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**INFLUENCE OF MODIFICATION ON THE STRUCTURE AND
MORPHOLOGY OF FRACTURE OF ALSI13MG1CUNI SILUMIN**

Remigiusz ROMANKIEWICZ, Ferdynand ROMANKIEWICZ

Faculty of Mechanical Engineering, University of Zielona Góra

Introduction

Alloy AlSi13Mg1CuNi is used for casting pistons for internal combustion engines. It is frequently used in thin-wall casts working under medium, or sometimes higher loads. The structure and the mechanical properties of AlSi13Mg1CuNi alloy may be improved through applying thermal treatment or a simple technological modification with suitable micro-additives. To achieve the advantageous state of the structure of AlSi13Mg1CuNi alloy requires a modifying process involving refinement of the primary silicon crystals as well as the change of the morphology of the eutectic silicon from lamellar into fibrous [1-6].

The authors have tried to modify AlSi13Mg1CuNi alloy applying AlCu19P1,4 master alloy to refine the primary silicon crystals, whereas AlSr10 master alloy is used to refine the eutectic. It has been recognized that it is purposeful to investigate the influence of modification of AlSi13Mg1CuNi silumin on its structure and morphology of fractures in an impact resistance test.

Description of the experiments

Melting and modification of AlSi13Mg1CuNi

The experiment were carried out for the AlSi13Mg1CuNi technical alloy, of the chemical composition showed in table 1. The melting process and the modification were carried out in a graphite-chamotte melting crucible in the furnace chamber.

Table 1 Chemical composition of the AlSi13Mg1CuNi alloy

Element	Al	Mg	Cu	Ni	Fe	Zn	Ti
Content, %	12,4	1,06	0,97	0,92	0,47	0,078	0,0084

The modification process was carried out while overheating the metal bath to temperature 1003 K (730°C). The modifying additives included AlCu19P1,4 and AlSr10 master alloys. They were applied in combinations in total amounts of 0,6 and 0,25% (table 2). The modification processes lasted 10 min. The modification conditions as well as the results of the experiments are presented in table 2.

Table 2 The influence of the modification of the AlSi13Mg1CuNi alloy on the impact resistance

Cast Nr	Modification conditions	Impact resistance [J/cm ²]
1	Without modification	3,0
2	Modified with 0,25% AlSr10 and 0,2% AlCu19P1,4	6,0
3	Modified with 0,25% AlSr10 and 0,4% AlCu19P1,4	6,3
4	Modified with 0,25% AlSr10 and 0,6% AlCu19P1,4	6,0

The results of the experiments

The influence of the modification on the change of the structure of AlSi13Mg1CuNi silumin is presented in Figure 1. It shows that the alloy in non-modified state (Fig. 1a) reveals lamellar precipitation of eutectic silicon as well as a few crystals of primary silicon. The complex modification of AlSi13Mg1CuNi alloy with additives 0,25% AlSr10 and 0,2% AlCu19P1,4 caused change of the morphology of eutectic silicon from lamellar in to fibrous one (fig. 1b).

