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REVIEW ARTICLE

RECENT TECHNIQUES USE FOR ARSENIC DETECTION IN CONTAMINATED GROUND WATER

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ABSTRACT

Writing reviews of some aspect of the measurement of arsenic in water as described in the literature is a popular activity. The field is too large to be encompassed by any one review article, and so the authors of each recent review have defined a present situation of arsenic in ground water around the world; however, there is significant overlap, as several writers have chosen the topic. In the paper that we are the focus will be on a current techniques use for detection of arsenic in ground water. As will be discussed below, there is currently considera ble interest in the arsenic content of drinking water (it high enough to be a health hazard).

INTRODUCTION

Many areas of scientific study, research, and practice depend on the availability of technique use for detection. These days many thermal power plants, manufacturing industries, also wants vital information about the raw materials, intermediates, final products, and wastes, containing what concentration of metals, any hazardous wastes not produce in the end, While the general public may not have ever had any formal education in the role that chemical measurements play in ensuring the quality of their lives, many citizens of different countries assume that information about the composition of their blood can be reliably determined of metal toxicity and transmitted to their doctor; they also assume that it is safe to eat the food they buy and a high proportion of them will also assume that it is safe to drink the water that comes out of the tap in their homes. The outcomes of arsenic reviews about different analysis techniques, research and development are made available in the relevant literature, and, therefore, the needs of many scientific works to known the better technique use for detection, which is very precise and accurate.

Arsenic Detection Methods

There are several existing methods for the detection of arsenic in laboratory and new detection techniques are continuously under research. Some of the recent technologies used for detection of arsenic in laboratory are given below.

Colorimetric methods

Gutzeit method

(Dhar *et al.*, 1997): have reported a detection limit of 0.04 mg/L with 95% confidence limit, using silver diethyldithiocarbamate (AgDDTC) in Pyridine. (George *et al.*, 1973) have carried out a collaborative study for a colorimetric measurement of arsenic in poultry and swine tissues, using AgDDTC as the complexing agent. The sensitivity was 0.1 mg/kg in tissues. (Melamed, 2005): have described about "Gutzeit" method developed over 100 years ago. In this method testing the ware sample with a reducing agent (zinc granules) that transforms the arsenic compounds present in the water samples into arsenic trihydride (arsine gas). The reaction with the AgDDTC produces a highly colored compound.

The concentration of arsenic in the water sample can be measured by calibrated color scale in Spectrophotometer. A considerable amount of research has been dedicated to developing an arsenic-detection colorimetric method that matches or exceeds the sensitivity of the Gutzeit method while improving safety, accuracy, and reproducibility. (Taylor, 2010): The trace analysis of arsenic in aqueous systems involved the use of a Gutezeit procedure, involving the formation of arsine gas by reaction with hydrogen under the catalytic action of elemental zinc. The sensitivity of Gutzeit is about 1 µg/L. With the help Spectrophotometer with an electronic display to measure the color in more accurate. A spectrophotometric absorption measurement is made at a wavelength of 535 nm.

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In-Situ Visual and Tristimulus Colorimetric method

(Rahman *et al*., 2008): A simple in situ visual and tristimulus colorimetric method for the determination of trace arsenic in environmental water after collecting arsenic on a test paper impregnated with mercury (II) bromide and rosailine by its reduction aeration has been developed. The color development on the test paper is based on the formation of $AsH(HgBr)_2$ (yellow) and/or $AsH(HgBr)_3$ (brownish yellow) by a reaction between mercury (II) bromide and arsine (AsH_3), which is produced through the reduction of As(III) (arsenite ion) in a sample solution. To a sample solution, potassium iodide, tin (II) chloride, zinc sand and 4ml of 6 M of hydrochloric acid solution were added successively. The liberated arsine was collected on the test paper. The yellow or brownish-yellow color intensity on the test paper was measured by a tristimulus colorimeter and also by a visual method. The established method is applicable to the determination of arsenic in environmental water sample such as river, brackish and seawater types.

Photometric methods

(Dasgupta and Huang 2002): A simple, fast and sensitive Light-Emitting Diode (LED)-based photometric method for the differential determination of ppb-ppm levels of As (III) and As (V) in potable water in the presence of ppm levels of phosphate was developed. The detection chemistry is based on the well-known formation of arsenomolybdate, followed by reduction to heteropoly blue. The front-end of the measurement a system is configured to selective retain P (V) and As (V), based on the considerable difference of the pKa of the corresponding acids relative to As (III). Thus, it is As (III) that is injected into the medium, oxidized in-line with $KBrO_3$ to As (V) and forms Mo-blue that is detected by an LED-based detector. Only As(III) is measured if the sample is injected as such; if all As in the sample is prereduced to As(III) , the system measures As(V)+As(III). In the present form, limit of detection (LOD) (S/N=3) is less than 8 $\mu g\ l^{-1}$ As, and the linear range extends to 2.4 $mg\ l^{-1}$. Potential interference from dissolved silica and Fe (III) is eliminated by the addition of NaF to the sample.

