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CFD Modelling of a Biomass Incinerator for Prediction of Risk Areas for Corrosion Damages

In this thesis a numerical model for predicting areas with high risk of corrosion in biomass fired boilers has been developed. The model was developed through
a literature study and tested in a full scale CFD analysis of the second boiler at Verdo heat and power plant. STAR-CCM+ was used for the CFD calculations.
The model is based on the metal temperature of heat transfer surfaces in the boiler and the concentrations of potassium chloride(KCl) and oxygen(O2). A series of preliminary analyses of the used models were conducted in order to validate the simulation of the combustion processes. The main simulation consist of: a wood chip grate firing simulated with a bed model, a biomass suspension firing simulated with combustion of Lagrangian particles and a fully spacial and physical resolved, integrated steam circuit of super heater 3(SH3). The fully resolved SH3 provided a precise load distribution of the super heater. The average outlet temperature of the steam in SH3 was within 10 % of the temperature measured by Verdo. The developed corrosion model does not predict precise corrosion rates but only high, medium and low levels of corrosion risk. The most severe spots of corrosion seen by Verdo were predicted by the model with good precision similar to the corrosion profile across SH3. A numerical model for coarse ash deposition was also developed, showing good
agreement between the heaviest fouling areas in the boiler and the model. Deposition rates of 1 cm day was predicted in the bottom and mid section of SH3.
The secondary air nozzles in the furnace had a poor configuration, as the jets pushed the freeboard combustion zone together instead of mixing it with oxygen
rich air as intended. A result of this was an uneven load distribution in the boiler and in particular SH3

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Saturday, September 1, 2012
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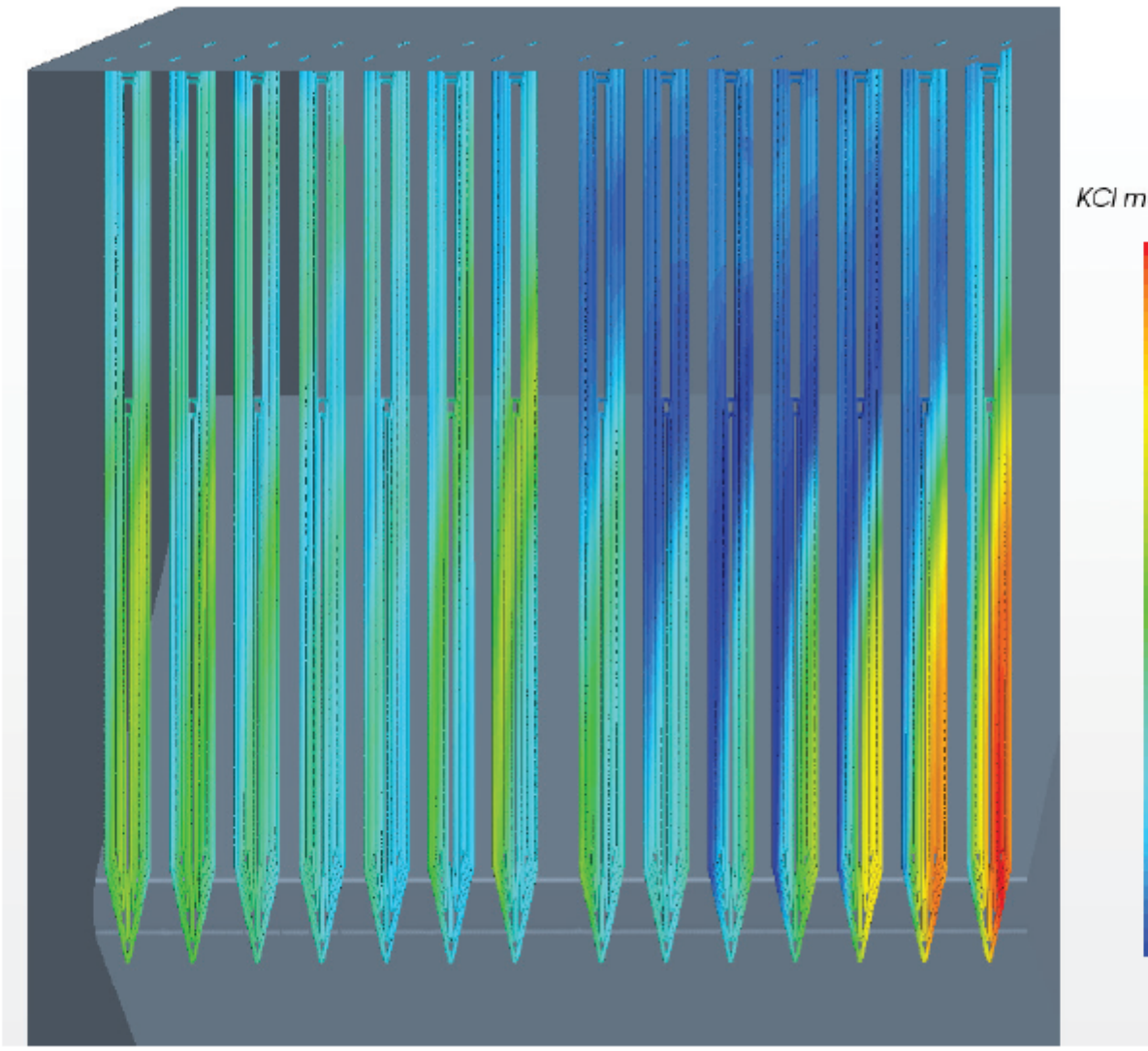
182
Image:



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