

NOVEL INCLUSION ENGINEERING METHOD FOR IMPROVING CLEANLINESS AND MECHANICAL PROPERTIES OF STEEL PLATES SUITABLE FOR PRESSURE VESSEL APPLICATION

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ABSTRACT

Non-metallic inclusions, which are present in steel, are known to be main sites of fatigue and tensile crack nucleation and defects in steels. The content, size and distribution of oxide inclusions significantly affects steels quality especially for high quality plates, wire rods, bearings, steels for a pipe lines, rails & wheels etc. Non-metallic inclusions are a significant problem in cast steels that can lead to excessive nozzle clogging during continuous casting and defects in finished product. 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.

Boiler Quality or Pressure Vessel Plates are superior quality carbon steel plates which have consistent controlled properties and are designed to withstand the internal pressure of pressure vessels, boilers and valves. Boiler quality or Pressure Vessel Steel Plates are very popular due to its diversity of use and longevity. The application requires excellent cleanliness, high tensile strength, corrosion resistance etc.

Steel Melting Shop-II, of Bhilai Steel Plant a unit of Steel Authority of India Limited produces different grades of Boiler Quality Plates through BOF-LF-RH-CC route. The presence of inclusions in plate greatly affects the mechanical properties including the impact properties. Inclusions also tend to clog the nozzle of SEN leading to abrupt stoppage of casters. To overcome this problem, Ca treatment practice is being followed at SMS-II, BSP for plate grades but that was giving inconsistent results.

Increasing the retention period of Ca in steel can increase the efficiency of Ca treatment process. If retention period of Ca is increased it can interact with majority of inclusions and transform them into respective molten calcium aluminates and calcium silicates. But Ca owing to low boiling point and very high vapour pressure is lost easily resulting in poor Ca recovery. A new inclusion engineering technique was used adopted to improve the Ca treatment practice. Barium bearing CaSi cored wire was used for calcium treatment of steels. Ba in combination with CaSi has led to significant improvement steel cleanliness. As a result of better steel cleanliness the mechanical properties like impact toughness was also improved.

Keywords: Steel Plates, Non Metallic Inclusion, Clean Steel, Ca Treatment, SEN Clogging

