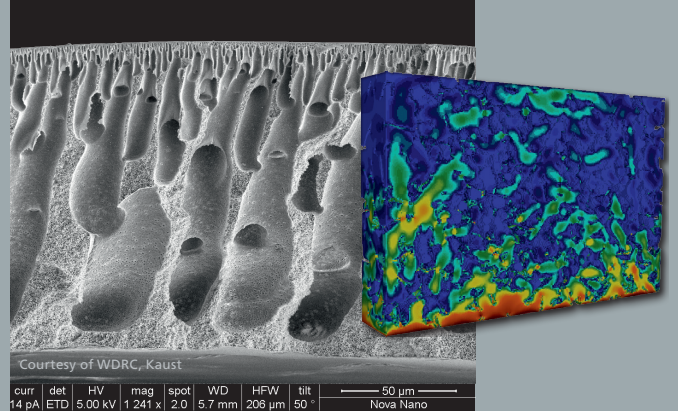

COMPETENCES AND CONTACT

Fraunhofer ITWM

FRAUNHOFER INSTITUTE FOR INDUSTRIAL MATHEMATICS ITWM

Colloid filtration, reactive flow, adsorption, osmosis

Filtration and separation processes, such as
- colloid filtration
- active carbon air filters
- catalytic filters
- water purification with functionalized membranes
- filtration with surface activated nonwoven media, etc.

require pore-scale and macro-scale modeling and simulation of reactive flow.

The software tool **PoreChem** enables
- 3D pore-scale simulation of reactive flow in the presence of surface and/or volumetric reactions
- usage of different kinetic relations for describing the reactions
- investigation of the influence of the interplay between the morphology (microstructure) of the filtering medium and the local convection/diffusion/reaction processes on the filtration efficiency
- simulation of multiscale reactive transport.

The pore-scale simulations can be done on 3D micro CT images, or on virtually generated nonwoven or sponge or finger-like filtering media. Micro-scale (pore-scale) and macro-scale simulation of forward and reverse osmosis processes enables optimal selection of membranes and process parameter.

PoreChem

Our competences and services

- Multiscale modeling and simulation of complex filtration and separation processes including the rheological and material behavior of the media
- Simulation of multi-phase and fluid-structure interaction problems in filtration and separation by coupling different codes for flow, particle transport and deformation
- Taylor-made simulation software for your applications in filtration, separation, purification and mechanical characterization of nonwovens, felts and textiles
- Consulting based on simulation studies for an integrated design of filters including all aspects: starting from the manufacturing process, optimizing the functionality up to the life time performance under real industrial conditions

Contact

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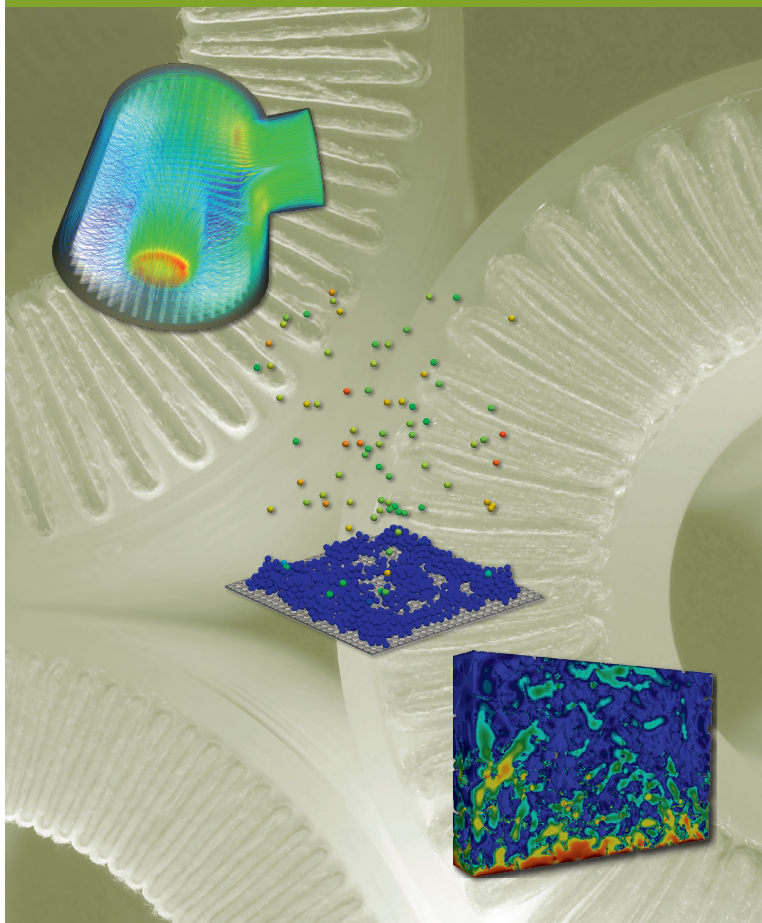
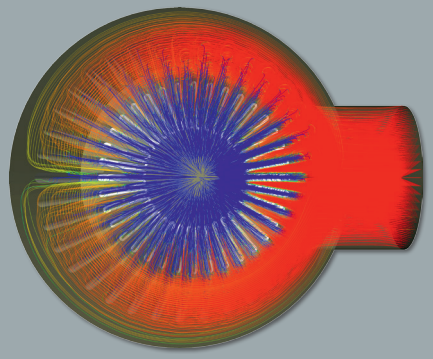
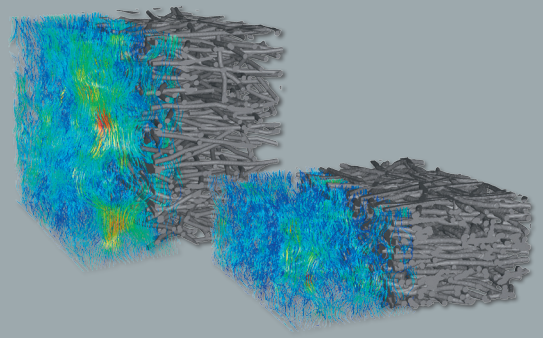
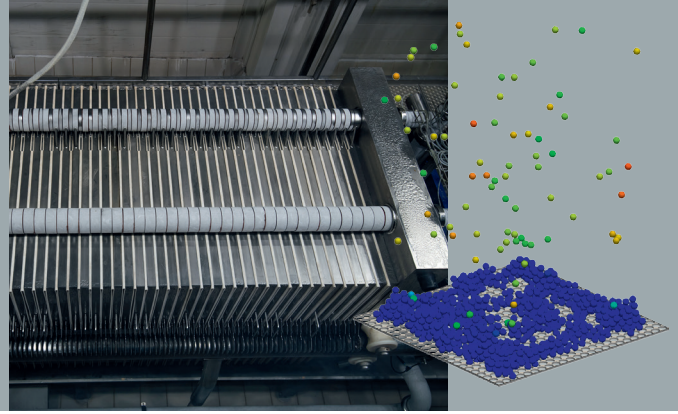
FILTRATION SEPARATION PURIFICATION









