THE EFFECT OF LITHIUM CONTENT ON THE MASS OF THE PART WHEN ALLOYED WITH LITHIUM ALUMINUM

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Abstract - At present, aluminum alloys are widely used alloys after iron-carbon alloys in the production of mechanical engineering parts. The article presents the process of alloying an alloy of grade 8176 aluminum with a combination of lithium fluoride. Bunda quoted the legirlash process in the same way. In the first method, lithium fluoride powder was mixed with a halide aluminum alloy wrapped in aluminum foil. In the second method, lithium fluoride powder was mixed with an aluminum alloy without exposure. Experiments have shown that a combination of 3 different amounts of lithium fluoride is introduced into the aluminum alloy. A combination of lithium fluoride is mixed in an amount from 5 gr to 15 gr. The experiments were carried out in a muffle furnace of the brand SNOL-1,6.2,5.1/11– I2M. The experiments carried out led to the fact that the furnace is set to 750 °C. In the article, the authors identified a lot of details of the samples obtained during the experiments and presented the relevant analyses and conclusions.

Keywords: Aluminum, Lithium, Muffle furnace, LiF, Part, Mass, Aluminum foil.

1. Introduction

Alloying of metals and alloys with other metals makes it possible to improve the quality of the developed products (technologies). In particular, the use of aluminum for the development of special products and coatings finds its role in almost all branches of industry and technology [1]. Currently, aluminum and its alloys are used in many industries. First of all, aluminum and its alloys are widely used in the aviation and automotive industries. In addition, aluminum is increasingly being used in other industries, such as mechanical engineering, electrical engineering, instrumentation, construction, chemical industry, and consumer goods production.

Including in Uzbekistan, Uzavtosanoat machine-building enterprises produce spare parts for automobile engines made of aluminum alloys [2].
Researchers around the world have conducted various experiments on aluminum-lithium alloys. In particular, Russian and Chinese scientists S. Y. Betshofen, R. Wu, I. A. Grishin, A. A. Petrov and K. A. In a scientific article jointly written by Speransky, an analysis of the mechanical properties of mechanisms made of Mg-5Li-3Al alloy was carried out.

Their experiments show that lithium in the Mg–5Li–3Al alloy softens interatomic bonds in the crystal lattice, and they found that parts made of this alloy are resistant to prismatic vibrations, and anisotropy leads to a decrease in texture [3].

Scientists from Harbin Engineering University in China Wang Yu., Wu Ya., Liu M. used cheaper soldering elements and proposed a technology for producing materials with the required strength, forging viscosity and high elasticity [4].

Researchers from the Technological University of Tajikistan and the University of Poduan in Italy Nazarov S.A., Ganiev I.N. Ganieva N.I., Kalliari I. in their joint scientific work, they analyzed the microstructure and mechanical properties of aluminum-lithium alloys alloyed with rare metals. At the same time, they conducted a study on a proprietary Al+6% alloy. From the studies of Tajik and Italian scientists, it can be concluded that the addition of rare metals to alloys as alloying elements in small quantities leads to an increase in the microcathematicity and strength of the alloy [5].

2. Materials

A fibrous compound of aluminum grade 8176 and lithium was obtained as an object of research for the experiment. The mass fraction of components in the composition of aluminum alloy grade 8176 in % is shown in Table 1 [6].

Table 1. The content of aluminum grade 8176

Aluminum alloy grade	Mass fraction, in %							
	Main components		Combinations					Other components
	Al	Fe	Si	Cu	Mg	Zn	Ga	Additional alloys
8176	Main component	0,4-0,5	0,07	0,01	0,02	0,04	0,01	0,18

LiF is a binary chemical compound of lithium and fluorine and is a lithium salt of hydrofluoric acid [7]. Under normal conditions, it is a white powder or a transparent colorless crystal, a non-hygroscopic, almost insoluble compound in cold water. It is soluble in nitrate and hydrofluoric acids. The density at this temperature is 848.2 g/cm^3, the expansion coefficient of the fiber volume is 1.81·10-4 G-1*g/cm^3 in the liquid state [8]. The boiling point is 1673 °C [9].

Figure 1: Lithium fluoride.

3. Research and Methods

The experiments were carried out in a muffle furnace of the brand SNOL-1,6.2,5.1/11-I2M (Fig.2) [10]. At the same time, the studies were carried out in a muffle furnace in a position set at 750 °C. The studies were conducted in 2 different ways.In the first method, a fibrous compound was added to the flux in a state enclosed in aluminum foil. Before the start of the experiments, the connection of the fibers of One was prepared by wrapping in aluminum foil of 5 gramms (Fig.3).

