Assignment 10

The due date for submitting this assignment has passed. As per your instructor, you must not submit this assignment.

1) Empirical correlations for convective mass transfer coefficients are obtained from experiments of mass transfer for given set of conditions and a surface. What are the following equation:

mass transfer coefficient = \frac{1}{4} \text{ driving force} \times \text{ mass transfer coefficient}

2 points

2) The mass transfer coefficient is measured for a variety of conditions such as fluid velocity, temperature, physical properties, fluid properties etc and a suitable correlation is developed. Which of the following statements are true with respect to the development of the empirical correlations:

A. For an air-water interface, the individual mass transfer coefficient can be obtained by dividing the driving force by the concentration of a solute in the air and the saturated vapor pressure of water at the temperature of the air at the interface.

B. The correlation method only applies to obtain mass transfer across an air-water interface.

3 points

3) Accidental errors can be introduced to measure the interface concentration accurately. The resistance to one of the phases is represented by an appropriate Arrhenius factor, for example, the solute transfer coefficient can be expressed by

\begin{align*}
\text{mass transfer coefficient} = \text{driving force} \\
\text{mass transfer coefficient} = \text{arrhenius factor} \times \frac{1}{4} \text{ driving force}
\end{align*}

3 points

4) The following is a mass transfer coefficient obtained for an air-water interface transfer coefficient:

\begin{align*}
\text{mass transfer coefficient} = \frac{1}{4} \text{ driving force} \\
\text{mass transfer coefficient} = \text{arrhenius factor} \times \frac{1}{4} \text{ driving force}
\end{align*}

3 points

5) The general component of mass transfer for any system can be written as

\begin{align*}
\text{Rate of Change of Accumulator} = \text{Rate in} - \text{Rate out} + \text{Rate of Generation} - \text{Rate of Loss}
\end{align*}

2 points

6) Consider the evaporation of a selected chemical A from water at 100 °C. The concentration of chemical A at the aqueous phase is assumed to be constant at 10 mg/L. The mass transfer coefficient, \( \text{mass transfer coefficient} = 10^{-4} \text{ m/s} \) and the air mass transfer coefficient, \( \text{mass transfer coefficient} = 10^{-3} \text{ m/s} \). Assume the evaporation flux (mg/L) is 10% of the initial concentration of A in a background as air in a closed environment.

3 points

7) A lake has a volume of 100,000 m³ and a surface of 100 m². The lake has a concentration of A in the water due to some contamination. The overall evaporation mass transfer coefficient across the air-water interface was 10^{-4} \text{ m/s}. Estimate the time (in hours) taken for the concentration to reduce to 0.5% of initial concentration. (Round the time to the nearest decimal place).

3 points

8) Consider a solute of volatile pure liquid chemical A in an impervious surface such as a seal or concrete or metal. What is the following equation:

\begin{align*}
\text{mass transfer coefficient} = \text{driving force} \\
\text{mass transfer coefficient} = \text{arrhenius factor} \times \frac{1}{4} \text{ driving force}
\end{align*}

3 points