WHITEPAPER

Mix Steel:
Optimization of special steel sequential casting operations with different chemical compositions

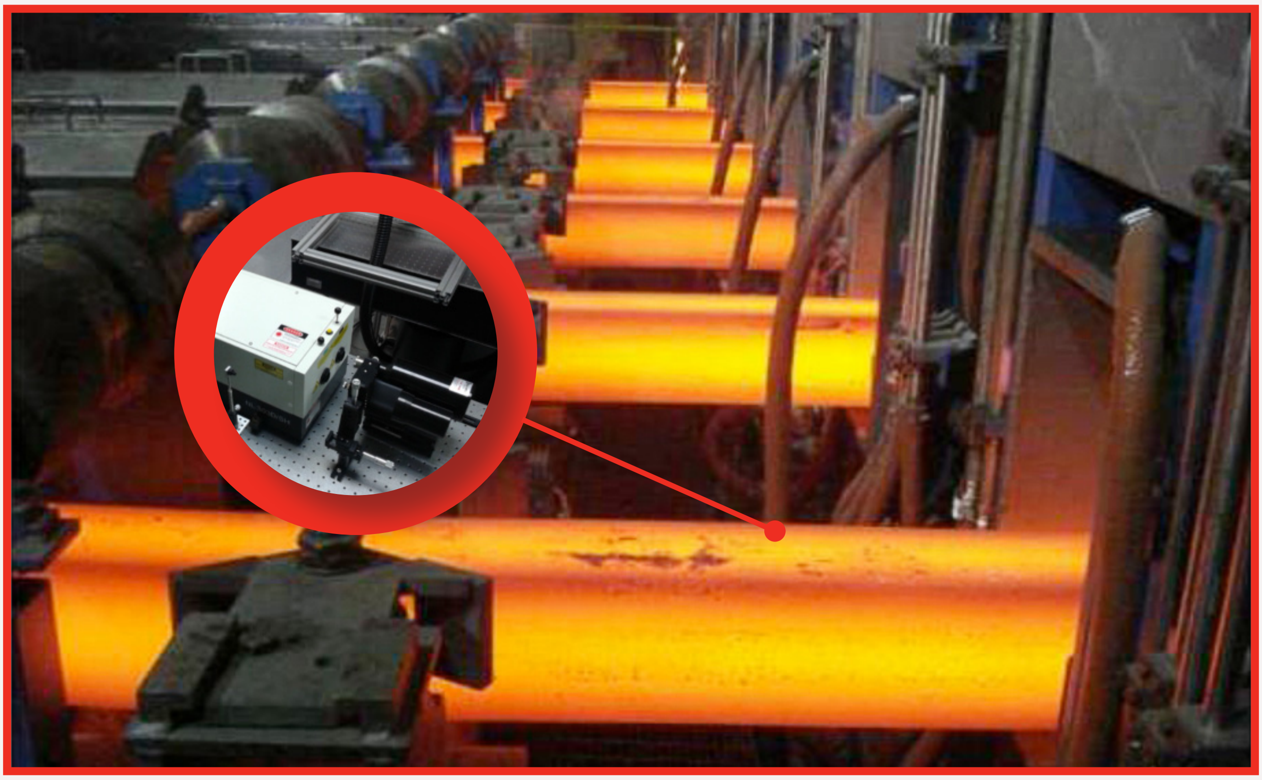
sidenor

Steel retains a dominant position in the automotive industry, showing its capacity to comply with requirements and exceeding the selection criteria, compared with other materials, according to its characteristics such as resistance, degree of deformation, resistance against corrosion, machinability, weldability....that is, characteristics which are substantially affected by **chemical composition**.

Many metallurgical operations are performed in the furnace and undergo refining in order to achieve a proper chemical composition adjustment, which must be ensured in all other metallurgical processes such as, for example, continuous casting. Here, special importance is given to the operation practice called **sequential casting of different steels or Mix Steel**, where ensuring the stability of the chemical composition is a crucial factor.

This process consists in casting in sequence two steels with a different chemical composition, thus increasing **productivity**, reducing **costs** and optimizing **metallic losses** for the purpose of manufacturing less billets which are generally called interruption or mixing billets, whose chemical composition does not meet customer needs and which are finally intended for scrapping.

The success of the Mix Steel process is based on predicting accurately the **cutting length** included in the mixing billet. In order to perform this theoretical calculation, the software which controls the continuous casting machine in Basauri Works includes an **integrated mathematical model**: the accurate cutting length of material to be scrapped is thus calculated online.



The model has been **developed, patented and published in high-impact reviews by the team of Sidenor R&D**. It is based on establishing the corresponding mass balances in the tundish, in a non-steady state; these balances lead to a series of equations which, in turn, produce curves that show the chemical composition evolution over time and can be easily translated into length units. The intersection of these curves with the specific range for the second casting precisely indicates the **cutting length of the critical material to be scrapped**.

The **mathematical model** has been validated according to various experimental trials in which the chemical evolution in the intermixing billets surface has been precisely measured. We have collaborated with the University of Malaga (UMA), as part of the Lacomore project, within the framework of the RFCS (Research Fund for Coal and Steel) European Project, and experts in **LIBS** technology (Laser-induced breakdown spectroscopy). During the industrial testing, a LIBS equipment was installed in the billet continuous casting, right before oxy-cutting. Not only has the project overcome all obstacles related to a fully innovative technology, among which the difficulty of entering through the scale and reaching the steel matrix, it was also successful in **strengthening the current manufacturing protocols** of highly-demanding steels by providing a versatile and operationally sustainable tool for determining the cutting length of Mix Steel, for all billet sizes, including the latest format of 240 mm, where Mix Steel plays a crucial role.

The model also covers the inherent requirements of the solidification process by integrating the modelling of the "liquid cone" in the first part of the mixing billets. The determination and calculation of this length is crucial in the entire process.

The developed cutting model presents a high level of accuracy despite the complexity of the project and contributes to maintaining Sidenor's competitive position in the special steel market.