Clean Steel Technology-Use of refractory Shroud

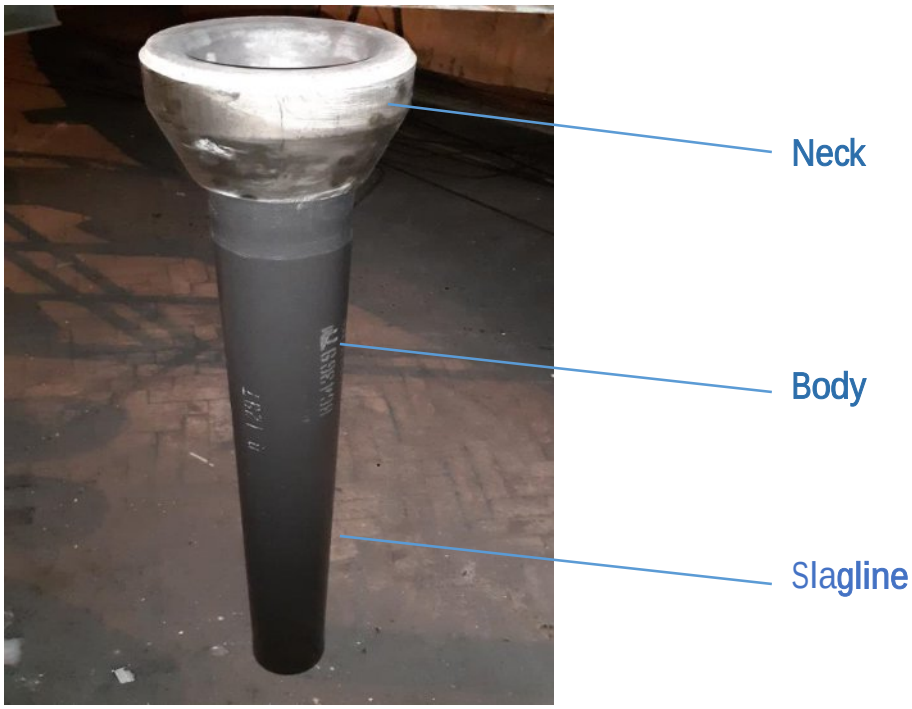
Continuous Casting of steel is the widely used and most preferred mode of molten steel solidification in recent times. Steel cleanliness and composition control along with surface and internal quality of strands are becoming a real concern for steel makers. The growing demand for better surface finish and high strength light weight steel has put quality requirement to be of the top notch priority.

The tundish is one of the large metallurgical vessel through which metal steel flows into the mold for further solidification. It can be considered the pre last step for inclusion modification and control. During the flow of the metal from the ladle to the tundish and then to the mold molten steel interacts with refractory, slag, tundish covering compound and atmosphere. Thus proper design and better tundish operation techniques to be employed to deter more inclusion production and facilitate the inclusions removal process.

The continuous casting unlike ingot casting has got better yield and better internal and surface quality as far as the detrimental effects of segregation and macro inclusions are concerned. The formation of ‘V’ segregates and inverse ‘V’ segregates has also been reduced to significant low levels with the introduction of electromagnetic stirrer and application of soft reduction in continuous casting processes.

Refractory Shroud practices

The pouring stream from the ladle to the tundish is protected from re-oxidation by the application of refractory shroud. The shroud is a long tubular (bell type or straight) structure usually made up of alumina carbon mix 20-25% carbon(94% graphite) and 70% alumina(tabular,fused alumina with fused mullite addition) and can sometimes contain 0.5% zirconia.It will have anitioxidants(like Al,Si etc) to protect the carbon from reoxidation.The top conical part normally known as the neck is an area of high wear and normally contains less carbon. The slag line is highly corrosive and material is chosen to counter the tundish slag composition. The slag line may contain alumina or zirconia or magnesia carbon mix.The body generally comprises of alumina carbon. The inner body layer (3-5mm) is preoxidised to impart thermal shock resistance properties as the shroud is put into service without preheat where as the outer body is coated with glazing material to prevent air aspirations.



View of the ladle Shroud

Top view of Shroud and Gasket

The neck is generally sealed with an jet of argon to protect metal stream from air ingress at the junction between ladle shroud and collector nozzle. Particular amount of argon flow around the shroud neck is to be maintained to prevent oxygen and nitrogen pickup. Bell and Reverse Tapered design of shroud are currently developed to avoid blowbacks when submerged opening practices are employed.

Gasket made of cera paper(Alumina silicate material) and a graphite coating on the inner ring which facilitates easy removal of shroud during ladle changeover, reduces heat loss, minimises risk of air ingression being in close proximity to the shroud neck and also reduces abrasion between shroud and the collector nozzle.

The major advantages of using Ladle Shroud are:

- Acts as a connector between ladle and tundish.
- Protects the flowing stream from re-oxidation and prevents inclusion formation.
- Improves steel cleanliness.
- Minimises tundish powder entrapment and bath turbulence.
- May allow submerged opening depending on the design
- Can be re-used and can achieve high life with specific finite-element flange designs.