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Original Article

Investigation the Concentration of Heavy Metals in the Sediment of Zayandehrood River Bed

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ABSTRACT

Objective: Zayandehrood habitat has economical and environmental importance in central plateau of Iran and it performs a vital role for habitants, agriculture section and the industries which are located along river bed. So current research has been done to measure the contamination of heavy metals, its changes along the river route and defining the important and effective regions on this contamination. It was defined and stations of sampling along the zayandehrood river route to gain this aim. **Methods:** The samples were taken from the depth of 30 to 50 cm of the substances which are located in river bed. In each sample, the absorbable thickness and whole metals of Lead, Cadmium, Cobalt, Nickel and Copper were measured. The maximum thickness for all studied elements in this station was observed after Isfahan city (Isfahan-Yazd Highway Bridge). Among these heavy elements, the thickness absorbance amount for lead metal in 6 stations was in toxic amount. The thickness of Cobalt in 5 stations and Copper in one station was in toxic amount. The absorbance amount of lead in Dorche bridge was 2.5 times and in Yazd-Isfahan Highway Bridge was 3.5 times more than the toxic amount.

Results: According to the results of this research and according to other researcher's studies, Cadmium metal which has special importance because of its pollution on the environment has pot and toxicity along the river route, but the studies have been done via other researches in Gavkhooni pond, have registered the toxicity amount of this element. we can conclude that Isfahan city and also the region which is the center of big industrial factories near Nekouabad Dam and Polchalleh, have the most pollutant effects on zayandehrood habitants.

1.INTRODUCTION

Along the continuous centuries, the rivers were as the most important resources to provide the required amount of water or human beings for agriculture, so they

have key roles in forming the ancient civilizations. Zayandehrood river is a big water route which is flowing in a hot and dry region and caused wide farms and gardens and also a big civilization in this basin, so we can expect that the permanence and the activity of this civilization, is related to the stability and the health of

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this river. As this basin is including industrial regions and also wide farms, so it provide the living needs of the habitats in the fields of agriculture, animal husbandry and the exist industries in this region. These farms can provide their essential water via Zayandehood River. So we can conclude that the health of agriculture products and animal husbandry in this water basin, are related to non pollutant and to the health of Zayandehood river. Zayandehood basin not only including the agriculture industry but also is including the big industries, cities and villages. Among these industries we can point to Mobarakeh Steel Company, Iran Poly Acrylic, Isfahan Iran Melt, Sepahan Cement, also many of factories and production plant which are existed in the forms of different industrial zones and they have included a wide section of this mentioned area. Isfahan, Falavarjan, Mobarakeh, Zarinshahr, Najafabad, Fooladshahr, Khomeinishahr ... are among the cities which are located near this river. The main source of supplying the water of Zayandehood River, is Dimeh spring which is located in 140 km distance of Isfahan west and the flowing waters resulted from snow melt on Zagros east heights which the average amount was estimated about 800 million cubic meters each year. Because of non-sufficiency of water for this basin for agriculture usages, the water transfer has been done via Karoon water basins from past times to now. Zayandehood water basin is including 7 sub basins entitled: Plasjan, Shourdehaghan, Morghab, Khoshkrood, Zarcheshmeh, Rahimi and Gavkhooni pond (non name, 1376). Surely, it is value to mention that in recent studies, this water basin has been categorized to: aquiferous basin (mirage), pool basin (basin mediocre), water-shade basin (basin shallow) (Ghayumi Mohammadi, 1389). The theory which this research has been alone is including this fact that the heavy metals and elements will be increased along the zayandehood river bed because of entering the agricultural water seeping, industrial effluents and home sewages. The aims of this

