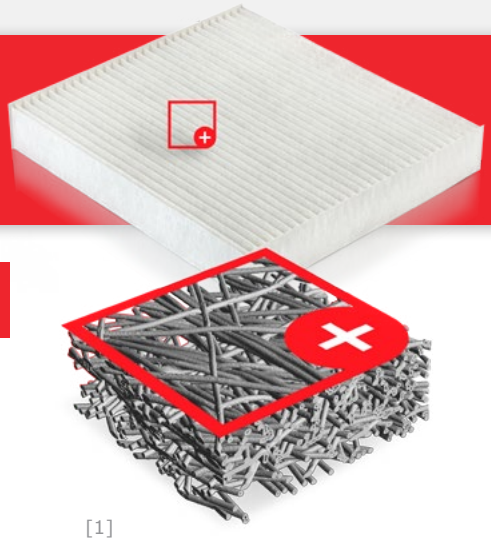
GeoDict

MATH
2 MARKET

Case Study
Air Filter Media



Our Mission

In industry and everyday life, filters serve a variety of purposes. For each of those applications, a specialized solution is needed to fulfill raising demands on filter efficiency, capacity and life time. GeoDict supports filter development through modelling and simulation. Use GeoDict to:

Understand the behaviour of your filter media from square one by looking at the details of filter media and particle deposition.

Design novel filter media by varying e.g. thickness, fiber types, layering.

Predict the particle filtration properties of novel filter media.

Replace time-consuming building and testing of filter prototypes with accurate simulations.

[1]

Workflow

Scan a small piece of the filter media by µCT to resolve pore-scale features.

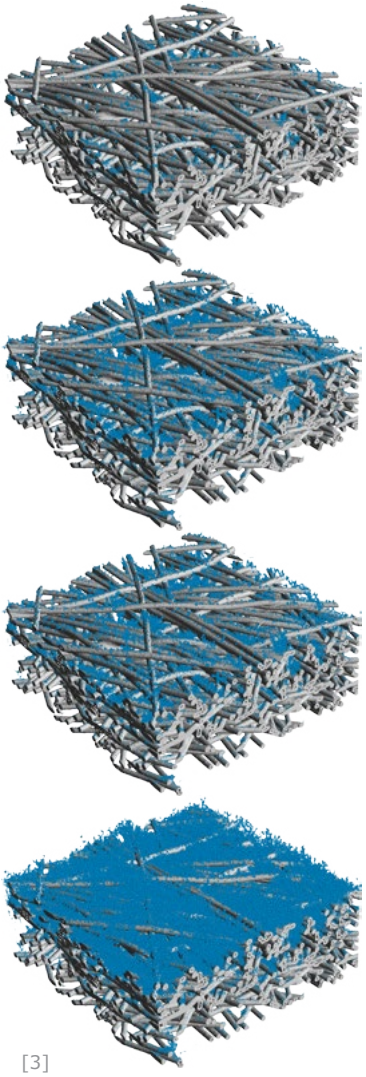
Segment the µCT-scan into fibers and pores.

Analyze the segmented µCT-scan to find pore size distribution and largest through pores.

Simulate a single pass experiment to find pressure drop, filter efficiency, filter life time, and filter capacity.

Model the filter media for porosity, fiber diameter, and fiber orientation.

Optimize the filter media by repeating the analysis for different models.



[3]

[2]

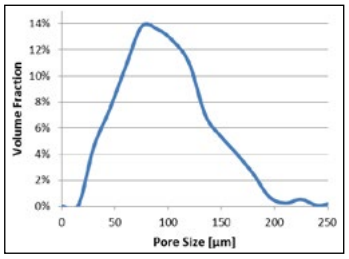
[1]: PA66 - GF50
[2]: Fiber orientation

Air filter properties predicted with GeoDict

Air filter medium analysis

The µCT-scan from a cabin air filter is segmented with ImportGeo-VOL.

Cut-Out	1.5 x 1.5	mm
Resolution per Voxel	1.5	µm
Media Thickness	600	µm
Effective porosity	80.85	%

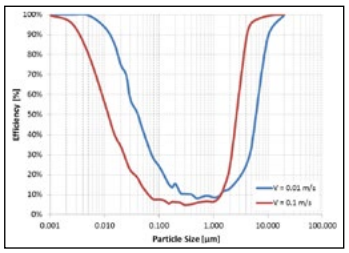


[4]

Pore size distribution

of the filter media is determined with PoroDict. Fig [4]

Max. through pore size	81	µm
Mean pore size	65	µm

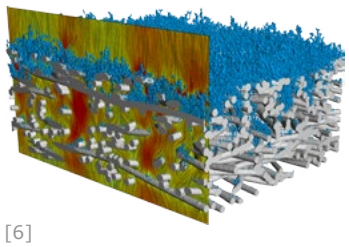


[5]

Pressure drop of clean media

is determined with FlowDict for air at 20°C at a mean velocity of 0.1 m/s.

Permeability constant	1.51 e -10	m²
Flow resistivity	1.22 e+05	kg/(m³s)
Pressure drop	7.35	Pa
Mass flow rate	0.12	kg/(m²s)

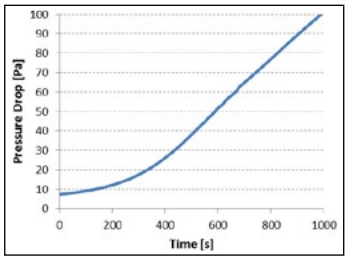


[6]

Initial filter efficiency

is computed with FilterDict for air at 20°C for two different mean velocities: 0.01 m/s and 0.1 m/s. The simulation assumes that the filter is discharged and considers diffusion, impaction, and interception of particles. Fig [5]

MPPS at 0.01 m/s	0.5	µm
MPPS at 0.1 m/s	0.3	µm



[7]

Filter life time and capacity

are determined with FilterDict by simulating a Single Pass experiment using SAE-fine test dust, with a concentration of 1 mg/l under a constant flow rate of 60 l/min, and a filter area of 100 cm2. Fig [6], [7]

Initial pressure drop	7	Pa
Pressure drop at 1000 s	101	Pa
Total deposited dust after 1000 s	93	g/m²
Total filter efficiency by weight	93	%

[1] micronAir cabin air filter
[2] µCT slices and 3D structure
[3] Filter-Media at different stages of particle loading
[4]: Pore Size Distribution
[5]: Filter efficiency for test dust SAE-fine
[6]: Mean velocity through loaded filter media
[7]: Single pass experiment: Pressure drop over time

Air filter properties predicted with GeoDict

Models of filter media look just like the µCT-Scans. Depending on porosity, fiber orientation, and fiber diameter, different filtration properties of filter media can be predicted and optimized.

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