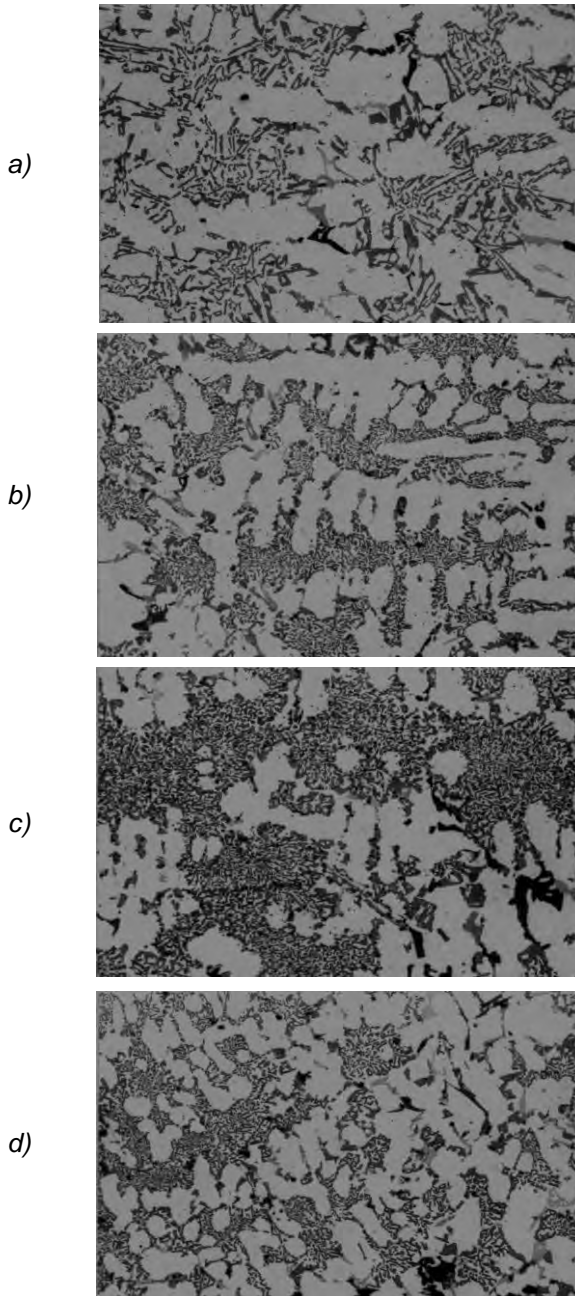


Fig. 1 Microstructure of the AlSi13Mg1CuNi alloy (magn. 250x): a) non-modified, b) modified with 0,25% AlSr10 and 0,2% AlCu19P1,4, c) modified with 0,25% AlSr10 and 0,4% AlCu19P1,4, d) modified with 0,25% AlSr10 and 0,6% AlCu19P1,4.

Further increase of additive of AlCu19P1,4 master alloy to 0,4% (fig.1c) and to 0,6% (fig. 1d) by the same additive of AlSr10 caused similar effect of the change of the structure. However the complex modification with 0,25% AlSr10 and 0,6% AlCu19P1,4 resulted in refinement of the crystals of primary silicon (fig. 1d).

The surface of the fracture of the AlSi13Mg1CuNi alloy are presented in the scanned microphotographs (Fig. 2). They imply that the sample of the non-modified alloy (Fig.2a) is characterized mostly by a fissile fracture. The samples of the silumin after the complex modification with AlSr10 and AlCu19P1,4 are characterized by mixed fracture (fig. 2 b, c and d). However this samples are characterised by a considerably increased contribution of the surface of the plastic fracture.

The Microphotography of the zone of profile of the fracture of AlSi13Mg1CuNi alloy (fig. 3) confirmed the fracture characters of the samples o silumin.

