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REMOVAL OF ARSENIC FROM WASTEWATER BY ACID TREATED RICE HUSK

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Abstract - *Acid treated rice husk is promising, economical and effective adsorbent for arsenic removal from waste water. Rice husk contain cellulose in high amount which has potential to adsorb heavy metal. Acidic modification of rice husk increase capability to adsorb arsenic from solution. The efficiency of acid treated rice husk varies on many parameters like amount of acid treated biochar, equilibrium contact time, concentration of arsenic in waste water, temperature of waste water, and level of pH. The maximum adsorption capacity (q_m) was found to be 3.32 mg/g, 3.25 mg/g, 2.26 mg/g at 30°C, 40°C and 50°C respectively for acid treated biochar.*

Key Words: Rice husk, biochar, acid modification.

1. INTRODUCTION

Agricultural waste or residue is made up of organic compounds from organic sources such as rice straw, oil palm empty fruit bunch, sugar cane bagasse, coconut shell, and others. Rice husk a major by-product of the rice milling industry, is one of the most commonly available lignocellulosic materials that can be converted to different types of fuels and chemical feedstock's through a variety of thermochemical conversion processes. This husk contains about 75 % organic volatile matter and the balance 25 % of the weight of this husk is converted into ash during the firing process, is known as rice husk ash (RHA). This RHA in turn contains around 85 % - 90 % amorphous silica. The moisture content ranged from 8·68 to 10·44%, and the bulk density ranged from 86 to 114 kg/ m^3. Rice husk is unusually high in ash, which is 92 to 95% silica, highly porous and lightweight, with a very high external surface area. With such a large ash content and silica content in the ash it becomes economical to extract silica from the ash, which has wide market and also takes care of ash disposal.

Wastewater is water whose physical, chemical or biological properties have been changed as a result of the introduction of certain substances which render it unsafe for some purposes such as drinking, agriculture, and bathing.

wastewater is defined as "a combination of one or more of domestic effluent consisting of Blackwater (excreta, urine and fecal sludge) and greywater (kitchen and bathing wastewater) water from commercial establishments and institutions, including hospitals industrial effluent, storm water and other urban run-off agricultural, horticultural and aquaculture effluent, either dissolved or as suspended matter" (Corcoran et al. 2010). Arsenic content in water bodies of different place of the globe by anthropogenic and natural sources.

2. MATERIALS

2.1 Rice Husk

Rice husk is the organic waste generate after the cleaning of rice. These husk were found to be highly carbonaceous material which is the prime requirement of adsorbent. Samples of rice husk about 15 kgs was collected from rice mill. The sample is directly collected from the cleaning stage where rice husk is removed from rice and from husk. The sample is collected in large jute sac.

2.2 Waste Water

Waste water is the water that discharge by the people form industries, houses, institutional buildings etc. with the presence of various contamination such as soap, fecal contamination, chemical etc. This water cannot be reuse and they were discharge to sewers. In the present study Wastewater samples of about 5 liters was collected form Leather Complex. Which was discharge after washing leather and passed from various chemical treatment process in leather complex.

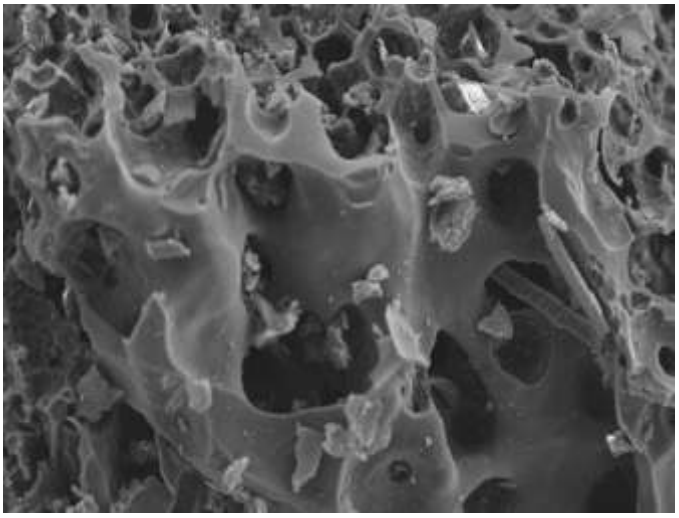
3. METHODOLOGY

Methodology adopted for making adsorbent was pyrolysis method and acid treatment was followed in order to increase the adsorbent efficiency. Taking rice husk from mill, washed, sieved through 75 micron sieve. Rice husk was then shifted to the crucible with a capacity of 100 gm and they were properly covered and then kept in muffle furnace at a temperature of 550^{o}C for 3 hours so that it get properly convert into biochar. Burnt rice husk is weighted (W_i) and then placed in the pore line boat and firmly press with the figures or spatula so that the burnt rice husk do not fall out of the pore line boat and then it is kept in tube furnace for 1 hr 30 min at 750^{0}C. Then total ash content is calculated.

