A METHOD TO EVALUATE MEDIA INHOMOGENEITY WITH HIGH SPATIAL RESOLUTION

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Flat sheet media is extensively used for various filtration applications, such as automobile, HVAC, etc. The air permeability, a commonly measured property of filter media, is constantly measured for quality control purposes, and is thereafter quoted as input of product design, performance prediction, etc. The instrument for such measurement is standard Frazier Differential Pressure Air Permeability tester that measures the overall air permeability of a 70mm diameter circular area on a media. To increase confidence of such measurement, at multiple locations are tests conducted. However, appreciable variations possibly exist, thus bring up concerns of their effect on filter performances. To tackle such a question, one may wonder that given a certain distance on a flat sheet, how much can air permeability possibly vary, or in another word, what are the length scales of air permeability. Furthermore, if there are any even smaller length scales of variation within a covered circular area? Such difficult questions cannot be answered by a relatively easy test setup such as a Frazier tester, due to its fixed measurement area and time-consuming procedure if numerous smaller areas needs to be covered. There is therefore a gap between test capability of a single number at a single scale (70 mm diameter) and complex reality of potentially many length scales.

To bridge this gap, a new test method is proposed to cover multiple scales, if not all, of flat media sheet. This method not only covers an area as big as a Frazier tester does, but also measures at many smaller length scales within the tested area. Specifically speaking, at certain differential pressure, the air velocities on the clean side of the media are measured at numerous locations with a spatial resolution of 2.0 mm achieved uniformly. Such scan of air velocity makes a 2D visualization of local air permeability in tested area possible. Proposed method uses a technique of Constant-Temperature Anemometry (CTA), which is a kind of Hot-Wire Anemometry (HWA). CTA/HWA is commonly used in Aeronautics and Astronautics industry, it has an advantage of miniature sensing volume of typical 1.5 mm × 70 μm, as being used in Cummins Filtration. Small sensing volume enables rapid frequency response of up to 45 KHz and negligible intrusive disturbance to air flow next to media sheet, which are essential advantages of proposed method. Coupled with a 2D automated traverse system with spatial resolution at micron-level, CTA probe is able to measure air velocities at many locations as desired by customer on a timely manner. Additionally, considerations are also given to post processing of data, which comprises of conversion of raw signals, data reduction, 2D visualization and interpretation. Examples are given of 2D distribution of air permeability, along with an attempt to quantify the prominent length scale in scanned area.