Additives to Mitigate Slagging and Fouling In Biomass Combustion

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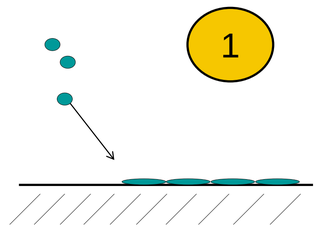
The Problem

- **Slagging and fouling is estimated to cost the global utility industry billions of pounds every year.**
- **During biomass combustion, inorganic components in the fuel (ash) become soft or molten at high temperatures, depositing on boiler walls and surfaces.**
- **Slagging takes place in high temperature regions(labelled A), while fouling takes place in the lower temperature regions, away from combustion zone: on superheaters (B) and heat exchangers (C)**

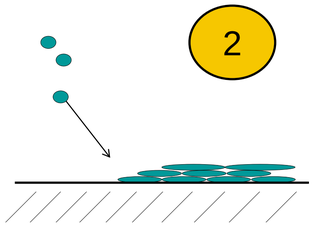
The Research Aim:

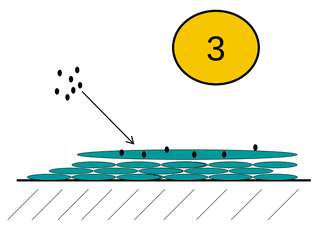
- To determine whether additives can be used to reduce slagging and fouling deposition, or make the deposits easier to remove.

How Deposition Works:

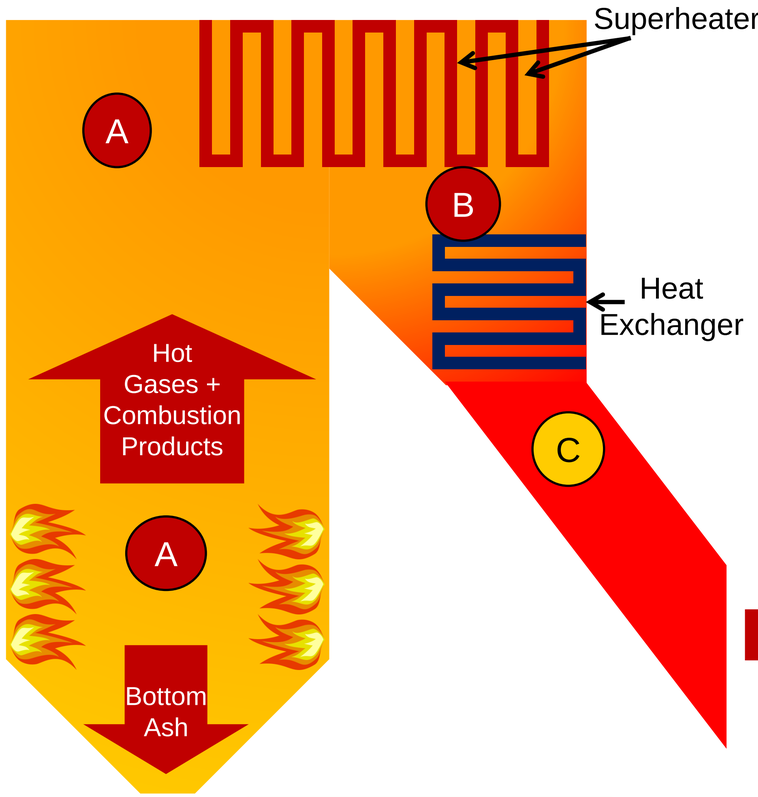


The molten/sticky ash is carried by the combustion gases. They impact on the cooler surfaces, solidifying.





More sticky ash deposits on the solidified ash, building the deposit, increasing thermal resistance and surface temperature. Solid ash particles may be absorbed, thickening the slag.



Simplified diagram of a typical pulverised fuel boiler

Additives:

Additives may be added to the fuel in an attempt to change the composition of the ash after combustion. In biomass, a large percentage of ash is composed of SiO_2, which has a low melting point. By increasing the melting point of the system, (for instance, increasing Al_2O_3 content), deposition can be reduced.

The Approach:

- Assessing ash residue and deposit composition, with and without additives, using a range of analytical methods (elemental analysis, microscopy, etc.)
- Studying ash behaviour under heating using ash fusion testing, and conducting mechanical tests upon the deposits afterwards
- Pilot scale combustion testing at PACT, a specialist R&D facility for low-carbon energy in Sheffield.
- Developing a numerical model to predict slagging and deposition potential, and the impact of additive-biomass blending.

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