Water Loss from a Tank

(Dated: May 6, 2005)

To calculate the water loss from a tank of water, use the following equations[1]:
To calculate the mass of water lost in pounds per hour (lbm/h), use the equation that you found:

$$W_p = (.097 + .038)v \times (P_w - P_a) \times A \tag{1}$$

where P_w is the saturation vapor pressure of water at the actual temperature in psia[2], P_a is the saturation vapor pressure of water at the dew point in psia, v is the air velocity in mph, and A is the area of the tank in ft^2. Both P_w and P_a are temperature-dependent. P_a is also dependent on the relative humidity, since it is calculated for the dew point.

To calculate the saturation vapor pressure in psia, use this equation:

$$P_w = .0882\ e^{17.27\ T/(T+237.3)} \tag{2}$$

where T is the temperature of the water in ^{o}C.

To calculate the dew point, you will need to know the relative humidity and the temperature of the air. Use

$$T_{dp} = \frac{b \times f(T,H)}{a - f(T,h)} \tag{3}$$

where T is the temperature of the air in ^{o}C, T_{dp} is the dew point in ^{o}C, $a = 17.27$, $b = 237.7$, H is the relative humidity expressed as a decimal (e.g., 50%=.5), and

$$f(T,H) = \frac{a \times T}{b + T} + Ln(H). \tag{4}$$

Just calculate the dew point with Eq. (3) and plug that into Eq. (2) to get P_a:

$$P_a = .0882\ e^{17.27\ T_{dp}/(T_{dp}+237.3)} \tag{5}$$

Then plug everything into Eq. (1) and chug.

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[1] Note: All non-temperature units are conventional, not metric. The equation I started with was from the link you provided, and it wasn't metric. You could easily convert them.

[2] psia = 14.7 + psi. Basically, your adding in atmospheric pressure to whatever your gauge reads.