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Production of Activated Carbon from Rice Husk and Rice Straw for Adsorption Studies

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Abstract:- The study proposes a process for converting rice residue (straw, husk) into activated carbon (AC). The raw material has been thermolyzed at 500ºC, and the carbonizate was activated at 800ºC. Appropriate techniques were used to study the characteristics of the AC produced. SEM has been used to examine the porous structure of activated carbon. Activated charcoal made from rice husk belongs to the wood activated carbon (WAC) product, while activated carbon derived from rice straw compares to the BAU-A grade, according to the results of the experiments. This study presents a sensible strategy for obtaining viable secondary adsorbent materials for adsorption in liquid media from agricultural by - products.

Keywords:- *Rice straw and husk, activated carbon, carbonization, activation of carbonizate, sorbent.*

I. INTRODUCTION

India and China account for the major rice production, rice straw forms a major component of agro-residues, and thus, could be a potential source of feedstock for biofuels production [1]. Scientists were trying to think about how to make activated carbon with high adsorption performance from inexpensive raw materials, as the use of activated carbon has increased day by day around the world. Researchers in the United States and elsewhere are increasingly interested in the activated carbon found in rice straw and husks. Rice has been one of the world's most important agro-food crops. Today, rice output across the globe is expected to be around 485 million tonnes per year. As per Kazagro trading JSC, Kyzylorda, Almaty, and Turkestan are the paddy areas of Kazakhstan. Kyzylorda is the country's major grain region, producing over 85% of the country's rice. After collecting and industrializing rice production, considerable amounts of wastage in the form of straw (approximately to 50% of weight) and husk (approximately to 20% of weight) are produced. The use of husk and straw, basically, stays a significant issue for farmers. The bulk of rice husk and straw is heated, resulting in a worsening of the ecosystems. The use of rice straw and husk, but also the manufacturing of desired carbonaceous materials, would be a collaborative solution to the environmental and technology difficulties. The thermal procedure of rice husk and the generation of phenolic-compounds from it have been studied by many authors [1, 2]. The use of rice straw and husk to make broadly appropriate adsorbent activated carbon is recommended in this study. AC has been typically made from different types of carbon-containing organic materials, including charcoal (DAK, BAU, etc.) [3,4], coal coke (AC brand AR, AG, etc.), and others. [5-13] Petroleum coke, agricultural trash, coconut shells, fruit shells, pulp manufacturing debris, refuse, used rubber tyres, industrial wastewater, synthetic polymer effluents, and other materials. Using agricultural waste to make activated carbon is pollution-free since it eliminates the utilization of wood as an unrefined substance, reducing deforestation and encouraging more sensible use of agricultural waste. Another process for manufacturing activated carbon from barley waste was identified [14]. It also includes hot air heating and maintaining the first carbonization temperature between 290 and 320 ℃. The time duration is 7 to 15 minutes in a cylindrical reactor. Another technique of creating activated carbon from barley waste exists: carbonization of oilseed straw at 450–500 ℃ in an inert nitrogen environment, followed by activation by steam at 820–850 ℃ [15]. Some studies have been conducted on the production of high porosity activated carbon prepared from rice husk, which does have selective sorption ability for pb^{+2} ions [16–17]. Some other studies have found that combining rice husks and polytetrafluoroethylene produces a porous structural material [18].

II. EXPERIMENTAL

The tubular furnace is equipped with stainless steel, has a length of 250 mm and an interior diameter of 25 mm, and has been used to heat 10 g of raw material. Carbonization was carried out after the tube was covered. The carbonization temperature has been increasing at a rate of 10 ℃/min until it reaches 500 ℃ and has been maintained for 100 min. Carbonization yields from husk and straw were 44% and 37%, correspondingly. Thereafter, a vessel has been coupled to the bottom of the muffle furnace to deliver steam to the apparatus, maintaining a water-to-carbonizate mass ratio of 2:1. The activation has been done at 800 ℃, and the amount of AC produced ranged from 27 to 29 percent, based on the weight of the husk and straw employed. The resultant AC surface can be examined using a JEOL JSM6510 LV SEM (scanning electron microscope - Japan).

