CHEMICAL ENGINEERING

Mechanical operation (MO)

Hand Notes For GATE, IES, PSUs & Competitive Exam

Hand Notes

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Mechanical Operation :-

↳ Particulate Solids — Solid Characteristics,
                              Size Reduction.
                              S-S separation

↳ Dynamics of solids — fluidization, Sedimentation
                                     Elutriation

↳ Mining   —   Mining of solids.

Characteristics of Solid :-

↳ Physical property (density, M.P, k)
↳ Particle Shape
↳   "   Size

Particle Shape :-

↳ Regular Particles (spherical particles) $\frac{\text{Surface Area}}{\text{Volume}}$ = minimum
↳ Irregular Particles

Pt. is min in only spherical particle

Sphericity

$$\phi = \frac{(S/V)\text{ sphere having same volume}}{(S/V)\text{ irregular particle for of same Volume}}$$

assume hypothetical Sphere

$$V_p = \frac{\pi}{6} d_p^3$$

$$S_p = \pi d_p^2$$

$$\phi = \frac{(S_p/V_p)\text{ sphere}}{(S_p/V_p)\text{ particle}}$$

$$\left(\frac{S_p}{V_p}\right)_{\text{sphere}} = 6/d_p$$

$$\phi = \frac{S_m/V_m}{S_p/V_p}$$

same volume

* $\phi < 1$

is less than one for irregular particle as it gets broken in rather sphere

* If irregular particle is sphere

  $\Rightarrow$ $\boxed{\phi = 1}$

* $\phi \rightarrow 1$, particle is near to the regularity.

* $\phi \rightarrow 0$, particle is far away from regularity.

Q.) Cube $a \times a \times a$, Sphericity.

$$a^3 = \frac{\pi}{6} d_p^3$$

$$\left(\frac{6a^3}{\pi}\right)^{1/3} = d_p$$

$$\phi = \frac{\frac{6}{a}\left(6/\pi\right)^{1/3} a}{6a^2/a^3} = \frac{\left(6/\pi\right)^{1/3} a^2}{6 a^2}$$

$$= \frac{6/a \sqrt[3]{6/\pi}}{6a^2/a^3}$$

$$\phi = \sqrt[3]{\frac{\pi}{6}} \simeq 0.806$$

* ϕ is independent of particle size

* **Particle Size :—**

  Dimension occupy by the particle in vector space.

  for 1-Dim = linear dimension = diameter.

  2-Dim = Planner dimension = Area.