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THE EFFECT OF ADSORBENT DOSAGE OF HYDROTHERMAL CARBONIZATION BANANA PEELS IN HEAVY METALS ADSORPTION

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ABSTRACT

Hydrothermal Carbonization (HTC) is chemical process for the conversion of organic compounds to structured carbons. Banana peels has been used to remove heavy metals by using HTC. Banana peels, a waste material that have good potential as an adsorbent to remove toxic metals like lead from water. Heavy metals are brought out in great amounts during industrial activities and contaminate the surroundings. The objectives these projects are to synthesize banana peel hydrochars adsorbent via HTC process and to determine the effect of adsorbent dosage of hydrothermal carbonization banana peels in heavy metals adsorption.Conventional methods are the removal of heavy metals require high operational cost, need highly skilled labor, and generate sludge at the end of the operation. Compared to other techniques, banana peels adsorbent is a cost-effective adsorbent, easy to operate, environmentally safe and no health risk for the operator. The major problem associated with banana peels adsorbent is that the activated carbon is produced from various low-cost raw materials have little or poor adsorption capacity against various pollutants as compared to commercial coal-based activated carbon. This study is expected to solve 2 major problems of banana peels: To prepare highly effective banana peels adsorbent through the understanding of its adsorption mechanism, facile approach of its production via hydrothermal carbonization (HTC). There are 3 phases that occur in this project. First, Synthesis of Banana Peel Based Hydrochar. For synthesis of banana peels, banana peel was chopped into small pieces and soaked in sodium hydroxide (KOH) solution for 2 hours and transferred into the PTFE and put into the oven then heat for 2 hours at 230oC. Second, Physico-Chemical Characterization of Banana Peel Hydrochar.By using FTIR, functional group and the carbon structure on the synthesized banana peel hydrochars has been detected. For the last phase is Evaluation of Heavy Metals Adsorption, by using AAS. The initial concentration of Pb, Cr and Cu has been analyzed. Next, put the different dosage in every 25ml of concentration and then put on the shaker and shake for 3 hours at 150 rpm. Lastly, filter and then checked the final concentration. The results show that the removal capacity of the hydrochars increased when the adsorbent dosage is increased. In conclusion, when the adsorbent dosage is increase, the ability of hydrochar to absorb he heavy metals is increased.

1. INTRODUCTION

Hydrothermal carbonization (HTC) is a chemical process for the conversion of organic compounds to structured carbons. In this research, banana peels are used because of constituting cellulose, hemicelluloses, lignin and pectin in its biomass containing functional groups like carboxyl, hydroxyl and amine. These functional groups are

reported as important for binding of metal ions on bio Sorbents. The banana is one of the major fruit consumes worldwide in large quantity. [1] Banana is one of the largest consumed fruit in the world and use-less peels, therefore, creates one of the major agro-waste problems. Now days, agricultural materials are receiving more and more attention as adsorbents for the removal of heavy metals from water. Adsorbents of agricultural origin have polymeric groups like cellulose, hemi-cellulose, pectin, lignin and proteins as active centers for metal uptake. [2] Banana peels, a waste material, have good potential as an adsorbent to remove toxic metals like lead from water. Heavy metals are brought out in great amounts during industrial activities and contaminate the surroundings. The industrial effluents which contain different derivatives of heavy metals such as Cd, Pb, Ni, Cr, As, Cu, Fe etc. are continuously discharging to the ecosystem and producing a significant toxic impact on the aquatic environment.[3] Metal ions are non-biodegradable and many of them are soluble in aqueous media and easily usable for living beings. The main aim of this research was to determine the effect of adsorbent dosage of HTC banana peels in heavy metals adsorption.

2. MATERIAL AND METHODS

2.1 Synthesis of Banana Peel Based Hydrochar

Collection of banana peels followed by washing process with distilled water for several times to remove impurities. The cleaned banana peels are chopped into small pieces (0.5-1.0cm), and then are used as the feedstock. The banana peels will be modified in 2 different solutions; nitric acids and potassium hydroxide, where the banana peel pieces are added into each of the solutions and soaked for 2 hours. After soaking, the mixture is transferred into a PTFE inner steel autoclave and heated at 230oC for 2 hours. Next the autoclave is taken out of the furnace and cooled to room temperature. Obtain the product is vacuum filtered and washed with distilled water until neutral. Finally the sample is dried in oven at 80oC overnight.

2.2 Physico-Chemical Characterization of Banana Peel Hydrochar

Characterization of banana peels hydrochars adsorbent by Fourier Transform Infrared spectrophotometer (FTIR) to characterize the surface functional group and the carbon structure on the synthesized banana peel bioadsorbent. (FTIR) are

mainly used to measure light absorption of so-called mid-infrared light, light in the wave number range of 4,000 to 400 cm-1 (wavelengths 2.5 to 25 μm), in order to identify and quantify various materials.

2.3 Evaluation of Heavy Metals Adsorption

The adsorption tests are performed with three common heavy metals including copper (II) and chromium (II) ions. The adsorption experiments are carried out in the Erlenmeyer flasks containing 50 ml of an aqueous solution of M (II) ions. (M= copper, and chromium) and 0.1 g of the synthesized banana peel hydrochars. The influence of initial M(II) adsorbent dosage of the solution are investigated. The mixture is mixed thoroughly until obtaining the adsorption equilibrium. The concentrations of heavy metals before and after the adsorption are analyzed by atomic absorption spectroscopy (AAS). All experiments are conducted in triplicate and averaged the results. Blank samples are run along with.

