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# Evaluation and Comparison of Depth and Season Effects on Heavy Metals and Contaminants Concentrations in an Aquatic Region

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***Abstract*—** *Considering different contaminants in aquatic areas such as seas or lakes and even wastewaters, heavy metals removal is one of the basic environmental issues which must be considered very seriously when studying any aquatic region. Concentrations of such contaminants in a region called Jask in Persian Gulf made in necessary to study the content of different heavy metals in different depths and different seasons in the aforementioned area in order to remove the possible existing contaminants. These metals are Zn, Cu, Pb, Fe and Mn which were measured in Summer and Winter in depths of 3,10 and 15 meters in Jask station as one of the stations for further protection. Based on the accurate measurements and analysis it was determined that Fe in sediments was more than other pollutants in both cold and warm seasons and in all the 3 studied depths (273.17±7.07 mg/kg, 245.16±0.38 mg/kg, 248.27±0.16 mg/kg respectively in cold seasons and* 265.12±0.12 *mg/kg,* 240.94±0.73 *mg/kg,* 234.39±0.18 *mg/kg respectively in warm seasons) while in the 3 meter depth, Zn had the least contamination with concentration of 54.534.8±0.02 mg/kg and Mn had the minimum value of contamination in 10 and 15 meter depth (25.02±0.87mg/kg and 31.55±0.43 respectively) in cold seasons. In comparison, in warm seasons the minimum contamination belonged to Zn in the 3 meter depth with 34.8±0.02 mg/kg and Mn had the minimum contents in the 10 and 15 meter depths with 20.19±0.39 mg/kg and 30.93±0.05 mg/kg respectively.*

***Keywords*—***Aquatic region, contaminants, depth, heavy metals, sediments.*

## I. INTRODUCTION

Today aquatic environmental protection against sever threats of industrial and modern developments, is one of the most serious concerns in all around the world. In this field, heavy metals considered as one of the most dangerous pollutants. Removal of heavy metals from water recommended as the most important issue in social health and hygiene account for their stability and tendency in augmentation in human bodies. As a result treatments with object of heavy metals refining received much more attention in last decades.

Determination of suitable processing method is the key point in refining phenomenon as it should be selective with respect of objective pollutant. Meanwhile analyzing methods for evaluation of pollutants concentrations and types in water are vital criteria. It should be mentioned that by later results it was approved that all heavy metals accumulate in the aquatic environments while affected widely from water salinity and minerals, temperature, pH-value, microbial activities and so on [1].

Also density and dissolved oxygen (DO) can manage contaminants' amounts and intensify its tendency for sedimentation or dissolving [2]. As recommended, any changes in foregoing physio-chemical parameters can widely influence on water quality [3].

Additionally it was demonstrated that different types of metals act differently when enter to the sea, some of them are dissolved or changed to other complex materials in comparison with others, which sediment or convert to colloids [4].

However fortunately all accumulated contaminations in the sediments are degraded during years and only heavy metals are augmented in sediments and remain forever. Heavy metals appear in various forms in the sediments as combination with solid minerals, adsorption on clay granules after combination with Fe or Mn or in the form of combination with organic metals [5].

As a result clean economic approaches for evaluating, analyzing and treating these categories of pollutants need much more attention during years.). This station which is located in neighbor of Persian Gulf, suffers from various types of natural, industrial and urban unclean sources because it is located in the Hormozgan province which is surrounded by different kinds of unclean activities [6].

A brief summary of number of surrounded industries in the Persian Gulf zone is depicted in Table I. In this zone only two kinds of climate conditions exist as a long-term warm season and a short-term cold one [7]. So the following studies carried out in the two considered seasons and three different depths of Jask station. Concentration evaluation of five different heavy metals of Fe, Mn, Zn, Pb and Cu followed by great statistical analyzing method as SPSS.

