COMPARISION BETWEEN PERFORMANCE OF ACTIVATED CHARCOAL AND ACTIVATED JAVA TREE BARK IN REMOVAL OF ARSENIC (III) FROM WATER

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Abstract— **The presence of arsenic in water is one of the greatest threats to public health. Several efficient physical and natural processes investigated by different workers are available for the removal of arsenic from drinking-water. The aim of this experimental investigation is to establish a comparison between the performance of two sorbents for the removal of arsenic (As III): A synthetic commercially available sorbent known as activated charcoal and a natural sorbent prepared at the laboratory-HNO_3 activated java plum tree bark (AJB). The project includes evaluation of the maximum removal efficiency of adsorbents at various adsorbent dosages, contact time and pH for different initial As (III) concentrations using jar apparatus. The results indicated that activated java plum bark stands neck to neck with activated charcoal in removal of As (III) from water.**

***Index Terms*— Activated charcoal, Activated java tree bark, Arsenic, Jar apparatus.**

I. INTRODUCTION

Of the most serious problems that we are facing today, environmental pollution is one. The major cause of environmental pollution is metal pollution. Drinking water is the major source of arsenic exposure to human beings [1]. Nowadays, one of the most important understudy topics of public health organizations is pollution of water with arsenic. Arsenic related problems are spread over several countries distributed among millions of people such as in Bangladesh, China, Canada, Germany, India, Iran, Nepal, Pakistan, Thailand, and USA [2].

Although arsenic is present naturally in low abundance it is the commonly known toxic element which causes adverse effects on human health. Ground water contamination with arsenic is a global issue and is a serious concern that should be resolve as its detrimental effects have been reported in several countries. WHO has set a provisional guideline of 10μg/L after considering the lethal impacts of arsenic on human health whereas USEPA has recommended a maximum contaminant level (MCL) of arsenic as 10 μg/L [3].

Most of the population in India depends on groundwater as the only source of drinking water supply. It is considered to be clean and pollution free as compared to surface water. But nowadays groundwater is getting polluted due to prolonged discharge of industrial effluents, solid waste and domestic sewage dumping causing detrimental effects on human health. This necessitates the supply and consumption of healthy and arsenic free drinking water in order to reduce the exposure risk and safeguard the public health [4].

II. MATERIALS AND METHODS

A. preparation of adsorbents

Activated carbon was purchased commercially. Activated java tree bark was prepared by drying the barks in sunlight for 2 days. And were finely powdered in an electrical grinder. The grinded powder was sieved to obtain fine particles of size 300-150 mm. The powdered bark was washed several times with tap water followed by distilled water till the wash water was colorless. Washed powdered barks were then dried in oven for 1 hours at 45^0C.For activation the barks were treated with 0.1 N HNO_3 (1:1 ratio) and kept for 1 hour in room temperature. The barks were then oven dried at 40-45^0C for 2 hours and then finally stored in a bottle for further use.

B. Arsenic stock solution

All the chemicals used were of analytical grade.1.32 g of arsenic trioxide, previously dried at 105^0 for 1 hour and accurately weighted was dissolved in 5ml of sodium hydroxide solution (1in 5) in a 1000 ml volumetric flask. The solution was neutralized with 2N sulfuric acid, and then recently boiled and cooled water was added to volume and mixed (1ml= 1 mg As). Solutions of required concentrations were prepared by diluting the stock solutions.

C. Instrumentations

A U-V visible spectrophotometer (Hatch model no. DR 2700) was used for analysis. A high precision digital balance was used for weighing. A digital pH meter was used for pH

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measurement and Jar apparatus was used for effective stirring.

D. Experimental methods

Estimation of arsenic(As) was carried out experimentally by using variamine blue as a reagent. The method is based on the reaction of As(III) with potassium iodate in acid medium to liberate iodine, which oxidizes variamine blue to form a violet colored species having an absorption maximum at 560 nm [5].

1liter of Arsenic solution of initial concentrations 300 µg/L and 500µg/L respectively were prepared by diluting the stock solution separately in 6 beakers. The experiment was carried out at various pH (4,6,8), adsorbent dosages (0.1, 0.3,0.5 mg/l) and contact time (30,60,120 min) using jar apparatus for well mixing.

Supernatant samples were taken at each intervals in 10 ml beakers and reagents were added; potassium iodate (2%, 1mL), hydrochloric acid (0.4 M, 1 mL), variamine blue (0.005%, 1mL) and 2 mL of 2M sodium acetate solution. The solution was kept for 5 min. The absorbance of the colored species was measured at 560 nm [5].

The % removal efficiency was calculated as:

Removal efficiency (E) = [(Co-Ce)/Co]*100 (1)

Where,

Co and Ce are concentration of As (III) in initial solution and supernatant after adsorption respectively [3].

