

Quantum Mechanics_vapour quality

In Thermodynamics, **vapour quality** is the mass fraction in a saturated mixture that is vapour;[1] i.e. saturated vapour has a "quality" of 100%, and saturated liquid has a "quality" of 0%. Vapour quality is an intensive property which can be used in conjunction with other independent intensive properties to specify the thermodynamic state of the working fluid of a thermodynamic system. It has no meaning for substances which are not saturated mixtures (i.e., compressed liquids or superheated fluids).

Quality χ can be calculated by dividing the mass of the vapour by the mass of the total mixture:

$$\chi = \frac{m_{\text{vapour}}}{m_{\text{total}}}$$

where m indicates mass.

Another definition used by chemical engineers defines quality (q) of a fluid as the fraction that is saturated liquid.[2] By this definition, a saturated liquid has $q = 0$. A saturated vapour has $q = 1$. [3]

Calculation

The above expression for vapour quality can be expressed as:

$$\chi = \frac{y - y_f}{y_g - y_f},$$

where y is equal to either specific enthalpy, specific Entropy, specific volume or specific internal energy, y_f is the value of the specific property of saturated liquid state and $y_g - y_f$ is the value of the specific property of the substance in dome zone, which we can find both liquid y_f and vapor y_g .

Another expression of the same concept is:

$$\chi = \frac{m_v}{m_l + m_v}$$

where m_v is the vapour mass and m_l is the liquid mass.

Steam quality

The genesis of the idea of vapour quality was derived from the origins of Thermodynamics, where an important application was the steam engine. Low quality steam would contain a high moisture percentage and therefore damage components more easily [citation needed]. High quality steam would not corrode the steam engine. Steam engines use water vapour (steam) to drive pistons or turbines which create work. The quality of steam can be quantitatively described by *steam quality* (steam dryness), the proportion of saturated steam in a saturated water/steam mixture. I.e., a steam quality of 0 indicates 100% water while a steam quality of 1 (or 100%) indicates 100% steam.

The quality of steam on which steam whistles are blown is variable and may affect frequency. Steam quality determines the velocity of sound, which declines with decreasing dryness due to the inertia of the liquid phase. Also, the specific volume of steam for a given temperature decreases with decreasing dryness. [4][5]

Steam quality is very useful in determining Enthalpy of saturated water/steam mixtures since the enthalpy of steam (gaseous state) is many orders of magnitude higher than enthalpy of water (liquid state).

References

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2. ^ Wankat, Philip C. (1988). *Equilibrium Staged Separations*. Upper Saddle River, New Jersey: Prentice Hall. pp. 119-121. ISBN 0-13-500968-5.
3. ^ Perry's Chemical Engineers' Handbook (7th Edition), p 13-29
4. ^ Soo, Shao L. (1989). *Particulates and Continuum: A Multiphase Fluid Dynamics*. CRC Press.
5. ^ Menon, E. Sashi. (2005). *Piping Calculations Manual*. New York: McGraw-Hill.

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