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Assessment of Toxic Heavy Metals in Water Samples from Various Region of Mekran Using Spectroscopic Technique

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Abstract: Heavy metals are the metals that are found at the bottom of the periodic table and have a higher density than 5 g/cm^3. Even though heavy metals are necessary for organisms in little amounts but they can be poisonous to the living environment in high amounts. chemical wastes of industries, dumping of hospitals wastes into rivers and other materials which contain heavy metals are main causative ways of serious health hazards. Water is an important component of life on earth and it helps all activities carry out in living creatures. Clean and healthy water is the basic need for living organisms. This research was carried out on heavy metal analysis in drinking water in two districts of Balochistan named Kech and Gwadar. 13 water samples were collected from both districts. The concentration of zinc, chromium, iron, copper, arsenic, nickel, manganese of water samples was analyzed using flame atomic absorption spectroscopy (FAAS) and colorimetric methods. The highest concentration was analyzed in heavy metals in District Kech, Copper (Cu) 0.09 ppm, Iron (Fe) 5.55 ppm, Zinc (Zn) 0.35 ppm, Nickel (Ni) 0.22 ppm, Manganese (Mn) 0.743 ppm, Chromium (Cr) 0.05 ppm and Arsenic (As) was not detected. The highest concentration was analyzed in heavy metals in District Gwadar, Copper (Cu) 0.08 ppm, Iron (Fe) 3.36 ppm, Zinc (Zn) 0.43 ppm, Nickel (Ni) 0.22 ppm, Manganese (Mn) 0.140 ppm, Chromium (Cr) and Arsenic (As) were not detected. The aims and objectives of this study are to determine the mean concentrations of heavy metals including Cu, Cr, Zn, Ni, As, Mn, and Fe in water samples of different regions of Mekran Balochistan. People of Mekran mostly use water from lakes, rivers, and stream water for drinking and other purposes. There is no water purification system in the Mekran region and people are being affected by drinking contamination of water, in which heavy metals are one of the main causative ways of health effects. This research will enhance the knowledge of the local people of the Mekran division about the toxicity of water contamination, especially heavy metals.

Keywords: Water, Heavy Metals, Assessment, Spectroscopic Analysis

1. Introduction

Water is an important component of life on earth and it helps all activities carry out in living creatures. Clean and healthy water is the basic need for living organisms [1, 2]. On earth or land, the water can be found in lakes, streams, and ponds, etc. Each lake, stream, and pond do not have the same characters of water due to their extension, deepness, and nature. The nature and characters of surface water can be different from groundwater due to the direct interaction of surface water with environmental pollution [3]. Clean and healthy water is the basic need for living organisms [1]. Nearly, 800 million people do not get pure and healthy water and 2.5 million people use unhygienic water [4]. Pakistan lacks pure drinking water and only 25.61% population have

facilities of pure drinking water. In Pakistan, drinkable water (surface and ground) is being polluted by the waste and toxic products of industries like dying chemicals, fertilizers, metal, pesticides, petrochemical, energy and power, cement, leather, sugar processing, food processing, construction, steel, engineering, mining, and so on. Such toxic products are runoff with water and accumulated in rivers, lack, stream and make water polluted [5]. Among the four provinces of Pakistan, Baluchistan is the largest and landscape province of Pakistan that occupied about 44% of the overall landscape area of Pakistan, where the resources of water are groundwater and surface water, and the percentage of surface water is about 54% and groundwater is about 46%. Other sources of water are, well, rivers, lacks, streams, and so on [1, 6]. The word water pollution means "any kind of change in the quality of water" [7]. There are many sources of water pollution but two main sources are very common that are natural and human activities or anthropogenic. Natural sources like mountain erosion, death of the deep living organisms, the flow of the surface water pollution, and salty water are the sources of groundwater pollution or contamination. The agriculture waste, chemicals, automobile service, digging of well, waste of human beings, discharging the hospitals waste, discharging of domestic waste cause water pollution which is due to the anthropogenic [8]. In water pollution, the most important pollution is known as heavy metals pollution and the heavy metals are also named as trace elements [9]. The presence of heavy metals in surface water can also become the source of contamination of groundwater and this contamination can affect the physical and chemical character of groundwater [10]. Contaminated water has a different color, taste, look and such kinds of water become more dangerous to human beings and aquatic organisms [11, 12]. Heavy metals like Cu, Fe, Cr, As, Zn, Ni, and Mn cause different categories of diseases like damage of red blood cells, diarrhea, cancers, effects on to liver, cells, tissues damages, kidney, and heart failure, syndrome, bradykinesia and tremor [13-18]. This research was carried out for the determination of the centration of heavy metals (Cu, Fe, Ni, Zn, Mn, As, Cr) in water samples of the Makren region of Balochistan. Water is causing different diseases in living organisms and human beings in Balochistan and so this research will give enhancement about the heavy metals and their effects which are being caused due to drinking water.

