ملخصات مدار

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العمليات الموحدة للدقائق الصلبة

Find sphersity

$$\Phi_s = \frac{6 V_p}{S_p D_p}$$

V_p → volume particle

S_p → area particle

D_p → diameter eq

$$\frac{\pi}{6} D_p^3 = \text{الباتيكل}$$ (← cylind, cube, cuboid)

* surface diameter (ds)

$$ds = \sqrt{\frac{S_p}{\pi}}$$ S_p → area particle

* volume diameter

$$dv = \sqrt[3]{\frac{6 V_p}{\pi}}$$ V_p → volume particle

* Surface volume diameter

$$dsv = dv^3 / ds^2$$

specific surface area = $\frac{\text{Area}}{\text{Volume}}$

$r = \frac{D}{2}$

Area

cylinder $= \pi D\left(\frac{D}{2} + h\right)$

spher $= \pi D^2$

cuboid = 2*(طول * عرض) + 2*(طول * ارتفاع) + 2*(عرض * ارتفاع)

cube = (الضلع)^٢ * ٦

circle $= \frac{\pi}{4} D^2$

Volume

cylinder $= \frac{\pi}{4} D^2 h$ دائرة

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

cuboid = طول * عرض * ارتفاع

cub = (الضلع)^٣

degree mixing % (quality)

$$Sr^2 = P(1-P)/n$$ → completly random mix $b = 1$, $S = Sr$

P → initial propation of on particle, equal → 0.5, massfraction ☺

n → number of partical of samp

$$So^2 = P(1-P)$$ → unmixed $b = 0$

for unmixd

$$I = \frac{1}{\sqrt{n}}$$

degree of mixing

$$b = \frac{So - S}{So - Sr} \text{ oR } Sr/s$$

$$b = \frac{So^2 - S^2}{So^2 - Sr^2}$$

$\boxed{\text{ball mill}}$ $\boxed{r = \frac{D}{2}}$ $Hz * 2\pi = rad/s$

$W_c = \sqrt{\frac{g}{r}}$ critical velocity

$r = r_{ball} - r_{patricl} \approx \underline{\underline{r}}_{ball}$
radius

~~optimum~~
actual speed $= (0.5 - 0.75) W_c$

$W_{ball} > W_{criticl}$
the speed rotaion is too high and the ball is contact with the side of mill

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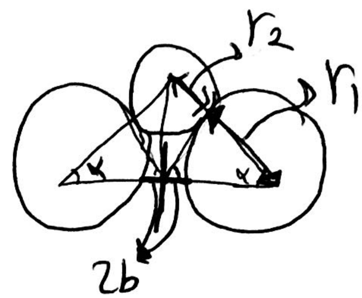
$\boxed{\text{Crusing Roll}}$ angle of nipe $= 2\alpha$



$\cos\alpha = \frac{r_1 + b}{r_1 + r_2}$ (r_1 → Roll, r_2 → particle)

Area $= 2b *$ طول roll

Volumetric $=$ Area $*$ Velocity

actual $=$ Volumetric $*$ نسبة actual

mass $=$ density particle $*$ Volume

$*$ power consumtion (crushing) L → size Mm

① Rittinger's law (fine) $E = K_R f_c \left(\frac{1}{L_2} - \frac{1}{L_1}\right)$ (K_R → m^4/kg)

② Kick's law (coarse) $E = K_K f_c \ln \frac{L_1}{L_2}$ → size reduction ratio (K_K → $\frac{m^3}{kg}$)

③ Bond's law (intermidate)

$E = E_i \sqrt{\frac{100}{L_2}} \left[1 - \frac{1}{q^{1/2}}\right]$

$W = 10 W_i \left[\frac{1}{L_2^{1/2}} - \frac{1}{L_1^{1/2}}\right]$

kW.h/ton size → Mm

CH 7 packed ped

[Voidage e, pressure drop]

