

**DETERMINATION OF OPTIMUM GRAIN REFINEMENT  
PARAMETERS FOR HYPOEUTECTIC ALUMINIUM-SILICON  
ALLOYS BY A VOLATILE MOULD COATING PROCESS**

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## ABSTRACT

The study produced hypoeutectic aluminium silicon alloy, established its optimum conditions for grain refinement, pouring conditions and assessed the degree of porosity generated in the cast ingot. This was with a view to evolving a standard for the use of volatile mould coating (VMC) process for the grain refinement of aluminium-silicon alloys.

A hypoeutectic aluminium-silicon alloy and an alumina based mould coating containing volatile hexachloroethane ( $C_2Cl_6$ ) compound were developed. Also, a metallic mould was produced from grey cast iron material. The prepared mould was thereafter coated with the developed alumina-based coating using different concentrations of hexachloroethane. The developed aluminium-silicon alloy was melted at various degrees of melt superheats of  $50^\circ C$ ,  $75^\circ C$ ,  $100^\circ C$ ,  $125^\circ C$  and  $150^\circ C$ . At each superheat, the molten aluminium-silicon alloy was poured into the metal mould at various coating thicknesses ranging from 1 mm to 5mm.

The effects of the hexachloroethane concentrations in the mould wash on the grain size, bulk density, apparent porosity and mechanical properties of the developed aluminium — silicon alloy were determined using standard methods. The effects of the degrees of melt superheat and the mould coating thickness on these properties were similarly determined.

The results showed that an increase in the hexachloroethane content in the mould coating did not produce any significant change (apparent porosity less than 0.05%) in the amount of open microporosity of the prepared alloy. It was also observed that the Brinell hardness value, the ultimate tensile strength and 0.2% proof stress progressively increased as the concentration of the

volatile hexachloroethane content in the mould coating increased up to optimum value of 15

wt.%. It was also noted that the addition of up to 15 wt.% hexachloroethane to the alumina-based mould coating gradually reduced the grain sizes of the hypoeutectic aluminium silicon alloy from 31.0 $\mu$ m to about 8.01 $\mu$ m. Increase in amount of the melt superheat up to 150°C resulted in coarsening of the grains of the prepared hypoeutectic aluminium silicon alloy. It was observed that the optimum mechanical properties, grain sizes and surface finish of hypoeutectic aluminium silicon alloy cast in hexachloroethane coated mould were attained when its content in the mould coating was about 15 wt.%.

It was concluded that the optimum conditions for grain refinement of hypoeutectic aluminium-silicon alloys using the volatile mould coating (VMC) process were achieved when the hexachloroethane content in alumina-based mould wash was 15 wt.%, with coating thickness and melt superheat of 2mm and 50°C respectively. Furthermore, the volatile compound (hexachloroethane) was effective for use in alumina-based mould coating for grain refinement of hypoeutectic aluminium silicon alloy.