EQUATIONS RELATING THE MAXIMUM HUMIDITY OF AIR TO ITS ADIABATIC-SATURATION TEMPERATURE

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In developing mathematical models of heat- and mass-transfer apparatus (e.g., desiccators) it often becomes necessary to use the relation between the humidity of saturated air d_S and its adiabatic-saturation temperature ("wet-bulb" temperature) t_M.

The value of d_S is determined uniquely by the value of t_M, either according to the enthalpy—humidity diagram or from respective humidity tables. The use of discrete t_M and d_S values leads to difficulties, however, when mathematical models of complex processes are analyzed by simulation on digital computers.

For this reason, it is worthwhile in such cases to replace the collection of discrete values of interdependent parameters by an approximated functional relation.

Various approximations to the nonlinear relation $d_S = d_S(t_M)$ have led to an exponential equation of the

$$d_s = \exp(a + bt_M + ct_M^2)$$

kind as the most suitable for a sufficiently wide and practical range of values.

A mathematical processing of tabulated data has yielded the following equations for the humidity of saturated air: within the range of t_M from 10°C to 50°C

$$d_s = \exp(0.601 + 0.0296t_M - 53.8 \cdot 10^{-6} t_M^2), \tag{1}$$

and within the range of t_M from 50 to 80°C

$$d_s = \exp(1.157 + 3.83 \cdot 10^{-3} t_M + 60.9 \cdot 10^{-6} t_M^2). \tag{2}$$

These equations cover the range of air humidity from 8 to 572 g/kg under a barometric pressure of 745 mm Hg.

This approximation of the $d_S(t_M)$ function ensures a relative error within 0.3% if Eq. (1) is used, and within 0.5% if Eq. (2) is used.

NOTATION

d_S is the humidity of saturated air, g/kg;
t_M is the air temperature at adiabatic saturation, °C.

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