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Low temperature entrained flow gasification behaviour of Victorian brown coal

Tao Xu, Joanne Tanner, Sankar Bhattacharya
Department of Chemical Engineering, Monash University, Australia,
email: Tao.Xu2@monash.edu, Joanne.Tanner@monash.edu,
Sankar.Bhattacharya@monash.edu

In Australia, Victorian brown coals represent a significant, low cost energy resource with large proven reserves. However, their utilisation is limited almost exclusively to mine-mouth power generation with relatively low efficiencies and high greenhouse gas emissions. As an alternative technology, coal gasification is a process that can convert coal to cleaner power, as well as precursor feedstocks for the production of chemicals, hydrogen, and transportation fuels.

Previous work on Victorian brown coal gasification was mainly conducted using fluidised bed technologies, with low carbon conversion and low calorific value fuel gas. Therefore, the current work focuses on entrained flow gasification of Victorian brown coals, specifically targeting gasification behaviour from low temperature (700°C) to high temperature (1400°C).

In this study, the relationship between carbon conversion, temperature and residence time was investigated by gasification of chars produced by rapid pyrolysis. The experiments were performed using dried Victorian brown coals (particle size 90-106 µm) pyrolysed under 100 % N_2 and gasified under 20% CO_2 in N_2 in an atmospheric drop tube furnace under entrained flow conditions. The char properties, char reactivity, carbon conversion, and gas composition were investigated at residence times from 6-24 s and at temperatures from 700-1000 °C.

As expected, carbon conversion increased with increasing temperature and residence time, and the syngas quality also improved. At the maximum temperature and residence time of 1000°C and 24s, the carbon conversion and CO concentration reached 100% and 33%, respectively, which is close to the theoretical value at thermodynamic equilibrium.