TEXTURAL DEVELOPMENT OF ACTIVATED CARBONS PREPARED FROM RECYCLED PET WITH DIFFERENT CHEMICAL ACTIVATION AGENTS

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Abstract

In this work a series of microporous activated carbons, with different burn offs, was prepared from recycled PET provided by Selenis (Portalegre-Portugal). These AC were prepared by chemical activation with KOH, NaOH and H_3PO_4, and carbonised under a N_2 flow of 85cm^3min^{-1} between 873 and 1273K. The carbonised samples were then cooled and successively washed until the washable solutions achieved a pH around 7.0, afterwards these were dried at 110ºC. All adsorbents were characterised by the adsorption of N_2 at 77K and the pH_{pcz} and the elemental analyse were determined. First, with all activation agents when the carbonization temperature increased up to 723K, the carbonization yield increased. With NaOH, the carbonization yield varied from 8 to 31% and the optimal ratio of NaOH/PET was less than with KOH. The pore size was in all cases larger (between 1.15 and 2.4 nm) when compared with the AC obtained with the other activating agents. On the other hand, the AC prepared with H_3PO_4 present the narrowest pore size (between 0.76 and 0.83 nm) and the highest micropore volume (0.34 cm^3 g^{-1}) was obtained with a ratio of H_3PO_4/PET =0.75. All samples prepared with H_3PO_4 present an acidic point of zero charge, between 2.3 and 4.2.

AC prepared by chemical activation with KOH, when the carbonisation temperature increased from 873 to 1173 K the yield decreased from 33.5 % to 23%. While at 1273K, the carbonization was too extensive, so this temperature was considered too high, as we only obtained ash. Fig.1 presents the N_2 adsorption isotherms on some of the AC activated with KOH at different temperatures, with a ratio of KOH/PET=2. All isotherms are type I typical of microporous carbons. At lower temperatures, the initial steep increase in adsorption is followed by an almost horizontal plateau. However at 1173K the extent of the opening of the knee shows an obvious variation, which generally increases with the pore enlargement.

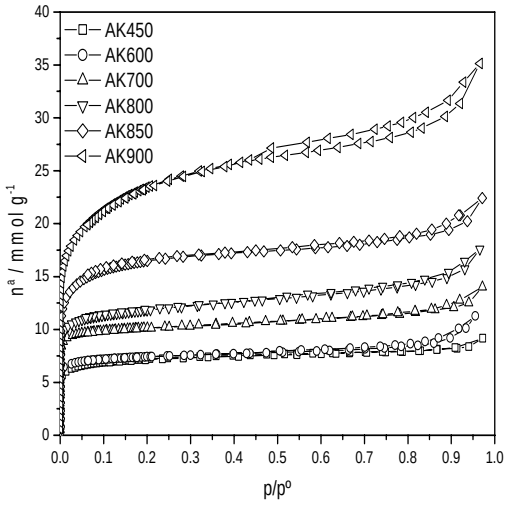

Fig. 1. Adsorption isotherms of N_2/77K on AC prepared from recycled PET with KOH at different temperature; (KOH/PET = 2).

These samples present the highest surface area and also the highest micropore volume when compared with those prepared by chemical activation with NaOH or H_3PO_4. The micropore volume and the mean pore size increase from 0.18 to 0.75 cm^3g^{-1} and 0.64 to 1.52 nm respectively and reach a maximum value at 1173K. All AC prepared with KOH had a basic point of zero charge between 6.44 and 7.96, but when NaOH was used as activation agent the AC has a highest point of zero charge, around 9.4. These parameters are relevant to the AC selection for application in organic compounds removal, as the adsorbents with a basic point of zero charge and lower oxygen percent were considered more efficient for organic pollutant removal and specifically for phenol removal. In our work, the chemical activation with different agents, and in particularly with KOH, allows one to produce AC with a well-developed microporosity (0.75 cm^3g^{-1}) and a shorter time of carbonisation-activation is needed when compared with some published methods.