Porosity distribution in spherical activated carbon particles

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Introduction
Controlled gasification of carbonaceous materials, as the fundament of char activation process, has been an extensively studied field. Many authors have focused their work to the synthesis of activated carbons from different raw materials, using both thermal and chemical activation methods concerning thermal activation, influence of carbonization parameters, applied activating agent, reaction temperature and retention time has been described [1,2,3].

The objective of this work is to evaluate the characteristics of the porosity, at various levels of both gasification temperature and conversion degree, following the radial distribution of porosity in Quercus Agrifolia carbon spheres.

Char spheres were activated, using CO2 as activating agent (300 ml/min), at 820 and 860°C. For each one of these temperatures, the gasification reaction was run until desired conversions (30, 50 and 70%) were reached. The activation process was performed using TGA equipment (TA Instrument SDT 2950). In order to perform the evaluation of the radial distribution of the porosity, two layers were removed from particles, obtaining then three fractions for analysis: an outer layer, between 4 mm and 3.5 mm diameter, a medium layer between 3.5 mm and 1.95 mm diameter and the core of 1.95 mm diameter.

Porosity of obtained samples was measured according to physical characterization performed using an automatic system (Quantachrome Autosorb 1), through physical adsorption of nitrogen at –196°C, obtaining the micropore volume (V0), total pore volume (Vt) and the mesopore volume calculated as the difference between Vt and V0.

Results and Discussion
Figure 1-a and 1-b depicts evolution of micropore volume and mesopore volume respectively as a function of reaction conversion. From obtained results some points could be highlighted:
1. For given experimental conditions, there were not significant differences in observed porosity ($V_{mi} + V_{me}$) values or in its development between the three analyzed particle zones at low temperature. The analysis should include the macropore volume in order to find out the expected trend (higher pore volume for the external layer and lower for the core).

2. Mesoporosity is enhanced at low activation temperatures, reaching the highest values for high conversion levels. Under such circumstances, mesoporosity appears to decrease toward the core of the particle.

3. For the high activation temperature, both micro and mesoporosity show the same pattern in the middle zone and in the core of the particle as conversion is increased. In the external layer the mesopore formation undergoes a slight increment up to the greatest achieved conversion.

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