USE OF AGRICULTURAL BYPRODUCT FOR THE ADSORPTION OF Fe(II) FROM AQUEOUS SOLUTION

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ABSTRACT

The term environment , which etymologically means surrounding is concerned as a composite term for the condition in which organism live and thus consist of air , water, food and sunlight, which are basic need of all living beings and plant life, to carry out on their life function. The environment also include other living things such as temperature, winds, electricity, etc. On the other word environment consist of both biotic and abiotic substances.

Rapid industrialization and technological development enhance the concentration of heavy metal poisoning posing a significant threat to the environment and public health because of their toxicity, accumulation in the food chain and persistence in nature. Industrial waste constitute the major source of various kind off metal pollution in natural water. Heavy metal ions are reported as priority pollutants owing to their mobility in natural water ecosystem and their toxicity. The heavy metal removal from aqueous solution has been traditionally carried out by chemical precipitation. The presence of Copper ,Zinc, Cadmium, Lead, Mercury, Iron, Nickel, and other metals have potentially damaging effect on human physiology and other biological system when the tolerance level are exceeded.

Keyword : *Tamarindus indica* fruit shell substrate, Iron removal, batch study, metal ion solution, spectrophotometer , pH meter.

INTRODUCTION:

Pollution of the environment is one of the most harmful ecological crisis to which human beings are subjected today. It is well known that three basic amenities are needed for living organism, air, land or soil and water. Sometimes in the past, these amenities were pure, virgin, undisturbed, uncontaminated, and basically most impossible for living organism but, the situation is just reverse today, because progress in science and technology is also leading to pollution of environment and serious ecological imbalance, which in the long run may prove disastrous for mankind. Environmental pollution is the reason of urban, industrial, technological evolution and speedy exploitation causing fast deflation of every beat of natural resource.

Thus environmental pollution is defined as “addition of constituents to water, air or land which adversely alter the natural quality of the environment. Heavy metal ions are stable and persistent environmental contaminants. Since they can not be degraded and destroyed. These metal ions are harmful to aquatic life and water contaminated by toxic metal ions remains a serious health problem. Salt of various heavy metals and other potentially hazardous material are being discharged in increasing amount into the aquatic environment. Water containing significant concentration of some of the metal ions are toxic to human beings, animals, as well as organic organism. The toxicity of heavy metal ions even at the trace level recognized with respect to public health for many years. The heavy metal ions have been evaluated as toxic to aquatic life above certain threshold toxicity level. Exposure to heavy metal toxicity can result from every facet of natural activity such as mining, transport, energy and industry. Continue release of metal ions into the environment has been justified on the basis of dilution to undetectable level, level below the toxicity in the receiving water body.

Toxicity of Iron :

Toxicity of iron overdose has been one of the leading causes of poisoning death in children younger than 6 years. Iron is used in pediatric or prenatal vitamin and mineral supplements and for treatment of anemia. Iron tablets are particularly tempting to young children because they look like candy. Iron overdose in adult is typically is suicide attempt. Iron overload may developed chronically as well as specially in patients requiring multiple transfusions of red blood cells this condition develop in patients with sickle cell diseases thalassemia and hematologic malignancies such as myelodysplastic syndrome.

Iron toxicity can be classified as corrosive or cellular. Ingested iron can have an extremely corrosive effect on gastrointestinal mucosa , which can manifest as nausea, vomiting, abdominal pain, hematemesis , and diarrhea; patient may become hypovolemic because of significant fluid and blood loss .
The therapeutic dose for iron deficiency anemia is 3- 4 mg.

MATERIAL AND METHOD

This chapter deals with experimental techniques employed for binding of metal ions with *Tamarindus indica* fruit shell substrate. The *Tamarindus indica* fruit shell is dried and finally powdered in an electric grinding machine and sieved through mesh. 2 mg of powder was treated with 20 part of aqueous formaldehyde solution (39%) and five part by volume of 0.25 N Sulphuric acid. The whole mixture was stirred occasionally for 6 hours at 50^0C and filtered. The residue was washed with double distilled water, the pH of this filtrate was 4-5 till it is free sulphuric acid and then dried in an electric oven at 60^0 C till it becomes moisture free and then powdered . it was then polymerized with formaldehyde in an acidic medium.

