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Increase of foundry properties of secondary silumins

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Abstract

The work is devoted to increase of foundry properties of secondary silumins. The influence of a chip contents in charge, quantities of iron in an alloy and the modifier used for processing of liquid metal, on fluidity, linear shrinkage, crack resistance and a porosity number of silumin AlSi9Cu2 is considered.

Keywords: Secondary silumins, Foundry properties, Modifying

1. Statement of the research problem

Foundry properties concern to number of the important technical characteristics determining castings' quality, their mechanical and service properties. Silumins have as a whole high enough foundry properties: good fluidity and crack resistance, low linear and volumetric shrinkage. Use of secondary raw material, first of all shavings, by manufacture silumins has an adverse effect on their foundry and mechanical properties, first of all, owing to pollution charge by the iron, cutting fluid, plastics and other undesirable impurity. It demands carrying out of additional actions on refining of liquid metal.

It is necessary to note, that in the literature in an insufficient measure the influence of quality initial charge on foundry properties silumins is clarified. On this question there are only separate, frequently inconsistent data. So in work [1], influence of the iron and molybdenum contents on fluidity, density, shrinkage and porosity of alloy AlSi12Cu2 has been investigated. Authors have shown, that with increase in the iron contents the fluidity L (rod test) at temperatures 680, 730, 880 °C has decreased approximately for 20 % (Fig. 1).

Introduction of molybdenum in quantity of 10 % from the iron content resulted at researched temperatures in increase fluidity on 5...10 %. Also it has been established, that with increase in the iron contents at 1 % the density raised, the volume shrinkage decreased for 12 %, the volume of the concentrated shrinkage cavity and a porosity number increased. At additional alloying by molybdenum the density has increased, and shrinkage characteristics appreciablly decreased. As a whole above mentioned results testify about negative influence of iron on foundry properties silumins. Does not cause doubt, that these parameters in the certain measure depend on quality charge, for example, from the maintenance in it of a chip, and also from rifining technology of liquid metal. In the given work an attempt to study influence of the specified factors on fluidity, porosity, crack resistance of secondary silumins is made.

2. Results of researches and their discussion

In our work [2] researches on increase of foundry properties of alloy AlSi12Cu2MnNi are carried out. The alloy has been melted in the induction furnace from a chip with the raised maintenance of the iron, polluted with cutting fluids. After

refining by a universal flux in furnaces, an alloy it was processed by the modifier [3] containing: 25-40 % of a carbonate of sodium $NaCO_3$, 12-20 % silicon carbide SiC, 3-8 % of the titanium, the rest - sulfur in 125 kg pouring ladles. The quantity of the modifier changed within the limits of 0...0,4 % from weight of liquid metal. Apparently from figure 2, with increase in an additive of the modifier from 0 up to 0,16 % porosity number decreases from 3...4 up to 0...1 in accordance with GOST 1583-93, and fluidity increased with 230 up to 420 mm. At the further increase in the modifier a porosity number and fluidity did not vary.

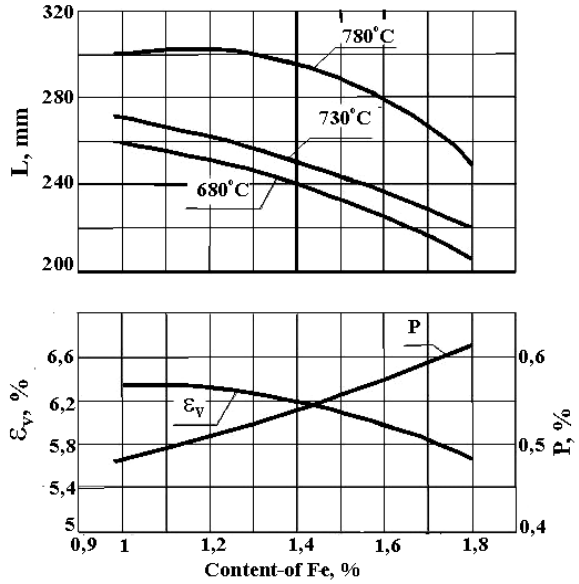

Fig. 1. Influence of iron content on fluidity L, volumetric shrinkage ε_V and porosity P of alloy AlSi12Cu2

