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Study and Analysis of Activated Carbon Made From Rice Husk

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Abstract— In present research the attempt has been made to prepare Activated carbon (AC) from rice husk and analyse it according to adsorption capacity. For characterization Methylene blue and Iodine number test are applied to find the surface area and efficiency of AC. The AC is activated in two stages in muffle furnace at the temperature of 4500C for different times using phosphoric acid as activating agent. The specific surface area obtained by methylene blue test for single and double stage activation were 16.08323 and 15.85203 in 10-3 km2/kg respectively. The amount of methylene blue adsorbed was 0.00507 mg/g for single stage and 0.00499 mg/g for double stage activation. Iodine number values found were 716.247 and 749.790 for single and double stage activation respectively.
Keywords—rice husk, activated carbon, phosphoric acid, iodine number, methylene blue number

I. INTRODUCTION

Activated carbon is amorphous carbon which is generally obtained from various carbonaceous materials. Activated carbon is characterized by large surface area and high degree of porosity due to which it has huge adsorption capacity. Activated carbon is widely used for removal of toxic heavy metals, organic pollutants and dyes from waste water and air. Usually activated carbon increases the cost of the treatment process. Due to its economical drawback the interest to enforce cheaper raw materials for the production of activated carbon has incited. Subsequently, a wide variety of agricultural biomass and by-products has been investigated as precursors for the production of activated carbon in addition to wood and coal. The choice of a cheap precursor waste biomass reduces the production cost of activated carbon.

Rice husk is formed from hard material like opaline silica and lignin. It is enriched with fibre components. Rice husk is cheaply and easily available agricultural waste which is generally used as fertilizer, insulation material etc. The ash of rice husk is potential source of amorphous reactive silica which has variety of applications in science. Rice husk ash as a pozzolanic reactive material can be used to improve surface of transition zone between microscopic structure of cement paste and aggregate in the high performance concrete. Most of the ash is used in production of Portland cement. Due to its amorphous nature it is also used in the preparation of activated carbon.

The manufacturing processes used for the activation of carbon includes chemical and physical methods. Both of them were previously used for the preparation of rice husk activated carbon. In present research acid activation method is used for preparation of activated carbon with phosphoric acid as an activating agent.

II. MATERIALS AND METHODS

2.1 Sample Preparation

The method of activation by Yanping Guo et al., (2006) was adopted. The samples were grind in powder form and sieved through 300-micron sieve.

2.2 Single stage Activation

About 10 grams of sample was mixed with 50 grams of 30% by weight phosphoric acid solution. Then the slurry was kept in muffle furnace at temperature 1700C until blackish sticky slurry was formed. The time taken for slurry formation by rice husk was 1 hour. Further carbonization was done at temperature 4500C for 45 minutes and 1 hour and cooled to room temperature. The obtained AC was washed several times with distilled water to bring the pH between 6.5-8.5 and dried overnight at 1050C in hot air oven.

2.3 Double stage Activation

10 grams of activated carbon sample was again mixed with 50 grams of 30% by weight phosphoric acid solution and the slurry was kept in muffle furnace at temperature 1700C for 45 minutes. Then the carbonization was done at temperature 4500C for 45 minutes and cooled to room temperature. The obtained AC was washed several times with distilled water to bring the pH between 6.5-8.5 and dried overnight at 1050C in hot air oven.

2.4 Testing of Activated Carbon:

The various adsorption characteristics of AC can be studied by using different adsorbates like methylene blue and iodine. The methylene blue number testing method of activation by Abdulrahman et al., (2010) was adopted and ASTM method D 4607-94 was adopted for finding iodine number.

