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Impact of Speed of Cooling of Initial Phase (α) and of Eutectics (α + β) on Physical and Mechanical Properties of Al-Si-Mg Alloys

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ABSTRACT

The work shows the results of testing the speed of cooling cylindrical samples intensively cooled at one end. Designated cooling curves and their derivatives. The tests were subjected to alloy and A356.
Cooling speed varies in a wide range of both alpha phase crystallization and solidification eutectic. Increasing the cooling rate of temperature changes the location of T sol (start). At a higher speed of cooling of alloys achieves a higher density and hardness after heat treatment T6

Keywords: Al-Si-Mg alloys, speed cooling, cooling rate, mechanical properties

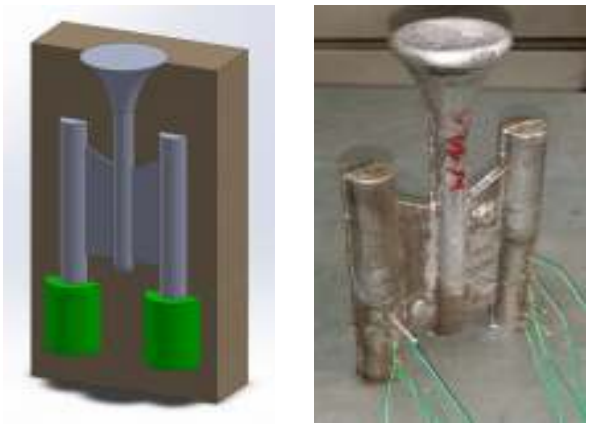
1.0. OWN RESEARCH

Assessing the impact of cooling speed on structure and properties of AlSi7Mg alloys on is very much the work of [1-7]. In the work of the cooling curves shall be recorded, calculates the speed of cooling and evaluates the structure of or properties of alloys. Similar studies were done by the author. The assessment of the speed of cooling of a ALSi7Mg alloy was conducted by preparing an alloy of the composition shown in table 1. Before pouring it into the mould, the alloy was modified by using TiB5 master alloys. In order to obtain high variability of the cooling speed, the casting technology shown in figure 1 was used in the tested sample. Samples in the form of a bar with a diameter of 25 mm touched the cooling plate with their lower ends, as shown on figure 1a. Thermocuples were placed every 5 mm, beginning from the cooling plate, so as to register the process of cooling of the metal.

Table 1. Composition of ALSi7Mg alloy (wt.%)

Chemical composition of the examined alloy [%]					
Si	Mg	Cu	Ti	Sr	Zn
7,67	0,48	0,06	0,206	0,0002	0,090

The registered processes of cooling are shown in figures 2 and 3. Analysis of the curves (of cooling) allows for the determination of thermocouples and average cooling speeds in the periods of solidifications in phase α as well as the coagulation of eutectics.



a/ b/

Fig.1 Test bar: a/ mold sands with chills, b/ casting whit thermocouples

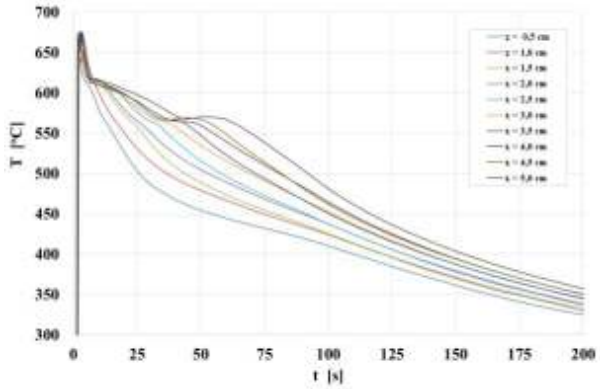


Fig. 2 Curves of cooling

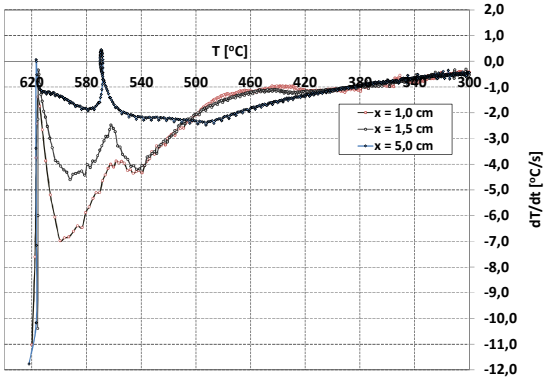


Fig. 3 Curves of the TDA

In figure. 3 cooling rate showing the custom which are determined in the following temperatures. In every field of cooling rate of change in broad ranges. Instantaneous speed determines microstructure phases: primary and eutectic. Influence of cooling rate on the position of the temperature T_{lik}, $T_{sol(s)}$, $T_{sol(f)}$ shows the figure 4. The samples were subjected to standard heat treating T6, after which the density of the alloy in function f' – distance from the cooling plate – and the hardness were determined. The results of this examination are shown in figure 5

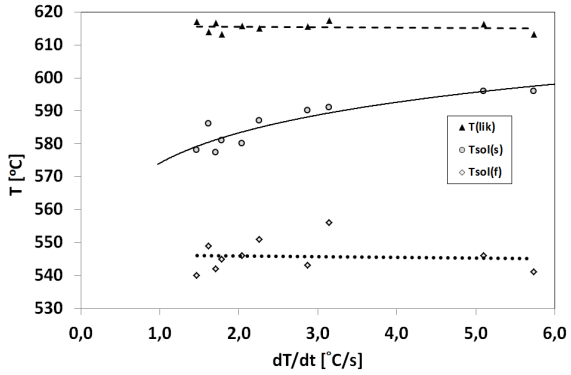


Fig.4. The impact of the cooling speed on the values of temperatures: T_{lik}, $T_{sol(s)}$, $T_{sol(f)}$ on the curve of cooling

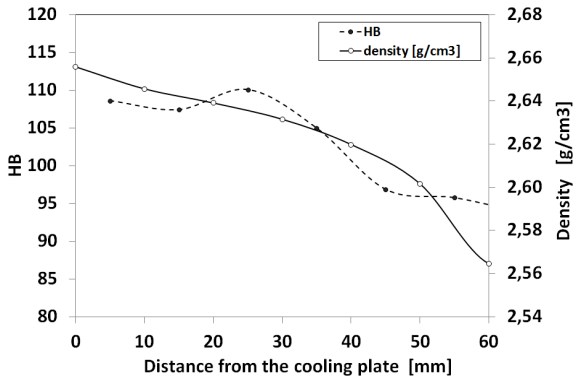


Fig 5. The impact of the cooling speed on the density and hardness alloys after heat treatment T6

2.0. CONCLUSIONS

From the results of the conducted examination, the following conclusions may be drawn:

- High cooling speeds (above 3^{o} C/s) lead to the disappearance of the recalescens effect in the period of eutectic transformation
- Increase of cooling speed leads to the increase of the value of $T_{sol(s)}$ and has a small impact on the remaining characteristic temperatures (T_{Lik}, $T_{sol(f)}$).
- Higher cooling speeds cause the alloy to have higher density and hardness in the state after heat treatment T6.

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