

A First Course on Kinetics and Reaction Engineering

Unit 40. Gas-Solid Reactions

Nomenclature

ε_s	solid porosity
ρ_s	solid density
C_A	concentration of A; an additional subscript S denotes the concentration within the solid; an additional subscript g denotes the concentration in the bulk gas phase; a superscripted 0 denotes the value at the start of the process
C_S	concentration of the solid; a superscripted 0 denotes the value at the start of the process
D_{eA}	effective diffusion coefficient for A
R	solid particle radius
k_g	gas phase, concentration mass transfer coefficient
r	radial distance from the solid particle surface
r_i	net rate of generation of i by chemical reaction per unit solid mass
t	time

Equations

$$\frac{\partial}{\partial t}(\varepsilon_s C_{As}) = \frac{1}{r^2} \frac{\partial}{\partial r} \left(D_{eA} r^2 \frac{\partial C_{As}}{\partial r} \right) - r_A \rho_s \quad (40.1)$$

$$\frac{\partial}{\partial t}(C_s) = -r_s \rho_s \quad (40.2)$$

$$\left. \frac{\partial C_A}{\partial r} \right|_{r=0} = 0 \quad (40.3)$$

$$D_{eA} \left. \frac{\partial C_A}{\partial r} \right|_{r=R} = k_g (C_{A,bulk\ gas} - C_A|_{r=R}) \quad (40.4)$$

$$C_A|_{t=0} = C_A^0(r) \quad (40.5)$$

$$C_S|_{t=0} = C_S^0(r) \quad (40.6)$$