SOLIDIFICATION PATH OF CAST IRON ALLOYED WITH 9.0%AL

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Abstract. This paper aims at developing a new family of cast iron containing up to 9.0% aluminum. This Al-content was chosen as oxidation resistance of cast iron sharply increases at 6 – 8 % Al.

However, the application of these alloys has been limited due to their white structure with excessive complex iron- aluminum carbide formation in the microstructure which renders the material rather brittle, hard and unmachinable. This study is a trial to decrease the hardness and improve the machinability of the alloy through the reduction of carbide formation in its microstructure .

Alloying with 9% Al resulted in the formation of complex iron – aluminum κ-carbides with the formula $Fe_3AlC_{0.6}$. The structure was sensitive to Si – content, cooling rate, inoculation with Ca – rich inoculant as well as alloying with 1.0% copper. Differential thermal analysis as well as repeated quenching from different temperatures were used to study the solidification behavior of this alloy. Alloys containing up to 3.5% Si solidified with the complex carbide formed as primary phase. Inoculation with CaSi and alloying with 1% copper suppressed the primary carbide formation and solidification starts with primary austenite crystals. The solidification of alloys containing up to 3.5% Si ends with the invariant 5 – phase reaction: L + κ → γ + a + G. With increasing Si – content to 5.0% the alloy solidifies through one eutectic reaction: L → a + G and ferrite together with graphite are the only existing phases down to the room temperature.