On a Subgrid Approach for Simulating Industrial Filtration Processes

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Nowadays Computational Fluid Dynamics (CFD) simulations are often used in studying various filtration processes and in the design of filter elements. Single grid, sequential and parallel algorithms and software for CFD simulations of filtration processes were presented earlier presented by Fraunhofer ITWM [1,2]. The current talk discusses one of our recent algorithmic developments, namely the subgrid resolution approach. The subgrid resolution is a challenging approach, which belongs to the class of variational multiscale methods. It describes how the fine grid details are incorporated by solving auxiliary problems in appropriately chosen grid cells on a relatively coarse computational grid. This is done via a systematic and a careful procedure of modifying and updating the coefficients of the Navier-Stokes-Brinkmann system in the chosen cells. The key ingredient to the proposed algorithm, besides employing the coarse and the fine grid, is the usage of correct parameters, which becomes the critical part of this algorithm.

We introduce the concept of '*quasi-porous'* coarse cells and describe the subgrid algorithm. The results are presented in such a way, that the efficiency and accuracy of the subgrid method is compared with the results obtained by solving the same problem on the coarse and fine computational grid. Results from the numerical simulation of industrial filters are presented. Since it is a new algorithm, specific to filtration related flow models, new findings and results follow a detailed formulation of the numerical algorithm.

[1] O.Iliev, V.Laptev, D.Vasileva, Algorithms and software for flow through oil filters. Filtech Europa, Volume I, pp. I-327 - I-334, October 2003.

[2] M. Dedering, W. Stausberg, O. Iliev, Z. Lakdawala, R. Ciegis, V. Starikovicius, On new Challenges for CFD Simulation in Filtration, Proceedings of World Filtration Congress, Leipzig, 2008.