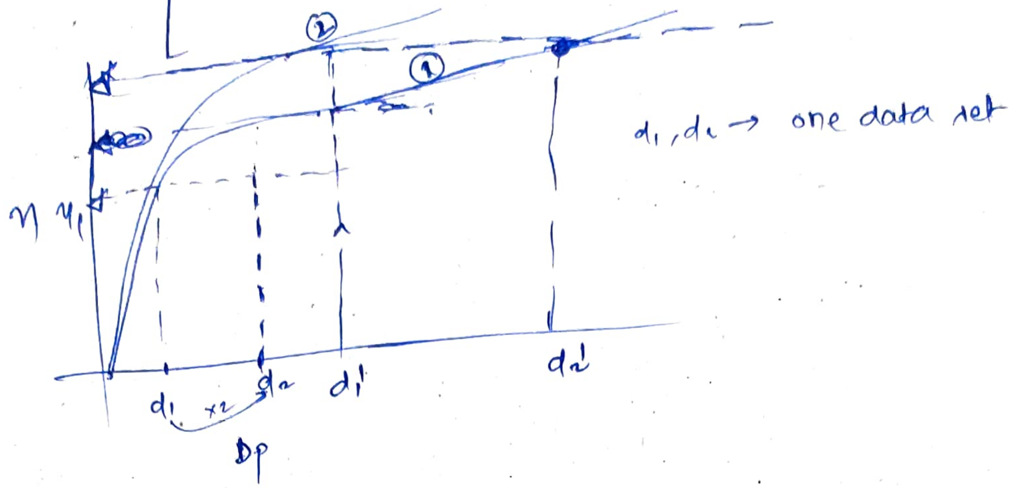
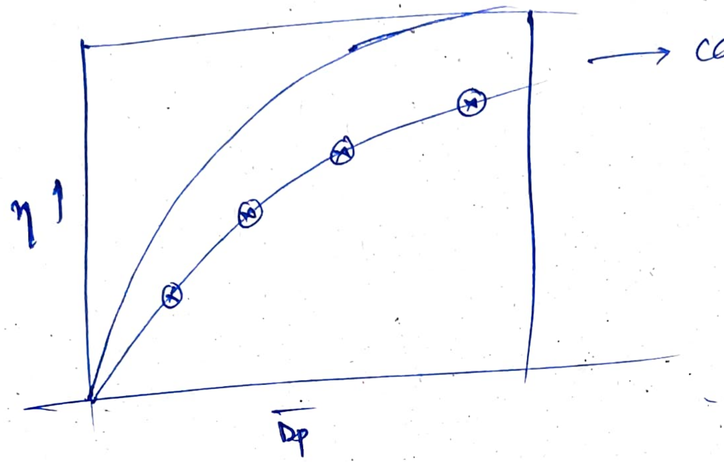
If $\frac{d_2}{d_1} = \left[\frac{d_2}{d_1} = 2.0 \Rightarrow \boxed{d_2 = 0.2 \cdot d_1} \right.$





1) $d_1 = 5\mu m$, $d_2 = 10\mu m$

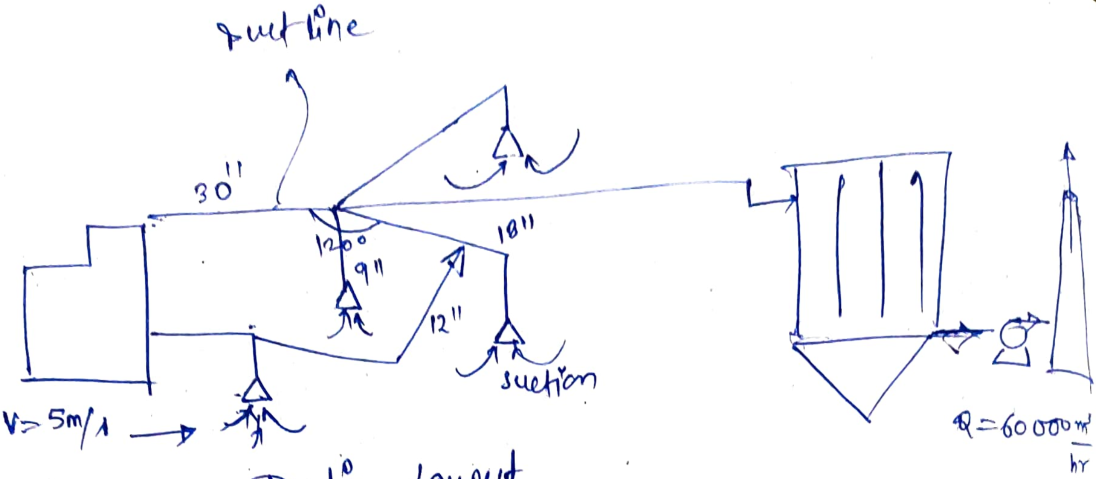
2) $d_1 = 15\mu m$, $d_2 = 30\mu m$

$\Delta P = 1000$ psi in a cyclone std value

→ if η is not achieved with one cycle then add 1 or 2 more to it

→ Assume some data if given in exam but assumpt^n should be based on some std source.

