THE EFFECT OF DEVELOPED TECHNOLOGIES OF THERMAL CYCLIC TREATMENT ON STRENGTH PROPERTIES OF CASTING ALUMINUM ALLOYS SILUMINS

Karpenko K., student of SumDU
Govorun T., curator
Dunaeva M.M. – ELA

It is very important in technology to reduce consumption of the materials by replacing ferrous metals with lighter nonferrous metals, especially aluminum and its alloys. However, aluminum is more expensive than steel, but it reduces the weight by 60%.That's why aluminum parts are cheaper than the steel ones.

Aluminum and its alloys have a set of properties that provide them with significant advantages over other materials. They have low density, higher strength, high resistance to corrosion, can withstand heavy static and dynamic load. Moreover, the raw materials of aluminum are practically unlimited since it is the most abundant metal in nature.

Aluminum casting alloys, compared to cast iron and steel,have several important advantages: the ability to obtain a more accurate cast molds with minimal surface roughness. These alloys also have higher resistance to corrosion. Alloys that mainly consist of aluminum and silicon - silumins typically contain from 5 to 14% Si. Due to its high casting properties, silumin is the main material used in the development of technological aluminum alloys and has highly strong casting properties simultaneously [1].

The typical silumins alloy AL2 (AK12) contains 10-13% Si. In the cast state it consists mainly of eutectic and a number of excess silicon crystals. The mechanical properties of this alloy are very low: tensile strength is σv = 120 - 160 MPa with elongation $\delta<1\%$. Therefore, when using silumins coupled with a particular technology may strengthen them.

According to some references [1]: at strengthening silumins, preference is given to modifications, which are made by treating liquid silumin with small amounts of sodium salts. At modification, a certain dispersion of particles of eutectic mixture takes place, as a result of sodium surrounding the formed silicon crystals, eventually inhibiting their growth.

Annealing is used to relieve residual tensions by partial removal of heterogeneity by diffusion and alignment of the partial

structure in grains of α-solid solution. However, it is also used to alter the shape and size of the particles of the second phase. Quenching is used to obtain the maximum possible supersaturation of solid aluminum solution, which provides a significant strengthening of the alloy.

The main goal of aging regime (natural or artificial) is to achieve higher strength of cast alloy or a more stable size of details. Depending on the combination of temperature and exposure time of artificial aging, higher strength and better ductility properties of alloys can be obtained.

The capabilities of thermocyclic treatment (TCT) when used for non-ferrous alloys are numerous [2]. Effect of thermocyclic treatmentislargely determined by the selected mode. For silumins, the most appropriate mode is high thermocyclic treatment. Thermocyclic treatment is characterized by the following parameters: the number of cycles, the maximum and minimum temperatures in cycles, speed of heating and cooling, and the presence or absence of short-term exposures to temperature. Parameter values at research should have a practical sense as well as effective influence on the properties. After TCT, casting alloys are characterized by an increase in plasticity while maintaining or slightly in crease in strength in comparison with standard treatment regimes. For example, elongation for alloy AL2 increased more than 2 times. Duration of treatment is reduced by 1.5-4 times [2]. Properties, that change after thermocyclic treatment depends on the chemical composition and phase composition of the alloy.

Using thermocyclic treatment in silumins significantly improves the mechanical properties such as strengthening and plastic properties. The intensification of diffusion, phase and structural transformation lead storeduction in processing time of heat treatment, improves full range of mechanical properties, and hence - the reliability of machine parts.

References

1. Материаловедение: учебник для вузов по напр. подготовки и спец. в области техники и технологии / Б.Н. Арзамасов, В.И. Макарова, Г. Г. Мухин и др. - 4-е изд., стер. - М.: Изд-во МГТУ им. Н.Э. Баумана, 2002. - 646 с.: ил.

2. Смагоринский М.Е. Справочник по термомеханической и термоциклической обработке металлов: справочное издание / М.Е. Смагоринский, А.А. Булянда, С.В. Кудряшов; Под общ. ред. М.Е. Смагоринского. - СПб.: Политехника, 1992. - 413 с.: ил.

New Technology and Modern World: матеріали VII науково-практичної студентської конференції лінгвістичного науково-методичного центру кафедри іноземних мов, м. Суми, 22 травня 2013 р. / Відп. за вип. Г.І. Литвиненко. - Суми: СумДУ, 2013