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Research Paper

Batch Adsorption Studies of the Use of Eggshell And Snailshell Derived Carbon For Iron Removal From Wastewater

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ABSTRACT
This study was aimed at comparing the adsorption of heavy metal ions using adsorbent derived from egg shells and snail shells. Eggshell and snail shell used were collected from a poultry farm in Ogbomoso and Dugbe market respectively, both location in Oyo State, Nigeria. Both precursor materials were chopped into smaller pieces and pyrolyzed at 500^{O}C for 120 mins. Batch sorption tests were conducted in wastewater treatment by varying absorbent dosage with the sorbate from 5 to 20 g (at 5g intervals) in 200ml of wastewater sample and agitated intermittently at room temperature. More than 80% removal efficiency was achieved for iron by both carbon at 5g dosage, indicating strong affinity of both carbon for iron. These results indicate that carbon of both snail shell and eggshell can be used as an effective, low-cost adsorbent to remove iron from paint wastewater.

KEYWORDS: *Heavy metals, Egg shell, Snail shell, Precursor, Carbon, Iron.*

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I. INTRODUCTION

Environmental quality is degrading on daily basis as a result of toxic contaminants in aqueous streams, arising from the discharge of untreated effluents into water bodies and biosphere. Water pollution is largely caused by the disposal of industrial waste which is done freely without any prior processing [1]. Toxic effects of heavy metals on human safety are very well known: negative effects on metabolism, damages to organs, heart disease, disorder to nervous system and allergies. Moreover, the accumulation of heavy metals in body tissues and binding to enzymes may disrupt the correct functioning of the cells, with tumors [2].

Paint effluents contain high amounts of heavy metals and organic pollutants therefore, the removal of these toxic pollutants from effluent before discharging to the environment and from raw water before public use is essential for the protection of health and environment [3]. Both the manufacture and the use of paint result in the generation of significant quantities of waste. These wastes occur in solid, liquid, and gaseous form and, because of the nature of paint, they may be hazardous or toxic. Paint has impacts on the environment at all stages of its life cycle including: manufacture of the raw materials used to make paint; manufacture of the paint itself; application of the paint; and removal of the paint, if required. Heavy metals particularly, iron (Fe), lead (Pb), chromium (Cr), cadmium (Cd), copper (Cu) and nickel (Ni) are widely used for the production of color pigments of paint.

Treatment of industrial wastewater is increasingly necessary with respect to international regulations which mandated the reduction of different compounds in the cleaned water [4]. The positive outcomes from the biochars use have encouraged more research focused on pollutants removal with environment-friendly agricultural waste such as bambara nut and rice husk,[5]; modified sugarcane bagasse,[6]; wood and bone [7];[8]; coirpith,[9].

In present study eggshell and snail shell powder have been used as a new low-cost adsorbent for the removal of iron from paint wastewater by varying the adsorbent dosage to measure the optimum dosage with highest efficiency.

II. MATERIALS AND METHOD

Eggshell that was used for the study were gotten from a poultry farm in Ogbomoso, Ogbomoso North Local Government while snail shell were purchased at Dugbe market, Ibadan South West Local Government, both in Oyo state, Nigeria. The precursor materials- eggshell and snail shell, were washed with clean water to remove the impurity that might have adhered to them and thereafter, dried under intense sunlight and open air for 7 days for moisture removal. Both precursor materials were weighed and pyrolyzed at 500 ^{O}C for 120 mins in a bioreactor at Forestry Research Institute of Nigeria (FRIN). Char produced was reduced in size to enhance adsorption rate and sorted with 1.18 mm sieve before storage. The paint wastewater sample was collected under stringent conditions from a local paint industry at Aleshinloye Market, Ibadan South West Local Government Area of Oyo State, Nigeria. Batch study was conducted on wastewater. 5, 10, 15 and 20 g of adsorbents were put in 200 ml of wastewater sample. The flask containing raw wastewater samples were shaken intermittently for 1 hour, allowing sufficient time for adsorption equilibrium and wastewater was filtered through (Whatmann No. 44) filter paper.

