Simultaneous Heat and Mass Transfer

- Condensation
- Evaporation
- Drying
- Chemical reaction with large heat effects (Absorption, Adsorption)

Effect of Temperature Gradients on Mass transfer
- They are the direct cause of molecular motion
- They may cause bulk motion of the fluid
- They influence phase equilibria and reaction rates

Effect of Mass transfer on Heat Transfer
- Mass transfer fluxes transfer energy and affect temperature gradients

Simultaneous Heat and Mass Transfer

Gas-Phase-Controlled Drying (Evaporation)

\[
q = y_{k,o}q \quad \text{and} \quad T_i = T
\]

\[
x_{k,i} = x_k
\]
Simultaneous Heat and Mass Transfer
Gas-Phase-Controlled Drying (Evaporation)

Mass Balances: \[
\frac{dn_k}{dt} = - AN_k
\]

Energy Balance: \[
\frac{d(mC_{p,av}T)}{dt} = Aq - A \sum_k M_k B_k
\]

Molar Fluxes: \[
\Delta y_k + \ldots = \sum_{j\neq k} \left( \frac{x_{j,av} N_j - x_{k,av} N_k}{h_j C_t} \right)
\]

Heat Flux \[
q = h(T_o - T)
\]

Equilibrium \[
y_k = f(x_k, T)
\]