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Standardized Testing of Filter Systems regarding Their Separation Efficiency in Terms of Allergenic Particles and Airborne Germs

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Abstract : Our surrounding air contains various particles. Besides typical representatives of inorganic dust, such as soot and ash, also particles originating from animals, microorganisms or plants are floating through the air, so-called bioaerosols. The group of bioaerosols consists of a broad spectrum of particles of different size, including fungi, bacteria, viruses, spores, or tree, flower and grass pollen that are of high relevance for allergy sufferers. In dependence of the environmental climate and the actual season, these allergenic particles can be found in enormous numbers in the air and are inhaled by humans via the respiration tract, with a potential for inflammatory diseases of the airways, such as asthma or allergic rhinitis. As a consequence air filter systems of ventilation and air conditioning devices are required to meet very high standards to prevent, or at least lower the number of allergens and airborne germs entering the indoor air. Still, filter systems are merely classified for their separation rates using well-defined mineral test dust, while no appropriate sufficiently standardized test methods for bioaerosols exist. However, determined separation rates for mineral test particles of a certain size cannot simply be transferred to bioaerosols, as separation efficiency of particularly fine and respirable particles (< 10 microns) is dependent not only on their shape and particle diameter, but also defined by their density and physicochemical properties. For this reason, the OFI developed a test method, which directly enables a testing of filters and filter media for their separation rates on bioaerosols, as well as a classification of filters. Besides allergens from an intact or fractured tree or grass pollen, allergenic proteins bound to particulates, as well as allergenic fungal spores (e.g. Cladosporium cladosporioides), or bacteria can be used to classify filters regarding their separation rates. Allergens passing through the filter can then be detected by highly sensitive immunological assays (ELISA) or in the case of fungal spores by microbiological methods, which allow for the detection of even one single spore passing the filter. The test procedure, which is carried out in laboratory scale, was furthermore validated regarding its sufficiency to cover real life situations by upscaling using air conditioning devices showing great conformity in terms of separation rates. Additionally, a clinical study with allergy sufferers was performed to verify analytical results. Several different air conditioning filters from the car industry have been tested, showing significant differences in their separation rates.

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