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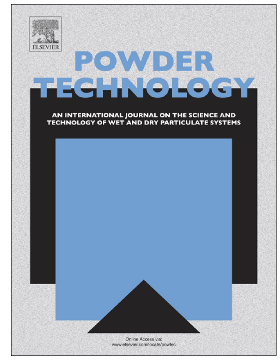

Detection and estimation of capillary interparticle forces in the material of a fluidized bed reactor at high temperature by powder flow characterization

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DETECTION AND ESTIMATION OF CAPILLARY INTERPARTICLE FORCES IN THE MATERIAL OF A FLUIDIZED BED REACTOR AT HIGH TEMPERATURE BY POWDER FLOW CHARACTERIZATION

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Abstract

Two ceramic powder samples having different compositions of surface impurities and particle size distributions were considered. These two samples resulted from a high temperature fluidized bed reactor which in its operation showed changes of working condition that might be attributed to the onset of strong interparticle forces. The flow behaviour of these powders was characterized by the High Temperature Annular Shear Cell (HT-ASC), between ambient temperature and 500 °C. Furthermore, a model is developed to relate the change of the powder flowability to the formation of a liquid phase due to the melting of particle impurities present on the particle surface. In particular, the model is used to predict, on the base of the salt composition, the intensity of the interparticle forces at different temperatures. The interparticle forces predicted by the model can be compared with those that can be inferred from the powder flow properties measured with the HT-ASC. Therefore, it is demonstrated that it is possible to derive a theoretical model to predict interparticle forces in a particulate material relevant to fluidized bed reactor, on the basis of the impurities composition. Furthermore, it is demonstrated the possibility to correctly estimate the intensity of average interparticle forces in the same kind of material by the interpretations of bulk flow properties measured with a shear tester, even in the case in which capillary forces take the place of the much weaker van der Walls forces. More in general, the paper suggests a method by which powder rheology can be used to indirectly evaluate the effects of the interparticle forces on fluidization processes even in case in which strong capillary interaction occur.