III. RESULTS

3.1 Methylene Blue Number

3.1.1 Single stage activated carbon.

Conc mg/l	Initial abs.	Co-Ce(g/dm3)	qeq(mg/g)	SMB	%Re
10	0.24	0.01114078	0.00111	3.53723	0.022282
15	0.364	0.01604369	0.00160	5.09392	0.032087
20	0.417	0.02104369	0.00210	6.68144	0.042087
25	0.546	0.02604369	0.00260	8.26895	0.052087
30	0.603	0.03114078	0.00311	9.88729	0.062282
35	0.798	0.03589806	0.00359	11.39774	0.071796
40	0.803	0.04089806	0.00409	12.98526	0.081796
45	0.911	0.04614078	0.00461	14.64984	0.092282
50	1.083	0.05065534	0.00507	16.08323	0.101311

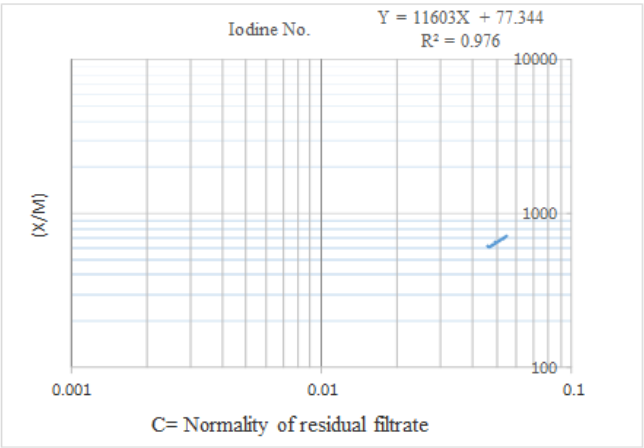
3.1.2 Double stage activated carbon.

Conc mg/l	Initial abs.	Co-Ce(g/dm3)	qeq(mg/g)	SMB	%Re
10	0.24	0.0096845	0.00097	3.074848	0.01937
15	0.364	0.0149757	0.00150	4.75484	0.02995
20	0.417	0.0199272	0.00199	6.326942	0.03985
25	0.546	0.0250728	0.00251	7.960696	0.05015
30	0.603	0.0300243	0.00300	9.532799	0.06005
35	0.798	0.0350243	0.00350	11.12031	0.07005
40	0.803	0.0400728	0.00401	12.72324	0.08015
45	0.911	0.0449757	0.00450	14.27993	0.08995
50	1.083	0.0499272	0.00499	15.85203	0.09985

3.2 Iodine Number

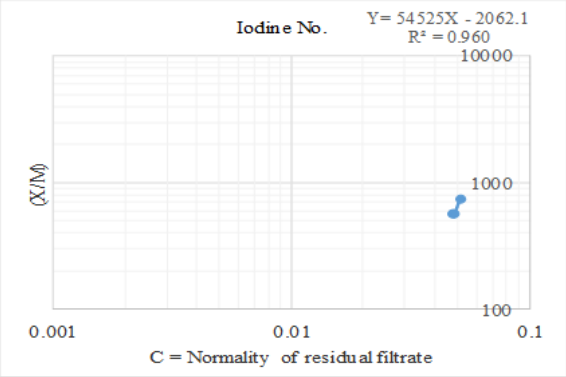
3.2.1 Single stage activated carbon.

C	X/M
0.0463	622.84
0.047	613.71
0.055	716.247



3.2.2 Double stage activated carbon.

C	X/M
0.048	573.72
0.0486	565.346
0.0515	749.79



IV. RESULT ANALYSIS

The iodine number is 716.247 for single stage activation with R2 = 0.977 and 749.79 with R2= 0.9601 for double stage activation.

The values of methylene blue number test, amount of methylene blue adsorbed (qeq) is 0.00507mg/g and 0.00499mg/g for single and double stage activation respectively.

Also specific surface area for the single stage activation is 16.08323X10-3 Km2/Kg and for double stage activation 15.85203X10-3 Km2/Kg

Hence for iodine number test the double stage activated carbon gives better result compared to single stage activation.

For methylene blue number test the values for amount of methylene blue adsorbed and specific surface area are better for single stage than double stage activated carbon.

Hence two different tests i.e. methylene blue and iodine number gives variable results with single and double stage activation. Hence it is recommended to select the various governing factors like temperature of activation, duration of activation, activating agent (acid) optimally by considering iodine number and methylene blue number so as to get maximum efficiency for adsorption along with maximum specific specific surface area.

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