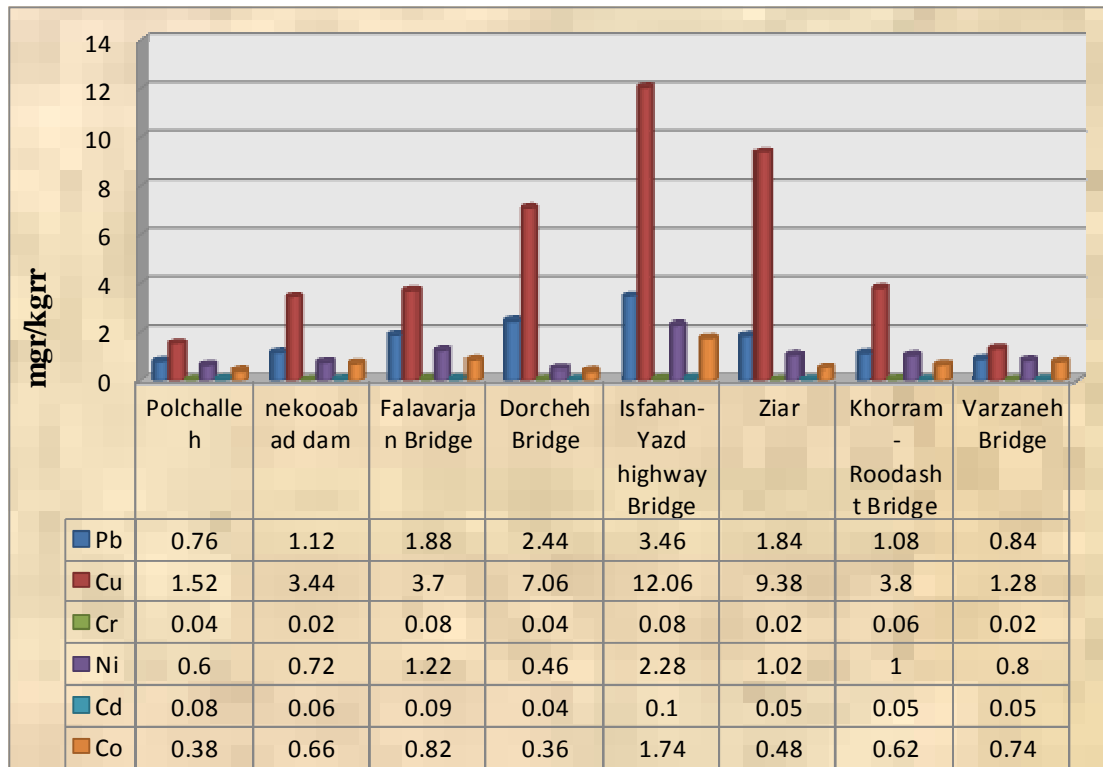
current research are including: A) Measuring the heavy elements along Zayandehood River bed in specific stations. B) Studying the pollution changes and defining the sensitive and important points in river pollution. Isfahan province industrial center and the condition of their sewage repulse.

2. MATERIALS AND METHODS

According to the agricultural regions situation, industries and the cities located along this river route, eight points along this river were chosen which are including: Falavarjan ancient bridge, Dorcheh bridge, Isfahan-Yazd highway bridge, Ziar bridge, Khorram-Roodasht bridge and Varzaneh bridge. During the time of rain diminishing and decreasing the water amount of artificial lake behind Zayandehood dam, the gates of this dam were closed and the entrance of water to this river was prevented, so some affairs have been done to take the soil samples from this river bed in some specified points. The sampling from bed soil, has been done via using Google Earth software and their coordinates have been specified. At the time of sampling by using the GPS method, the places were defined and via using a tubular drill, the soil sample of bed was taken with the depth of 50 cm. The sampling was done in compound method such that in these specified places, the sampling was done from 3 points in river with and the taken substances were mixed together and the thickness of heavy metals like: Lead, Cadmium, Cobalt, Nickel, Copper were measured. The measurement of heavy elements has been done via digestion method in Acid Nitric mixture, Acid Hydrofluoric and Acid perchloric mixture. Also the measurement of heavy elements which were extractable with DTPA, was done with Lindsay and Norvell methods.

Table 1.**The geographical information related to sampling stations in studied region**

row	Station name	Geographical length	Geographical width
1	Pole challeh	51°14'22.45" E	32°22'46.48" N
2	Nekooabad Dam	051°32.425 E	32°23.417 N
3	Falavarjan Bridge	51°30'56.52" E	32°33'18.32" N
4	Dorcheh Bridge	51°33'54.73" E	32°36'50.14° N
5	Isfahan-Yazd highway bridge	51°45'.903 E	32°35'.898 N
6	Ziar Bridge	51°56.362' E	32°31.036' N
7	Khorram-Roodasht bridge	52°1.213" E	32°28.720" N
8	Varzaneh bridge	52°39.378' E	32°25.443' N

3. RESULTS**Fig. 1.** The comparison of available concentration gradient changes of studied elements from the start to end point of route (along with data table)