→ If suction is very low then we need to do friction calcul^n in suction pipe to overcome such losses.



Ducting Layout

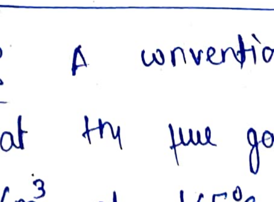
Angle of bend that are forbidden → 90°, 60°, 45°, 30°

→ Now using dia, length and angle of bend we can find out ~~out~~ our total pressure loss

let we get. $Q_{new} = 80,000 \; m^3/hr$ from our calculation

↕

→ using ducting layout we find the hood that is asked we add up all suction line ~~frictional~~ upto that



~~using~~ by calculating all pressure losses due to friction and bends.

Prob 1 : A conventional cyclone of dia of 500mm is used to treat the flue gas containing cement dust particulate of 3.5 gm/m³ at 165°C and 1.0 atm pressure. The inlet gas velocity is 17 m/s and no. of turn the gas complete in the cyclone is 5. $\rho_p = 2700 \, kg/m^3$, $\rho_g = 1.04 \, kg/m^3$.

Viscosity of gas = 0.019 cP

Particle size (μm)	>50	50-40	40-30	30-20	20-15	15-10	10-5	<5
% by wt	19.5	10.0	7.5	15.0	21.0	15.0	9.5	2.5

Calculate :

1) cut size particle diameter
2) overall collection efficiency of the cyclone
3) outlet concⁿ of dust from cyclone.

Given : $D = 500 mm$
$\rho = 3.5 gm/m^3$
$T = 160°C$
$P = 1.0 atm$

$b = 0.2D$
$h = 0.5D$

① $D_{p\,min} = \left[\dfrac{9\mu_f b}{\pi N V(\rho_p - \rho_F)}\right]^{1/2}$

$= \left[\dfrac{9 \times 0.019 \times 10^{-3} \times 0.2 \times 0.5}{\pi \times 5 \times 17\,(2700 - 1.04)}\right]^{1/2}$

$D_{p\,min} = 4.87 \times 10^{-6}\ m$

$\left[D_{p\,min} = 4.87\ \mu m\right]$

② $\eta = \dfrac{1}{1 + \left(\cancel{D_p/D_{p\,min}}\right)^2}$

$d_p \rightarrow$ Mass mean dia = 27.0 μm

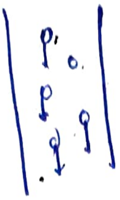
$\eta = \dfrac{1}{1 + (d_{pc}/d_p)^2}$

$\eta_1 = 0.99$
$\eta_2 = 0.988$
$\eta_3 = 0.981$
$\eta_4 = 0.963$
$\eta_5 = 0.928$
$\eta_6 = 0.868$
$\eta_7 = 0.606$
$\eta_8 = 0.513$

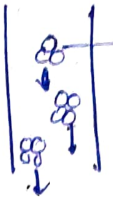
$\cancel{\dfrac{0.019}{100 \times 10}} \rightarrow$

(2) Flocculation :

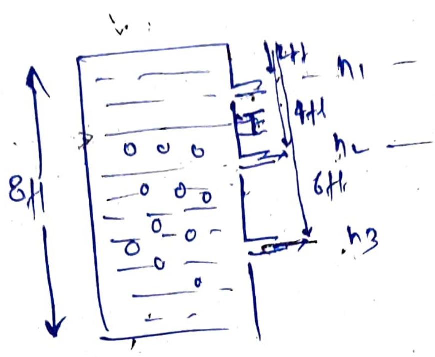
Discrete settling →



Flocculation



Imaging technique use to find flock size (not for natural flocculating mix)



