Number One Toxic Environmental Contaminant Element

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ABSTRACT

Arsenic is a ubiquitous metalloid element ranks as the number one toxic environmental contaminant. Inorganic Arseic is considered the most potential human carcinogen in ground water . It is generally present as dissolved Arsenite As^{3+} or Arsenate^{5+} besides the organic form. Arsenites are much more soluble, mobile and toxic than Arsenates in aquatic and soil environments. Pronlonged drinking of arsenites rich water leads to arsenicosis and result in various pathophysiological condition like alteration of skin colour ,hard patches on palms and soles of feet , cancer of the skin bladder, kidney ,lung & vascular disesses in humans. WHO has recommended provisional guideline value of total arsenic concentration in drinking water is 0.01mg/L. Since 1993 however the national standard for maximum acceptable concentration in drinking water is 0.05mg/L. The occurence of As in ground water was first reported in 1980 in West Bengal in India and the first case of Arsenic poisoning in Human was diagnosed at the school of Tropical Medicine Calcutta in 1983.

Although human exposure to arsenic is caused mainly through arsenic contaminated underground drinking water. Recent studies have shown that Besides drinking water food chain is a major contributor to arsenicosis. Thus contaminated water for irrigation result in possibility of arsenic uptake into crop plant. Arsenic content in straw grain and husk of rice is especially important since paddy fields are extensively irrigated with underground water having high level of arsenic concentration. Straw, husk are widely used as animal feed. So arsenic gets deposited into the animal body through feed ,rice , straw & husk as well as from drinking water which inturn finds a route into the human body through food chain that is through the consumption of animal products like beef ,mutton, pork ,chicken, egg ,milk & fish.

As rice and fish are the staple food in Bengal hence the Deltaic region is worst affected by arsenicosis. It is important to know the Accumulation of arsenic in fish and its contribution for human exposure through food chain and the consequent effect of arsenic load on fish health as it could have significant implications on aquaculture. Accumulation of arsenic in different tissue and organs of fishes in contaminated water has been reported. Recent studies have shown that arsenic is carcinogenic to other animal also.

KEY WORDS:- Arsenicosis, Carcinogen, Pathophysiological, Arsenite.

INTRODUCTION

In traces Arsenic is found everywhere and it enters the environment from natural and manmade sources. The main natural sources are volcanoes low temperature volatilization, wind erosion, forest fires and sea spray. Among the chemicals arsenic trioxide world production is about 50000 t/year. A good portion of which is used in preparation of various herbicides and wood preservatives.

Arsenic enters the living world in the body of plants and animals from the soil and water and is released through combustion decomposition and volatilization. The heavy metal reaches water bodies from the industries, chemical factories and certain insecticides. Both inorganic and organic compounds containing Arsenic are widely used as herbicides.

MATERIAL AND METHOD

Arsenic content can be analysed in water, plant and animal samples by Atomic absorption spectrometer equipped with gas flow meters for argon or nitrogen and hydrogen. Another method of arsenic estimation is colorimetric in which an orange red solution of complex of arsenic with silver is prepared. For this an arsine generator assembly is needed to produce arsine by reducing arsenic in presence of zinc. Nowadays kits are also available for spot detector.

