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IMPROVING THE QUALITY OF CASTINGS BY OPTIMIZATION OF THE MOULDING-CASTING TECHNOLOGY

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Abstract: One of the main stage of obtainig of castings is the pouring of the liquid alloy. Durring this process may occur a series of defects in the matherial structure or the configuration of the casting. According to the specialty literature the casting defects represent any deviation from the shape, dimensions, weight, the external aspect, macro and/or micro-structure and mechanical or chemical properties of the piece required by standards, norms or contractual technical conditions. The occurrence of these defects in castings can lead to increased the percentage registered with direct effects on company costs. For castings to obtain without defects Romanian foundries places great importances on the liquid alloy elaborating technology, moulding-cating technology and the materials used to achievement the moulds and cores. Thus, the development of the foundry department leads to a decrease in operations performed in the cutting processing department (by increasing the casting precision the allowances are smaller and share of the further processing will decrease). The paper presents the possibility of improving the quality of grey cast iron castings by moulding-casting technology optimization in order to decrease the percentage of rejects registered in industrial practice. Thus, the casting Supporting Roll-type is analyzed because it was registered a high percentage of defects (adherences, burrs and misalignment of the castings). These types of defects that lead to rejection of castings could be eliminated by changing the moulding technology, respectively by changing the way location of the plan of separation of the pattern and the mould and application of technological measures for the use of two types of cores (a vertical central core for obtaining the hollow from inside the casting and a lateral cores for obtaining the external configuration of the casting). The optimization of the moulding-casting technology for castings analyzed lead to a decrease percentaje of rejects and decrease the company costs.
Keywords: grey cast iron, castings, quality, mould, core

INTRODUCTION

After the industrial revolution the problem of quality have imposed increasingly more. Besides the fact that the concept of quality is a characteristic that accompanies any product the concept of quality structure becomes more complex. Besides the basic characteristics of a product the quality issues begin to target some elements related to exploitation behavior of products: reliability, maintenance and availability.

Structurally the quality issues are targeting the following processes: research and design, production, sales, corrective and preventive maintenance activities, issues of internal and external logistics and quality issues the users of the manufactured products [1].

Depending on the alloy that is poured is necessary to take into account certain technological aspects related to mould and casting. Thus, [2,3]:

» The mould must:
  - withstand all the mechanical, thermal and chemical stresses to which is subject by the liquid alloy;
  - to reproduce as accurately (shape and size) both exterior and interior of the casting
» The casting:
  - must be appropriate to technical specifications;
  - must have commercial aspect;
  - must be appropriate in terms of quality;
  - must be advantageous in point of view price/quality ratio.

PRESENTATION THE TECHNOLOGY FOR OBTAINING THE CASTING (SUPPORTING ROLL TYPE)

In the industrial practice of the foundry the diversity of castings imposes the analysis of the technologies used so that the castings to results no defects. For this is analyzed the moulding-cating technology for the piece Supporting Roll. This casting is a component of the hoist gearing of an industrial furnace door. This cating was chosen for study because they registered a high percentage of defects of this type of castings (adherences, burrs, misalignment).

The piece Supporting Roll is poured of unalloyed grey cast iron with lamellar graphite EN-GJL-350 and the elaboration of the cast iron was made in normal conditions [2,4,5]. The moulding technology starts from the finished part drawing (figure 1) and includes two main stages: the manufacture of pattern and achievement of mould [3,6,7,8].

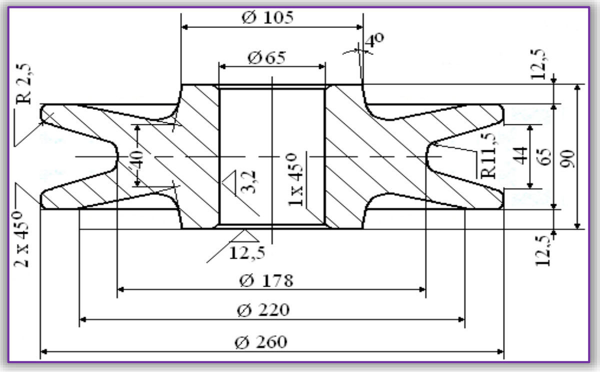

Figure 1. The finished part drawing (Supporting Roll)

For realization of the pattern it is necessary to establish the mould separation plan and pattern separation plan. Thus, for casting analyzed the symmetry plane is the same with sectioning plan of the pattern and also the same with the mould separation plan. The separation surface is plane and the castin position is horizontal. According to the technology used the sectioning plane of the pattern divides the pattern into two symmetrical parts (figure 2).