Preparation and estimation of Fe(II) metal ion solution :

10 ml of 0.0001 M Ferrous ammonium sulphate solution was taken in beaker and 2 ml of acetate buffer , 5 ml of hydroxylamine hydrochloride and 4 ml of orthophenanthroline was added to form a stable complex, absorbance was measured against blank spectrophotometrically. The curve for estimation of Fe(II) ions by this method by varying concentration of Fe(II) ion solution and measuring the absorbance . the concentration of unknown Fe(II) solution were determined from this method.

ADSORPTION:

Adsorption is one of the most effective physical process for the removal of toxic metal from waste water. It is a surface phenomenon which may be in term of an unit operation that utilizes surface forces. Based on the concept of parting a chemical species between a bulk phase and an interface or accumulation of a substance near the interface. Adsorption is classified as localized, non localized, negative, positive and static dynamic , it is based on the strength of binding forces.

The substance which adsorbs another substance is called adsorbant, while substance which get adsorbed on the first substance is called adsorbate. It is more commonly refer as physical and chemical adsorption. Ion exchange process is physical adsorption and electrostatic is chemical adsorption.
Several workers describe the use of various fruit shell and various agricultural byproducts such as peanut skin, onion peel, puddy husk , puddy straw, sugarcane bagasse, green emblica leaves , garlic skin ,etc. For the removal and recovery of toxic heavy metal ions from mining and industrial waste water. This methods are cheap and ubiquitous and capable of scavenging discharge limit.

GENERAL PROCEDURE ADAPTED FOR EQUILIBRIUM EXPERIMENT:

Equilibrium experiments were conducted by taking 1 gm of fruit shell substrate prepared as above with 100 ml metal ion solution containing the respective metal ion for predetermined type in BOD bottle until equilibrium was reached. The mixture was then filtered through Whatmann's no 41 filter paper and the solution was analyzed for the respective metal ions. The quantity of metal ions are adsorbate on the substance was calculated by the difference between the initial and final concentration of the metal solution. It can be studied by the following two methods; the initial and final metal ion concentration was found out before and after adsorption on fruit shell substrate and percent of metal ion adsorbate was calculated. The results are shown in forms of figure.

Result and discussion :

1] Batch studies

Batch studies were carried out by agitating a known weight of *Tamarindus indica* fruit shell substrate placed in contact with 100 ml of metal ion solution of different concentration. The suspension was continuously stirred on shaker, the effect of pH and initial metal ion concentration , contact time , temperature and adsorption doses have been studied.

A]Effect of pH : The effect of pH on the adsorption of Fe(II) ions solution has been studied, when 1gm of Tamarindus indica fruit shell substrate was agitate with 100 ml of metal ions solution for 1 hour at room temperature. The pH of metal solution was varied between 3-10 . the results are tabulated in the form of figure. The final pH was found to be less than initial pH. The percentage removal gradually increases, as the initial pH of the solution was raised from 3-10. The percent of metal ion removal was found maximum at pH 5 and further removal are decreases as the pH are increases. The pH of metal solution was maintained at 5 in order to prevent the possibility of precipitation.

B]Effect of contact time (time of agitation)

100 ml of metal ion solution was agitated with 1gm of fruit shell substrate for different time intervals varying from 5 - 120 minutes (2 hours). it is shown that the percent of metal ion removal from solution occured within 5 minutes showing that the metal ion adsorption was very fast. The maximum metal ion removal are found at contact time 60 minutes and value remains constant at contact time even after 2 hours. Hence 1 hour contact time was fixed for further study.

C]Effect of initial metal ion concentration

100 ml of Fe(II) ion solution was agitated with 1 gm of substrate at pH 5 for 1 hour. It was observed that with increasing thee metal ion concentration , the percentage of metal ion removal from solution decreases.

D]Effect of doses of fruit shell substance

The pH of 100 ml metal solution was adjusted to 5 and varying doses of fruit shell substrate from 1gm to 10 gm were added. The solution was agitated for desired time of 1 hour. It was observed that the removal of metal ion increases with increase in doses of fruit shell substance. However 1 gm was chosen for further studies.

E]Effect of temperature

The adsorption of Fe(II) ions by the substrate have been investigated at variable temperature from 30-70. it was observed that with the increase in temperature the binding of metal ions decreases.

