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USING OF EXOTHERMIC INSERTS IN THE LARGE STEEL CASTINGS PRODUCTION OF A PARTICULARLY

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Abstract

Using a computer program, the process of forming shrinkage defects is simulated, in parallel with the use of exothermic inserts, in order to increase the efficiency of feeding the casting and reduce metal consumption on profits. At the same time, a reasonable choice of the design of profits is of great importance, as well as the calculation of their minimum permissible sizes used at the current production in the manufacture of the "Side Frame" casting of railway cars.

Keywords: Side frame, profit, defects, exothermic insert, modeling.

1. Introduction

The production of high-quality and highly responsible castings with low cost costs is the main task of foundries. In the manufacture of castings, regardless of the technology, the formation of the mold is one of the most common defects that significantly reduce the quality of the castings, which are defects of shrink origin. Global reasons for their formation may be errors in the design of technology, as well as disruption of production processes. During the study, several types of defects arose. The article deals only with defects with shrinkage origin. Shrinkage defects are usually

formed in thickened casting areas, which harden in the last place, and in fact this is a different degree of development of the same shrinkage defect.
The shape of the resulting shrinkage defects depends on the crystallization nature of the alloy in the casting, which in turn is determined by the temporal, thermal parameters of the casting formation process.
In order to compensate for such defects for the production of "Frame Side" castings, the traditional technology of production with several profits is used in foundries, which leads to the marriage of casting on gas shells and low yield.
The problem of increasing the competitiveness of equipment today is largely determined by the quality of production of large-sized cast blanks for their load-bearing systems. Many factors are involved in the process of forming the service properties of the casting. Each factor is important in its own way and affects the quality of the resulting casting. The main parts of freight cars obtained by steel casting methods are the "Side Frame" and the "Overpressure Beam" of the trolley, elements of the traction device. The "Side frame" of the trolley is subject to the greatest loads during operation - one of the main structural elements of the trolley frame 18-100 and serves to transfer the load on the trolley axles through the axle box.
In foundry, profit is used to ensure volume shrinkage. Profit is part of a runner system that serves to feed castings on time crystallization in order to prevent the formation of shrinkage shells. After the casting is formed, the profit is separated from it, as well as the entire runner system, and disposed of.
Since the increase in profit efficiency can be classified into the following groups:
- Increasing the efficiency of the geometric shape of profits;
- Use of atmospheric and superatmospheric pressure profits;
- Heat insulation of profits;
- Exothermic heating of profits.

2. Methods

In view of the above, the use of telescopic exothermic inserts is recommended to improve the efficiency of feed profits, as a result of which profit can be reduced to 50%. At the same time, it was also decided to assess the economic profitability when using telescopic exothermic inserts (Figure 1) [8].

Figure 1. General view of exothermic inserts with shaped rod

Studies using exothermic inserts in the production of "Side Frame" were carried out in two stages.

At the first stage, the casting process was modeled using the ProCAST program, which consisted in filling the mold with liquid metal and solidifying it (Figure 2).

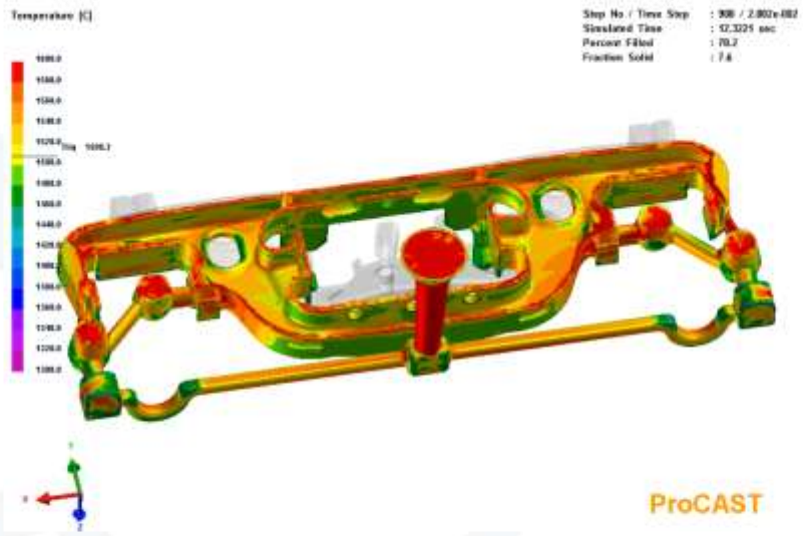

Figure 2. Modeling of casting process "Side frame"

After filling the mold and cooling the castings, they were cut into two parts along the located place of formation of the shells found during the simulation. After that, machining was carried out with layer-by-layer milling, both casting and profit. In practice, it was confirmed that the choice of the exothermic insert was determined correctly, as evidenced by the dense metal structure at the shrinkage sink sites in the casting (Figure 3) and the solidification of the profit with theoretically correct formation of the shrinkage direction (Figure 4).

