Reheating Furnace Walking Hearth Operation & Optimization Training

Energy Milestones Corporation

Advancing Professionals to the next level

Energy Milestones is proud to be accredited, partner and associated with the following association bodies:

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Overview

Hot rolling operations require high-quality reheated semi-finished steels at the lowest possible cost and the optimal production rate of the rolling mill. The reheating furnaces used to heat semi-finished steels in a hot rolling mill consume a large amount of energy and simultaneously generate a significant amount of pollutants. Because of this, there is a need to explore ways to reduce energy consumption, as well as contaminants and associated costs. This can be done by improving the fuel efficiency of the reheating furnaces

Course Objectives

The three basic things required to start and sustain combustion are fuel, oxygen, and sufficient energy for ignition. The combustion process is most efficient if fuel and oxygen can meet and react without any restrictions. However, in practical heating applications, it is not sufficient to consider only the efficient combustion; the heat transfer aspects also need to be taken into consideration. The following are the critical parameters for a combustion system in the Reheating furnace:

- The quantity of heat required to be imparted to the charge material.
- Generation of heat within the furnace is required not only to heat the charge material but also to compensate for all heat losses that occur.
- Transfer of part of the available heat from the furnace gases to the surface of the heating charge material.
- Equalisation of the temperature within the charge material.
- Losses of heat from the furnace through the doors, walls, etc.
- The exhaust gases carry heat.
- Emissions of the pollutants (e.g. NOx, etc.) are caused by the exhaust gases.
- There are two main objectives.
- The primary objective is to develop a simulation model of billet temperature that considers real-time changes in thermal conditions, including their thermal properties and thermal radiation view factors.
- The second objective is to develop a practical furnace control optimisation method that responds to real-time non-steady-state condition changes in the operation of a reheating furnace in rolling mills, without using trajectories. By applying these immolation models and control methods to the real operation of reheating furnaces, reheating fuel costs can be minimised, and the loss caused by operators' differences and conservative actions can also be minimised.

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Course Content

1. Background

- Fundamentals of reheating in steel rolling.
- Strategies to reduce fuel consumption.
- Key causes of inefficient furnace performance.
- Overview of previous furnace control approaches.

2. Modeling the Reheating Furnace

- Furnace and Line Performance: Mill layout, billet/bloom movement, cycle time analysis.
- Heat Balance: Understanding heat requirements, heat loss, and temperature differences.
- Heat Transfer Mechanisms: Gas-to-metal transfer, thermal conduction, and coefficients.
- Material Thermal Properties: Specific heat, emissivity, absorption rate, conductivity.
- Furnace Modeling Techniques:
  - Mesh creation.
  - Component-level heat balance.
  - Interaction and temperature of billets and hearths.

3. Simulation of the Model

- Input Data: Billet orders, material properties, operating conditions.
- Simulation Results:
  - Temperature distribution and longitudinal heat transfer.
  - Impact of mesh size and time increments.
- Thermal Conductivity Analysis:
  - Effects on billet core temperature.
- Control Parameter Selection:
  - Billet extraction temperature estimation.
  - Model and parameter selection for control strategy.

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Course Content

4. Furnace Operation Optimization

- Optimization Methodology:
  - Objective functions, variables, constraints.
  - Scheduling and temperature adjustment techniques.
- Reducing Computation Time:
  - Selective billet tracking.
  - Temperature change limiters.
- Control Performance Evaluation:
  - Furnace temperature response.
  - Actions during unexpected stoppages.
  - Handling billets with higher target temperatures.
- Conclusion:
  - Summary of findings.
  - Design improvement suggestions based on simulation insights.

Targeted Audience

- **Maintenance Engineers and Managers**
- **Maintenance Technicians and Supervisors**
- **Reliability Engineers and Technicians**
- **Technical Support and Supervisors**
- **Technologists**
- **Technology Supervisors and Managers**
- **Operations Engineers and Managers**
- **Operation Technicians and Supervisors**
- **Operational Management.**

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Course Methodology

Facilitated by an experienced professional trainer, this training course will be conducted as a highly interactive workshop session. A variety of training methodologies and facilitation techniques will be employed before and during the course, as applicable. These methods are aimed at enhancing individual and group interaction while maximising learning. Some of these methods are:

- **Online Pre-post Test**
- **Colourful Visual Aids**
- **Gamification**
- **Self-Assessment Instruments**
- **Simulations**
- **Case Studies**
- **Videos**
- **Group Exercises & Discussions**
- **Role plays**
- **Indoor & Outdoor games**