

A Novel Mobile Granular Bed Filter

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Granular filters, which are used to separate particles from a gas flow, have attracted a great deal of interest in comparison with other filter technologies, such as electrostatic precipitators, because of their operational simplicity, low operating costs, and insensitivity to high temperatures and abrasive environments. Their limitations include a low efficiency for sub-micron particle interception, and an increased pressure drop with filtration time. The recently patented Novel Mobile Granular Bed Filter (NMGBF) is a hybrid device that maintains the advantages of granular filters while minimizing the drawbacks.^{1,2}

The flow field in the NMGBF consists of a high-speed gas jet, sparsely loaded with particles 50 microns or less in size, and a slowly moving flow of dense filter material. During the design phase, the Eulerian granular multiphase model in FLUENT was used to simulate the complex flow in the device. It provided a wealth of technical information that went beyond the classical theoretical and experimental development program, and helped guide the optimization of the filter geometry.

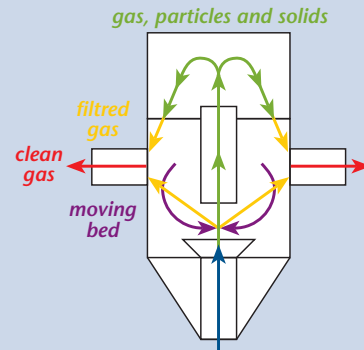
In the first phase of the simulation work, FLUENT was used to model the single-phase aerodynamic profile of the air in the empty filter (without the mov-

ing bed). This allowed the scale-up designer to easily visualize the characteristics of the main flow distribution, including the importance and location of turbulence in the filter when geometry modifications were made. Key parameters were also obtained, such as the fluid residence time, flow split, velocity profile, and pressure drop.

Granular multiphase simulations were carried out for steady and unsteady operating conditions. The particle-laden incoming gas flow was modeled as the primary phase, using composite properties, and the moving filter material (with $d = 500 \mu$ and $\rho = 2650 \text{ kg/m}^3$) was modeled as the secondary phase. The results, including volume fraction profiles and pressure oscillations during operation, showed good qualitative agreement with experimental measurements. The results were used to optimize the filter design and guide efforts to scale-up the device. ■

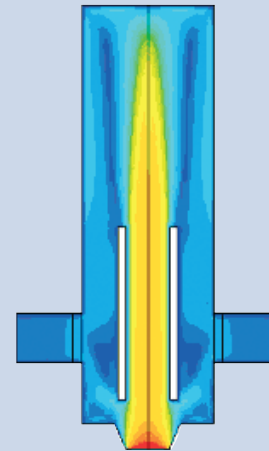
references:

1. N. Abatzoglou, M. Gagnon, E. Chornet, Proceedings, Progress in Thermochemical Biomass Conversion, Edited by A.V. Bridgewater, Blackwell Science, 1, p. 365-378, 2001.
2. N. Abatzoglou, M. Gagnon, E. Chornet, Canadian Journal of Chemical Engineering, 80(1), p. 17-27, 2002.



gas and entrained particles

Diagram of the NMGBF



Air velocity profile after inlet geometry optimization (to reduce turbulence)