ACTA TECHNICA CORVINIENSIS
BULLETIN OF ENGINEERING

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THE USAGE OF TYPE SILIUMINIU ALLOYS WITH MAGNESIUM FOR CASTING A VERY LARGE USED PIECES

Abstract:
ATSi7Mg aluminum alloy is subjected to the processes of hardening and aging. The structural transformations are related mechanical properties of the alloy. The prezence of the Mg2Si phase is the main cause of increasing resistance of alloys Al-Si-Mg, but with the presence of stable phase Mg_2Si reduces refractivity of ternary alloys.

Keywords:
aluminum alloy, mechanical properties, magnesium

INTRODUCTION

Among the advantages of alloys siluminium $ATSi_{12}$; $ATSi_{10}MnMg$; $ATSi_7Mg$; $ATSi_7MgTi$ is the used in humid atmosphere like maine atmosphere As the concentration of Si growth there is a decrease of the linear thermal expansion coefficient, but to obtain a raft structure raft in the cast [1] [2] [4] [5] [6] (the material is fragile and difficult to process).

For finishing the structure, increase the mechanical resistance and improve mechanical machining by cutting of type AAT siluminium (hipo and eutectic) is added to Na and Cl and salts containing F and Na, S, P, etc.. in the alloy. The hypereutectic alloys have much Si_I in the structure and is difficult to be modified with salts containing Na. A greater effect in modifying these alloys siluminiu hypereutectic is obtained with substances containing S or P [6] [7] [8] [9].

SYSTEM ALLOYS IN AL-SI + EA (ALLOYING ELEMENTS)

System Al-Si alloys + Ea is one of most used in the casting aluminum alloy of great importance pieces because it possess superior mechanical and technological proprieties than other cast aluminum alloys (AAT).

The most typical alloy system Al-Si-Mg is widely used in casting of $ATSi_7Mg$ (6-8% Si, 0.25-0.4% Mg, the rest). This alloy is used both in the hardening state (T4) and after partial aging (T5). Is is used for castings pieces with thin walls and complex shapes used in the condition of medium loaded forces (body pump, etc.). The advantages of alloy ATSi7Mg are: good casting properties (high fluidity, minimum linear contractions) like as $ATSi_{12}$; the tendency of formation of small cracks hot high temperature; good mechanical strength and satisfactory plasticity; compared with ATSi10MnMg not require autoclaves to pressure *crystallization; is the possibility to used modifier containing Na as S, P, etc.[2]; Like disadvantages ATSi$_7$Mg shows: reduced machining by cutting; with increasing concentration of Mg decreases plasticity (mechanical R_m increases and the capability of machining); resistance to corrosion from HNO_3 ; reduced refractivity, which may increase with increasing concentration of Si, Mg or Cu.*

The hardening basic phase of ternary alloys is Mg_2Si noted as β', the type chemical intermetalic component (determined by normal valence). Possess crystalline elementary cube network and does not form solid solutions α with its constituents, what is characteristic ionic combinations in contrast with benthonic phases type (ex: Mg_2Al_3).

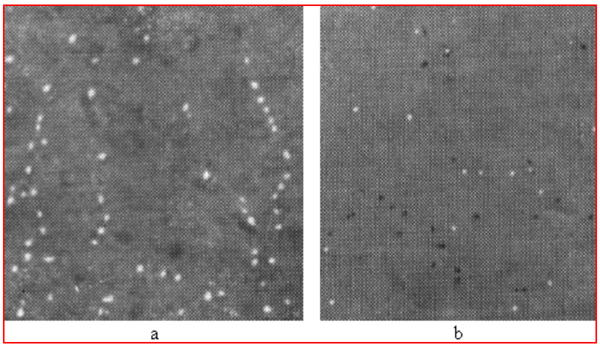

Fig. 1 Structure of alloy ATSi$_7$Mg (10000:1) aged a-135 °C/15 h and b- a-135°C/15 h

