Estimation of arsenic(III) and chromium(VI) contamination in gangetic plains of Bhagalpur, Bihar, India

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Abstract- Chronic exposure to human beings due to presence of $\operatorname{arsenic(III)}$ and $\operatorname{chromium(VI)}$ in drinking water resources has caused adverse effect. Hexavalent Chromium more then permissible limit may cause cancerous disease whereas $\operatorname{arsenic(III)}$ more then permissible limit cause $\operatorname{arsenicosis}$. With a view to assess the quality of water, both groundwater and surface water samples have been collected for analysis of As(III) and Cr(VI) from Gangetic plain of Nathnagar block to sabour block of Bhagalpur District. The surface water from Jamuniya dhar was found to contain high concentration of As(III) due to anthropogenic activities. Adjoining diara land of jamuniya dhar are highly affected from groundwater arsenic contamination. During the analysis of Cr(VI) it has been estabilised that no groundwater samples have contamination whereas surface water sample have been found to contain hexavalent chromium more then permissible limit. The analysis of As(III) has been done by mercoquant kit and Cr(VI) by U.V. double beam spectrophotometer.

Keywords: Arsenic, Chromium, Groundwater, contamination.

I. INTRODUCTION

In recent scenario toxic metal pollution is becoming a serious hazard for population of Gangetic plain in Bihar. Bhagalpur district is one of the most affected from arsenic(III) and chromium(VI) in water resources [1,2,3]. The main sources of these metallic pollutant is geogenic in Gangetic plain of Bihar. Arsenic oocurs naturally in alluvial sediment of the Gangetic deltas [4,5,6,7]. Chromium contamination in groundwater may be found due to seepage from chromate minerals or improper disposal of waste containing chromium by anthropogenic and industrial activities [8,9]. Arsenic is released in groundwater by soil from solid phase on soil grain to liquid phase in water. Arsenic affected areas in Bhagalpur District are mainly flood plains [10]. Naturally emission of arsenic in Gangetic basin issues are getting complicated due to many unknown facts. while Chromium is the 17th most abundant element of the earth's crust [11]. It occurs naturally as chromate (FeCr2O4) in Ultramafic and Serpentine rocks or complexed with other metals like Crocoites, Bentorite and Taropacaite, Vauquelinite. Chromium exists in several oxidation state, but the most stable and common form are Cr(O), the trivalent Cr(III), Pentavelent Cr(V) and hexavelent Cr(VI) species. Cr(O) is metallic form, while Cr(V) is inactive state. Cr(0) produced in industry and solid with high fusion point is usually used for the manufacturing of steel and other alloys. Cr(VI) in the form of chromate (CrO42-) dichromate (CrO42-) and CrO3 is considered the most toxic form of Chromium, as it possess high oxidizing potential, high stability, and mobility across the membranes in living organisms and in the environment [12,13]. It is easily soluble in water, while Cr(III) in form of oxides, hydroxides, and shulphates is less toxic and relatively insoluble in water. It possesses lower mobility and is mainly bound to organic matter in soil and aquatic environment [11,14].

Geochemical factors behind arsenic and Chromium emission is fluvial plains that represent Holocene aquifers of recent alluvial sediments and have routes oriented from the Himalayan base. These geochemical and geophysical factors may depend upon temperature, pressure, volume, liquidity, mobility of aquifers and concentration of metallic ions. These physical factors geochemically affects metallic contamination in groundwater. Many other accurate geophysical factors have been not explored yet [6,15].

II. GEOGRAPHICAL AND SOCIO ECONOMICAL STATUS OF STUDY AREA

Nathnagar block of Bhagalpur district is widely affected from As(III) contamination in groundwater. It is located near southern bank of Ganga locally known as "Jamuniya Dhar", latitude 25.23915180 longitude 86.9283360. Jamuniya dhar originated from main stream of Ganga due to creation of Diyaras, Jamuniya Dhar flow merge in another sub stream of Ganga near middle of town "Shankar talkies Ghat". These sub stream flow through city and joines to mainstream of Ganga near Barari. We collected samples from surface water of jamuniya Dhar from Champanagar to Babupur ghat, Sabour, eastern end of Bhagalpur town. Groundwater sampling has been conducted

for the hydrological presence of Arsenic, Chromium and fluoride in Dildarpur, Baria, Srirampur, Gosaidspur Hardaspur, Sahpur, Madhopur, Raghopur and Runnuchak Makanpur villages of Nathnagar block. Villages in this block are Dildarpur, Baria, Srirampur, Gosaidspur Hardaspur, Sahpur, madhopur, Raghopur and Runnuchak-Makanpur. The Government of Bihar has established arsenic mitigation units.

III. COLLECTION OF WATER SAMPLE

Water samples were collected in air tight autoclaved bottle in triplicate. Surface water sample have been collected from Jamuniya dhar to Babupur ghat via sahebganj, University Ghat, Budhanath Ghat, Adampur and barari, located in township of Bhagalpur, In addition to this, present status of metallic contamination has been assessed by analysing water samples of Jamunia Dhar with adjoining villages of Diara.