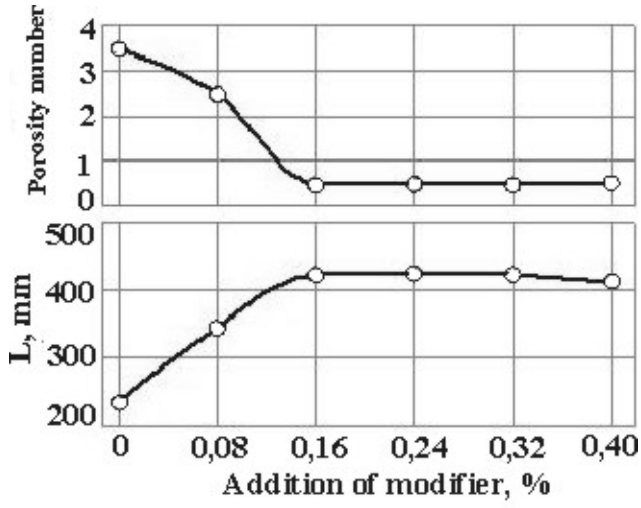

Fig. 2. Influence of the modifier on fluidity and a porosity number of alloy AlSi12Cu2MnNi

Positive influence of the modifier revealed by its ability to refining of liquid metal from oxides and products of disintegration of cutting fluids, and also by its ability to change of structural components of an alloy, first of all, intermetallic: S (Al_2CuMg), T (Al_6CuNi), W ($Al_xMg_5Si_4Cu_4$), Al_7Cu_2Fe, Al_3Fe, Al_5SiFe, Al_4Cu_2Fe, Al_8SiFe_2.

Complex researches on influence of a chip (from 1 up to 19 %), iron (from 0,6 up to 2,3 %) and the modifier (from 0,02 up to 0,22 %) on structure and foundry properties: fluidity (rod test ∅5), crack resistance (test of type a H-beam) and linear shrinkage (cylindrical test) of alloy AlSi9Cu2 have been carried out.

Researched factors rendered essential influence on the form and the sizes intermetallic phases, the parameter of their shape relation of the maximal size to minimal). The last changed in limits from 1,5 up to 45...50 (Fig. 3).

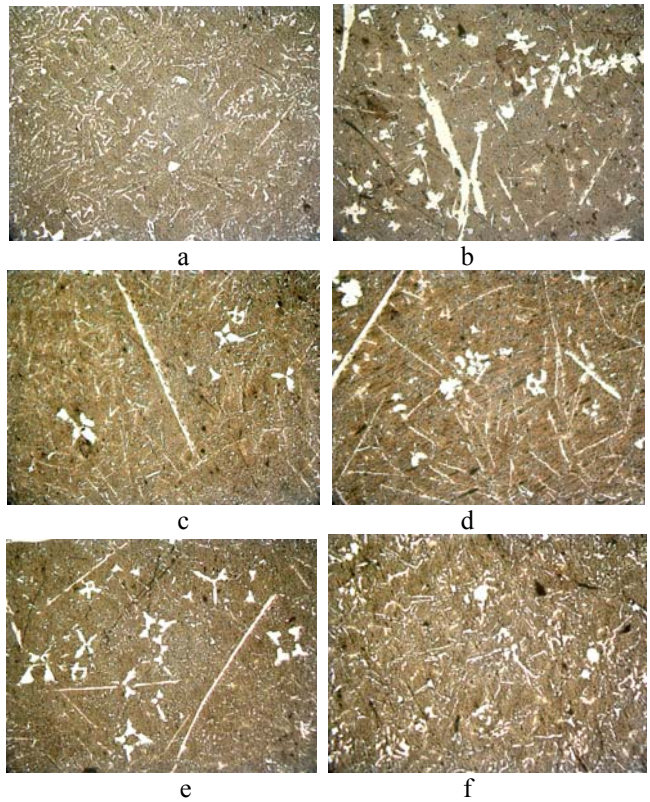

Fig. 3. Structures of alloy AlSi9Cu2: a - 1 % chip; b- 19 % chip; c - 1 % iron; d - 2 % iron; e - 0,06 % modifier; f - 0,18 % modifier.