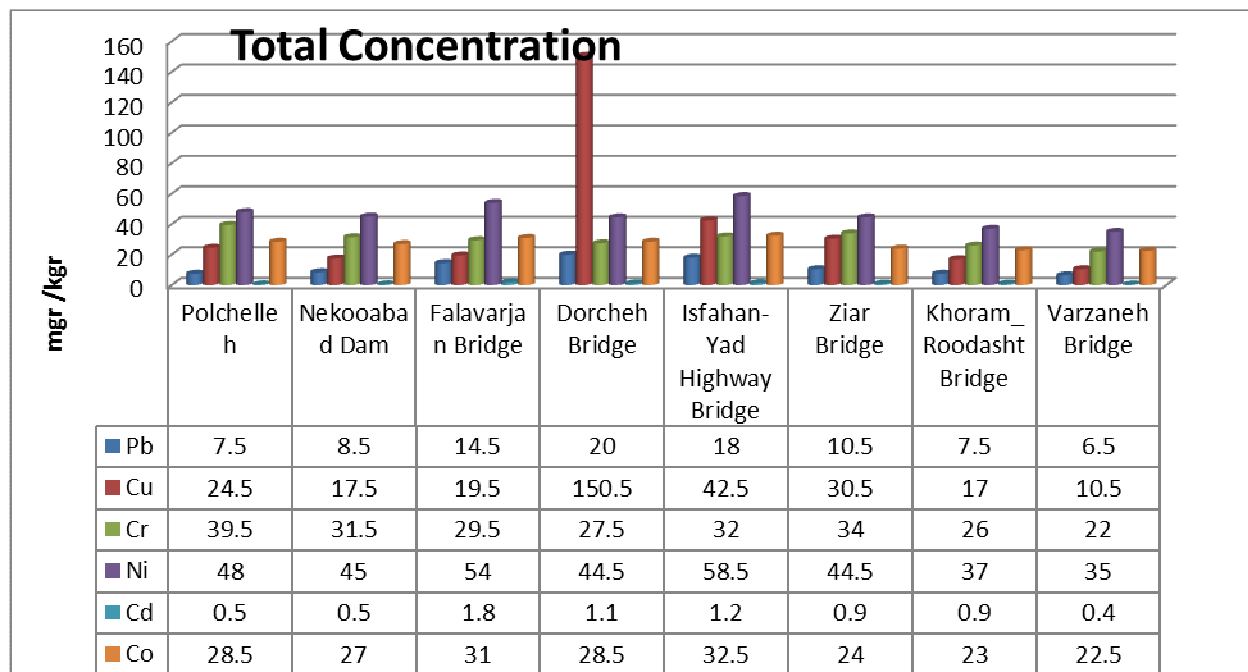


Fig 2. The comparison of Total concentration gradient changes of studied elements from the start to end point of route (along with data table)

4. DISCUSSION

Lead (Pb): the concentration changes of available Lead from high point of river to the station after Isfahan city (Isfahan-Yazd Highway Bridge) has first increasing trend and then decreasing trend and the most amount of concentration in both sides of Isfahan is indicating the increasing of Lead entrance to the flow river habitant in this region, this matter can be because of cars passing from these regions, increasing the industrial activities and also entering the industrial pollutants which are resulted from human activities in this region and is because of being approached to Isfahan city. Among eight stations, six stations have the lead amount in toxicity amount. Which are including: Nekoo Abad Dam, Falavarjan Bridge, Dorcheh Bridge, Yazd-Isfahan Highway Bridge, Ziar ridge and Khorram-Roodasht Bridge.

Copper (Cu): the concentration amount changes of copper from high point of river to the station which is located after Isfahan (Isfahan-Yazd Highway Bridge), first has increasing trend and then decreasing trend, this kind of trend is similar to lead and we observe the maximum amount of concentration after Isfahan city.

Cadmium (Cd): the thickness changes of Cadmium from the high point of river to the station which is located after Isfahan (Isfahan-Yazd High Way Bridge) is untidy and we can observe the maximum amount of thickness in this station and after that there will not be any changes in thickness.

Nickel (Ni): the Nickel thickness changes from the high point of river to the station which is located before Isfahan (Dorcheh Bridge) has first increasing trend and at the station after Isfahan city, Isfahan-Yazd High Way Bridge has sudden increasing trend and then it will be decreased by a slow trend and the maximum amount of thickness will be seen in the station located after Isfahan city.

Chrome (Cr): the thickness changes of Chrome from high point of river to the low point of river are untidy and the biggest amount of Chrome will be observed after Isfahan city (Isfahan-Yazd High Way Bridge) and Falavarjan Bridge (two stations before Isfahan).

