STUDYING THE MACROPOROSITY DEVELOPMENT FROM THE PRECURSOR TO THE ACTIVATED CARBON BY SEM

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Introduction

Bagasse is the principal by-product of the production of saccharose by sugar cane. Its principal use is as fuel for the sugar mill's furnaces. Processing of Guava juices and jams produces a large amount of solid wastes, in particular seeds which remain unused. Aroma industries release Almond shells. In the search for other alternative chemical uses for lignocellulosic by-products and to generate economic utilization for theses cheap and abundant wastes, it is proposed to use them as starting materials for the preparation of activated carbons. The latter are used in the air or liquid cleaning. In the case of fluid treatment, the macroporous activated carbons are preferred because they can facilitate the access to the micropore system and they have important liquid retention. Here, we report the results of a study on the evolution of macroporosity from the precursor to the activated carbon for the three precursors.

Experimental

The botanical analysis of three agricultural by products (Bagasse, Guava seeds and Tropical Almond shells) is performed using extraction methods [1]. Then, the three raw materials are respectively subjected to physical activation : carbonization at 800°C under N_2 atmosphere (70 mL/min), 1 hour soaking time ; oxidation under a CO_2 atmosphere (60 mL/min) at 800°C until 40-50 % burn-off in a quartz tube crossing an electrical furnace. The macropore evolution is studied from the precursor to the activated carbon obtained, using the scanning electron microscopy (Hitachi S2500).

Results and discussion

The botanical analysis of the three precursors is reported in table 1. Bagasse is rich in holocellulose and extractives, Guava seed in lignin and extractives while Tropical Almond shell is rich in holocellulose and lignin.

The SEM results show that :

- The fiber of Bagasse is arranged longitudinally while that of Guava seed or Tropical Almond shell is athwartship.
- The porosity (quantity, localization, distribution and size) is different in function of the precursor.
- The macroporous structure is retained from the precursor to the char and from the char to the activated carbon. And the organization of the fiber increases from the precursor to the activated carbon.
- The porosity development varies with the precursor. Some macropores are created. Others, already present, are widen directly or by union of two smaller pores.

Conclusion

The objective of this work is to correlate the precursor structure (mixture of the major components: holocellulose…), texture (existing porosity…) to the porosity of the resulting activated carbon and to see in which measurement these results can be generalized. Lignocellolosic materials give essentially micro and macroporous activated carbons. Considering the uniform development of porosity for Guava seed during the two steps of physical activation, it seems to be the best precursor for the preparation of activated carbon.

References

1. Ouensanga A. Variation of fiber composition in sugar cane stalks. *Wood and Fiber Science* 1989 ; **21** : 105-111.

Table 1. Botanical analysis of the three precursors.

precursor	Guava seeds	Bagasse	Tropical almond shells
Lignin (% weight)	41.7	22.1	40.3
Cellulose	28.0	41.3	37.9
Hemicellulose	15.5	24.7	21.6
Extractives	16.8	13.4	1.6

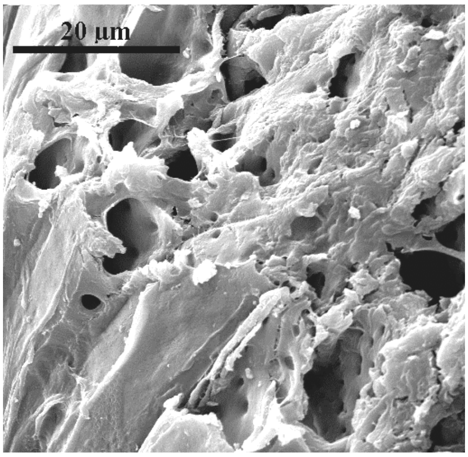

Figure 1. Guava seed (total porosity : 0.2 cm^3/g).

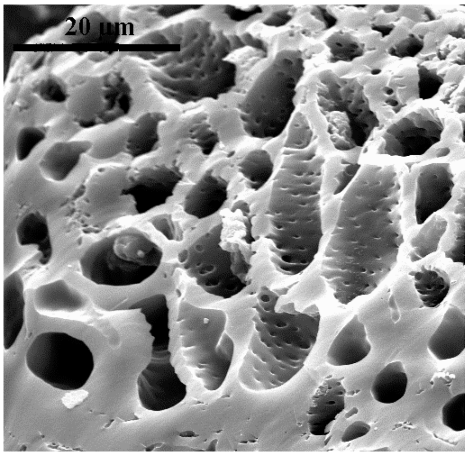

Figure 2. Guava seed char (800°C; 1h; 10°C.min^{-1}). Char yield : 28.4 % ; DR micropore volume calculated by CO_2 adsorption isotherm at 273K : 0.2 cm^3/g.

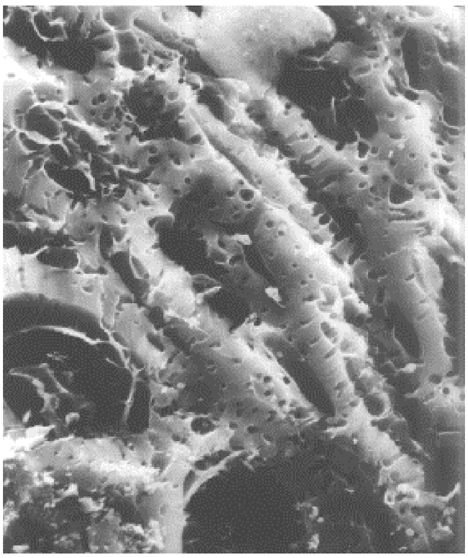

Figure 3. Activated carbon from Guava seed (oxidizing gas : CO_2, BO = 40 %). DR micropore volume calculated by N_2 adsorption isotherm at 77K : 0.4 cm^3/g.