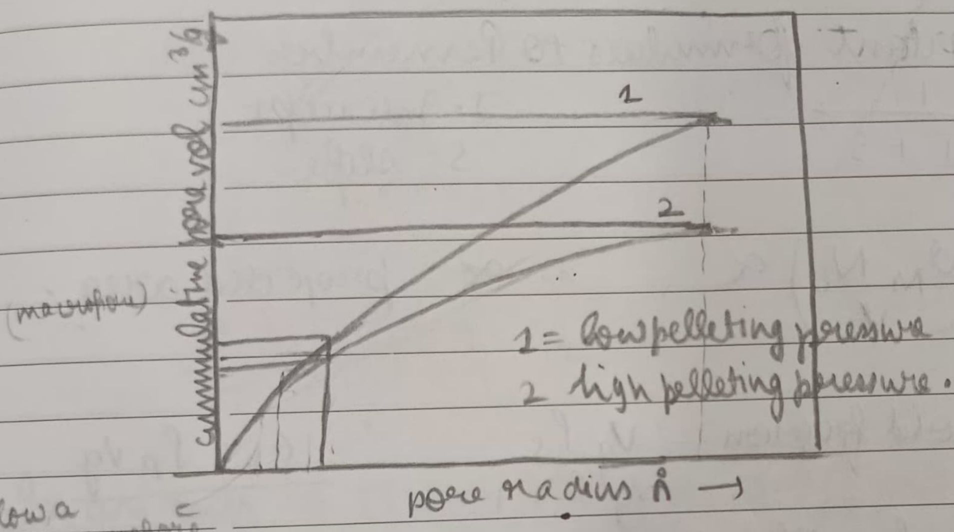
Most catalysts → alumino - silicates (silicones, etc.).

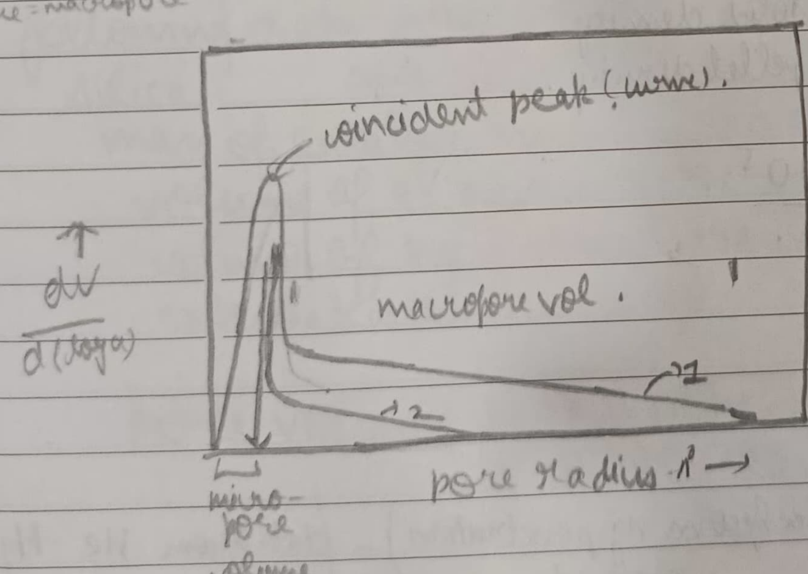
$\theta = 140^\circ$ (average)

↓ For most catalyst solid surface and Hg.

$$\boxed{a(\text{Å}) = \frac{8.75 \times 10^5}{P(lb/in^2)}}$$

P in Psi.





→ Wheeler's parallel pore model

Assumption
1) Pores are having same average radius ($\bar{a}$).
2) Pores are having same average length ($\bar{L}$).
3) Pores are parallel and not connected to each other.

If m_p = mass of catalyst
S_g = surface area / g.
V_g = pore vol / g
n = number of pores

$$\boxed{\begin{aligned} m_p S_g &= (2\pi \bar{a} \bar{L}) n \\ m_p V_g &= (\pi \bar{a}^2 \bar{L}) n \\ \bar{a} &= \frac{2 V_g}{S_g} \end{aligned}}$$

Some Important formulaes to Remember

$$v_m = \frac{1}{I + S}$$

I = Intercept
S = slope

$$S_g = \left(\frac{v_M N_0}{V}\right) \alpha$$

α = projected area.

