Influence of germanium oxide on the mechanical properties of aluminum alloy

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ABSTRACT

Currently, various studies are being conducted on alloying machine materials with various unique elements. In particular, studies were conducted to improve the properties of aluminum alloy by alloying elements such as lithium, zirconium, ytterbium, erbium into its composition. The wear resistance of the cast samples was determined using a device for measuring the wear resistance of a diamond stone.The research was tested in the laboratory of the department of Foundry Technologies of the Tashkent State Technical University.

Keywords: mechanical properties, germanium oxide, aluminum, resistance furnace, wear resistance

1. Introduction

Currently, scientists around the world are conducting research aimed at improving its mechanical properties by introducing various unique elements into the structure of aluminum alloys [1-2]. Studies using rare elements as a less legible element show that their addition improves the mechanical properties of aluminum alloys. The addition of cerium (Se) to the AL-Cu-Mg-Ag alloy improves the thermal stability of the Ω-phase, therefore the operating temperature of the alloy has increased [3]. Li et al. [4] the addition of Y to aluminum alloy in an amount of 0.1% -0.2% (mass fraction) at high temperatures for room temperature and Y (iterbi) improves the

strength properties of aluminum alloy grade 2519 and indicates that it has changed the density and size of the phase θ. Nd (neodymium) is mainly in the form of an AlCuNd intermediate compound, in which the limiting force increases at grain boundaries and improves the mechanical properties of alloy 2519 at high temperatures [5]. Some recent studies have shown that Yb (ytterbium) it is considered an effective element with a low level of leaching in aluminum alloys [6]. It was confirmed that the addition of Yb (iterbi) improved the mechanical properties of Al-Cu-Mg-Ag and Al-Zn-Mg-Cu-Zr alloys [7]. In addition, the complex addition of Yb, Cr and Zr (zirconium) to the Al-Zn-Mg-Cu alloy significantly increases the resistance to recrystallization. The article presents the authors' research aimed at improving the mechanical properties of aluminum alloy by introducing germanium oxide into it.

2. Materials and methods

In the studies, a resistance furnace was used to cast aluminum samples.In the studies, the composition of the AK7 and D16 brand alloys included germanium oxide, a combination of germanium with oxygen.Technically, germanium is classified as a metalloid or semi-metal, one of a group of elements that possess properties of both metals and non-metals. In its metallic form, germanium is silver in color, hard, and brittle. Germanium's unique characteristics include its transparency to near-infrared electromagnetic radiation (at wavelengths between 1600-1800 nanometers), its high refractive index, and its low optical dispersion [8-9]. Germanium dioxide, also called germanium(IV) oxide, germanium, and salt of germanium, is an inorganic compound with the chemical formula GeO_2. It is the main commercial source of germanium. It also forms as a passivation layer on pure germanium in contact with atmospheric oxygen [10-11].

Germanium oxide was introduced into the samples in a ratio to the weight of the charge of 1%, 2%, 3%. The samples were poured into sand-clay molds at a temperature of 750 ° C [12-13]. The cast samples were processed by cutting on a lathe of the same size 17x23 mm. The cut samples were examined on a device for measuring the wear resistance of a diamond stone. The drawing of the device is shown in Figure 2. In doing so, using the method of reducing the length of the samples, their eyelight was measured [14].

Figure 2. A device that measures wear resistance.

Each sample was kept in the device under the influence of the same forces of 50 N for 10 minutes. Samples were taken from the device and their height was measured.

3. Results and discussion

Then the first AK7 alloy samples were measured, while the D16 alloy samples were measured.The results of changing the heights of the samples are presented in the table (Table 2).

Table 2. The results of measuring the wear resistance of the samples are presented.

	GeO_2+0 %	GeO_2+1 %	GeO_2+2 %	GeO_2+3 %
AK 7	19.10	20.50	21.70	20.50
D1 6	20.00	21.50	22.30	19.70

Based on the measurement results, a binding graph was developed (Fig. 4). At the

same time, it was taken as a basis that the height of the poured samples was reduced due to the compound with germanium oxide.The measurement results showed the effect of germanium oxide on the alignment of aluminum alloys.

4. Conclusions

Based on the above experiments, the following conclusion can be drawn. When aluminum alloy is leached with germanium oxide, the hardness of the alloy increases by 10-15%.When we introduce germanium oxide in the amount of 1% and 2% into the composition of an aluminum alloy, it can be seen that it has increased wear resistance and 3%, on the contrary, it has decreased. In conclusion, it should be noted that the inclusion of germanium oxide in the alloy from 1% to 2% serves to increase its mechanical properties.

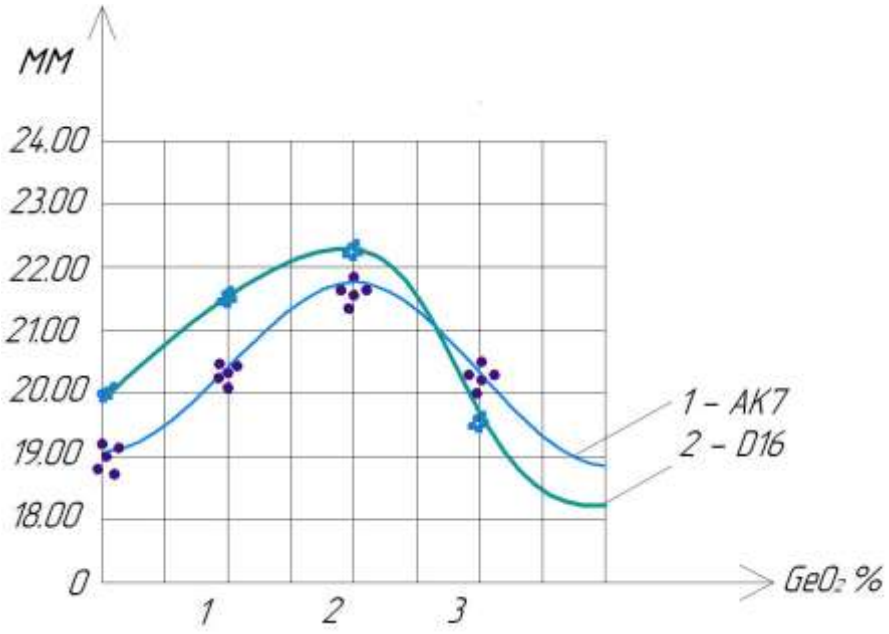

Figure 4. Link graph.

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