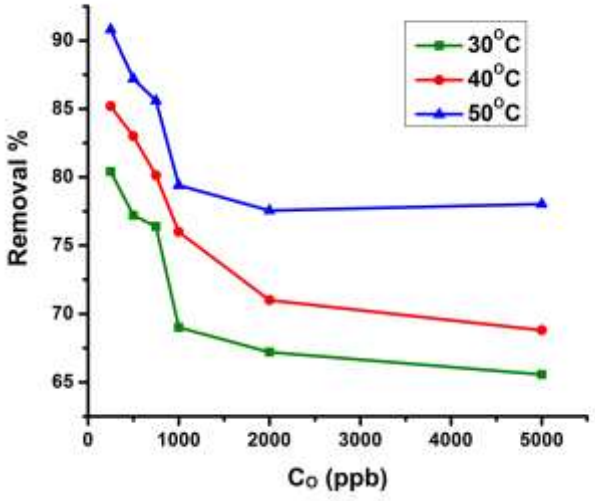
After the estimation of Ash content of burnt rice husk which is now called biochar was exact 3 gm is weighted and mix with 150 ml of molar of H_2SO_4 solution in conical flask and subjected to magnetic stirrer with magnet pin in it for 5 hrs. Then biochar was shifted to the Teflon Autoclave Vessel then it is placed in oven for 1 hr 30 min at 150^{o}C and then it is taken out and kept for cooling when it got cooled it is washed with distilled water in order to bring the pH to 7 which is neutral and then it is again dried by keeping it in hot air oven. Biochar was crushed in mortar and pestle and kept in a sealed packed zipper bag. Identification of acidic group of biochar was under taken by using $NaHCO_3$, NaOH, and HCL.

