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Finite Element Temperature Analysis of Reverse Hot Strip Rolling of AISI 304 with Steckel Mill

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<Abstract>

Steckel mill with two furnace coilers at entry side and delivery side of the roll stand is commonly utilized in hot strip rolling of AISI 304 which is one of the most popular austenite stainless steel. In the process, Steckel mill rolling speed is changed periodically and repeat of change between maximum (rolling passes) and zero speed (between passes) causes overcooling of top and bottom ends of the strip compared with middle of the strip.

Knutsen and Parker(ISIJ International Vol.48(2008),No.2,pp200-207) proposed expression model which forecast the recrystallization rate of both ends of the strip, and they estimated the mechanism of residual deformation structures in both ends after hot strip rolling. In this model, recrystallization behavior strongly influences the deformation resistance of the strip, and the temperature distribution of the strip due to generation of heat during processing.

In this report, Finite Element temperature analysis of reverse hot strip rolling of AISI 304 with Steckel Mill was simulated by using the **ECOMERI™ Professional** that built according to their recrystallization model, and surface temperature distribution of the analysis was compared with those of actual operation log data which showed that the results matches well.

< Result and Discussion >

The analytical result is shown in Fig.1 and the log data of real process is shown in Fig.2. *Micro pass schedule* of each observation point of the strip was derived from the pass schedule of a real process, and analytical conditions were optimized for the **ECOMERI™ professional**. In Fig. 1, the overcooling caused by time loss for crop-shirr before the second pass was reproduced accurately. Moreover, there is a reduction in the acceleration due to speed limit of the down-coiler which causes over-cooling. The over-cooling obstructs the recovery of the strain in the final pass, was almost reproduced using the **ECOMERI™ professional**.

The observed instrument was assumed to be placed at 2m from the roll-bite to the downstream for the analysis. It turned out that the surface temperature measured at this position was lower than the thickness average temperature, as a result of the analysis. Because the metallurgy phenomenon and the average temperature have a good correlation, it is necessary to use the average temperature. ***Since the average temperature is relatively stable, applying the average temperature is strongly recommended for the fine metallurgy design.***

< Concluded Remarks >

An accurate temperature analysis of Steckel mill was executed, by considering a detailed pass schedule of real process.

The **ECOMERI™ professional** is a convenient and useful tool for the process design and the metallurgy design since it can be modified under different conditions of each process.

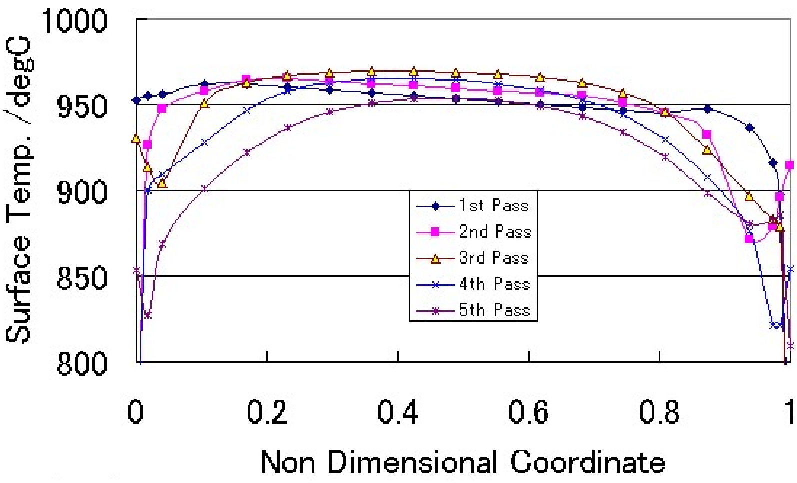

Fig.1　Analyzed Surface Temperature of Rolled Material
(5Pass, 31.1mm^t => 5mm^t, by **ECOMERI™** Professional)

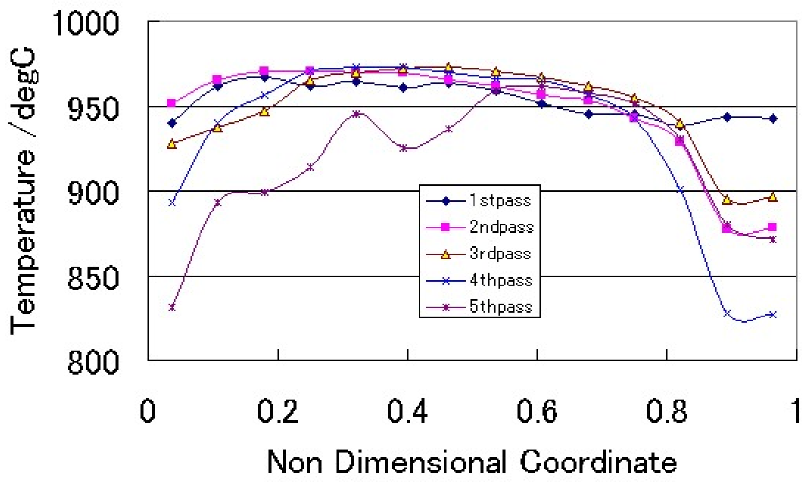

Fig.2　Surface Temperature of Rolled Material
Original Sorce:　Knutsen and Parker
(ISIJ International Vol.48(2008),No.2,pp200-207)

This concludes my report.