isrjournals

International Journal of Advanced Research in Civil,Structural,Environmental and Infrastructure Engineering and Developing

Volume: 3 Issue: 1 Mar,2017,ISSN_NO: 2320-723X

Waste water treatment using vegetative peels

A.Akilan , E.Arulalan

Mr.Deventhiran Asst.Professor Panimalar Engineering College India

ABSTRACT*-Banana peel, a common fruit waste has been investigated to remove and preconcentrate Cr(III) from industrial wastewater. It was characterized by FT-IR spectroscopy. The parameters pH, contact time, initial metal ion concentration and temperature were investigated and the maximum sorption was found to be 95%. The binding of metal ions was found to be pH dependent with the optimal sorption occurring at pH 4. The retained species were eluted using 5mL of 2 M HNO3. The mechanism for the binding of Cr(III) on the banana peel surface was also studied in detail. The Langmuir and Dubinin-Radushkevich (D-R) isotherms were used to describe the partitioning behavior for the system at different temperatures. Kinetic and thermodynamic measurements of the banana peel for chromium ions were also studied. The method was applied for the removal and preconcentration of Cr(III) from industrial wastewater.*

Keywords***:*** *Banana peel; Chromium; Sorption; Kinetics; Adsorption Isotherms; Thermodynamics.*

1. Introduction

Heavy metals are produced in large amounts during industrial activities and contaminate the environment. Metal ions are non-biodegradable and many of them are soluble in aqueous media and easily available for living organisms. Heavy metals account for a number of disorders in plants and animals and their removal from aqueous media is an important and challenging task . Chromium exists in aqueous media in two oxidation states, hexavalent Cr(VI), and trivalent Cr(III) and the toxicity of chromium depends upon its oxidation state. In a solution the Cr(VI) exists in various forms depending upon the pH, such as chromate ($Cr_2O_4^{2-}$), hydrochromate ($HCrO^{4-}$), or dichromate ($Cr_2O_7^{2-}$) . In human blood the chromium only exists in Cr(III) where it is responsible for maintenance of blood metabolism. The recommended daily dietary intake (DDI) of chromium for human is 50–200 μg/day . Various industries and manufacturing plants such as tanneries, paints and pigments, electroplating, metal processing, wood preservatives, textile, dye industry, steel fabrication, and canning use chromium for various applications and discharge large quantity into the environment . Chromium enters into the body through breathing, eating, drinking or skin contact of chromium and its compounds. The toxic effects of Cr(VI) include skin rashes, nose bleeding, respiratory tract infection, suppressed immune system, hepatic diseases, and lung cancer

Numerous methods are available for the removal of heavy metals from aqueous solutions including chemical precipitation, ion exchange, ultra-filtration, reverse osmosis, and adsorption. However, these methods have some limitations due to the production of secondary wastes, large quantity of slug formation and high operational costs . In contrast adsorption is more advantageous than the other methods due to its simple operation design with sludge free environment and low cost . The high cost of activated carbon and other conventional adsorbents stimulates the researchers to use low-cost agricultural products and by-products as adsorbents for the removal of heavy metals from water. Agricultural wastes such as fruits peels, rice husk, saw dust, baggas, sugar beet pulp, soya bean hulls, clay and related minerals had shown better results when used as adsorbents for heavy metals in

Volume: 3 Issue: 1 Mar,2017,ISSN_NO: 2320-723X

comparison with those of other physical and chemical techniques . Cellulosic and lingo-cellulosic materials are used by several researchers as efficient adsorbents due to their higher adsorption capacity for metal ions . The agricultural products and by-products contain cellulose, lignin, pectin and several other compounds that have potential functional groups such as hydroxyl, carbonyl, amino, carboxylic and alkoxy, which have great affinity for the metal ions . The adsorption capacities of chemically treated agricultural adsorbents are much better than untreated adsorbents . In raw adsorbents several viscous compounds such as lignin and pectin occupy the pores of cellulose fibers . Grafting copolymerization onto cellulose incorporates side chains without destroying its whole structure. Cellulosic materials such as wood, pulp, paper, cotton, rayon and cellophane have been subjected to grafting copolymerization with vinyl or amino monomers by several researchers to produce grafted adsorbents for the removal of heavy metals from wastewater .

Banana is one of the world's most important crops grown by more than 130 countries. India, China, Uganda, Philippines, Ecuador, Brazil, Indonesia, Columbia, Cameroon and Ghana were the top ten bananas producing countries in the world in 2012. In India the banana production in 2012 was about 24.9 million tons while the total world production of banana during 2012 was about 139.2 million tons . Several research groups have used raw and chemically treated banana peels and banana stalks for the removal of toxic heavy metal ions from aqueous solutions and industrial wastewater . In the present work the raw banana peels are first treated with acid, alkali and bleaching agents ($NaClO_3$, H_2O_2) and then the bleached pulp is functionalized with acrylonitrile. The grafted banana peels (GBPs) are used as adsorbent for the removal of Cr(VI) from water. The enhancement in adsorption capacity of banana peels after chemical treatment may be due to the removal of viscous compounds such as lignin and pectin . The incorporation of acrylonitrile ($\_CH_2{=}CH\_C{\equiv}N$) side chain to the cellulosic skeleton also enhanced its interaction with adsorbate molecules.

