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Status of Arsenic Contamination in India

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Abstract

Arsenic (As) contamination of drinking water has been reported from several parts of the world and exposure to high concentrations of arsenic through food and water became a serious public health crisis with a wide range of deleterious health impacts. In India, more than 10 million people inhabited in the regions of Brahmaputra and Gangetic plains have chronically been exposed to high levels of arsenic above WHO guideline value for safe levels of arsenic in drinking water. The maximum permissible limit of arsenic in drinking water recommended by the World Health Organization (WHO) is 10 µg/L, but in India, due to lack of alternative drinking water source, the accepted level is 50 µg/L set by the Bureau of Indian Standard (BIS). The actual source of groundwater arsenic contamination, in the Ganga–Brahmaputra basin, is yet to be established, though it is detected in very high concentrations. Considering the chronic toxicity of arsenic, treatment of arsenic contaminated water has become a high priority and treated water must meet drinking water standards. This review presents recent status of arsenic contamination in groundwater, and various methods suitable to be adopted in mitigating its adverse effects on public health in India.

Keywords: Arsenic, Arsenicosis, India, Groundwater, Treatment.

1. INTRODUCTION

Arsenic is widely distributed in the nature and contamination of ground water with arsenic affects a number of countries worldwide including India. The exposure to high concentrations of arsenic through food and water became a serious public health crisis due to highly toxic nature of arsenic with a wide range of deleterious health impacts (Shankar et al., 2015). The extended arsenic exposure can cause carcinogenic and non-carcinogenic effects such as melanosis, keratosis, skin lesions, neurological disorders, hepatic damage, respiratory complications, and other cancers (Singh, 2015).

In India, first case of arsenicosis due to arsenic contaminated ground water was reported in the state of West Bengal in 1984. Several other states such as Bihar, Uttar Pradesh, Jharkhand, Assam, Punjab, Haryana, Himachal Pradesh, Manipur, Chattisgarh were found to be contaminated with arsenic levels far exceeding the World Health Organization (WHO) standard of 10µg/L and the Bureau of Indian Standard (BIS) of 50µg/L in drinking water (Singh et al., 2014). More than 10 million people inhabited in the regions of Brahmaputra and Gangetic plains have chronically been exposed to high levels of arsenic above WHO guideline value for safe levels of arsenic in drinking water. However, the highest level of groundwater arsenic contamination of 2182 µg/L was reported in the Buxar district of Bihar (SOES, 2012). Other districts like Patna, Bhojpur, Samastipur, and Bhagalpur, the arsenic level in drinking water exceeded 1000 µg/L and more than 50 µg/l of arsenic were detected in Vaishali, Saran, Begusarai, Khagaria, Munger, and Katihar districts of Bihar. In Assam, Podumoni and Kathalguri blocks shoed maximum of 67.57% and 44.45% groundwater contamination by arsenic respectively. The high levels of arsenic contaminated groundwater in different districts are listed in table 1.

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Table 1 Status of Arsenic contamination in groundwater in various states and districts of India.

Sl. No.	State	Districts
1	Assam	Sivsagar, Jorhat, Golaghat, Sonitpur, Lakhimpur, Dhemaji, Hailakandi, Karimganj, Cachar, Barpeta, Bongaigaon, Goalpara, Dhubri, Nalbari, Nagaon, Morigaon, Darrang and Baksha
2	Bihar	Begusarai, Bhagalpur, Bhojpur, Buxar, Darbhanga, Katihar, Khagaria, Kishanganj, Lakhisarai, Munger, Patna, Purnea, Samastipur, Saran, Vaishali
3	Chhattisgarh	Rajnandgaon
4	Haryana	Ambala, Bhiwani, Faridabad, Fatehabad, Hissar, Jhajjar, Jind, Karnal, Panipat, Rohtak, Sirsa, Sonepat, Yamunanagar
5	Jharkhand	Rajmahal, Udohwa, Sahebganj
6	Karnataka	Raichur and Yadgir
7	Manipur	Bishnupur, Thoubal
8	Punjab	Mansa, Amritsar, Gurdaspur, Hoshiarpur, Kapurthala, Ropar.
9	Uttar Pradesh	Ballia, Lakhimpur-Kheri, Bahraich, Ghazipur, Gorakhpur, Bareilly, Siddharthanagar, Basti, Chandauli, Unnao, Moradabad, Sant Kabir Nagar, Sant Ravidas Nagar, Gonda, Bijnor, Mirzapur, Shahjahanpur, Balrampur, Meerut, and Rae Bareli.
10	West Bengal	Bardhaman, Hooghly, Howrah, Malda, Murshidabad, Nadia, N-24 Parganas, S- 24 Parganas.

2. Mitigation Methods

Considering the chronic toxicity of arsenic, treatment of arsenic contaminated water has become a high priority and treated water must meet drinking water standards. There are several methods available for removal of arsenic contamination from water. The most frequently used technologies include precipitation method, adsorptive processes, lime treatment, ion exchange resin, membrane filtration techniques, oxidation, manganese greensand, coagulation assisted microfiltration, enhanced coagulation, iron oxide coated sand, granular ferric hydroxide method, diluting with rain water and Aquifers etc (Joshi and Chaudhuri, 1996; Kumar, 2015).

Arsenic mitigation technologies have to compete with other technologies in which cost and practical feasibility appears to be the major determinant in the selection of a treatment method by the users. The use of hybrid systems (i.e., membrane technology combined with classical processes) with renewable energy could be the solution to overcome the still unsolved problems related to Arsenic removal. The bioremediation can be an alternative way to breakdown arsenic contamination. In many arsenic affected areas, arsenic removal may be the only option in the absence of an alternative source of drinking water supply. Presently, importance is given to adopt *in situ* removal of arsenic as it is environment friendly because no sludge is produced. However, the success of any arsenic mitigation measure depends upon awareness creation and capacity building of the public in the affected areas. Further research is needed to develop more efficient technologies for removal of arsenic from drinking water source.

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