Ethyl Violet Molybdoarsenate methods

(Mulvihill *et al*., 2008): The spectrophotometric determination of arsenic in water samples based on micro particle formation of ethyl violet-molybdoarsenate. It is a simple and sensitive method for the determination of arsenic in water samples was developed. The method is based on the formation of micro particles of ethyl violet and molybdo arsenate, which gives an apparently homogeneous blue color to the solution. The absorption of the excess dye in spectrophotometer gradually decreases due to its conversion to a colorless carbinol species under strongly acidic conditions. Consequently, the sufficiently low reagent blank enables the spectrophotometric determination of arsenic with the detection limit of 4 μg/L. The coefficient of variation for the spectrophotometric at 50 μg/L was 3.5% (n=5). Furthermore, it is possible to detect concentration as low as 10 μg/L of arsenic visually. These methods will be useful as a simple, rapid and cost–effective field test of arsenic.

Atomic Spectrometry

(Behari *et al*., 2005): Atomic absorption spectrophotometer with vapour generation assembly (AAS-VGA) is well known technique for the trace analysis of arsenic. However, total arsenic analysis (As (III) +As (V)) is very crucial and it requires reduction of As (V) to As (III) for correct analysis. As (III) is reduced to AsH_3 vapours and finally to free As atoms. Which are responsible for absorption signal in AAS. The vapour generation assembly attached to AAS has acid channel filled with 10M HCL and the reduction channel with sodium borohydride. The sample prepared in 3M HCL can be reduced with KI for 30 min before introduction the instrument. It is observed that acid concentration of the sample in both the situations play an important role. Analysis in both the methods is sensitive at ppb levels.

(Taylor 2010): Used Graphite Furnace-Atomic Absorption Spectrophotometer (GFAAS) at a stabilized temperature. To obtain maximum sensitivity, samples are often preconcentrated 5:1 by an evaporation process.

(Gomeg *et al*., 2001): Used atomic fluorescence spectrometry (AFS) has recently been for the detection of arsenic hydride in the ultraviolet spectral region because of the small background emission produced by relative cool hydrogen diffusion flame.

(Sarkar *et al*., 2011): The detection of arsenic in water samples from groundwater under field conditions proposed. A comparative analysis based on experimental determination of arsenic in large number of water samples by Test kits (gutzeit Method) and by atomic absorption spectrophotometer (AAS) has been made. It is observed that when the actual concentration of arsenic in water is below 100 ppb, the results of measured by test kit are lower than that obtained by AAS. On the other hand higher values of arsenic concentration are given by test kit, when the actual concentration is over 100 ppb. In general, the result obtained by test kit is found to differ by 20-50% from that obtained by sensitive laboratory method AAS.

Liquid Chromatography

(Guo *et al*., 2012): Observed the urinary inorganic arsenic metabolites is measured by liquid chromatography taking urinary samples the levels of total urinary inorganic arsenic metabolites for the exposed group, monomethylarsonic acid, dimethylarsinic acid, and total inorganic arsenic respectively. The low level occupational arsenic exposure, the concentration of total urinary inorganic arsenic metabolites might be misleading due to the confounding effect resulting from intake of seafood, such as arsenosuger.

Wagtech Digital Arsenator

Analysis of As by Arsenator is based on the Gutzeit reaction. In this method, As – both As(III) and As (V) – dissolved in water reacts with sodium borohydride in the presence of sulfamic acid and generates arsine gas. The latter is then purged out by hydrogen generated by excess borohydride and carried onto the mercuric bromide impregnated test strip where it reacts with mercuric bromide and produces a yellow spot. The intensity of the spot is measured using reflected light.

Monitoring of Arsenic

(Kamal *et al*., 2010): For monitoring of arsenic in ground water taking average values of different tube wells data. A spatial and temporal distribution of ground water Arsenic Contamination Intensity (GACI) has been developed using Geographical Information system (GIS) in order to assist decision making process in some critical areas The digitized boundary maps with longitude-latitude coordinates storing information in the form of metadata has also been developed to visualize GACI information in the form of census blocks of area. The user interface GIS approach can help policy makers deciding proper groundwater utilization and taking necessary steps to supplying safe drinking water to the domestic and industrial areas.