TABLE I. Variaty of industries neighboring the Persian Gulf.

| Type of Industry | Number of Existence | Under Construction |
|---|---|---|
| Petrochemical | 2 | 9 |
| Fertilizer | 3 | 2 |
| Natural Gas | 5 | 4 |
| Aluminum Maker | 2 | - |
| Refinery | 12 | 4 |
| Desalination Installation | 26 | 22 |



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## II. Materials and Method

In the current study a strategic multi industrial-faced station was selected based on its availability with respect of depth, climate conditions and industrial wastewaters unload point.

All experimental procedures carried out in the similar processes as in the previous works [8], [9] and followed by an analytical method of SPSS.

Geographic characteristics of the Jask as the considered understudy station tabulated as following (Table II).

TABLE III. Geographic situations of the under studying zone.

| Zone | Geographic Properties | |
|---|---|---|
| | Geographic Width | Geographic Length |
| Jask | 25˚ 38’ 29” N | 057˚ 46’ 09” E |

## III. Results

### A. Evaluation of Heavy Metals Concentration

Analyzing results of the conducted experiments displayed that in the Jask stations, Fe had the greatest concentration amount approximately equal to 255 mg/kg[1]. Also sediments that were formed in 10 meter depth of the zone had the lowest content of Mn in warm seasons, 20.2 mg/kg.

Table III shows details of concentration for all five aforementioned heavy metals in various seasons and depths.

TABLE IIIII. Determination of heavy metals concentrations in sediments at different depths and seasons in Jask Station.

| Heavy Metal | Depth | Concentration (mg/kg)[1] | |
|---|---|---|---|
| | | Cold Seasons | Warm Seasons |
| Pb | 3 | 238.65±0.43 | 92.24±0.13 |
| | 10 | 226.15±1.15 | 89.24±0.21 |
| | 15 | 231.76±0.94 | 92.63±0.34 |
| Mean Value | - | 232.19±5.48 | 91.37±1.62 |
| Mn | 3 | 97±0.32 | 95.16±0.08 |
| | 10 | 25.02±0.87 | 20.19±0.39 |
| | 15 | 31.55±0.43 | 30.93±0.05 |
| Mean Value | - | 51.19±34.48 | 48.76±35.11 |
| Fe | 3 | 273.17±7.07 | 265.12±0.12 |
| | 10 | 245.16±0.38 | 240.94±0.73 |
| | 15 | 248.27±0.16 | 234.39±0.18 |
| Mean Value | - | 255.53±13.76 | 246.82±14.02 |
| Cu | 3 | 67.9±0.48 | 55.54±0.12 |
| | 10 | 76.31±0.38 | 53.34±0.06 |
| | 15 | 75.18±0.18 | 54.63±0.13 |
| Mean Value | - | 73.13±3.97 | 54.5±0.96 |
| Zn | 3 | 54.534.8±0.02 | 34.8±0.02 |
| | 10 | 52.22±0.81 | 30.43±0.27 |
| | 15 | 51±0.75 | 34.34±0.15 |
| Mean Value | - | 52.57±1.66 | 33.19±2.09 |

### B. Statistical Analysis

By the analysis of variance (ANOVA) and Tukey test it was demonstrated that difference in season climate conditions exerted significant change in pollutant concentrations except Mn ($P<0.05$). Also different depths represented the same results for two understudy heavy metals as Fe and Mn ($P<0.05$).

In this station Pearson test approved that for the whole three depths in cold seasons there existed a linear significant relevance between the concentration of Pb with Fe, MN and Zn ($P<0.05$) while Pb had a significant revers relationship with Cu similarly to Zn and Cu.

Additionally Mn heavy metal had a linear respect with Fe, Zn and Pb while showed a revers pattern with respect to Cu. Also for the warm seasons Pb heavy metal followed a particular linear connection with Cu and Zn as well as Mn and Pb. As a whole ANOVA and one-direction variance test proved that Mn did not represented significant changes in the two seasons and all remaining heavy metals had different amounts in each specific depth ($P<0.05$).

Also it was demonstrated that this metal had direct relation with Fe, Zn and Cu in the foregoing seasons. In the case of Jask station it was approved that for the two cold and warm seasons Mn concentrations passed through a direct significant relationships ($P<0.05$) and concentration of this metal followed a deep linear revers relevance with increasing of depth ($P<0.05$).

