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Quantitative Estimation of Heavy Metals in Ground Water in Meerut Region in Uttar Pradesh

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Abstract: *On the basis of the survey and recent news, districts in western Uttar Pradesh that reeling under the threat of heavy metals endemic threat are: Meerut, Rae Bareli, Gonda, Bijnore, Sant Ravidas Nagar, Ballia, Shahjahanpur and Mirzapur. They all have heavy metals content above the limited range of parts per billion (ppb) in the groundwater in some areas. Heavy metals content above the considerable limit in water is considered toxic and can cause lung and skin cancer and other types of diseases. It is also harmful in agricultural field. Ground water from around the Meerut city part of western Uttar Pradesh, contaminated with poisonous heavy metals. This study has been carried out to determine the variability of the level of heavy metal contamination in the groundwater western Meerut district. Inductive coupled plasma mass spectroscopy was used for the analysis of heavy metals.*

Keywords: *Heavy metal contamination like arsenic, lead, cadmium, and mercury, groundwater, inductive coupled plasma spectroscopy.*

I. Introduction

In today's context heavy metals in environment rapidly increases by the industrialization, urbanization and increasing pollution in rivers of India. Pesticides and insecticides are also responsible for the metal pollute soil and water. Recent studies on the toxicity of heavy metals in water, tells us the how much is this is harmful for the farming of rice and humans life and environment **[1,2]**. All heavy metals have comparably smaller cationic size because of the heavier nucleus and increasingly compressed electrons. Metals are divided into three categories on the basis of their biological function and their effects- (1) Essential metals and their functions and effects K, Mg, Mn, Co, Ni, Cu, Zn, Mo, Na, V and Zn. (2) Nonessential or non-toxic metals Cs, Sr, T and Rb. (3) Toxic metals As, Pb, Hg, Cd, Au and metalloids Ge, Sb and Se [**3].**

The main sources of heavy metals in the environments are paint industries, sugar mills, biomedical wastes of hospitals and private clinics, etc. in which some of the metals are biodegradable and some are not. Some industries didn't have a proper catchment basin that's why the contamination of metals comes into the soil or flowing rivers and continue through the ground water. In ground water heavy metals come from through the soil by the natural processes or by the change in soil pH. Many reactions occur in the soil environment like precipitation and dissolution, acid and base, sorption or ion exchange and oxidation or reduction, these processes can force the speciation and mobility of metal contaminants **[4,5]**.

By the contamination of heavy metals many harmful effects may occur in the human health. This causes the many diseases also depending on the metal or its quantity ingested **[6]**. The toxicity of lead can cause weakness in fingers, wrists, or ankles. Studies show long-term exposure to lead at work can lead to decreased performance. High levels of lead can cause damage to the brain, kidney, and can cause anemia in both adults and children **[7]**. Arsenic enters the human body through ingestion, inhalation, or skin absorption. Arsenic is a very toxic metal for the plants, animals and the human body. The toxicity of mercury can cause metal disturbance and destruction in hearing, vision and movement **[8]**.

Many instruments/techniques are used to determine or quantitative estimation for the heavy metals in water like UV-visible spectrophotometer, Cyclic Voltammetry, AAS, ICP-OES and ICP-MS. From these techniques GFAAS and ICP-MS are the most effective techniques for the estimation of heavy metals in water. We can determine the heavy metals in water at very low concentration (0.1µg/l). In this paper, we estimate the concentration of heavy metal in groundwater samples by using the ICP-MS in the area of the Meerut region in Uttar Pradesh.

II. Material and Methods

Collection of water samples

Samples should be collected in the different types of bottles whether it is in linear polyethylene, reagent bottle or borosilicate glass bottles. When we collected the samples, remember that bottles are properly cleaned. Water samples are collected from the hand-pumps from the different areas of the Meerut. These samples were

collected during the month of November. After collecting the samples, these samples are digested by the nitric acid for the analysis of heavy metals by ICP-MS.
Samples were collected from the different areas-
Water sample no. 1- Partapur industrial area
Water sample no. 2- PAC near the domestic sewage
Water sample no.3- Datawali village Near Kali River
Water sample no.4- Daurala village Nearby sugar mill
Water sample no.5- Mawana nearby paper mill and Kali River
Water sample no.6- Begum bridge near the domestic sewage it is the center area of the city.

