Breakthrough Experiments of Miniaturized and Full-Size Cartridge for Organic Vapors

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Modelization of cartridge service life requires activated carbon parameters that are typically obtained from static equilibrium adsorption isotherms with N_2 at 77 K. In a previous study we have shown that carbon parameters such as the micropore volume could be obtained from breakthrough experiments with organic vapors and the Dubinin Radushckevish (DR) equation. However, many of the solvents selected were water soluble, and control of the environmental conditions proved difficult. Therefore, the aim of this study was to design a miniaturized (MINI) cartridge capable of reproducing full-size cartridge breakthrough experiment to gain a better control over environmental conditions and to characterize the microporosity of activated carbons with hydrophobic organic vapors.

To validate the MINI approach, a parallel breakthrough experiments set-up was designed and a repeatability and reproducibility study was conducted. Ten commercially available cartridges and their "equivalent" MINI were studied with five organic solvents at 298 K, 500 ppm and 40% relative humidity . Experimental (gravimetric) and calculated adsorption capacities were used to construct an OV universal adsorption isotherm for each activated carbon. The micropores of the series of activated carbon were also characterized with Ar at 87.3K and CO_2 adsorption at 273 K for comparison

Results have shown similar breakthrough times and adsorption capacities of activated carbon for the MINI and full-size cartridges. The predicted (DR) micropore volume from the OV universal adsorption isotherm corresponded to the values obtained with argon. The pore size characterization with Ar and CO_2 adsorption data in combination with the OV universal adsorption isotherm allowed for a reliable and more complete characterization of narrow microporosity in activated carbon for OV.