Superficial velocity

$$Re = \frac{u \rho}{\mu S (1-e)}$$

$\rho \to$ fluid

$S \to$ specific suffac partica

$Re < 1$ laminor

$Re > 100$ turblunt

$$C'_D = \frac{5}{Re} + \frac{0.4}{Re^{0.1}}$$

$Re < 1$ (laminor) $C'_D = \frac{5}{Re}$

$1 < Re < 100$ (transit) $C'_D = \frac{5}{Re} + \frac{0.4}{Re^{0.1}}$

$C'_D = $

$Re > 100$ (turbulnet) $C'_D = \frac{0.4}{Re^{0.1}}$

$$C'_D = \frac{e^3 * (-\Delta P)}{S(1-e) * L} * \frac{1}{\rho u^2}$$

$-\Delta P \to$ drg

$\rho \to$ fluid

$u^2 \to$ superficial velocity

$G = u\rho$ kg/m².s

$G \to$ Flow rate flux

$\rho_{H_2O} = 1000$ kg/m³

$S_B = S(1-e)$

$e \to$ percent of voidage

$(1-e)$ percent of solid

$S_{sperical} = 6/d$

cylinder $d = h$ $S = 6/d$

non spherical partical plates

$$C_D' Re^2 = \frac{4K \rho_f d_p^3 g}{\mu^2 \pi}(\rho_p - \rho_f) \quad \text{free of } u$$

$$\frac{C_D'}{Re} = \frac{4K \mu g}{\pi \rho_f^2 u_0^3}(\rho_p - \rho_f) \quad \text{free of particle size}$$

$K = ??$

$\frac{\pi}{4} d^2 = \text{Area partical}$

$d = —$

$\underbrace{\text{Area} * \text{طول}}_{\text{الضلع}} = K d_p^3$

$K = ✓$

$mm^2 \rightarrow 10^{-6} m^2$
$cm^2 \rightarrow 10^{-4} m^2$
$mm^3 \rightarrow 10^{-9} m^3$
$mN \rightarrow 10^{-3} N$

Find terminal velocity → setting

$C_D' Re^2 \rightarrow \log \rightarrow$ table 3.4 $\rightarrow \log Re \rightarrow$ correction + log re (3.7 table) $\rightarrow$ Re

$Re = \frac{u d \rho}{\mu}$ → particle, → fluid

Find partical size

$\frac{C_D'}{Re} \rightarrow \log \rightarrow$ table $\rightarrow \log Re \rightarrow$ table

Fludization

How to ~~[illegible]~~ calculate U_{mf}?

$e = 0.4$ [spherical particle] glass

1- Stock's law

$$U_{mf} = \frac{0.00059\, d^2 (\rho_s - \rho) g}{\mu}$$

$$Re_{mf(1)} = \frac{U_{mf}\, d \rho}{\mu}$$

$Re_1 < 1 \Rightarrow$ done

$Re_1 > 1$

$\Downarrow$

$$Ga = \frac{d^3 \rho (\rho_s - \rho) g}{\mu^2}$$

ρ_s → solid, particle; ρ → fluid

$$Re_{mf} = 25.7\left(\sqrt{1 + 5.53 \times 10^{-5}\, Ga} - 1\right)$$

$$Re_{mf} = \frac{u d \rho}{\mu}$$

$u = \checkmark$

at min. f

$$\Delta P = L(1-e)(\rho_s - \rho) g$$

$$U_{mf} = \frac{0.0055\, e^3 * d^2 (\rho_s - \rho) g}{(1-e)\mu}$$

$$m_s = (1-e) A L \rho_s$$

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non spherical particle (plates)

$$u = \frac{1}{K''} \frac{e^3}{S^2 (1-e)^2} \frac{1}{\mu} \frac{-\Delta P}{L} \quad \text{(carmen)}$$

$$U_{mf} = \frac{1}{5} \frac{e^3 (\rho_s - \rho) g}{S^2 (1-e) \mu}$$

$$Re_{mp} = \frac{u\, d_p \rho}{\mu} \quad \begin{matrix} > 1 \; \times \\ < 1 \; \checkmark \end{matrix}$$

$Re_1 > 1$

$$Ga = \frac{d_p^3 \rho g (\rho_s - \rho)}{\mu^2}$$

$$d_p = \sqrt[3]{\frac{6 V_p}{\pi}}$$

$$Re_{mf} = 33.65\left(\sqrt{1 + 6.18 \times 10^{-5}\, Ga} - 1\right)$$

$$U_{mf} = \frac{\mu}{d_p \rho} Re_{mf_p}$$

$$\frac{Re_o}{Re_{mf}} = \frac{U_o}{U_{mf}}$$

$U_o \Rightarrow$ spherical particle

$$Re_o = \left(2.33\,Ga^{0.018} - 1.53\,Ga^{-0.016}\right)^{13.3}$$

$$Re_o = \frac{U_o d \rho}{\mu}$$

What the voidage (extant of expansion) (e)

1. $$Ga = \frac{d^3 \rho(\rho_s - \rho) g}{\mu^2}$$

Re_o ✓

U_o ✓

U_{mf}

ignore the wall effect

$$\frac{4.8 - n}{n - 2.4} = 0.043\,Ga^{0.57}\left[1 - \cancel{1.24\,d/dt}\right]$$