Digestion procedure of water for quantitative estimation of heavy metals.

Take 100 ml sample in a griffin beaker and add the 5ml conc. HNO_3

↓

Cover the sample with a watch glass

↓

Place this mixture on a hot plate setting the temperature 90º and allow to evaporate 5ml remember that mixture should not be bumped out

↓

Cool the mixture and then added again 5ml conc. HNO_3

↓

Again, this mixture is placed on a hot plate until digestion is complete and allows evaporating the mixture till the 3ml portion is left

Cool the mixture and wash the walls of beaker and watch glass by the distilled water

↓

Then filter the mixture and centrifuged for the removal of other insoluble impurity

↓

Again filter the mixture and make up the volume to 100ml of distilled water with 1% HNO_3

↓

Now the sample is ready for the analysis by ICP-MS.

III. Methodology

The digested water samples were analyzed by the inductive coupled plasma mass spectroscopy. Samples are analyzed at the flow rate of 1.0mL min^{-1} for 20-30 minutes.

IV. Results and discussion

Here we have taken the different areas of groundwater samples for the analysis of heavy metals. By the results of analyzing groundwater samples we can compare the concentration of heavy metals in different areas of Meerut.

Lead (Pb)-

From the study of these samples the concentration of lead is too much higher than the permissible limit of WHO. 0.05µg/l is the permissible limit from the WHO guidelines. The graph of lead shows variability of concentration in these samples and all the samples had higher limit than the permissible limit. We see that maximum concentration is present in sample no.1 and minimum concentration is present in sample no.5.

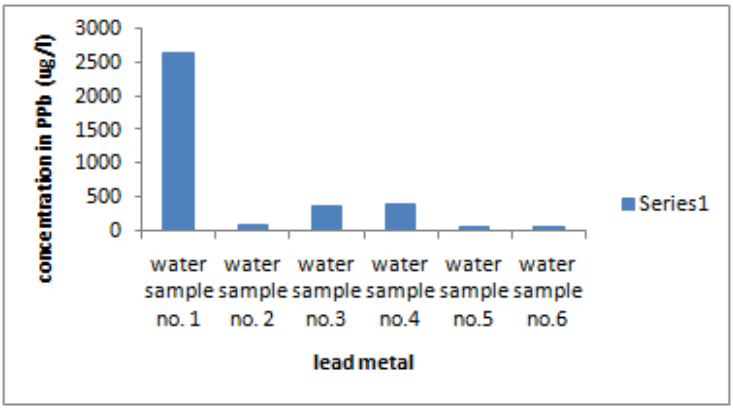

Fig. 1

Cadmium (Cd)-

The permissible limit of cadmium by BIS is 0.003mg/l. Result shows the concentration of cadmium is also higher than the permissible limit given by the Bureau of Indian Standard. From the analysis we can say that the maximum concentration is present in sample no.1 and minimum is in sample no.2.

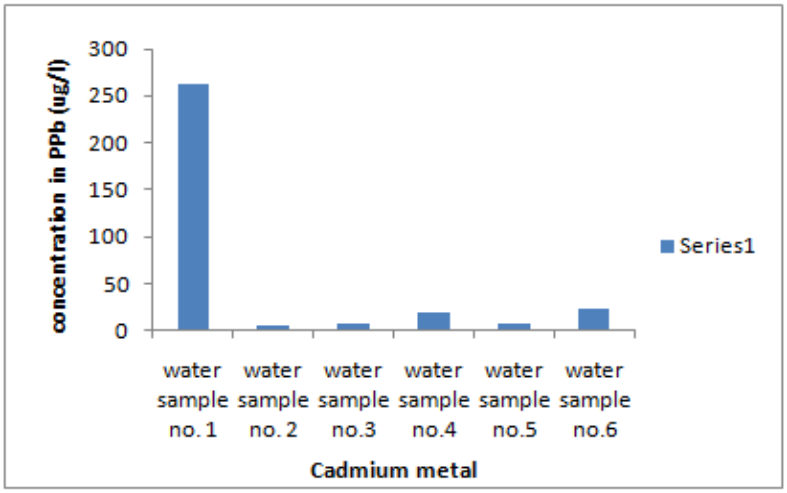

Fig. 2

Arsenic (As)-

The permissible limit of arsenic in drinking water is 10µg/l. In all these samples, only in one sample the concentration of arsenic is higher than the permissible limit given by the WHO. The maximum concentration is present in sample no.5 and the minimum concentration is present in sample no.2.