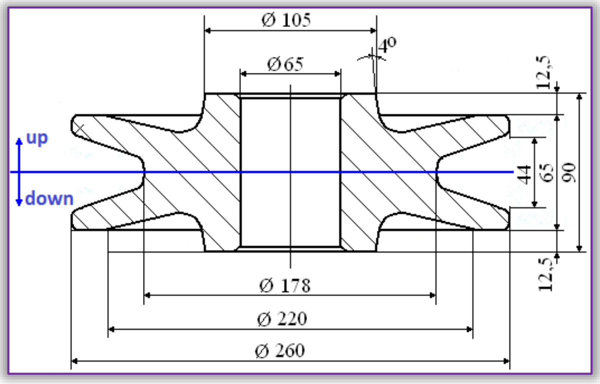

Figure 2. Choosing separation plan

To obtain the pattern dimensions is taken into account the contraction coefficient α. For the piece analyzed is chosen α = 1% [6,8]. After establishing the size of allowances of contraction, the constructive inclinations and the dimensions of the core marks are determined the configuration and the dimensions of the pattern. The pattern is made of wood and is presented in figure 3. This pattern is made up of two assembled halves (M1 şi M2).

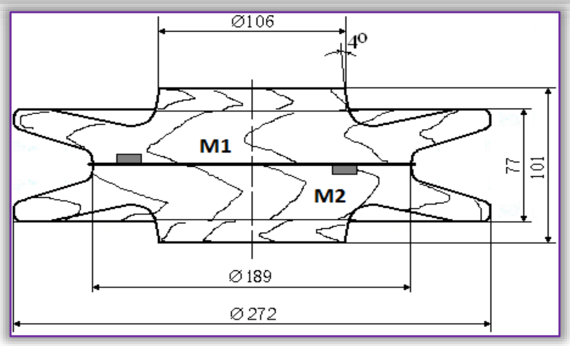

Figure 3. The wooden pattern

For removal the shrinkage cavity the moulding technology requires the use of a central riser (figure 4). On the technological drawing (figure 5) are presented the dimensions of the central core marks. Thus, the height of the upper mark is 106 mm and the heigh of the lower mark is 20 mm (figure 5).

