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The stress of machine parts for pressure die casting and dies that are in contact with liquid metal influencing their service life

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Abstract

Stress of material surface at die, pressing sleeve and piston in pressure die casting process from liquid alloys is analysed. That is heat fatigue and heat and chemical effect of liquid alloys. The measures for service life of mentioned parts are choose of material, lubricants and using equipment for control of die temperature.

Keywords: Pressing sleeve; Piston; Die casting process: Heat fatigue; Service life; Die temperature.

1. Introduction

At hot and cold pressure die casting the effect of molten zinc respectively aluminium alloy on the material of pressing sleeve, piston and die shows. It is a hot and chemical effect but also an effect of thermic fatigue.

It is possible to analyse in the first order at hot pressure die casting the effect of zinc molten liquid alloy on pressing piston usually made from grey iron provided with steel rings according to figure 1.

It is one of most stressed parts of the pressing mechanism that are in contact with zinc molten alloy.

2. Description of the approach

Interaction process of molten zinc alloy with the injection piston is analysed from the standpoint of factors influencing its durability. As a starting point for theoretical analysis with regard to great complexity of the system grey iron – zinc melting is used analysis including cycling of pressure die casting process and going out from judging of various factors that are of use.

At the grey iron the range graphite-matrix has the highest concentration of defects and internal energy with regard on different structures. The molten zinc alloy in sense of internal energy decreasing causes dissolving primarily in this area according to the arrowheads 1 in the figure 2.

Besides, further there are two phases pearlite and ferrite in the matrix. The range of these two phases is the further example of defects and higher internal energy. With regard on decomposing the phases and their smaller difference the concentration of defects is smaller than in the last case.

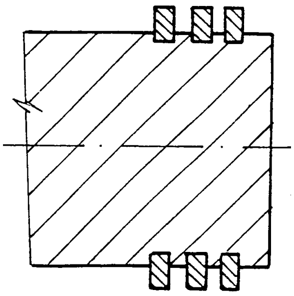

Fig. 1. The injection piston of grey iron with steel rings

The internal energy of the area is smaller, too and the zinc melting dissolves this area secondary according to the arrowheads 2 in the figure 2.

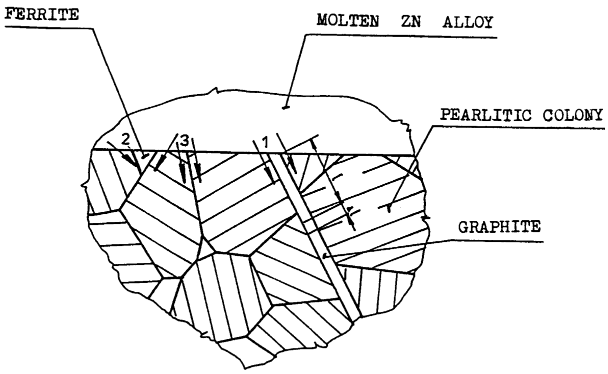

Fig. 2. The graphite-matrix of the grey iron

There is certain uncoherentness on the bounds of pearlitic colonies, too. The concentration of defects is the smallest with regard on similarity of neighbouring phases.

The molten zinc alloy dissolves these boundaries marked with the arrowheads 3 in the figure 2 in the third series.

3. Results

Dissolving the zinc alloy is cyclic and works always during the i-th casting cycle-during the injection that the front of the zinc alloy advances the selection 1 according to the figure 2. The whole length of the zinc alloy advance after the i-th cycle

$$\ell = i \cdot \Delta\ell \quad [\mathrm{m}] \qquad (1)$$

where is: i – number of casting cycles,

$\Delta\ell$ – the length of the advance effecting front of the zinc alloy at one casting cycle (m),

ℓ – the length of the advance-effecting front of the zinc alloy after the i-th casting cycle (m).

Through the advance according to the arrowheads 1, 2, 3 (fig. 2) the certain areas of the plunger are bordered and dissolved towards the inside gradually. By merging the more attacked areas the new interface of the molten alloy and the plunger is made. The dissolving advance runs according to the competent phase diagrams. By the change of the original correct geometry the plunger rings are attacked least. The durability of this plunger is higher than the one without ring.

The detail of the primarily effected interface graphite-pearlite is on the figure 3.

Fig. 3. The detail of the primarily effected interface graphite-pearlite

The alloy attacks the interface of pearlitic colonies fast simultaneously or with smaller intensity. Then the pearlitic colonies, graphite and pearlite are swum out into the molten alloy where they are dissolved gradually. The effect of aluminium molten alloy at cold pressure die casting is analogously.

4. Conclusions

Thermic and metallurgic activity at repeating cycles of pressure die casting projects into durability of the die and individual parts that are in contact with molten alloy. According [1] the durability of the die sinks linearly in semilogaritmic dependence number of cycles – temperature of molten alloy (fig. 4). It is necessary to lay stress on that durability of the part also depends on the material of the part e.g. the durability of grey iron is substantially shorter than the durability of steel at analogous stress (fig. 5).

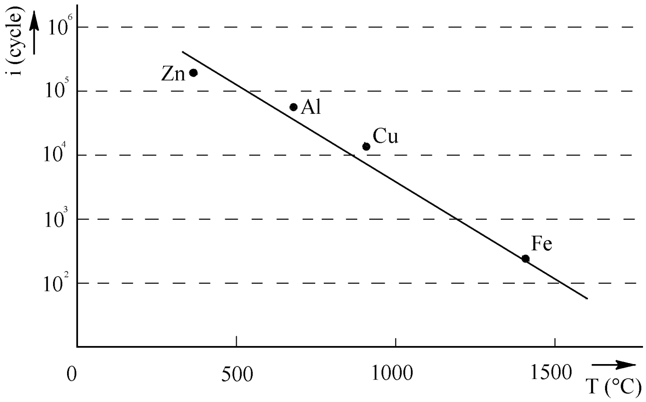

Fig. 4. The durability of the die

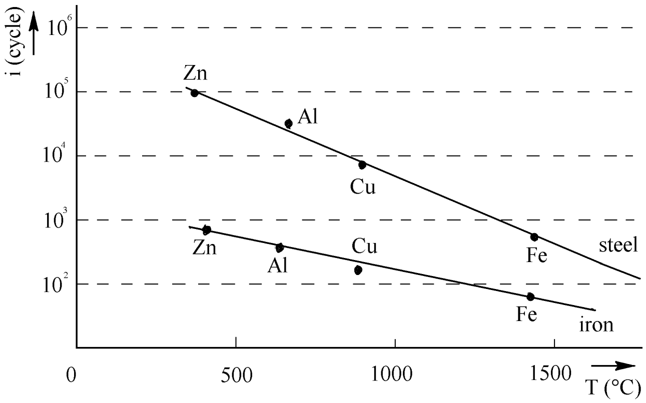

Fig. 5. Confrontation of the durability components from steel and iron

For better clearing of examinated problem it is necessary the further search e.g. with the methods of electron microscopy.

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