① → equivalent volume sphere diameter, the surface - volume equivalent sphere diameter

① → equivalent volume sphere diameter.

Surface - volume sphere diameter.

Projected area diameter of cuboid particles.

Martin's Diameter.

↳ line Bisecting Projected Area.

Equivalent circle diameter → circle with area equal to projected area.

Feret's diameter.

↳ Distance between parallel tangents

→ Diameter of Sphere. having same volume

↳ $\frac{4}{3}\pi \frac{d^3}{8} = 1\times2\times4$

$\frac{d^3\pi}{6} = 8\ mm^3$

$d = \left(\frac{8\times6}{\pi}\right)^{1/3} = \left(\frac{48}{\pi}\right)^{1/3} = \underline{2.481\ mm}$

→ Diameter having same surface to volume ratio

$$\frac{\frac{\pi d^2}{\cancel{2}}}{\frac{\pi d^3}{6}} = \frac{2(1\times2+2\times4+1\times4)}{(1\times2\times4)} = \frac{2(2+8+4)}{8} = \frac{\cancel{28}}{\cancel{8}} = \frac{14}{4} = 7/2 = 3/d$$

$\frac{\pi d^2}{4}$

$d = \cancel{6}^{2}/7 = \cancel{0.85}$ 1.71

$A_1 = 1\times2 = 2 \Rightarrow \frac{\pi d_1^2}{4}$ $\quad d_1 \Rightarrow \sqrt{8/\pi} = 1.59$ m.m

$A_2 = 2\times4 = 8 \Rightarrow \frac{\pi d_2^2}{4}$ $\quad d_2 \Rightarrow \sqrt{\frac{32}{\pi}} = 3.19$ mm

$A_3 = 1\times4 = 4 \Rightarrow \frac{\pi d_3^2}{4}$ $\quad d_3 \Rightarrow \sqrt{\frac{16}{\pi}} = 2.25$ mm

(2) Sphericity $\Rightarrow$ $\dfrac{\text{(Surface area of Sphere of Same volume)}}{\text{Actual Surface Area}}$

↳ ~~volume of Cube = $L^3 = D^3$~~

~~Sphere volume = $\pi/6$~~

~~$\frac{\pi d^2}{6L^2} = \frac{\pi d^2}{6L^2}$~~

$L^3 = \frac{\pi D^3}{6}$

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

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

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

$= \boxed{0.805}$ ✓

(3) → Sand mixture was screened through 12 mesh.

Screen Analysis → each screen is identified in meshes per inch.

According to Tyler Screen Series
200 mesh screen ⇒ 0.074 mm.
↳ Area of next screen smaller screen is twice the next smaller screen.

Ideal Screen

overflow
screen
underflow

↳ Smallest Particle in overflow > largest particle in underflow.

Cut-Diameter

D_{pc} ⇒ equal to mesh opening.

Screen effectiveness

Feed

Material Balance ⇒ $\boxed{F = D + B}$

overflow (Oversize)

underflow

$$Fx_F = Dx_D + Bx_B$$

$$\boxed{\frac{D}{F} = \frac{x_F - x_B}{x_D - x_B}} \quad \boxed{\frac{B}{F} = \frac{x_D - x_F}{x_D - x_B}}$$

$$E_A = \frac{\text{Oversize material A in the overflow}}{\text{Total entering in feed.}}$$

$$= \frac{D x_D}{F x_F}$$

→ effectiveness based on undersize

$$E_B = \frac{B(1-x_B)}{F(1-x_F)} \Rightarrow \frac{\text{Undersize material in underflow}}{\text{Total entering in feed.}}$$

$$\frac{D}{F} = \frac{x_F - x_B}{x_D - x_B}$$

$$E = E_A \times E_B \Rightarrow \frac{D B x_D (1-x_B)}{F^2 x_F (1-x_F)}$$

$$\frac{B}{F} = \frac{x_D - x_F}{x_D - x_B}$$

$$\Rightarrow \frac{(x_F - x_B)}{(x_D - x_B)} \times \frac{(x_D - x_F)}{(x_D - x_B)} \times \frac{x_D (1-x_B)}{x_F \times (1-x_F)}$$

