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RESEARCH OF THE CAUSES OF CRACK FORMATION IN ONE OF THE HALVES OF THE GLASS FORM AFTER ITS FINAL

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Abstract
The aim of the work is to find the causes of crack formation in half of the manufactured glass mold. The structure of the alloy makes it possible to draw conclusions about the causes and introduce recommendations for avoiding the occurrence of such defects.

Keywords: Glass mold, chill, microcrack, gating system.

Introduction
The operation of glass mold parts is carried out in the cyclic mode "molten glass - air" according to the principle of opening-closing with an interval of 0.3 ... 2.0 s per operation, depending on the volume and requirements for the wall thickness of the glass product. During one cycle, the glass mold is filled with molten glass (with a temperature of 950-1200 ° C), the glass product is blown, the metal mold opens to remove the glass container and closes to receive a new portion of the molten glass.

With this principle of operation of the part, when under the conditions of cyclic changes in temperatures and media with different chemical composition and state of aggregation, physicochemical processes occur in the boundary layer of the contacting surfaces, structural changes occur in the body of the product and, as a result, the integrity of the working surface of the glass mold is violated, leading to to its premature removal from the production line. The purpose of this work, in accordance with the request of the enterprise, was: Determining the causes of crack formation in the final half of the glass mold fig. 1. in order to exclude similar defects in the future. The manufacturability of the design of a cast part made of low-alloy cast iron according to the drawing Vn-28–330 was assessed: – The casting has overall dimensions of 341 × 164.2 × 107.5 mm; – Casting thickness variable from 75 to 42 mm; – Allowance for machining of all surfaces of the casting is provided, which is 6 mm. The part as a whole is manufacturable for manufacturing from low-alloy cast iron by casting into a sand-clay mold. It is not possible to analyze the gating-feeding system used, since the molding technology, material and thickness of the cooler used to cool the internal cavity of the casting, as well as the design of the gating system and sections of its elements (riser, slag trap, feeders) were not presented by the enterprise. An important element of the technology in the manufacture of a casting is the temperature of the cast iron melt in the process of spheroidizing modification (for cast iron with fermicular graphite) and the temperature of pouring the cast iron into a mold. After pouring, the castings are cooled for 20-30 minutes. in the form, and then they are knocked out. Further, the castings are cleaned with subsequent visual control for their suitability. No defects were found at this stage. To remove the chill, especially the part of the casting that was formed by the refrigerator, the castings are subjected to heat treatment according to the following regime:

– Heating to a temperature of 940 °C for 5–6 hours;
– Exposure at a temperature of 940 °C for 4–6 hours;
– Cooling together with the furnace to a temperature of 600–650 °C;
– Cooling together with the oven with the door open to a temperature of 300–350 °C;
– Further cooling in air outside the furnace to the shop temperature.

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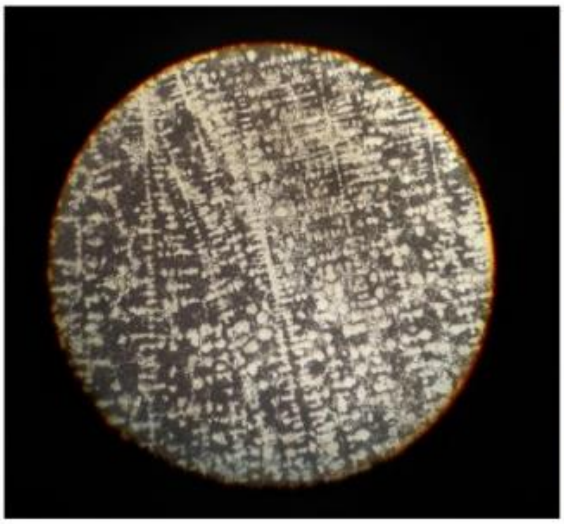

Figure 1. The structure of cast iron x100, pickling 4% solution of HNO_3 in alcohol

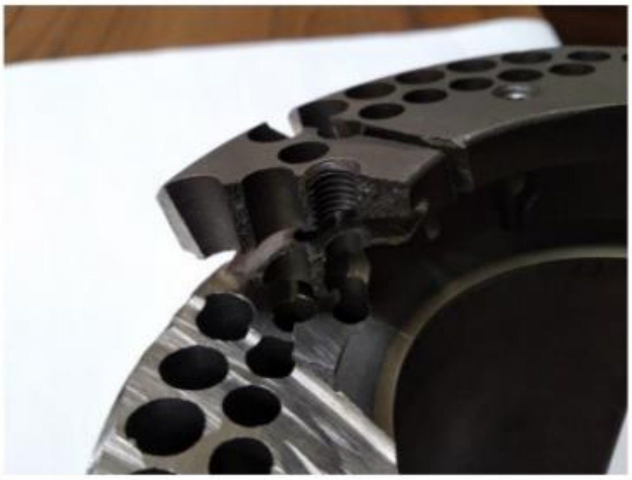

Figure 2. Crack and fracture

Figure 3. Fracture of the oxidized surface

Conclusions from the Results

• A microcrack in the glass mold formed in the crystallization interval. The reason for it could be the high temperature of pouring cast iron into the mold, as well as the tendency of cast iron to form a chill;
• The need to adjust the chemical composition of cast iron;
• The thicknesses of the cooler and the refractory coating, the surfaces in contact with the liquid metal, which are important here, must be adjusted;
• The presence of undissolved cementite inclusions in the structure indicates the need to increase the temperature and holding time of graphitizing annealing to exclude the presence of cementite in the cast iron structure;
• Introduce into the technology of making pig iron the control of each heat for chilling by a wedge-shaped sample.

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