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Effect of Interparticle Forces on the Fluidization of Fine Particles

Investigation is reported (*1*) of the effect of interparticle forces on the feasibility of gaseous fluidization of particles ranging below 50 μ in diameter. Both the onset of fluidization and the quality of fluidization were determined by measurements of pressure drop across the bed, and by measurements of heat transfer between the bed and a heated plate immersed in the bed. The interparticle adhesive forces and friction coefficients were measured by the inclined-plane method.

When particles finer than about 50 μ in diameter are to be fluidized, difficulties arise that are related to interparticle forces. The object of the investigation was elucidation and description of the effect of these forces on the fluidizability of fine particles and the quality of fluidization; such information should be useful for processes such as fluorination of uranium compounds, preparation of uranium monocarbide, and coating of reactor-fuel particles. These particulate materials were used; their average diameters are in microns: iron, 1.6, 3.3, and 18; nickel, 18, 81, and 137; glass balloons, 19, 35, 58, 73, 137, and 194; alumina, 11, 13, 27, 68, and 96.

The interparticle forces were determined by an inclined-plane method. The solids were fluidized with nitrogen in Lucite columns having inner diameters of 8.2 and 14 cm. The pressure drops across the bed of particles, as well as heat-transfer coefficients between the bed and an electrically heated plate immersed in it, were measured for determination of the incipient velocity of fluidization. These measurements were also used as a measure of the quality of fluidization.

The ratio of the incipient velocity of fluidization, calculated by a conventional relation without accounting for the interparticle forces, to the same velocity determined experimentally was used as an index (F.I.) describing the fluidizability of a particulate material. The study indicated that the fluidizability is mainly related to the interparticle adhesive force; the effect of interparticle frictional force proved to be negligible.

The value of F.I. decreased with decrease in the ratio of gravitational force to the sum of gravitational force and adhesive force of a particle. A state of fluidization was generally achieved as long as this ration was $\geq 10^{-3}$; when it was smaller, generally the particles could not be fluidized.

The quality of fluidization proved to be closely related to F.I. and to the force ratio; it decreased with decrease in the two parameters. The decrease was attributed to the formation of channels, and thus to the restriction of movement of particles caused by the interparticle adhesive forces.

Fluidizability and quality of fluidization could be improved by introduction of additional energy into the bed to separate the particles from one another; a suitable method appears to be transmittance of sonic energy.

Reference:

1. M. G. Baerns and D. Ramaswami, *ANL-7086* (Argonne National Laboratory, Aug. 1965) (available from CFSTI, Springfield, Va. 22151, at $3.00—microfiche, $0.65); *I.E.E.E. Fundamentals* **5**, 508 (Nov. 1966).

Notes:

1. This information may interest the petroleum-catalysis and heavy-construction industries, and researchers using fine-particle fluidization.

(continued overleaf)

2. Inquiries may be directed to:
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Patent status:

Inquiries concerning rights for commercial use of this innovation may be made to:

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