New acrylic monolithic carbon molecular sieves for O_2/N_2 and CO_2/CH_4 separations

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Abstract

The modification of activated carbon fibres prepared from a commercial textile acrylic fibre into materials with monolithic shape
using phenolic resin as binder was studied. The molecular sieving properties for the gas separations CO_2/CH_4 and O_2/N_2 were evaluated
from the gas uptake volume and selectivity at 100 s contact time taken from the kinetic adsorption curves of the individual gases. The
pseudo-first order rate constant was also determined by the application of the LDF model. The samples produced show high CO_2 and O_2
rates of adsorption, in the range $3–35 \cdot 10_{-3}$ s_{-1}, and in most cases null or very low adsorption of CH_4 and N_2 which make them very
promising samples to use in PSA systems, or similar. Although the selectivity was very high, the adsorption capacity was low in certain
cases. However, the gas uptake in two samples reached 23 cm_3 g_{-1} for CO_2 and 5 cm_3 g_{-1} for O_2, which can be considered very good. The
materials were heat-treated using a microwave furnace, which is a novel and more economic method, when compared with conventional
furnaces, to improve the molecular sieves properties.

Keywords: Carbon fibres; Molecular sieves; Heat treatment; Scanning electron microscopy; Adsorption properties