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RESEARCHES REGARDING THE INFLUENCE OF THE MOULDING - CASTING TECHNOLOGY OF THE ROLLING MILL CYLINDERS

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ABSTRACT
The paper introduces the technology of moulding-casting for the Adamit-type steel at the metallurgical company, and the experiments have been carried out in the same company.
The first step in obtaining some mill rolls corresponding from the point of view of the quality is strictly respecting their fabrication technology. It is shown that the moulding and casting technologies are determinated in obtaining the necessary hardness to assurance of the optimum behavior in exploitation.
Keywords: rolling mills, technology of moulding-casting, Adamite-type steel

1. INTRODUCTION
Using the Adamite hypereutectoid steel rolls for the hot rolling of the shaped sections has become greater and greater, because these can replace successfully the forged steel rolls or those cast from nodular graphite cast iron.
A peculiar importance regarding the roll exploitation behaviour has their fabrication technology. If the moulding-casting technology for the Adamite steel rolls is not complied, a series of defects (hard "spots", pores on the barrel roll surface, fissures in the spindle-barrel connection zone, etc.) can be recorded, leading to their rejection [1].
The fabrication technology of the hypereutectoid steel rolls treats the problems regarding the form execution, steel making, roll casting and **drawing-rapping**, cleaning and quality control, the gauge reduction and the heat treatment applied to the rolls [2].

2. ADAMITE STEEL MOULDING-CASTING ROLLS TECHNOLOGY ANALYSIS
2.1. Forms execution
The differences between the physical-mechanical proprieties of the crust, core and spindle of the rolling roll are provided not only by changes in the chemical composition, but also by using the forms with various heat conductivities in the form component parts [3,4]. Thus, the spindles are cast in dies made from the forming mix and the roll barrel in the mould.
In order to make the forms for obtaining the **spindles** there will be used forming mixes whose composition is the following [3,4,5]: recycled mix – 70…80%; Aghires sand – 10…25%; refractory clay – 5…10%; water – 50%.
The **mould** represents the die metallic part, destined to getting the working crust from the roll barrel and it is made of grey cast iron or of cast steels, having shaped or plain surface, according to their destination. The moulds having plain surfaces are for casting the rolls used at rolling the barrels and sections where the gauges are carried out by mechanical processing.
The die for obtaining the **casting funnel** is shown in Figure 1.

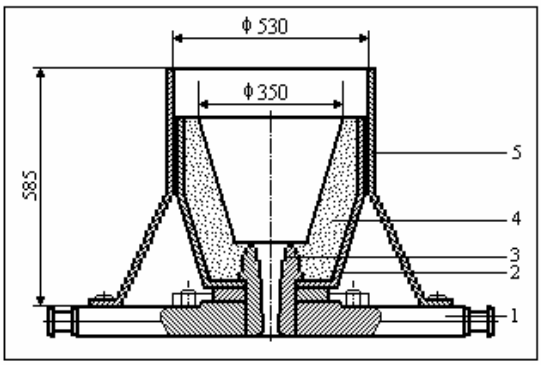

Figure 1. Casting funnel: 1- forming plate; 2 - metallic jacket; 3 - tapping part; 4 - forming mix; 5 - support frame.

The components of a form assembled for casting are presented in Figure 2.

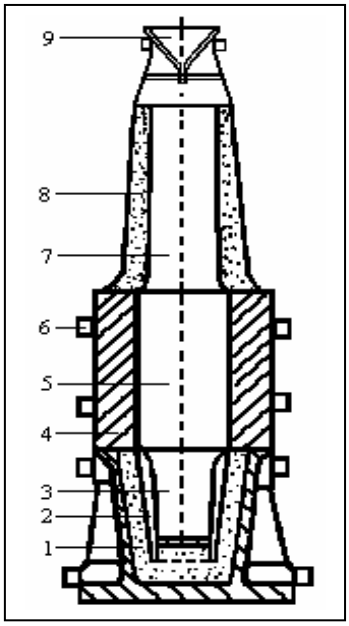

Figure 2. The mould for directly casting the rolling rolls: 1- low spindle die; 2 – low spindle mould; 3 – low spindle; 4 – metallic die (mould); 5 – roll barrel; 6 – lifting eyes; 7 – high spindle; 8 – high spindle die; 9 – casting funnel