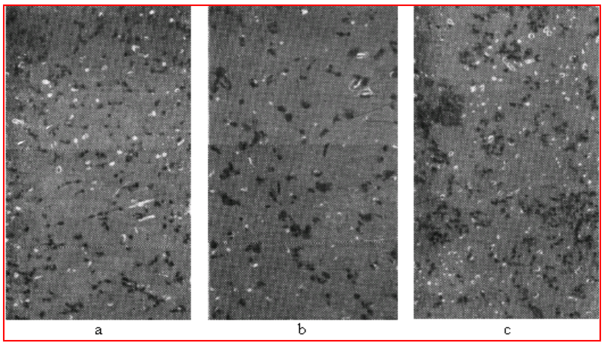

Fig.2 Structure of alloy ATSi$_7$Mg(10000: 1) aged a-165°C in times:a15h b-25h, c-100h

Regarding the influence of Si and Mg on the effect of loss of mechanical resistance of alloys Al + Mg + Si at high temperatures [5], [6], [2], [8] ,it shows that the decomposition of α solid solution of Mg and Si in Al folow the next schedule:

1. *Appear in the crystal network of solid solution the Guillet-P zone. There is a change to approaches atoms of Si and Mg and formation of metastabile β' phase; (Mg_2Si) - the process is very intense at high temperatures and slow at ambient temperature. Reset of atoms position had place with the distortion is strong crystalline network and consequently there is as result strong growth mechanical resistance of siluminium type alloys at ambient temperature and reducing refractivity of temperature used in aging process (160-170oC and higher).*
2. *There are a formations of small grains mono- and two-dimensional phase metastabile β'(Mg_2Si) which possess crystalline hexagonal network. It is believed that the training phase Mg_2Si is the main cause of increasing resistance of alloys Al-Si-Mg, but with the apparition of stable phase Mg_2Si the refractivity ternary alloys will be reduce .This clear happened at heated at 170-180°C retention time of 25h to return treatment.*
3. *Stable phase Mg_2Si is formed in alloys type siluminium in process to maintain at 185-220°C for several hours and at 300°C for 30 minutes to aging, with strong reduce resistance of alloy.*

The alloy aging process at 180-225°C with reduced times of process can provide for ATSi7Mg alloy high strength and low plasticity. Refractivity of these alloys can be strong increased by two ways:

- *It strengthens the solid solution α by a complex process of alloying which assure the separation of the granular stable phases crystallized in form of branches*
- *make an bonding of Si free (elementary) in the stabile component ($Al_8Si_6Mg_3Fe$, Al_4Si_2Fe, Al_5SiFe etc.) An example of these components is phase Mg_2Si which is found in most siluminiu alloys (ATSi$_{12}$, ATSi$_7$Mg, etc.)*

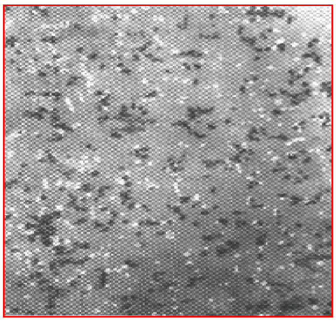

Fig. 3 Structure of alloy ATSi$_7$Mg (10000:1) aged a-175°C/10 h

Mg_2Si phase is formed through a series of transformations that strongly distorts the crystalline network of alloy and increases the

mechanical resistance at ambient temperature (due to hardening and aging processes).

