

Summer Research Program 2011/2012

Victorian Brown Coal Char Gasification Reactivity and Structural Evolution

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Objective

The proposed project aims to use advanced image-processing program and high-temperature thermo-gravimetric analyser to clarify the reactivity and structural evolution of Victorian brown coal during gasification in steam and carbon dioxide, and ultimately develop a mathematical model describing the global kinetics of brown coal char conversion during gasification and oxy-fuel combustion.

Description

Victorian brown coal is the single largest source meeting >85% of the electricity need in the State of Victoria. Its gasification in reducing gases such as steam and carbon dioxide is a promising way to generate the value-added syn-gas (H_2/CO mixture) which

can either burn efficiently or be used for the synthesis of liquid fuels and chemicals. The key sub-process for brown coal gasification is the heterogeneous conversion of char (i.e. activated carbon derived from the initial pyrolysis of coal in a hot gasifier), requiring lengthy residence time and harsh conditions (high temperature/pressure and even the use of catalyst) for its completion. The proposed project will focus on the use of advanced image-processing program (Image-Pro 6.1) and thermo-gravimetric analyser (TG/DTA) to study the structural evolution and reactivity of brown coal char. As shown on the right, the brown coal char and its time-resolved unburnt residues will first be observed by scanning electron microscopy (SEM) for both surface topography and cross-section, the resulting images are then analysed statistically by Image-Pro to get the distribution of pore, particle size and wall thickness of the porous char samples. The resulting information will be eventually combined with the TG/DTA char reactivity data to build up a comprehensive model describing the global transformation of char during gasification.

Apart from the use of TG/DTA and high-temperature drop-tube furnace for char reactivity study, the use of SEM and image-pro will also be involved to statistically process the char structural evolution. A high-quality journal paper is expected from this study.

