**INTRODUCTION**

The Twentieth century started with an extensive damage to the natural resources (Tomer, 1999). Unplanned industrialization, urbanization, pollution explosion, change in life-style, over exploitation of natural resources, commercial establishment and modern agricultural practices have degraded the quality of environment. The main effects being faced are:

- Continental invasion of air and water.
- Marine pollution through waste discharges.
- Release of variety of chemical and biological contaminants into the water bodies, on land and in air.
- Ground water pollution.
- Acid rains and nuclear fallout.

These effects are not only covering the pollution of environment but also are responsible in creating genetic erosion in plants, animals including human beings and microorganisms. Water is a prime natural resource and is a basic human need. The availability of adequate water supply in terms of its quality and quantity is essential for the existence of life.

Water is available in nature as surface water and ground water through the self-purification mechanisms like physical, chemical and microbiological process at natural bodies, are carried out in nature. However, natural water is rarely suitable for direct consumption to human beings. Rapid industrialization and population growth resulted to generation of large quantities of wastewater and causing problem of their disposal. Industrial waste constitutes the major source of various kinds of metal pollution in natural water. The presence of heavy metals in the environment has been of great concern because of their increased discharge, toxic nature and other adverse effects on the receiving streams. When the concentration of toxic metal ions exceed tolerance limit, they may become real health concern (Singh and Lal, 1992). There is an immediate need to introduce cleaner technologies to minimize the pollution and to protect the degrading environment. It is not possible to achieve zero waste discharge but it is an

**ABSTRACT**

The studies on removal of Bismuth were conducted using *Ferronia elefuntum* Fruit shell. Adsorption efficiency has been evaluated. The effect of pH, contact time, adsorbent dose, concentration of metal, particle size and temperature were studied. The results reveal that Langmuir and Freundlich isotherms are followed during adsorption process. Thermodynamics parameter indicate the feasibility of the process. Kinetic studies have been performed to understand the mechanism of adsorption. Column studies have been carried out to compare these with batch capacities.

**Key words**: Trivalent bismuth, Adsorption, Langmuir and Freundlich isotherm, *Ferronia elefuntum* fruit shell.

**FERRONIA ELEFUNTUM FRUIT SHELL : A CARRIER FOR SCAVENGING THE BISMUTH FROM AQUEOUS SOLUTION**

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essential to treat the waste.

Among the toxic heavy metal ion which present in potential health hazard to aquatic animals and human like Pb, Cd, Cr, V, Bi and Mn are important. The maximum tolerance limit for Bismuth (III) for public water supply are 0.5 mg/L. Toxicity of metal depends on the type of metal, doses & the ionic form.

Toxicity of Bismuth (III) and its salt include malaise, kidney damage, albuminuria, diarrhoea, skin reactions, tremor of the finger and hands and sometimes serious exodermatitis.

Literature survey reveals that, there are many methods namely coagulation, precipitation, ion exchange and adsorption, for removal of Bismuth (III) metal ions from aqueous medium. However, adsorption is an easy and economical process for removal and retrieval of cation from aqueous medium. Efficiency of adsorption process mainly depends on nature of absorbent, absorbate, pH, concentration, temperature, time of agitation etc.

These cheap and efficient absorbents can carry to the need of population in the rural areas and the population in the industrial area where safe drinking water is not available. In the present study, Bismuth (III) is removed by using *Ferronia elefuntum* Fruit (Gharde et al., 2004; Shukla and Shikhardane, 1992; Lhagan et al., 1992; Rampure and Patil, 1996) as a adsorbent.

Adsorbent

The *Ferronia elefuntum* fruit shell was first dried at a temperature of 160°C for 6 hours. After grinding it was sieved to obtain average particle size of 200 nm. Then the dried amount of 0.5 g of *Ferronia elefuntum* fruit shell was first dried at a temperature of 160°C for 6 hours. After grinding it was sieved to obtain average particle size of 200 nm. Then the dried amount of 0.5 g of *Ferronia elefuntum* fruit shell was stored in desiccator for final studies.

