M3TC NUS National University of Singapore

Direct co-combustion of coal with biochars produced from new hydrothermal technology

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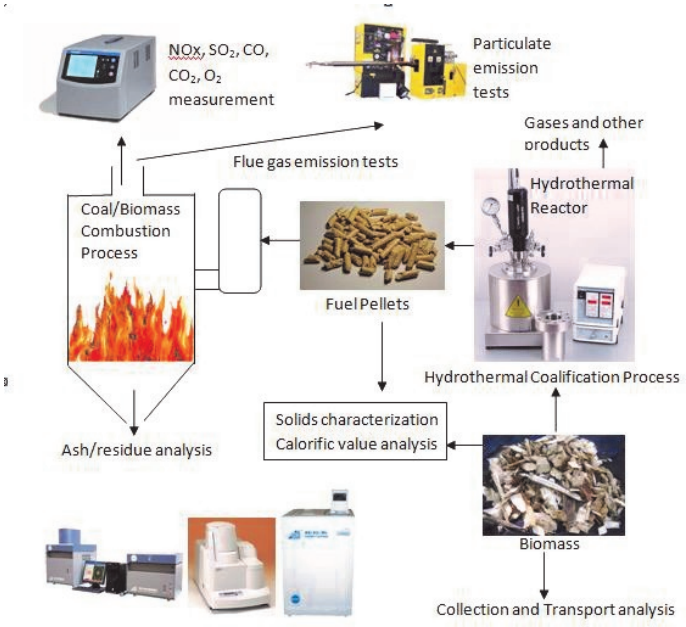
One of the biggest challenges today is global warming induced climate change. One of the major sources contributing to the rapidly increasing temperatures on earth is the emission of carbon dioxide from the combustion of fossil fuels. Minerals, Metals and Materials Technology Centre (M3TC) is actively working to develop innovative technologies to reduce the use of fossil fuels during power generation. The primary objective of this project is to produce biochar from biomass that can be co-combusted with coal in power generation .



Introduction of biomass-derived fuels to displace fossil fuels is widely regarded as an essential component of overall strategies to address global warming. In this project, various waste biomass materials will be explored and treated, with the aim of making them more suitable feedstocks for bio-fuels that can reduce the consumption of conventional, fossil fuels. Co-firing of coal and a suitably pre-treated biomass material offers the possibility of significant, immediate green house gas reductions.

Our Current Research Approach

The economical production of biomass-derived power fuel for use in an existing power plant is the principal goal of the current project. We will explore a range of hydrothermal pre-treatment processes on a laboratory scale, utilizing aqueous slurries in closed, pressurized vessels. The most critical parameters to be investigated and optimized are the biomass type (trees, grasses, construction waste, etc.), biomass size, biomass/water ratio, pre-treatment time, reactor temperature and pressure.

Project Objectives

- To optimize the hydrothermal process to densify the energy content of biomass;
- To pelletize and optimize co-combustion of biomass fuel;
- To perform techno-economic analysis of Singapore biomass-to-energy conversion

Waste loblolly pine wood (top) and after hydrotheral pretreatment (bottom).

For energy densification, biomass was treated in water at temperatures around 260°C and equilibrium pressures (~680 psig) for 2-5 minutes to produce a hydrophobic solid that is easily dried and pelletized. Other products include non-condensable gases and condensed liquid that is mostly water.

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