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RESEARCH AND EXPERIMENTS REGARDING THE QUALITY OF THE CONTINUOUS CAST STEEL

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ABSTRACT

The research and experiments shown in this paper were performed with the purpose of emphasising a series of technological factors specific to continuous casting and the way they influence the draw out level and the quality.

The experiments were performed in electric steel making plant equipped with two electric-arc furnace, having a capacity of 100t each, and a continuous casting machine. In a first stage, the continuous casting machine cast blooms of 240 x 270 mm, but then, after the modernisation in august – november 2001, semi-finished products of Φ 150 mm were cast.

The quality and the draw-out level were influenced by several technological factors, the quality of liquid steel (the non-metal inclusion content, the oxygen, sulphur and gas content), the metal bath temperature, the argon ebullition parameters and the cooling parameters being taken into consideration when performing this research.

The experiments analysed the causes that led to reducing the draw-out level and lowering the quality, as well as the ways of avoiding them. A special attention was paid to placing the immersion tube exactly on the crystallographic axis, and to the cooling parameters, taking into consideration the relatively small size of the semi-finished product and the influence of those over the solidification process and its consequences over the quality.

1. INTRODUCTION

The present days tending in entire world, in the area of the casting procedures the steel semi-finished products, it is the continuous casting. Through this procedure, the specialists in this area try to obtain the semi-finished products, which have a section close to the clamping section.

In this way, it results one of significantly development regarding both the metal, the energy, the labour, and considerable investment are

reducing. Yet, these facts impose the greatest first-class performances from the obtained semi-finished products.

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2. INDUSTRIAL RESEARCH AND RESULTS OF THE ANALYSES

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The study of the defects, which appear in the semi-finished products, it is effectuates on the 65 charges of steel (the OLT 35 and the OLT 45 steel grades, conforming the romanian standard specification). It is persuade the parameters of the elaboration, the treatments in the liquid state of the steels, and the cast of this steel, and also, colligate there with detected defects.

The internal transverse cracks can be caused by the transversal tensions given the casting direction. The causes of their appearance is the unadequate cooling, and because the liquid core of the products have a too biggest elongation in transversal section. One of the internal transverse crack forms is presented in figure 1.

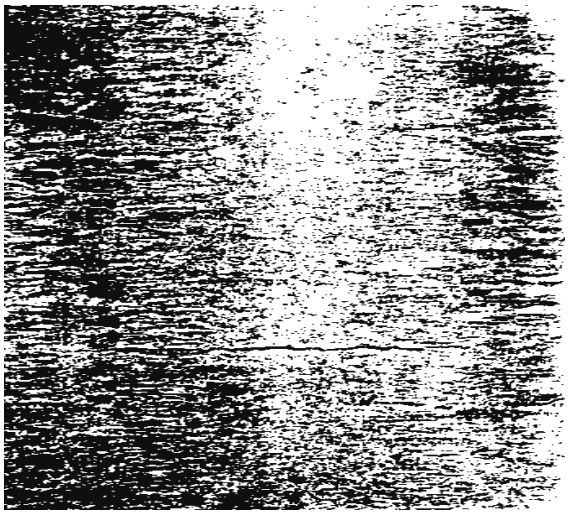


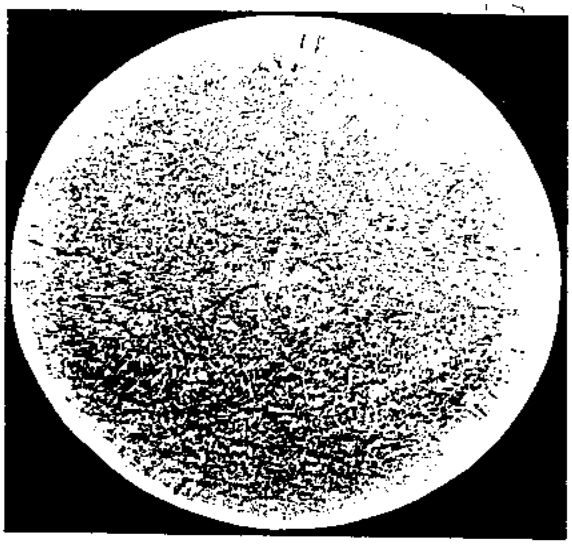
FIGURE 1.
THE INTERNAL TRANSVERSE CRACKS APPEARED AT THE CONTINUOUSLY CAST SEMI-FINISHED PRODUCTS

