Simulation and the Future of Filter Design
Digital Generation of Filter Media and Filter Pleats Models

(Part 3)

Filter media makers and filter manufacturers increasingly turn to digital filter design and digital filter media design. By using digital methods, they fulfill client requirements quickly and at low cost. Digital modeling of filter media and filter pleats, starting from CT- or µCT images, is decisive in understanding existing filter media. However, the true power of digitalization resides in the development and optimization of novel filter designs in the computer, a process called digital generation.

The variety of digitally generated filter media models includes nonwoven fabrics (including nanofiber webs), fabricated metals such as woven wire cloth and sintered wire meshes, textile woven fabrics, ceramics, open cell foams, filter paper, micro-membranes, porous plastics, etc., etc. The potential for variations of media constructions through generation of models and their combination is staggering.

The models of filter materials are generated from user-defined parameters that are known from the manufacturing process. Often, though, these parameters are fine-tuned based on insights gained from µCT-based digital modeling and geometrical analysis of the model. Statistical properties, such as accurate fiber parameters and fiber orientation distribution, are entered in this way in the digital model generator.

The result is a detailed digitally generated 3D model of the filter media that reveals the microstructure and allows the kind of close examination otherwise only possible from a µCT-scan. Easily and interactively, the underlying statistical properties of the model may be changed to design new filter media. Later, the filtration process is simulated and compared to the tested properties of existing products. In such a way, the performance of newly designed filters and filter media may be optimized.

In turn, the parameters entered to obtain the improved design are applied in the fabrication of the new, optimized materials. If needed, µCT-imaging provides verification that the manufactured material corresponds to the optimal digital design.

> Digital generation is an astonishingly fast process even for complex material models, opening up untapped cutting-edge opportunities in profitable development of improved filters and filter media.

> Figure: Designing a 3D oil filter medium model by entering user-defined parameters. The digital generation of filter pleats and filter media, and improvements to the designs are carried out on standard hardware quickly and interactively.

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Author: Andreas Wiegmann, Ph.D.
Math2Market GmbH
info@math2market.de
www.math2market.com

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