Section A-Research paper
ISSN 2063-5346

DETECTION OF ARSENIC METAL CONTAMINATION OF GROUND WATER SAMPLES FROM SEVERAL REGIONS IN WEST BENGAL

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Abstract

Arsenic (As) contamination of groundwater affects the health of about 140 million people in India. Long-term exposure to As increases mortality dramatically because it causes a variety of malignancies, lung diseases, and cardiac problems. The current study used a method that enables the measurement of the concentration of heavy metals and arsenic in various water samples from various regions of West Bengal districts. Howrah, South 24 Parganas, North 24 Parganas, and Kolkata were the chosen districts. The arsenic pollution, as well as the contamination of Cd, CN, Pb, Hg, Ni, Mo, Cr, Total suspended solid, Total hardness ($CaCO_3$), and BOD and COD levels, were all tested. The concentration in water containing arsenic samples varied from 0.22 to 1.92 mg/L, above the allowable level of arsenic, which is 0.01 mg/L in drinking water (according to WHO). According to our research, chronic poisoning from arsenic accounts for the majority of water pollution and poses a risk to the 3.5 million people and communities who use this untreated water.

Introduction

Exceeding the acceptable limit of 10 µg/L set by the "World Health Organisation" (WHO) for arsenic (As) in groundwater poses a threat to the health of almost 100 million Indians (1). In addition, several countries, including Bangladesh, India, China, Nepal, Cambodia, Vietnam, Myanmar, Laos, Indonesia and the USA, are negatively impacted by elevated waterbodies As associated with exposure to As and protracted As exposure both dramatically increase mortality from cardiovascular illnesses can lead to lung, skin, liver, and bladder cancer (2).

As poisoning has also been linked to the death of newborns, a drop in intelligence, and problems with movement in children (1). Investigations have shown that freshwater isn't only related to As-containing guest atoms but also affected by pH, UV irradiation, and soluble guest elements. Alluvial deposits from the Holocene era are associated with that same Carboniferous Period by as-rich components. (3). As a systemic toxin, arsenic is known to cause problems with the kidneys, the digestive system, the nervous system, and the heart. In addition, long-term exposure to arsenic has been linked to several malignancies, including bladder, kidney, skin, and liver cancers. Compared to naturally occurring arsenic, acute toxicity is more toxic ls, which is connected to the speciation of As. Arsenic is present primarily in its inorganic forms in groundwater, either as (III) or (V). Both inorganic forms, when As(V) is converted to As (III), are harmful to humans. The primary mechanisms behind the breakup of ATP production and As (III) inhibitions of different succinate dehydrogenases are the detrimental consequences. Owing to As (III) affinity for these sulfhydryl enzymatic reactions and As and Phosphoric's molecular resemblance, these negative consequences are brought on, which causes PO_4^{-3} to be changed into As O_4^{-3} (4).

The residents of the Bengal basin have rendered the freshwater importable by indiscriminately using the waters of the streams and rivers as conduits for coal ash and sewage. Moreover, the development of high-yielding “Boro” dry-season rice exacerbated the need for irrigation. As a result, West Bengal and Bangladesh switched their water supply strategy from groundwater to water from the surface in the early 1970s (5). In

order to supply the demand for drinking, farming, and corporate water, numerous million wells (varying from low seed hand-pumped to heavy-duty motor-driven) are put into place. Arsenic (As), which may have adverse health effects at levels greater than 10 µg/L in drinking water, was found to have high amounts in a significant portion of the Around the 1990s wastewater in the Lesser Himalaya (6). In the Himalayas, particularly in the areas of Bangladesh, many hydrogeological studies have been carried out to assess the groundwater recharge and comprehend the impact of groundwater movements (at the local to regional scale) on the transport of As-contaminated waters inside these drainage basins (5). However, in-depth hydrogeologic investigations are sparse in the southwestern Himalayan region (West Bengal), prompting district-level sustainable groundwater assessments by the Central Groundwater Regulatory Boards and Water District Investigative Commission (7). The findings of the groundwater pollution investigation using samples of water taken from four West Bengal districts are presented in this paper.

