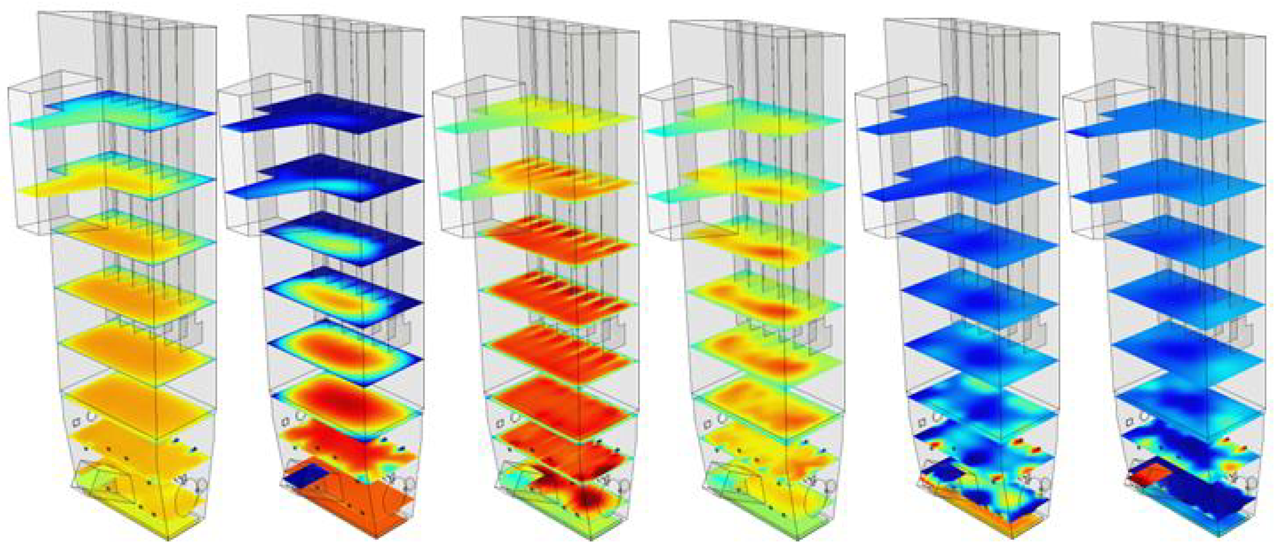
Modeling and durability

Computational fluid dynamic simulation (CFD)

CFD is used to model conditions inside boiler furnaces. Effects of low loads and fast ramp rates on furnace conditions are evaluated. Results can be used to find suitable designs and operation modes to reduce e.g. emissions, corrosion and material stresses.



a) b) c)

Fig. a) Temperature, b) vertical gas velocity and c) O2 contours in a CFB at full (left) and 40% (right) loads

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Dynamic modeling of power plants

Dynamic models can be used to analyze the behavior of different process variables in the boiler and turbine processes. The analysis results can be used to estimate theoretical load change rates for different types of process configurations and thermal and mechanical stresses caused by power transients with different ramping speeds.

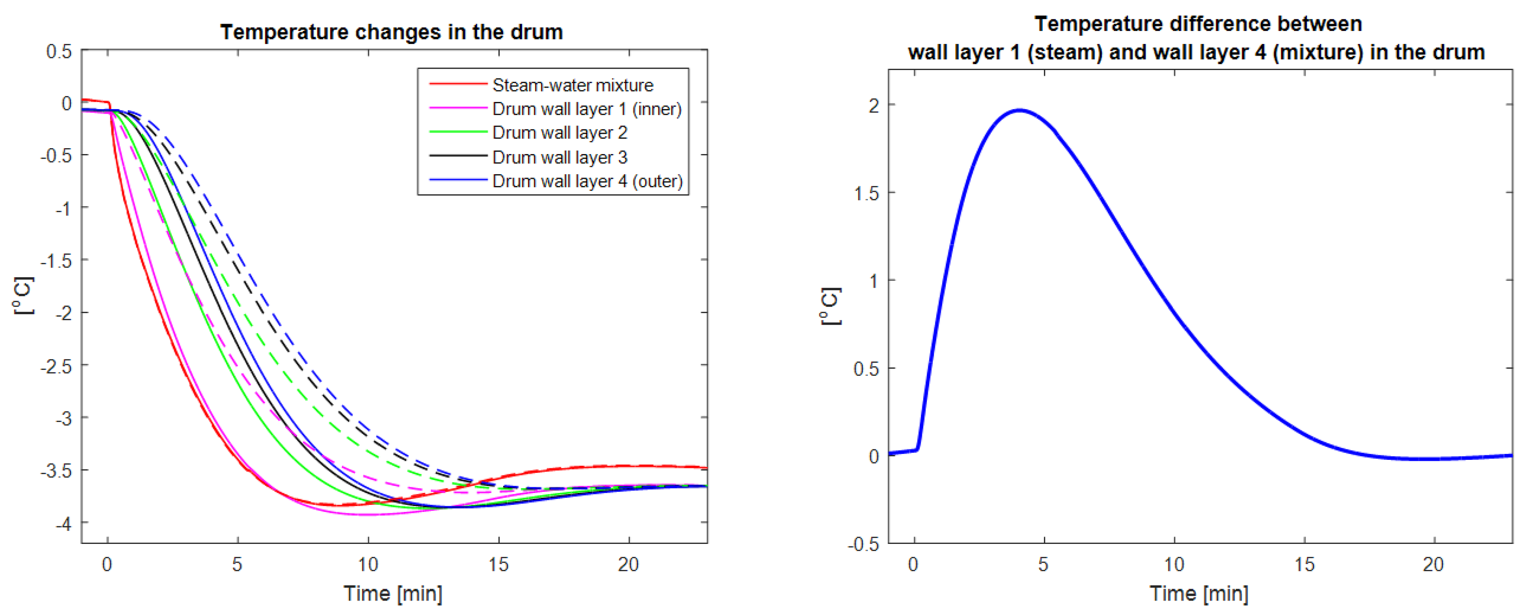
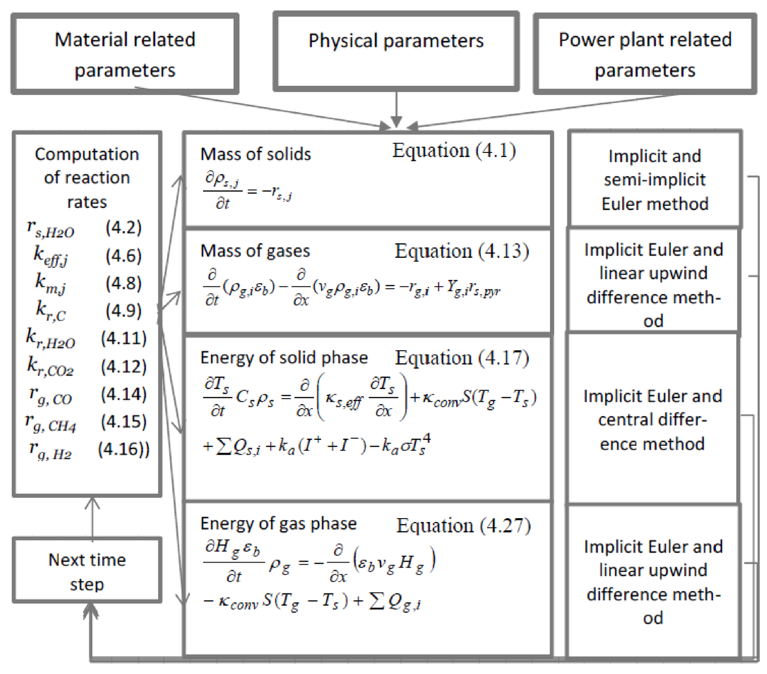


