ABSTRACT (EN)

A plasma torch (the source of plasma) with Gerdien arc was utilized as the source of energy in a reactor for gasification of biomass and for the degradation of organic compounds dissolved in water circling around the arc where the dissolved compounds are exposed to an intensive ultraviolet radiation.

Thermal plasmas have electrons, ions and neutrals in thermal equilibrium and are quite often characterized by higher pressures and temperatures than nonthermal plasmas. Therefore, thermal plasmas generally carry a huge amount of energy which can be employed for heating and subsequent gasification of various types of materials. Thermal plasma gasification reactors are operated at higher temperatures than conventional reactors which results in a very good composition with a high percentage of hydrogen and carbon monoxide in produced synthetic gas.
Spruce sawdust and spruce pellets were gasified at feeding rates up to 60 kg/h. Oxidizing media such as water, carbon dioxide, oxygen or their mixtures had to be added to the reactor during experiments to avoid the formation of solid carbon. The compositions of produced gas significantly corresponded to calculated compositions and the produced gas was of high quality – hydrogen content approximately 45 % vol., carbon monoxide approximately 48 % vol., a minimal presence of higher hydrocarbons and the tar content under 10 mg/Nm^3. The lower heating value of the produced gas was at around 10 MJ/Nm^3.

Plasma water treatment is applied in Advanced Oxidation Processes (AOP). Phenol, nicotine and azodye Orange II were chosen as model substances. These substances were dissolved in water which circles around the arc in a plasma torch body and were exposed to the extreme source of far ultraviolet radiation with a sufficient energy to degrade them. Radical reactions involving a hydroxyl radical play an important role in degradation processes. Experiments, lasting several minutes, revealed a significant decrease (40-90 %) in the concentrations of model substances. The energetic demand of the described water treatment was 250-500 kWh/m^3.