

POSTER

MESO AND MACROPOROSITY EVOLUTION OF ACTIVATED CARBONS FROM EUCALYPTUS WOOD.

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Introduction

Porous evolution of char formation and activation, starting with lignocellulosic materials, is frequently studied, remarking specially micro and mesopore evolution (1,2). In this work we focused the study on meso and macropores evolution, specially on SEM, gas adsorption and mercury porosimetry results correlation. In this way we tried to explain structural changes occurring during charring, previous heating up to activation temperature, and gasification, as well as the way that selected macropores are formed.

Experimental

Raw material was Uruguayan eucalyptus wood sawdust. *Wood char* was prepared by pyrolysis in a horizontal tube furnace at 800°C (named C800). As the char was heated up to activation temperature, *preheated char* was as well prepared, in N₂ and CO₂, (named C8N8 and C8C8). More information about procedures used can be found in other paper presented in this conference. Activated carbons were prepared in the same furnace, using steam or CO₂. For *CO₂ activation*, samples were heated at 10°C/min from ambient temperature up to 800°C, 1 to 4 h soaking time, and cooling in N₂. Products were named C8YZC, where YZ is burnoff percentage, and C indicates carbon dioxide atmosphere. For *steam activation*, the experimental procedure was similar, but the initial heating from ambient temperature up to 300°C was performed in N₂ atmosphere, and the activation temperatures were 750 and 800°C. Steam was produced inside the furnace by changing, at 300°C, N₂ gas by preheated liquid water, at the same molar flow than the CO₂ activation case. Activated carbons were named C8YZW (750) or C8YZW (800), depending on the activation temperature.

Characterization of char and activated carbons was done through N₂(77K) and CO₂(273K) adsorption, mercury porosimetry and scanning electron microscopy. An automatic adsorber

Autosorb-1 from Quantachrome, and a Carlo Erba porosimeter 4000 were used, scanning up to a 2.000 bar maximum pressure; micrographs were obtained using a JEOL scanning electron microscope model JSM 840.

Results and discussion

N₂ S_{BET}, N₂ V_{DR}, and meso and macropore volumes for char, preheated chars and activated carbons are shown in Table 1 and 2. For the sake of simplicity, pore size distribution from mercury porosimetry (3) are shown for wood, C800 and some derived products only, on Fig. 1-4.

An important macropore presence was noted in original sawdust (Table 1 and Fig. 1). Heating during charring produced contraction of wider macropores in C800 (Fig. 2), while char heating up to 800°C produced only a small increase in total macropore volume (Table 1). Comparison of pore distribution for preheated chars showed that heating in CO₂ atmosphere increased the importance of wider macropores in a small degree (Fig. 3). For initial CO₂ gasification stages a new macropore contraction was noted (Table 2), probably as a result of predominancy of the "annealing" effect over the gasification one. For the same burnoff, pore diameter widening is more important for steam activation and higher activation temperatures. The gasification effect is seen as a creation of mesopores from micropores, and of macropores by mesopore widening and coalescence (Fig. 4). For steam gasification, the meso and macropores formation was largely more important than for CO₂ gasification, and the volume formed was doubled.

The corresponding SEM micrographs, not shown in this abstract, are very illustrative about the porosity formation process. For sawdust and char, only fissures and isolated holes are seen. In the case of heated chars, the beginning of macropore formation, particularly on places where original wood "pits" were present (4), is verified. Finally, for derived activated carbons,

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pore formation as a consequence of gasification is clearly noted.

Conclusions

Macropore evolution for wood char and derived activated carbons is a process involving successive "annealing" and pore widening effects. The presence of more reactive places in the original material determines the preferential creation of macropores with a selected range of pore diameters.

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References

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Table 1. Wood sawdust, C800, and N₂ and CO₂ preheated C800 porous evolution

	Wood sawdust	C800	C8N8	C8C8
N ₂ S _{BET} (m ² /g)	-	490	600	600
N ₂ V _{DR} (cm ³ /g)	-	0.21	0.24	0.25
V _{MESO} (cm ³ /g)	0.03	0.05	0.02	0.04
V _{MACRO} (cm ³ /g)	0.41	0.92	1.10	1.08

Table 2. C8YZC and C8YZW series porous evolution

	C8YZC Series				C8YZW (800) Series			C8YZW (750) Series		
Burnoff (%)	13	26	35	47	26	40	56	20	36	47
N ₂ S _{BET} (m ² /g)	780	970	1040	1220	870	1030	1190	810	940	1070
N ₂ V _{DR} (cm ³ /g)	0.31	0.39	0.44	0.48	0.36	0.43	0.50	0.34	0.39	0.45
V _{MESO} (cm ³ /g)	0.07	0.06	0.15	0.26	0.24	0.38	0.60	0.11	0.26	0.36
V _{MACRO} (cm ³ /g)	0.94	0.91	0.98	1.10	1.59	1.97	2.38	1.37	1.63	2.04

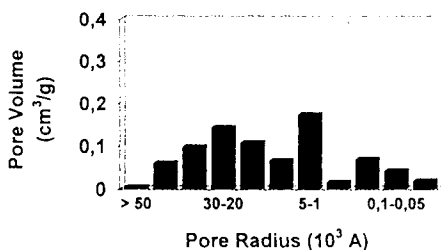


Fig. 1. Wood

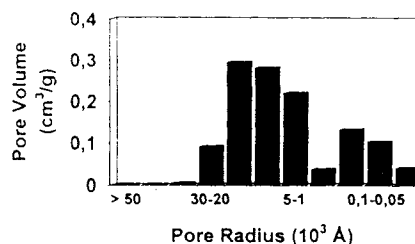


Fig. 2. C800

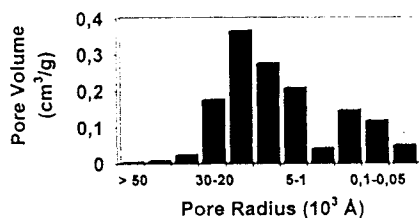


Fig. 3. C8C8

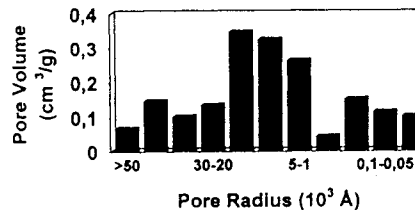


Fig. 4. C847C