The internal longitudinal cracks can be considered as interdendritic separation, and there is classified in two great categories:

- internal longitudinal cracks which appear on the surfaces of the semi-finished products;
- internal longitudinal cracks which appear in the central zone of the semi-finished products.

The first categories cracks form is situated on the crust, nearly to the product surfaces and these are caused by the shrinkage stress in the passing zone of the crystalliser, at the secondary cooling when the steel is superheated or the cast speed is too biggest. In figure 2 is presented one of the internal longitudinal cracks, appeared on the surface.

FIGURE 2.
INTERNAL LONGITUDINAL CRACKS
ON THE SURFACES
OF THE CONTINUOUSLY CAST
SEMI-FINISHED PRODUCTS



The second categories cracks are extended until the core of the continuously cast products. These defects are caused by the lower value of the Mn / S ratio, or simply, by the greatest sulphur content of the steel chemical composition. In figure 3 is presented one forms of the internal longitudinal cracks, appeared in the central zone of these products.

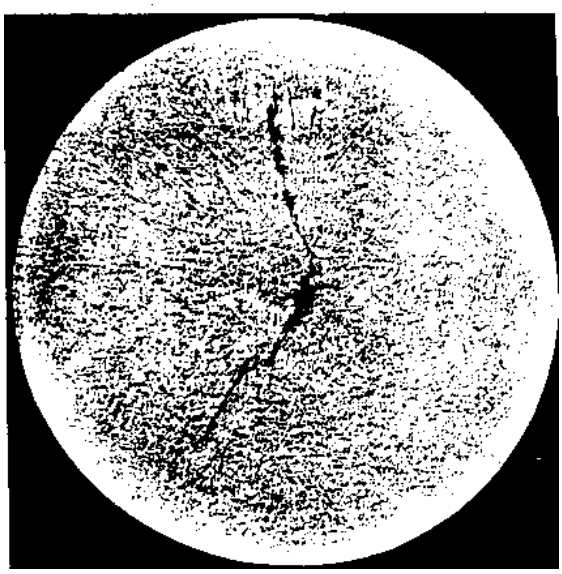


FIGURE 3.
INTERNAL LONGITUDINAL CRACKS
IN THE CENTRAL ZONE
OF THE CONTINUOUSLY CAST
SEMI-FINISHED PRODUCTS

The non-metallic inclusions in the continuously cast semi-finished products, in main have an endogene nature, and are represented by the oxides, silicates, nitrides, but can be an exogene nature, provides from the casting powders or from the refractory lining of the ladle. Also, these forms of defects can be caused by the distributor or from the immersion tubes.

The exogene types non-metallic inclusions have a spherical form and uneven distribution. This defect form is presented in figure 4. These defects appear due to the casting powders drawing, because in the crystalliser exists the excessive turbulence of the steel level.

