The MA model: The moist air model is used to determine properties of a mixture of dry air and water vapor.

Assumptions:

(i) Moist air is a mixture of two perfect gases, water vapor and dry air. The dry air is assumed to be a pseudo-pure gas with $\bar{M}_a = 29 \ \frac{\text{kg}}{\text{kmol}}$ and $c_{pa} = 1 \ \text{kJ/(kg}\cdot\text{K)}$.

(ii) When moist air is in equilibrium with liquid water or solid ice, the equilibrium between water vapor and the condensed phase (liquid water or ice) is not affected by the presence of dry air.

(iii) Constituents of dry air do not dissolve in the condensed phase of water.

MA model equations:

$$\omega \equiv \frac{m_v}{m_a} = \frac{p_v \cancel{\forall} \bar{M}_v / (\bar{R}T)}{p_a \cancel{\forall} \bar{M}_a / (\bar{R}T)} = \frac{\bar{M}_v}{\bar{M}_a}\frac{p_v}{p_a} = 0.622\frac{p_v}{p - p_v}; \qquad \left[\frac{\text{kg H}_2\text{O}}{\text{kg d.a.}}\right], \tag{2}$$

$$\phi \equiv \frac{n_v}{n_{v,\max}} = \frac{y_v}{y_{v,\max}} = \frac{p_v/(\bar{R}T)}{p_g/(\bar{R}T)} = \frac{p_v}{p_g} = \frac{p_v}{p_{\text{sat@T}}}; \tag{3}$$

$$v \equiv \frac{\cancel{V}}{m_a} = \frac{\cancel{V}}{p_a \cancel{\forall} \bar{M}_a/(\bar{R}T)} = \frac{\bar{R}T}{p_a \bar{M}_a} = \frac{R_a T}{p_a}; \qquad \left[\frac{\text{m}^3}{\text{kg d.a.}}\right]; \tag{3}$$

$$h \equiv \frac{H}{m_a} = \frac{H_a}{m_a} + \frac{H_v}{m_a} = h_a + \frac{m_v}{m_a}\frac{H_v}{m_v} = h_a + \omega h_v = h_a + \omega h_{g@T}; \qquad \left[\frac{\text{kJ}}{\text{kg d.a.}}\right]; \tag{3}$$

$$h_a = c_{pa}(T - 0) \cong T; \ \left[\frac{\text{kJ}}{\text{kg}}\right]; \ h_v \cong h_g(T) \cong h_g(0^\circ\text{C}) + c_{pv}(T - 0) = 2501.3 + 1.82T; \ \left[\frac{\text{kJ}}{\text{kg}}\right] \tag{3}$$

General state equations: (Applies to any substance)

$$m = \rho \cancel{V}; \ \rho = \frac{1}{v}; \ \text{ke} = \frac{V^2}{2000}; \ \text{pe} = \frac{gz}{1000}; \ e \equiv u + ke + pe; \ j \equiv h + ke + pe; \ h \equiv u + pv \tag{4}$$

$$E = me; \ S = ms; \ KE = m(\text{ke}); \ PE = m(\text{pe}) \tag{5}$$

$$\dot{m} = \rho A V; \ \dot{\cancel{V}} = AV; \ \dot{E} = \dot{m}e; \ \dot{S} = \dot{m}s \tag{6}$$

Reference: Chapter 11 introduces properties of gas mixture and chapter 12 builds on it to develop the moist air (MA) model.