted. However, the southwestern of the Dubai coastal region was moderately, slightly, or unpolluted. They concluded that the main reasons of these levels are the anthropogenic discharge and natural deposits (Al-Darwish et al, 2005). [13]

There is an investigation that was conducted to analyze the concentration of seven heavy metals, (Zn, Mn, Fe, Ni, Cu, Pb, Cd) in roadside soil samples of three different sites in Dubai: one with more than two traffic signals, one traffic signal, and one with no traffic signal. The study reported that the heavy metals concentration was higher in sites with more than two traffic signals Cd (0.17–1.01), Pb (259.66–2784.45), Cu (15.51–65.90), Ni (13.31–98.13), Fe (325.64–5136.37), Mn (57.95–166.43), and Zn (91.34–166.43) mg kg_1. These values were within the range of tolerance limit except the lead, and this increase was due to the automobile exhaust emissions (Aslam, Khan, & Khan, 2011) [14]. Besides to the analysis of heavy metals in soil and water, many studies were done as well on fishes to measure the level of heavy metal contaminants. Since many residents in UAE depend on fish for their food, many articles were published to evaluate their risk of dietary exposure to heavy metals. Al-Ghais (1995) [15] studied the concentration of different heavy metals (lead, manganese, nickel, cobalt, and copper) in liver and heart of a popular fish in UAE called SparusSarba and he studied the level of mercury in the muscle of this fishes, and he found a heavy concentration of mercury. Another research was done by De Mora et al (2004) [10], to determine also the concentration of heavy metals in tow commercially important fish species, spangled emperor and orange spotted grouper from the coast of the UAE. He found that the liver of spangled emperor fishes had a high level of Cadmium.

A study was done in three different places in UAE (Dubai, Sharjah, Um Al quein), to detect the concentration of eight heavy metals (Co,Zn,Cu,Mn,As,Cd,Mg,Pb) in the liver and meat of Wild Red Spot emperor fish. The results order of metals concentration in the fish meat, in Dubai and Sharjah, was Zn > As > Cr >Mn> Cu > Hg >Pb> Co > Cd, and in fish liver Zn > Cu > As >Mn> Cd > Cr > Co > Hg >Pb. While in Um Alquein, the Cu concentration in meat fish was higher than Mn, and Cd was higher than Mn in the fish liver. These concentrations did not exceed the permissible level of human consumption of fish (Kosanovic, Hasan, Subramanian, Al Ahbabi, Al Kathiri, & Aleassa, 2007)[16]

IV. RESAERCH METHODOLOGY

In this work, water samples were selected from costal area from different places, in Abu Dhabi and in Jebel Ali, Dubai. These samples were collected in prewashed polyethylene bottlesChlorides were determined by Argentometric method, and sulfate by Turbidimetry method and also by UV spectroscopy methodSamples were analyzed with Alpha 4, Atomic Absorption Spectrophotometer (Chem.Tech analytical) with standard methods of APHA, (1992), for heavy metal determination. 0.5 ml of con; HNO3 was added to 50 ml of each sample of sea water. The mixture was heated in a beaker on a hot plate with magnetic stirrer. Samples were heated by adding 1Mleachof nitric acid till clean solutions were obtained. The clear solutions were cooled and made up to 25 ml in a standard flask using distilled water. These digested samples were used as blank samples for the spectrometric studies.

V. RESULTS AND DISCUSSION

The results of heavy metals in sample 1 and 2 are shown in figure 1and 2 respectively. The concentration of Al, Cd, and Pb wereless than 0.5 in both samples, the concentration of copper and magnesium wereless than 0.1 in both samples, and Cr and Ni concentrations were less than 0.2. Zn concentrations were the lowest and they were less than 0.04. The results of analysis of water in both samples for heavy metals have no difference.