2] Column study

The column studies were carried out in a column made of Borosil glass of 2 mm internal diameter and 15 cm length.Column studies were made by using data obtained from batch studies. The optimum condition were maintained. The column of fruit shell substrate(10 gm) was prepared in a glass tube. The initial solution (2-3 litre) was watched passed from the top through this column and collected at the bottom(throw-pot value). The metal content in this solution was analyzed by given method. The rate of flow of solution was maintained at 3-4 ml/minute. The results are obtained from this studies shown that 70-90 ml throw pot value collection, the percentage removal decreases. This may be because of adsorption site of substrate by metal ions.

fig.1 Effect of pH

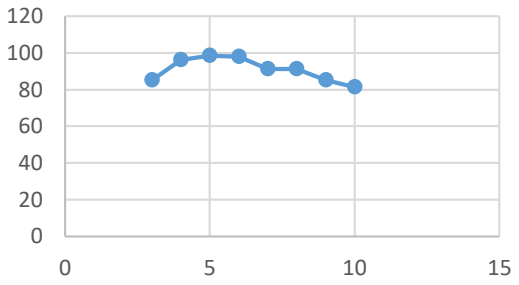


fig.2 Effect of contact time

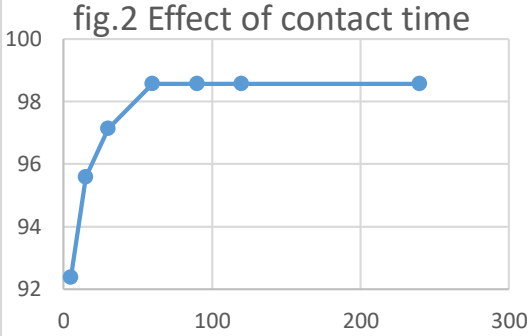


fig.3 Effect of initial metal ion concentration

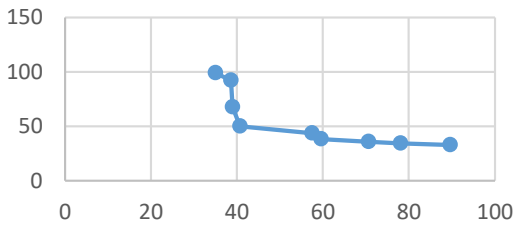


fig.4 Effect of doses of fruit shell substrate

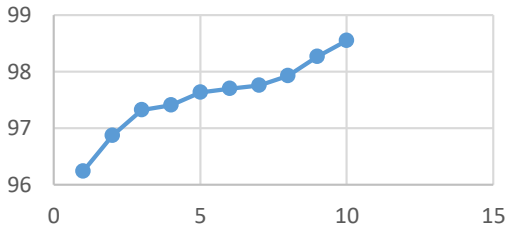


fig.5 Effect of temperature

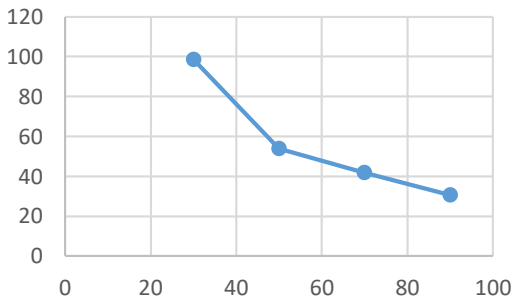
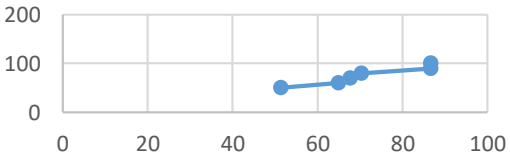


fig.6 Adsorption of Fe(II) ions using packed column of Tamarindus indica fruit shell



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Conclusion :

The adsorption behaviour are like typical ion exchanger with selectively characteristic . Hence, it has different affinity for different metal ions. The metal ions in the solution exchange with the H^+ resulting into decrease in pH of the metal ions solution is less than the initial pH and the useful range of operation is limited by th H^+ concentration in weekly acidi tto basic condition. The present study demonstrate that a modified *Tamarindus indica* fruit shell substrate could be used successfully for the removal of Fe(II) from aqueous solution. The maximum adsorbant capacity of formaldehyde modified substrate achieve upto 80-90% at 45 minutes indicates that substrate has more binding capacity compared to activated charcoal. The substrate material are inextensive and easily available, needs simple processing for effective adsorption of metal ions without use of any sofisticated equipment expert attention. Thus the method could bee utilized for removal of heavy metal ions from industrial effluents after prior seperation of particular metal ions from other impurities present. Finally it is concluded that adsorbant prepared from the fruit shell material seems to offer inexpensive but effective altternative to the expensive commerial ion echange resin. Thus adsorbant will certainly go a long way in the tertiary treatment of potable water as well as industrial effluents. The results are encouraging and further work is progressed in the direction.