



REMOVAL OF ARSENIC FROM DRINKING WATER BY ELECTRO COAGULATION TECHNOLOGY

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ABSTRACT

Arsenic impurity in drinking water is a great concern in different regions of the world as well as in India. Several technologies have been delved to remove arsenic from water, similar as coagulation and co-precipitation, ion exchange, adsorption, and rear osmosis. In the present exploration paper, pH of 7 was set up to be most applicable for treating the drinking water for junking of arsenic by Electro- coagulation Technology. With time, pH increases but the increase is within safety limit specified by WHO. More junking of arsenic was observed with adding current viscosity. Current viscosity equal to 6.57 mama / cm sq (with 2.5 A current) with four electrodes gave better results. It was possible to bring residual arsenic content in the treated water within the admissible limit (10 ppb) in 40 twinkles of electrolysis time.

KEY WORDS: Metal contamination Arsenic, heavy metals, water quality, Electro-coagulation Technology.

INTRODUCTION

Arsenic is a metalloid element. It exists in combination with other elements in nature. All ores of arsenic have high amount of arsenic.^[1] It's attention in utmost jewels ranges from 0.5 to 2.5 mg/ kg.^[2- 3] Arsenic occurs in groundwater primarily as the result of natural weathering of arsenic containing jewels, although in certain areas, high arsenic attention are caused by artificial waste discharges and operation of arsenical dressings and fungicides.^[4] Arsenic impurity of groundwater is set up in both the developed and developing countries. Arsenic is a carcinogen and its consumption can negatively affect the gastrointestinal tract and cardiac, vascular and central nervous systems. Exposure to arsenic through drinking water is a great trouble to mortal health. Considering the high toxin of arsenic, the World Health Organization (WHO) and USEPA set a maximum respectable position of arsenic in drinking water at 10 µg/ L (USEPA, 2002 WHO, 1993).^[5]

Arsenic is present in water and wastewater substantially in the forms of arsenate (As(V)) and arsenite (As(III)). In the environmentally applicable pH range of 4- 10, the dominant As(V) species are negatively charged (H_2AsO_4^- and HAsO_4^{2-}), while the dominant As (III) species are neutrally charged (H_3AsO_3). The negatively charged As(V) species are more likely to be adsorbed and are generally more fluently removed. In treatment

systems As(V) is removed more efficiently than As(III).^[6- 8]

Several examinations have been worked on the junking of arsenic by electro- coagulation. Eilen et al. Studied the electro- coagulation of drinkable water.^[9] Mameri et al. Also studied the electro coagulation process with aluminium bipolar electrodes.^[10] Literature check reveals that Mollah et al. studied electro- coagulation in an evolving technology that's being effectively applied moment for waste water treatment, the deficit of scientific understanding of the complex chemical and physical processes involved is limiting unborn design and hindering process.^[11] In 2001 Gregor studied the effect of forms and attention of arsenic on its junking through aluminium grounded coagulation treatment processes were tracked for three drinking water treatment shops.^[12] Electrocoagulation is an arising water and wastewater treatment technology that involves electrolytic oxidation of an anode material and in situ generation of coagulant.^[13]

An disquisition was done by Kobya et al. (2011), employed aluminum and iron electrodes to remove arsenic from drinking water by electrocoagulation system. It was concluded that at a current intensity of 5.2 A/ m², 93.5% of arsenic was removed by an iron electrode at a pH of 6.5 and response time of 12.5 min. Using a

analogous current intensity with a pH of 7, the response time of 15 min and aluminum electrodes redounded in an arsenic junking of about 96 using the electrocoagulation system(Kobya *etal.*, 2011). In 2011, Lacasa *etal.* observed both electrocoagulation practices using iron and aluminum electrodes. She successfully removed arsenic to a attention of smaller than 10 µg per boxy cadence.

Also, it was conclusively set up that aluminum electrodes couldn't efficiently remove arsenic when the current intensity was lower than 2 mama. The mentioned disquisition covered current consistence of 0.1 – 4 mama / cm² in applying both electrodes. likewise, the junking effectiveness was advanced than 99.9 in pH ranges of 7 – 9(Lacasa *etal.*, 2011). In another outstanding disquisition, Zhang *etal.* delved the effect of electrocatalytic declination of imidacloprid wastewater using Ti/ PbO₂ – Tb electrodes. After 2.5 h of declination under a current viscosity of 8 mama / cm², pH 9, temperature 30 °C and 7.0 g/ L NaCl electrolyte 70.05 of chemical oxygen demand and 76.07 of imidacloprid were removed(Zhang *etal.*, 2020).