2. Experimental Work

Ultrapure water obtained from the Milli purifier system (Millipore crop Bedford, MA, USA) was used throughout the study. All chemicals were of analytical reagent grade and obtained from E. Merck (Darmstadt, Germany). Concentrated nitric acid was used for the digestion of samples. Working standard solutions were prepared from stock standards [19]. 200ml of water samples were taken into 250ml of beaker and 10ml of concentrated nitric acid was added and placed in a sand bath for digestion. After digestion samples were cooled and filtered with Wittman filter paper (0.42 nm) into a 50ml of volumetric flask and made-up to the mark with distilled water. Samples were taken to the instrument for the analysis of heavy metals.

3. Sample Collection

Water samples were collected at different Districts of Mekran. Mekran is divided into three Districts, Kech and Gwadar. Overall, thirteen (13) water samples were collected from two Districts namely Kech and Gwadar Out of thirteen, eight (8) water samples were collected from different areas of District Kech and other four (4) samples were collected from District Gwadar. All samples were collected in polyethylene bottles in triplicate and properly labeled and samples were analyzed using FAAS, except arsenic. Arsenic was analyzed by using colorimetric methods.

4. Result and Discussion

According to Raja, V., et al. [20] different groundwater samples collected from Groundwater of Industrial Township Virudhunagar, Tamil Nadu, India, provided Cu range between (0.01 to 0.07ppm), that were below the provided limit of BIS standard used, however according to Makren Balochistan research, the elevated concentration range of Cu were obtained ranging from (0.01 to 0.09ppm) in district Kech and copper were obtained in district Gwadar ranging from (0.04-0.08ppm) that most of the selected area were above the WHO recommended limit 0.05 because samples were collected from mining areas. Tasneem, A., et al. [21] explained the concentration of iron in groundwater with ranging of (0.175 to 13.865 mg/L) in Singair Upazila, Manikganj District, Bangladesh where the concentration of iron has a higher value than the WHO limit value (0.3) that relates in the present study of Mekran Balochistan which revealed the concentration of iron in ranging of (0.88-5.55 ppm) in district Kech and in district Gwadar (1.15-3.36 ppm). Where the concentration of iron in both districts was higher than the WHO limit (0.3ppm). Iron concentration was high in district Kech because all the waste materials, like the dumping of waste hospital and other iron-containing material in rivers which flow with water and accumulated in lakes water and district Gwadar water in the pipeline system, the piped are made up of iron steel that's why iron concentration was high. The concentration of chromium was only found in two selected areas of district Kech which are named Ziarat dam (0.01ppm) and Herok (0.05ppm) and chromium is not detected in district Gwadar. This showed, there is no high source of chromium in both districts. This result was compared with Rahman, M. A. T., et al. [22] where the concentration of chromium was higher value than WHO because samples were selected in industrial areas. Arsenic was not detected in any water samples of district Kech and Gwadar because there are no sources of arsenic in both districts. Where Nazir, M., et al. [23] work explained the concentration of arsenic (0.012ppm) and the WHO limit is

0.01ppm. Zn was found in the range of (0.04-0.35 ppm). The minimum value of Zn was found in the water samples of Village Herok and the maximum value was detected in water samples, Ziarat Dam. In district Gwadar, Zn was found in the range of (0.10-0.43 ppm) which are under the limit of WHO value 5ppm, and Jangir, S. K., et al. [24] worked on the heavy metals in water in Jhalawar (Rajasthan) where zinc was ranged in the pond water (0.0322 ± 0.00198) which is within the WHO limit. Ni was found in the range of (0.02-0.22 ppm) in district Kech. Ni was found in the range of (0.07-0.22 ppm) in district Gwadar. where most of the results were above the WHO limit (0.07ppm) this is due to the natural occurrence of heavy metals in mountains and their erosion accumulating into lakes and other drinking water. Topal, M., et al. [25] analyzed the concentration of nickel was over in limit.

