Elimination or Minimization of Oscillation Marks – Improved Cast Surface Quality
Reducing Subsurface Defects from Continuous Cast Slabs will Increase Productivity and Yield

During the continuous casting process, molten steel is poured into a mold to produce semi-finished steel shapes. As the steel passes through the mold, hydraulic or motor-vision levers perform mold oscillation cycles to prevent the solidifying shell from sticking to the mold. Consequently, oscillation marks form on the steel and can include entrapped argon bubbles, inclusions, and elemental segregation.

While oscillation marks do not necessarily pose a problem in many grades, they are the cause of many continuous cast slab surface and subsurface defects, especially when the mark forms a hook shape. The oscillation marks also act as nucleation sites for surface cracking and transverse cracks that require surface treatment prior to hot rolling.

This project seeks to develop strategies that can be used on industrial continuous casters to reduce oscillation mark depth and, in particular, to minimize the formation of hook-type defects that are prevalent on ultra low carbon grades.

To address these needs, researchers will determine: (1) surface conditions and mold materials that could decrease the heat transfer rate in the meniscus region of the caster; (2) the possibility of changing the heat transfer rate locally in the mold to counteract the increased transfer rate during negative strip time; and (3) the ability of the meniscus position to be independently controlled. This research will contribute to minimizing oscillation marks in continuous cast slabs, helping the steel industry increase hot charging ratios and reduce the necessity for pre-rolling surface treatments.

Examples of steel surface oscillation marks.

Benefits for Our Industry and Our Nation
Improved cast steel slab surface quality decreases casting defects, increases continuous cast slab surface quality, reduces slab surface treatments and associated energy usage, and improves productivity and overall yield.

Applications in Our Nation’s Industry
These practices will benefit continuous casting processes and could provide more applications for ultra low carbon steel grades.
**Project Description**

The goal of this project is to develop strategies that can be used on industrial continuous casters to reduce oscillation mark depth and to minimize the formation of hook type defects that are prevalent on ultra low carbon grades.

**Barriers**

Major barriers to overcome include:

- Lack of knowledge surrounding surface conditions and mold materials that decrease heat transfer in the meniscus of the caster.
- Lack of knowledge to control the meniscus independently.

**Pathways**

This project will focus on increasing understanding of oscillation mark formation and developing new approaches to the operation of a continuous caster. This approach will lead to the elimination or minimization of the defects associated with oscillation marks.

**Progress and Milestones**

- Study the effect of mold surface condition and complete mold material designs (Complete)
- Determine mold surface condition and materials that could decrease the heat transfer rate in the meniscus region of the caster (Complete)
- Determine the possibility of locally changing heat transfer rate in the mold to counteract the increased heat transfer rate during negative strip time (Complete)
- Conduct meniscus modeling and develop techniques & guidelines for meniscus control (Complete)
- Issue guidelines for meniscus control (Complete)

**Commercialization**

Knowledge gained through this research will develop the foundation to build a technology that minimizes or eliminates oscillation marks during steel casting.

**Project Partners**

**Research Organization:** Carnegie Mellon University  
Principal Investigator: Alan W. Cramb (cramb@andrew.cmu.edu)

**Recipient Organization:** American Iron and Steel Institute  
Pittsburgh, PA

**Industry Partners:**  
Dofasco Inc.  
Hamilton, Ontario, Canada

Gallatin Steel  
Ghent, KY

SeverStal  
Dearborn, MI

Stelco Inc.  
Hamilton, Ontario, Canada

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