

Potassium hydroxide high temperature modified corn straw charcoal and lead ions adsorption study

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Key words: Straw charcoal, Potassium hydroxide, Activation, The adsorption.

Abstract. In this paper, the effects of potassium hydroxide concentration, soaking time, activation time, activation temperature and heating rate on the adsorption performance of corn straw were studied by using potassium hydroxide as activator and high temperature modification of corn straw activated carbon. The optimum conditions were as follows: the solid-liquid ratio of straw carbon to potassium hydroxide solution was 1: 4, the immersion time was 24 h, the concentration of potassium hydroxide was 0.9 g / ml, the activation time was 2 h, the activation temperature was 800 °C and the heating rate was 5 °C / min. The iodine adsorption value of the corn straw was 899.38mg / g, which was obviously better than that of the commercial activated carbon.

Introduction

Straw gasification is a measure to solve the problem of straw burning ban, but the cost is difficult to promote, only in the financial support to be applied, straw gasification dry distillation of carbon black residue (hereinafter referred to as straw carbon) heat value is high, often used to replace the traditional charcoal, the use of low value. It was found that the products of carbonized straw with high temperature (higher than 400 °C) had similar structure with activated carbon, and polar groups such as carboxyl groups on the surface [1-2]. If activated, it was possible to prepare activated carbon. Domestic and international research on activated carbon and its modification, but the research on the modification of corn straw has been rarely reported. This paper explores the method of preparing activated carbon from corn stover carbon at high temperature by potassium hydroxide, and opens up a new way to improve the comprehensive benefit of straw gasification project way.

Experiment methods

The key instruments used in the experiment were the SGM68168 Artificial Intelligent Tubular Resistance Furnace and the SHZ-82 Thermostat Oscillator. The main reagents used were analytical grade pure potassium hydroxide, iodine, potassium iodide, sodium thiosulfate and potassium dichromate; and commercially available activated carbon And Huxian East Han Village straw gasification plant corn stover carbon.

Carbon adsorption capacity test

The activated carbon and corn stalk charcoal were prepared by washing and drying, and then pulverized into 100 mesh. The iodine adsorption value of the sample was measured by iodine adsorption method.

Exploration on Preparation Conditions of Corn Straw Activated Carbon

Potassium hydroxide concentration optimization [2-6] experiment

Respectively, weighed 25g straw charcoal placed in the beaker, followed by adding 0.10,0.30,0.50,0.70,0.90,1.1g / ml potassium hydroxide solution 50ml, soak 24h, filter, drying, placed in SGM68168 type artificial intelligence tube resistance Furnace, set the heating rate of 5 °C / min, 700 °C activation of 1.5h, after cooling to neutral, dry 8h, determination of iodine adsorption value, to determine the optimal concentration of potassium hydroxide.

Immersion time optimization experiment

Respectively, weighed 25g straw charcoal placed in the beaker, the best concentration of 1.2.1 by adding potassium hydroxide solution 50ml, followed by soaking 6h, 12h, 18h, 24h, 30h and 36h, filtration, drying, placed in SGM68168 type artificial Intelligent tube resistance furnace, set the heating rate of 5 °C / min, activated at 700 °C modified 1.5h, after washing to neutral, dry 8h, determination of iodine adsorption value, to determine the best soaking time.

Activation time optimization experiment

Respectively, weighed 25g straw charcoal placed in the beaker, the best concentration of 1.2.1 by adding potassium hydroxide solution 50ml, immersion 1.2.2 determined the best time, filtration, drying, placed in SGM68168 artificial intelligence tube In the resistance furnace, the heating rate was set at 5 °C / min, and the mixture was activated at 700 °C for 0.5h, 1.0h, 1.5h, 2.0h, 2.5h and 3.0h. After cooling, it was neutralized and dried for 8h. Adsorption values to determine the optimal activation time.

Activation temperature optimization experiment

Respectively, weighed 25g straw charcoal placed in the beaker, each added 1.2.1 the best concentration of potassium hydroxide solution 50ml, soaked 1.2.2 to determine the best time, filtration, drying, placed in SGM68168 artificial intelligence tube Resistance furnace, set the heating rate of 5 °C / min, followed by 400 °C, 600 °C, 700 °C, 800 °C, 900 °C, respectively, the optimal time modified by modified 1.2.3, after cooling to neutral, Drying 8h, determination of iodine adsorption value, to determine the best activation temperature.

Results and Discussion

Effect of Different Soaking Alkali Liquor Concentration on Adsorption Performance of Carbon

The data obtained in 1.2.1, with the concentration of potassium hydroxide as the abscissa, the iodine adsorption value is the ordinate as Fig.

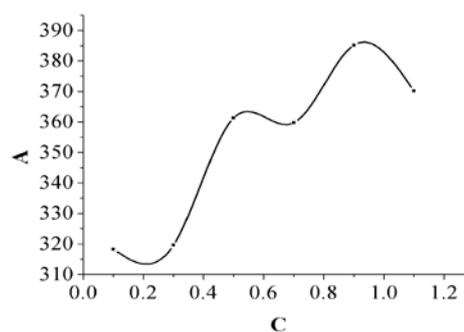


Fig. 1. The influence of different Alkali concentration on adsorption value of carbon

It can be seen from Fig. 1 that, on the whole, the concentration of potassium hydroxide has little effect on the carbon adsorption capacity of maize straw, but there is a difference. When the concentration of potassium hydroxide reaches 0.9g / ml, the iodine adsorption value reaches the maximum. Alkali concentration is too large and too small adsorption effect is not ideal. When the concentration is too large, the swelling effect of the lye is too strong, which will break the uncracked cellulose and lignin skeleton in the corn straw. [3], which is not conducive to the formation of good activated carbon pore structure. When the concentration is small, The swelling of cellulose and lignin is not sufficient, leading to insufficient pore size.