The removal efficiency and the adsorption capacity are calculated as follows:

$$\text{M (II) removal (\%)} = ((\text{Co-Cf}))/\text{Co} \times 100 \qquad (2.1)$$

Where Co and Cf are the initial and equilibrium M (II) concentration (ppm) respectively.

$$\text{qf (mg/g)} = ((\text{Co-Cf}))/(\text{W x V}) = ((\text{Co-Cf}))/\text{dAC} \qquad (2.2)$$

where V (mL) is the volume of the M (II) solution, W (g) is the weight of the adsorbent, dAC (g/L) is the dosage of the hydrochars.

3. RESULTS AND DISCUSSION

3.1 Fourier Transform Infrared spectrophotometer (FTIR)

Fourier Transform Infrared spectrophotometer (FTIR) is used to characterize the surface functional group and the carbon structure on the synthesized banana peel bioadsorbent.

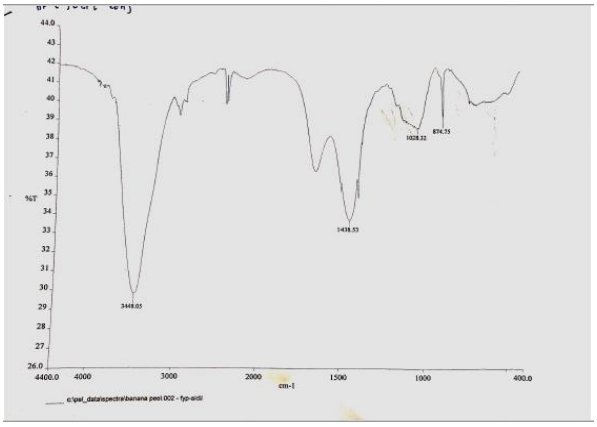

Figure 3.1

In this test, FTIR model spectrum RX1 brand of Perkin Elmer was used. The infrared spectrum of a sample was recorded by passing a beam of infrared light through the sample. In banana peels with KOH, it contains alkyl group, hydroxyl, and aromatic ring. All of the content will be abstract the heavy metals that contain in solution.

3.2 Heavy metal adsorption of Banana Peel hydrochars

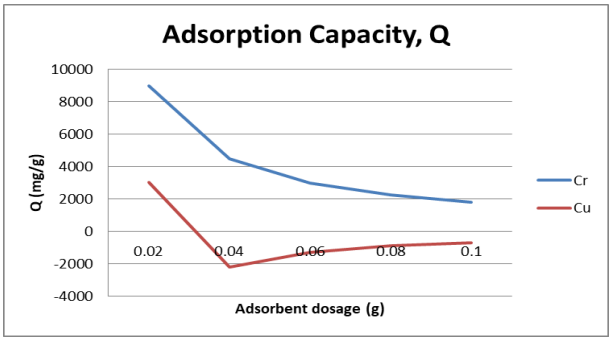

Figure 3.2

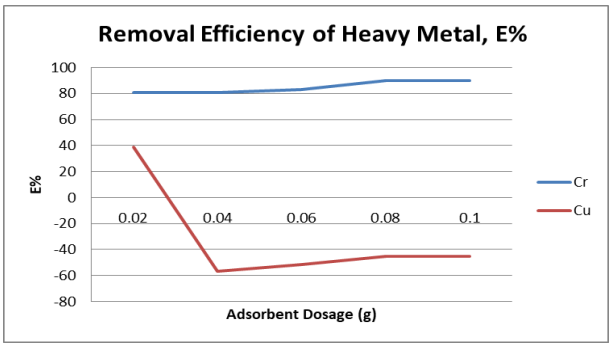

Figure 3.3

Figure 3.2 and figure 3.3 shows the adsorption capacity and removal efficiency of heavy metal using banana peel hydrochar respectively. From the figures, it can be seen that the increment of banana peel dosage results in decrease of adsorption capacity. However, with increment of banana peels dosage the remover efficiency also increases. The results are normal situation to most adsorbent in formal research seen settled amount of metals ion was employed. The increasing percentage of remover efficiency showed that the hydrochar treated with KOH are effective adsorbents for heavy metal's pollution treatment. The same pattern was obtained for both Cu and Cr ion.

4. CONCLUSION

Fresh banana peels were used as biomass feedstock to prepare banana peels hydrochar using KOH. Based on the results, when the dosage of banana peels is increased, the adsorption capacity will be increased. In addition, the banana peel proved that can remove the heavy metals in water based on the percentage of removal efficiency. It can be concluded that the obtained banana peels hydrochar could be excellent adsorbent for heavy metal remover in aqueous environment.

REFERENCES

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[3] (Hossain, 2016)Hossain, M. A. (2016). Removal of Copper from Water by Adsorption onto Banana Peel as Bioadsorbent. International Journal of Geomate, 227–234. https://doi.org/10.21660/2012.4.3c