ESTIMATION AND MITIGATION OF ARSENIC CONTENT IN GROUND WATER / SURFACE WATER OF THE DISTRICT OF HOOGHLY AND PASCHIM MIDNAPUR OF WEST BENGAL

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Water is the essence of life. A man can not survive without water. Water is the life. 70% of the blood of a human body is water. 60% of the protoplasm of a cell in a human body is water. Hence, the drinking water which we are drinking every day must be safe, purified, germless and contaminant less. Major sources of our drinking water are weir, bore holes, ponds, river, lakes, Tube wells and hand pump Tube wells. Most of the surface water sources are either free from fluoride ion or Arsenic or contain traces or certain amount of fluoride ion and Arsenic. Arsenic is a toxic metalloid element present in untreated water (contaminant) that can be fatal to human health. A new technical method for the mitigation of arsenic from groundwater/ surface water of the district Hooghly and Paschim Medinipur by the filtration process through the special laterite soil has been adopted in this study. After mitigation the amount of arsenic was found to be below detection level.

INTRODUCTION

Arsenic has been described by the World Health Organization (WHO) as one of the lethal chemicals associated with major public health issues which cause chronic arsenic poisoning, also called arsenicosis which results due to drinking water contaminated with naturally occurring soluble inorganic arsenic is consumed by human being for a longer period. Out of 18 districts of west Bengal in India have been reported to have groundwater contaminated with arsenic having concentration greater than WHO's maximum permissible limit (10 mcg/L) (Mukherjee *et.al* 2003). The most widespread arsenic-affected areas in the world are found in the Ganga-Brahmaputra plains in India and the Padma- Meghna plains in Bangladesh (Ghosh *et.al.* 2015). In rural areas of West Bengal ground water is the most important source of drinking water. The rice is the main grain used in the diet in the state

which, in the raw state, has been reported to contain 93.8% inorganic arsenic and 88.1% in cooked state (Halder *et.al.* 2015). As per the estimation of State Government, at least 79 blocks across the state were found severely affected, involving 26 million individuals across 2600 villages (Paul. *et.al.* 2013).Treatment of chronic arsenic toxicity in west Bengal have completely failed in getting any clinical and biochemical benefits and this makes it more important to search for an easy and long term mitigation process which can be easily adopted and be utilized everywhere (Basu. *et. al.* 2005). The Inorganic arsenic has been classified as a "human carcinogen" having maximum contaminant level 0.01 ppm (EPA 2014) by environmental protection agency of United states. Arsenic enters into ground water via natural and multiple anthropogenic pathways including smelting, combustion of fossil fuels and various agricultural practices. However, the predominant sources of Arsenic contamination are through the weathering of geologic materials. The toxic character of As (III) depends on its chemicals form present in our environment.

Arsenic can exist in five forms, namely As (III), As (v), Mono methyl Arsenic Acid, Di methyl Arsenic Acid and Arsenobetaine arranged in the order of decreasing toxicity in the environment.

The effect of inorganic arsenic contamination on the human health depends on the level of arsenic contamination in the drinking water and can take years to manifest (Basu.*et.al.*2005). In north 24 Paragana district, there are 12 blocks (160 villages), south paragana district 9 blocks (283 villages), Nadia district 11 blocks (122 villages), Murshidabad district 14 blocks (168 villages), Malda district 4 blocks (163 villages), Bardhman district 2 blocks (21 villages), Hooghly 1block (13 villages), Howrah 3 blocks (3 villages) and Kolkata there are 5 blocks which have been identified as arsenic affected district.

According to publication of the Anand bazar Patrika, 2017, some researcher of Jadavpur University have examined experimentally taking 1080 samples of drinking water of 1080 different tube wells of 1080 different schools of the block 'Deganga' of North 24 Paragana district and they have found that 25% of the total 1080 samples i.e. 270 samples are affected with extremely high levels of Arsenic contamination. Hence one of the great problems in drinking water that raises concern over the world is that million of the people still have to use Arsenic contaminated water for their drinking purpose.

METHODOLOGY ADOPTED FOR THE PRESENT STUDY:

The only aim and objective of this study is to provide a cheap and easy method to estimate and mitigate the arsenic content in ground water/ surface water of the district of Hooghly and Paschim Midnapur of west Bengal in order to eradicate the dreadful diseases caused by arsenic contaminated drinking water. A new technical method for the mitigation of arsenic from groundwater/ surface water of the district Hooghly and Paschim Medinipur by

the filtration process through the special laterite soil by using atomic absorption spectrometer has been adopted in this study.

Before filtration, the estimation of arsenic present in the samples (SBT) was performed followed by the filtration of samples of water through a special laterite soil for mitigation of arsenic and by using AAS.

The following tools were used to carry out the present study:

(i) Laboratory equipments for doing experiments.

(ii) Instrumental analysis equipments like Thermo-UV-1 Spectrometer, double beam configuration, made in Germany.

(iii) Analytical methods for preparation of data or use of significant figures, common errors etc.

(v) Research model for removing Arsenic. (Own opinion model)

CONTRIBUTION TO THE EXISTING KNOWLEDGE

Many technological methods have already been discovered for the mitigation of arsenic in drinking water which is not accepted perfectly in large scale uses. These technological methods for the mitigation of arsenic in drinking water are:-

(i) Coagulation and filtration method: This treatment can effectively removed many suspended and dissolved constituent from water besides arsenic, notable turbidity iron (Fe), Manganese (Mn), Phosphate ($Po43^-$), and fluoride (F^-). Significant reductions are possible in order, colour and potential for Trihalo methane formation. Thus coagulation and filtration to remove arsenic will improve other quality parameter resulting in ancillary health and esthetic benefits. However, the optional conditions vary for removal of different constituents and coagulation to remove arsenic may not be optional for removal of other compounds, notably phosphate and fluoride (F-). During coagulation and filtration, Arsenic is removed through three mechanisms (Edwards, 1994). **(**a) Precipitation, (b) Co-Precipitation, and (c) Adsorption

All three of these mechanisms can independently contribute towards contaminant removal. In the case of arsenic removal direct precipitation has not been shown to play an important role.

