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A Thermomechanical-Microstructural Model of a Hot Strip Mill

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ABSTRACT

Growing demand for thinner and wider advanced high-strength steel (AHSS) grade hot-rolled material presents a significant challenge to existing hot strip mills, particularly in producing products in a cost-effective way and within equipment constraints. To optimize the mills' throughput while avoiding equipment overloading, a thermomechanical-microstructural model has been developed. The model predicts roll forces, torques, and power in the roughing and finishing stands; estimates the minimum time required for cooling of the motors between sequential bars; and calculates mechanical properties of hot bands coiled at various coiling temperatures. The paper summarizes successful experiences of the model utilization.

INTRODUCTION

Growing demand for thinner and wider Advanced High Strength Steel (AHSS) grade hot rolled material presents a significant challenge to existing hot strip mills, particularly in producing products in a cost-effective way and within equipment constraints. To optimize a mill's throughput, while avoiding equipment overloading, a thermomechanical-microstructural model of a hot strip mill has been developed. The model predicts roll forces, torques, and power in the roughing and finishing stands, estimates the minimum time required for cooling of the motors between sequential bars, and calculates mechanical properties of hot bands coiled at various coiling temperatures. The paper summarizes successful experiences of the model utilization.

MODEL FORMULATION AND COMPONENTS

A Brief History of Development

To assist the Gary Works 84-inch Hot Strip Mill (HSM) in analyzing equipment changes or proposed improvements in the mill operations, a computer program, BARTEMP [1], was developed at the U. S. Steel Research and Technology Center between 1980 and 1983. Initially, BARTEMP was intended to predict the transient, through-thickness (1D) temperature distribution in the middle of the bar width, at any arbitrarily chosen location along the bar length, from reheat furnace dropout to the coiler entry. The program could handle any integrated mill layout, including reversing and tandem roughers, and it could account for head-to-tail-end temperature variations along the bar length.