Finally it was found that Zn heavy metal had considerable linear and reverse relationships with increasing depth for warm and cold seasons, respectively.

## IV. Discussion

In the case of Jask station many different parameters can effectively influence on the pollutant concentrations as well as ship-making industry while it can unload huge amount of Pb heavy metal to the sea. Since it is a vital foundation of dye industry, also in the case of any maintenance and repair, painting and any other activities this pollutant can enter to the sea and talented the aquatic environment for pollution [10].

However Pb can concentrate in the soil as a salt and its solubility can be managed by pH-value of the soil as basic environments reduce amount of Pb solved, it also can speed-up formation of organic compounds.

On the other hand sediments of lowest depths have the most saturated properties with respect of this pollutant. Additionally density increased by incrementing of depth, so rising of water salinity can accelerate concentration of Pb in the sediment [11].

It should be recommended that this heavy metal has the least amount in the cortex but as it can be found in the gasoline and diesel fuels as well as industrial wastes vastly, it played the most vital role for Jask station contamination, while it was demonstrated that industrial landfills saturated by this heavy metal [12].

Another important factor that can distribute pollutants differently is especial size of sediment granules [13]. Also ceramics factories introduce Pb to the environment and so unfavorable dangerous concentration of metal happened.

By the results it was approved that 3 meter and 15 meter depth of the Jask station with respect of cold and warm seasons, contaminated with the least and the most amount of Mn heavy metal, respectively.

Another factor accelerate augmentation of Pb in the sediments is the clay form of sediments. It was evaluated that if mean value of any heavy metal decreased from beach to the sea, it can show that concentration of foregoing metal dependent to the activities of ships and tankers. So probably

[1] Mg/kg: milligram/ kilogram of dried sediment



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high concentration of Mn metal in depth of three meter can raise from that [14].

Table IV summarized standard values of considered heavy metals in the cortex and comprised amount of contamination with respect of Jask station. In table V recent and understudy research results tabulated and the comparison can be done.

TABLE IV. Worldwide standard concentrations of heavy metals Vs. Jask

| | Heavy Metals | | | | |
|---|---|---|---|---|---|
| | **Mn (mg/kg)** | **Fe (mg/kg)** | **Cu (mg/kg)** | **Zn (mg/kg)** | **Pb (mg/kg)** |
| Mean values in the worldwide sediments | 1000 | 241 | 32 | 95 | 19 |
| Jask | 49.9±33.7 | 251.1±14.3 | 63.8±9.9 | 42.9±10.3 | 161.8±72.7 |

TABLE V. Concentration determination of heavy metals in some nearby regions Vs. Jask station (in two seasons)

| **Station** | **Heavy Metal Type [12]** | | | | |
|---|---|---|---|---|---|
| | **Zn (mg/kg)** | **Cu (mg/kg)** | **Fe (mg/kg)** | **Mn (mg/kg)** | **Pb (mg/kg)** |
| Khark Island | - | 31 | 0.46 | - | 33 |
| North West of Persian Gulf | - | 17.4 | 30552.7 | - | 10.4 |
| Jask, Cold Seasons | 52.6±1.7 | 73±4.1 | 255.6±13.8 | 51.1±34.5. | 232.3±5.4 |
| Jask, Warm Seasons | 33.2±2.2 | 54.6±1.24 | 246.7±14.1 | 48.8±34.9 | 91.2±1.7 |

## V. CONCLUSION

Results achieved from the measurements and analysis in Jask station showed that among the existed heavy metals in this region in summer and winter, Fe in both seasons and in all depths had the most concentrations while the minimum concentration was clarified in Mn in both seasons and at the second and the third depths. Also, Zn had the least amount as a heavy metal pollutant in both seasons at the first studied depth. According to this research in a comparison with the average value in the worldwide sediment, this spot had relatively more heavy metal concentrations of Fe (around 10 mg/kg), Cu (almost twice) and Pb (approximately 8 times) in the measured sediments and less contents in Mn (almost one twentieth of the worldwide sediment value) and Zn (around 52 mg/kg).

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