(3) →

$$E = \frac{D}{F} \times \frac{B}{F} \times \frac{(x_D)\,(1-x_B)}{x_F \quad (1-x_F)}$$

$x_F = 0.4$
$x_D = 0.8$
$x_B = 0.2$

$$= \left(\frac{x_F - x_B}{x_D - x_B}\right) \times \left(\frac{x_D - x_F}{x_D - x_B}\right) \times \left(\frac{x_D}{x_F}\right)\left(\frac{1-x_B}{1-x_F}\right)$$

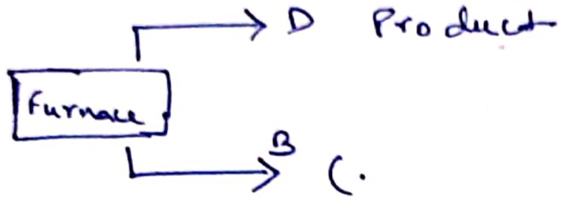
$$= \left(\frac{0.4 - 0.2}{0.8 - 0.2}\right) \times \left(\frac{0.8 - 0.4}{0.8 - 0.2}\right) \times \left(\frac{0.8}{0.4}\right)\left(\frac{0.8}{0.6}\right)$$

$$= \frac{0.2}{0.6} \times \frac{0.4}{0.6} \times (2) \times \frac{0.8}{0.6}$$

$$= \frac{\cancel{2} \times \overset{2}{\cancel{4}} \times \cancel{2} \times 8}{\underset{3}{\cancel{6}} \times \underset{3}{\cancel{6}} \times \underset{3}{\cancel{6}}} = \frac{16}{27}$$

$$= \boxed{0.59}$$

④ → we have x_F ⇒



C.

$F =$ 100 tonne/H

$x_B = \boxed{0.05}$

$x_F = 0.75$

we have efficiency.

$$E = \frac{D}{F} \times \frac{B}{F} \times \frac{(x_D)}{(x_F)} \times \left(\frac{1-x_B}{1-x_F}\right)$$

$$E = \frac{(x_F - x_B)}{(x_D - x_B)} \times \frac{(x_D - x_F)}{(x_D - x_B)} \times \left(\frac{x_D}{x_F}\right) \times \left(\frac{1-x_B}{1-x_F}\right)$$

$$0.5 = \cancel{\frac{(0.05 - x_B)}{F}} = \frac{0.7}{(x_D - 0.05)} \times \frac{(x_D - 0.75)}{(x_D - 0.05)} \times \frac{x_D}{0.75} \times \frac{0.95}{0.25}$$

$$0.5 = 3.54\left(\frac{x_D^2 - 0.75x_D}{x_D^2 - 0.1x_D + 0.0025}\right)$$

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estimation ⇒

$$0.5 = 3.54 \left(\frac{\cancel{x_D}\left(x_D - 0.75\right)}{\cancel{x_D}\left(x_D - 0.1\right)} \right)$$

$$0.5\,x_D - 0.05 = 3.54\,x_D - 2.655$$

$$2.605 = 3.04\,x_D$$

$$x_D = \left(\frac{2.64}{3.04} \right) = \boxed{0.868}$$

$1 - x_D$ ⇒ fines consentration in over flow

↳ 14%

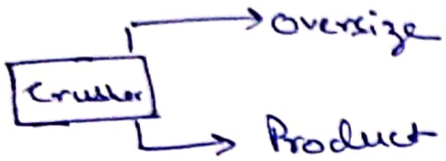
F ⇒ 100 tonne/H

$$D/F = \frac{x_F - x_B}{(x_D - x_B)} = \frac{0.75 - 0.05}{0.86 - 0.05}$$

$$= \frac{0.7}{0.81} = 0.864$$

$$D = 86.4 \text{ tonne/hr.}$$

6 → 5



$$\boxed{B = 100\ kg/h}$$

$x_F = \cancel{0.146}\ 0.694$

$x_D = \cancel{0.168}\ 0.764$

$x_B = 0.113$

$$\epsilon = \left(\frac{D}{F}\right)\left(\frac{B}{F}\right)\left(\frac{x_D}{(x_F)}\right)\left(\frac{1-x_B}{(1-x_F}\right)$$

