Glossary of Terms in Powder & Bulk Technology

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5. Particle Properties

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abrasiveness	The ability of a particle to cause wear on a contact surface. This quality is determined by its hardness factor and sharpness of the points of contact. The actual degree of wear then depends on power factors of both the contact pressure and the relative velocity of the contact surfaces. Hard, sharp, angular shaped particles may be expected to be highly abrasive.
aerodynamic diameter	The diameter in µm, of a unit density sphere that has the same terminal velocity in air as the particle in question.
apparent particle density	(See density, apparent particle).
Blain fineness	The fineness of a particulate material, expressed as the surface area per unit of mass.
Bond work index	The energy required to reduce the size of unit mass of material from infinity to 100 µm in size.
Brownian motion	The random movement of small particles in a disperse phase caused by the bombardment of molecules of the surrounding media.
classification	Grading in accordance the particle size, shape, density or other attribute.
cleavage	The tendency to cleave, or split, along definite parallel, closely spaced, particle planes of least cohesion.

coagulation	The change from a fluid to a more or less irregular solid state.
coalescence	The joining together of fluids originally separated by boundaries.
de-flocculation	The breaking down of flocculates.
density, apparent particle	The mass of a particle divided by its volume.
density, effective particle	The mass of a particle divided by its volume including open pores and closed pores.
density, immersed particle	The mass of a particle per unit volume of suspension fluid displaced.
density, true	the mass of a particle divided by its volume, excluding open pores and closed pores.
dispersion	The separation and distribution of one phase in another.
effective particle density	(See density, effective particle).
electrokinetic potential	(See zeta potential).
flocculation	The coalescence of particles into floccs.
fouling	The building up of particles onto surfaces because of the particles stronger attraction to the surface than to the fluid in which they are dispensed.
free-fall velocity	Velocity of fall of a particle though a still fluid at which the affective weight of the particle is balanced by the drag exerted by the fluid on the particle.

hardness

Hardness is characterised, in general, by the resistance of a material to deformation. This property reflects a material's susceptibility to abrasion by other material of contact and its ability to abrade other materials. As such, the value is a measure of its resistance to wear and aggressiveness to cause wear on other materials. When the surface is sufficiently large, absolute hardness is normally measured by determining the resistance to indentation, as in Brinell, Rockwell, Vickers diamond pyramid and scleroscope hardness tests. For particles and powders hardness, it is generally described in relation to its capacity to scratch or wear other materials, without itself suffering surface degradation. Ten materials of different hardness are defined by Mohr's scale of hardness, to act as a basis for comparison and interpolation.

immersed particle density

(See density, immersed particle).

Mohr's scale of hardness

A scale that gives a comparative order of hardness by expressing it in terms of the ability of one material to scratch another, without itself being affected. A set of reference materials is listed with which others may be compared.

In ascending order of hardness, these are:

1. Talc
2. Gypsum
3. Calcite
4. Fluoride
5. Apatite
6. Orthoclase
7. Quartz
8. Topaz
9. Corundum
10. Diamond

It should be noted that some material surfaces are an-isotopic in hardness, the resistance to scratching being 'tougher' in one direction than another. The ability to mark another surface is dependent upon the intensity of local pressure, therefore a particle that has sharp corners will concentrate any given contact force on a smaller area.

Ostwald ripening	The growth of some particles in a suspension at the expense of others as a result of dissolution and re-crystallisation.
particle density	(See density, apparent density, or density, effective particle).
particle density, true	(See density, true).
sedimentation	The settling of particles in a still fluid, resulting in grading by mass.
settling velocity	The distance per unit time that a particle falls in a still fluid. Stokes' law has been developed, at low Reynolds number, to relate settling velocity to particle size.
temperature	Generally, most materials are handled in ambient temperature conditions. In sensitive cases, the physical properties of the bulk material may be affected at high ambient temperatures, and almost certainly so at elevated temperatures. High temperature also affects the gas in the voids, almost invariably to increase the gas viscosity and thereby significantly influence the effects of bulk volume changes (See porosity). Hot, fine powders from driers and kilns are considerably more prone to sustained aeration and fluidity than the same material at normal ambient temperature. This is because of the increased resistance to loss of excess air from the voids by virtue of the reduced permeability of the mass to the higher viscosity gas. Changes of temperature also cause secondary effects of moisture holding capacity of the gas, condensation migration and 'thermal ratcheting', a process of repeated change of volume due to fluctuating thermal variations, as between day and night conditions, that alternately contract a bulk volume in a silo to cause settlement, and then expand to stress the container walls.
terminal velocity	1 See free-falling velocity. 2 See terminal gas velocity
velocity, free fallin	See free-falling velocity.
viscous drag	The resistance to movement of a particle through a fluid.

zeta potential

The potential difference between the surface of a solids particle immersed in water or a conducting liquid and the fully dissociated ionic concentration in the body of the liquid.

It can be determined using the Smoluchowski equation:

$$z = 4 p.h.U / Eoo$$

where:
- z is the zeta potential
- h is the viscosity of the liquid
- U is the velocity of a particle under an applied electric field Eoo.

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