

Supercritical Gasification

Supercritical gasification normally takes place in the presence of water and is an alternative to conventional gasification for wet feedstocks as drying of the feed material is not required.

Supercritical water gasification takes advantage of the changes in the physicochemical properties of water from the liquid state to the supercritical state. Interest in applications of supercritical water for biomass gasification mainly concerns the favorable physical properties of water and the way these properties change in the supercritical region, which causes water to act as a solvent as well as a catalyst. In addition, through hydrolysis reactions water can also act as a reactant.

The critical point for pure water is 374 °C and the critical pressure is 22.1 Mpa; above this temperature and pressure, water is in its supercritical phase. Above the critical point, physical properties of water change and water behaves as a homogeneous fluid phase. In its supercritical state, water has a gas-like viscosity and liquid-like density, two properties which enhance mass transfer and solvation properties, respectively; gasification of biomass in supercritical water is mainly influenced by the density, viscosity and dielectric constant of supercritical water. The changes in the thermophysical properties of water such as the lack of phase boundaries and non-polar like solvent behavior provides for salt separation and nearly tar-free gasification of biomass due to salt precipitation and dissolution and conversion of tar-precursors in a hydrothermal medium.

At the time of this writing, applications of supercritical water gasification of biomass are limited to laboratory and pilot-scale investigations.