Filter Element Simulation Toolbox (FiltEST)

More than a decade of experience and expertise in modeling and simulation of filter elements are combined in this simulation toolbox. FiltEST includes the simulation of the

- fluid flow through the housing and the filtering media
- transport of particles and deposition, and the
- evolution of permeability distribution and differential pressure caused by the loading.

FiltEST enables the user to evaluate filter element designs before the prototyping stage and assists the product developer in finding the optimal combination of filter materials, geometrical features (e. g. pleat packing density) etc.

To this end, FiltEST offers

- import of CAD data for the filter element's housing, the filter media, inlet(s) and outlet(s)
- flexible "virtual test stands" for single-pass and multi-pass efficiency tests, covering a wide range of efficiency tests
- output of the computed efficiency data accessible to common worksheet software
- storage of simulation results for 3D visualization
- coupling to elasticity solvers (e. g. FeelMath).

Structural mechanics of nonwovens at various scales

FeelMath is a very efficient software for the simulation of the (effective) mechanical properties of composite and porous materials, including (anisotropic) nonwovens, felts and textiles.

Amongst others, FeelMath computes the effective

- stiffness and strength
- thermal conductivity and expansion
- viscoelastic creep and relaxation.

In contrast to most FEA tools, FeelMath avoids the loss of accuracy for stresses and strains by computing these quantities directly. The software operates on generated material structures as well as on imported CT images, enabling the user to obtain a deeper understanding of the material under consideration.

FeelMath is compatible to both commercial codes (e. g. ANSYS®, ABAQUS®, GeoDict®) and own simulation tools (e. g. FiltEST). In particular, the coupling of FeelMath with FiltEST combines the benefits of structural mechanics simulations with the computation of flow properties, e. g. the effective permeability of deformed heterogeneous nonwovens.

Modeling and simulation of separators: Cake filtration

Suspension flows and the filtration process of particles with separators (i. e. sedimenter, centrifugal, press filter) causes a cake formation which can be simulated on all relevant scales with discrete and/or multi-phase models.

On the macroscopic scale, the cake building in a filter press is simulated with a multi-phase flow modeling (i. e. on our software platform CoRheoS using our modules GRAIN and FLUID). The particles are modeled with a continuum granular material law covering the full regime between dilute and dense flow interacting with the surrounding fluid (e. g. air, water, oil). The local increase of the particle concentration near the separator causes the cake formation and pressure increase. Details on the particle-particle interaction and cake formation are modeled on the micro-scale. Using the Discrete Element Method (DEM) and coupling with our fluid dynamics tools.

Sample applications include

- inhomogeneous density distribution in a press filter
- cake formation models including depth filtration
- cross filtration for water purification
- flow distribution and particle separation in a mill
- chromatography simulation of Asymmetric Flow Field Flow Fractionation (AFFFF).

FiltEST FeelMath FLUID GRAIN