

Evaluation and Comparison of Filtration Efficiency using Number and Surface Area Concentration Monitors

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Abstract

We evaluated filters' filtration efficiencies based on lung deposited surface area concentration, and compared the results with number based efficiencies. Recent toxicological studies indicate that surface area appears to be an important parameter in the toxicity of ultrafine particle (UFP, particles with diameter less than 100 nm). Hence, such a method provides additional health-related information when evaluating a filter's performance. This is especially important to filters controlling human exposure to particles, such as the HVAC filters and cabin air filters for vehicles. Using different challenging particles, we measured and compared filtration efficiencies based on number and surface area concentrations for a HVAC filter. The lung deposited surface area concentrations measured upstream and downstream of the test filter by a Nanoparticle Surface Area Monitor (NSAM) agree very well with the calculated values from the particle size distributions measured by a Scanning Mobility Particle Sizer (SMPS), confirming the feasibility of the method using NSAM. For UFP, the surface area based filtration efficiency is lower than the number based one, because the peak of surface area based size distribution is closer to the Most Penetration Particle Size (MPPS) of the test filter than the peak of number based size distribution. Similar results were observed for on-road tests of a cabin air filter.

Keywords: nanoparticle surface area monitor (NSAM), filtration, ultrafine particle

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