GLYCINE MAX BARK SUBSTRATE, A GOOD SCAVENGER FOR THE SORPTION OF Ni (II) FROM INDUSTRIAL WASTE WATER.

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Abstract:
Rapid developments and increase in mining and industrial activities have gradually redistributed many of the toxic metals from the earth's crust to the environment. Heavy metal pollution in the environment has gained significant importance in the recent times because of its detrimental effect on human health. Environmental protection and waste management are the issues which are of great concern for developing and especially developed countries and with economic liberalization; the industrial scenario has also changed rapidly. This rapid industrialization has resulted in accelerating the flux of heavy metals into the environment. Toxic organic compounds and heavy metal contamination is of environmental concern due to its effect on human health. Quantities of heavy metals such as Ni, Pb, Cr, Cd, Zn, Cu, and Fe are important constituents of industrial wastewaters. The possible chronic effects on human health from perpetual injection of low concentrations of these metals could be disastrous. Wide growth in industrialisation is expected in coming decades; the accumulation of these potentially toxic metals will contaminate land, soil and water bodies. Thus they may enter human food chain by accumulating in plants Treatment of wastewater containing heavy metals by adsorption is already emerged as a major field of research. The present work explores the possibility of using natural polymeric substance, like Glycine max bark substrate for the sorption Ni (II) from industrial waste streams. The dried and powdered Glycine max bark is contacted with 1% NaOH and resin product so obtained is found to be highly efficient in the removal of Ni (II) from the solution. The metal ion uptake increases with increasing pH of the solution. It is observed that more than 83% of the metal ion is removed by the substrate from the solution instantaneously. By using packed columns of the substrate the metal ion concentration from the waste waters can be reduced to very low levels which are within the acceptable water quality standards.

Key words: Heavy metals, Ni (II), Glycine max bark substrate

Introduction:

In view of toxicity of heavy metals, the public health authorities have been imposing stringent limits, regarding their concentration in the effluents. Agricultural products and by products (such as peanut skin, onion skin, rice straws, wheat glumen, wheat flour, garlic skin etc.) were reported to remove the heavy metal cations from wastewaters to below the discharge limits efficiently & economically. The authors used Glycine max bark substrate for the removal and recovery of Ni (II) from the wastewaters and the results are reported in the present work. Much more work by various researchers on this topic has been reported [1-10].

Experimental:

The Glycine max bark substrate is dried and finally powdered in an electric grinder. The powder was sieved and 2 g of powder were added to a mixture of 20 g of 0.2 N H_2SO_4 & 5 g of 39% HCHO and the whole mixture was stirred occasionally for 6 hour at 50^0C and then filtered. The residue was washed with distilled water till it was free from H_2SO_4 and then dried in an electric oven at 60^0C, till it was moisture free and then powdered.

Results & Discussion:

Effect of pH: It was found that the metal ion uptake increases with increasing pH of the solution. The maximum metal recovery occurs between 2.5 - 10.5 pH and sorption of Ni(II) by the bark at high pH values is indicative of enhanced ion exchange probably as an acid form ion exchanger. (Ref: Fig 1 and 2)

Effect of Temperature: It was found that the percentage removal of nickel ions from solution on to the substrate decreased with the increase in temperature and therefore the studies were done at room temperature.

Effect of Contact Time: It was found that, above 41.6% of Ni (II) was removed from the solution, within 5 minutes, thus showing a very fast metal ion uptake on substrate. The percentage removal of Ni (II) after a contact time of one hour is found to be 60. This value had gone up marginally after 24 hours contact time. (Ref: Fig 3 and 4)

Effect of Anions: The effect of anions on the sorption of Ni (II) on the Glycine max bark substrate has been investigated and the results show that removal of the heavy metal is in the acetate solution was more than nitrate solution.