(Hwang *et al*., 2002): Monitoring of low level arsenic exposure during maintenance of Ion Implanters. The collection of urine and blood samples arsenic concentration was 3.6µg/g. The arsenic intake via ingestion, rather than through inhalation, might play a significant role in the elevation of urinary arsenic levels. The ion implantation elemental arsenic was the ion source in the manufacturing process. Through injection, inhalation and skin permeation arsenic can cause minor to serious health effects. California has determined under Assembly Bill 1807 and proposition 65 that inorganic arsenic compounds are cancer-causing compounds. Non-cancer effects from arsenic exposure including irritation of the eyes, nose and bronchi, vascular disorders. Arsenic and its compounds are also used in insecticides, weed killers, fungicide and wood preservative. In indoor arsenic sources include tobacco smoke; one cigarette typically contains 40 to 120 nano grams of arsenic.

(Nielsen *et al*., 2010): Tap water may be an important source of exposure to arsenic. Obtaining and analyzing samples in the context of large studies of health effects can be expensive. As an alternative, studies might estimate contaminant levels in individual homes by using publicly available water quality monitoring records, either alone or in combination with geographic information system (GIS). In Washington state arsenic concentration is prevalent median 0.6µg/L. Natural arsenic salts are presents in all waters, with natural concentrations of less than 10 parts per billion (ppb). Unfortunately, there is an increasing number of countries where toxic arsenic compounds in groundwater, which is used for drinking and irrigation, have been detected at concentration above the WHO determined safe drinking limit of 10 ppb. Of particular concerns is the situation in Bangladesh, where it is estimated that there are more than 1 million people drinking arsenic-rich water.

(Kaye, 2008): Arsenic is an effective chemical pollution in many countries. Normally there are small traces of arsenic in blood, urine, hair and fingers and toe nails, but these are very low and will not be detected with the tests. Normally arsenic concentration in urine is less than 0.005 mg/100g: in hair or fingernails, less than 0.003 mg/lg. Stomach contents should be examined for crystals and color, i.e., green is suggestive of Paris green; yellow of arsenic; while of the trioxide. Arsenic trioxide is the most common. Sulfide. Urine or blood should analyze periodically to determine the rate of arsenic elimination. In blood arsenic levels will become relatively low, where as urine levels may be high for at least 10 days. In chronic exposures, the urine may be positive for months.

(Joshi *et al*., 2010): The novel approaches to biosensors for detection of arsenic in drinking water development of whole-cell biosensors for the detection of arsenic in drinking water. Our pH based E.coli system has very high sensitivity and through it requires freeze-drying, may be suitable for further development towards our ultimate goal of a cheap, disposable arsenic quantification system. The bicarbonate of buffer ion present in groundwater appears to increase the sensitivity of the biological arsenic-responsive promoter. The Bacillus end spores can form the basis of an arsenic-detection system, through the current version may lack the required sensitivity for this application.

(Johnston and Heijnen 2011): Monitoring of arsenic in ground water should be planned nationally, starting with random testing of tube wells throughout the country to determine the extent of the problem. The blanket testing of all wells in selected district should follow, it identify each and every contaminated well. Blanket testing programmed could also include other activities that are essential for additional monitoring and management operations, such as the location of each well using a Geographic Information System (GIS), the diagnosis of arsenicosis patients in the district surveyed.

(U.S.E.P.A. 2007): Arsenic occurs naturally in rocks, soil, water, air, plants and animals. It can be released into water, including drinking water through naturally processes such as erosion or through human actions, including agricultural applications, mining or disposal of arsenic–laden consumer products (ex. paints, dyes and soaps). The water testing for arsenic can either be done in a laboratory, where the water samples are delivered, or can be done using field testing kits, the monitoring of arsenic in ground water taking water sample from tube wells it can occur in one tube well and another tube well located 100 meters away.

(Burris and Reisinger 2006): Mobilization of arsenic from the anthropogenic sources can lead to groundwater contamination. Arsenic in soils can also be derived from natural geolologic sources, resulting in low milligram per kilogram (mg/kg) levels of naturally occurring arsenic. Arsenic that is naturally occurring in soils can be mobilized by human activities to cause ground-water contamination. Arsenic Monitored Naturally Attenuation (MNA) is an important and cost-effective remedial option to be considered along with other possible, appropriate remedial actions. The mitigation of arsenic ground water contamination by natural attenuation processes may be an appropriate processes may be an appropriate remedial option in combination with long-term monitoring (MNA). The strategic Environmental Research and Development Program (SERDP) –funded research effort examining arsenic sequestration process in aquifers.

Conclusion

The presence of arsenic, in water sources is a serious problem in worldwide that’s need to be the urgently identify the affected area by fast and accurate detection techniques. The review article introducing the recent techniques use for analysis of arsenic in water sources, in recent Wegtech digital arsenator is use by most of the researcher because it is easy to handle and cost beneficial and very sensitive technique for blanket test. Second most preferable method for confirmatory test is AAS, the superiority of this technique is that it can measure 20 elements without any interference from trace to high concentration.

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