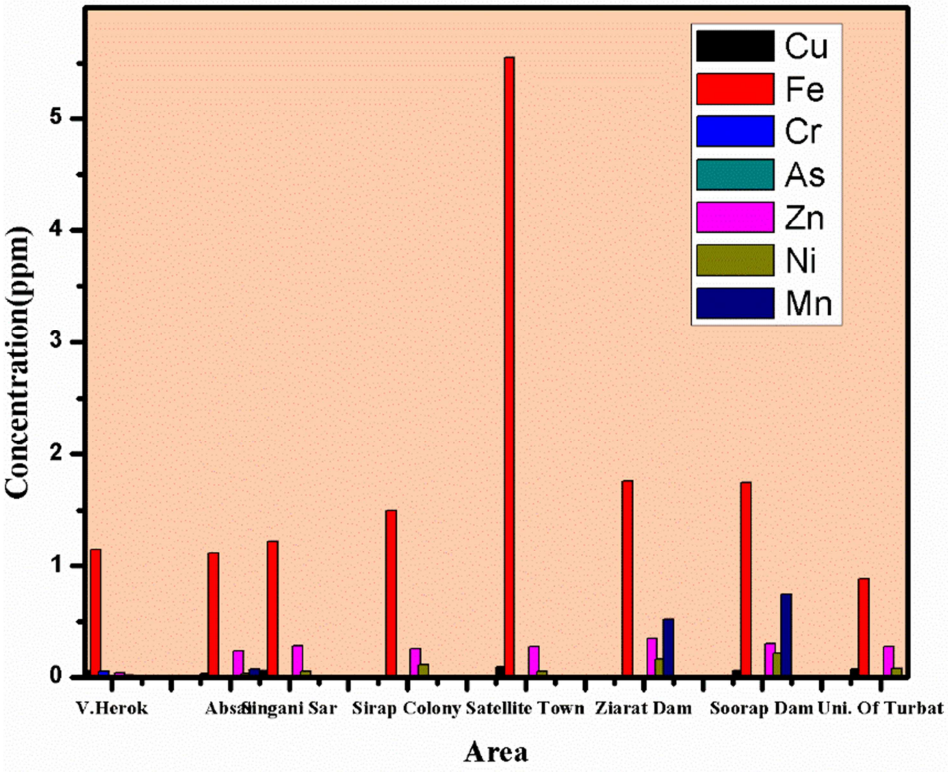

Figure 1. *Concentration of heavy metals in water samples of district Kech.*

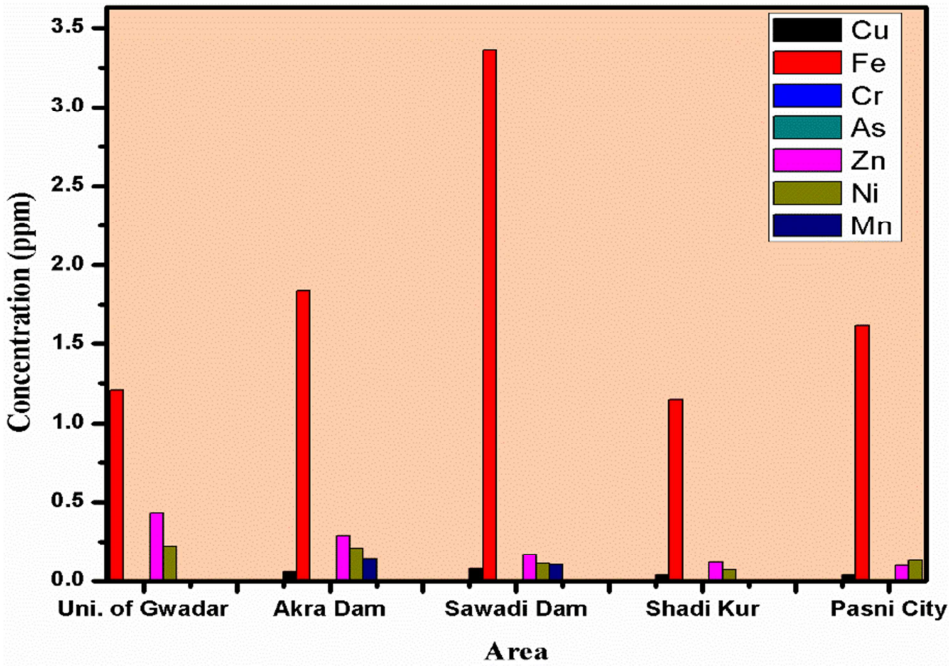

Figure 2. *Concentration of heavy metals in water samples of district Gwadar.*

Table 1. *Comparative analysis of heavy metals in water.*

Heavy Metals	Area	Concentration	Reference
	Kech	0.01-0.09 ppm	This work
Copper	Gwadar	0.04-0.08 ppm	This work
	southeast Nigeria	Less than 0.05 (WHO)	[20]
	Kech	Not detected	This work
Iron	Gwadar	Not detected	This work
	Singair Upazila, Manikganj District, Bangladesh	0.175 to 13.865 mg/L	[21]
	Kech	0.01-0.05 ppm	This work
Chromium	Gwadar	Not detected	This work
	Meghna Ghat industrial area, Bangladesh	0.07 mg/L	[22]
	Kech	Not detected	This work
Arsenic	Gwadar	Not detected	This work
	Waste water	*0.012ppm*	[23]
	Kech	0.04-0.35 ppm	This work
Zinc	Gwadar	0.10-0.43 ppm	This work
	Jhalawar (Rajasthan)	0.0322 ± 0.00198	[24]
	Kech	0.02-0.22ppm	This work
Nickel	Gwadar	0.07-0.22ppm	This work
	Elazığ keban dam lake, Turkey	4.51 µg L^{-1}, 0.00451ppm	[25]

Table 2. *Analyzed concentration of heavy metals in water samples of district Kech.*

S. No	Area	Cu	Fe	Cr	As	Zn	Ni	Mn	Elements	WHO (Ppm) [19, 24, 26, 27]
1	V. Herok	0.06	1.15	0.05	ND	0.04	0.02	ND	Cu	0.05
2	Absar	0.03	1.11	ND	ND	0.24	0.03	0.069	Fe	0.3
3	Singani Sar	0.06	1.22	ND	ND	0.29	0.05	ND	Cr	0.05
4	Sirap Colony	0.01	1.5	ND	ND	0.26	0.11	ND	As	0.01
5	Satellite Town	0.09	5.55	ND	ND	0.28	0.05	ND	Zn	0.003
6	Ziarat Dam	0.01	1.76	0.01	ND	0.35	0.17	0.523	Ni	0.07
7	Soorap Dam	0.06	1.75	ND	ND	0.31	0.22	0.743	Mn	0.5
8	Uni. Of Turbat	0.07	0.88	ND	ND	0.28	0.08	ND		

Table 3. *Analyzed concentration of heavy metals in water samples of district Gwadar.*

S. No	Area	Cu	Fe	Cr	As	Zn	Ni	Mn	Elements	WHO (Ppm) [19, 24, 26, 27]
1	Uni. of Gwadar	0.07	1.21	ND	ND	0.43	0.22	ND	Cu	0.05
2	Akra Dam	0.06	1.84	ND	ND	0.29	0.21	0.140	Fe	0.3
3	Sawadi Dam	0.08	3.36	ND	ND	0.17	0.11	0.101	Cr	0.05
4	Shadi Kur	0.04	1.15	ND	ND	0.12	0.07	ND	As	0.01
5	Pasni City	0.04	1.62	ND	ND	0.10	0.13	ND	Zn	0.003