2.2. Painting and drying

The forms for the low spindle, the high spindle (respectively the mould part of the high spindle) and the casting funnel are painted in crude condition with refractory paint based on graphite, with the following composition [3.5]: 20 kg graphite; 10 kg basic emulsion; 5…8 l water (the thickness of the paint layer is 0.3÷0.5mm). After drying, the forms are painted hot at a temperature of 120 ÷ 150^{0}C with another layer of paint. The operation is repeated until a 0.2÷0.4 mm layer is obtained. After drying the first layer the operation is repeated until a paint layer of 1.2÷1.5 mm is obtained. The paint for the barrel has the following composition [98]: amorphous graphite - 50…53%; flaky graphite - 30%; molyphtane - 3%; dextrine (roasted starch) - 3%; apă-10…15%, until a density of ρ = 1,2…1,3g/cm^3 is obtained.

The mould drying is made according to the diagram presented in Figure 3 and for drying the mould for spindles and funnel it is used the diagram shown in Figure 4. In the diagrams there are used the following notes: *Wi – heating speed, ^{0}C/h; Wr – cooling speed, ^{0}C/h; te – temperature of soaking, ^{0}C; τ_i – heating period, h; τ_e – thermal retardation, h; τ_r – cooling time, h. Wr_2 – open air cooling;*

After finishing the drying cycle w_{r2}, the funnel is taken out of the oven, it is repainted and it is protected by flame for providing the technological assembly temperature.

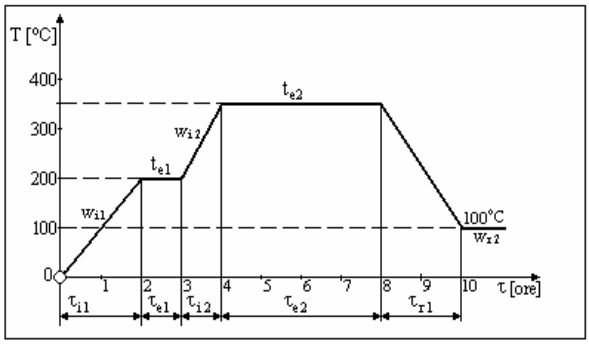

Figura 3: Diagram of drying the mould:
$Wi_1 = 100^0C/h$; $Wi_2 = 100^0C/h$;
Wr_2 – open air cooling;
$te_1 = 200^0C/h$; $te_2 = 300^0C/h$;
$\tau_{i1} = 2h$; $\tau_{i2} = 1h$;
$\tau_{e1} = 1h$; $\tau_{e2} = 4h$;
$\tau_{r2} = 2h$.

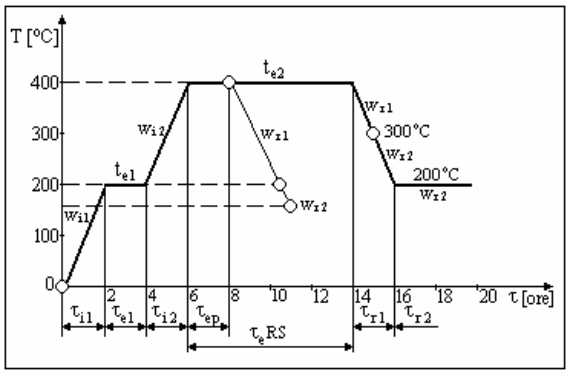

Figure 4: Diagram of drying the forms and the funnel:
$Wi_1 = 100^0C/h$;$Wi_2 = 100^0C/h$;
$Wr_1 = 100^0C/h$; Wr_2 – open air cooling;
$te_1 = 200^0C/h$; $te_2 = 400^0C/h$;
$\tau_{i1} = 2h$; $\tau_{i2} = 2h$;
$\tau_{e1} = 2h$; $\tau_{ep} = 2h$;
$\tau_{eRS} = 8h$; $\tau_{ri} = 8h$

After finishing the drying cycle, the frames and the mould are taken out of the oven at 200^0C for remedies and repaintings, then they are introduced in the casting pits and are soaking at a temperature of 300^0C in order to provide the technological assembly temperature.

2.3. Casting and rapping the mill rolls

The roll casting is made directly, bringing the casting ladle over the casting funnel (Figure 5,a).