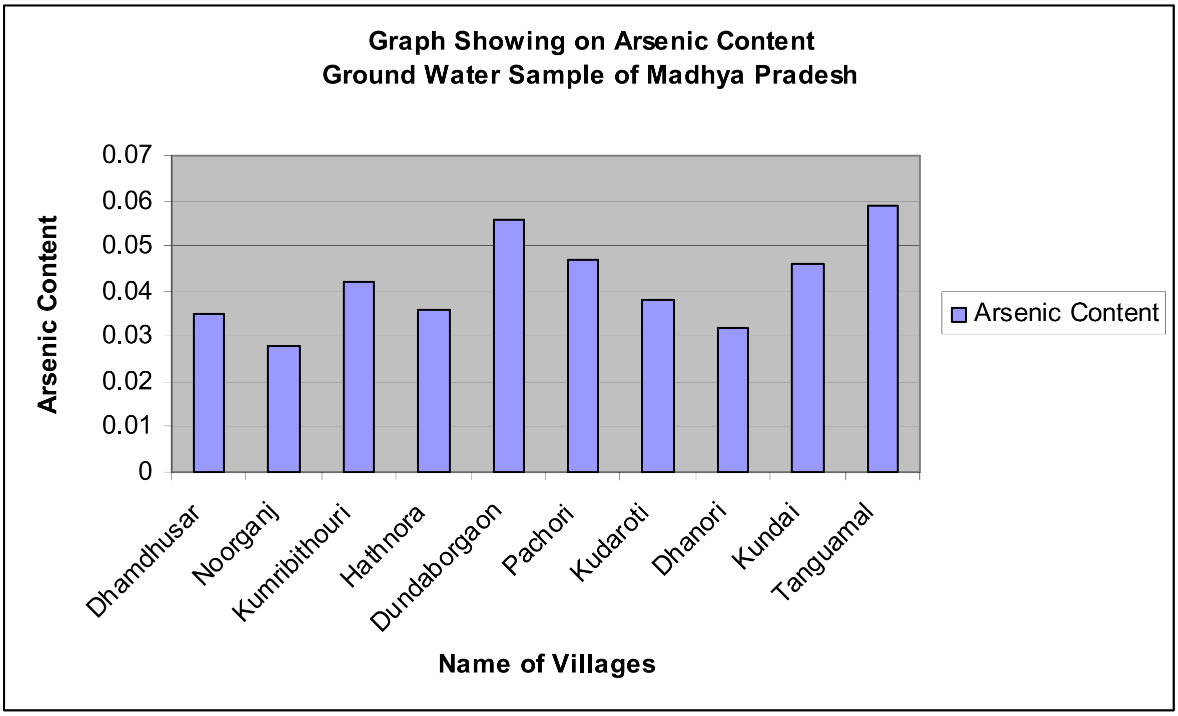
RESULT AND DISCUSSION

The analytical result of water samples from different villages as mentioned are presented in Table 1. As the result shows some of the villages have little high concentrations of arsenic than is the safe limiting value. Although low consumption of arsenic for long shows no adverse effect but above safe limiting value (0.05mg/ltr) shows toxic effect after prolonged intake.

Arsenic contamination of ground water and suffering of the people of West Bengal are well known[3,4].

Concentration of Arsenic with some other parameters in Ground Water Samples. Collected from villages in Madhya Pradesh.

S. No.	Name of Villages	pH	Conductivity micromho /cm	Concentration in mg/L			
				Acidity	Alkalinity	Hardness	Arsenic Content
1.	Dhamdhusar/Raisen	5.4	1875	46.3	262	262	.035
2.	Noorganj/Raisen	7.8	2025	28.9	406	142	.028
3.	Kumribithouri/Raisen	6.2	2416	35.2	332	184	.042
4.	Hathnora/Betul	8.0	2378	25.8	286	96	.036
5.	Dundaborgaon/Betul	6.6	1945	39.7	424	214	.056
6.	Pachori/Betul	7.2	1686	52.6	372	202	.047
7.	Kudaroti/Betul	7.7	2154	44.5	512	156	.038
8.	Dhanori/Betul	5.2	1936	56.2	292	178	.032
9.	Kundai/Betul	8.4	2868	36.4	432	88	.046
10.	Tanguamal/Betul	8.8	2556	32.7	354	112	.059



Our neighboring country Bangladesh is also seriously affected and is considered to be the world's largest affected area[5]. As reported [6, 7] some villages of Rajnandgaon (Chhatisgarh) have quite high concentration of Arsenic (more than 0.52mg/L) in dugwell. Here Villagers have developed skin lesions and some other complications.