Fig. Simulated effects of 5 bar pressure drop to live steam temperature and drum wall temperatures in four depths above (dashed lines) and below (solid lines) steam-water mixture level in the drum of a circulating fluidized bed boiler. Temperature changes are still tolerable.

Fig. In a BioGrate boiler, biomass reacts through the three main reactions that occur either in parallel or sequentially: drying, pyrolysis, and char conversion. The BioGrate boiler model considers these three stages of biomass combustion. The model accounts for mass and energy conservation and considers a solid and a gaseous phase.



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Development of a model for creep fracture and fatigue analyses

The pressure parts and especially the superheaters of electricity-generating power plants are exposed to creep, fatigue and the combined effect of creep and fatigue during their useful life, which is important to consider in component design in order to avoid in-use damages of the components. A viscoplastic material and damage model has been developed. The 3D-model has been used in solid elements to analyze creep and high temperature fatigue of superheater headers.

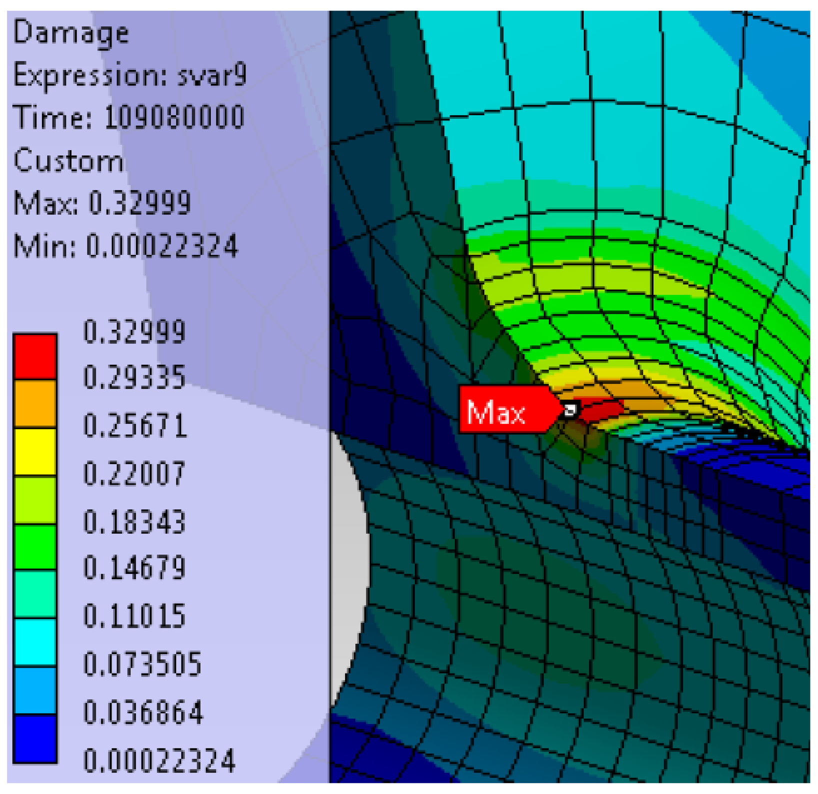

Fig. Damage distribution near the most critical location of the header

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