From the submitted data it is visible, that the increase in the chip content in charge composition with 1 up to 19 % has resulted in sharp integration intermetallic phases without essential change of their shape parameter (Fig. 3 b). Fluidity L has decreased about 455 mm up to 365 mm, linear shrinkage ε_l has decreased with 1,2 up to 0,8%, probably, owing to increase of gas porosity with 1 up to 4 numbers on GOST 1583-93. Test on crack resistance had showed that the alloy with 1 % chip had no cracks, and in the alloy with 19 % chip the length of a crack l_c has length 40 mm (Fig. 4).

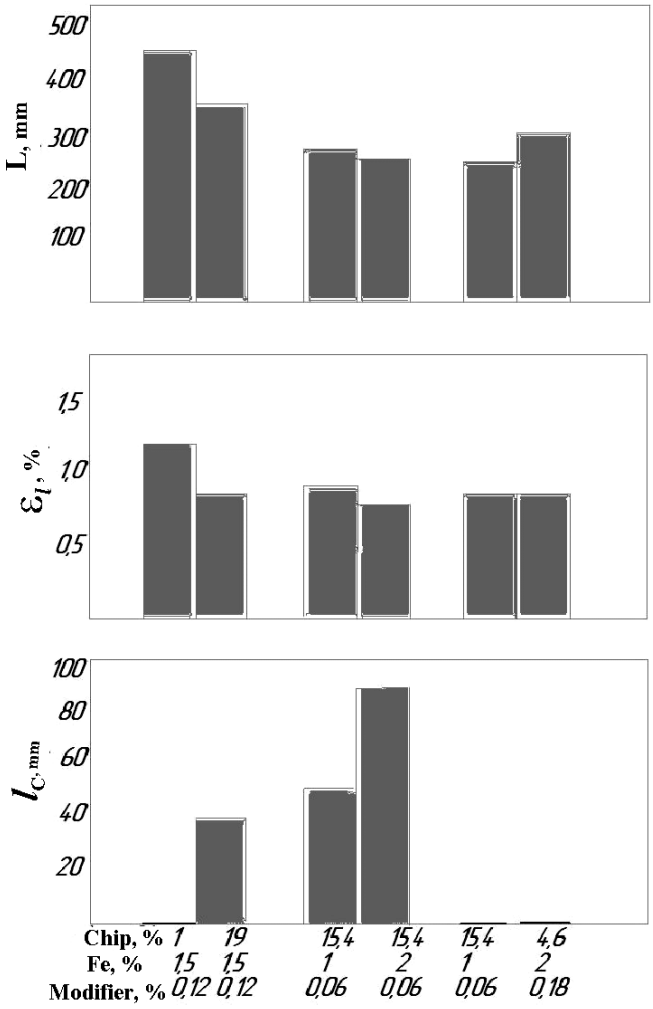

Fig. 4. Influence of the chip, iron and the modifier on foundry properties of alloy AlSi9Cu2

The increase in the iron content approximately in 2 times has resulted in appreciable integration intermetallic phases, and also in growth of their shape parameter (Fig. 3 c, d), fluidity and gas porosity with 2 up to 4 number, and in decrease of fluidity from 295 mm up to 265 mm, and linear shrinkage with 0,9 to 0,6 %. The length of a crack in test about 1 % iron has made 53 mm, and at 2 % iron there was a full destruction of test on perimeter of 92 mm.

In alloy AlSi9Cu2 processed of 0,06 % of the modifier intermetallic phases (Fig. 3 e) have been submitted by the extended inclusions with shape parameter of the near 20. With increase in the modifier up to 0,18 % there was a reduction of their sizes and shape parameter (Fig. 3 f) and increase of fluidity with 260 up to 320 mm. Linear shrinkage has remained practically constant - 0,8 %; cracks were not observed.

3. Conclusions

It is confirmed, that the increase in quantity of a chip in charge and iron in an alloy results in reception rough intermetallic inclusions and in decrease of foundry properties of secondary silumins. Refining of liquid metal by the modifier [3] allows to improve structure and foundry properties of aluminium alloys.

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