									Ni	0.07
									Mn	0.5

5. Conclusion

The research was carried out to determine the different heavy metals (Cu, Fe, Ni, Zn, Mn, As, Cr) in different areas of district Kech and Gwadar of Makren Balochistan. The concentration of copper was found suitable for dirking in the water samples of both district Kech and Gwadar. Iron was found very high in both districts Kech and Gwadar. This shows a negative impact on the people of district Kech and Gwadar. Chromium was only found in two areas of district Kech which are suitable for the people and in district Gwadar Chromium was not found in any location. Arsenic was not detected in water samples of both districts. Zinc was found in the water samples of both districts within the limit of WHO recommendation. In district Kech, the concentration of nickel of observed high in water samples as compared to WHO recommendations except for the water samples from village Herok which was found within limit WHO recommended value. The concentration of Nickel was found higher in water samples district Gwadar as compared to WHO recommended value. Manganese was found only in three water samples of district Kech including Absar, Ziarat Dam, and Soorap Dam, in the water sample of Absor the concentration is suitable for drinking but in the water sample of Ziarat dam and Soorap dam its concentration was observed higher which have negative health effect to people. In the district, Gwadar manganese was found in Akra Dam and Sawadi Dam water samples. Water is being contaminated in the Mekran Balochistan region and people are facing low quality of water in district Gwadar and some areas of district Kech. In the future, the concentration of heavy metals will increase and

water will not be able to drink. To prevent such events in the future, the government needs to make water purification plants in both districts and prevent people from different diseases which are caused by water contamination.

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