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Study of the Drying Behavior of High Load Multiphase Droplets in an Acoustic Levitator at High Temperature Conditions

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Abstract

Experimental data on the drying behavior of suspension droplets is limited, although its importance in industrial applications for the material processing, chemical or food industry involving sprays dryers. This fact is particularly significant for high load and temperature conditions close to those found in the mentioned industrial applications. In this work, the drying behavior of acoustically levitated multiphase droplets has been experimentally investigated. The experiments have been performed using water-glass particles suspensions. The glass particles have a mean particle size and relative density of 13 μm and 2.5 respectively. The acoustic tube levitator has been modified in order to allow experiments at high temperature conditions. The flow rate, temperature and relative humidity of this air stream can be controlled by an air conditioning system. A CCD camera and a back-light illumination system are used to measure the droplet cross-sectional area and vertical position of the droplet during the drying process. The effect of the initial droplet volume ($0.05\ \mu l < V_0 < 0.7\ \mu l$), initial solid mass load ($0.01 < Y_S < 0.5$), ambient air relative humidity ($0.05 < HR < 0.45$) and ambient air temperature ($60ºC < T < 120ºC$) on the mean porosity of the grain and first drying period duration has been studied. An experimental correlation that predicts the final porosity of the dried grain has been obtained. The most important parameters to be considered for the porosity are the initial solid mass load and the initial droplet volume. The relative humidity of the air presents a moderate influence on the drying behavior of the droplet and the temperature is the parameter that presents a lower impact on the mean porosity. In addition, particular attention should be given to the drying behavior of small droplets that present a very low mean porosity values for high solid mass loads.

Key words: spray drying, multiphase droplet, droplet drying, acoustic levitator

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