IV. EXPERIMENTAL METHODS

Analysis of total As(III) and Cr(VI) concentration in water sample has been done by Merkoquant (EM Quent) arsenic kit (MERK) (Figure 1). This kit is composed of chemicals like (1M or 1N) KOH, Potasium hydroxide solution, Zinc dust, small quantities of conc. HCl and test strips coated with mercuric bromide to detect the arsine gas evolved in the process. This kit is designed to detect tri or penta valent arsenic by converting arsenic to arsine gas, the reaction between metal dust and HCl generate hydrogen gas that combines with As(III) present in the water sample and form arsenic trihydrate (arsine) AsH3, a very toxic colourless gas which bind to mercuric bromide strip and strip was measured semiquantitatively by visual comparison of AsH3 – mercuric bromide reaction zone with colour scale which is supplemented by kit.



Figure 1. Analysis of arsenic by Merkoquant (EM Quent) arsenic kit.

Chromium(VI) test was conducted by UV double beam spectrophotometer (Pharo300). Water sample was prepared by Spectroquant Chromate test kit (Merk) (Figure 2). Total Cr(VI) present in the sample was determined after pretreatment of the sample by using this kit. In this procedure dry test tube is taken and 1 level microspoon (assembled in the cap of the bottle) Cr-1 reagent is added then 6 drop of reagent Cr-2 is added, provided in the kit. After that it is shaken properly until the reagent is completely dissolved. It is left for 1 min at room temprature and measured in the spectrophotometer by balancing bar code for set up wave length.



Figure 2. Spectroquant Chromate test kit for determination of chromium presence in aqueous medium.

V. RESULT AND DISCUSSION

Jamunia dhar flow is a dead stream of Ganges river. During study it has been found that all sewage of Bhagalpur is directly dischargd in this. Bhagalpur is also known as "silk city" due to presence of large number of small scale house hold silk dye industries located in Nathnagar and Champanagar locality. During visit it was found that more then 80 house hold dye industries located in these locality have directy discharged their used dye in Jamunia dhar. Arsenic concentration in surface water near Trimuhan and Sahebganj were found more than permissible linits. So, one of the reson for arsenic concentration in Jamunia dhar may be due to the disposal of dyes containg arsenic, whereas increased concentration of chromium (VI) near Trimuhan and Sahebganj found to be more then permissible limit may be due to the presence of higher dyes concentration in surface water of Jamuniya dhar (Figure 3).





Figure 3. Graph (a) and (b) shows presence of arsenic and chromium concentration, respectively in surface water of "Jamuniya dhar" (a tributary of the river Ganges).

Twenty five groundwater samples of adjoining villages of Jamuniya dhar in Nathnagar blocks have been collected and analysis for As(III) and Cr(VI). It has been found that Dildarpur and Rattipur Baria village groundwater samples have arsenic contamination whereas there is no trace of chromium concentration (Table 1).

Sample	Concentrarton of As(III) in ppm
S1	0.5
S2	0
S3	0.2

S4	0.01
S5	0.5
S6	0.25
S7	0.5
S8	0.5
S9	0.8
S10	0.5
S11	0
S12	0
S13	0.01
S14	0.25
S15	0.02
S16	0.05
S17	0.8
S18	0.5
S19	0.2
S20	0
S21	0.01
S22	0.01
S23	0.5
S24	0.2
S25	0.5

Table 1. Presence of arsenic concentration (ppm) in ground water of adjoining villages of "Jamuniya Dhar".

Gosaidaspur and Srirampur situated south to the Jamunia dhar has arsenic mitigation unit installed by the state goverment which has become nonfunctional at present and the arsenic mitigation unit at Raghopur, Hardaspur and Madhopur, the adjoining villages of Gosaidaspur is functional. With regards to water supply, these unit are insufficient to cater to the need of potable water to the inhabitants of villages.



Figure 3. Visible symptoms of arsenicosis among vilagers of Dildarpur.

Many vissible symptoms of arsenicosis have been found in Dildarpur village (Figure 3).Mass of people have been affected from arsenicosis in these villages whereas few patients of arsenicosis have been found in Gosaidaspur and Srirampur vilaages. Despite this, other villages where arsenic mitigation unit are functional, arsenicosis case was negligible.

VI. CONCLUSSION

Thus it has been established that groundwater of Gangetic plain of Bhagalpur district is arsenic contaminated. Presence of arsenic in groundwater is more than permissible limit of 0.05 ppm. whereas hexavalent chromium is negligible in groundwater of study area. In addition to this, surface water of Jamuniya dhar has been found severely affected from arsenic and chromium contamination which may be due to disposal of dyes effluents. In this study, first report of surface water contamination of arsenic in the mentioned specific region of Bihar has been observed.

VII. REFERENCES

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