Abstract: A measurement campaign has been conducted both in a pilot-scale pulverized fuel and in a pilot-scale circulating fluidized bed test rig to evaluate the behavior of two different online corrosion sensors during the co-combustion of straw with bituminous coal. The online corrosion sensors based on the linear polarization method were equipped with material rings of the alloy 10CrMo9-10 and air-cooled to a material temperature of 530 °C (PF) and 560 °C (CFB). They were implemented at a flue gas temperature of approximately 750–800 °C in both test rigs to simulate superheater tubes. The derived signals were compared with flue gas measurements (O2, CO2, SO2, and HCl) as well as selected fine particle measurements and deposit sampling during co-firing tests of 0, 10, 25, 40, 60, and 100% straw with coal on an energy basis. Slight deviations between the fuels tested in the different test rigs were observed. Main differences were measured in the coal ash composition and chlorine content of the straw. Online corrosion sensors reacted quickly to changes in the blend composition. While no enhanced corrosion was detected during the co-combustion of 10% and 25% straw, both sensors
identified possible corrosive processes on the metal surface during the 60% straw case. The detected signal change could be correlated to an increased share of chlorine in the fine particles (in the PF and the CFB test rigs) and deposits (only in the CFB tests). Interestingly, a smaller signal change was detected during the 40% straw case in the PF combustion, in contrast to a larger signal gradient during the 40% case in the CFB tests. Two reasons could be identified for this behavior: On the one hand, the sensor used in the PF tests showed a lower sensitivity due to a different design of the sensor head. On the other hand, a significant amount of chlorine was detected in the aerosolic particles in the CFB tests in contrast to no chlorine in the PF experiments during this case. The known interaction mechanisms of alkali mitigation during combustion of difficult fuels (sulfation and embedding in alumino-silicates), which lead to a chlorine reduction in the fine particles, were investigated thoroughly. It was found that sulfation might be more pronounced under conditions typical of CFB systems.

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