MODELLING OF FURNACES AND COMBUSTION SYSTEMS

(718) - COMPUTATIONALLY EFFICIENT ALTERNATIVE TO A FULL SCALE TRANSIENT SIMULATION OF A REHEATING FURNACE

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Steel is the most widely used alloy in the world. Reheating of steel slabs in a reheating furnace is an intermediate step in the long and complicated process of steel making. These furnaces reheat the slab to about 1250°C, which makes them suitable for hot rolling. During this reheating process temperature uniformity within the slab is very important, because it often leads to quality concerns in the later stages of the production process. A detailed understanding of the reheating process is hence important both from the perspective of product quality and of energy use. Unfortunately the extreme conditions inside the furnace do not allow for detailed experimental investigation. Numerical tools like Computational Fluid Dynamics are useful in such situations, but when applied to such massive and complex installations, full scale transient models often lead to unpractically high computational costs.

In this paper the Truncated Transient Slab Model is developed, which is capable of predicting the transient behaviour of the slab during its residence inside the furnace in a computationally efficient way. This is accomplished by coupling two different models: a steady-state model of the complete furnace and a transient model of the truncated domain around a single slab. Flow profiles from the complete furnace are used as boundary conditions for the truncated model, thereby replicating the flow conditions of a full scale transient model in a much smaller domain. The advantage of this modelling approach when compared to full scale transient models, is a significant reduction in simulation time while maintaining a high grid resolution. A direct comparison of simulation time is not possible due to the difference in furnace design. However compared to the state of the art this modelling approach can be used to simulate furnaces three times the capacity, in half the time and using a third of the computational resources.

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