Effect of Light Metal Ions: Light metal such as Na^+, Ca^{++} and Mg^{++} show considerable effect on the sorption of Ni (II) by the Glycine max substrate and it was found that the sorption of metal ions by the substrate gradually decreased in the presence of increasing concentration of these light metal ions. (Ref: Fig 5)

Effect of Concentration: The effect if initial metal ion concentration on the uptake of Ni (II) by the Glycine max bark substrate was also studied and the results are shown as an isotherm in the fig. It is observed that the above metal ion removal from the solution increases with increasing the initial metal ion concentration, although the percentage of metal ion recovery naturally decreased. (Ref: Fig 6)

Column Experiment: A continuous process employing a packed column of Glycine max bark substrate is expected to be more efficient and economical to operate than the batch process. Several column experiments have been conducted. In each case, 1000 ml of metal ion solution of various concentration (50, 100 and 200 mg/L of Nickel) was passed down through a column of 20 mm internal diameter packed with 10 g substrate at the rate of 5 ml per minute and the results show that nickel concentration in the solution can be reduced to sub-ppm levels, when the initial Ni (II) concentration was less and increases marginally as the initial concentration increases. This indicates that it is possible to effectively reduce the Ni (II) concentration from the solution to desired levels by using the columns in series. (Ref: Fig 7 and 8)

Substrate's Capacity: It was found that the capacities of the Glycine max bark substrate for the binding of Ni (II) is above 1.51meq per gram of the substrate.

Recovery of the sorbed metal ions: The sorbed heavy metal ion can be leached out from the substrate using dilute nitric acid. The washed substrate can be reused.

Conclusion:

The Glycine max bark substrate seems to be very efficient and economical for removing toxic heavy metal ion like Ni (II) from industrial wastewaters. By employing adequate columns of the substrate, the residual metal ion concentration in the effluent can be reduced to very low levels that are within the acceptable discharge limits. The raw materials employed for the preparation of the substrate are widely available and inexpensive. It is found that the metal ion binding capacity is appreciably high, thus it can be concluded that Glycine max bark substrate seems to offer a very cheap and useful product for effective removal and recovery of toxic heavy metal ions from industrial wastewater effluents. By using such substrate, it is possible to use waste cellulosic material for preparing a very efficient cation exchanger, which is more effective and cheaper than the cation exchange resins available in the market. This in turn removes heavy metal cations (toxic and non-toxic) from their respective effluents. These metal ions can be recovered and reused thereby solving the problems of toxic effect of wastewater on living organisms. This also helps to solve wastewater pollution problem.

Fig 1- : EFFECT OF pH ON THE UPTAKE OF Ni^{++} BY USING *Glycine max* SAMPLE

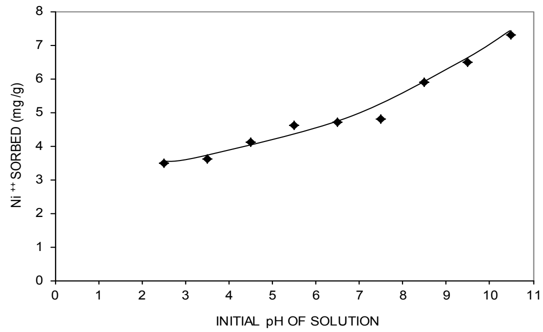


Fig 2-: RELATION BETWEEN INITIAL AND FINAL pH DURING SORPTION OF Ni^{++} BY *Glycine max* SAMPLE

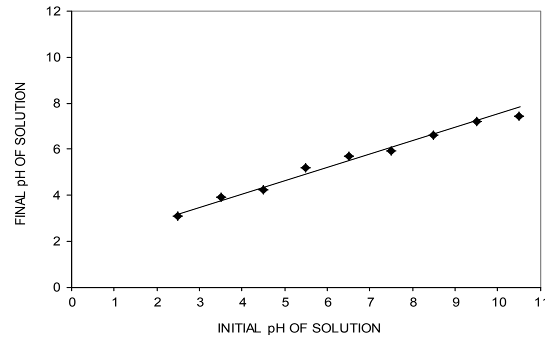


FIG 3- : EFFECT OF CONTACT TIME ON THE UPTAKE OF Ni ++ BY MODIFIED *Glycine max* SAMPLE

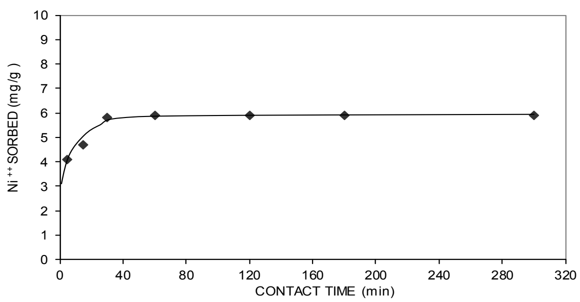


FIG 4-: RELATION BETWEEN CONTACT TIME AND RATIO OF INITIAL TO FINAL CONCENTRATION FOR SORPTION OF Ni^{++} BY MODIFIED *Glycine max* SAMPLE

