0150 Development of Submerged Entry Nozzles that Resist Clogging - Plant Trials

Benefits

- Reduced refractory costs.
- Increased steel quality and cleanliness.
- Increased steel production through elimination of unscheduled shut-downs and consistent throughput.
- Increased energy efficiency.

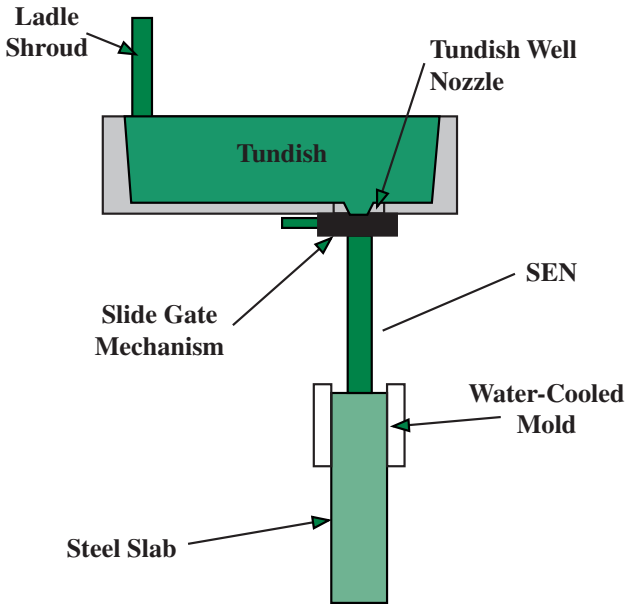
Applications

- Submerged Entry Nozzles (SENs) are used in the steelmaking process to prevent reoxidation of the molten steel steam by the surrounding environment and from air entrainment and splashing when the molten stream strikes the liquid surface in the mold. Elimination of accretion formation and the associated clogging of SENs will lead to increased strand speed, greater time between changes of SENs, and minimize interruptions in the casting process.

Nozzle clogging is a build-up of accretions on the internal bore of refractory nozzle used in the continuous casting of steel. The purpose of the refractory nozzle is to protect the steel stream from reoxidation and control its flow as the steel moves from the tundish to the mold of a continuous caster. The accretions eventually build up to a level that either completely blocks the flow of steel or disrupts the flow of steel to the extent that casting must be aborted.

Nozzle clogging in the continuous casting of aluminum-killed steels has been a problem for nearly 30 years. Snow and Shea first reported observing alumina and steel nodule accretion formations on the walls of ladle nozzles associated with the teeming of fine grained aluminum-killed steels in 1949. It was not until the advent of continuous casting that nozzle clogging would be recognized as a major hindrance to productivity.

Clogging continues to be a problem with modern slab and thin slab casters. Several methods to counter clogging have been introduced such as calcium treatment and argon injection, however clogging often continues to limit productivity in the steel industry.



Project Goal:
To develop combinations of steelmaking practices, flow conditions, and refractory SEN systems that resist clogging and can withstand the thermal stresses that develop during casting.

Progress and Milestones

- ❖ Project start date: July 2002

1. Literature Survey
2. Preliminary Analysis of Candidate Materials
   - 2.1 Static Accretion
   - 2.2 Simultaneous Thermal Analysis
3. Casting Simulations
   - 3.1 Surface Roughness/Permeability
   - 3.2 Evaluate Promising Candidate Materials
4. Thermal Spray Coating
   - 4.1 Casting Simulation of Coated Alumina Nozzle
   - 4.2 Studies of Non-Graphite Substrates
   - 4.3 Studies of Graphite-Containing Substrates
5. Industrial Trials
   - 5.1 Coat Nozzles
   - 5.2 Conduct Trial with 2nd Strand at Control
   - 5.3 Post-Mortem Analysis

- ❖ Project completion date: July 2006

Total Project Cost: $571,820

Duration: 4 years

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