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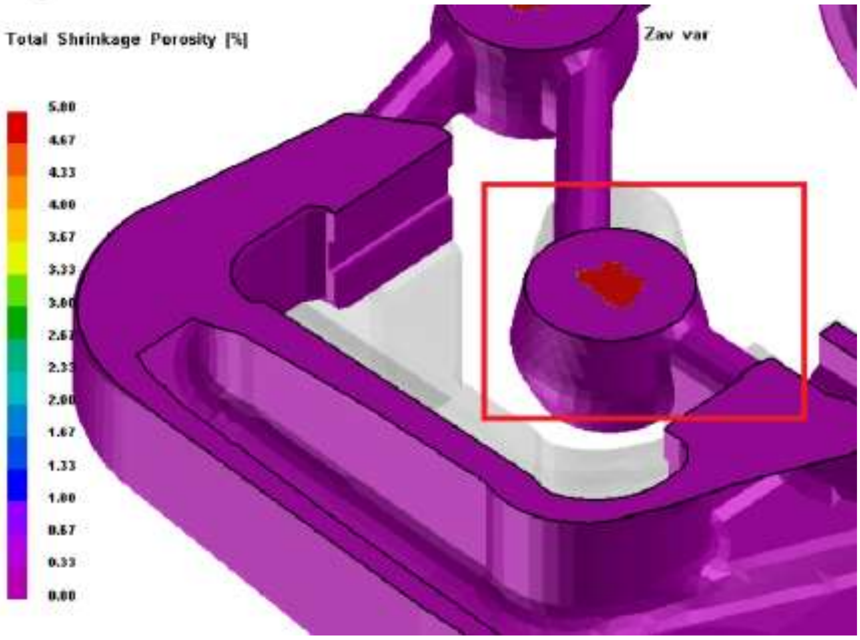

Figure 3. Formation of shrinkage shells in casting

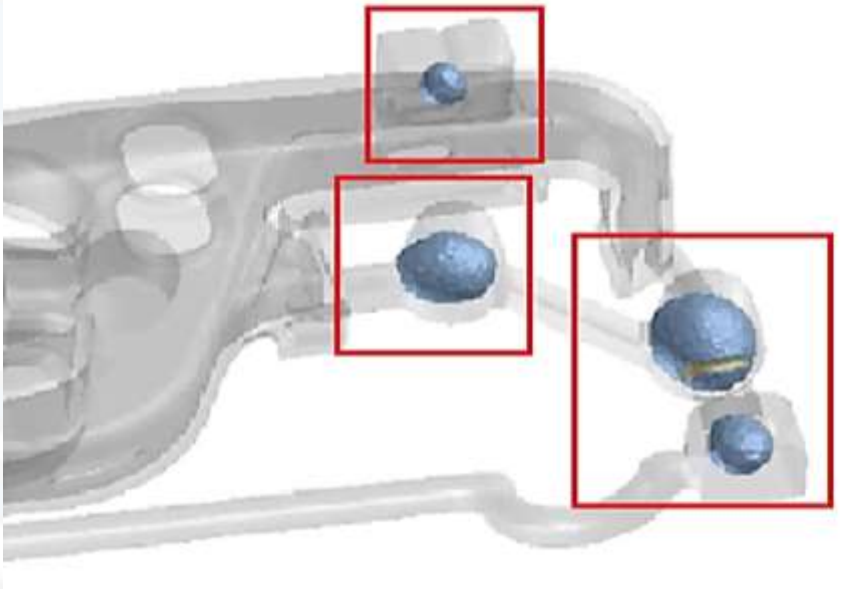

Figure 4. Profit solidification

As already noted, the use of exothermic inserts on the one hand allows increasing the productivity of steel casting production, due to a decrease in profits, increasing the yield of suitable casting, increasing casting qualities and reducing scrap. Thus, it is possible to easily compare the cost of the exothermic insert based on the weight of the metal saved to the cost of the molten steel. Based on this assumption, the effectiveness of exothermic inserts can be estimated.

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3. Results and Discussion

In order to determine the productivity of exothermic inserts in exchange for ordinary profit, an economic calculation was made by comparing the technology of casting with profits and exothermic inserts (Table 1).

Table 1 - Metal balance, to the weight of metal breaker.

Balance Sheet Indicator	According to the current technology			Using the Inserts		
	%	kg	t	%	kg	t
Yield of suitable casting	55,6	3430	8918,0	60,9	3430	8918,0
Runners and Profits	33,7	2080	5408,0	28,4	1600	4160,0
Inevitable losses	2,6	160	416,0	2,6	144	374,4
Plums, scraps	2,8	170	442,0	2,8	155	403,0
Waste	2,3	140	364,0	2,3	130	338,0
Irretrievable losses	3,1	190	494,0	3,1	175	455,0
Total	100	6170	16042,0	100,0	5634	14648,4

Then made an annual calculation of financial productivity from the use of exothermic inserts in the production of the Side Frame casting:
Annual Programme – 2 600 pieces
Pure casting mass – 490 kg
Mass of runner system – 260 kg
Mass of runner system using exothermic inserts – 200 kg
Specific rate of electric power consumption per 1 ton of annual casting – 2 160 kWt*h
Including furnace – 3 300 kWt*h
Cost 1 kWt*h – 450 sum
Cost of the 1st exothermic insert – 205 463 sum
Number of exothermic inserts per casting – 4 pieces
The cost of expenses is at 1 ton of release of castings – 7 805 625 sum.

The financial performance results are shown in Table 2.

Table 2 - Total Cost of the Annual Casting Program

Expenses	According to the current technology, billion sum	Using Exothermic Inserts, billion sum
Basic Material Costs for Annual Casting Program	125,218	114,340
Energy (furnace) costs per annual program	39,704	36,255
Cost of Profit Trimming	3,150	2,423
Exothermic inserts flow rate	0	2,137
Total	168,072	155,155

The annual economic effect of exothermic inserts was 12.917 billion sum.

4. Conclusion

On the basis of complex semi-industrial research, a rational casting technology was developed and mastered using exothermic inserts in the production of large steel castings of a particularly responsible purpose.

As the experiments carried out showed, when replacing the usual profit for exothermic inserts, the labor intensity for cutting and exposing the places of installation of profits decreased, the metal consumption of the mold and material costs for charge materials decreased by 8.7% and 7.7%, respectively. Application of the proposed technology made it possible to increase yield of suitable casting by 7%.

The work was carried out in agreement with the foundry (Tashkent, Uzbekistan). The results of the study are the basis of the changed technology for the production of casting "Side Frame".

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