III. RESULTS AND DISCUSSIONS

Various factors like pH, adsorbent dosage, contact time and initial ion concentrations affects the metal ion concentration.

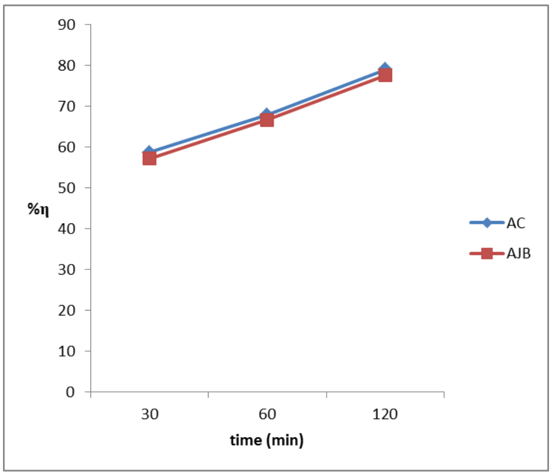

Fig 1 (a)

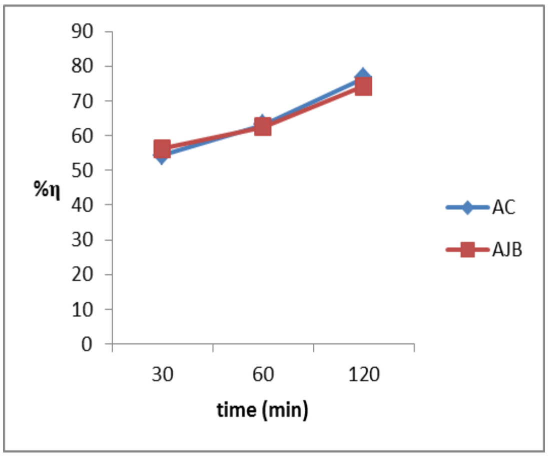

Fig 1 (b)

Fig 1:Removal efficiencies of AC and AJB at adsorbent dosage: 0.3 mg/L, pH: 4, Fig 1(a): at $C_0$300 µg/L and Fig 1(b): at C_0 500 µg/L.

Table I : comparison between removal efficiencies of Activated charcoal and activated java tree bark at Adsorbent dosage: 0.1 mg/L

Adsorbent	pH	As initial concentration C_0: 300 µg/L						C_0: 500 µg/L					
		Removal efficiency at stated stirring time, (min)											
		30		60		120		30		60		120	
		C_e	η %	Ce	η %	Ce	η %	Ce	η %	Ce	η %	Ce	η %
Activated carbon (AC)	4	146.1	51.3	110.4	63.2	75.9	74.7	258	48.4	191.5	61.7	138.5	72.3
	6	128.4	57.2	97.5	67.5	66.3	77.9	223.5	55.3	177	64.6	128.5	74.3
	8	123	59	90	70	56.4	81.2	213.5	57.3	158	68.4	102.5	79.5
Activated java tree bark (AJB)	4	143.1	52.3	105.7	64.9	79.8	73.4	246	50.8	173.5	65.3	140.5	71.9
	6	107.4	64.2	83.1	72.3	63.3	78.9	188.5	62.3	145.5	70.9	117.5	76.5
	8	104.1	65.3	77.2	74.2	62.1	79.3	181.5	63.7	137.5	72.5	105.5	78.9

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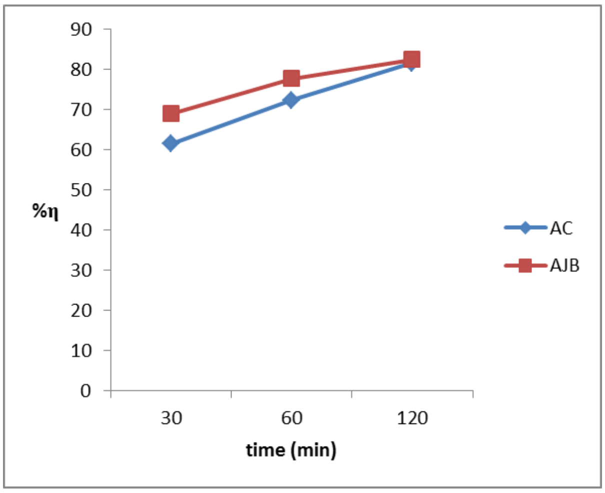

Fig 2 (a)

