

Abstract

The fluidization behavior of several nanopowders with and without mechanical stirring agitation is presented. Each of the three nanopowders studied (silica R974, alumina Alu-C, and titania P25) exhibited distinct particle and fluidized bed properties. The effect of mechanical stirring agitation of two different sized impellers on the fluidization expansion of these nanopowders was investigated for different rotational speeds. For silica R974 and alumina Alu-C, maintaining mechanical stirring agitation during fluidization was observed to have a positive effect on the bed expansion ratios when compared to conventional non-agitated fluidization. This improvement to fluidized bed expansion occurred at all experimental gas velocities for alumina Alu-C, but was limited to gas velocities below 0.5 cm/s for silica R974. In the case of titania P25, the powder was compacted along the walls of the fluidization column, which inhibited its ability to become fluidized. Increasing the impeller size was found to improve the fluidized expansion of alumina Alu-C, but was only beneficial to the bed expansion of silica R974 at gas velocities below 0.5 cm/s for agitation speeds greater than 300 RPM. Additionally, it was observed that agitation promoted bubbling, gas bypassing, and particle elutriation for the fluidized beds of both silica R974 and alumina Alu-C. It was also found that the improved fluidization expansion only occurred if the agitation was present during fluidization. Preprocessing the nanopowders with agitated fluidization did not result in greater bed expansion for the subsequent conventional non-agitated fluidization. This indicated that mechanical stirring agitation only caused temporary changes to the size and structure of nanopowder agglomerates. Mechanical stirring agitation was concluded to be a suitable technique only for actively assisting fluidization expansion, and not a favorable method of preprocessing powders for further conventional fluidization.