Q1: What is Thiele modulus?

A1: Thiele modulus gives Relation between catalytic activity and size of particle. The Thiele Modulus was developed to describe the relationship between diffusion and reaction rate in porous catalyst pellets with no mass transfer limitations. This value is generally used in determining the effectiveness factor for catalyst pellets.

for nth-order irreversible reactions

$$M_T = L\sqrt{\frac{(n+1)k'''C_{as}^{(n-1)}}{2D_e}}$$

Q2: What is the significance of the Thiele modulus in catalysis?

A2: For small M_T or $M_T < 0.4$, we see that η = 1, the concentration of reactant does not drop appreciably within the pore; thus pore diffusion offers negligible resistance. This can also be verified by noting that a small value for M_T either a short pore, slow reaction, or rapid diffusion, all three factors tending to lower the resistance to diffusion. For large, or M_T or $M_T > 4$, we find that $\eta = 1/M_T$ the reactant concentration drops rapidly to zero on moving into the pore, hence diffusion strongly influences the rate of reaction. We call this the regime of strong pore resistance

Q3: What is catalyst effectiveness factor?

A3: Catalyst effectiveness factor is given by

$$\text{Effectiveness factor, } \eta = \frac{(\text{actual mean reaction rate within pore})}{(\text{rate if not slowed by pore diffusion})}$$

$$\eta = \frac{1}{\phi}\left(\mathrm{Coth}\,3\phi - \frac{1}{3\phi}\right)$$

Where φ =Thiele Modulus

1st order reaction rate:

Spherical Pellet $\phi = \frac{R}{3}\sqrt{kSa\rho p / De}$

Cylindrical Pellet $\phi = \frac{R}{2}\sqrt{kSa\rho p / De}$

Slab Pellet $\phi = L\sqrt{kSa\rho p / De}$

Q4: The chemisorption properties of platinum group metals for CO and H2 are less pronounced on TiO2 supports. The chemisorption of H2 is reduced on Ni/SiC and SiO2; formation of Ni–Si alloys is assumed. Which effect could be responsible for this?

A4: SMSI = strong metal–support interaction.

Q5: What influence do potassium promoters have on acidic cracking catalysts?

A5: Acidic cracking centers are neutralized by bases; potassium lowers the coking tendency of Al2O3 supports