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CHARACTERIZATION OF BEAN HUSK-BASED ADSORBENT

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ABSTRACT

The discharge of dyes is one of the major water pollution which can cause severe damage to both human beings and animal. Hence, the need for treatment of wastewater containing dyes. This research was aimed at finding out the potential of beans husk as a viable adsorbent for treatment of dye-containing wastewater.The bean husk potential adsorbent was washed, dried and sieved. It was then characterized using Scanning Electron Microscopy (SEM), Fourier Transform Infrared Spectrophotometry (FTIR), Energy dispersive spectrophotometry (EDS).The adsorbent prepared has several pores, with functional group like O-H, S-H, C=C and C=O for the bond formation between the adsorbent and the dyes. The carbon and carbon compounds-content of bean husk is very high (100% CK). The bean husk is suitable as an adsorbent for the decolurization of textile wastewater. And has a potential of being effective for wastewater treatment.

Keywords: Characterization, Bean husk, Potential adsorbent, Energy dispersive spectrophotometry, Wastewater treatment.

INTRODUCTION

Water pollution is a great challenge faced in developing countries [1]. Some dyes are mutagenic, carcinogenic and tetratogenic. Hence, dyes effluents must be treated before being discharged into the water bodies [2].

There are different methods of removing dyes from textile wastewater such as adsorption, ozonation, radiolysis, flocculation, membrane filtration, coagulation; bacterial, algal, fungal and advanced oxidation processes [3].

Adsorption process is effective and affordable which has been used for the removal of colored effluents from wastewater [4]. Commercial activated carbon has been the most common adsorbent because it is very effective for dye removal in wastewater but it is restricted due to its high cost and its reconstruction problem [5]. This prompted the researchers into looking out for alternatives that are efficient but not expensive. There are different established low cost alternatives agricultural wastes such as; rice husk, rice bran, coconut shells, sawdust of various plant, maize corn cob, sugar cane bagasse, banana peels, wheat bran, and industrial waste such as clay, soil and so on [6].

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METHODOLOGY

Preparation of Adsorbent

The adsorbent was prepared by the modification of the method of Abdulsalam and Giwa, 2018 [3]. The material was collected from a local store in Ogbomoso; it was handpicked by separating beans from the beans husk, the beans husk was thoroughly washed with water of temperature of 50°C and it was later washed with distilled water. The bean husk was placed in the oven at 110°C for 20 hours, grinded and then sieved using 10-20 m mesh sieve. The potential adsorbent (beans husk) is then placed in an air-tight container.

Characterization of Adsorbent

The surface characteristics of the Bean husk was studied using scanning electron microscope (SEM), Fourier Transform Infrared Spectroscopy (FTIR), and Elemental Diffraction X – ray Spectroscopy (EDS). These were used to elucidate the surface morphology, surface functional groups and elemental composition of the potential adsorbent.

DATA, VALUE, AND VALIDATION

Surface Functional Group

The FTIR spectrum shows the number of adsorption peaks and the complex nature of the materials which indicatesthe functional group on the adsorbent. The FTIR of bean husk is represented in Figure 1, which shows that the adsorbent haspotential adsorption siteswhich are being represented by their functional groups: O-H of alcohol (3432.0); S-H (2357.0); C=C of alkene or aromatic ring (1633.3);and C-O (1050.21) for the bond formation between the adsorbent and the dyes. It was also reported that the FTIR spectrum of sawdust [3] which are similar to bean husk and are represented by their functional group such as OH (3240cm^{-1}), C=S (1104cm^{-1}) and C=C (1574cm^{-1}). While the functional groups observed on bambusatulda [7] were O-H group (3451.35cm^{-1}), C-H (2920.09cm^{-1}), C-C (1635.71cm^{-1}) and C=O (1735.59cm$^{-1)}$. All these adsorbents are reported to have high efficiency; therefore bean husk has the potential to be an efficient adsorbent.

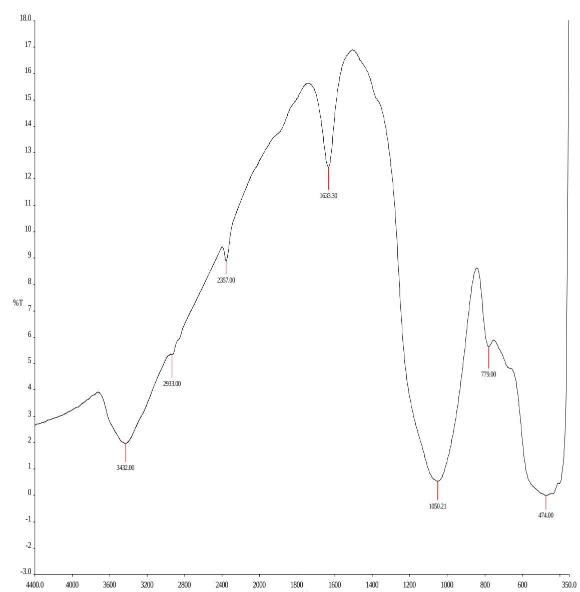

Figure 1: Fourier Transform Infrared (FTIR) Spectroscopy Micrograph of bean husk

Table 1: Bands assigned in the adsorbent

Band (cm^{-}) of bean husk spectra	Functional group assigned

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3432	O-H
2357	S-H
1633.3	C=C
1051.21	C-O

Surface morphology of the adsorbent

The Scanning Electron Spectra used to study the surface morphology of the adsorbent is presented at ^{x} 100 magnification (Figure 2). The image reveals the surface of the adsorbent which is highly porous showing that the adsorbent would have more pores for adsorption of dyes.