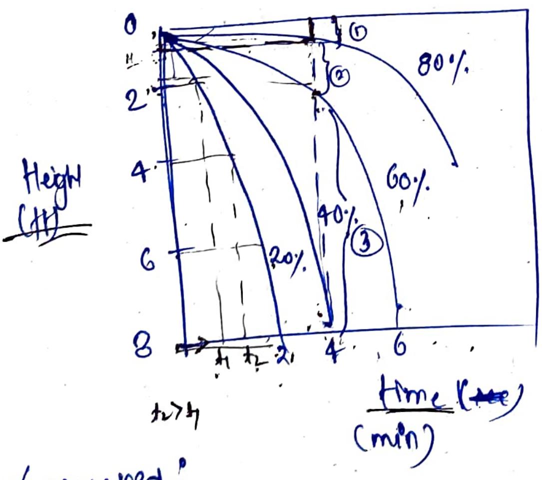
timer	% solid removal h_1	h_2	h_3
0			
t_1	—	—	—
t_2	—	—	—
t_3	—	—	—

volume of water. (C_0)

by checking outlet at diff ht.

Ht	time required for a specific % seperation (20%)		
h_1	t_1	t_1'	t_1''
h_2	t_2	t_2'	t_2''
h_3	t_3	t_3'	t_3''
	for 20%	40%	60%

when conc is at outlet of a certain h i.e h_1, h_2, h_3



if residence time = 4 min

① ≈ 0.5 ft

② ≈ 0.7 ft

③ ≈ 6.8 ft

% removed :

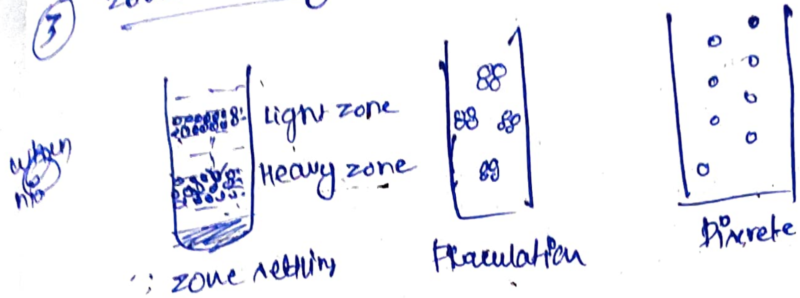
$$\rightarrow \left(40 + 60\% \times \frac{6.8}{8} + 80\% \times \frac{0.7}{8} + 100\% \ \frac{0.5}{8}\right)$$

% sepern of solids achieved.

→ We can take any residence time a/c to how much seperation we need

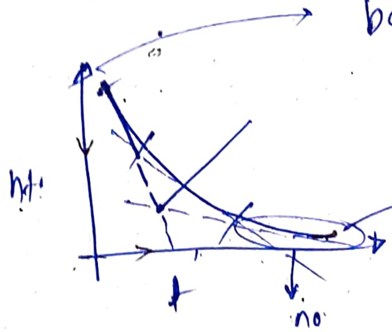
Flock → easily breakable
→ unbreakable (ex → suspended particle + polyacrylamide)

③ Zone settling



In Z.S we see different zone of particle light zone, heavy zone settle ∴

→ happen when conc. is very high.



→ based on residence time (t) we can find height of solids in cylinder
→ ht × A → volume of solid collected → we find how much solid removed

→ not due to settling but to compression occurs ~~during~~ ~~to~~ due to ↓ top settling particles.

τ ↑ (res. time) Vol tank ↑se

A (area of settling tank) = $\dfrac{Q \times t_u}{h_o}$

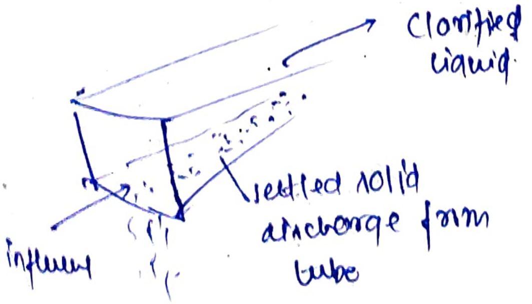
Q — flow rate, t_u — time, h_o — initial ht.

$\tau = \dfrac{V}{v_o}$

$\boxed{V = Q \times t_u}$

V — volume of settling tank.

Inclined plate or tube settling.



@ $t = 0$ $Q = Q_0$ $Z \rightarrow Q_1$

@ $t = t$ $Q = Q$ (due to layer dust) $\rightarrow Q_2$

↓ gradually decrease with time. — constant ① pressure filtration.

$$Q = \frac{Q_1 + Q_2}{2}$$ → for designing Bag filter

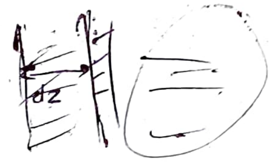
→ ① for Industrial unit (bag filter) constant pressure filtration is used.

Filter velocity $= \dfrac{Q_G}{A}$ — Q_G → gas flow rate, A → surface area.