Analysis of iron ion in the treated and untreated water samples was replicated to cater for possible variations.

The removal efficiency of adsorbents was calculated using:

Percentage adsorbed = $(Ci-Ce)/Ci \times 100$

Ci (mg/l) represents initial concentration of effluents before process of adsorption

Ce (mg/l) represents residual concentration after adsorption of effluents

III. RESULT AND DISCUSSION

Adsorbent dose is an important parameter owing to its effect on efficiency (%) and on the amount of iron adsorbed per unit weight of biomass. Adsorption process is mainly depends upon the particle size of the adsorbent, small particle size larger surface area, increases the adsorption capacity. It was observed from figure 1, that percentage of iron removal increased with increasing of adsorbent dose, this is attributed to an increase in the sorptive surface area and the availability of more active adsorption sites. Snail shell carbon exhibited highest removal efficiency at 5g dosage and increased steadily as the dosage increased, same observation is adduced for eggshell adsorbent until at 20g that the removal efficiency dropped to 88.7%. [10] noted that the decrease of qe with increase of adsorbent dose might be due to the formation of aggregates between the eggshell powder particles at high adsorbent doses, reducing the effective active site area. At 10g and 15g dosage eggshell showed higher percentage removal of 93.7 and 96.8% respectively indicating that the optimum removal take place at 15g dosage. However for snail shell the optimum removal take place at 20g dosage. The effectiveness of eggshell to adsorb iron at lesser dosage can be attributed to the porous nature of eggshell

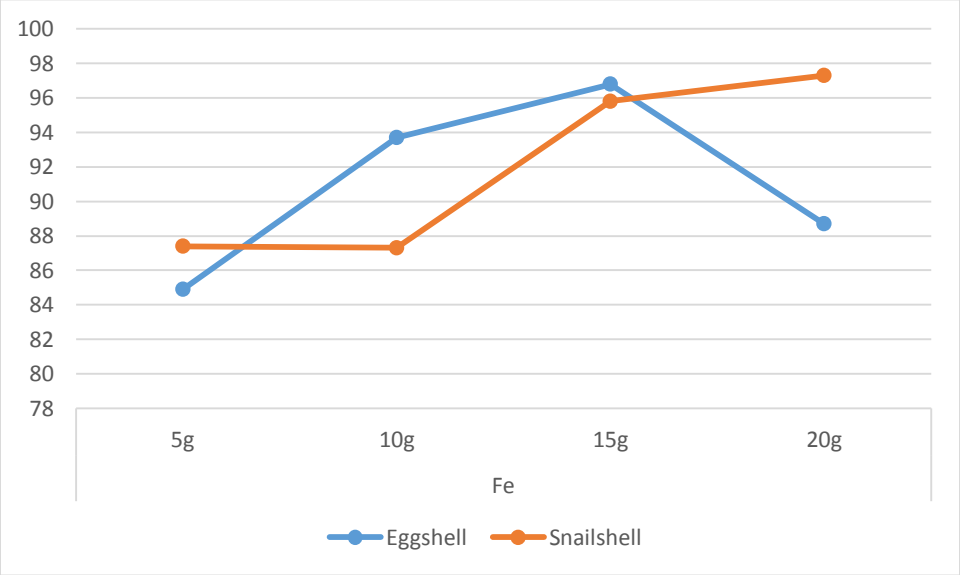

Figure 1: Comparison of % removal of the two adsorbents on the treatability of iron in paint wastewater

IV. CONCLUSION

The applicability of eggshell and snail shell in the removal of iron from paint effluents has been studied. The results showed that eggshell and snaillshell by-product may be a promising adsorbent for removal of pollutants of iron present in wastewater effluents. The percentage of the iron ions removed from the paint wastewater ranges between 84.9- 96.8% and 87.4-97.3% for eggshell and snail shell respectively. The present findings suggest that such eggshell and snail shell are expensive as a waste material available in Nigeria and many parts of the world, these wastes when utilised can provide a simple, effective and low cost method for removing Fe form contaminated water.

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