Similar observation was reported for sawdust [3] that it was highly porous and the porosity increased after the treatment with concentrated sulphuric acid.

It was also reported that the surface morphology of raw sawdust [8] which reveals an irregular and porous surface topography of the adsorbent and speculated that this may due to high surface area of the material.

Another result was observed for Ackee apple in which the SEM image reveals well developed pores at the surface which enable dye to be trapped and adsorbed into and the average pore diameter was found to be 2.82nm [9].

A report was obtained for the surface morphology of banbusatulda before and after modification [7]. Before the adsorbent was being modified, the surface was uneven and has raw pores which signify the presence of macropores very clearly. After modification it was seen that there is reduction in fractured structure with increase in surface toughness and more active pores were seen. With the presence of pores on bean husk, it is evident that it should be a viable adsorbent like the other adsorbents with pores.

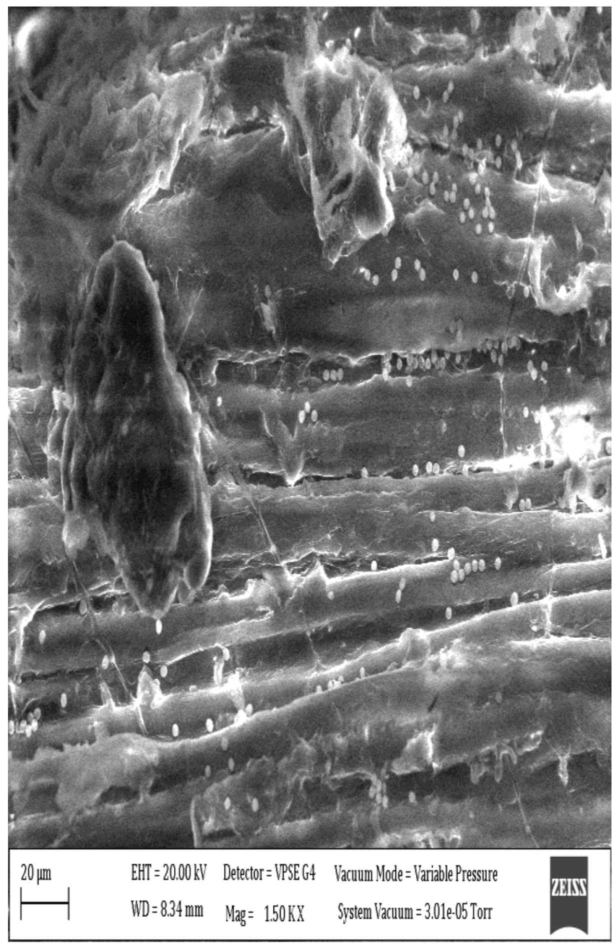

Figure 2: Scanning Electron Microscopy (SEM) image of bean husk

Elemental composition of the adsorbent

The elemental composition of bean husk as illustrated in Figure 3 shows a high percentage of

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carbon and carbon compounds (100%). It indicates that all elements present is either carbon or exist as a compound of carbon. Given that the efficiency of an adsorbent is also a function of it carbon content [10], bean husk as a potential adsorbent is very promising.

Similar observation was reported for acid-modified sawdust [3] which shows a high percentage of carbon content (66.77%) which makes the adsorbent a good one.

Another research also explained the elemental analysis of acid activated moringa oleifera [10] which shows the highest amount of carbon by weight (69.40%) and (76.11%) by atom and the lowest amount of oxygen followed by the base activated sample which makes it an efficient adsorbent for removal of dyes. Given that the efficiency of those adsorbent with 60-70 % carbon content, bean husk 100% carbon-carbon compounds content very promising as an effective adsorbent.

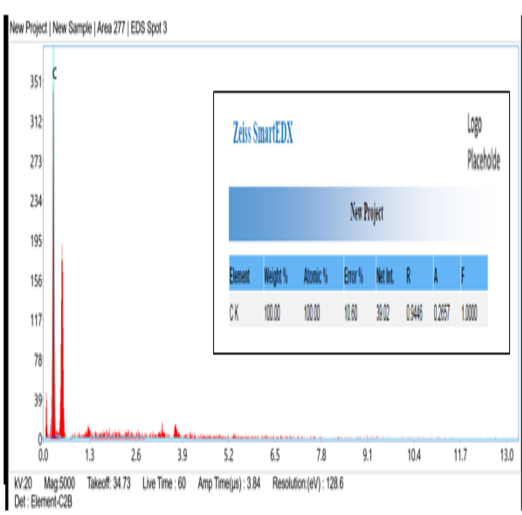

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Figure 3: Elemental Diffraction x ray Spectroscopy (EDS) of bean husk

CONCLUSION

The Surface morphology of bean husk indicates the presence of pores while the presence of functional groups that can be used for chemiosorption is revealed by the Fourier Transform Infrared Spectra. Also, the high carbon content of bean husk as highlighted by theElemental Diffraction X-ray Spectra are all indications that bean husk will be a viable adsorbent. The adsorbent made from bean husk is suitable as an adsorbent for the decolurization of textile wastewater. And has a potential of being effective for wastewater treatment.

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