

9.9: Hot Water - Pressurized Subcritical Water

As described in Section 9.10, water heated above its critical temperature of 374.4°C and kept under very high pressure reaches a special state called supercritical fluid. However, at temperatures above its normal boiling temperature of 100°C but below those required to reach the supercritical state, the properties of liquid water change markedly. Whereas the dielectric constant of liquid water at 25°C is 78, that of pressurized subcritical water at 205°C is 33, the same as methanol at 25°C . At temperatures between 100°C and 205°C , water behaves like a mixture of water and methanol and becomes a much more effective solvent for organic substances. Such superheated water has a number of uses such as extracting organic materials from plant biomass, extracting pollutant organic materials from contaminated soil and sediments, and as a reaction medium for organic chemical reactions. The decrease in dielectric constant of water and the increase in solubility of substances at higher temperatures means that the solubilities of some substances in superheated water may be orders of magnitude higher than in water at 25°C .

A potentially useful application of pressurized hot water is its application as a medium along with pressurized O_2 in which organic substances are oxidized. This procedure has been used to make oxygenated products from organics as refractory as coal. It has also been used as a means of destroying oxidizable pollutants in water. For example, the organic matter in sewage can be removed by reaction with O_2 in superheated water.

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