ENHANCING SURFACE ROUGHNESS OF CASTINGS WHEN SAND-RESIN MOLD CASTING

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In this connection, studies aimed at improving the obtaining process of high-quality castings of mining equipment are relevant. At the same time there is a need for studying physical and mechanical relationship of mixes in which a resin from various factors is bonding (rate and time of thermal impact for mixture, rate of the enclosed load of mix in the course of forming, etc.).

In particular, there is reasonability of increasing the mixture pressure in the manufacturing process of a mold [1-3].

Keywords: castings, surface, roughness, mixture, microstructure

INTRODUCTION

Obtaining process of mining equipment castings (castings of combines, conveyors parts) in sand-resin molds does not quite meets current requirements. Casting in sand-clay molds (S) is characterized by low values of yield ratio owing to different types of defect: burning, shrinkholes, gas porosity, hot and cold cracks, blockages and other defects (Figure 1). In addition, casting in sand-clay molds does not always provide castings with the required level of mechanical properties.

EXPERIMENTAL PART

Equipment and tools

One of the important tasks in foundry production of mechanical engineering is increasing surface roughness of castings. In particular, obtaining castings of mining equipment with increased surface roughness.

Increasing roughness of mining equipment castings reduces specific amount of metal and size of allowances for machining [2]. Experimental studies to determine optimum casting manufacturing technique of part “Link” of mining conveyor by shell mold casting were carried out at Parkhomenko Karaganda Machine Building Plant LLP.

Experimental installation for the manufacture of shell molds made of sand-resin mixture (Figure 2) based on a forming semiautomatic device of model 51713 was developed for carrying out testing. It consists of the bunker in which sand-resin mixture is filled up, furnaces, plates for the additional application of loading, a table on which the electro-heated model plate with model is established.

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Experiment show (Figure 4), the number of burning on castings can be reduced by the combined method (static pressure on mixture plus heating of sand-resin mixture).

In the sand-resin and sand-clay molds the liquid metal before surface skin occurs is able to penetrate deeper into the gaps between the grains due to insufficient degree of compaction. Compared to molds compacted by VSP process and compression process, wherein the intense forming process of a solid skin and mixture compaction process hampers the penetration of the liquid metal. Analysis of the experimental data shows that the amount of metal penetration depends on the casting wall thickness, the degree of compaction. For example, when used repressed operation casting shell molds, the number of burning in castings reaches 0.14 g/cm², whereas in the conventional filling without compaction mixture reaches 0.19 g/cm².

Analysis of the relative change in height of peaks on the mold surface showed that the increase of compaction causes improvement of surface roughness and molds, in turn, castings. Obtaining castings with a smooth surface can be achieved by using well-defined compaction modes. Roughness of castings was determined by roughness of molds.

As it can be seen (Figure 5), the dependence of the mold surface roughness on the casting surface roughness is linear and expressed by the dependence:

\[ R_{zf} R_{zc} = 20 - 25 \mu m. \]

The use of shell molds for the manufacture of mining equipment castings has significantly increased the roughness of the casting surface.
CONCLUSIONS

The experimental data results to study the dependence of the burn-mixture to the pressure shown in Table 1 and the diagram (Figure 6). As can be seen from the diagram, the applied load during the formation of the shell mold significantly affects the size of burning in its decline.

Pressure 0.18 ... 0.25 MPa, determined as the optimal for obtaining casting molds of “Link” can be regarded as very satisfactory and for the size of burning. As the pressure increases, the reducing rate of burn-on castings decreases.

Table 1 Impact of loading rate in the forming process of a shell on burning size of castings

<table>
<thead>
<tr>
<th>No.</th>
<th>Mixture pressure in the forming process / MPa</th>
<th>Burning size / g / cm²</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.1</td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.2</td>
<td>0.14</td>
<td>Mixture composition: sand 1K0315 - 70% + 1K02 - 30% , binder mixture ~ 5% .</td>
</tr>
<tr>
<td>4</td>
<td>0.3</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.4</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0.5</td>
<td>0.13</td>
<td></td>
</tr>
</tbody>
</table>

Thus, according to results of the experiments the following conclusions can be drawn:

- It is experimentally proved that the application of a load (1.8 ... 2.2 MPa) in the shell forming process significantly increases roughness of the mold surface, improves its mechanical properties, decreases the amount of burn-on castings (Figure 7).
- It is experimentally proved that increase in mixture pressure (on 0.03 ... 0.05 MPa) reduces roughness of shell molds, without reducing technologically necessary size of gas permeability.
- Using this mold manufacturing technique for mining equipment castings is economically reasonable as the percent of casting defect decreases, specific amount of metal of castings due to casting wall thickness reduction and improvement of surface roughness decreases. Obtained molds have the uniform density and thickness of a shell, and also accurately reproduce a model configuration.
- It is experimentally proved that the suggested mold obtaining method for mining equipment castings is quite applicable under industrial conditions.
- After carrying out the appropriate heat treatment (depending on operating conditions of casting and...
its appointment) obtaining of the following microstructures of castings from steel 45 is provided: Figures 8, 9, 10.

REFERENCES


Note: The responsible for England language is Nataliya Drag, Karaganda Kazakhstan