Evaporation of water

Science Background

Evaporation

In evaporation process a liquid is converted into a gas or a vapor. In evaporation, some molecules in the liquid break away and enter the gas or vapor state. Evaporation is a cooling process. The cooling occurs because the molecules with the highest kinetic energy tend to escape the liquid first. The molecules left in the liquid have a lower average kinetic energy. Thus the liquid's temperature decreases.

Volatile liquids evaporate more rapidly than other liquids at the same temperature. Such liquids have relatively weak intermolecular forces. In general, the rate of evaporation depends on the strengths of the intermolecular forces and the rate at which heat is supplied to the liquid.

Enthalpy change

Chemical changes are generally accompanied by energy changes; energy is absorbed or released (usually as heat). Breaking chemical bonds in reactants requires energy, and energy is released as new bonds form in products. The net result of these steps depends on the relative sizes of the energies associated with breaking and forming bonds and determines if the reaction absorbs or releases energy

The amount of heat involved in a reaction depends not only on what the reaction is, but also on the temperature at which the reaction occurs and whether the reaction occurs under conditions of constant pressure or constant volume. In the laboratory, many reactions are conveniently carried out at constant pressure in beakers or flasks that are open to the atmosphere. The amount of heat absorbed or released under this condition is the *enthalpy change*, ΔH, for the reaction, where $\Delta H = H_{products} - H_{reactants}$.

Endothermic and exothermic reactions

A reaction in which heat is absorbed from the surroundings (the enthalpy change, $\Delta H = H_{products} - H_{reactants}$, is positive) is called endothermic reaction. During such reactions the heat is gained and the surroundings cool down. Some phase transitions (melting and vaporization) are endothermic.

A reaction in which the heat is released to the surroundings (the enthalpy change, $\Delta H = H_{products} - H_{reactants}$, is negative) is called exothermic reaction. During such reactions the heat is lost and the surroundings heat. Some phase transitions (solidifying and condensation) are exothermic.

Forces of intermolecular attraction

The major factor that determines the rate of evaporation is the intermolecular forces of attraction between molecules. For instance: alcohols evaporate faster that water, because water molecules have stronger intermolecular forces of attraction than alcohols; one H_2O molecule can form up to four hydrogen bonds, whereas $C_nH_{2n+1}OH$ can only form two or three hydrogen bonds, because only one OH group is attached at the end of the carbon chain.

Moreover, the intermolecular forces of attraction also increase when the relative molecular mass increases. In this experiment, only water and ethanol are tested, so the major difference in evaporation is due to these hydrogen bonds.