OPTIMIZATION OF NONWOVEN FILTER MEDIA CHARACTERISTICS

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The goal of this study is to optimize filter media by increasing the dust holding capacity (DHC), while maintaining the pressure drop and Beta ratio (β). Three main parameters define the performance of a filter, namely the DHC, filter efficiency and pressure drop. The DHC defines the quantity of solid particles which a filter media can trap and hold before the maximum allowable pressure drop is reached. In this study, the key factor is the use of micro structure models to optimize the filter media. To generate various filter media, the FiberGeo module of GeoDict® software is used, while the FlowDict and FilterDict modules are used to simulate the flow behavior and track the particles.

Three different filter media are modelled. They all consist of the same two types of glass fibers (dual phase). The distribution of the thicker fibers over the media thickness (height) is the same for all models. However, the thinner fibers are distributed differently over the thickness of the filter media [1]. The three models are called homogeneous model, linear increasing model, and exponentially increasing model. The naming is based on the distribution of the thinner fibers through the thickness of the filter media from top to bottom of media. To make the three models comparable with each other, they were modelled to all have the same pressure drop in the clean state. To ensure this, FlowDict simulations were used to guide the choice of geometric model parameters.

The simulation steps consist of modelling the filter media with different spatial distributions of the two types of fibers, simulating the clean fluid flow through the filter media and finally simulating the particulate flow. The simulation provides all details on deposition location and pressure drop over time.

Filtration simulations on the three different models were run using the FilterDict module of GeoDict®. Filter life-time simulations were carried out using multi pass filtration runs. In a multi pass simulation, fluids move in a circuit through the system, and the particle size distribution and concentration in front of the filter change over time. Outputs of these simulations are pressure drop, filtration efficiency and count/mass of the deposited dust as a function of time. The results show that by changing the distribution of the thin fiber type through the model height, the DHC of the filter media changes as well. In this way, the structure of the dual phase filter media can be optimized to achieve higher DHC, while keeping the initial pressure drop the same. As a demonstrating example, in Fig. 1, the variation in DHC through the three filter media structures is shown and compared with each other.

Fig. 1: Different filter media structures having two types of fibers (dual phase) with different particle filtration behavior.

References:

[1] M. Silin, S. Jaganathan, Optimal gradient hydraulic media to maximize dust holding capacity, Proceedings of FILTECH 2015, 24.-26. Feb. 2015, Cologne, Germany.