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TAMARINDUS INDICA SEEDS AS A NATURAL ION EXCHANGER FOR REMOVAL OF IRON (III)

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ABSTRACT

The new selective, sensitive and rapid method was developed for removal of iron from aqueous solution. The seeds were dried and pulverized to 200 mesh. This powder was treated with 39% formaldehyde and 0.2 N sulphuric acid. This treated powder of *tamarindus indica* seeds was tested for absorption efficiency. The absorption study was carried out with equilibration of 1.0 g of natural resin at different time intervals. The removal of iron (III) from standard solutions without adjusting the pH and also after adjusting pH at 6.0 was carried out. 1.0 g of natural resin removes up to 99.0% iron (III) from its solutions.

Key words: *Tamarindus indica*s seeds, Natural resin, Removal, Iron (III).

INTRODUCTION

Iron is the most abundant element in earth crust, is the least expensive and most useful. Sufficient iron is essential in the diet of human and animals for the growth of tissues. Pure iron is required in large amounts in metal industries. The industrial waste water and municipal waste water with this toxic metal ion in the environment is an important matter. The discharge of industrial waste water containing heavy metals is toxic for the life of aquatic organism and it makes water supplies undesirable for drinking also. As this material is accumulated, this metal enters from the environment into the biological systems. and causes serious diseases like cancer; kidney failure, brain tumor, siderosis. Many more diseases are caused by heavy metal pollution. All over world, industries are forced to lower down (to acceptable levels) the contents of heavy metal in water and industrial waste water. The ion exchange method is a convenient method for the removal of heavy metal. The rapid industrialization, which causes the problem of industrial effluents, has grown significantly and majority of these release large volumes of effluent or waste water. This uncontrolled

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industrialization has ignored environmental protection at a global level. As industrial effluent varies in nature from industry to industry and the problem gets aggravated as no standard treatment can be carried out by these industries themselves. Effluent is generally discharged into water resources either untreated or inadequately treated and create problem of water pollution[1-3]. The tremendous increase in use of heavy metals has invitably resulted in increased flow of metallic substances in aquatic environment. The metals are of special concern, because of their persistence. The industrial waste constitutes the major source of various kinds of toxic metals, which are significantly toxic to human being and biological environment. They include the heavy metals like chromium (VI), copper (II), lead (II), mercury (II), manganese (II), cadmium (II), nickel (II), zinc (II), iron (II) etc.[4] The removal of heavy metal from waste water is essential due to their toxicity. The main source of water contamination with chromium ions are industrial waste water from the surface metal treatment plants and from tanneries[1]. The release of large quantities of heavy metals into the natural environment has resulted in a number of environmental problems. The main manmade pathway through which heavy metals enter into environment is via waste water from industrial processes. Most of the industries do not have satisfactory waste disposal system or treatment plants[5]. The ion exchange and adsorption are common operations used for the waste water treatment. In ion exchange processes, zeolites and resins are used for the removal of heavy metals such as Pb^{2+}, Cr^{3+}, Fe^{3+} and Cu^{2+} and ammonia[5]. The electroplating industries release the huge amounts of heavy metals into the environment. In our laboratory, we have done work on removal of heavy metals by using water hyacinth as natural tool[6] and *casuarinas equisetifolia* bark as a natural ion exchanger for removal of heavy metals from industrial effluents[7]. Present work is the extension of our previous work developed for removal of iron (III) from solutions using *tamarindus indica* seeds powder as a natural exchanger.

EXPERIMENTAL

Apparatus: A spectrophotometer 'Elico Model SL-159' with 10 mm path length quartz cells and pH meter 'Control Hydrodynamic' were used for absorbance and pH measurements.

Reagents: All chemicals used were of analytical reagent grade. Hydrochloric acid, sulphuric acid and formaldehyde (Qualigens and fine chemicals. Pvt. Ltd., India). The standard metal ion solution of ferric ammonium chloride (Loba. Chem. Laboratories and fine chemicals, India) were prepared by dissolving respective salts with dilute hydrochloric acid.

Botanical classification of tamarindus indica

Kingdom: Planate
Division: Magnoliphyta
Class: Magnoliopsida
Order: Fabales
Family: Fabacceae
Sub Family: Caesalpinioideae
Tribe: Detarieae
Genus: Tamarindus
Species: Indica

Materials and methods

The 5 Kg seeds of *tamarindus indica* was pulverized after drying in sun light in open air for one week. Small size pieces of dried seed were grinded for 200 mesh powder. This powder was chemically treated with 39% formaldehyde and 0.2 N sulphuric acid at 80°C for half an hour. After cooling and washing with doubled distilled water, it was allowed to dry overnight in open air. Dried powder was used for adsorption study.

