The impact of biomass ash as an additive on the nitrogen partitioning of coals and NOx emissions

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Abstract for oral presentation

In 2016, coal provided 28.1% of global energy consumption. 3.8 Gtoe of coal is produced each year; as a result large amounts of harmful emissions are released into the atmosphere from power production every day. An emission of particular concern is nitrogen oxides (NO_x). A typical 600MW coal power plant with emissions control, still emits approx. 3.3 k tonnes of NO_x each year. The Industrial Emissions directive requires reductions of NO_x emissions as low as 150 mg Nm^{-3} by 2020 in the UK. The deployment of existing add-on NOx abatement technologies, such as SNCR or SCR, would require large capital investments that cannot be afforded by plants that are expected to close down or convert to biomass within the next few years. Under these circumstances, the use of additives for the reduction of NOx could be a more cost-effective solution. Biomass fuels tend to have reactive ashes due to high contents of alkali metals (i.e. potassium). Besides its role in ash formation and ash related problems in boilers, potassium is a well-known catalyst for the pyrolysis reaction. Furthermore, the potassium in the biomass or other metals, such as iron, may influence the N-partitioning of the coal and consequently NOx emissions. With the emergence of fuel flexible power stations, as coal plants convert to biomass, biomass ash streams would be readily available.

This study is to evaluate the effects of co-combustion of two types of biomass ashes on the combustion characteristics of three subbituminous coals. Initial investigation to assess the impact of the additives (5-50% w/w) on the reactivity of the fuels was carried out in a thermogravimetric TA TGA-Q5000C at low heating rates of 10K min^{-1}. In order to study the impact of the additives on nitrogen partitioning in a furnace environment, the coals (with and without 15% w/w ash) were devolatilised in a drop tube furnace at Leeds in N_2 at a temperature of 1373K. Additionally, combustion experiments of the coals and mixtures of the coals with 15% w/w of the ash additives in a drop tube furnace were undertaken at Northeastern University (USA) at 1373K in air. Gas analysers were used to monitor the emissions from the DTF combustion experiments (CO, CO_2, NO, NO_2 and SO_2).

The experimental work has shown for the subbituminous coals tested, both additives lead to a decrease in nitrogen retained in the char during combustion. The higher release of nitrogen during devolatilisation would favour NO_x reduction in a Low NO_x combustion chamber.

Keywords: Coal combustion, biomass ash, NO_x emissions, co-combustion, nitrogen partitioning

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