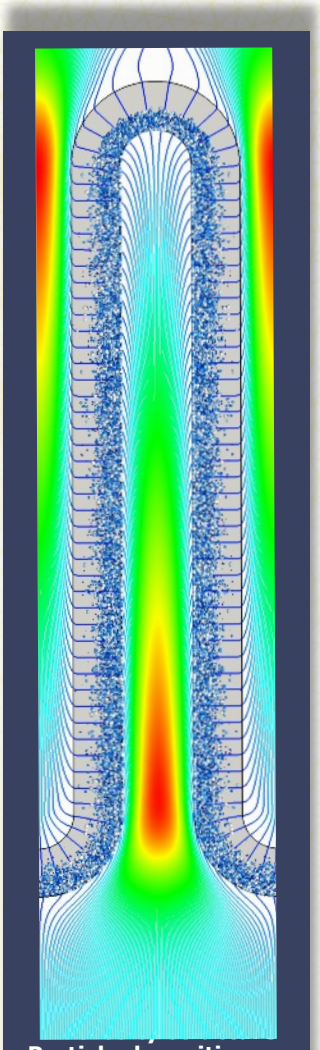
DHCAE Meso Scale model for filter applications

The filter modelling is based on a meso scale approach, which considers the filter media and the filter cake as porous zones. The approach combines relationships derived from a micro model, from literature or from test rig measurements to a cell-based filter model for the filter cake and the filter media. The models are organized in different groups:

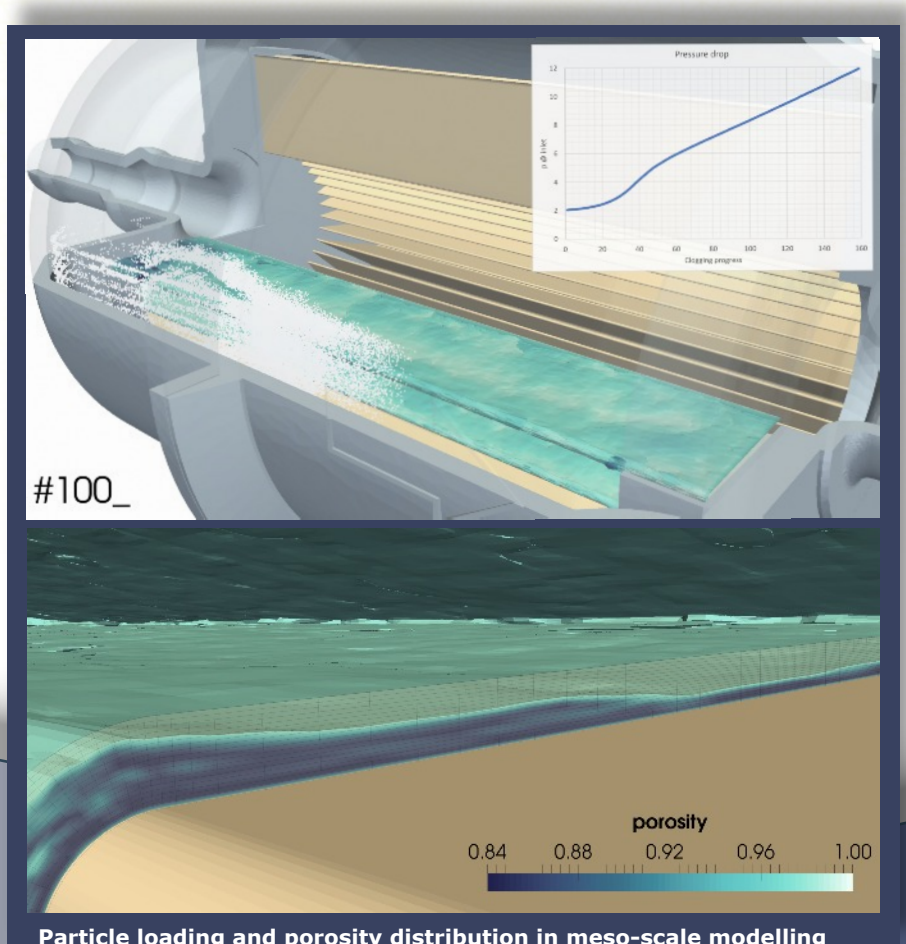
- Resistance models: Here a number of resistance models such as the Ergun equation, Jackson-James relation or Darcy's law are available. Typical input parameters are the porosity, characteristic diameters or sub models to calculate the latter.
- Porosity models: Constant or locally predefined porosity models are available, as well as sub models to develop the porosity within the iterative particle depositions.
- Efficiency and deposition models: Various deposition models are available for the filter media and the filter cake, e.g. lookup tables for deposition probabilities as a function of particle diameter and velocity.

These models can be combined to specific application areas according the available input. E.g. if filter efficiency relations for flat filter media are available from an experimental setup, these input data can be used to model the local deposition at pleated filters. Here an Ergun equation for the local permeability of the developing cake and a Jackson-James relation can be used for the permeability in the media. If no appropriate data to a specific model are available assumptions can be made e.g. to consider the filter loading with specific permeability models at 100 % efficiency.

The models for the filter media and filter cake are locally and cell based. For instance, each computational cell in the domain can have an individual resistance, filling level and porosity. Already deposited particles contribute to the local characteristic particle diameter representative for the cell, hereby affecting the resistance, porosity and efficiency models.



Particle deposition in pleated filter media



Particle loading and porosity distribution in meso-scale modelling

Extension to macro-modelling

The meso scale completes the macro modelling by the capability to investigate local effects in the filter media and filter cake in detail. In particular local and regional blockage caused by cake growth can be considered in form of individual resistance zones.

CastNet integration

The setup of the meso scale solver is completely integrated into CastNet. A complete GUI based workflow is realized for the case setup.

Templates support the user with an efficient case setup.

The boundary layer meshing capabilities in CastNet are used to generate a layered section around the filter for a reliable resistance modelling.

The solving with different particle load cycles is fully automated.

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