Going Towards Saturisk 2. Updates and improvements for predicting service life of organic vapors cartridges

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Background: Because no ESLI (End-of-Service-Life-Indicator) is routinely available yet for organic vapors respirator cartridges, semi-empirical models are used to predict the cartridge service life for many different chemicals. There are different tools available on the web, including Saturisk, released by the IRSST in 2008. As the quality of the generated breakthrough time (service life) depends on the quality of the input data, it was decided to investigate where improvements could be realized. Also, Saturisk could provide user with data for 6 different non-powered air purifying respirator cartridges. Saturisk 2 should be able to provide breakthrough data for about 20 powered and non-powered air purifying respirator cartridges.

Methods and Approach: The existing predicting models rely on data from the activated carbon such as micropore volume, environmental exposure data (T, P, concentrations…) and physio-chemical data for the organic vapors. To check accuracy of the model-predicted results, a comparison with experimental results is often made. Experiments performed with real cartridges are time consuming and control of the exposure conditions (vapor concentration, humidity, temperature, flow rates) might be difficult during long experiments.

Therefore, the aims of the study were:

- Develop a universal “Small Scale Cartridge” (SCC) capable of reproducing breakthrough tests of real-size cartridges, while allowing a better control of exposure conditions.
- to compare different methods to determine the micropore volume

Five organic vapors with different volatilities were used in this study. Breakthrough tests were carried out at 21 °C, at a concentration of 500 ppm and at 40% relative humidity, with SCC and real cartridges. Conditions for downscaling real cartridges experiments with SCC were determined. It was required to calculate an amount of activated carbon to put in the SCC to maintain equivalent air velocity and apparent carbon density between the SCC and the real cartridge.

Results: It was shown that the breakthrough times for the SCCs were close to that of the real cartridges for a similar vapor concentration. Furthermore, the SCC allows determination of adsorption isotherms to calculate the activated carbon adsorption capacity and micropore volume. Those values were compared with data obtained with N_2, Ar and CO_2 adsorption.

Preliminary conclusion: This SCC proved to be an efficient means to obtain reliable data to be used on a modified version of the Wood’s model to estimate the service life of cartridges while providing controlled environmental conditions and reducing waste (less solvents used).