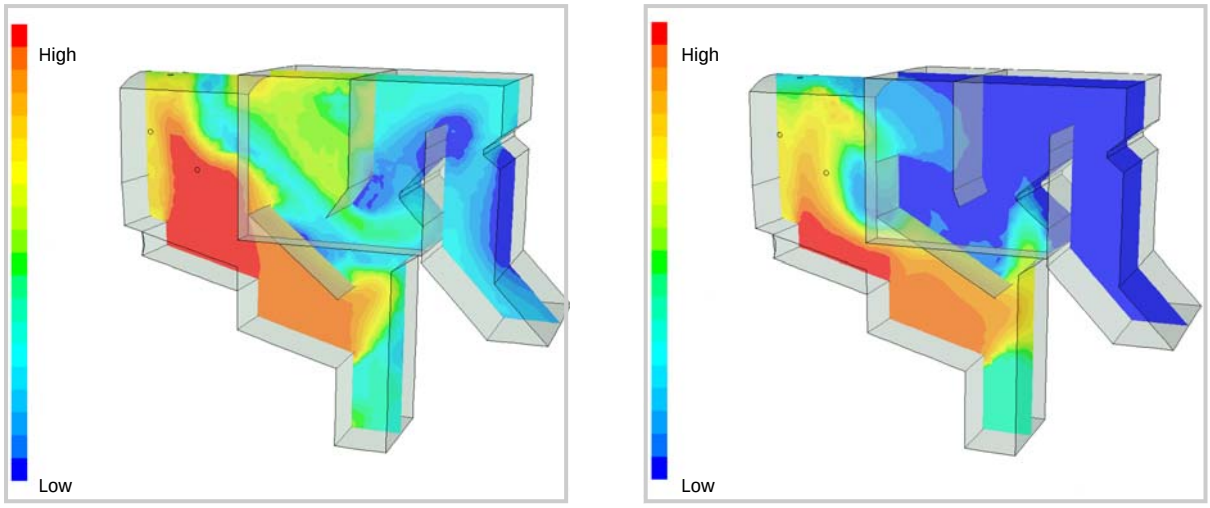
New furnace model based on a commercially available CFD-Solver

Optimal Design of Biomass and Waste-Fired Boilers



CO level in a waste-fired boiler before and after optimization. The left figure shows the non-optimized boiler, while the right figure shows a reduced CO level in an improved design. (Blue regions equal to low CO concentration).

For the past decade FORCE Technology has been involved in design and optimization of power plants using a mixture of experimental and numerical techniques.

Background

Optimal design and operation of a power plant are important to ensure a low emission level, high efficiency and few non-operational hours.

Biomass and waste-fired boilers are receiving increased attention as focus on resource availability and CO2 load on the environment has increased. Biomass-based fuels are carbon dioxide neutral, if burned at the rate the fuel is grown. The Danish power production industry consumes large amounts of biomass-based fuels in order to fulfil the Danish carbon dioxide reduction policy. Waste-fired boilers utilize an energy resource that was formerly not taken into account.

Competences at FORCE Technology

Different aspects of flow conditions in boilers have been investigated and optimized by FORCE Technology including:

- General study of gas flow in boilers and optimization of boiler design
- Optimization of air injection and mixing
- Flue-gas cleaning equipment evaluation
- Reduction of deposition and erosion
- Heat transfer evaluation.

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The Joint Project

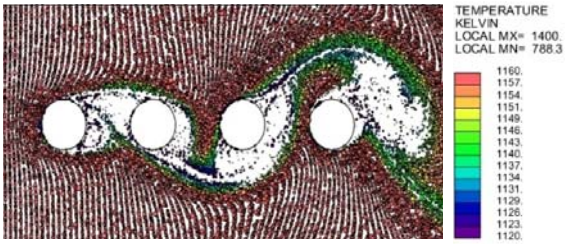
FORCE Technology has been involved in a larger Danish research project, the Joint Project, with the purpose of coordinating and ensuring continuous development in design of grate-fired biomass boilers. The forum of the Joint Project consisted of manufacturers of biomass-fired boilers, power companies, universities and research centres. The Joint Project had focus on the following:

1. Slagging and fouling in straw-fired grate boilers
2. Sulphur chemistry in straw-fired boilers
3. Nitrogen chemistry in straw-fired boilers
4. Furnace modelling.

Models developed were implemented in a new furnace model based on a commercially available CFD-solver. The model assists manufacturers in design and construction processes and provides further insight into the processes governing the performance of biomass-fired grate boilers.

Dynamic Simulation of Power Plants

Furthermore FORCE Technology has participated in a research project with the aim of developing a model simulating the steam cycle in a power plant. The model is coupled to a CFD-tool calculating the flow pattern, thermal conditions and chemical reactions taking place in a furnace. Ash deposit build-up is included in the CFD-calculation. The resulting model enables the designer to produce a time-varying prediction of deposit build-up, emissions and plant efficiency. Additionally, the dynamic model can be applied for evaluation of different control strategies.



Calculated particle distribution and ash deposition on a super heater tube in a biomass-fired boiler

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