Ash transformation and deposit build-up during biomass suspension and grate firing: Full-scale experimental studies - DTU Orbit (18/01/2019)

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An attractive option for reducing the net CO2 emissions is to substitute coal with biomass in large power plant boilers. However, the presence of chlorine (Cl) and alkali metals (K, Na) in biomass may induce large operational problems due to ash deposit formation on the superheater tubes. The aim of this study was to investigate ash transformation and deposition behavior in two biomass-fired boilers, firing wheat straw and/or wood. The influence of straw firing technology (grate and suspension) on the ash transformation, deposit formation rate and deposit characteristics has been investigated. Bulk elemental analysis of fly ashes revealed that fly ash from suspension firing of straw has high contents of Si, K and Ca, while fly ash from straw firing on grate was rich in the volatile elements K, Cl and S. Investigations of deposit formation rates were made in the superheater and convective pass regions of the boilers by use of an advanced online deposit probe. During straw firing on grate, the measured deposit formation rate was close to 38 g/m2/h. Data from straw suspension firing showed a deposit formation rate of 41 g/m2/h. The deposit formation rates during straw suspension firing and straw grate firing were on similar levels. This was observed even though the concentration of fly ash in the flue gas was significantly higher during straw suspension firing. The influence of co-combustion of wood with straw on deposit formation rate, probe heat uptake and deposit characteristics was also investigated during suspension firing conditions. Data from 35% straw suspension firing with wood showed a deposit formation rate of 33 g/m2/h for the first 12 h. The deposit formation rate increased to 41 g/m2/h with 100% straw firing. The probe heat uptake reduction up to 40 h of exposure time was 3.0, 7.3, 8.4 and 16.5 kW/m2 during 35, 65, 80 and 100% straw firing, respectively.

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