MECHANICAL PROPERTIES OF THIXOFORMED 7075 FEEDSTOCK PRODUCED VIA THE DIRECT THERMAL METHOD

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Keywords: Semi-solid metal, thixoforming, direct thermal method, aluminium 7075, mechanical properties.

Abstracts: This paper presents an overview of measured mechanical properties of thixoformed aluminium 7075 feedstock produced by the direct thermal method (DTM). The DTM feedstock billets were processed with a pouring temperature of 685 °C and holding periods of 20 s, 40 s and 60 s before being quenched and subsequently thixoformed. A conventionally cast feedstock billet was produced with a pouring temperature of 685 °C and was allowed to solidify without quenching. The feedstock billets were later formed by an injection test unit in the semi-solid state. Tensile testing was then conducted on the thixoformed feedstock billets. Tensile properties for 7075 DTM thixoformed feedstock billets were found significantly influenced by the thixoformed component density. Samples with longer holding times were found to have higher density and higher tensile strength.

Introduction

Semi-solid metal (SSM) processing involves a forming operation between liquidus and solidus temperature that provides an advantage of enhanced flow control. There are two methods for SSM processing consisting of rheoforming which involves the material without an intermediate solidification step; and thixoforming which involves use of feedstock billets which undergo an intermediate solidification step. Thixoforming operations required the preparation of a globular feedstock billet which is then reheated to the SSM temperature range before forming [1]. The fraction solid and phase morphology of the feedstock billet are crucial parameters in order to allow the success of the operation.

Several methods have been used to produce globular microstructure feedstock billets. Direct thermal method (DTM) is one of thermal profile control processes that produced a globular microstructure feedstock billet. The DTM allows the formation of a globular microstructure by controlled billet solidification temperature profile arising from controlled heat transfer between the metal and the mould material. This process provides a thermal equilibrium arrest, which is rapidly achieved due to the rapid cooling action which also provides for multiple nucleation sites. This process enables diffusion dominated ripening to yield a globular primary phase microstructure [2].

Most aluminium semi-solid formed components are made from cast alloys such as A356 and A357 due to their good fluidity. These cast aluminium alloys, though have relatively poor mechanical properties when compared to conventional wrought aluminium alloys. The wrought aluminium alloys have significant advantages in terms of higher ultimate tensile strength and yield strength [3]. Superior mechanical properties of 7075 for example make it reliable for highly stressed aerospace components.

Primary phase grain structure and morphology influence the mechanical properties, with smaller size and globular grain morphology producing improved properties after heat