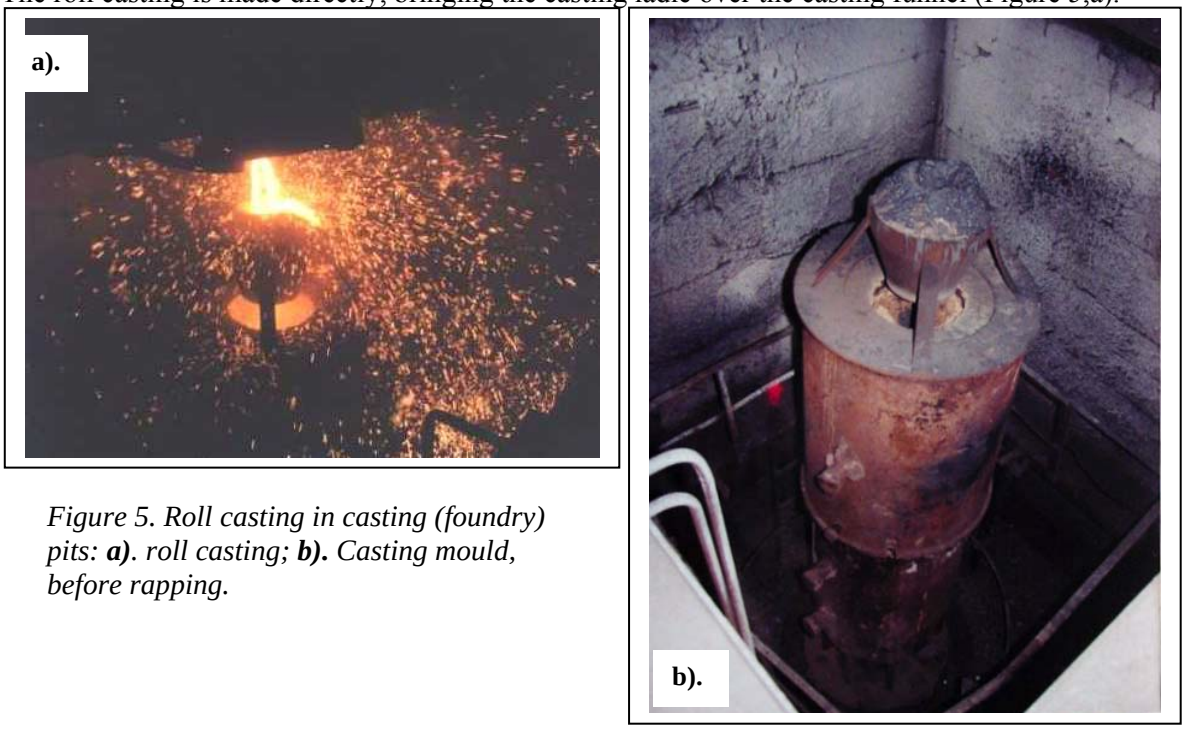

*Figure 5. Roll casting in casting (foundry) pits: **a)**. roll casting; **b).** Casting mould, before rapping.*

Generally speaking, from a made charge there are cast four rolls (in four different casting pits), one after the other, the casting beginning with the roll having the largest diameter. The steel temperature at the beginning of the casting will be compulsory within 1420…1430^{o}C [5,6].
After finishing the casting the casting funnel is removed and the casting pit is covered in order to carry out a controlled cooling. The cast rolls are left in the pit to be cooled up to a temperature of maximum 80^{0}C on the barrel (the cooling period is about 72…78 hours) [5]. The shape of a cast roll in the pit before rapping is shown in Figure 5, b. The roll rapping is made in an order reverse to mounting of the forming frames and after rapping the rolls will be stored in a place kept from cold air currents, shocks and humidity. Figure 6 presents a set of four rolls cast from a heat at a metallurgical enterprise.

Figure 6. Rough-cast rolls for rolling.

3. CONCLUSIONS

The great variety of rolled products and the various work conditions determined to create an extreme large range of rolls. Besides the technical work and service conditions when choosing the rolls it should be taken into account especially the roll durability in service (wear and break strength). In order to obtain a maximum durability of the rolls it is necessary to establish a best correlation between the forming-casting technology and the service life conditions. Strictly obeying the forming-casting technology implies the following:

- Obeying the forming mix recipe and the die drying diagrams;
- The casting temperature shall be within 1420..1430^{0}C in order to avoid emerging the structure defects;
- The roll cooling is made in the pit up to the temperature of maximum 80^{0}C on the barrel and the cooling period is about 72…78 hours.

4. REFERENCES

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