

On modelling and simulation of filtration efficiency tests

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Filtration efficiency tests, such as TFEM and multipass tests, provide important information about the performance of the filters. Usually these tests are conducted after designing a prototype, in order to determine its performance and to decide if the design meets the expectations, or improvement is needed. In general, conducting these tests is expensive and time consuming procedure.

The presented modeling and simulation of filtration efficiency tests have a two-fold purpose: it aims at better understanding of filtration processes, and provide the engineers with powerful tools that assist the design of efficient filters. One of the goals is to include these simulations in the so-called virtual design, where the filter performance can be evaluated before manufacturing the prototype.

A model and an analytical solution for filtration in a closed system, consisting of a filter element and a contaminated fluid reservoir, will be presented. Such a closed system is typical for the above mentioned tests. Furthermore, the numerical simulation of efficiency tests in filter elements using our software tool, SuFiS®, will be discussed. The software tool was developed earlier with the aim of simulating flow field and pressure drop in filter elements, mainly to improve the design of the filter housing. Recently, it is further extended to simulate the particles transport and capturing. Parameter identification methods from measurements (performed for simple filters) are combined with CFD simulation, in order to predict filter efficiency for newly designed complicated filter elements. The parameter identification is based on solving auxiliary problems for one dimensional filtration process. The developed software tool is not only used to evaluate the efficiency of the manufactured filters, but also assists engineers in designing new filter elements and selecting the appropriate filtering medium. Various simulation results will be demonstrated.

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