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Fireside Corrosion Study of Superheater Materials under Oxy-Coal Firing Conditions

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The need to reduce CO_2 emissions from coal-based power plants has led to the development of Carbon Capture and Storage (CCS) technologies. Oxy-coal or O_2/CO_2 combustion is a promising option for the CCS technology due to the high CO_2 concentration in the flue gas and an overall reduced flue gas volume when compared with air firing. The high CO_2 content can be readily captured and stored. The oxy-coal firing method however also leads to high concentrations of SO_2, SO_3, and H_2O in the flue gas and a change in the ash chemistry that could increase the fireside corrosion risk of vital plant components such as superheaters operating under severe conditions. Fireside corrosion of materials in conventional coal air-firing plants is either caused by gas phase oxidation or deposit-induced (coal ash) corrosion. The aim of the present study is to investigate the effect of oxy-coal flue gas and ash deposits on fireside corrosion of commercial superheater materials.

In this study, the fireside corrosion performance of selected superheater alloys (T24, P92, VM12-SHC, Alloy 800HT and Sandvik 7RE10) are evaluated after 2000 *hours* of exposure at a metal surface temperature of 600 °C under oxy-coal flue gas atmospheres. The alloys were first exposed in an oxy-coal combustion test facility for 100 *hours* under realistic combustion conditions to initiate the process of corrosion. In the ongoing laboratory studies, the pre-corroded probes are further exposed in a horizontal test tube furnace for 1900 *hours* under a simulated oxy-coal gas mixture and fly ash deposits from combustion. After a combined 2000 *hours* of exposure, the corroded materials will be analyzed via optical microscopy, SEM-EDX, XRD and EBSD. Thermodynamic modeling studies have also been carried out with the help of thermo-chemical software package FactSage™ to study the thermodynamic behavior of the flue gas and how it reacts with a system.

Keywords: High-temperature Fireside Corrosion, Deposit-induced Corrosion, Gas Phase Oxidation, Superheater Alloys, Oxy-coal Combustion.