Some of the most distinguished advantages of the electrocoagulation system include easy to use and maintain, automatic and nonstop operation, low- cost, doesn't bear chemical complements, rapid-fire and effective operation. On the other hand, unfortunately, this system produces H₂ gas, which decreases safety. The other disadvantages also include erosion of anodes and sludge conformation on cathodes which plummets the total effectiveness of the process, high capital costs, a swell of iron and aluminum ion attention in the treated water inflow, and considerable power consumption(Alidadi *etal.*, 2014). The base of the electrocoagulation system is that in a colloidal result, ions with contrary charges collide and precipitate. In this process, the pollution junking agents(iron hydroxides or aluminum hydroxides) are formed due to oxidation- reduction responses as soon as an applicable current intensity is applied to the electrodes(Bazrafshan *etal.*, 2015). Among colorful anodes, the most common types are Ti/ RuO₂ – TiO₂(Hu *etal.*, 2012), Fe, Al, graphite carbon, Ti/ PbO₂, Ti/ Pt, Ti/ TiO₂ – RuO₂ – IrO₂, and boron-unravel diamond(Bamos *etal.*, 2021; Can *etal.*, 2022; Fajardo *etal.*, 2014; Nunes *etal.*, 2016).

The objects of this study were to assess the impact of important water chemistry factors on arsenic junking by electrocoagulation and to examine the performance of electrocoagulation for arsenic junking in laboratory and field settings. Factors studied were the pH, arsenic oxidization state, original arsenic attention, and the attention of dissolved phosphate, silica, and sulfate.

EXPERIMENTAL

Experimental Setup

The EC reactor having 3 litre of capacity was fabricated with acrylic distance of consistence 5 mm. Iron plates(12.2 cm. × 7.8 cm.) with consistence of 1 mm were used as the electrodes for the trials. EC reactor with mono-polar electrodes connected in parallel was used in trials. A regulated direct current force(0- 30 V, 15 A, Make Scientific Electronics, Roorkee) was used for trials.

Sample Preparation

The chemical used were analytical reagent grade. The arsenate result was prepared from sodium arsenate Na₂HAsO₄·7 H₂O, from E. Merck Grade., The stock result was prepared by dissolving 0.416 gm of sodium arsenate in 100 ml. Distilled water(1 ml = 1 mg As(V)). The intermediate arsenic result were lately prepared before each trial. The arsenic sample result was prepared by dissolving applicable remained in 7.12 to 7.36 range.

Apparatus

Atomic Absorption spectrometer with hydride generation technique has been used for arsenic detection, The advantage of hydride technique is that spectral interference are virtually ruled out because only the element determined enters the atomizer as gaseous metal hydride.

RESULT AND DISCUSSION

The treatment process has to insure that arsenic attention in the supernatant is within the admissible limit of 10 ppb as specified by WHO. thus the attention of arsenic in treated water is more important than the chance of arsenic removed.

Effect of pH on arsenic removal – The results are given in Table 1 and Fig.1.

Table-1 Effect of pH on arsenic removal.

S.No.	Initial pH of water sample	Residual Arsenic content(ppb)
1.	5	17.36
2.	6	6.558
3.	7	4.523
4.	8	1.244

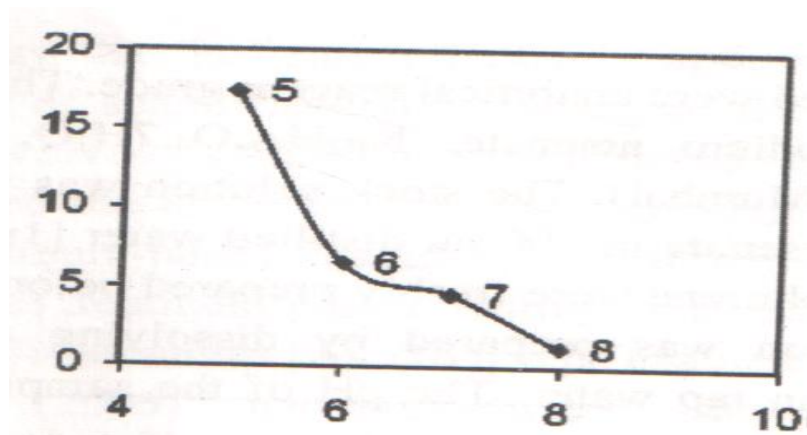


Fig. 1- Effect of pH on removal of arsenic.

Variation in pH with time: The pH of the water increased with time of electro-coagulation as shown in table 2 and Fig.2. The initial pH for this run was 7.12. The current density was kept as 6.57 mA/cm².

Variation in pH with time: The pH of the water increased with time of electro-coagulation as shown in table 2 and fig. 2. The initial pH for this run was 7.12. The current density was kept at 6.578mA/cm².

