ADSORPTION AND DESORPTION OF SO_2 ON ACTIVE CARBON

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Introduction

Activated carbons have been used for many years, quite successfully, for adsorptive removal of impurities from exhaust gas and wastewater streams. They are probably the most versatile of the solid adsorbents, which have chemicals finally distributed on their internal surface and the most widely used for applications in air pollution control and solvent recovery.

The main objective of the present research is to determine whether activated carbon, Commercial or from apricot stones (AC), could be used effectively to adsorve pollutant gas SO_2, from flue gases.

Experimental

Preparation of Activated Carbons from Apricot stones

Apricot stones were cracked and sieved at about 2.5 mm. The stones were carbonization in a fluidised bed reactor, at 850°C, in flowing N_2 (3 dm^3/min), for about 45 min-1 hour and activated at 825°C for two periods of time (8 hours each), in flowing CO_2 (3 dm^3/min).

Characterization of Activated Carbons: Commercial and Apricot stones

The analyses are given in *Table 1.*

Adsorption and Desorption of SO_2

The samples (5 g) were treated with N_2 (600 cm^3/min) at 400°C for 30 minutes, to remove moisture and impurities. The adsorption occurs at three temperatures (T_{ads} = 20, 75 and 150°C), in flowing SO_2 (1400 cm^3/min). The carbon was then subjected to thermal desorption, in a stream of N_2 (600 cm^3/min), at heating ramp ranging from adsorption temperature to 400°C. This adsorption/desorption process described was performed two times.

Results and Discussion

Adsorption of SO_2

This study showed that the commercial carbon samples present certain instability, when adsorption and desorption occurred at 20°C, since different results were obtained for the three assays carried out. In Figure 1, it can be observed for the fine carbon (FC), that the adsorbed quantity of SO_2 decreases markedly with the increase of the adsorption temperature, as certain author have described [1,2]. However, for the coarse carbon (CC) this behaviour was not observed. When the amounts of SO_2 adsorbed at 75°C and 150°C are compared, the adsorption amounts at 150°C are slightly higher than the adsorption amounts at 75°C. It can be seen that, the CC adsorbed higher quantity of SO_2 than the FC. It can also be seen that, the amount of SO_2 adsorbed by the activated carbons decreases with increasing number of cycles, conferring what other authors have found [2]. Based on these experimental results, the temperature of 75°C has been selected as the adsorption temperature to carry out the adsorption and desorption process, on the AC.

In Table 2, it can be observed the amounts of SO_2 adsorbed on the Apricot-Carbon (AC) and the differences between the commercial carbon and the AC. The adsorption amounts of SO_2 on the AC were higher than the adsorbed on the commercial carbon, however, this quantity also decreases with increasing number of cycles.

Desorption of SO_2

In Figure 2, it can be observed that the desorbed quantity of SO_2 decreases markedly with the increase of the adsorption temperature, for the commercial activated carbons (FC and CC). For the temperature of 75°C and 150°C, the desorbed amounts are practically the same. It was also observed that, the FC desorbed more quantity of SO_2 than CC, this difference is more significant at 20°C. Once again, the desorption amount of SO_2 by the activated carbon decreases with increasing number of cycles. The desorption experimental results, obtained in this work are in accordance with previous studies [2], which conferring that the SO_2 can be adsorbed on the activated carbon in two different processes: physisorption (at lower temperature and occurs by one weakly bound on he surface carbon) and chemisorption (at higher temperature and occurs by one strongly bound on he surface carbon). In Table 3 it can seen the number and the temperature peak formation.

In Table 2, it can be observed the amount of SO_2 desorbed from the Apricot-Carbon (AC) and the differences between the commercial Carbon and the AC. The desorption amounts of SO_2 by the AC were higher than those desorbed by the Commercial carbon. However, for the second desorption it was observed that SO_2 desorbed quantity is slightly lower than the quantity desorbed from the second desorption of the commercial carbon sample. It was observed that this quantity also decreases with increasing number of cycles.

Conclusions

AC sample adsorbed and desorbed higher quantity of SO_2 from the surface of the carbon than the observed by the Commercial sample. This fact could be attributed to the difference properties, such as surface groups and the porous structure

AC will be the best sample for use in the removed of SO_2 from the exhaustion gases, released in the combustion systems.

References

1. Lisovskii, A., Shter, G. E., Semiat, R. and Aharoni, C, *Carbon*, 1997; **35** (10-11):1640-1643.
2. Davini, P., *Carbon* 1990; **28** (4): 565-570.

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Table 1 – Characteristics of the carbon samples

CARBON	Surface Area B.E.T. (m^2/g)	Total Pore Vol. (cm^3/g)	Particle Size (mm)	PZC
Commercial *	1116	0.610	Fine carbon (FC): 0.85 – 1.25 Coarse carbon (CC): 1.25 –1.70	9.8
Apricot	737	0.186	1 – 1.75	10.4

* MERCK BDH 33034 4Y

Table 2 – Resume of the adsorption and desorption amounts of SO_2 on the carbon samples, Tads = 75°C

	Fine Carbon	Coarse Carbon	Apricot-Carbon
1st Adsorption (mg/gC)	9.6	12	21.1
2nd Adsorption (mg/gC)	4.5	5.3	12.7
1st Dedsorption (mg/gC)	2.2	2.4	4.2
2nd Dedsorption (mg/gC)	1.2	1.3	0.9

Table 3 – Resume of the desorption - temperature peak formation

Carbon	T_{ads} (°C)	Assays	Temperature (°C)
Commercial	20	1st e 2nd Desor.	95 e 300 (Physiso. and Chemisor.)
	75	1st e 2nd Desor.	338 (Physisorption)
	150	1st e 2nd Desor.	338 (Physisorption)
Apricot	75	1st Desor.	146 (Chemisorption)
		2nd Desor.	138 e 297 (Physiso. and Chemisor.)

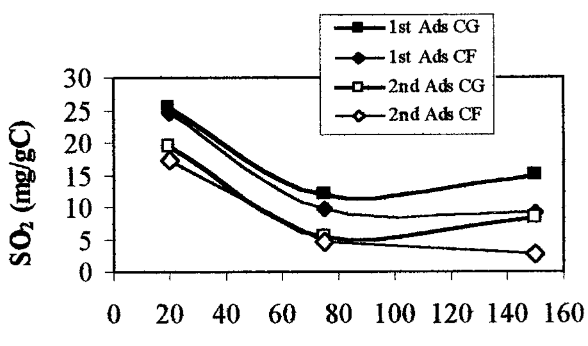

Figure 1 – Amount of SO_2 adsorbed by the carbon samples at three adsorption temperature.

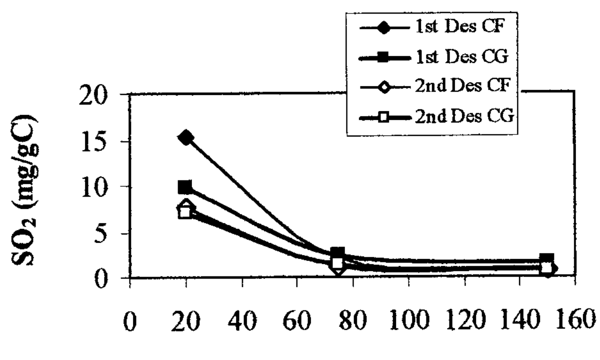

Figure 2 – Amount of SO_2 desorbed by the carbon samples at three adsorption temperature.