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Over the last few years the adsorptive purification of the gas phase in HVAC-Systems has got more and more focussed. One of the reasons for this trend is the fact that people in Europe and North America spend 85-90 % of the day time in indoor environments, i.e. vehicle cabins and especially buildings. During this time they can be exposed to a variety of harmful gaseous compounds. Regarding adverse health effects VOCs (volatile organic compounds), which can be released from different indoor sources such as building materials, cleaning agents and cosmetics, are an important group of specific indoor contaminants. In addition, due to energy saving HVAC-concepts, parts of the air in buildings get recycled and mixed with preferably small amounts of fresh air before being re-introduced into the building. This could lead to an accumulation of VOCs in the indoor air. The latter can be avoided by an efficient adsorptive removal of these compounds in ventilation systems.
For the validation of adsorptive indoor filter media the relatively new international standard DIN EN ISO 10121-1 recommends toluene as a model compound for VOCs as challenge vapor with a concentration of 9 or 90 ppm in conditioned air (☒=23±0,5 °☒, RH: 50±3 %). The filter media tests according to ASHRAE 145.1 are carried out at a toluene concentration of 100 ppm. However, VOC concentrations in real buildings are typically one or more orders of magnitude lower than in the standard tests. Carrying out tests at more realistic concentrations would require a much longer period of time (weeks or months). However, the knowledge of the behavior of adsorptive filters under indoor relevant conditions is useful to compare the quality of filters and to approximate their service time. To face this problem the Wheeler-Jonas [1], [2] and Yoon-Nelson [3] equation were used to predict the adsorption performance data at low concentrations down to 0,1 ppm using test results from standard tests at higher concentrations. The possibilities and limits of the predicting methods will be presented for the exemplary system of toluene and activated carbon (AC) based filter media with different properties in comparison with experimental data.
Besides the concentration, the considered standards recommend RH values which can differ from the humidity of indoor air. Higher humidity content can result in a reduction of adsorption capacity and slower adsorption kinetics of toluene. Hence the effect of higher relative humidity (up to 90 % RH at 23 °C) on the adsorption performance of toluene on filter media with various characteristics of the AC (pore size distribution and surface chemistry) was also part of the study. The results will be discussed in the presentation.

References:

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3. Y.H. Yoon, J.H. Nelson, Application of gas adsorption kinetics I. A theoretical model for respirator cartridge service life, American Industrial Hygiene Association Journal, 45 (1984) 509-516.

References

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