ϵ_p = void fraction = $\dfrac{V_g \rho_s}{V_g \rho_s + 1}$

$\epsilon_p = \rho_p V_g$

ρ_s = solid density
ρ_p = pellet density.

$$a(\text{Å}) = \frac{8.75 \times 10^5}{p(\text{psi})}.$$

$$\bar{a}(\text{Å}) = \frac{2 V_g}{S_g}.$$

Pore volume = (data from Hg penetration method) − (data from He-Hg method).

In He-Hg method for determination of pore volume
i.e vol of Hg displaced − Vol. of He displaced = pore volume
(total volume) (solid volume).

Q. Calculate the external surface area of non porous spherical particle of 2μ diameter. What size particle would be necessary if the external surface area is to be $100 \, m^2/g$. The density of the particle is $2 g/cm^3$.

$$S_g = \frac{6}{\rho_g d_p}$$

$$100 = \frac{6^3}{\frac{2}{10^3} \times d_p}$$

$$\frac{10}{3} = d_p$$

$0.033 \mu m$

$$S_g = \frac{6}{d_p \rho_g} = \frac{6}{2 \times 10^{-6} \times 2 \times 10^{6}} = \frac{3 \times 10^{6}}{2} = 1.5 \, m^2/g$$

Q. In an exp to determine catalyst particle porosity & pore volume and solid density the following data were obtained on a sample of activated silica.

mass of catalyst sample = 101.5g.
volume of He displaced by the sample = $45.1 cm^3$,
volume of Hg displaced by the sample = $82.7 cm^3$.
calculate the req. prop.

pore volume = vol. of Hg displaced − vol. of He displaced
$= 82.7 - 45.1$
$= 37.6 \, cm^3$,

V_g = pore volume = $37.6 / 101.5 = 0.371 \, cm^3/g$.

porosity: $\epsilon = \frac{V_g \rho_s}{1 + V_g \rho_s} =$

$$\epsilon = \frac{\text{void volume}}{\text{Total volume}} = \frac{0.371}{82.7/101.5} = 0.45$$

a4 ρ_s = solid density

$= \frac{\text{mass}}{V_{solid}}$

$= \frac{101.5}{45.1} = 2.25\ g/cm^3$,

~~$\epsilon_p = \frac{V_g \rho_s}{1 + V_g \rho_s}$~~

~~$\epsilon_p = \frac{0.371 \times 2.25}{1 + 0.371 \times 2.25}$~~

→ Q Alumina is made into large cylindrical pellet for studying rate, the gross measurements for 1 pellet are

mass = 3.15 g

diameter = 1 inch

thickness = 1/4th inch.

volume = 3.22 cm^3

Al_2O_3 particles contain micropores & the pelleting process introduces macropores into it the macropore volume of the pellet is 0.645 cc & the micropore volume is 0.40 cm^3/g

From the info. calculate the ρ_p (density of pellet), macropore void fraction in pellet, micropore void fraction in the pellet, solid fraction, density of the particles, total void fraction of the particles, density of solid phase.

Ans density of pellet $\rho_g = \frac{3.15}{3.22} = \frac{\text{mass}}{\text{volume}} = 0.978\ g/cm^3$

macropore void fraction = $\frac{\text{macropore volume}}{\text{total volume}} = \frac{0.645}{3.22} = 0.2000$

$= 0.0619$

micropore ~~pore~~ void fraction $= \frac{0.4\times 3.15}{3.22}$

$= \underline{\underline{0.391}}$.

solid fraction $= 1 -$ (macropore void fraction) $-$ (micropore void fraction)

$= 1 - 0.2 - 0.391$

$= \underline{\underline{0.409}}$.

$$\boxed{\text{solid fraction} + \text{macropore void fraction} + \text{micropore void fraction} = 1}$$

density of the particle $= \frac{\text{mass}}{\text{total volume} - \text{macropore vol.}}$

$= \frac{3.15}{3.22 - 0.645}$

$= \underline{\underline{1.22\ g/cm^3}}$.

void fraction of particle $= \cancel{\frac{0.6450}{3.22-0.645}} = \frac{\text{macropore}}{(\text{total volume} - \text{mac}) / \text{mass}}$

$= \cancel{0.25048}$.

$= \frac{0.40}{(1/1.22)} =$

$= \cancel{0.327}$. $\underline{\underline{0.488}}$

density of solid $= \frac{\text{mass of solid}}{\text{total volume} - \text{macropore} - \text{micropore}}$

$= 2.39\ g/cm^3$.