The Influence of Metallic Addition on Fluidity of Aluminum (LM6) Alloy

R. Ahmad\textsuperscript{1,a}, R. Sadeghi\textsuperscript{1,b}, M.B.A. Asmaei\textsuperscript{1,c}, H. Mohamad\textsuperscript{2,d}, Z. Harun\textsuperscript{1,e}, S. Hasan\textsuperscript{1,f}\textsuperscript{*}

\textsuperscript{1}Department of Manufacturing and Industrial Engineering, Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Bedug Pahat, Johor, Malaysia

\textsuperscript{2}School of Materials and Mineral Resources Engineering, Universiti Sains Malaysia, Engineering Campus, 14300 Nibong Tebal, Penang

\textsuperscript{a}cslee@uthm.edu.my, \textsuperscript{b}larasol@gmail.com, \textsuperscript{c}mohdibya@gmail.com, \textsuperscript{d}hasmaliza@uum.edu.my, \textsuperscript{e}zawali@uthm.edu.my, \textsuperscript{f}aalam@uthm.edu.my

Keywords: Aluminum alloys, Chromium, Fluidity

Abstract. The effect of Cr addition on the fluidity of aluminum (LM6) alloy has been investigated by spiral fluidity test. Presence of 0.1 wt.\% Cr decreased fluidity of melt due to formation of sludge. In fact Cr changes the morphology of the intermetallic phase from \(\beta\)-intermetallics less harmful polyhedral morphology (\(\alpha\)-intermetallics). The \(\beta\)-phases have largest surface to volume ratio, hence they have the largest interfacial region with the melt and are the most detrimental intermetallic to drop off the fluidity. In Cr-containing alloys the effect of \(\alpha\)-phase is less detrimental than \(\beta\)-phase to the fluidity. On the other hand sludge formation and consuming Si and shifts the local chemical composition of the melt to the aluminum side of the phase diagram which has lower fluidity than eutectic and hypereutectic compositions.

Introduction

Thin wall castings often are profitable due to their light weight structure, which enables for increased payload and condensed energy consumption in automotive and aerospace applications. There has been a growing demand to meet the severe requirements of the design engineers for fabricating thinner section castings with excellent mechanical properties [1].

Aluminum alloys have been considered as capable materials to meet these necessities due to their low density, high specific strength and specific stiffness combined with good castability [2]. Aluminum LM6 alloy is one of Al-Si casting alloy with 10-13\% Si. It has been rewarding alloy for diverse industry applications such as automotive and aerospace functions [3]. However, thin wall castings of this material can cause manufacturing problems related to mold filling. Rapid cooling of thin wall sections of the casting reduce the fluidity of the molten metal, which could cause the molten metal to prematurely freeze before it can completely fill the mold cavity, resulting in an incomplete fill or cold shuts. Hence, one of the prime factors to be taken into account in foundry practices of thin section castings is the fluidity and a thorough knowledge about the various factors influencing it is also essential [4]. The factors determining fluidity can be basically divided into (i) physical conditions such as temperature difference between metal and mold, metal flow rate through gate and (ii) chemical conditions such as composition of the alloy sold.
