CEN 3313

MASS TRANSFER

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How we can maximize the amount of molecules/time?

$$\frac{\dot{V}}{A} = \frac{(P_1 - P_2)}{t} \text{ x D}$$

Fick's law of diffusion is the mass transfer analog of

(1) Newton's law of viscosity for momentum transport, and

(2) Fourier's law of heat conduction for energy transport.

Flux = Gradient x Diffusion constant

The subject of transport phenomena includes 3 closely related topics:

fluid dynamics (momentum transport),

heat transfer (energy transport),

mass transfer (mass transport).

General Molecular Transport Equation

$$\text{Rate of Transport Process} = \frac{\text{Driving Force}}{\text{Resistance}}$$

- Evaporation of liquid water in an open pail into the air because of the difference in concentration
- A piece of sugar added to a cup of tea dissolves by itself and diffuses to the surrounding solution.
- In fermentation process, nutrients and oxygen dissolved in the solution and diffuse to the microorganism.
- In a catalytic reaction, the reactants diffuse from the surrounding to the catalyst surface
- Diffusion in living tissue involves the transport of small amounts of solutes like salts, antibodies, enzymes, or steroids.
- Separation process like distillation, absorption

Two mechanisms for mass transfer:

- Molecular Diffusion (*random-walk process*)
- Convective Mass Transfer

Your Turn

Will a heat transfer coefficient and a mass transfer coefficient be related?

References

1. Geankoplis, C.J., Transport Processes and Separation Process Principles, Prentice-Hall, Pearson Education, 2003

2. Incropera F. P., Dewitt D. P. , Bergman T.L., Lavine A.S., Fundamentals of Heat and Mass Transfer, John Wiley & Sons Inc.

3. Middleman S., An Introduction to Mass and Heat Transfer: Principles of Analysis and Design, John Wiley, High Education, 1997.

4. Cussler E.L., Diffusion : Mass Transfer in Fluid Systems, Cambridge University Press, 3rd Edition, 2009.