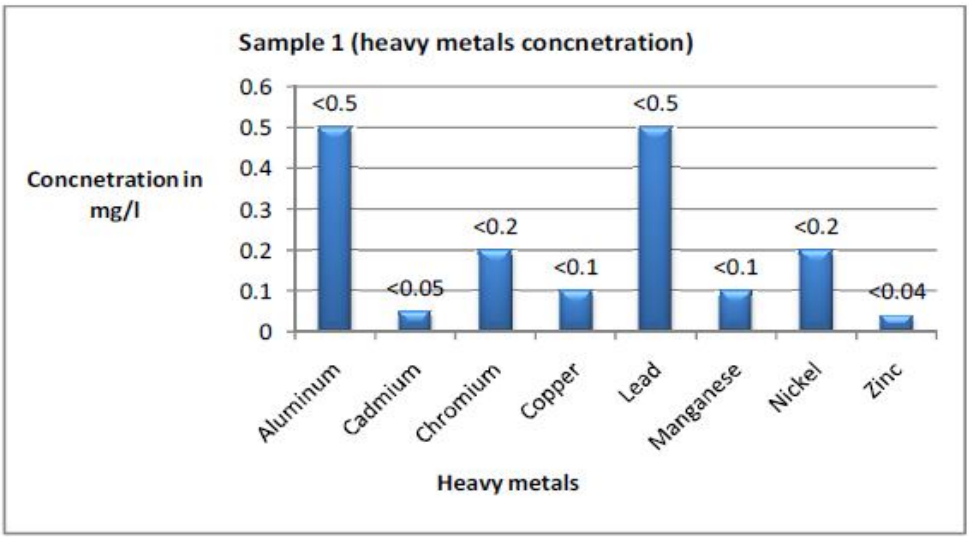


Fig 1: sample 1 heavy metals concentration

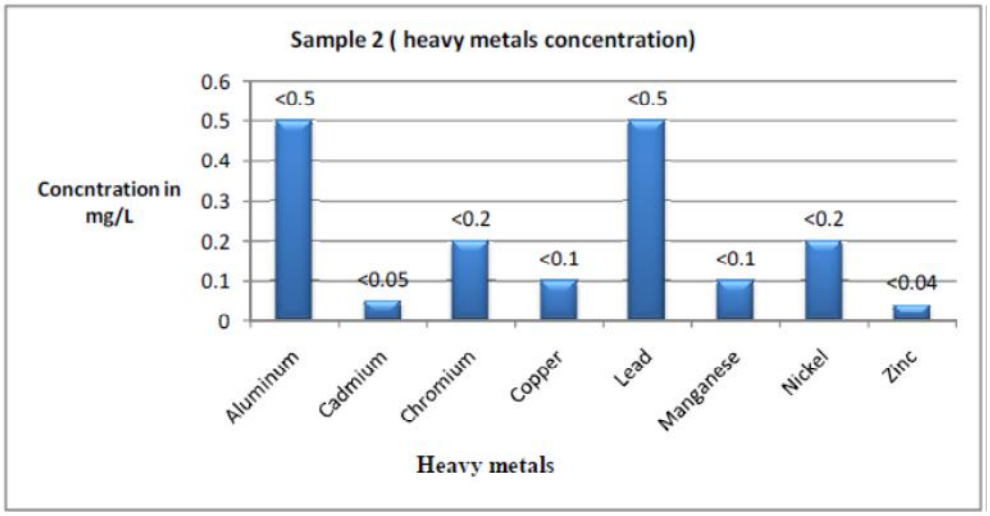


Fig 1: sample 2 heavy metals concentration

Table 1 shows a comparison between the essential heavy metals of the current study (Al,Cu,Zn,Mg) with the international standards of WHO and EPA (drinking water standards), and the EPA aquatic life criteria. WHO drinking water standards were taken from the WHO guidelines for drinking water quality, the fourth edition 2011.As it is shown in the table, Znconcentration is within the permissible levels of drinking water standards of WHO and EPA and within the safe level of aquatic lifeand they are less than 4 mg/l, 5mg/l and 0.09 mg/l respectively.Cu level is less than 0.1mg/l. This value is less than 2 mg/l which is the WHO drinking water criteria of Cu, and less than EPA drinking water standard which is 1.3 mg/l which means it safe according to the drinking water standards. But the value of Cu of the study is unsafe for aquatic life since it is higher than the 0. 0048.However; magnesium level was higher than the safe dose of WHO&EPAdrinking water criteria, which is higher than 0.002 mg/l. Therefore, among the essential metals, Mg is higher than the safe dose.

Table 1: Comparison between the essential heavy metals concentrations of the current study with international standards in (mg/L)

Sample No.	Al	Cu	Zn	Mg
1	<0.5	< 0.1	< 0.04	<0.1
2	< 0.5	<0.1	< 0.04	< 0.1
(WHO drinking water quality , 2011) [24]	N.D	2	4	0.002
EPA drinking water quality [25]	0.2	1.3	5	0.05
EPA Aquatic life criteria [26]	N.D	0.0048	0.09	N.D

The same comparison that was done in the previous on essential heavy metals was also done on the non-essential heavy metals as it is demonstrated in table 2. Cr concentration which is < 0.2 is safe for aquatic live, since it is lower than the 1.1m and it is quit safe for drinking as it is compared with EPA drinking water criteria. The amounts of Pb, Cd, & Ni values are higher than the EPA aquatic life criteria, EPA and WHO drinking water standards.

Table 2: Comparison between the non-essential heavy metals concentrations of the current study with international standards in (mg/L)

Sample No.	Cd	Pb	Cr	Ni
1	< 0.5	< 0.5	< 0.2	< 0.2
2	<0.5	<0.5	< 0.2	<0.2
(WHO drinking water quality, 2011) [24]	0.003	0.01	0.05	0.07
EPA drinking water quality [25]	0.005	0.015	0.1	N.D
EPA Aquatic life criteria [26]	0.04	0.21	1.1	0.074

VI. SUMMARY AND CONCLUSION

Heavy metals are natural components of the Earth's crust.These concentration levels were extremely low which do not cause any chemical or health hazard to the society or living organisms. However, the concentrations of some heavy metals were not within the WHO and EPA standards. Among the essential metals, Mg was not within the safe dose neither of WHO and EPA drinking water standards nor of EPA aquatic life standards. Cu levels as well exceeded the EPA aquatic life criteria. For the non-essential heavy metals, Cr was the only metal that fell below the standards, but the rest (Pb, Ni, Cd) had exceeded these standards.

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