$$= \left(\frac{x_F - x_B}{x_D - x_B}\right)\left(\frac{x_D - x_F}{x_D - x_B}\right)\left(\frac{x_D}{x_F}\right)\left(\frac{1-x_B}{1-x_F}\right)$$

$$= \left(\frac{0.694 - 0.113}{0.764 - 0.113}\right)\left(\frac{0.764 - 0.694}{0.764 - 0.113}\right)\left(\frac{0.168}{0.146}\right)\left(\frac{1-0.113}{1-0.146}\right)$$

$$= \left(\frac{\cancel{0.033}\ 0.581}{\cancel{0.055}\ 0.651}\right) \times \left(\frac{\cancel{0.022}\ 0.070}{\cancel{0.055}\ 0.651}\right) \times \left(\frac{0.764}{0.694}\right)\left(\frac{0.887}{\cancel{0.854}\ 0.306}\right)$$

$$= \frac{3}{5} \times \frac{2}{5} \times 1.195 = \cancel{0.29}\ \boxed{0.306}$$

$$\frac{B}{F} = \frac{x_D - x_F}{x_D - x_B} = \cancel{\frac{2}{5}}\ \frac{0.070}{0.651}$$

$$F = \cancel{2.5}\ 9.3 \times B = \cancel{250}\ 930\ kg/hr.$$

⑥ → Cumulative $x_F = 55\%$ $x_B = 0$ $x_D = 76\%$

$$\epsilon_{16} = \left(\frac{x_F - x_B}{x_D - x_B}\right)\left(\frac{x_D - x_F}{x_D - x_B}\right)\left(\frac{x_D}{x_F}\right)\left(\frac{1-x_B}{1-x_F}\right)$$

$$= \left(\frac{0.55}{0.76}\right)\left(\frac{0.76-0.55}{0.76}\right)\left(\frac{0.76}{0.55}\right)\left(\frac{1}{0.45}\right)$$

$$= \frac{0.\cancel{55}}{\cancel{0}.76} \times \frac{0.21}{0.76} \times \left(\frac{0.\cancel{76}}{\cancel{0.55}}\right) \times \left(\frac{1}{0.45}\right)$$

$$= \frac{21 \times 100}{76 \times 45} = \boxed{0.61}$$

$B \Rightarrow$ 2 tonne/h.

$$\frac{B}{F} = \frac{x_D - x_F}{x_D - x_B}$$

$$\frac{2}{F} = \frac{0.76 - 0.55}{0.76 - 0}$$

$$F = \frac{0.76}{0.21} \times 2 = 7.23 \text{ tonne/h}$$

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7 →

Mesh No		% Retained	Screen Opening	$(D_{pi})_{avg}$ (mm)	x_i/D_p
4			4.699		
6	−4 +6	5 (0.05)	3.327	4.013	0.01245
8	−6 +8	6.2 (0.062)	2.362	2.8445	0.02179
10	−8 +10	13.0 (0.13)	1.651	2.0065	0.06478
14	−10 +14	16.6 (0.166)	1.168	1.4095	0.11777
20	−14 +20	15.0 (0.150)	0.833	1.0005	0.14992
28	−20 +28	12.4 (0.124)	0.589	0.711	0.17440
35	−28 +35	9.0 (0.099)	0.417	0.503	0.17892
48	−35 +48	8.2 (0.082)	0.295	0.356	0.23033
65	−48 +65	5.0 (0.05)	0.208	0.2515	0.19880
100	−65 +100	4.8 (0.048)	0.147	0.1775	0.27042
150	−100 +150	3.3 (0.033)	0.104	0.1255	0.26294
200	−150 +200	1.5 (0.015)	0.074	0.089	0.16854

$\sum \frac{x_i}{D_i} = 1.85106$

Specific Surface Area $\Rightarrow \frac{6}{\phi_s \rho_p} \sum \frac{x_i}{D_{pi}}$

$\Rightarrow \frac{6 \times 1.85106}{5 \times 10^{-1} \times 0.38} = 59 \text{ cm}^2/\text{g}$

$74 \text{ cm}^2/\text{g}$

Taking Sphericity as 0.38

Varies from 0.079 − 0.437
mean value ⇒ 0.297