Round-Robin evaluation of the methodology for filtration efficiency tests in different filter media against nanoparticles

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The filtration of airborne nanoparticles is becoming an important issue as they are produced in large quantities from material synthesis and combustion emission. Current international standards dealing with efficiency test for filters and filter media focus on measurement of the minimum efficiency at the most penetrating particle size. The available knowledge and instruments provide a solid base for development of test methods to determine the effectiveness of filtration media against airborne nanoparticles down to single-digit nanometer range.

An interlaboratory evaluation is performed under the Technical Committee 195 of European Committee for Standardization (CEN/TC195) for the development of the methodology to determine effectiveness of filtration media against air-borne particles in the 3 – 500 nm range. An indicative test set up is presented in Figure 1.

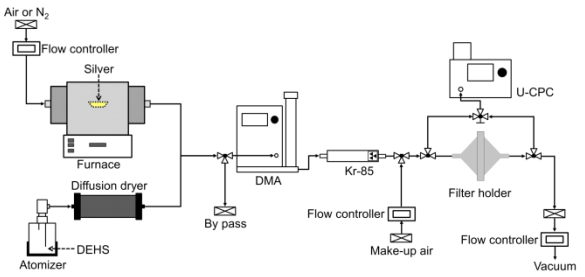

Figure 1. Test set up to measure the effectiveness of filtration media.

Five different laboratories, ETH/Empa, University of Minnesota, Politecnico di Torino, Unifil and Camfil, participate in the round robin test in order to ensure the accuracy of the test method. The qualification of test rig and apparatus is performed prior of the filtration efficiency measurement tests.

Highly uniform and ununiform filters are tested in this investigation. Furthemore, filters with electrostatic charge are challenged with nanoparticles to investigate this effect among different laboratories. . Each laboratory is to test different samples of the filter media in order to ensure repeatability. The filtration efficiency tests are carried in different face velocities. Some indicative results are presented in Figure 2. The filtration efficiency results among different laboratories show noticeable discrepancies. Possible factors contributing to this deviation could be the test set up, effective filtration area, uniformity of the flow velocity in the filter holder, aerosol flow pressure, temperature and relative humidity, concentration of the challenging aerosol, monodispersity of test aerosol, neutralization efficiency and environmental conditions.

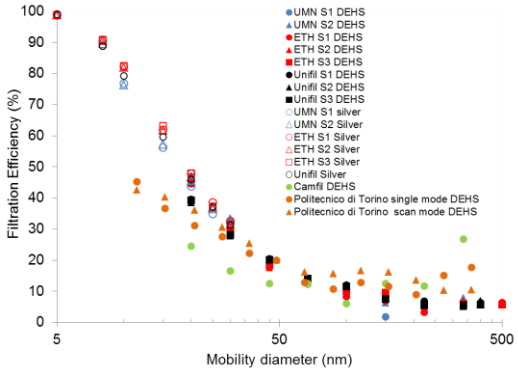

Figure 2 Filtration efficiency data among different filter samples and laboratories at 5 cm/s face velocity.

Statistical analysis, based on ISO 5725-2, will be performed in order to evaluate the methodology. Theoretical model are to be applied and compared with the experimental results. In addition, upon the completion of the round robin tests, sensitivity analysis is to be implemented, addressing the aforementioned discrepancies.

International Organization for Standardization (1994) ISO 5725-2:1994(E) "Accuracy (trueness and precision) of measurement methods and results -- Part 1: General principles and definitions".

International Organization for Standardization (1994) ISO 5725-2:1994(E) "Accuracy (trueness and precision) of measurement methods and results -- Part 2: Basic method for determination of repeatability and reproducibility of a standard measurement method".