The source of arsenic is not yet clear. However from preliminary investigation and considering the geological formation of the area it appears that the source of arsenic in particular location may be interpreted. It is actually the specific geochemical condition that aid in the release of As^{III} into ground water. Arsenic release from sediments is attributed mainly to desorption or dissolution of arsenic from iron oxide. This happens mainly due to reducing conditions in aquifers below the so called redox zone or transition between oxidising and reducing conditions a few meters below the water table. Here the higher oxidized As^{V} reduced to As^{III} which is released into ground water. The reason for onset of reducing conditions are several, rapid burial of organic matter, high microbial activity or recent anthropogenic carbon. Some or all of these contribute to the reduction process and mobilization of As^{III} which is then released into relatively deeper ground water.

CONCLUSION

In water, the most common valence states of arsenic are As(V), or arsenate which is more prevalent in aerobic surface waters and As(III) or arsenite, which is more likely to occur in anaerobic ground waters. In the pH range of 4 to 10, the predominant As (III) compound is neutral in charge, while the As (V) species are negatively charged. Removal efficiencies for As(III) are poor compared to removal As(V) by any of the technologies evaluated due to the negative charge.

The technologies perform most effectively when treating arsenic in the form of As(V). As (III) may be converted through pre-oxidation to As(V). Chlorine, ferric chloride, and potassium permanganate are effective in oxidizing As(III) to As(V). Pre-oxidation with chlorine may create undesirable concentrations of disinfection by-products. Ozone and hydrogen peroxide should oxidize As(III) to As(V).

Coagulation/Filtration (C/F), is an effective treatment process for removal of As(V) in to laboratory. The type of coagulant and dosage used affects the efficiency of the process. Within either high or low pH ranges, the efficiency of C/F is significantly reduced. Alum performance is slightly lower than ferric sulfate. Other coagulants were also less effective than ferric sulfate.

Lime Softening (LS) operated within the optimum pH range of greater than 10.5 is likely to provide a high percentage of As removal for influent concentrations of 50 µg/L. However, it may be difficult to reduce consistently to 1 µg/L by LS alone. Systems using LS may require secondary treatment to meet that goal.

Activated Alumina(AA) is effective in treating water with high total dissolved solids (TDS). However, selenium, fluoride, chloride, and sulfate, if present at high levels, may compete for adsorption sites. AA is highly selective towards As(V); and this strong attraction results in regeneration problems, possibly resulting in 5 to 10 percent loss of adsorptive capacity for each run. Application of point-of-use treatment devices would need to consider regeneration and replacement.

Ion Exchange (IE) can effectively remove arsenic. However, sulfate, TDS, selenium, fluoride, and nitrate compete with arsenic and can affect run length. Passage through a series of columns could improve removal and decrease regeneration frequency. Suspended solids and precipitated iron can cause clogging of the IE bed. Systems containing high levels of these constituents may require pretreatment.

Reverse Osmosis (RO) provided removal efficiencies of greater than 95 percent when operating pressure is at ideal psi. But it is rather expensive and wastage of water is more. The water recovery is the volume of water produced by the process divided by the influent stream (product water/influent stream). Discharge of reject water or brine may also be a concern.

Electrodialysis Reversal (EDR) is expected to achieve removal efficiencies of 80 percent. One study demonstrated arsenic removal to 3 µg/L from an influent concentration of 21 µg/L.

There is no medicine yet though chronic arsenic poisoning. The only remedy is safe water, and nutritious food and physical exercise. After launching an awareness programme the contaminated tubewells are to be sealed and the safe tubewells are to be tested every three months to see whether there is contamination or not.

We do not know how many more states in India may have similar arsenic contamination of ground water. We do not care to test the quality of underground water for various purposes. From our past experience we have observed that if proper sample collection, preservation and analysis are not done, differences in analytical reports of water are very common. Hence utmost care should be taken.Analytical result of arsenic in urine,hair,skin-scales from different laboratories need to be checked before reportingand samples are to be evaluated against standard reference material.

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