4. RESULTS

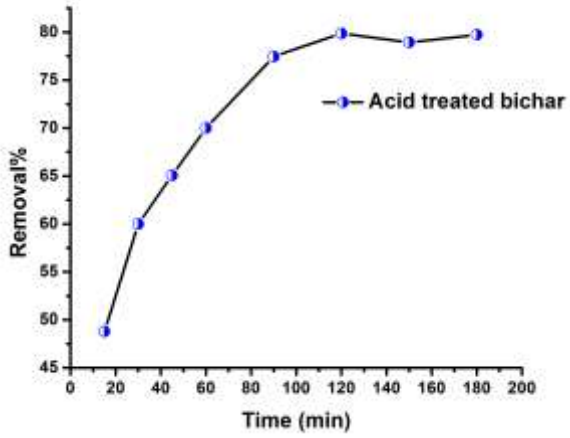
Results for FESEM



Results for Equilibrium dose of Adsorbent

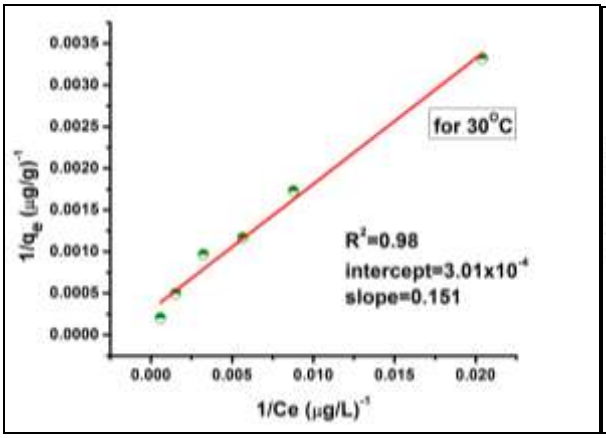


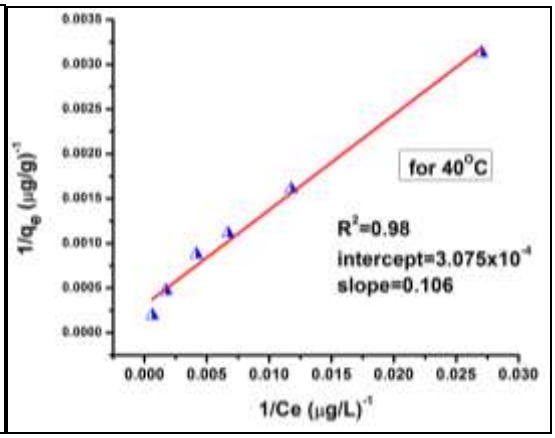
Equilibrium Contact Time

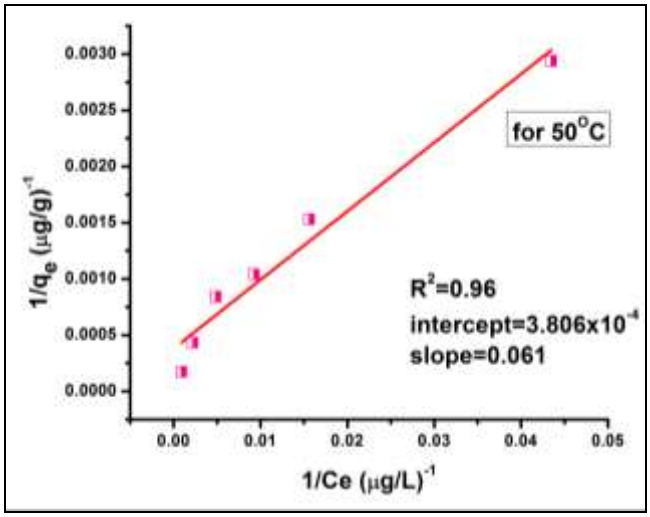


Result of Isothermal studies at different temperature

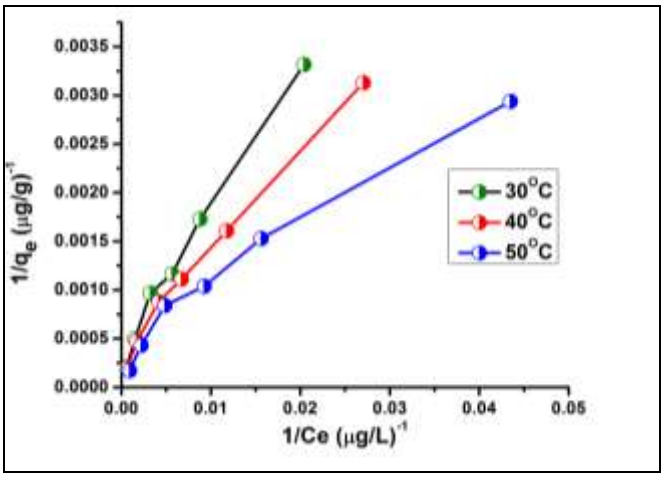
Langmuir Isotherm at 30⁰, 40⁰ and 50⁰ C



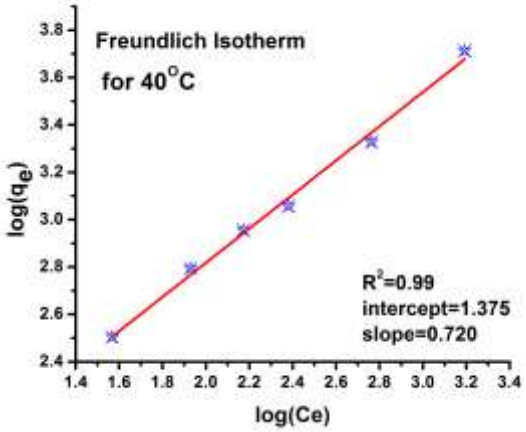


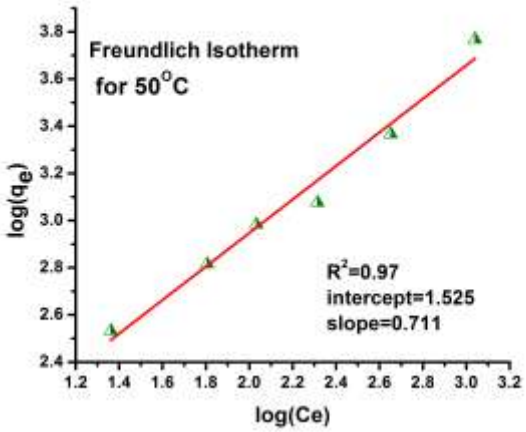


Langmuir Isotherm (different temp.)

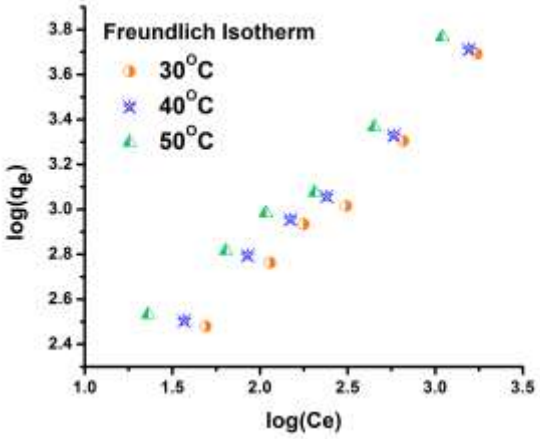


Freundlich Isotherm at 40⁰C and 50⁰ C





Freundlich Isotherm(different temp.)



5. CONCLUSION

Biochar made from rice husk is an environmental friendly adsorbent. Modification of biochar by acid introduces many (10^{21} sites/g) active sites on the surface of biochar and makes it active for adsorbent. Adsorption of Arsenic on the adsorbent were studied with different parameters. Adsorption was found suitable at higher temp. Indicating its endothermic nature. The isotherm states indicate that both the Langmuir and the Frundlich isotherm describe the adsorption process in both the cases. The max adsorption capacity (q_m) was found to be 3.32 mg/g, 3.25 mg/g, 2.26 mg/g at 30°C, 40°C and 50°C respectively for acid treated biochar. The values of R_L is both the cases for both the adsorbents tell the feasibility of adsorption. Analysis the Frundlich Isotherm it also indicate the feasibility of adsorption. The presence of $FeSO_4$ has been found to have played a detrimental role in removal of Arsenic for the adsorbents. Whereas, the presence of bicarbonate plays a detrimental role in the removal percentage for acid treated biochar.

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