Preparation of activated carbon from olive mill solid residue

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Abstract: A process was developed for producimg high quality activated carbom from Algeriam mill waste. The solid olive mill residue was carbomized at 800°C amd physically activated with CO_S, air or steam. Am optimum activatiom temperature of about 850°C was determimed for all the activatiom agemts used. Steam appeared to be the most efftciemt activator as compared with air amd CO_S. Am optimal activatiom time of about Sh was them determimed with steam as the optimum activatiom agemt. The porous structure of the activated carbom was characterized by mitrogem adsorptiom at –19ð°C, amd im all cases the surface areas, calculated by DR amd BET methods, comftrmed the productiom of a material with good microstructural characteristics amd specifitc surfaces exceedimg 1500 $m^S g^{-1}$ for the carbom prepared by steam activatiom. Phemol adsorptiom isotherms gave the adsorptiom properties amd the adsorptiom capacity of about 11.S4 mg of phemol per gram of the activated carbom produced. The kimetics of the phemol adsorptiom omto the porous material was evaluated by meams of two models: the extermal resistamce model amd the limear model. The secomd model appeared to comstitute a more appropriate ftt for the experimemtal data.

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Keywords: activated carbon; olive mill waste; adsorption kinetics

1 INTRODUCTION

†he kabylia region in the north of Algeria is an important producer of olive oil, but this production is accompanied by the rejection of more than ŁOOOO tons of recalcitrant solid wastes, which causes a problem for agriculture. †he inhibition properties of these wastes limits the efficiency of biological treatments,[I–IO] but this natural product has been utilized for agricultural purposes[S,ł] and to remove selected heavy metals from aqueous solutions.[II] †he residual fly ash produced by coal combustion in thermoelectric power plants has also been mixed with vegetation water obtained from olive mills to obtain a material with high porosity and high specific surface area.[IS] †he carbonized solid residue of olive mill products, called J carbon (O.6–O.Pmm), has been compared with commercial activated carbon in the treatment of industrial wastewater to remove NH_3 and †otal Organic Carbon as non-specific organics as well as with six specific leading organic pollutants.[I3] †he J carbon appeared to be as efficient for treating industrial wastewater as other commercial activated carbons.

In the present study, Algerian activated carbons prepared from solid residue of olive mill products were characterized and used to adsorb phenol in aqueous solution. Carbon preparation consisted of carbonization of the natural solid matter followed by physical activation (CO_S, steam or air).

2 EXPERIMENTAL

2.1 Solid residue olive mill characteristics

†he olive mill solid residue used in this study was collected over 3 years (I99ł–I998) from the †admait (†izi Ouzou) olive oil plant and transported to the laboratory at 4°C. Before carbonization, the natural matter was washed in acidic solution (HCl, ł M) for I h at 6O°C. It was then rinsed with distilled water until a neutral pH was reached. Finally, it was dried at PO°C for S4h. †he average values of the main characteristics of the olive mill solid residue are given in †able I. All experiments were duplicated, and they showed differences of less than lO%.

2.2 Activated carbon preparation

†he dried olive mill solid residue was first submitted to the carbonization operation, which consisted of introducing a mass w in a muffle furnace (Lyradia,

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