Cobalt (Co): the thickness changes of Cobalt has approximately increasing trend before the station of Yazd-Isfahan High Way Bridge and highest amount of Cobalt has been observed after Isfahan city and then it will be encountered with intensive decrease of thickness, then it will increase with a slow trend.

Among all kinds of studied metals, in this research, (Lead, Copper, Cadmium, Nickel and Chrome and Cobalt), the maximum amount of these elements will be observed after Isfahan city which is indicative of entrance of high amount of these elements in this region.

Total Thickness:

Lead (Pb): the highest amount thickness of lead will be seen in two stations around Isfahan city and in none of these samples, the thickness is in toxicity amount.

Copper (Cu): the thickness change of whole copper is untidy before Dorcheh Bridge station and then it is

decreasing and the maximum thickness of copper will be seen before and after of Isfahan.

Chrome (Cr): the thickness change of whole Chrome is little in first six stations and then it is decreasing in two end stations. There was no toxicity thickness in samples and we can observe the highest amount of thickness in first stations (Polchalleh).

Nickel (Ni): the highest amount of thickness for nickel can be seen after Isfahan city (Isfahan – Yazd High Way Bridge station) and this amount is lower than toxicity limit.

Cadmium (Cd): the highest amount of Cadmium thickness can be seen in Falavarjan Bridge station and tow stations after it (Dorcheh Bridge and Isfahan – Yazd Highway Bridge) and there is not any toxicity in them.

Cobalt (Co): the cobalt thickness will be in toxic amount in five stations among eight stations in addition the highest amount of Cobalt thickness can be observed in station after Isfahan city. For copper and cobalt, we can observe toxicity level which for Copper, there was just toxicity level in the station before Isfahan city (Dorcheh Bridge), also for Cobalt the thickness of toxicity in five stations which are including: Polchalleh, Nekoabad Dam, Falavarjan Bridge, Dorcheh Bridge and Yazd – Isfahan Highway Bridge. As you can see in the station of Dorcheh Bridge and Falavarjan Bridge, there is pollution of heavy metals like Cobalt and Copper, regard to this fact that both of these plains are among the most important of agriculture in Isfahan province and for instance, Falavarjan plane are wide and spread rice farms to irrigate their agricultural products, Zayandehrood river will be used, the pollution of these waters can endanger the health of human, domestics (?) and living habitants. Polchalleh, Nekoabad Dam and Ziar regions are also the important centers of agriculture section in Isfahan which use Zayandehrood water as the main source supply their essential agricultural water and existing of pollution from Cobalt in Zayandehrood River in these centers can be dangerous for health of agricultural products in these plains. By paying more attention to changes trend of heavy metals thickness in Zayandehrood River bed (longitude transect from Polchalleh to Varzaneh), we can understand that for the elements of: Cobalt, Nickel, Lead and Copper there are withstanding amount thickness of these elements in both sides of Isfahan and this fact is indicating of pollutant effects of artificial activities of this city on Zayandehrood habitant and it is as an alarm that these pollutant can be effective on the health of inhabitants destroying the geographical elements of this river bed (river, river bed, GavKhooni pond, human, domestics, plants). For Cobalt, the highest amount of thickness was seen in station after Isfahan and also in first station which was in toxic amount. As we can see, the mass of industrial units in Isfahan (Mobarakeh Steel, Isfahan Iron melting, Poly Acrylic Iran and Sepahan cement), so this kind of pollution can be the result of these industrial centers and can threaten the health of river habitant in this region.

Whole conclusion:

We can draw conclusion from findings of this research that the most important centers of pollutant in Zayandehrood habitant with heavy metals are:

A region which is located between two first stations (Polchalleh and Nekoabad Dam) where has the biggest center of Isfahan province industrial factories.

Isfahan city which is located between stations four and five (Dorcheh bridge and Isfahan- Yazd Highway Bridge)

The maximum amount of thickness for studied elements was seen in station located after Isfahan city (Isfahan- Yazd Highway Bridge).

Among these studied heavy elements, the thickness amount of lead in six stations was in toxic amount. The thickness of lead in Dorcheh Bridge was 2.5 times more than toxic amount and in Isfahan- Yazd Highway Bridge, was seen 3.5 times more than this amount. The whole amount of thickness for Cobalt in five stations and for Copper in one Station was in toxic amount. So, hypothesis A, which is defined heavy elements along Zayandehrood River bed will be increased due to entrance of agricultural and industrial effluents and home sewages, is proven.

Cadmium which its pollution has especial importance of environment, has not any toxicity thickness along river route.

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