Table 2: Variation of pH with time.

S.No.	Time (Min.)	pH
1.	0	7.12
2.	10	7.18
3.	20	8.05
4.	30	8.38
5.	40	8.56

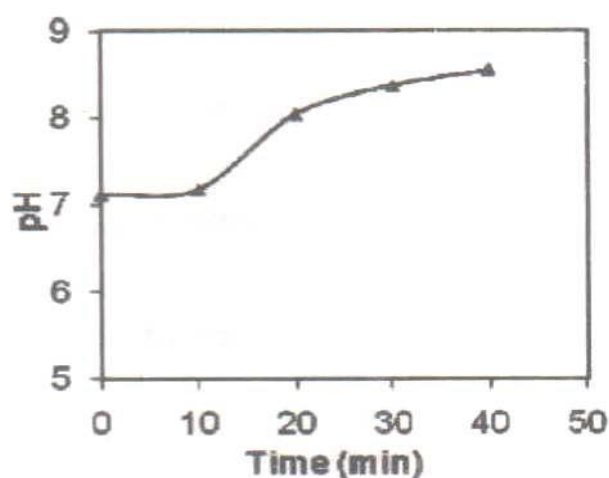


Fig. 2- Variation of pH with time.

Effect of current density on removal of Arsenic

The results are given in Table 3 and Fig. 3.

Table 3: Effect of current density on removal of Arsenic.

S.No.	Time (Min.)	Residual Arsenic (6.15 mA/cm ²)	Residual Arsenic (5.25 mA/cm ²)	Residual Arsenic (3.943 mA/cm ²)
1.	0	1192.2	1190	1192
2.	10	129.2	192.7	200
3.	20	123.6	101.2	66.68
4.	30	22.5	38.3	32.76
5.	40	10	17.88	19.59

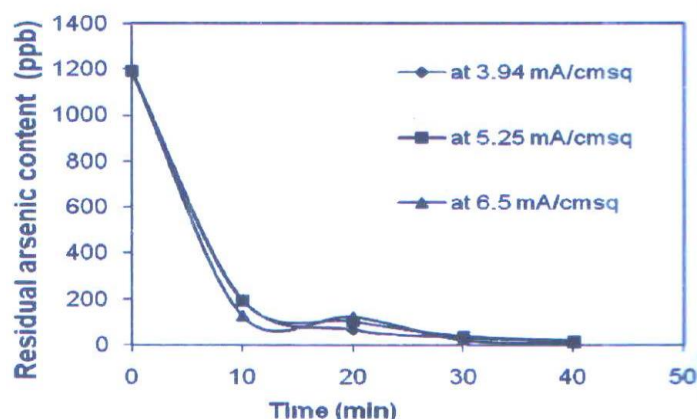


Fig.3- Effect of pH on removal of arsenic.

A comparison was made between theoretical and experimental electrode dissolved in EC are shown in fig.4.

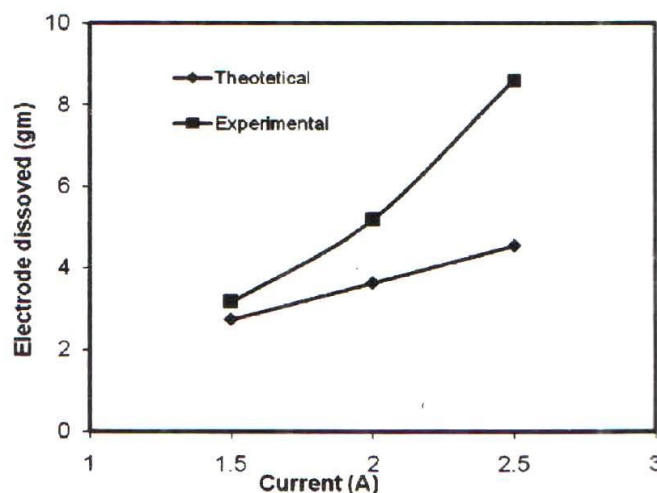


Fig. 4- Comparison between theretical and experimental electrode dissolved in EC.

CONCLUSION

On the basis of present study, It is concluded that –

1. pH of 7 was found to be most appropriate for treating the drinking water for arsenic removal by EC.
2. With time, pH increases but the increase is within safety limit prescribed by WHO (as per the limit is safe to drink water upto pH of 8.5).
3. Better rem,oval of arsenicwas observed with increasing current density, It was found that for current density equal to 6.57mA/cm² (with 2.5A current) with four electrodes gave better result as compared to 3.94 and 5.25 mA/cm².
4. It was possible to bring the residual arsenic content in treated water within the permissible limit (10ppb) in 40 min. Of electrolysis time.

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