

The Kinetics of Fireside Chlorine Corrosion in Biomass Combustion System, and the Influences From Gas and Deposit Ash Chemistry

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Serious fireside corrosion has been frequently encountered in high temperature region in biomass-fired heat or power plants. The corrosion mechanisms is characterized as “active oxidation”, in which the evaporation of metal chlorides and the transition of gas metal chlorides to oxides at metal/scale interface or within the original metal oxide layer are responsible for a quick-growing but non-protective oxide layer. In such case, a thick, porous and poorly adhesive oxide scale is formed on heat transfer tubes, and much serious material loss than passive oxidation is detected.

Although the mechanisms of the chlorine-induced corrosion in biomass-firing condition is well acknowledged, little work has been done regarding the corrosion kinetics and factors influencing the corrosion rate. A wide range of factors related with flue gas and fly ash chemistry, temperature and boiler steel metallurgical characteristics can contribute to the corrosion kinetics. A deep understanding of such influences on corrosion kinetics can provide a general guide for design and maintenance of the combustion facilities, thus to improve reliability and availability of heat transfer components.

In this paper, the theoretic basis of the corrosion kinetics is discussed. Experimental investigations were focused on the influence from flue gas composition, flue gas temperature and deposit ash chemistry. Combustion tests firing straw, wood and lignite coal were carried out in a 0,5MW pulverized fuel facility to investigate the deposit ash chemistry and to provide deposition ash for long-term laboratory tests, which were carried out in an electrical furnace with a range of well-defined gas composition including HCl, H₂O, SO₂, O₂ and N₂ at different gas temperatures. Synthetic deposit ash and real ash from combustion tests of straw, wood and lignite coal were applied. Several promising new boiler materials: 7CrMoVTiB 10 10, HCM12A and NF709 were investigated for the investigation. Weight change after exposure in the laboratory furnace were determined. Some species were analyzed with SEM-EDX. “Active oxidation” in the initial form of pit corrosion is observed of all the materials, and general trends of material loss related with flue gas and deposit ash chemistry have been obtained.