LONG-TERM TRANSIENTS IN FLUIDIZATION OF OXIDE NANOPARTICLE AGGLOMERATES

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Nanopowders are frequently fluidized for research during the last two decades. Interestingly, it was believed for a long time that nanopowders cannot be fluidized since they are classified as group C, very cohesive powders, in the Geldart diagram. For these powders the acting adhesion forces are too strong to allow fluidization. However, many studies showed that nanoparticles can be fluidized as micron-sized fractal agglomerates with very low densities and very high porosities [1]. The high porosities of the agglomerates are very attractive because most of the particle surface is accessible for mass transfer and reaction.

The formation of the agglomerates in the fluidized bed is a dynamic process which includes collision, unfolding, breaking, and reagglomeration. This makes it likely that the agglomerate size distribution will change over time. On the other hand, long-duration fluidization of nanopowders is required for possible industrial applications such as coating or catalysis. Therefore, a better understanding of, the influence of time on the properties of fluidized nanoparticle agglomerates is crucial.

Here we present a detailed analysis of the agglomerate size distribution over time during long-time fluidization of oxide nanoparticles. A settling tube set-up is used to investigate the agglomerate size distributions (see Fig. 1) as well as X-ray tomography which suggest stratification of the bed during long time fluidization (see Fig. 2). Further, the influence of the acting contact forces on the arising agglomerate size distributions was investigated. The results show that microscopic properties such as agglomerate size distribution can directly be linked to macroscopic properties as the bed expansion and that the time is a very important factor for the fluidization of nanopowders, because the bed dynamics changes strongly over time.

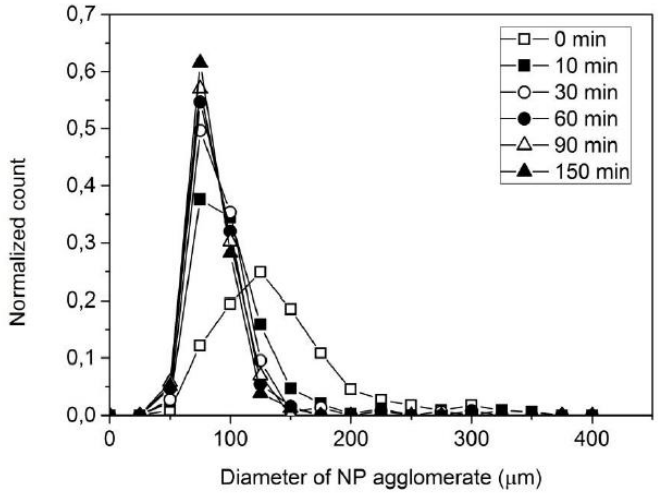

Figure 1: Agglomerate size distribution over time. A decrease of the mean agglomerate size is obvious.

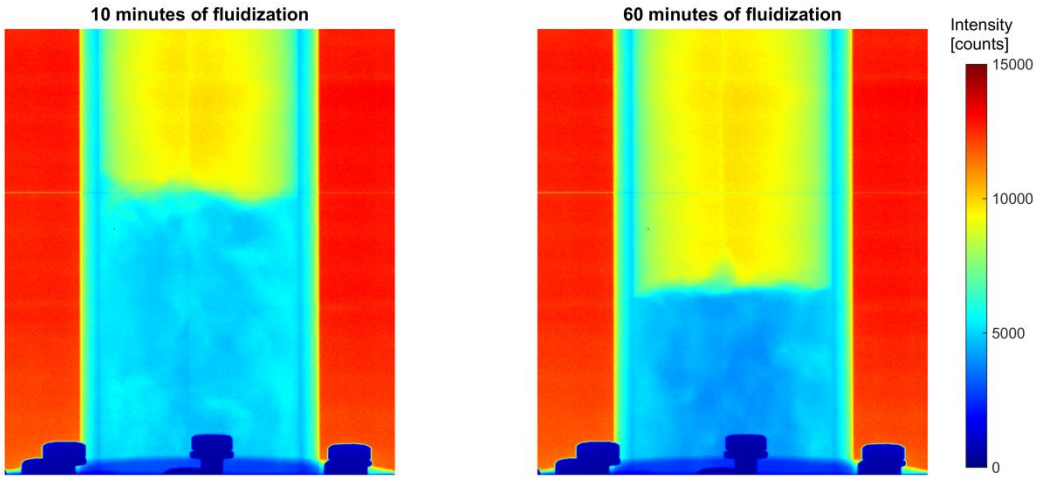

Figure 2: X-ray tomography of fluidized nanopowders after 10 min and 60 min. A decrease and densification of the bed is obvious.

1. van Ommen, J.R., J. Valverde, and R. Pfeffer, *Fluidization of nanopowders: a review.* J. Nanoparticle Res., 2012. 14(3): p. 1-29.