(ii) Ion Exchange Resin method: Different Resins will have differing selectively sequences and resins have been developed specifically to optimize removal of sulphate, nitrate and organic matter. Various strong base anion Exchange Resins are commercially available which can effectively remove arsenate from solution, producing effluent with less than 1 mg / l arsenic. Arsenite, being unchanged, is not removed. Analyses have taken advantage of this specificity to develop procedures for analytical differentiation of arsenic and arsenate.

(iii) Adsorption method: Arsenite is removed either through co precipitation or adsorption on to pyrite. The drawback of zero valent iron is that the treated water contains very high ferrous iron. Therefore, another removal treatment process is needed to remove the ferrous iron.

(iv) Membrane method: Synthetic membranes are available, which are selectively permeable. The structure of the membrane is such that some molecules can pass through, while others excluded or rejected.

Membrane filtration has the advantages of removing many contaminants from water, including bacteria, salts and various heavy metals.

(v) A rapid field detection method: Arsenic detection by Auricchloride ($Aucl_3$) on whatman filter paper No-3. The Arsine gas subsequently came in contact with $Aucl_3$ soaked filter paper and reducted the $Aucl_3$ metallic gold.

(vi) Nano filtration method: The NF membrane ESIO used in this experiment is made of Aromatic Polyamide, and it's the nominal salt rejection of ESIO is 99.6% the groundwater, to which 200 mg As/L of arsenite. [As(III)] and arsenate [As(v)] is added, was used for feed water. The NF membranes coupled with the bicycle pumping system are ESIO (Nitro Denko Co. Ltd.) and HS5110 (Toyobo Co. Ltd.) of which nominal salt rejection is 99.6 % and 94% respectively, and are made of Aromatic polyamide.

(vii) Bicycle pump reverse osmosis process: It was possible to operate the NF process coupled with a bicycle pump system. It the ratio of arsenite to arsenic (As(III)/As) were low, rejection of arsenic by NF would be enough. On the other hand, if arsenide is a major component (As(III)/As), NF could not satisfy drinking water standards because arsenite rejection was relatively low.

(viii) Novel Method- Engineering application: Experimental results prove that this noble method is very effective in removing arsenic in its pentavalent form, Arsenate [As(v)]. Hence the arsenic in the form of As(iii) in ground water should be oxidised to As(v). The groundwater from Wells could be pumped over a series of cascades to aerate the water (Johnson *et.al* 2001).

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RESULTS AND DISCUSSION

A number of absorbing materials have been developed based on their availability and cost of preparation. Jing *et.al.*,2005 and Westerhoff *et.al.*2006, have reported some of those absorbents as granular ferric oxide and hydroxide, activated alumina granular titanium dioxide etc. Laterite soil has also been reported to be very effective in arsenic absorption (Maji *et.al.*

2007), however the literature and studies on such work are very limited. In the present study attempts have been made for the removal of arsenic from ground water/ surface water by the filtration through a special laterite soil.

Before the experiment, the amount of arsenic in the untreated water sample water was measured first by using AAS (Atomic Absorption Spectrometer). Then the filtration method by using is special laterite soil was performed. Contaminated drinking water was first passed through the inlet pipe into a 75 cm long and 9 CM diameter PVC tube containing special laterite soil and after filtration through special laterite soil the filtrated and treated water was finally collected from the outlet pipe. Now the amount of arsenic contamination was measured from the filtrated and treated water by Atomic Absorption Spectrometer.

Now it is seen that the MCL of arsenic in the filtered and treated water is 10 µg/L or less.

Name of municipality	**Total Population**	**Population density/Km^2**	**Gender ratio**	**As in sample before treatment**	**As in sample after treatment**
Komra Sansad	1826	1534	1.04	BDL	BDL
Srimantpur	>2173	>592	1.02	0.01	BDL
Kharar municipality	12118	1181	1.02	BDL	BDL
Ghatal municipality	219555	1000	1.06	BDL	BDL
Arambagh Municipality	285207	1100	1.04	0.02	BDL
Tarakeshwar municipality	30947	2348	1.08	0.15	BDL
Balagar (2) Hooghly	----	-----	-----	0.014	BDL
Balagar (1) Hooghly	-----	-----	-----	0.010	BDL
Srimantpur primary school, Paschim Midnapur	-----	-----	-----	0.010	BDL
Arambag municipality, Hooghly	-----	-----	-----	0.020	BDL

On the basis of the above cited results, the following conclusions can be drawn:

Before Mitigation amount of Iron of the five different places according to the increasing order are:

$$0.74 = 0.74 < 0.78 = 0.78 = 0.78.$$

$\rightarrow$ Barasat = Balagar (I) < Balagar (II) = Srimantapur Jr. High School = Srimantapur Pry. School.

After mitigation: Amount of Arsenic of the five different places are equal. BDL = BDL = BDL= BDL= BDL $\rightarrow$ Srimantapur Pry. School = Srimantapur Jr. High School = Balagar (I) = Balagar (II) = Barasat Horitala.

After Mitigation amount of iron of the five different places according to the increasing order are

$$0.02 < 0.17 = 0.17 < 0.25 < 0.30.$$

$\rightarrow$ Barasat Horitala < Srimantapur Jr. High School = Srimantapur Pry. School < Balagar (I) < Balagar (II).

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