Predictive Control on Slab Reheating Furnace Using Rigorous Model

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Steel slabs are heated up in reheat furnaces prior to hot rolling. A disadvantage of the current control strategy at Tata Steel's hot strip mills is the lack of anticipation to furnace dynamics and planned disturbances. Model predictive control (MPC) allows for a systematic trade off between efficiency and production rates, and pushes the process towards its constraints without violating them and anticipates on planned disturbances.

This paper concentrates on the development of a rigorous dynamic reheat furnace simulation model, which forms the basis of an MPC as part of a feasibility study. The heat transfer principles included are: fuel combustion and transport of hot flue gas, slab heat distribution, heat losses through refractory and skids, and 3D radiation heat transfer using zoning method. The controller uses the rigorous dynamic model for state estimation and a reduced (simplified) dynamic model for short term predictions.

The controller is compared to the actual operation using simulations, where the control goals are maximizing production speed and minimizing the slab discharge temperature deviations from target and fuel usage. The simulations show a significant decrease in slab declassifications and a higher average production rate.

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