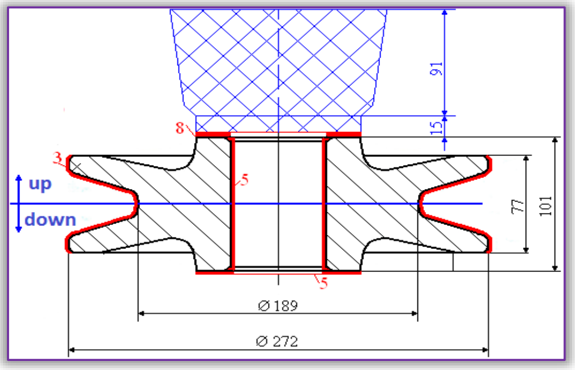

Figure 4. The location of the riser and the presentation of the allowances

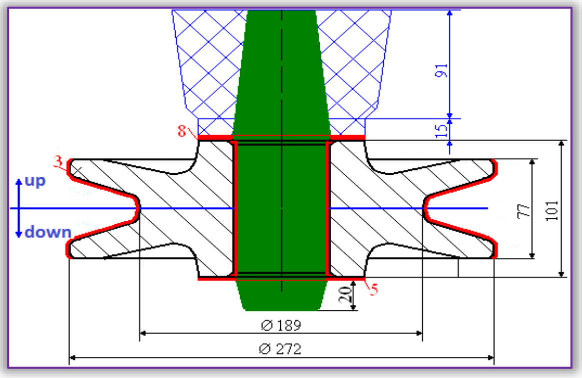

Figure 5. The dimensions of the vertical cylindrical core marks

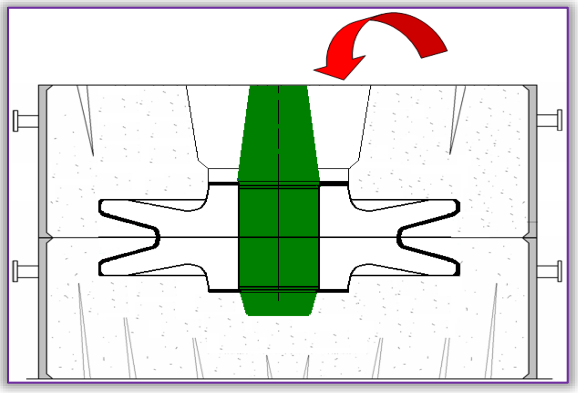

Figure 6. The mould assembled for casting

After making the wooden pattern and determining the location of the riser is achieved the mould parts and their assembly in order to casting the liquid alloy (figure 6).

OPTIMIZATION OF MOULDING – CASTING TECHNOLOGY OF THE CASTING STUDIED

The quality control carried out on a batch of castings *Supporting Roll* type shows that were registered mainly three types of defects: adherences, misalignments and burrs [2,11,12]. Removal these types of defects requires critical analysis of moulding-casting technology used and its optimization. Thus, for the removal of adherences is necessary to use the antiadherence paints and the use of the appropriate moulding sand [2,12,14].

Performed the analysis of actual moulding-casting technology for the casting *Supporting Roll* is noted that it is wrong taken on the problem of establishing the separation plane of both the pattern and mould. This is due to the fact that the location of the separation plane (for actual technology) lead to appearance of defects such as:

- Misalignment is a defect of the type F221 and occurs when the mould is submitted to a shearing action in a separation plane [13]. This defect is manifested by displacement a part of the casting in relation to other part that leads to deformation of outlines or sections of the casting (the halves of the casting are displaced relative to the longitudinal axis).
- Burr is a defect of the type A111 which appears as a surplus of mettalic material that adheres to casting in the plane of the separation surface [13].

To avoid occurrence of such defects is necessary to change the positioning of the separation plane (both the pattern and mould) and the optimal solution is considered as shown in figure 7 and the position of pouring is also horizontal.

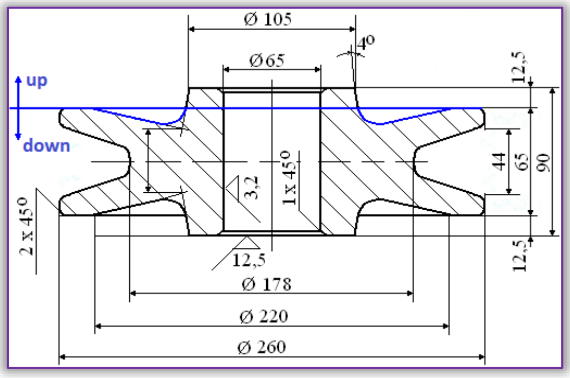

Figure 7. Sectioning of the patterns and the moulds

After establishing the separation plane (for pattern and mould) on the finished part drawing are added the allowances. Location of allowances is similar to current technology (as well as dimensioning the pattern).

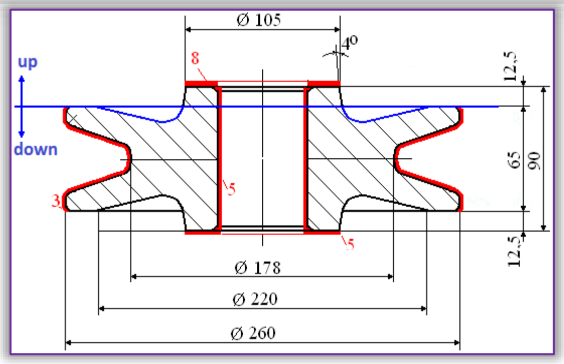

Figure 8. The presentation of the allowances

In the case of improved technology the pattern has the same dimensions, the gluing mode of components parts is the same but the pattern is no longer made of two symmetrical parts placed in two mould-parts. Thus, the pattern M1 (representing 2/3 of the pattern of the casting) will be located in the lower mould-part and the pattern M2 will be located in the upper mould-part (figure 9).

