Preparation of COD Sorbent for Wastewater by Fly Ash and Straw

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Abstract. The sorbent was prepared by agricultural waste straw and power plant waste fly ash. The sorbent was used to remove COD from wastewater. The straw is crushed and carbonized. Fly ash is modified by zinc chloride activation. Result showed that the adsorption effect of the sorbent exceeds 90%.

Introduction

At present, water pollution has become an increasing global concern. A large number of inorganic and organic pollutants entering into the water not only damage the water ecosystem, but also do harm human health. In addition, the industrial or agricultural production is affected. Activated carbon is widely used in wastewater treatment but the cost of treatment is higher.

China is rich in straw resources, most of which are discarded and burned, not only resulting in waste of resources, but also deteriorating environment. Also resulting in flying accidents are common. Fly ash is fine ash collected from the flue gas after coal combustion and is the main solid waste discharged from coal-fired power plant, which greatly pollutes soil, atmosphere and water quality. In this research, agricultural waste straw and power plant waste fly ash were used to prepare for activated carbon. The straw is crushed and carbonized. Fly ash is modified by zinc chloride activation. After mixing them together, use them for removing COD from industrial wastewater.

Experiments and Discussion

Determination of the Optimum Ratio of Straw and Fly Ash

The impact of straw and fly ash ratio on the COD in wastewater was investigated. The ratio of straw and fly ash was 4:1, 3:1, 2:1 and 1:1.

According to the figure 1, It can be shown that the removal rate of COD show tendency to descend with the increase of the adding mass of fly ash. When ratio of straw and fly ash is above 2:1, the removal rate of COD exceeds 90%. When the ratio of them is 1:1, the removal rate decreased significantly. Carbonaceous composition content of fly ash itself is not as high as straw, and it contains solid substances such as SiO₂, Al₂O₃, Fe₂O₃ and so on. Adding too much has no adsorption. Although adding straw can increase the removal rate of COD, considered the cost factor and the ratio from 4:1 to 2:1, the removal rate doesn't increase significantly. In this study, 2:1 mass ratio between straw and fly ash is more appropriate.
Effect of the mass ratio on the removal efficiency of COD

The Impact of the Adsorbent Adding Mass on Removal Rate of COD

The impact of different adsorbents on COD removal efficiency of wastewater was investigated. Taking 1000 mL of wastewater and injecting 10, 20, 30 and 40g adsorbents respectively, and the adsorption time is 20 min. The experimental results are shown in the figure 2.

According to the figure 2, the removal rate of COD increased with the addition of adsorbent. When the addition of adsorbent is 20g, the removal rate of COD can reach more than 90%. COD can be reduced to less than 50mg/L, which can meet the national second-level standard for industrial water. From the perspective of economy, it is appropriate to add 20g of adsorbent in this study.

Effect of Temperature on Adsorption Efficiency

The effects of temperature on adsorption efficiency were studied by selecting adsorption temperatures of 20℃, 30℃, 40℃ and 50℃. The experimental results were shown in Fig. 3.
As can be seen from Figure 3, COD removal rate increases first and then decreases with the increase of temperature. The adsorption efficiency of adsorbent at 50°C is lower than that at 40°C. The adsorption process moves faster at high temperature, and it is difficult to achieve a higher equilibrium process, and the adsorption efficiency decreases. The adsorption temperature of adsorbent in this study is 40°C.

**Effect of the Absorption Time on the Removal Rate of COD**

The effect of adsorption time on COD removal rate was determined at 40 C. Fig. 4 shows that the removal rate of COD increases with the increase of adsorption time, but the increase is not obvious after more than 20 minutes. Some studies have shown that the adsorption time is related to the adsorption properties. It is easier for the adsorbate to transfer from the surface to the micropore inside the adsorbent, and the resistance is smaller. With the increase of the adsorbate, the concentration gradient becomes smaller, and the adsorption power is less than Van der Waals force, which results in the decrease of the adsorption rate.
Conclusion
Through the study of the adsorption of COD from wastewater using fly ash and wheat straw, the results showed that the straw/fly ash ratio was above 2:1, the removal rate of COD reached over 90%. With the increase of the amount of adsorbent added, the removal rate of COD also increased. When the amount of adsorbent is 20g, the removal rate of COD can reach above 90%. With the temperature increase, the removal rate of COD first increased and then decreased. The adsorption efficiency of the adsorbent under 50℃ was lower than that under 40℃. The removal rate of COD increases with the adsorption time increasing.

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References


