THE STRUCTURE AND ADSORPTION PROPERTY OF RESIN-BASED SPHERICAL ACTIVATED CARBON

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Abstract

Resin-based spherical activated carbon (SAC) was prepared from ion-exchange resin (IER) by different process. The effects of oxidation and KOH impregnation on the carbonization behaviors of IER as well as on the surface functional groups and adsorptive property of the resultant SAC were studied. The results showed that oxidation can increase the carbon yield of resin and KOH impregnation can make the carbonization of resin take place at lower temperature. The large pores of the SAC from resin with KOH impregnation decrease largely and amount of surface functional group as well as adsorption ability to ethanol increase remarkably. The optimum conditions to prepare SAC with high yield are found at an oxidation temperature of 200℃, impregnated in KOH and the temperature of carbonization and activation is 600℃ and 850℃ respectively. The yield of resin-based SAC at the optimal condition is 28.3%, and the adsorption of alcohol is about two times that of the SAC without KOH impregnation.

Keywords
Activated carbon, Activation, Adsorption

Introduction

Spherical activated carbon (SAC) has some unique properties, and is widely used in water treatment, blood purification, and other fields. Ion-exchange resin (IER) is a promising material for preparation of SAC because of its commercial availability and uniform shape (Bratek, 2002). In this paper, resin-based spherical activated carbon was prepared from ion-exchange resin by different process. The effects of oxidation and KOH impregnation on the carbonization behaviors of IER as well as on the structure, surface functional groups and adsorptive property of the resultant SAC were studied.

Experimental

Sample Preparation

SAC was prepared from IER by using the following methods, shown in Figure 1.

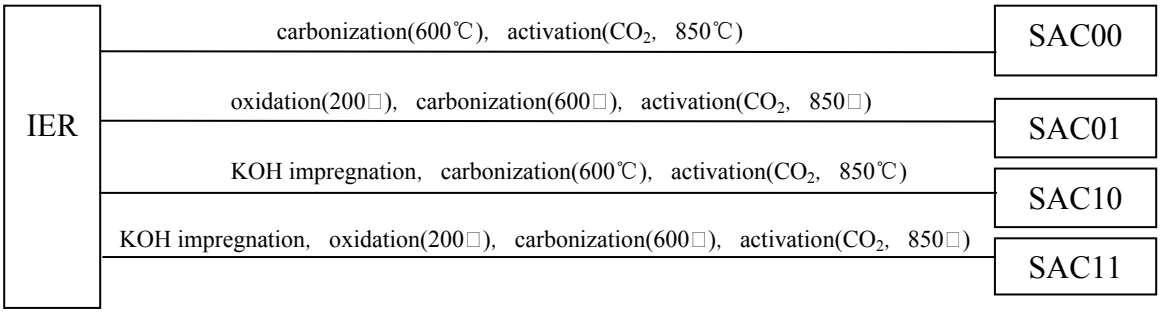

Figure 1. Preparation of SAC

Sample Characterization

The carbonization behavior of resin were studied with TG(NETZSCHTG-209). Titration method was used to determine the kinds and amount of functional group of SAC. The adsorption property of SAC was characterized by alcohol adsorption.

Results and discussion

The effect of KOH impregnation on the weight loss of resin

The weight loss of resin with KOH impregnation (resin b) and without KOH impregnation (resin a) were shown in Fig.2. It is clear that resin with KOH impregnation has higher yield than the resin without KOH impregnation.

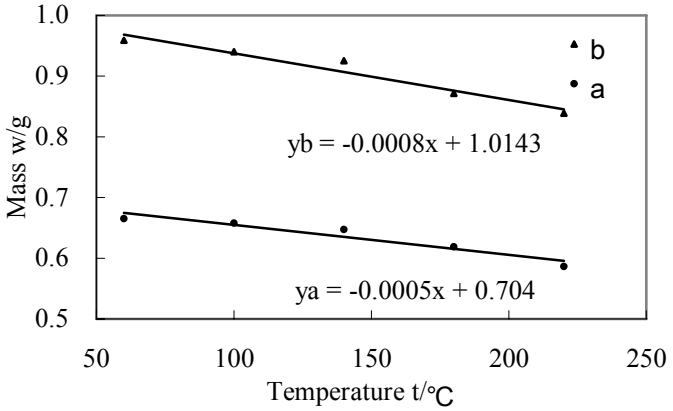

Figure 2. Weight loss of resin a & b during oxidation

The similar result can be found in their TG curves in N_2 atmosphere, Figure 3. The TG curves show that KOH impregnation can make the carbonization of resin take place at lower temperature, while the carbon yield increase.

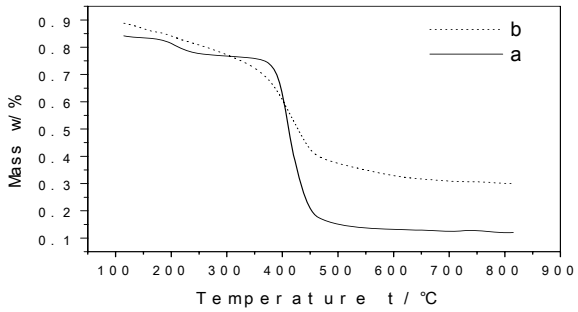

Figure 3. TG curves of resin a and resin b

The content of surface functional groups and adsorption property of SAC

The different preparation methods lead to different surface functional groups on the surface of SAC, causing different adsorption property, as shown in Table 1.

Table 1. The content of surface groups and adsorption property of SAC

Samples	−OH ($molg^{-1}$)	−COOR ($molg^{-1}$)	−COOH ($molg^{-1}$)	Total content of surface group ($molg^{-1}$)	Adsorption of alcohol (mgg^{-1})
SAC00	0.112166	0.091628	0.031619	0.235413	188.860
SAC01	0.066373	0.070417	0	0.136790	82.522
SAC10	0.088648	0.265118	0	0.353766	269.565
SAC11	0.020369	0.110482	0.12844	0.259291	147.315

It is noticed that oxidation before carbonization/activation lead to higher yields of SAC, while the surface functional groups decrease. However, KOH impregnation cause higher yields of SAC with more surface functional groups.

Conclusion

Oxidation can increase the carbon yield of resin and KOH impregnation can make the carbonization of resin take place at lower temperature. The large pores of the SAC from resin with KOH impregnation decrease largely and amount of surface functional group as well as adsorption ability to ethanol increase remarkably. The optimum conditions to prepare SAC with high yield are found at an oxidation temperature of 200℃, impregnated in KOH and the temperature of carbonization and activation is 600℃ and 850℃ respectively. The yield of resin-based SAC at the optimal condition is 28.3%, and the adsorption of alcohol is about two times that of the SAC without KOH impregnation.

References

Bratek, W., Bratek, K. and Kulazynski, M. 2002. The utilization of waste ion exchange resin in environmental protection. *Fuel Processing Technology,* 77-78, 431-436.