Figure 2: Muffle furnace brand SNOL-1,6.2,5.1/11-I2M

Table 2. Technical characteristics of the muffle furnace of the brand SNOL-1,6.2,5.1/11- I2M

Working temperature, ºC	1100
Power, kVt	2,2
Mass, kg	34
Workplace size, l	4
Dimensions of the working chamber (W×L×H), mm	160×250×100
Overall dimensions of the electric furnace (W×L×H), mm	415×570×500
Peculiar properties	Ceramic Muffle semi-open spiral Heater

In both methods, the flux content in the studied samples ranged from 5 to 15 g of the compound LiF. At the same time, 5 g of LiF contains 1.35 g of lithium due to the combination of lithium and fluorine in a ratio of 7/19. 10 g of LiF contains 2.70 g of lithium, and 15 g of LiF contains 4.05 g of lithium [11]. These calculations follow from the following.

The atomic mass of lithium is 6.94 a. e. m. and 18.99 a. e. m. [12]. This gives a negative mass of the elements 7 a. e. m. and 19 a. e. m. we obtain that the total mass of the compound is 26 a. e. m. [13]. From this

26 a.e.m. – 100%;

7 a.e.m. – x

$x=100*7/26$; $x=26,92\approx27\%$

It follows from this that:

Lithium makes up 1.35% of the total amount of 100% flux in the first experiment. Lithium accounts for 2.70% of the total amount of 100% flux in the second experiment. Lithium makes up 4.05% of the total amount of 100% flux in the third experiment [14].

Figure 3: LiF wrapped in aluminum foil.

Figure 4 shows a fiber compound added to an aluminum alloy before melting in 2 different ways.

a) *b)*

Figure 4: LiF compound added to aluminum alloy. a - wrapped; b-not wrapped.

Figure 5: Samples in the form.

For comparison, the study first cast aluminum alloy grade 8176 without any additives. The amount of flux in all samples was equal to 100 grams of crucible. The sample parts were cast into pre-prepared sand-clay molds (Fig.5).

The ingots obtained are shown in Figure 6. The samples were separated from the molds and processed on a lathe in a cylindrical shape of 17x22 mm of the same size (Fig.7).

Figure 6: Castings. a-aluminum alloy grade A-8176; b- 5 gr wrapped LiF added sample; c- 10 gr wrapped LiF added sample; d- 15 gr wrapped LiF added sample; v-5 gr not wrapped LiF added sample; g-10 5 gr not wrapped LiF added sample; e-15 gr not wrapped LiF added sample;

Figure 7: The processed part.

4. Results and Discussions

The processed samples were weighed on a scale (Fig. 8). First, a sample of aluminium alloy grade 8176 without the addition of lithium fluoride was cancelled. At the next stage, samples with the addition of lithium fluoride wrapped in foil were measured. Then samples were measured with the addition of lithium fluoride, which were not wrapped in foil.

Figure 8: The process of measuring the sample

The results are shown in tables and shown on a comparison graph.

Table 3. The first measurement results (added in wrapped condition)

№	Sample included LiF mass	The amount of lithium (in percent %)	Sample mass
1	-	0	14.1
2	5 gr	1.35	13.8
3	10 gr	2.70	13.6
4	15 gr	4.05	13.3

Table 3. The second measurement results (added in non-winding condition)

№	Sample included LiF mass	The amount of lithium (in percent %)	Sample mass
1	-	*0*	*14.1*
2	*5 gr*	*1.35*	*13.7*
3	*10 gr*	*2.70*	*13.4*
4	*15 gr*	*4.05*	*13.2*

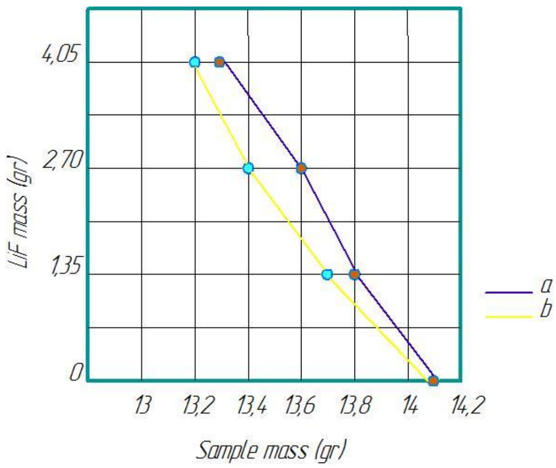

Figure 9: Graph of comparison of measurement results: a - LiF wrapped in foil; b - LiF not wrapped in foil.

As can be seen from the comparative graph, the measurement results of samples wrapped in foil a – line and the measurement results of samples not wrapped in foil b – line differ slightly from each other. But the addition of fiber wound on foil as an alloying element during the casting of sample parts reduced the release of slag.

5. Conclusions

Based on the results obtained, the following conclusion can be drawn:

1. Soldering aluminum with lithium significantly reduces the weight of parts;
2. The addition of fiber to aluminum as an alloying element in closed environments reduces the release of slag;
3. In a closed environment, the uniformity of lithium distribution in the aluminum alloy increases.
4. The introduction of lithium into aluminum alloy in an open and closed environment, the difference between the masses of parts is on average 2%.

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