

INCLUSIONS IN CONTINUOUS CASTING OF STEEL

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ABSTRACT

This paper first reviews the sources of inclusions in continuous casting of steel including both indigenous and exogenous inclusions, focusing on reoxidation, slag entrainment, lining erosion and inclusion agglomeration on linings. Secondly, the resulting defects in continuous cast steel products are reviewed, such as flange cracked cans, slag spots, and line defects on the surface of rolled sheet. Thirdly, the current "state-of-the-art" in the evaluation of steel cleanliness is summarized, discussing over 30 different methods including direct and indirect methods. Finally, this paper reviews operating practices to improve steel cleanliness at the tundish and continuous caster.

Key Words: Steel, Inclusions, Defects, Slab Caster, Plant Measurement, Review, Detection Methods

INCLUSIONS AND DEFECTS

1. Introduction

The ever-increasing demands for high quality have made the steelmaker increasingly aware of product "cleanliness" requirements. Non-metallic inclusions are a significant problem in cast steels that can lead to excessive casting repairs or rejected castings. Ginzburg and Ballas reviewed the defects in cast slabs and hot rolled products, many of which are related to inclusions.¹ The mechanical behavior of steel is controlled to a large degree by the volume fraction, size, distribution, composition and morphology of inclusions and precipitates, which act as stress raisers. The inclusion size distribution is particularly important, because large macroinclusions are the most harmful to mechanical properties. Sometimes a catastrophic defect is caused by just a single large inclusion in a whole steel heat. Though the large inclusions are far outnumbered by the small ones, their total volume fraction may be larger.²

Ductility is appreciably decreased by increasing amounts of either oxides or sulphides.³ Fracture toughness decreases when inclusions are present in higher-strength lower-ductility alloys. Similar property degradation from inclusions is observed in tests that reflect slow, rapid, or cyclic strain rates, such as creep, impact, and fatigue testing.⁴ **Figure 1** shows that inclusions cause voids, which can induce cracks.⁵ Large exogenous inclusions may cause trouble in the form of inferior surface, poor

Inclusions In Continuous Casting Of Steel

Roland Kiessling, Nils Lange



Inclusions In Continuous Casting Of Steel:

Continuous Casting N. A. McPherson, A. McLean, 1995 *Handbook of Non-Metallic Inclusions in Steels* Lifeng Zhang, Ying Ren, 2025-01-13 This handbook reports fundamentals industrial practices and new aspects for the formation and control solution of non metallic inclusions in different grades of steels It summarizes the latest research achievements of thermodynamics and kinetics such as deoxidation of real steels rather than pure iron precise calcium treatment prediction of the amount size composition and spatial distribution of inclusions in steel continuous casting semis which were rarely reported in other books in this field It is a useful reference for researchers in steel industries for the control of non metallic inclusions in steel and the production of high quality steels in industries such as automobiles household electric appliances bearings electric transformers high speed trains oil pipes and cutting wires **Effect of Steel Manufacturing Processes**

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Table of Contents Inclusions In Continuous Casting Of Steel

1. Understanding the eBook Inclusions In Continuous Casting Of Steel
 - The Rise of Digital Reading Inclusions In Continuous Casting Of Steel
 - Advantages of eBooks Over Traditional Books
2. Identifying Inclusions In Continuous Casting Of Steel
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Inclusions In Continuous Casting Of Steel
 - User-Friendly Interface
4. Exploring eBook Recommendations from Inclusions In Continuous Casting Of Steel
 - Personalized Recommendations

- Inclusions In Continuous Casting Of Steel User Reviews and Ratings
- Inclusions In Continuous Casting Of Steel and Bestseller Lists
- 5. Accessing Inclusions In Continuous Casting Of Steel Free and Paid eBooks
 - Inclusions In Continuous Casting Of Steel Public Domain eBooks
 - Inclusions In Continuous Casting Of Steel eBook Subscription Services
 - Inclusions In Continuous Casting Of Steel Budget-Friendly Options
- 6. Navigating Inclusions In Continuous Casting Of Steel eBook Formats
 - ePub, PDF, MOBI, and More
 - Inclusions In Continuous Casting Of Steel Compatibility with Devices
 - Inclusions In Continuous Casting Of Steel Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Inclusions In Continuous Casting Of Steel
 - Highlighting and Note-Taking Inclusions In Continuous Casting Of Steel
 - Interactive Elements Inclusions In Continuous Casting Of Steel
- 8. Staying Engaged with Inclusions In Continuous Casting Of Steel
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Inclusions In Continuous Casting Of Steel
- 9. Balancing eBooks and Physical Books Inclusions In Continuous Casting Of Steel
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Inclusions In Continuous Casting Of Steel
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Inclusions In Continuous Casting Of Steel
 - Setting Reading Goals Inclusions In Continuous Casting Of Steel
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Inclusions In Continuous Casting Of Steel
 - Fact-Checking eBook Content of Inclusions In Continuous Casting Of Steel

- Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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