Quiz-1, BT209, Date: 22/02/2024

Q1. Find the first-order rate constant for the disappearance of A in the gas reaction $A \rightarrow 1.6R$ if the volume of the reaction mixture, starting with pure A increases by 50% in 4 min. The total pressure within the system stays constant at 1.2 atm, and the temperature is 25°C.

Q2. When arterial blood enters a tissue capillary, it exchanges oxygen and carbon dioxide with its environment. The kinetics of deoxygenation of hemoglobin in blood was studied with the aid of a tubular reactor.

$$HbO_2 \rightleftharpoons Hb + O_2$$

Although this is a reversible reaction, measurements were made in the initial phases of the decomposition so that the reverse reaction could be neglected. The solution enters a tubular reactor (radius, R = 0.079 cm) that has oxygen electrodes placed at 5 cm intervals down the tube. The solution flow rate into the reactor is 19.6 cm^3/sec. Assume the initial concentration of HbO_2 to be 150 g/liter and molecular weight of HbO_2 to be 64500 g/mol.

Electrode Position (z, cm)	0	5	10	15	20	25	30
Percent Decomposition of HbO_2	0.00	1.93	3.82	5.68	7.48	9.25	11.00

(a) Find the initial concentration of HbO_2 in terms of mol/liter.

(b) Derive the PFR design equation $-r_A = \frac{F_{A0}}{\pi R^2}\frac{dX_A}{dz}$, where z is axial distance along the reactor.

(c) Assuming $\left(\frac{dX_A}{dz}\right)_{z_i} = \frac{X_{A,i}-X_{A,i-1}}{z_i-z_{i-1}}$, make a table for $-r_A$ vs C_A where A = HbO_2.

(d) Determine the reaction order and the forward specific reaction rate constant k for the deoxygenation of hemoglobin.

$1.9812 \times 10^{-4} \times 10^{5}$

1.9812×10

9.812