Diagram for Relative Humidity

Manfred Bucher

Department of Physics,
California State University, Fresno, CA 93740

The relative humidity, h , is defined¹ as the ratio of the partial pressure of water, P_{part} , to the saturated vapor pressure of water, P_{vap} , at the ambient temperature T_{amb} .

$$h = P_{part}(T_{amb}) / P_{vap}(T_{amb}). \quad [1]$$

Furthermore, the temperature T_{dew} , where the partial pressure of water equals the vapor pressure of water,

$$P_{part}(T_{dew}) = P_{vap}(T_{dew}), \quad [2]$$

is called the dew point.¹ Thus with a given temperature dependence of the vapor pressure, $P_{vap}(T)$, a knowledge of the dew point allows a determination of the humidity and vice versa. In this note we propose a diagram which shows these quantities in geometric proportions.

Let's assume we know the dew point temperature, T_{dew} , of the atmosphere holding a given water content, and we want to know the humidity, h , at a higher ambient temperature T_{amb} . We start out with a graph of the saturated vapor pressure of water as a function of temperature, $P_{vap}(T)$ (see Fig. 1). This curve may be drawn from tabulated data² or, for a qualitative discussion, with a sketch of an exponential curve.^{3,4}

Next we draw two vertical arrows from T_{dew} and T_{amb} on the temperature abscissa up to the curve. According to Eqs. (1) and (2), the length ratio of the left to the right arrows represents the humidity, h , at the ambient temperature. As visual aids we draw a (dashed) horizontal line from the top of the left arrow over to the right, and a percentage scale at the right arrow.

Clearly, the same diagram can be used to illustrate the inverse problem of finding the dew point from a knowledge of the humidity. □

References

1. D.C. Giancoli, *General Physics* (Prentice Hall, Englewood Cliffs, New Jersey, 1984), p. 357.
2. CRC Handbook of Chemistry and Physics, R. C. Weast,

Fig. 1. Representation of relative humidity, h , in a graph of the temperature dependence of the saturated vapor pressure of water, P_{vap} vs. T . T_{dew} and T_{amb} denote dew point and ambient temperature, respectively, and P_{part} denotes the partial pressure of water at T_{amb} .

ed., (CRC, Boca Raton, Florida, 1985), Vol. 66, p. D-189.

3. An exponential increase of the vapor pressure with increasing temperature is a very good approximation. This can be shown by integrating the Clausius-Clapeyron equation (see Ref. 4) and expanding about $T = 0^{\circ}C$.
4. F.W. Sears and G.L. Salinger, *Thermodynamics, Kinetic Theory, and Statistical Thermodynamics*, Third Edition, (Addison-Wesley, Reading, 1975), p. 195.