THE ROLE OF MODIFIERS IN IMPROVING CASTING PROPERTIES OF ALUMINUM ALLOYS

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Aluminum-magnesium alloys are considered to be one of the most required and reliable in automotive, machine-building, and other engineering industries. The role of magnesium content is attracting more and more attention, and it is known that the presence of this element leads to improved material characteristics in terms of hardness, microstructure, and other characteristics [1][2]. This work is aimed at exploring ways to optimize such systems by introducing graphene as a modifying element. Graphene is a new material known for its excellent effects on magnesium and aluminum alloys, and scientists are making increasing efforts to understand the differences between the effects of this element and other crystallographic carbon (C) structures such as carbon nanotubes, graphite and diamond [3][4]. To date, the effect of graphene on the microstructure of aluminum alloys has been studied, and it has been stated that this element significantly improves a grain refinement ability of the alloy, as well as reduces the porosity of aluminum alloys. Fluidity testing is an important aspect of the quality of material which depends on the chemical composition of alloys, conditions of the experiments, additional elements (flux), and others [5]. The main purpose of this experiment is to analyze the effect of graphene on the length of fluidity depending on its concentration.

For the experiment, a sand mold was first prepared to test the fluidity using quartz sand with a concentration of 85%, bentonite with a concentration of 11%, and water with a 4% concentration (Fig. 1).



Figure 1. Steps of the preparation of spiral mold for fluidity testing.

The alloys were melted in an induction furnace at a temperature of 720°C and graphene was added after obtaining the melted alloy of Al-Mg alloy. The process had

been carefully handled since mixing graphene requires non-stop attention, and it needs to be mixed using a special tool. The concentrations of graphene were chosen to be between 0.15 to 0.45% in increments of 0.15% difference.

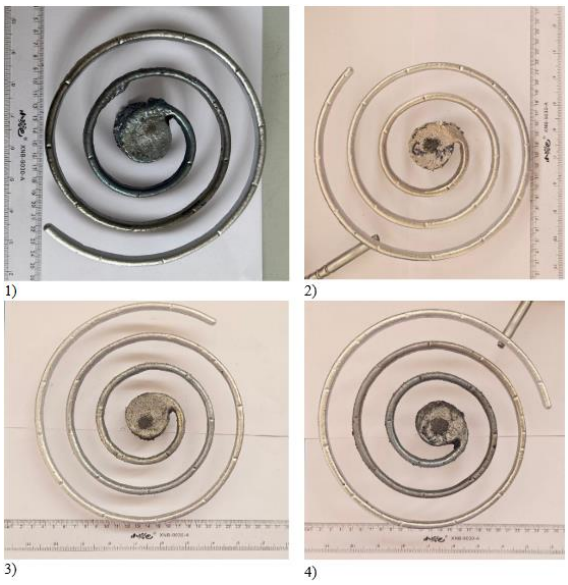


Figure 2. Fluidity tested samples: 1) with no addition of graphene; 2) 0.15% Graphene; 3) 0.3% Graphene; 4) 0.45% Graphene.

The figure above illustrates the fluidity test results of different samples. From the figure, it can be seen that the graphene impact is substantial, and each 1.5% added more value on the fluidity. The table below shows a trend of the change in fluidity ability of the alloy depending on the composition of the sample.

Table 1. Fluidity lengths of AL-Mg alloys modified with graphene.

Alloy	Content of graphene (%)	Fluidity length (cm)
Aluminum-magnesium	0	109
Aluminum-magnesium	0.15	118.5
Aluminum-magnesium	0.3	131.5
Aluminum-magnesium	0.45	133.5

In conclusion, results revealed that with a higher content of graphene, fluidity length had also increased dramatically and reached its highest with 0.45% of graphene addition. Meanwhile, even a small amount of graphene made a huge difference in length, changing the figure from 109cm to 118.5cm. Overall, the difference between the base alloy fluidity length and the length of the alloy modified with 0.45% of graphene is remarkable and amounts to 24.5cm.

Literature:

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