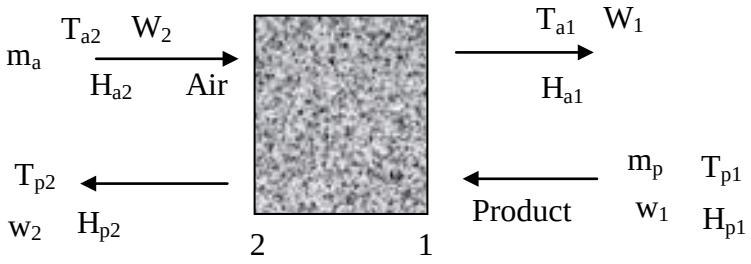
Simultaneous heat and mass transfer



An overall moisture balance for the countercurrent system gives

m_a = air flow rate (kg dry air/hr)
m_p = product flow rate (kg dry solids/hr)
W = absolute humidity (kg water/kg dry air)
w = product moisture content (kg water/kg dry solids)

An energy balance gives

q = heat loss from the dehydration system
H_a = heat content of the air (kJ/kg dry air)
H_p = heat content of product (kJ/kg dry solids)

Heat content of air and product are calculated from the following equations:

$$H_a = c_s(T_a - T_0) + WH_L$$

c_s = humid heat = 1.005 +1.88 W (kJ/kg dry air K)
T_a = air temperature, C
T_0 = reference temperature. 0 C
H_L = latent heat of vaporization for water (kJ/kg water)

$$H_p = c_{pp}(T_p - T_o) + wc_{pw}(T_p - T_0)$$

c_{pp} = specific heat of product solids (kJ/kg K)
T_p = Product temperature, C
c_{pw} = specific heat of water (kJ/kg K)