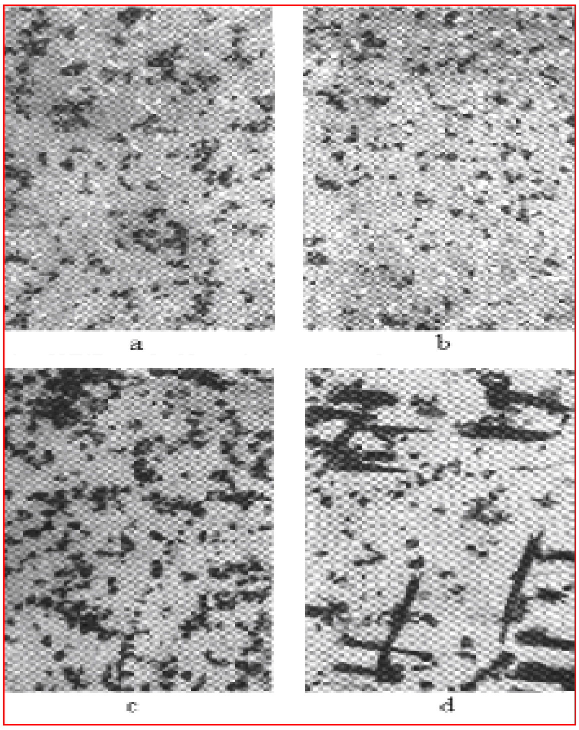

Fig. 4 Structure of alloy ATSi$_7$Mg(10000:1) aged:a-185°C/15h , b-200°C/10h, c-300°C/10h, d-300°C/100h

INTERPRETATIONS

In work [8], [9] it shows that the ternary alloy system Al-Si-Mg, were first observed in aluminum matrix areas which characterize stages of ante-separation. There not was established neither by X-ray observations the differences in areas structure for aging alloys. Despite lack evidence of structural changes, increased of mechanical properties of ternary alloys is a fact. Only at a temperature of 150°C authors [9] in 1958 established that the separation distributed locally of Mg and Si take place.

It is believed (with network vacancies which are formed during the hardening process) atoms of alloying elements Ea begin to be collected in the chains without any order, after which the atoms slowly sits in an order determined the by network parameter (4.04 Å) and the chain gets the same format with the elementary cell of the matrix. At high temperatures the atoms of Ea formed construction areas least different of the matrix. It shows [9] that this phase β'' move gradually in the phase β' rebuilding the crystalline matrix is accompanied by a strong distortion which is the main cause of increasing the mechanical properties of alloys siluminium. But such a tensioned state of the crystalline network helps to reduce refractory of alloys. This is observed as a strong fact, in changing the structure of α solid solution alloy type ATSi$_7$Mg at 165°C in the ageing process where the decomposition of α solid solution takes place relatively quickly.

Figure 1shows the solid solution alloy ATSi$_7$Mg in which ageing at 135°C for 15 hours produce formation and deposition of fine dispersed elemental Si [5].In addition to this Si there are deposits in the form round (white points) probably the Guillet areas or how to say „phase" β''.

We say that such products of the decomposing solid solution which is formed as chains in the alloys Al-Mg-Si is characteristic for the initial stage of aging. The structure of ATSi$_7$Mg aged at 150 °C for 15 h (Figure 1.b) confirms the words [16].

At higher temperatures the return process and the size of elementary high dispersed Si particles and a separation (white point) increase dramatically. (Figure 2). Structure of α solid solution after aging for 15 and 25 h (Figure 2 a, b) at 165 °C has many deposits of Si and formation of β'' metastable phase, and even the stable phase Mg_2Si (fig. 2 c)

From Figures 2 and 3 it is clear that with increasing aging temperature there is the decomposition of solid solution α is very intense and is formed by deposition metastabile phases that increase substantially with aging time. Very intense decomposition α solid solution had place at 175 °C with the maintenance of 10 h.

The figure 4 shows a large amount of fine and small and many particle high dispersed portions of Si$_I$ (primary) that were formed after reset the network. Particles Mg_2Si (in the form of narrow white strips) are shown oriented.

Very suggestive is the alloy ATSi$_7$Mg old aged at 185 °C for 15 h (Figure 1 a). But I clearly see this in Figure 1 b α solid solution decomposition at the aging temperature of 200 °C, virtually ends after 10h. This produce reduced resistance of alloy ATSi$_7$Mg at temperature of 200 °C.

CONCLUSION

Technological processes of casting under pressure are widespread in the industry. The process ensures a quality cast alloy type siluminium such as good walls and lack risk of mechanical cracks at hot state and cold state. The proprieties of cast alloys type siluminium can be improved by thermal treatment named artificial aging. There are many ways to make these treatments. These have resulted in changing the structure of alloy, with the apparition Mg_2Si phase (composed intermetalic component). This has an effect to increase mechanical resistance

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