Effect of Different Soaking Time on Adsorption Performance of Carbon

The data obtained in 1.2.2, the soaking time for the abscissa, iodine adsorption value for the vertical axis of Figure 2.

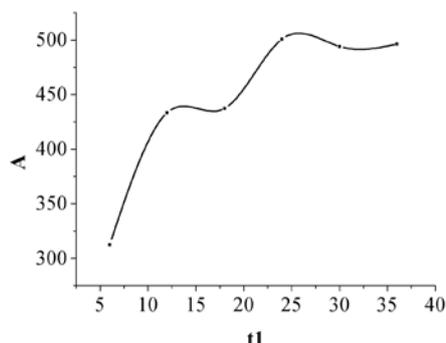


Fig. 2. The influence of different soaking time on the adsorption value of carbon

It can be seen from Figure 2, the best soaking time is 24h, soaking time is too long will make the straw cellulose and lignin skeleton collapse, the time is too short cellulose and cellulose swelling is not sufficient, is not conducive to cracking into holes. In the activation process, potassium hydroxide has a catalytic dehydroxylation effect, so that the hydrogen and oxygen in the raw material in the form of water vapor, and inhibit the production of tar, to avoid blocking the pores, thus forming a porous structure [4-6].

Effect of Different Activation Time on Adsorption Performance of Carbon

According to 1.2.3 data, the activation time is the abscissa, and the iodine adsorption value is the ordinate.

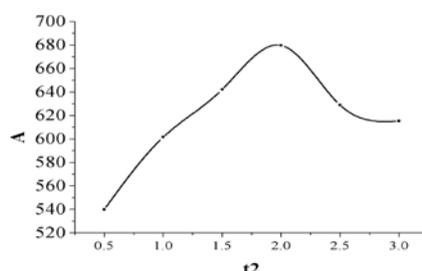


Fig. 3. The effect of different activation time on the adsorption of carbon

It can be seen from Fig.3 that the different activation time has a great influence on the adsorption performance of activated carbon. At 2h, the adsorption value reached the maximum, so the activation time was 2h. When the activation time is less than 2h, the residual cellulose and lignin in the straw are not enough, and the pore size is not well developed. When the activation time is more than 2h, the organic carbon chains on the inner surface of the activated carbon pore are further cracked, resulting in excessive pore size and even collapse, destroying the internal channel of the activated carbon, resulting in a decrease in the specific surface area and a decrease in the adsorption capacity.

Effect of Different Activation Temperature on Adsorption Performance of Carbon

According to 1.2.4 data, the activation temperature is the abscissa, and the iodine adsorption value is plotted as the ordinate.

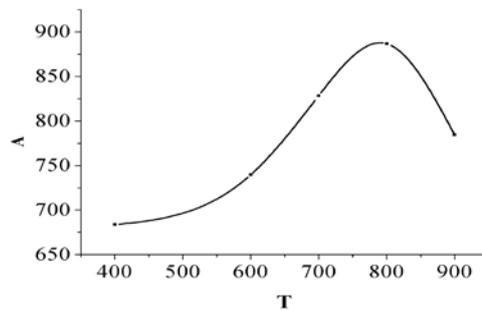


Fig.4. Effect of different activation temperature on carbon adsorption performance

It can be seen from Fig. 4 that the iodine adsorption capacity increases gradually with the activation temperature between 400-800 °C. When the activation temperature exceeds 800 °C, the adsorption value of modified carbon increases rapidly with the increase of temperature, indicating that the addition of potassium hydroxide drugs fundamentally changed the thermal decomposition of corn stalks. According to the KOH activation mechanism, the metal potassium, which is reduced during the activation process, can penetrate the [3] graphite microchip layer in the form of gaseous form at the boiling point (800 °C) to form new pores, and at 850 °C The reaction rate will be microporous wall surface is burned to form a hole or large pores, thereby reducing the specific surface area of activated carbon. And the temperature is too high will further damage the internal pore size of activated carbon, which is reflected in the experimental results are consistent. Therefore, considering the yield and adsorption properties affected by the activation temperature of the law, activated carbon preparation activation temperature selection 800 °C more appropriate.

Comparison of Adsorption Performance of Corn Straw Carbon, Commercial Activated Carbon and Corn Straw Activated Carbon

The adsorption of corn stalks, commercially available activated carbon and maize straw modified carbon iodide at the optimum conditions according to the procedure of 1.1 were summarized in Table 1.

Table 1. Effect of Different Activated Carbon on Adsorption Performance

Types	Weight(g)	Iodine sorption value (mg/g)
Corn Straw Carbon	0.5	281.73
Commercial Activated Carbon	0.5	600.03
KOH Activated Corn Straw Activated Carbon	0.5	899.38

It can be seen from Table 1 that the adsorption effect of modified corn stalks modified by potassium hydroxide at high temperature was significantly higher than that of activated corn and straw, and it was the standard of activated carbon, which could be called corn straw activated carbon.

Conclusions

- (1) Potassium hydroxide was used to modify corn charcoal at high temperature, and high quality corn straw activated carbon could be prepared.
- (2) The optimum conditions for the preparation of activated carbon from corn straw with high temperature of potassium hydroxide were: potassium hydroxide concentration 0.9g / ml, soaking time 24h, activation time 2h, activation temperature 800 °C.
- (3) The adsorption value of activated carbon prepared by potassium hydroxide at high temperature was 899.38mg / g, which was better than that of commercial activated carbon.

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