Numerical investigation of 3D spray dryer for optimized production of ash-free coal

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The drying of a solution containing ash-free coal in a spray dryer was simulated using computational fluid dynamics (CFD) method. 3D spray dryer was designed and simulated using GAMBIT and FLUENT respectively.

Parametric study was carried out in order to study several important parameters related with coal drying. These include the effect of drying gas (N2) flow rate on coal collection efficiency and residence time, the effect of N2 temperature on coal drying, the effect of droplet diameter on mean residence time of coal particles in the chamber and the effect of droplet diameter on vaporization. Furthermore, the drying rate of coal using NMP solvent was compared with the drying rate using 1-Methylnaphthalene (1-MN) as a solvent.

This paper describes and demonstrates the effectiveness of computational fluid dynamics, CFD, approach for prediction of several important parameters of spray drying that are difficult, if is not impossible, to examine experimentally.