STUDY ON BOILING POINT

The boiling point of a substance is the temperature at which it can change its state from a liquid to a gasthroughout the bulk of the liquid at a given pressure. A somewhat clearer (and perhaps more useful) definition of boiling point is "the temperature at which the vapor pressure of the liquid equals the pressure of the surroundings."

Process details

A liquid may change to a gas at temperatures below the boiling point through the process of evaporation. Any change of state from a liquid to a gas at boiling point is considered vaporization. However, evaporation is asurface phenomenon, in which only molecules located near the gas/liquid surface could evaporate. Boiling on the other hand is a bulk process, so at the boiling point molecules anywhere in the liquid may be vaporized, resulting in the formation of vapor bubbles.

The Reaction

Something that should be remembered is that boiling is evidenced by the appearance of bubbles containing vapor from the liquid. [Note: The bubbles that precede real boiling in the pot on the stove are either (formerly) dissolved air or water vapor forming on the very hot bottom of the pot that will be condensed before it can get to the top of the liquid.] Production of vapor requires energy and thus does not occur without some source of energy. This source can be a hot surface or even the liquid itself. Hot liquid will boil as it rises through the bulk liquid if the pressure of the environment drops to the vapor pressure of the liquid at its temperature. This production of vapor will quickly stop because the temperature of the liquid will be reduced by the vaporization thus reducing the vapor pressure.

This production of vapor can produce catastrophic results. One refinery release (which resulted in an explosion that killed 15 people) was initiated by the movement of hot liquid from the bottom of an inadvertently filled tower. When the liquid rose the pressure dropped and the liquid began to boil. This further mixed the tower and produced more vapor which expanded greatly and forced liquid into the vapor line. The head of the liquid in a normally gas filled line caused the pressure relief valves to open and vented material into a "stand pipe" where it escaped and caused a vapor cloud. The vapor cloud ignited and the resulting explosion killed 15 people. (From the CSB report of the incident)

Saturation Temperature

Saturation Temperature is another term that basically means boiling point. Saturation temperature is the temperature for a corresponding Saturation Pressure at which a liquid boils into its vapor phase. The liquid can be said to be saturated with thermal energy. Any addition of thermal energy results in a phase change.

If the pressure in a system remains constant (isobaric), a vapor at Saturation Temperature and Pressure will begin to condense into its liquid phase as thermal energy (heat) is removed. Similarly, a liquid at Saturation Temperature and Pressure will boil into its vapor phase as additional thermal energy is applied.

The boiling point corresponds to the temperature at which the vapor pressure of the substance equals the ambient pressure. Thus the boiling point is dependent on the pressure. Usually, boiling points are published with respect to standard pressure (101.325 kilopascals or 1 atm). At higher elevations, where the atmospheric pressure is much lower, the boiling point is also lower. The boiling point increases with increased ambient pressure up to the critical point, where the gas and liquid properties become identical. The boiling point cannot be increased beyond the critical point. Likewise, the boiling point decreases with decreasing ambient pressure until the triple point is reached. The boiling point cannot be reduced below the triple point.

Latent Heat

The process of changing from a liquid to a gas requires an amount of heat called the latent heat of vaporization. As heat is added to a liquid at its boiling point, all of this heat goes toward the phase change from liquid to gas, thus the temperature of the substance remains constant even though heat has been added. The word latent, which comes from Latin and means hidden, is used to describe this "disappearing" heat that is added, but doesn't result in an increase in temperature. Since heat is added with no corresponding change in temperature, the heat capacity of the liquid is essentially infinite at the boiling point.

Intermolecular interactions

In terms of intermolecular interactions, the boiling point represents the point at which the liquid moleculespossess enough heat energy to overcome the various intermolecular attractions binding the molecules into the liquid (eg. dipole-dipole attraction, instantaneous-dipole induced-dipole attractions, and hydrogen bonds). Therefore the boiling point is also an indicator of the strength of these attractive forces.

The boiling point of water is 100 °C (212 °F) at standard pressure. On top of Mount Everest the pressure is about 260 mbar (26 kPa) so the boiling point of water is 69 °C.

For purists with a knowledge of thermodynamics, the normal boiling point of water is 99.97 degrees Celsius (at a pressure of 1 atm, i.e. 101.325 kPa). Until 1982 this was also the standard boiling point of water, but theIUPAC now recommends a standard pressure of 1 bar (100 kPa). At this slightly reduced pressure, thestandard boiling point of water is 99.61 degrees Celsius.

Properties of Other Elements

The element with the lowest boiling point is helium[[1]]. Both the boiling points of rhenium[[2]] and tungsten[[3]] exceed 5000 K at standard pressure. Due to the experimental difficulty of precisely measuring extreme temperatures without bias, there is some discrepancy in the literature as to whether tungsten orrhenium has the higher boiling point.

Source : http://engineering.wikia.com/wiki/Boiling_point