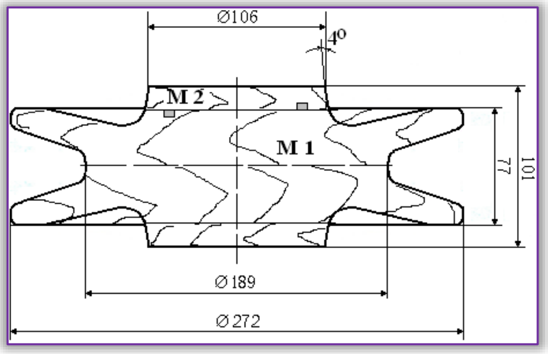

Figure 9. The wooden pattern in the case of improved technology

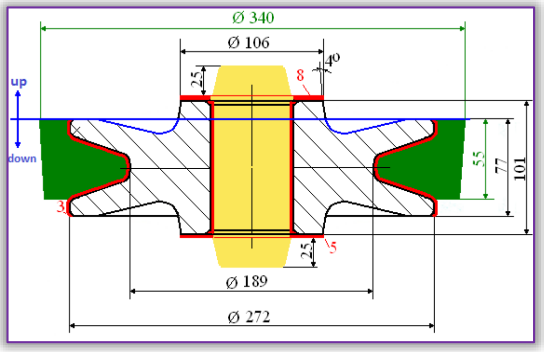

Figure10. Establishing the manner of location of cores

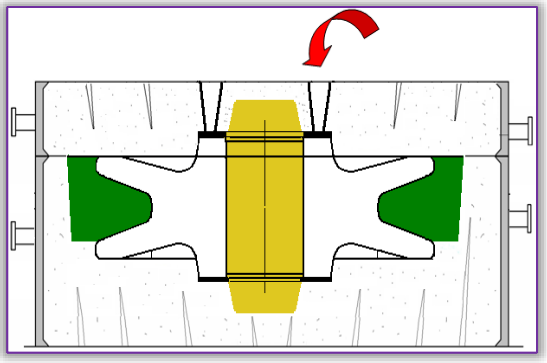
Figure11. The mould assembled for casting

For casting analyzed in technological point of view can choose the moulding technology with two cores (figure 10):
- a central core in order to obtain the hollow from inside the casting
- a lateral core in order to obtain the lateral configuration of the casting.

CONCLUSIONS

Generally, the quality of a product represents all the characteristics of the product which expresses the degree to which it satisfies the social needs based on technical and economic parameters, aesthetics, the usefulness and efficiency in exploitation [11]. Thus, the founfries is intended to achieve at least two of the objectives of the quality assurance system (7 *Zero*) namely *zero defects* şi *zero rejects*. In accordance with these all defects are detected before delivery products on the market and also put special emphasis on the preventive side so after each stage of the production process should result components that meet all requirements [11].

Thus, after performing the critical analysis of moulding-casting technology for casting *Supporting Roll* (this piece is cast of grey cast iron with lamellar graphite) are required few changes of current technology in order to decrease the percentage of registered rejects in industrial practice:
» Changing the positioning of the separation plane prevents the occurrence of casting defects (burrs, misalignments) and lowering labor processing of casting for their removal with direct effect on the price of casting;
» The use of two types of cores for casting has beneficial effects on quality of the castings and on their cost price ;
» The adoption of these technological measures lead on the one hand to reducing of the central core dimensions (of the upper core mark) and therefore to manufacturing of a simple core box and secondly to improve the quality of casting on the concave side due to application of lateral core;
» Changing the central core dimensions respectively of an upper mark of the central core and removing from moulding-casting technology of the riser involves the changing the dimensions of the upper mould jacket (which is reduced by half).
» In conclusion, there is a considerable drop (by approx. 50%) of the moulding sand for upper mould-part.

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