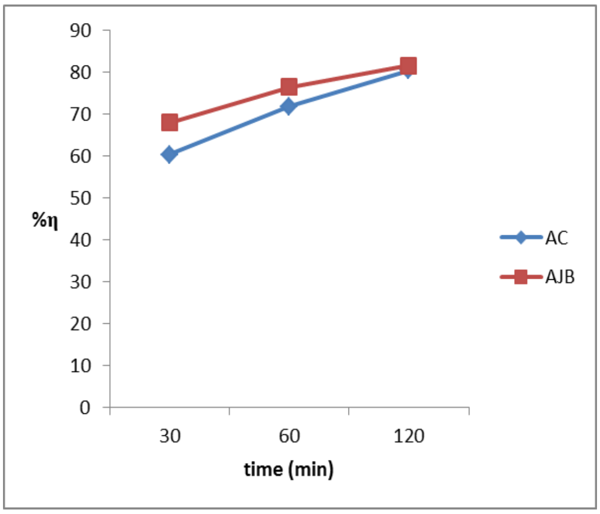

Fig 2 (b)

Fig 2: Removal efficiencies of AC and AJB at adsorbent dosage: 0.3 mg/L, pH: 6, Fig 2(a): at $C_0$300 µg/L and Fig 2(b): at C_0 500 µg/L.

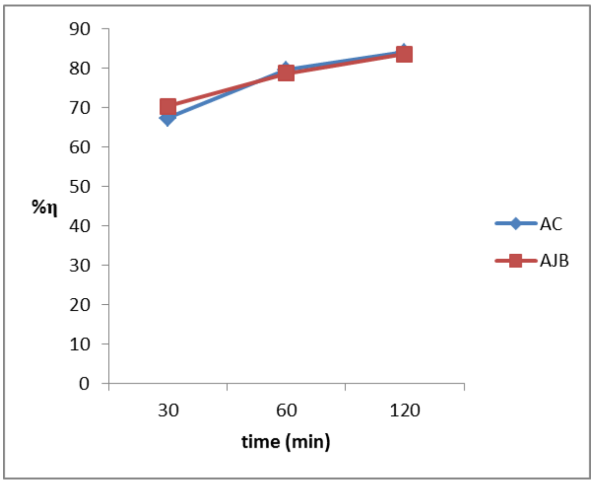

Fig 3 (a)

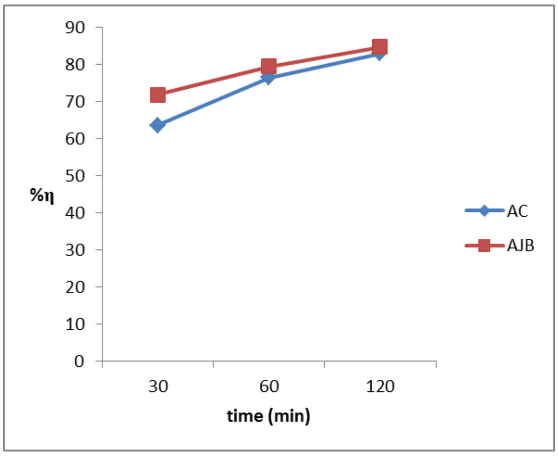

Fig 3 (b)

Fig 3: Removal efficiencies of AC and AJB at adsorbent dosage: 0.3 mg/L, pH: 8, Fig 3(a): at $C_0$300 µg/L and Fig 3(b): at C_0 500 µg/L.

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Table II: comparison between removal efficiencies of Activated charcoal and activated java tree bark at Adsorbent dosage: 0.5 mg/L

Adsorbent	pH	As initial concentration C_0: 300 µg/L						C_0: 500 µg/L					
		Removal efficiency at stated stirring time, (min)											
		30		60		120		30		60		120	
		C_e	η %	Ce	η %	Ce	η %	Ce	η %	Ce	η %	Ce	η %
Activated carbon (AC)	4	106.5	64.5	72.9	75.7	55.8	81.4	186.5	62.7	128.5	74.3	99	80.2
	6	95.1	68.3	75.6	74.8	30.9	89.7	154	69.2	138.5	72.3	71.5	85.7
	8	86.4	71.2	45.9	84.7	20.4	93.2	147	70.6	82	83.6	38	92.4
Activated java tree bark (AJB)	4	119.4	60.2	94.5	68.5	62.1	79.3	203.5	59.3	157.5	68.5	119	76.2
	6	85.5	71.5	64.8	78.4	23.1	92.3	146	70.8	117.5	76.5	42	91.6
	8	76.8	74.4	42.9	85.7	19.2	93.6	131.5	73.7	80.5	83.9	37.5	92.5

IV. CONCLUSIONS

The results shows that the natural adsorbent stands neck to neck with synthetic adsorbent in removing arsenic (III) from synthetic water. The adsorption increased with increase in pH, contact time and adsorbent dosage for both the adsorbents. The rapid adsorption during first 30 min was probably due to abundant availability of active sites on adsorbent surface and with the gradual occupancy of these sites the adsorption became less efficient. The results showed decrease in adsorption with increase in initial As(III) concentration.

From the results, it is evident that AJB can be used as potential, cost effective and environmentally safe adsorbents for the removal of As (III) from water.

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