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Using Thermo-Chemical Equilibrium Calculations in a Combustion CFD Environment for the Simulation of Slagging and Fouling in Lignite Fired Power Stations

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Inconvenient ash compositions are the root cause for a variety of slagging and fouling phenomena observed in many different lignite firing systems worldwide. Depending on the structure of the deposit an enhanced deposit formation can also lead to increased corrosion/erosion rates for the metal surfaces of the heat exchangers. The prediction of slagging and fouling in these firing systems is therefore key to optimize cleaning strategies and to avoid excessive deposit growth that endangers plant availability and reduces plant efficiency.

RECOM Services is a Spin-Off from Stuttgart University providing specialized combustion CFD modelling services to the power and process industry since 1999. The in-house developed CFD Modelling Software RECOM-AIOLOS applied in the combustion CFD analysis is a tailored application for the description of gaseous-, liquid- and solid-fuel-fired industrial-scale combustion systems. The predictive quality of the Software has been thoroughly assessed by validation against measured data from over 100 field operating boilers. The combustion CFD analysis has recently been extended in the VerSi project to include the usage of Thermo-Chemical Equilibrium Calculations for the assessment of ash transformation processes and their impact on the melting characteristics.

The approach pursued in the VerSi project is based on the tabulation of key results (e.g. amount and composition of the melt) from thermo-chemistry calculations depending on temperature and oxidation conditions. The slagging and fouling prediction utilises this data to derive the actual viscosity of several million particles tracked in a combustion CFD environment when hitting the wall of a heating surface. An appropriate deposition probability is calculated using a critical viscosity approach, thus enabling to derive local deposition rates.

The capabilities of the extended model description was validated with full scale measurements conducted at a lignite fired Power Station. The comparison revealed a quantitatively correct reproduction of the measured deposition rates in the simulation model.

The presentation at the GTT user meeting is intended to discuss the above mentioned modelling approach and to give insight into the accomplished accuracy of slagging and fouling predictions for lignite fired power stations.