Scheme: Seed powder → formaldehyde (700 mL) → 0.2 N sulphuric acid (10 mL) → heat for half hour at 80°C → substrate was cooled → substrate was filtered → washed with doubled distilled water → dried in open air → this substrate was used as insoluble ion exchange resin.

Phenol-formaldehyde resin: This resin is also called a Navioc resin. The chemical reaction occurs during formation of resin is as follows (Fig. 1).

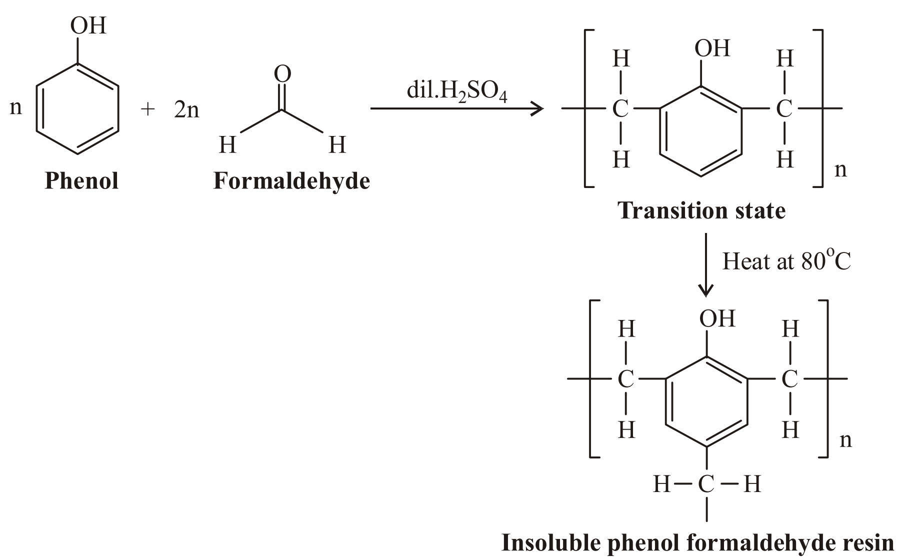

Fig. 1: Chemical reaction for formation of resin

Seed contains polyphenols; when these are treated with formaldehyde and H_2SO_4, they from phenol-formaldehyde resin, which acts as an ion exchanger[9].

General procedure: 1.0 g of resin was transferred in each round bottom flask numbered 1 to 5. 25 mL of 20, 40, 60, 80, and 100 ppm iron (III) solutions was added in cach flask and shaken for 1 hr, 2 hr and 3 hr. After shaking for respective time intervals the flask on shaker, solution was separated filtration. Then the concentrations of iron (III) was determined by spectrophtometric method[9].

RESULTS AND DISCUSSION

Increase in concentrations of iron (III) removaling efficiency decreases due to insufficient resin available for extractions. On increasing contact time, the efficiency of adsorption decreases while at constant pH, it remains constant. The results are reported in Table 1 for the removal efficiency of iron (III) by using natural resin and at pH 6.0.

Table 1: Effect of time interval and adjustment of pH on removal of iron before and after treatment

pH	Hours	Concentration before treatment (ppm)	Concentration after treatment (ppm)	%, Removal
		20	0.15	99.25
		40	0.15	98.75
-		60	0.80	98.66
	1	80	2.35	97.06
		100	6.35	93.75
		20	0.40	98.00
		40	2.45	93.87
		60	2.60	95.66
-	2	80	3.90	95.12
		100	5.10	94.90
		20	1.40	93.00
		40	2.80	93.00
		60	3.95	93.41
-	3	80	7.65	90.43
		100	8.35	91.65

Cont…

pH	Hours	Concentration before treatment (ppm)	Concentration after treatment (ppm)	%, Removal
		20	0.15	99.25
		40	0.60	98.50
6.0	1.0	60	0.65	98.91
		80	0.70	99.12
		100	0.75	99.25
		20	0.05	99.75
		40	0.15	99.62
6.0	2.0	60	0.35	99.41
		80	0.60	99.25
		100	0.75	99.35
		20	0.05	99.75
		40	0.15	99.62
6.0	3.0	60	0.20	99.66
		80	0.25	99.68
		100	0.40	99.60

CONCLUSION

This technique, with proper physical and chemical treatment to the *tamarindus indica* seeds powder, provides an efficient, economic and ecofriendly technique for removal of iron from waste waters. Raw material used for the preparation of substrate is widely available and inexpensive also. This method well help to solve water pollution problem.

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