Batch study

The dried amount of 0.5 g of *Ferronia elefuntum* fruit shell was taken in 250 mL reagent bottle and synthetic solution (200 mL) containing various concentration of Bismuth (III) ion was added and system is equilibrated by shaking the contents of the flask at room temperature so that adequate time of contact between adsorbent and final concentration of metal ion. Bismuth (III) was determined by spectrophotometry (Lagergren and Bil, 1998) using Hypo-phosphorus acid and potassium iodide method and measured absorbance at 460 nanometer. The spectrophotometer, Systronic (model 104) was used to measure the concentration of Bismuth (III) ion.

Equilibrium adsorption isotherm for Ce versus qe, plotted for *Ferronia elefuntum* fruit shell are shown in Figure 1. The adsorption capacity in mg/L was calculated then the equation.

\[ qe = (Co - Ce) \frac{V}{M} \]

Where, Co is the initial concentration of Bismuth (III) Ce is the concentration at equilibrium in mg/L. V is the volume of solution in litre and M is the mass of adsorbent in grams.

**ADSORPTION ISOTHERMS**

Equilibrium isotherms was studied for both Langmuir and Freundlich isotherms. The results are shown in Figure 2 and 3 which, illustrate the plot of Langmuir and Freundlich isotherms of *Ferronia elefuntum* fruit shell of Bismuth (III). The saturated monolayer can be represented by:

\[ \frac{1}{q_e} = \frac{1}{Q_o} + \frac{1}{b} \cdot \frac{1}{C_e} \]

The linearised form of the Langmuir isotherms is

\[ q_e = Q_o \cdot b \cdot C_e \]

The linearised form of the Freundlich isotherms is

\[ q_e = \frac{a \cdot C_e^{1/n}}{b + C_e} \]

Where Qo and b have been calculated and presented in Figure 2 and 3 which, illustrate the plot of Langmuir and Freundlich isotherms of *Ferronia elefuntum* fruit shell of Bismuth (III). The saturated monolayer can be represented by:

\[ \frac{1}{q_e} = \frac{1}{Q_o} + \frac{1}{b} \cdot \frac{1}{C_e} \]

The linearised form of the Freundlich isotherms is

\[ q_e = \frac{a \cdot C_e^{1/n}}{b + C_e} \]

Where Qo and b are Langmuir constants.

Effect of concentration of metal ion and contact time

The response of Adsorbate dose and contact time on the removal of Bismuth (III) is presented in Figure (4). The observations reveal that an increase in the adsorbate dose, rate of adsorption increase up to certain level and then it become constant. Also as the time of contact increase, adsorption increase and then it become constants.

Effect of pH on the removal of bismuth (iii)

The effect of pH on the removal of Bismuth (III) is presented in Figure 5. The straight lines plots of logCt Vs t for the adsorption process.

The rate of adsorption of Bismuth (III) on *Ferronia Elefuntum Fruit Shell* was studied by using the first order rate equation proposed by Lagergren (10). The plots of logCt Vs t is shown in Figure 5.

**CONCLUSION**

The following conclusions can be drawn from the presents study:

1. The percentage retrieved of Bismuth (III) is formed to be increase with decrease the initial concentration of Bismuth (III). The removal is found rapid in initial stages followed by slow adsorption up to saturation limit.
2. The developed technique of retrieval of Bismuth (III) ions using *Ferronia elefuntum* fruit shell appears to be a cheap and practical viable for the use of semiskilled worker in the villages.
3. The present work on adsorption process is in good agreement with Langmuir isotherm indicating monolayer adsorption process.
4. The result on adsorption process reveals that at pH = 1.0, Bismuth (III) uptake capacity is decrease.
5. The straight lines plots of logCt Vs t for the adsorption process shows the validity of Lagergren
and suggest the first order kinetics.
6. Regeneration studies are not necessary with the view that the cost of the adsorbent is very low and it can be disposed of safely.

REFERENCES

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