$t = t_F + t_c$ | t_F → time for filtration
t_c → time required to clean the filter

→ if not given, we $t_c = t_f$

t_{min} Q_{max} when $t_c \approx 0$



① Constant Pressure filtration —

$$t_f = \left(\frac{B}{2\,\Delta P}\right) V_G^2 + \left(\frac{C}{\Delta P}\right) V_G$$

V_G – vol. of gas filtered for deposited dust of 'dz' thickness.

B, C → will have to be provided.

→ If resistance of filter is negligible then —

$$t_f = \left(\frac{B}{2\,\Delta P}\right) V_a^2 \quad \text{where, } B = \left(\frac{M_G \cdot C}{\rho_B K}\right)\frac{1}{A^2} = \frac{K}{A^2}$$

C = cunningham collection factor

ρ_B = bulk density of filter cake

A = collection area through which gas is allowed to pass

$$t_f = K^* \cdot \frac{V_a^2}{A^2}, \quad K^* = \frac{K}{2\,\Delta P}$$

now $$\boxed{Q = \frac{V_a}{t_f + t_c}}$$

② Constant Rate filtration : (Q = const.) → rarely used

$$\Delta P = BQ^2 t + CQ \quad —— ①$$

@ $t = 0$ $\quad \Delta P = CQ$

$t = t$ $\quad \Delta P = \text{-------} \quad ①$

$$\Delta P = (BV_a + D).Q$$

$$\left[Q = \frac{V_a}{t_f + t_c} \text{ ------ } Q_{max} \right] \text{— operation range}$$

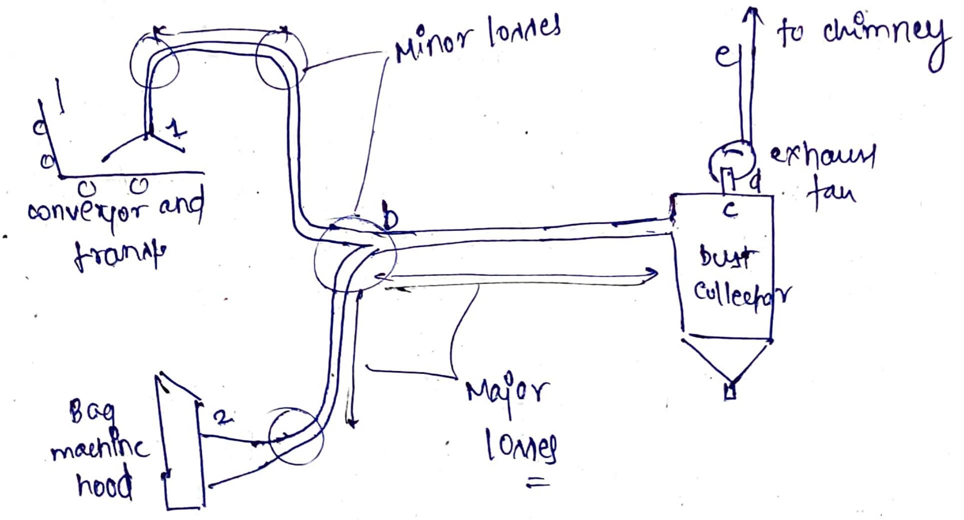
for Q_{max} find A/C ratio · It's two time greater

Increase the area – $A_c = ?$

find no. of bags needed ⇒ $(N \times A_{cp} = A_c)$

→ Instead of one large bag, if we use multiple small bags (20–30 cm dia, 8–10 ft long) the surface area will increase its A/C ratio.

→ To optimize A/C, pleated bag filters are used.



1b = distance 1 → b
2b " 2 → b

we use table given for different sections ~~friction~~ length and bend angle to calculate pressure drop pressure as at present. The time req. to chan[ge] both unit is 4 min. Find max % inc in overall capacity that could be attained by adopting this suggestion.

Radioactive Waste Management :

① Introduction slide –

② Content :–

1. ~~Radi~~ What is Radioactive waste
   (a) Composition
   (b) Type R.A waste with little brief

2. Difference b/w other industrial ~~and~~ waste & radioactive waste.
   → why it is more difficult to handle

~~4. Adverse effects~~
~~(a) On Humans and Animals~~
~~(b) On environment~~

3. Where and when is waste produced ?

4. Adverse effects
   (a) On ~~Living being~~ (Human, Animals
   (b) On Environment.

6. Storage and Disposal (wrt India इस डिस्कस करना है)
   a) storage techniques
   b) Disposal techniques

5. Treatment and Conditioning

Tirthup to Rameshwar