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Study of the Purifying Capacity of the Coconut Carbon from Fibrous Mesocarpe

G.H. Briton Bi, B.Yao and G. Ado
Laboratoire de Procédés Industriels de synthèse et de l'Environnement,
Département de Génie Chimique et Agroalimentaire, Institut National Polytechnique
Houphouët-Boigny, BP 1093 Yamoussoukro, Côte d'Ivoire

Abstract: In this study, synthesis and purifying capacity of the Coconut Carbon from Fibrous Mesocarpe were studied. The characterization of this absorbing material gave a specific surface of 315.4 m^2 g^{-1} and pores diameters ranging between 18.1 and 341.1 Å. The tests of treatment of wastewater highlighted, a COD fall rate going from 84 to 94% according to operating conditions, attesting great purification capacity of material.

Key words: Activated carbon, water treatment, coconut fibrous, pollutants elimination, wastewater

INTRODUCTION

The microporous adsorbents are abundantly used in the extraction of chemical or vegetable species in gas or aqueous phase because of their excellent capacity of adsorption. This capacity is related to their great specific surface and the development of their porosity. The activated carbon, one of these substances presents a very great porosity and a significant specific surface (500 to 1500 m^2 g^{-1}) (Legros, 1980; Legube, 1996; Avom *et al*., 2001). They are used in water purifying, discolouration of sugars, volatile solvent recovery, dyes fixing and gases treatment (Avom *et al*., 1997; Lee and Reucroft, 1999; Malik *et al*., 2002; Krishnan and Anriudhan, 2003). In order to develop biomass in tropical zone and singularly in Côte d'Ivoire, we were interested in a vegetable matter, abundantly available and without cost (the fibrous mesocarpe of coconut) whose carbon could constitute an alternative to industrialists ones relatively expensive. In this study, the mesocarpe fibrous of coconut, waste of the industry of copra were used to prepare a carbon, likely to reduce the polluting load of wastewater.

MATERIALS AND METHODS

Carbon preparation: The fresh mesocarpe fibrous of coconut are initially dehydrated at 150°C in a drying oven during 45 minutes and are carbonized at 600°C during 1 hour. The material obtained is treated with ebullient water during 30 min. This last operation is renewed 5 times. This last step is followed by a drying at 90°C of the product during 10 h.

Determination of the carbon characteristics: Specific surface and porosity were determined by adsorption-desorption of nitrogen according to the isotherm of Langmuir method. Measurements were performed with a Micrometrics Gemini 2375 V4-01 apparatus.

Procedure of the treatment test: The treatment tests were carried out into a tubular reactor with fixed carbon bed. Wastewater crosses the bed under variable flow. The evolution of the pollution parameter (COD) was studied for various granulometry of the carbon particles. Purified water samples were taken on the outlet side of the reactor and the COD, was performed respectively according to standardized methods AFNOR T 90-101.

RESULTS AND DISCUSSION

Characteristics of the materials: Table 1 shows respectively the characteristics of carbon. A specific surface (Langmuir) of 315.4 m^2 g^{-1} was obtained. This value, compared with those of the bibliography (500 to 1500 m^2g^{-1}) is relatively low. That can be due on the one hand, by the fact that it was not activated and on the other hand by the type of material. However the value of 315.4 m^2g^{-1} is largely higher than the specific surface of certain non activated adsorbent materials (Avom *et al*., 2001). The pores are mesopores (Legros, 1980) since their diameters vary from 18.1 to 481.1Å.

Table 1: Characteristic of the carbon

Specific surface of the carbon (m^2g^{-1})	Diameter of the pores (Å)
315.4	18.1-481.1

Corresponding Author: B.Yao, Institut National Polytechnique Houphouët-Boigny, Département de Génie Chimique et Agroalimentaire, BP 1093 Yamoussoukro, Côte d'Ivoire Tel: 00225 07 80 05 19 Fax: 00225 30 64 04 06

Pollution parameters variation: Figure 1 gives the evolution of the COD as a function of the time and the particles diameter. Generally, the curves are characterized by an ascending phase during the first 10 minutes, followed by a stationary one. This last phase seems to indicate a saturation of the absorbent. The maximum of pollutants is absorbed into 10 min, indicating a very fast surface phenomenon. Figure 2 and 3 represent the COD fall rate respectively as a function of the particles size and wastewater flow. Values of the correlation coefficients (R^2), higher than 0.9 translate the linearity of phenomenon. It appears that the COD fall rate is inversely proportional with the size of the particles and the flow of wastewater. Indeed, it is well-known that the global contact surface of a solid powder material increases when the size of the particles decreases and consequently, the acceleration of the adsorption phenomena. The effect of the flow translates certainly a problem of contact time that must be relatively high to allow a significant reduction of the COD. Moreover, the COD strong fall rate (higher than 80%) traduces the very good purifying capacity of the material synthesized. The optimum is obtained for a particle diameter of 0.5 mm and a flow of 0.5 L h^{-1}.

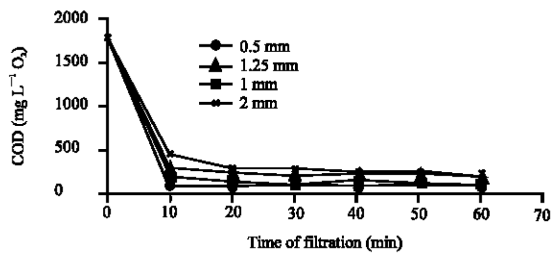

Fig. 1: COD as a function of the filtration time and the particle size

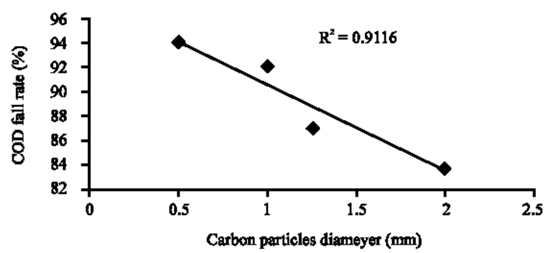

Fig. 2 : COD fall rate as a function of particles diameter

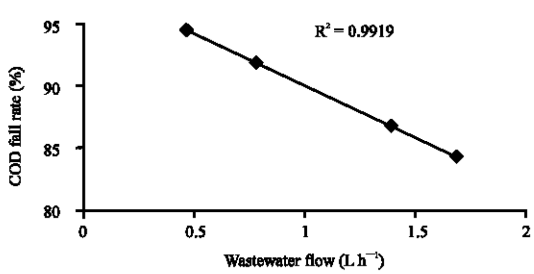

Fig.3: COD fall rate as a function of wastewater flow

CONCLUSIONS

The aim of this study was to evaluate the purifying capacity of the coconut carbon from fibrous mesocarpe. The results showed that the specific surface of this carbon was of 315.4 $m^2 g^{-1}$ and a pores diameters ranging between 18.1 and 481.1 Å. Implemented in the treatment of wastewater, it was obtained COD rates fall higher than 80%, indicating a good purifying capacity of this material.

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