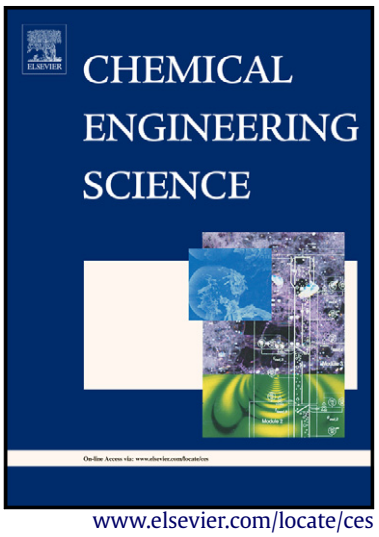

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Constraints on the functional form of the critical deposition velocity in solid-liquid pipe flow at low solid volume fractions

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Abstract

Of the various transition velocities that delineate flow regimes in multiphase pneumatic and hydraulic conveying, the critical deposition velocity is important because it separates depositing and non-depositing flows. However, no distinction has been made between the dependence of the critical deposition velocity on physical parameters and flow conditions at low solid volume fractions and in the limit of zero volume fraction, which are distinct mathematically. Here, the two cases are analysed separately, and a general functional form in terms of the particle Reynolds number and Archimedes number is proposed that is valid up to volume fractions of several per cent. An ultrasonic method for determining the critical value of the particle Reynolds number is presented, and results for four particle types at several nominal volume fractions (0.5, 1 and 3 % by volume) are combined with a number of data from the literature. The resulting expressions are found to compare well with several similar correlations for the critical deposition velocity and other transition velocities, and, unlike a recent best-fit approach for the pick-up velocity, incorporate an explicit dependence on volume fraction, to which the critical deposition velocity is most sensitive at very low volume fractions. Lastly, it is found that the functional forms for the critical deposition velocity in the literature are unable to reproduce the available data at higher volume fractions, and a number of suggestions are made for resolving this issue.