Prediction of the service life time of cartridges for personal protection in case of multicomponent gas

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This work is part of a larger work whose aim is to develop a model for prediction of the service life of cartridge for personal protection in various conditions. The model is based on coupled mass and heat transfer equations. The mass transfer at the interface of the activated carbon grain is based on the LDF approach. The mass balance lets a set of coupled nonlinear partial and ordinary differential equations. These were solved using the numerical Comsol Multiphysics® software. Experimental sorption isotherms and breakthrough fronts at 25 ° C were performed on four pure Volatil Organic Compounds –(VOC) in dry conditions: ethanol, cyclohexane, acetone and heptane. The measurements were made on a column filled with activated carbon provided by PICA. The measurements were used to determine both the Langmuir constants and the LDF mass transfer constant. These constants are then used in the model and the breakthrough curves in binary mixtures of acetone / ethanol, hexane / cyclohexane and ethanol / cyclohexane have been predicted at the time on a column of laboratory but also on a real cartridge mask gas.

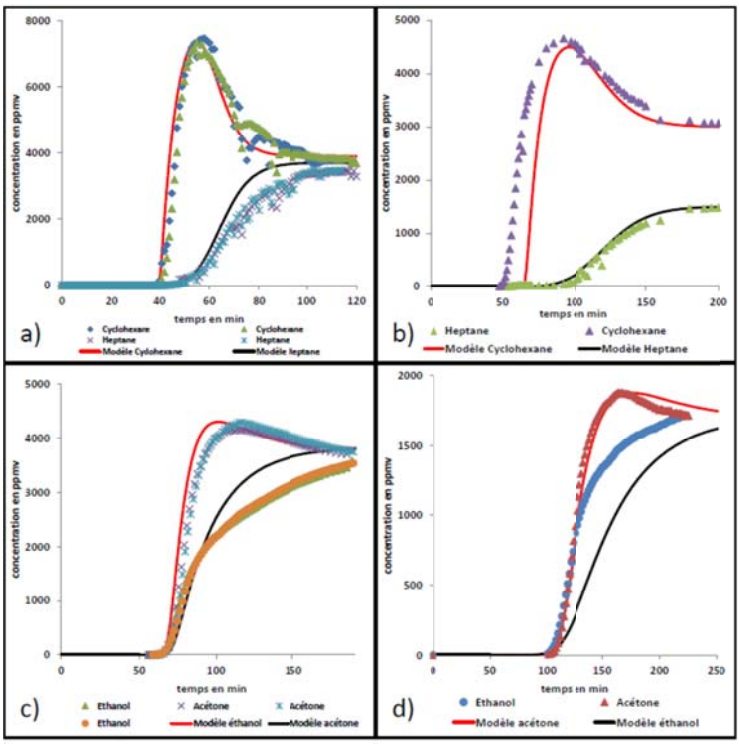

Figure: Experimental and predicted breakthrough curves for cyclohexane / heptane (above) and ethanol / acetone (below) binary mixtures on real cartridges.

The results show a very satisfactory agreement for both systems showing that it is possible to predict the behavior of cartridges using polar / polar, apolar / apolar or even polar / apolar binary mixture.