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# Measurement of Some Heavy Metals in Sediments from Two Great Rivers (Tajan and Neka) of Iran

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**Abstract:** In this study, determination of Pb, Cd and Zn was performed in sediment extracts of two great rivers in Mazandaran province (Iran) according to the Atomic Absorption Spectrophotometry procedure in eight sites. From each river four sites selected (2 for test and 2 controls). The results showed higher concentrations of Zn, Pb and Cd in the test samples compared to that in the control in two rivers. Significant different in level of Pb, Cd and Zn was not seen between two rivers ($p<0.05$). At sample site Tajan, which was the first test sample taken. This study can be a alarm to researchers for more study about pollution of sediments in Mazandaran and finding proper methods for reducing and removing.

**Key words:** Pb, Cd, Zn, sediment, River, Iran

## INTRODUCTION

Sediment is known as traps or sources of chemical compounds and elements from the river water. The distribution of heavy metals in sediment can be separated as exchangeable, carbonates, oxidizing, organic matter and residual fractions (Breder, 1997; Guo *et al*., 1997). Many studies have proved that heavy metal concentrations in stream sediments caused by contamination sources. Many studies showed the enrichment of heavy metals in river sediments influenced by adjacent landfills and some also reported the presence of heavy metals in sediments influenced by landfill emission plumes (Guo *et al*., 1997; Donahoe and Liu, 1998; Hlavay and Polyak, 1998; Ho and Hui, 2001; Klavins *et al*., 1995; Tessier *et al*., 1979). The metal concentrations determined in this study include that for Zn, Cd and Pb. Some authors have documented studies on Cu, Pb, Zn, Cd, Sn, As, Cr, Fe and Mn concentrations in sediments of rivers affected by mining activities (Ho and Hui, 2001; Klavins *et al*., 1995; Ryssen *et al*., 1999; Breder, 1999; Nolting *et al*., 1999; Stephens *et al*., 2001; Wang *et al*., 1987).

This study deals with concentrations of Pb, Zn and Cd that were extracted from the stream sediments located along a stream system in a populated region of Tajan and Neka rivers, Iran. Stream sediments were used because heavy metal concentrations selectively integrate in geochemical phases in sediments. The potential source of heavy metal concentrations in the vicinity is an inactive landfill that is located adjacent to the study stream.

## MATERIALS AND METHODS

**Sampling location:** The location of the study area is on the Mazandaran Plateau in the north of Iran. The stream studied was the South Dry Sac River.

Neka River Originates from Shah-Koh Mountain and enters the sea through Neka city. After flowing through the pass of Shamshir Bor, it flows into the Caspian Sea in the vicinity of Nowzar Abad. At first the course that this river flows is a mountainous one, with beautiful valleys covered with forests. On the condition that access is gained to the fringes of this river, recreational grounds or areas near Yanehsar can be accounted as attractive regions. It is one of the important and nourishing rivers. Its length is about 180 km with a basin area of about 3000 $km^2$. It is a permanent river with an annual average flow of 148.2 million $m^3$.

Tajan River Originates from Tizabad Mountain and after receiving many other small rivers (e.g., Lajim, Garmab-rood, Farim River,) passes through the city of Sari (the center of the province) and then enters the sea through Farahabad city. It is about 170 km long and is one of the most important rivers of Mazandaran province. Its catchment area is about 4,000 $km^2$ with an annual average water flow of 207.4 $km^2$.

**Choice of sediment size and sample collection:** Higher heavy metal concentrations are generally found on smaller grains of sediment because of the higher surface area to grain-size ratio. Therefore, the smaller the grain size, the higher the metal concentration accumulation.

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The project used sediment samples sieved between 80 and 360 meshes to restrict the grain size for more accurate results.

Four stream sediment samples were collected in four sites of the Tajan (T1-T4) that two site were (T1 and T2) in upstream as control group and four from Neka River (N1-N4) that (N1 and N2) were control. Four of these samples were taken upstream (control, N1 and N2-T1 and T2) and other from downstream. At each sample site, the samples were wet sieved and the sediments between the mesh sizes of 80 and 360 were saved for chemical analysis. At each sample site, a GPS instrument was used to save the location of the sample site as a waypoint in the instrument.