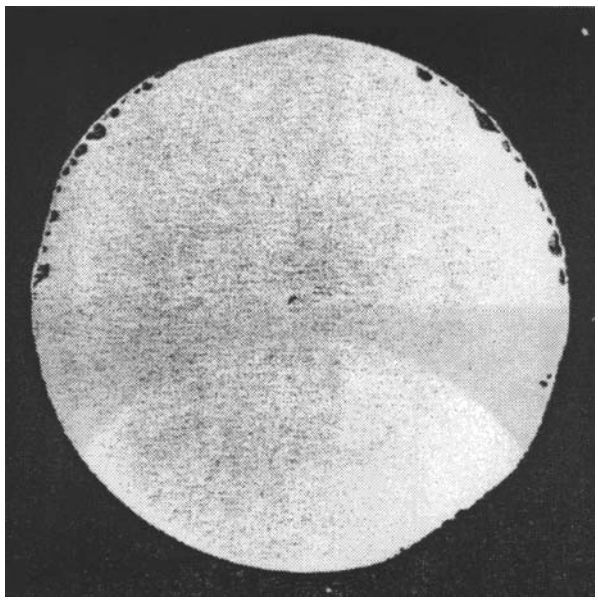


FIGURE 4.
THE EXOGENE TYPES
NON-METALLIC INCLUSIONS
AT THE CONTINUOUSLY CAST
SEMI-FINISHED PRODUCTS

The agglomerate type inclusions (presented in figure 5) are distributed bellow the "clouds" form and can be appear, in special cases, at the killed steels with aluminium. These inclusions are the alumina inclusions and grow together with the growth in the residual oxygen content in the steel chemical composition.

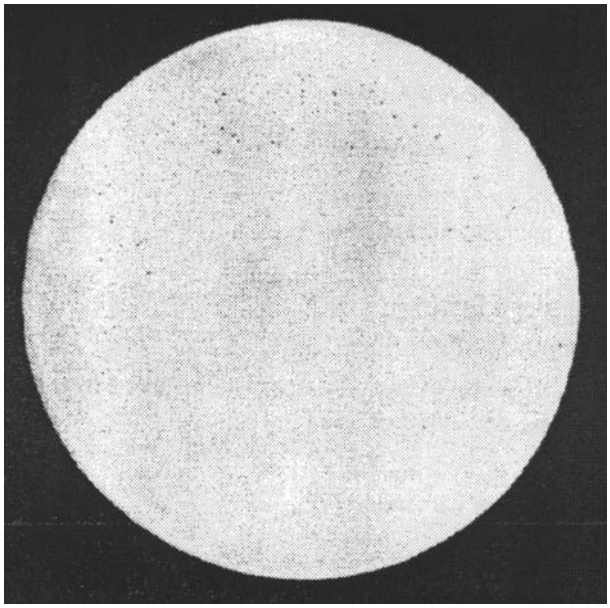


FIGURE 5.
THE AGGLOMERATE TYPE
INCLUSIONS
AT THE CONTINUOUSLY CAST
SEMI-FINISHED PRODUCTS

FIGURE 6.
THE TEMPERATURE STRESS CAUSED CRACKS AT THE CONTINUOUSLY CAST SEMI-FINISHED PRODUCTS (LONGITUDINAL SECTION)

The temperature stress caused cracks are fine, in the "star" form and can be visible on the entire surface of the cast products. The cause, which generated these defects consists in the local overquenching. Figure 6 presented one of these defects form.

3. CONCLUSIONS

For these researches results that followed conclusions:

- for the avoiding and attenuates these defects appearances in the continuously cast semi-finished products, one of the most important role it is constitutes by the casting parameters (casting speed, the steel castings temperature, the speed of cooling, the temperature and the flow capacity of the cooling water, and so on);
- also, the mitigation of the appearance of this defects can be realised through the correctly control and governing the elaboration's parameters (the Mn / S ratio, the barbotage and the supplementary treatments parameters, the vacuuming parameters, and so on).

The study showed that the main factors, which causes the defects appearance in the continuously cast products, and are the followed:

- the inherent defects, caused by the process parameters (the bigger casting temperature, the insufficient protection against the re-oxidation, and so on);
- the operational defects (the excessive fluctuation of the steel level in the crystalliser);
- defects, which appear because the wrong maintenance of the casting machine.

The high qualities semi-finished products, obtained through continuous casting, can be produced, if these three main factors are analyses and correlates in practical condition.

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