0101 Inclusion Optimization for Next Generation Steel Products

Benefits

- Improve process control and product quality by tailoring inclusion chemistry during ladle and casting processes.
- Increase understanding of the role of inclusions in steel production.
- Reduce inclusion agglomerates that cause nozzle and gate clogging and residual inclusions that lower the fatigue and fracture strength of steel products.
- Yield improvement of 0.5% for all cast products.
- 10% Improvement of hot rolled product yield.

Energy

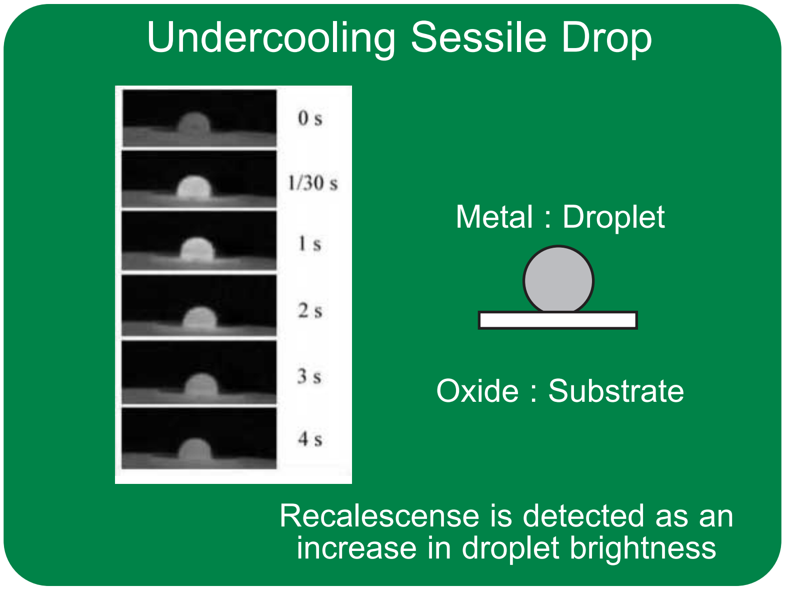
- Significant energy (30×10^6 GJ/year) and environmental savings (1857×10^6 kg of CO_2 per year) in steel production due to increased efficiency of the casting process, higher yield, and decreased energy consumption during reheating and rolling.

Applications

- This technology may be applied to all continuous cast steels; potential economic savings are estimated to be $100 million dollars per year.

Future trends in liquid steel processing will be towards chemical practices in the ladle that produce inclusions that are beneficial to the process rather than deleterious. This has the potential to radically simplify the casting process by eliminating the variations in cast structure that lead to product inconsistency. This will allow a greater percentage of current cast material to be applied, will increase the hot charging ratio and allow better product uniformity after rolling. In addition there is great potential for this technology in strip casting, as it will allow a more consistent process and new microstructure that may replace steels produced by conventional casting and rolling processes.

The successful development of these new practices has the potential to significantly reduce defects in cast product, to increase the productivity and yield of a continuous casting machine by at least 0.5%. Significant energy (30×10^6 GJ/year) and environmental savings (1857×10^6 kg of CO_2 per year) in steel production due to increased efficiency of the casting process and decreased energy consumption during reheating and rolling.



Project Goal:
To determine the conditions of formation of inclusions in liquid steels and to determine the processing conditions during casting that will allow these inclusions to become nucleants for solidification and subsequent solid state phase transformations.

The project will result in a new understanding of the role of inclusions in steel production and will be the foundation of inclusion engineered steels that are required for current and future casters.

Progress and Milestones

Project Start Date: September 2002

1. Confocal Scanning Laser Microscopy (CSLM)
   1.1 Study of Deoxidation
   1.2 Study of Inclusion Evolution
   1.3 Effect of Inclusions on Transformations

2. Casting Experiments
   2.1 Determine Undercooling Effects
   2.2 Inclusions That Affect Equiaxed Zone
   2.3 Large Scale Castings

Project Completion Date: March 2006

Total Project Cost: $448,210

Duration: 40 months

Research Organization:

Carnegie Mellon University (CMU)
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