The characteristics of the resultant activated carbon have been evaluated using standard protocols [3, 19–21], including iodine adsorption activity, moisture mass fraction, water total pore volume, and bulk density.

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III. RESULTS AND DISCUSSION

Figures 1 and 2 illustrate microphotographs of activated carbon at 500 times magnification, exhibiting the high porosity of the sorbent materials.

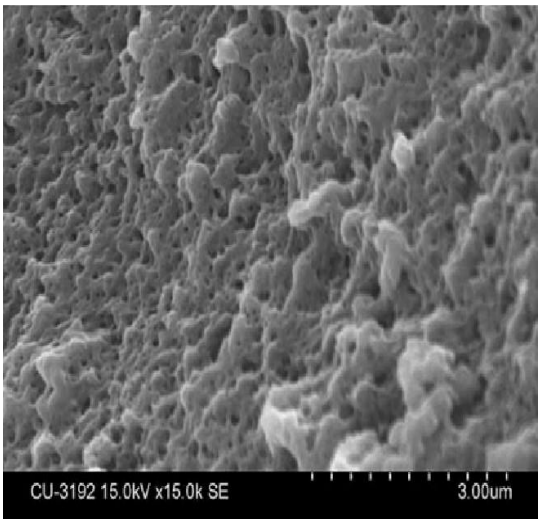

Fig. 1: Scanning Electron Microscope (SEM) image of Rice husk-derived activated carbon

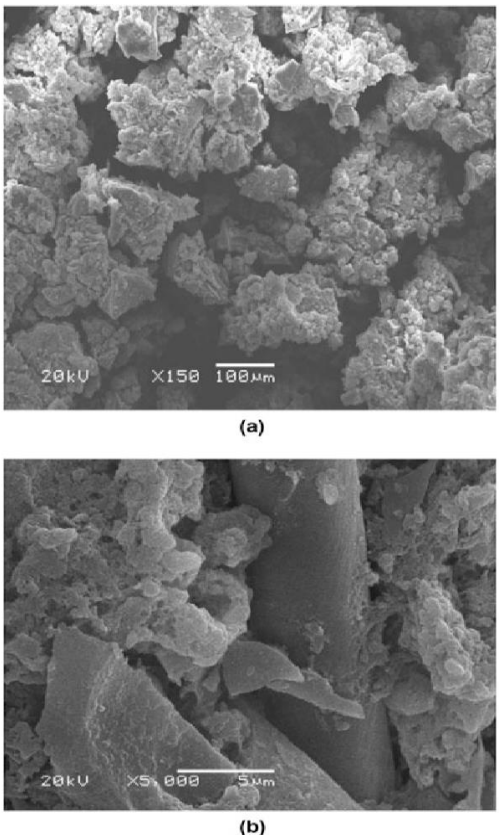

Fig 2: Scanning Electron Microscope (SEM) image Rice straw-derived activated carbon

Scanning Electron Microscope (SEM)for activated carbon (AC) derived from rice straw with (a) Amplification factor 150, (b) Amplification factor 5,000.

S. No	Activated Carbon(AC)	Iodine absorption activity, %	Water fraction of moisture	Total pore volume of water	Bulk density g/dm^3
1	Activated carbon derived from rice husk	55	3.8	1.53	238.1
2	Activated carbon derived from rice straw	69	3.8	1.65	183.3
3	BAU-brand	> 62	< 10.0	1.62	< 240.0
4	WAC-grade	>32	< 10.0	1.42	220.0-250.0

Table 1: Characteristics of activated carbons derived from rice husk and straw

Iodine adsorption activity might have been calculated using a titrimetric process; mass fraction of moisture was determined by drying the sample to a constant weight; water total pore volume was calculated by filling pores with water and suctioning excess water from the surface of the sample; and bulk density was determined using a weighing method, Table 1 shows the information. According to the findings, rice husk activated charcoal is equivalent to WAC activated charcoal, but rice straw activated charcoal is equivalent to BAU-A grade, which seems to be employed for adsorption in aqueous media [3].

IV. CONCLUSIONS

Rice straw and husks were used to make activated carbon. The qualities of the resulting products have been investigated. The produced sorbents potentially substitute wood activated charcoal due to specific features allowing for more efficient agricultural waste disposal, minimized deforestation, and the making of value-added products.

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