Co-firing of torrefied biomass in a power plant in an oxy-fuel atmosphere

PhD. Student	: ir.E.M.Gucho	**Phone**	: +31.53.489.3564
Thesis advisor	: prof.dr.ir.G.Brem	**Fax**	: +31.53.489.3663
Supervisor	: ir.E.A.Bramer	**E-mail**	: e.m.gucho@ctw.utwente.nl
Research group	: CTW/ThW	**URL**	: http://www.thw.ctw.utwente.nl
OSPT theme	: Energy conversion processes	**Research school**	: OSPT
Supported by	: STW	**Period**	: Oct 2009 – Oct 2013

Introduction

It is now broadly accepted that combustion of fossil fuels in power plants is one of the main contributors of green house gases in the atmosphere, which in turn raises the global warming effect. One way to lessen the global warming is by increasing the fraction of renewable energy usage e.g. biomass, wind, solar, etc. At present the amount of biomass in Dutch power plants is less than 10% (energy based). For the future, the electricity producing companies have a plan to increase the biomass co-firing ratio to at least 20% (energy based) in 2020. In order to achieve this, the fuel flexibility of the plant needs to be improved because of fluctuating biomass costs and properties. As there is a significant difference between the combustion properties of biomass and coal, pre-treatment of the biomass is essential. Torrefaction of biomass results in a more similar fuel compared to coal. Torrefaction is a mild process of pyrolysis at a temperature typically ranging between 200 -320 degree Celsius.

Torrefaction of biomass

Another challenge is to capture and store CO_2 in an efficient way. The CO_2 produced from conventional air combustion processes is diluted with nitrogen, resulting high energy penalty in its recovery using post combustion techniques. CO_2 capture can be attained easily from a more concentrated CO_2 stream, which can be achieved through oxy-fuel combustion. In this technique the oxygen stream is usually diluted by the recycled flue gas (RFG), as shown in (figure 1). The recirculation of flue gas, including NOx, in the absence of nitrogen in the oxidizer gas has a significant influence on NOx emissions. It is expected in this way to have high reductions of NOx (up to 70% vol) compared to NOx emission in conventional air combustion.

Research topic

This research is focused on the dual effect of CO_2 reduction with the use of torrefied biomass under oxy-fuel conditions in coal fired power plants (figure 1). However the application of oxygen enriched combustion processes for biomass and coal has not yet been demonstrated on large scale.

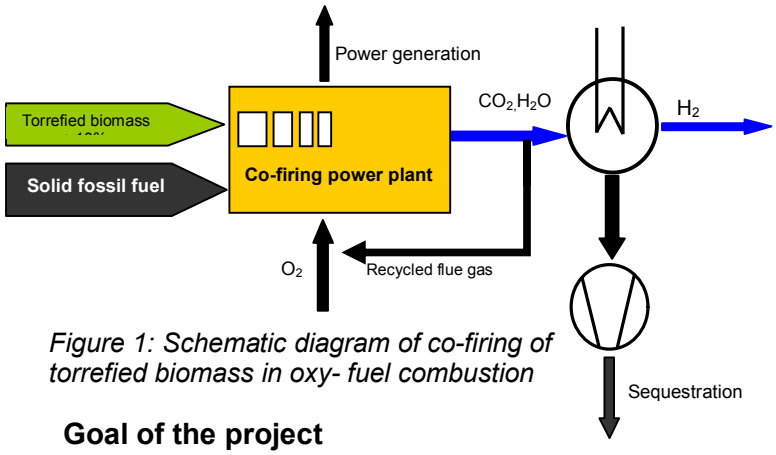

Figure 1: Schematic diagram of co-firing of torrefied biomass in oxy- fuel combustion

Goal of the project

The objective of the project is to perform experiments on the lab scale so that to increase understanding and the predictive capabilities of torrefied biomass combustion at high co-firing coal ratios under oxy-fuel conditions, with respect to combustion rate, emissions, fuel ignition, burnout and ash quality.
Key variables will be studied in a drop tube reactor and a novel cyclonic TGA [1]

Reference:

Bramer E.A. and Brem G.*A new technology for fast pyrolysis of biomass,* Pyrolysis and Gasification of biomass and waste, ed. Bridgwater A.V., CPL press, ISBN 1 872691 3, pp 63-74 (2003).

Acronym: BIOxyfuel

Acknowledgement

The research is sponsored by TW/NVV/KEMA /TSA This research is financed within CCC programme.