Method

The experiments were performed at a laboratory in West Bengal. 58 ground water samples were tested from four Districts of West Bengal, India for As detection and heavy metal contamination (Cd, CN, Pb, Hg, Ni, Mo, Cr), Total suspended solids, Total hardness as $CaCO_3$ and BOD, COD detection. The instrumental techniques used for detection were "Atomic Absorption Spectroscopy (AAS) and Inductively Coupled Plasma (ICP) Spectroscopy".

Result and discussion

Total 58 water samples, out of which 16 samples from Howrah, 12 samples from South 24 Parganas, 15 specimens from Kolkata and 15 specimens from North 24 Paraganas, were tested for to evaluate the arsenic contamination as well as heavy metal contamination (Cd, CN, Pb, Hg, Ni, Mo, Cr), Total suspended solids, Total hardness as $CaCO_3$, BOD, and COD. The acceptable range for As is 0.01 mg/L, Cd is 0.003 mg/L, CN is 0.05 mg/L, Pb is 0.01 mg/L, Hg is 0.001 mg/L, Mo is 0.07 mg/L, Ni is 0.02 mg/L and Cr is 0.05 mg/L. hardness as $CaCO_3$ is 200 mg/L, suspended solid mg/L 75 mg/L and oxygen is 4 mg/L.

The As level in district Howrah for all the 16 samples number fall in the range between 0.45 mg/L to 0.92 mg/L, in community South 24 Parganas for all the 12 samples, values fall in the range between 0.72 mg/L - 1.12 mg/L, in section North 24 Parganas for all the 15 samples values fall in the range between 0.68 mg/L - 1.72 mg/L, and in community Kolkata for all the 15 samples values fall in the range between 0.22 mg/L -0.92 mg/L, which is far away from the acceptable range (0.01 mg/ L). The higher bedrock arsenic content is predicted to be associated to the higher arsenic concentration in groundwater (8). Arsenic waste emissions from corporate, agriculture, and farming operations or major geological activities are to blame for the arsenic contamination (9). Cd, CN, Pb, Hg, Ni, Mo, Cr level in all four districts for all the 58 sample values fall in the acceptable range. Table 1 shows the mean of the total arsenic content in water samples from four sections. The As and heavy metals Cd, Ni, Pb, and Hg are known to harm DNA, cause cancer and harm the central nervous system, among other detrimental effects on human health (10).

Table 1. Arsenic amount(mean) in mg/L from various district in West Bengal. (Acceptable limit of As is 0.01 mg/L)

Serial number	**Total Arsenic as As (mg/L) (mean)**	**District**
1	0.805	Howrah
2	0.9	South 24 Parganas
3	1.33	North 24 Parganas
4	0.673	Kolkata

Conclusion

The study emphasises the danger posed by arsenic in the water from four districts in West Bengal, India. The arsenic pollution, as well as the contamination of Cd, CN, Pb, Hg, Ni, Mo, and Cr, Total suspended solid, Total hardness as $CaCO_3$, and BOD and COD levels, were all tested in a total of 58 water samples. According to our data, Arsenic in water samples varied from 0.22 to 1.92 mg/L, above the allowable level of arsenic, which is 0.01mg/L. The 300 million people's most outstanding health risk people who drink this water untreated is chronic arsenic poisoning. Mitigation actions are urgently required to safeguard the uninformed from such health issues. Households in high-risk areas would be informed about As and heavy metal contamination harm. However, solutions for centralising treatment, such as good deep installation or reverse osmosis systems, can be investigated if more wells are deemed dangerous. Because of the relatively varied aquifers in the area, arsenic spatial variation is very considerable, even within a single hamlet. Certain areas could be used to lessen the population's toxicity because this prediction cannot take into account small-scale changes. Similar methods for highly accurate As prediction modelling can be used at the national level to find the areas at risk more precisely.

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