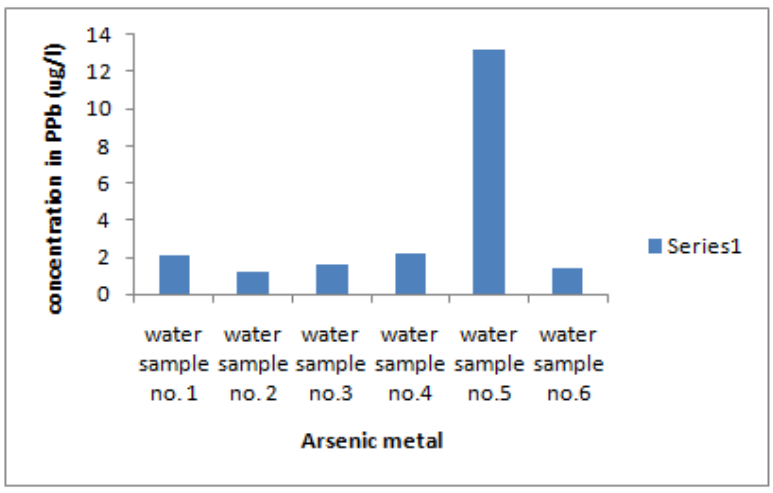

Fig. 3

Mercury (Hg)-

The permissible limit of mercury in drinking water is 0.001mg/l . In all this the concentration of mercury is under controlled. In all samples the concentration of mercury is lower than the limit given by the WHO.

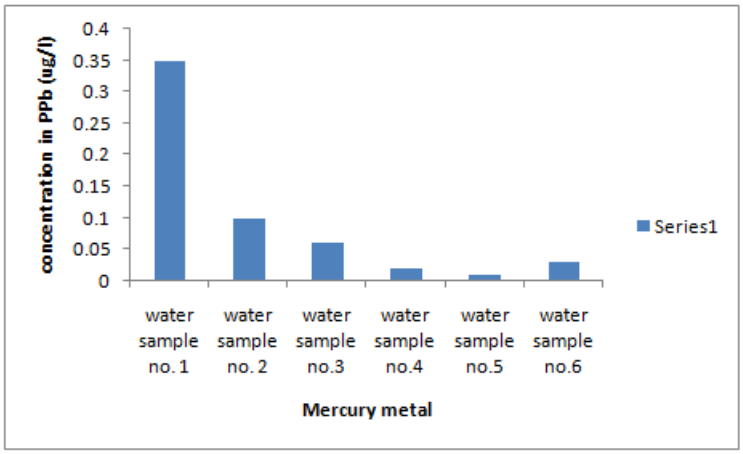

Fig. 4

V. Conclusion

The ground water samples are collected from the different areas of Meerut region, Uttar Pradesh for the estimation of heavy metals (lead, cadmium, arsenic and mercury) by using the instrument ICP-MS. In this study, we found that the concentration of these metals in some areas exceeded the WHO permissible limit for drinking water. We all know that the our daily life is totally depends on the water, and most of the community is also depends on the ground water either it is hand-pump or well water.

From the results of the present study, we can say that the concentration of heavy metals is overreaching in some areas from these samples. The uptake of these metals can cause various types of diseases depending on the metal and its concentration. Lead toxicity can cause the damage the nervous system in adults and children. The high level of lead can cause the damage the kidney and anemia in both children and adults. Cadmium can cause the loss of bone integrity. The high level of cadmium toxicity can cause irritation in the stomach and sometimes death. Arsenic can cause the skin lesions and other types of diseases. The high toxicity of mercury can cause the paralysis and blindness. Among these samples we can see that the concentration of lead is much higher than the other metals. So, that this study reveals the actual position of heavy metals in groundwater. In future it may be increased due to urbanization or industrialization. Therefore, we suggested that the people and government should be acquiring some technologies for controlling these heavy metals in groundwater for the public health.

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