New aspects in gas filter testing: Are small capacity cartridges still safe at high work rates?

Nadine Haupt, Peter Paszkiewicz

Hans-Ulrich Tobys
Berufsgenossenschaftliches Institut für Arbeitsschutz
BGIA – BG Institute for Occupational Health and Safety of HVBG, Germany
Email: nadine.haupt@hvbg.de

Problem definition:
Following the new user-oriented ISO approach in standardization of respiratory protective devices different work rate levels in terms of corresponding volume flow rates are discussed to be introduced into certain respirator tests. This is to make sure that even at elevated flow rates the use of RPD is still safe. There is a certain fear that very small gas filter cartridges might show some weaknesses under such forced conditions due to their short bed depth compared to the required residence time of some gases for adsorption. This concern was the reason for a pre-normative study on the dynamic behaviour of selected small gas filters types under continuous and sinusoidal flow mode at various flow rate levels.

Methods:
Small capacity gas filters against organic vapours with a capacity of about half of those usually known within Europe as A1 filter (according to EN 14387:2004) have been selected. Gas filter testing with cyclohexane at various concentrations (300 ppm and 1000 ppm) under continuous and sinusoidal flow mode has been performed at different average flow rates in the range of 30 – 80 lpm as defined by the ISO /TC /WG1 PG5 N014. An artificial lung was used to generate a sinusoidal function to roughly simulate human breathing. In addition to that the peak flows (90 – 250 lpm) corresponding to the respective sinusoidal average flow rates have also been tested continuously to study their influence on the residence time. An ABEK1 filter was used as a reference for most of the tests.

Findings:
The small cartridges show already at the beginning of the test an instantaneous breakthrough of the test gas under nearly all conditions performed. The effluent concentration was slowly increasing over time starting at different levels depending on the flow mode, the flow rate and the test gas concentration. In comparison to that the ABEK1 filter did not show this phenomenon at all.
Further it was found that the residence time is reduced by using the dynamic flow mode compared to the continuous flow at the same average flow rate.

Conclusion:
The observed and characterised effect of instantaneous breakthrough is reason for further systematic investigation taking even higher flow rates and other type of filters with their respective test gases into account. This is to provide the ISO standardisation committees with sufficient information to have a valid basis to create obviously necessary requirements and a residence test accordingly in view to more safety in use of gas filters in future.