$n =$ ✓

$$\frac{U_{mf}}{U_o} = e^n \Rightarrow e = ✓$$

$$= 2.51 \log\left(\frac{\left(1.83\,Ga^{0.018} - 1.2\,Ga^{-0.016}\right)^{13.3}}{\sqrt{1 + 5.53 \times 10^{-5}\,Ga} - 1}\right)$$

$$\boxed{U_0 = \frac{d^2 g \rho_s}{18 M}} \cdots \rightarrow \text{diameter particle}$$

gas cyclone

$\Downarrow$ sub in previous

$$U_0 = \frac{U_r}{U_t^2} r g \cdots \text{(gravitional field) cyclon}$$

$$U_0 = \frac{U_r}{U_t^2} 0.2 d_o g$$

$$U_r = \frac{G \rightarrow \text{mass velocity}}{\underbrace{2\pi r z}_{\text{surface area}} \rho}$$

$$U_t = \underbrace{U_{to}}_{\text{maxium at the well (velocity of the gas enter)}} \sqrt{\frac{d_t}{2r}}$$

$$\cdots U_0 = \frac{0.2 G d_o g}{\pi \rho z d_t U_{to}^2} \cdots$$

find d cyclon

$$\boxed{U_0 = \frac{0.2 A_i^2 d_o \rho g}{\pi z d_t G}} \rightarrow \text{gas inlet}$$

ρ(gas)

$$\boxed{G = \underbrace{A_i}_{\text{Area gas inlet}} \rho U_{to}} \ (kg/m.s^2)$$

uto: tangential velocity at circumference(velocity of the gas which enters the cyclone)
ut: tangential velocity at radius r
dt: diameter of cyclone

packed Coulum

Flooding rates in packed coulum

$F = SB/e^3$

① dry Towers

DP نفسه Bed

② wet towers $L=0$

$-\Delta P_w = (1 + k_1/d_n)\,\Delta P_d$

broken 5.5 — Rashing ring 3.3 — size solid

③ irrigated

$\Delta P = (1 + kL/d_n)\,\Delta P_d$

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flooding rate (velocity) (@ packed coulum)

$\frac{L}{G}\sqrt{\frac{\rho_g}{\rho_L}} \Rightarrow$ بنحسبها وبنروح على curve بنقاطع

$\rho_g \rightarrow$ estimate ideal gas law

$\frac{U_G^2\, SB}{g e^3}\left(\frac{\rho_G}{\rho_L}\right)\left(\frac{\mu_L}{\mu_w}\right)^{0.2} = \_\_\_ \rightarrow$ correction factor $\hookrightarrow 1 \rightarrow$ water

ρ ?

$SB \rightarrow$ (Table $\rightarrow$ design)

$e \rightarrow$ Rashing rings

$U_G = \checkmark$

mass velocity $= U_G * \rho_g$

رسمة الكتاب

جدول x 225

$$\frac{dv}{dt} = \frac{(-\Delta P) A^2}{r\mu \; vV}$$

[Filtration]

Constant rate

$$\frac{V}{t} = \frac{A^2(-\Delta P)}{r\mu v V}$$

Constant pressure

$$\frac{V^2}{2} = \frac{-\Delta P}{r\mu v} A^2 t \rightarrow \text{constant pres}$$

ΔP (increas at certine limit, $t_1 \rightarrow$ filtrate V_1)

$$\frac{1}{2}(\underbrace{V^2}_{\text{volume filtrate of const. P}} - \underbrace{V_1^2}_{\text{volume of filtrate (1)}}) = \frac{-\Delta P A^2}{r\mu v}(\underbrace{t}_{\text{total}} - \underbrace{t_1}_{\text{time of const P}})$$

Flow through Cloth

$A = 12 \times 2 * (A^2)$ — fram, frame

Constant rate

$$V_1^2 + \frac{LA}{v} V_1 = \frac{A^2(-\Delta P) t_1}{r\mu v}$$

Constant pressure

$$\frac{1}{2}(V^2 - V_1^2) + \frac{LA}{v}(V - V_1) = \frac{A^2(-\Delta P)}{r\mu v}(t - t_1)$$

washing rate $= \frac{1}{4}$ rate filtration

time of washing
OR volume of washing

$\left(\frac{dV}{dt}\right)_{filtrate}$

constant pressure $\left(\frac{\quad}{V}\right)_s$
$(t-t_1)$