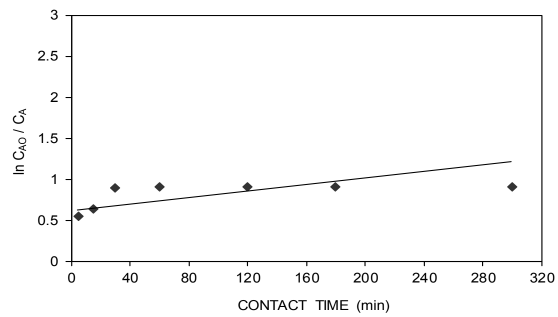


FIG 5-: EFFECT OF CONCENTRATION ON THE UPTAKE OF Ni^{++} BY MODIFIED *Glycine max SAMPLE*

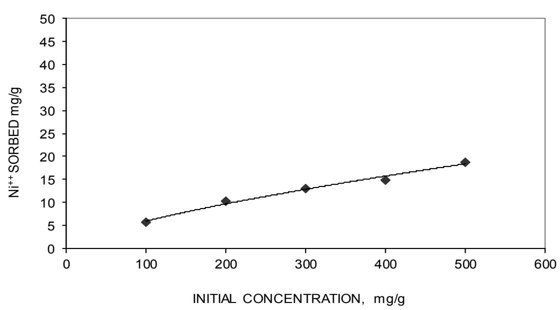


FIG 6-: EFFECT OF LIGHT METAL IONS ON UPTAKE OF Ni^{++} IONS USING *Glycine max* SAMPLE

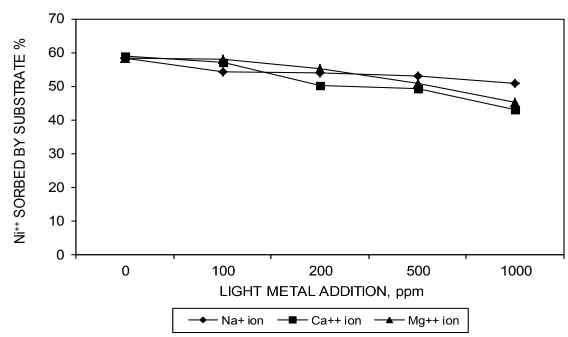


FIG 7-: ADSORPTION ISOTHERM OF Ni^{++} USING MODIFIED *Glycine max* SAMPLE

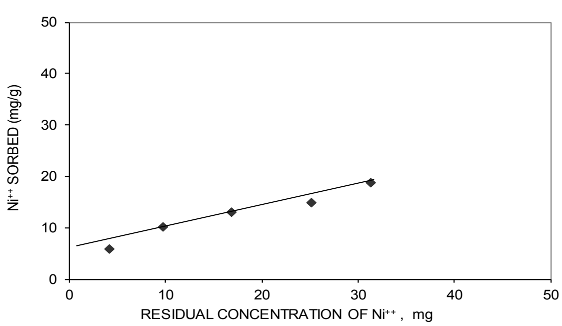
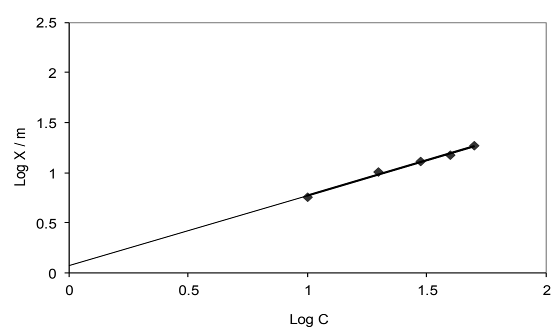


FIG 8- : FREUNDLICH ADSORPTION ISOTHERM OF Ni^{++} FOR *Glycine max* SAMPLE



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