2. Materials and Methods

2.1 Biomass Preparation Fresh banana peels were collected from domestic wastes, as its availability and transportation was easy. Banana peel contains lipids (1.7%), proteins (0.9%), crude fiber (31%) and carbohydrates (59%). The various minerals present are potassium (78.10 mg/g), manganese (76.20 mg/g), sodium (24.30 mg/g), calcium (19.20 mg/g) and iron (0.61 mg/g). The peels were washed several times with tap water and followed by distilled water. The washed material then cut in to small pieces and allowed to dry in a hot air oven at 80˚C for 24 hours. The moisture content was lost from it and the color change was observed from yellow to brownish black. The dried material was finely ground and screened through the sieves of cut size of 150-212µm. In a similar manner, fish scales were collected from the local fish market of city. These fish scales are made up of keratin protein which are also present in hair, thorn and nail. Mature fish scales were washed repeatedly with water to remove adhering dust and soluble impurities from their surface. The fish scales were allowed to dry in sunlight for 2 days. The scales were kept in an oven at 70˚C till the fish scales become crispy. The dried scales were then converted into size of 150-212 µm by grinding in mechanical grinder

2.2 Sampling

Volume: 3 Issue: 1 Mar,2017,ISSN_NO: 2320-723X

Sampling was done using standard method from a pharmaceutical industry situated in the Mahad MIDC. Samples were collected from industrial outlet in plastic bottles and then preserved at 4˚C. 2.3 Pretreatment of Adsorbent For Chemical pretreatment of Fish Scales - 10 gm of sample was soaked in 150 ml of 0.1M HCL, H2SO4, H3PO3, NaOH, Ca(OH)2 and Al(OH3) for 2 hours in rotary shaker in 100 rpm at room temperature. The fish scales were filtered and washed with deionised water. Resulting biomass were used for the Biosorption study. 2.4 Batch Studies The experiments were carried out in the batch mode for the measurement of adsorption capabilities. Waste water sample 500ml each was kept with 1.0gm of fish scale and banana peel, powdered as an adsorbent, in orbital shaker at 150 to 180 rpm at 25˚C. Then the separation of bioadsorbent and solution was carried out by filtration with Whatman Filter Paper No.42 and the filtrate stored in sample cans for determine the metal ion concentration using Atomic Absorption Spectrophotometer (AAS). An experiment is carried out by different concentration of dosage for incubation time 24 hours. Heavy metal ions were estimated before and after addition of powdered adsorbents. A.Study of Adsorbent Dosages The effect of adsorbent doses on the equilibrium adsorption of heavy metal ions were investigated with banana peel andfish scale of 1, 2, 5 g in three set of 500 ml wastewater . The Erlenmeyers were shaken for 24 hours with 120 rpm at room temperature. The water samples were then filtered and analyzed in terms of metal ions by AAS.

3 Results and Discussion

A. Effect of Biosorbent Dosages Various dosage of the prepared banana peels and fish scales bioadsorbent used to treat the industrial wastewater. The parameters such as Zinc, Iron have been change with the increase in the bioadsorbent dosage. The effects of adsorbent dosage were varied from 1 to 3 gm for banana peel and fish scale individually and mixture of both. Hence 3 mg was found to be the optimum dosage in treating the wastewater for Banana peels adsorbent. The plots of langmuir isotherms Ceq/q vs Ceq show that all the adsorbents followed the Langmuir isotherm with respect to the metal ions.

B. Effect of pH To study the effect of pH on adsorption, experiments were carried out in the pH range 3–8 for Zinc and Iron. Fig. 3 shows that the removal of metal ions was increased withincreasing initial pH of metal ion solution and maximum value was reached at pH 8 for Zinc and Iron. The plots of langmuir isotherms Ceq/q vs Ceq show that all the adsorbents followed the Langmuir isotherm with respect to the metal ions.

4 Conclusion The present work explores a new approach of development in the field of purification of water through minimal energy input, less labour and low investment, also proves to be biodegradable and effective compared to synthetic adsorbent and chemicals. Adsorption tends to increase with contact time. At first the increase in adsorption is very rapid as there are lots of free sites for the adsorption to take place. Thus it can be concluded that Banana peels and Fish Scales, which are discarded waste materials and are in abundance in the local market, can be used for the removal of heavy metal from waste water. Efficiency of removal of heavy metal concentration is more with banana peel and then with fish scale. Mixture of both the adsorbents gives more efficiency. The bio-adsorbents once used could be

re-used through desorption methods for a certain period of time and this could be employed commercially in the future.

REFERENCES

[1] Mr. N. Sridhar, Dr. J. S. Senthil kumar Mr. M. R. Subburayan, "Removal of Toxic Metals (Lead &Copper) from Automotive Industry Waste Water By Using Fruit Peels", International Journal Volume 1, Issue 2, ISSN 2348 – 9928, June 2014

[2] M. A. Hossain, H. H. Ngo, W. S. Guo and T. V. Nguyen, "Biosorption of Cu(II) From Water by Banana Peel Based Biosorbent: Experiments and Models of Adsorption and Desorption", Journal of Water Sustainability, Volume 2, Issue 1, page no 87–104, March 2012.

[3]K. Prabu, S. Shankarlal and E. Natarajan, "A Biosorption of Heavy Metal Ions from Aqueous Solutions Using Fish Scale (Catla catla)", World Journal of Fish and Marine Sciences 4 (1):, ISSN 2078-4589, page no. 73-77, 2012.

[4] Shailey Singhal1, Shilpi Agarwal, Kanchan Bahukhandi, Rajan Sharma, Naveen Singhal, "Bio-adsorbent: A costeffective method for effluent treatment", International Journal of Environmental Sciences and Research, Vol. 3, No. 1, pp. 151-156, 2014.

[5] Zahra Abbasi1, Mohammad Alikarami, Eshagh Rezaee Nezhad, Farzaneh Moradi, Vahid Moradi,"Adsorptive Removal of Co2+ and Ni2+ by Peels of Banana from Aqueous Solution", Universal Journal of Chemistry, vol 1, no.(3), page no. 90-95, , 2013.