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EDP Sciences

Pages:

353-359

Volume:

Vol. 85 No. 4-5

Date:

Tuesday, July 5, 2005

DOI:

<http://dx.doi.org/10.1051/lait:2005024>

In the computational fluid dynamics (CFD) analysis of spray dryers, the Euler-Lagrange model is used to compute the motions of the spray droplets and the heat and mass transfers between the droplets and the air stream. Such calculations are performed for hundreds to tens of thousands of droplets to represent the spray in the dryer. One limiting factor in drying mass transfer is the internal diffusion of water moisture inside partially dried particles. In order to model this internal diffusion of water moisture, each particle is represented by a series of concentric spherical shells. A one-dimensional diffusion equation is solved over these shells to obtain the internal distribution and diffusion of water moisture inside each particle. A key strength of CFD is the ability to carry out what-if and optimization analyses quickly. As an example, a dryer with a given set of feed conditions was considered. CFD simulations were carried out with the aim to find the optimum condition for the drying air. Key information of interest to the plant operator were extracted from the CFD results and presented in percentages of particles leaving the particle and air exits, and the particle conditions at these exits in terms of mean diameter, temperature and moisture content. From these results, the operator of the dryer can easily select the optimum operating conditions, which allows him to achieve the desired product quality at minimum cost.

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