

## 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.<sup>1</sup> 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.<sup>2</sup>

Ductility is appreciably decreased by increasing amounts of either oxides or sulphides.<sup>3</sup> 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.<sup>4</sup> **Figure 1** shows that inclusions cause voids, which can induce cracks.<sup>5</sup> Large exogenous inclusions may cause trouble in the form of inferior surface, poor

# Inclusions In Continuous Casting Of Steel

**L Cohen**



## **Inclusions In Continuous Casting Of Steel:**

## **Inclusions In Continuous Casting Of Steel** Book Review: Unveiling the Power of Words

In a world driven by information and connectivity, the power of words has been evident than ever. They have the capacity to inspire, provoke, and ignite change. Such is the essence of the book **Inclusions In Continuous Casting Of Steel**, a literary masterpiece that delves deep to the significance of words and their effect on our lives. Compiled by a renowned author, this captivating work takes readers on a transformative journey, unraveling the secrets and potential behind every word. In this review, we shall explore the book's key themes, examine its writing style, and analyze its overall effect on readers.

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