**Chemical extraction methods:** All procedures were done in central laboratort of Mazandaran medical university of Sari-Iran at September 2004. For the geochemical characterisation of Sari and Neka rivers sediments, the fine fraction (between 80 and 360 meshes) was extracted by wet sieving. Pb, Zn and Cd were analysed after acid digestion ($HCl+HNO_3+HF$-Breder, 1997) by Atomic Absorption Spectrophotometry. The data used came from the computed average of three digestions.

Standard of 2 and 10 ppm of Pb, Zn and Cd were prepared. The ICP was used to determine the concentrations of Pb, Zn and Cd in all sediment samples.

**Statistical analysis:** Data were analysed using the one-tailed variance test. The results are expressed as mean. The data were tested for homogeneity of variances at significant level of $p<0.05$ . Statistical data analysis was performed with SPSS (version.12) program for Windows software.

## RESULTS

Table 1 compare the concentrations analyzed at the test sites versus the control sites. Higher concentrations of Zn, Pb and Cd in the test samples compared to that in the control were seen. The space between Tajan and Neka shows the location of the landfill in reference to the sample sites. At sample site Tajan, which was the first test sample taken; each metal reached its highest concentration. Zn, Pb and Cd seemed to have the most stable values in the control values and the test values. Using the control area as a background, it would appear that the landfill does in fact affect the sediments of these Rivers with heavy metal concentrations.

t-test was performed on the data to show the correlation of the hypothesis that the landfill emits heavy metals into the study area and the actual data that was collected. The results are shown in Table 2.

Table 1: The concentration of heavy metals in each sample (ppm)

| Sample ID | Zn | Pb | Cd |
|---|---|---|---|
| T3 | 93 | 37 | 1.1 |
| T4 | 94 | 35 | 1.3 |
| N3 | 91 | 44 | 1.2 |
| N4 | 96 | 36 | 1.2 |
| T1 | 46 | 26 | 0.5 |
| T2 | 38 | 20 | 0.3 |
| N1 | 35 | 23 | 0.4 |
| N2 | 32 | 17 | 0.2 |

Table 2: t-test assessment on the data ($p<0.05$)

| Element | Mean of control | Mean of test | T-value | Critical value |
|---|---|---|---|---|
| Zn | 37.75 | 93.00 | 13.16 | 2.11 |
| Pb | 21.50 | 38.00 | 12.61 | 2.11 |
| Cd | 00.35 | 1.20 | 6.1 | 2.11 |

## CONCLUSIONS

The purpose of this study was to show the variation in concentrations of Pb, Zn and Cd in the sediments of two great Rivers in Mazandaran province that is affected by a landfill. The chemical analysis of the data shows that concentrations of metals are higher downstream from the landfill than in the control sites upstream from the landfill.

Results of this study are similar to Vidinha *et al*. (2005) assessment on Heavy metals contents in beach and dune sediments from Espinho to Mondego Cape (Portugal). Total Fe, Cu, Pb, Zn, Mn, Cd, Co, Ni, Cr, Ca, Mg and Al concentrations were measured in the fine fractions of the sediments. The absence of relationship between the analysed heavy elements and Al and the exhibition of contents higher than the rocks outcropping in the hinterland, point to an additional source of heavy metals related to human activities. The data showed that inputs from Aveiro lagoon (natural and anthropogenic), Douro River and coastal erosion (by littoral drift or advective currents) were the main sources of heavy metals.

In other study Demirak *et al*. (2005) studied Heavy metals in water, sediment and tissues of Leuciscus cephalus from a stream in southwestern of Turkey. Concentrations of Cd, Pb, Zn and Cr in water and sediments were assessed and there was no relationship between metal concentrations in the sediment and water. As with water, Pb and Cd concentrations in particular were higher in sediment than that in background levels. The results showed that the pollutants from the thermal power plant may be a source of these elements.

Fullbright Landfill is a possible point-emission source that could be emitting heavy metals into the stream via runoff. However, further studies should be projected that consider alternative sources for the high heavy metal content. Taking into account pH levels at each sample site and also collecting more samples of the study area could improve this study.

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