BURNERS, COMBUSTION AND HEAT TRANSFER

(612) - (*) - INFLUENCE OF LOAD-FLEXIBLE OPERATION ON HEATING SURFACE FOULING IN A GERMAN LIGNITE-FIRED POWER PLANT

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In view of the German energy transition (*Energiewende*) coal-fired power plants increasingly cover the fluctuating residual load rather than the base load for which the power plants were originally designed. Therefore, the off-design plant state is characterized by load-flexible operations with higher demands regarding load transients and load cycle numbers.

Load-flexible operations have an impact on a variety of plant components, such as the combustion system, water-steam-cycle and steam-turbine. This study only focused on the influence of load-flexible operation on heating surface fouling. The impact varies from age and design of the power plant. Thus, this study only centers on one German lignite-fired power plant power plant with an electrical output of 600 megawatts, where all diagnostic methods were carried out.

To determine the impact of load-flexible operations on the heating surface fouling of the boiler, cooled probes and the Particle-Wire-Mesh method were used. In order to measure the fouling on the boiler walls, cooled probes were inserted directly into the flue gas. The cooled probes are capable to simulate the fouling similar to a boiler tube. The probes were used over several hours during partial load and full load as well as over several weeks during different phases of operation. The fouling on the cooled probes was further analyzed using SEM/EDX. To determine the conditions in the flue gas during full and partial load, the temperatures as well as the particle species in the flue gas were analyzed. To achieve this, a different kind of probe was inserted into the flue gas following the procedures of the Particle-Wire-Mesh method described by Thiel et al. [1]. Using this, flue gas particles during full and partial load operation were extracted via a metal wire mesh. The flue gas particles were analyzed with SEM/EDX and characterized through size, shape, surface condition, stickiness and elemental composition.

Thus it was possible to trace the path of the particle species from the flue gas to the slag at the boiler tubes. Furthermore, thermochemical equilibrium calculations were carried out to investigate the formation of different slags during partial and full load. The fouling behavior on the cooled probes showed significant differences between full and partial load operation. This lead to the conclusion that lower flue gas temperatures reduce the formation of heating surface fouling. Additionally, the cooled probes showed the development of different fouling layers during several weeks of operation. It was shown that longer operation time did not lead to an increase in fouling as long as the operation was frequently done in partial load.

[1] Thiel C, Pohl M, Grahl S, Beckmann M: characterization of mineral matter particles in gasification and

combustion processes, Fuel 152 (2015), p. 88 - 95

Palavras-chave : lignite-fired, flue gas diagnostic, thermochemical equilibrium, heating surface fouling, load-flexible