

Virtual Media Design – New Advanced Method To Obtain Real Fiber Diameter Distribution As Key Input Parameter

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Today's requests for lower CO₂ engine emissions demand more efficient filters with increased dust holding capacity at lower pressure drop. The right selection and composition of the filter media is a key enabling step for meeting tomorrow's requirements. Key parameters of the fibrous media are porosity and fiber diameter distribution.

It is well known that the fiber diameter size predetermines particle collection efficiency. However, classical filtration theory does not account for a fiber diameter distribution to calculate performance or pressure drop. As classical filtration theory is based on the single fiber approach, performance can only be predicted for an isolated single fiber. The common approach to overcome this issue by integrating over different classes of a distribution works for particle diameters, but not for fiber diameters, as "the flow field and collection efficiency associated with each fiber size are influenced by the presence of fibers of other sizes. As a practical matter, the effective fiber diameter, based on pressure drop measurement [...] is a reasonable approximation" (Hinds 1999). However, modern simulation tools, e.g. GeoDict (www.geodict.com), generate virtual fibrous structures by rebuilding the fiber diameter distribution of real media. By this approach realistic performance can be predicted for all key parameters such as efficiency, pressure drop and capacity (Lehmann et al. 2008). Consequently it is essential for the development of filters to obtain a fiber diameter distribution as a finger print of filter media.

In the paper we are going to present a new advanced and automatic method to obtain fiber diameter distribution of real fibrous media. We present and discuss results for various kinds of fibrous media. We point out the importance of the right fiber diameter distribution. We conclude with comments on how this facilitates our development of innovative filter media.