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CALORIMETRIC STUDY ON ACTIVATED CARBONS OBTAINED FROM WASTE TIRES FOR THE ADSORPTION OF TRITON X-100

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Introduction

In recent years there has been a worldwide increase in tire waste, where World Cities generate about 1.3 billion tons of tire waste per year. This volume is expected to increase to 2.2 billion tons by 2025[1,2] and much of it ends up in sidewalks, wetlands, parks, and separators, causing health problems. One solution could be to use these waste tires as a resource to produce activated carbon, which can then be used to remove Triton X-100 from waterways. In this work a calorimetric study of activated carbons in benzene, water, hydrochloric acid, sodium hydroxide, and triton X-100 is carried out.

Materials and Methods

Activated carbons were obtained from waste tires with a particle size of 0.3mm. These carbons were obtained by chemical impregnation with potassium hydroxide, using two concentrations of impregnating agent (30% and 40%) and two carbonization temperatures (700ºC and 900ºC). The activated carbons obtained were characterized by: physisorption with nitrogen and carbon dioxide, elemental analysis, infrared spectroscopy, scanning electron microscopy, and Boehm titration. Finally, the activated carbons were studied with immersion calorimetry. In this study, the inmersion enthalpy was determined using different solvents.

Results and Discussion

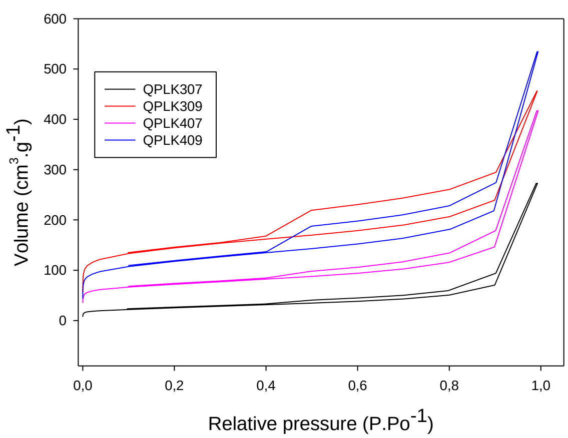

Figure 1. Isotherm of nitrogen adsorption at -196ºC.

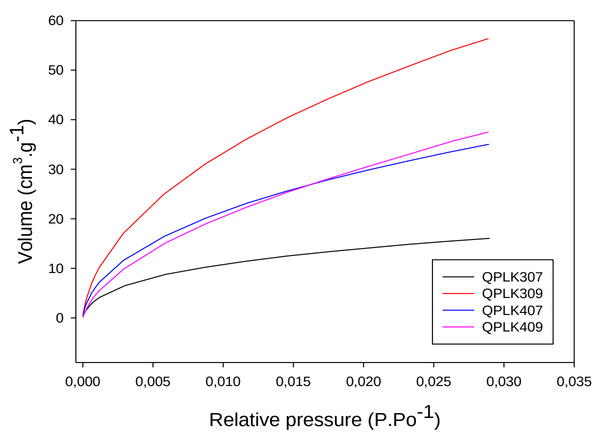

Figure 2. Isotherm of carbon dioxide adsorption at 0ºC.

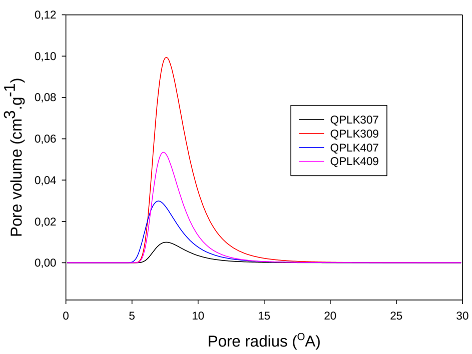

Figure 3. Pore size distribution by Dubinin-Astakhov.

Table 1. Textural properties of the activated carbon (Dubinin Astakov) and yield in the carbonization process

SAMPLE	Yield (g_{CA}/100g_{tire})	BET S_{BET} ($m^2.g^{-1}$)	BET C	Dubinin Astakov V_{micro} ($cm^3.g^{-1}$)	Dubinin Astakov E_o ($kJ.mol^{-1}$)	Dubinin Astakov n	Dubinin Astakov Pore width (Å)	V_{meso} ($cm^3.g^{-1}$)
QPLK307	41	89	380	0.033	6.293	2.1	7.6	0.39
QPLK309	40	528	770	0.198	7.093	2.2	7.3	0.51
QPLK407	40	263	1182	0.101	7.926	1.9	7.0	0.54
QPLK409	40	426	680	0.157	6.942	2.3	7.4	0.67

Table 2. Immersion enthalpies determined for solids in contact with triton x-100

Sample	Enthalpy of immersion J.g^{-1} Triton X100 200mg.L^{-1}	Enthalpy of immersion J.g^{-1} Triton X100 1000mg.L^{-1}
QPLK307	7,880	4,942
QPLK309	18,391	11,443
QPLK409	12,478	9,013

Figure 1 shows that the type of isotherm obtained, according to the IUPAC[3] classification is type IV, where a hysteresis loop is presented. This type of isotherms is characteristic of micro-mesoporous solids. With these isotherms, the textural parameters were determined, finding that the sample with the largest BET area is QPLK309, with a micropore volume of 0.198 $cm^3.g^{-1}$ and mesoporum 0.51 $cm^3.g^{-1}$. Additionally by Dubinin-Astakhov is a pore size between 7.0 -7.6 Å (figure 2, table 2).

Table 2 shows the immersion enthalpies of the activated carbons using Triton X-100 as a liquid at two different concentrations, finding that the enthalpy of immersion has a correlation with the BET surface area and the textural properties.

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