

GEO DICT

The Digital Material Laboratory

GEO DICT WORKFLOW FOR FILTER MEDIA

DIGITAL DESIGN AND DEVELOPMENT OF FILTER MEDIA FOR PROTECTIVE FACE MASKS

- Digital analysis of a complex filter media with nano and micro fibers
- Evaluation of the manufacturing process-induced morphology and properties
- Assessment of the impact of defects through variation of parameters
- Computation of mechanical and physical properties run on the μ CT scan model and/or generated models with GeoDict structure-generators e.g., FiberGeo



GeoDict Workflow for Digital Filter Media Development

1

Import and
segmentation

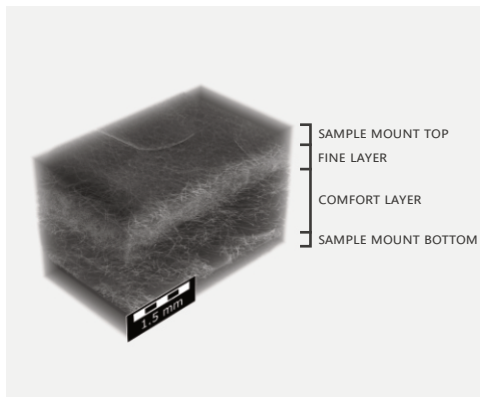


Image processing of the CT scans of a surgical face mask:

- CT Scan provided by the Heilbronn University of Applied Sciences, Germany
- 2-layer filter medium of an existing well-known surgical face mask was scanned by nano-CT with a resolution of 400 nm
- The ImportGeo-Vol module of GeoDict was used to import, process, and segment the scanned images

Result: Digital structure of the filter media

2

Fiber
identification

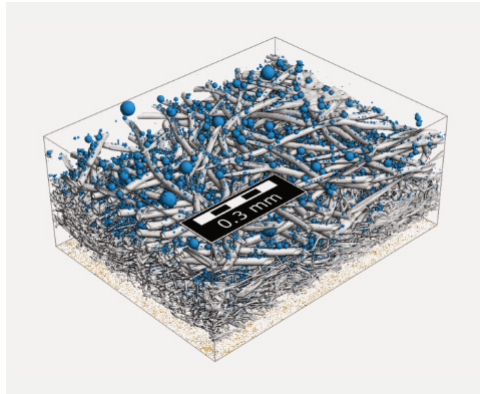


- The FiberFind module was used to analyze the digital structure and obtain relevant information about all fibers
- The information obtained was used to evaluate the sample with regard to the geometrical characteristics such as:
 - Fiber diameter
 - Fiber orientation
 - Fiber curliness

Result: Statistical description of fibers

3

Analysis of filter
performance



- Initial pressure drop and filtration efficiency of filter medium simulated using the FilterDict module
- Simulation results compared and validated with:
 - Laboratory experiments performed by Berger et al. from Heilbronn University of Applied Science, Germany

Result: Validated filter model and performance results

4

Optimization of
filter medium



- Optimization of filter medium focused on improving the fine layer
 - This layer performs the main filtration task and most of the pressure loss occurs in this specific layer
 - Generation of a digital twin using the FiberGeo module and entering the statistical parameters from the analysis with FiberFind.
- Extensive parameter study conducted during optimization:
 - Large number of 3D digital prototypes was modeled and simulated with GeoDict
 - Automation capabilities of the GeoDict software through Python scripts (GeoPy) were used to facilitate this process

Result: Improved digital prototype shows lower initial pressure drop, equal filtration efficiency, and needs less material