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Removal of Toxic Metal Atom Arsenic from Wastewater using Zeolites

Akanksha Singh[1], Satyapal Singh[2]
[1]M.Sc.Student, [2]Assistant Professor, Department of Physics and Material Science, Madan Mohan Malaviya University of Technology, India

Abstract: The contamination of heavy metals in water is found in many parts of the world.The occurrence of heavy metals in the environment can take place either naturally or by anthropogenic activities. Some of the most common types of heavy metals are-Arsenic,Mercury,Lead,Cobalt,Selenium etc.The contamination of these heavy metals can give birth to several types of diseases such as Cancer, skin diseases,hyperpigmentation,Respiratory problems and many more. Therefore the removal of these heavy metals is important. The overall objective of this paper is to remove Arsenic from water by the use of zeolite. To observe the adsorption of Arsenic at different pH using pretreated zeolite.Also to observe the variation in the weight at different pH and at different concentrations.

Keywords: Contaimination, adsorption, zeolite, Anthropogenic activities, hyperpigmentation, Heavy metals.

I. INTRODUCTION

Arsenic, A member of the pnictogen family is considered to be one of the noxious element of the periodic table, occurring in the periodic table on either side of the staircase line that starts between boron and aluminium.It is a metalloid .therefore it possesses both the properties of metals and non metals. The presence of arsenic can be found in food, water, and air etc.Due to its Carcinogenic effects, the removal of this element becomes very important. There are various ways of its removal. Some of the common techniques include filteration, adsorption, ion exchange, osmosis, coagulation/floccuation.out of these techniques Adsorption is considered as the easiest and the best way of its removal. The most common states of arsenic in which it exists is its +3 and +5 states. The +3 state of arsenic is considered to be most toxic than the +5 state. Being a member of group 15, it shows similarities in physical and chemical properties.Arsenic has been placed at position 1 in 2001 priority list of hazardous substances. Due to its nature the removal of this element is done by Zeolites in this paper.

Zeolites are three dimensional crystal structure formed by the elements aluminium, silicon and oxygen. The most important thing about the zeolites are their open cage like structure where they can trap other molecules .they can withstand high temperatures and pressures. They do not cause any harm to people and environment. Zeolites are of two types one is the natural zeolite and the other is the synthetic zeolite.There are varieties of zeolites found in nature, they may be either naturally occurring or may be synthesized in the laboratories for use.

Most common formula of zeolite is

$$Na_2O.Al_2O_3.xSiO_2.yH_2O$$

Zeolite Process is also called as Permutit process. It is a process in which the hardness causing salts are exchanged by the sodium ions present in the zeolite bed. The hardness causing salts may be the calcium ions or the magnesium ions .when these salts are passed through the zeolite bed exchange of calcium and magnesium ions takes place. The place of calcium and magnesium ions are occupied by the sodium ions, as a result sodium salts are obtained. In this way zeolites are capable of removing the hardness causing salts in water and making it suitable for use. Due to the continuous exchange of ions these zeolite bed gets exhausted and their pores closes. Thus it needs to be regenerated in order to carry out the softening process. In order to do so 10% NaCl solution is made to react with the zeolite bed. Thus regeneration of the zeolite bed takes place.

This process is easy and it does not require special skills.

II. METHODOLOGY

Prepare a 2 M solution of HCl.Add MgO in the prepared 2 M solution to make it supersaturated. Stir it with the help of magnetic stirrer keeping the temperature 25 degree and rpm at 250 in order to check whether the MgO dissolves further. Then 20 g of zeolite was dissolved in the prepared solution, again maintaining the temperature as 25 degree Celsius and rpm at 800 .The time duration being 2 hours. Dividing the solution equally into four parts keeping each at 40 ml and left stirring for 21 hours and setting rpm at 400 as shown in fig [1].A solution of HNO_3(1M) and NaOH(1M) was prepared in order to maintain the pH as 4,6,8,10. Filter the solution, shown in figure[2] and place it in the oven at 110 degree Celsius when it is dries as per Figure [3] . The weight of the pretreated zeolite was 4.72g.Each of the pH 4,6,8,10 of weight 0.99g,0.99g,0.99g,1.2g is treated with sodium arsenate each of ph (4,6,8,10) at concentrations of 40,50,60 mg/L as shown in figure [4].

Take a 1000 ml solution of distilled water in a beaker and add 40 mg of sodium arsenate in a solution .stirring is allowed for 15 minutes (Figure [5]). Each of the pH 4, 6, 8, 10 is divided equally into four equal parts (at 200 ml each).The process is done for all concentrations. All the beakers were left undisturbed for 8 days (Figure [6]). Filtering was done with the help of micro size filter paper Figure [7]. (All the samples were placed in the oven. Initially kept at 60 degree Celsius for one hour and then at 50 degree Celsius for 18 hours).All the 12 samples were weighted upto four decimal place after the duration of 18 hours.

III. RESULTS AND DISCUSSION

Figure 1-Pretreated process

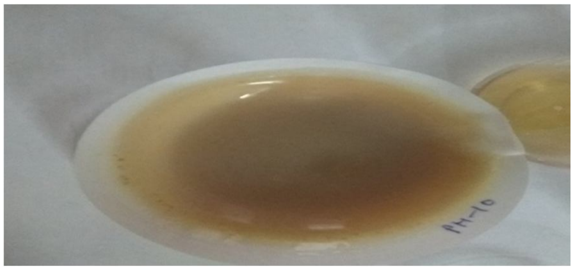


Figure 2-Filteration

Figure 3-Pretreated zeolite

Figure 4-Different concentration of sodium arsenate

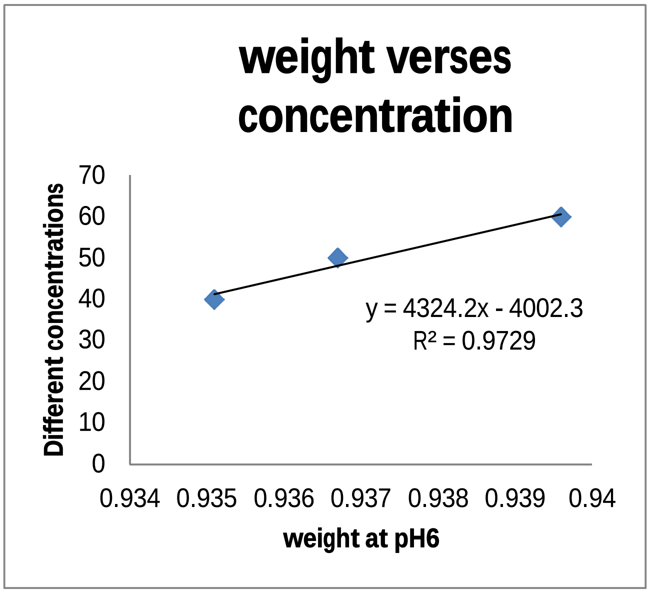
Figure 5-Addition of sodium arsenate in 1000 ml distilled water

Figure 6-Kept for eight days after maintaining the pH

Figure 7-Filteration after eight days

Figure 8-After filtration

Concentration(mg)/L	pH	Weight up to four decimal place (g)
40	4	0.9523
40	6	0.9351
40	8	0.8654
40	10	1.0256
50	4	0.9071
50	6	0.9367
50	8	0.8928
50	10	1.0107
60	4	0.9241
60	6	0.9396
60	8	0.8769
60	10	1.071



IV. IV.CONCLUSION

The above table shows that as the pH increases the removal efficiency increases. The maximum removal efficiency is seen to occur at pH 6.On further increasing the pH value, the removal efficiency decreases.

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