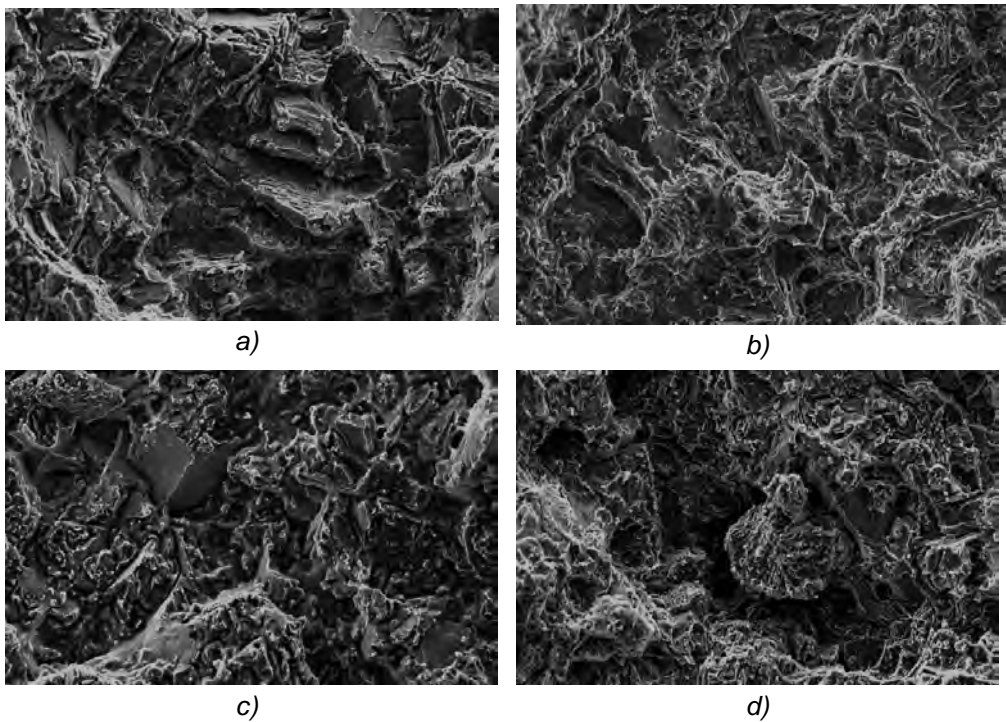


Fig. 2 The surface of the fracture of the AlSi13Mg1CuNi alloy (magn. 400x):
a) non-modified,
b) modified with 0,25% AlSr10 and 0,2% AlCu19P1,4,
c) modified with 0,25% AlSr10 and 0,4% AlCu19P1,4,
d) modified with 0,25% AlSr10 and 0,6% AlCu19P1,4.

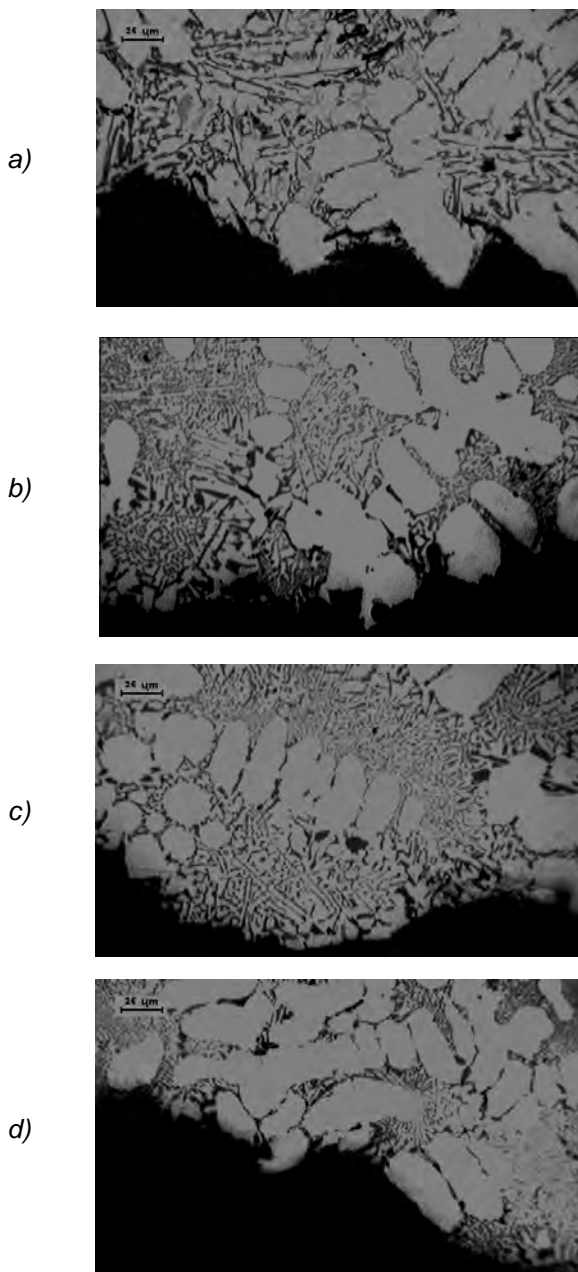


Fig. 3 Microphotography of the zone of profile of the fracture of the AlSi13Mg1CuNi alloy:
 a) non-modified,
 b) modified with 0,25% AlSr10 and 0,2% AlCu19P1,4,
 c) modified with 0,25% AlSr10 and 0,4% AlCu19P1,4,
 d) modified with 0,25% AlSr10 and 0,6% AlCu19P1,4.

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Summary

Influence of modification on the structure and morphology of fracture of AlSi13Mg1CuNi silumin

Remigiusz Romankiewicz, Ferdynand Romankiewicz

The investigation revealed that the modification of the AlSi13Mg1CuNi silumin with the additives 0,25% AlSr10 and AlCu19P1,4 simultaneously provided the change of the morphology of eutectic silicon from the lamellar into the fibrous one. The change resulted in a double increase in the impact resistance of the alloy and the widening of the plastic area of the fracture of the silumin samples.