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OPTIMAL BATCH CREATION FOR BELL-TYPE INDUSTRIAL BATCH ANNEALING FURNACE WITH AN ANNEALING TIME PREDICTION MODEL

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Abstract: Batch annealing process is highly automated and commonly used heat treatment process which is eligible for industrial applications. In this process, steel coils are vertically stacked one on top of each other and heated up to 720℃ between 13-25 hours. Temperature distribution and annealing time of each coil depend on weight, thickness, outer diameter, height, vertical position, etc. Having an optimal combination of coil batches increases the productivity of the process. and to create the optimal batches, annealing times of each combination should be predicted. For this purpose, a validated heat transfer model is used to simulate past 2 years' processes. More than 29,000 data are obtained which covers different coil parameters and annealing programs. A neural network model is constructed to predict the annealing time. Error rates of annealing time prediction model are between 30 to 50 minutes which is quite successful. After the validation of the annealing time prediction model, an Integer Programming formulation is developed for the optimal batch creation problem. An alternative approach is proposed for selecting the best batch combinations in a dynamic production environment. Increase in production efficiency is demonstrated in the computational study.