UNIVERSITI TEKNOLOGI MARA

PROCESSING OF ALUMINIUM FOAM BY INFILTRATION OF NaCl SPACE HOLDER

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ABSTRACT

The main objective of this study was to fabricate aluminium foam with central pillar by casting replication process incorporated with NaCl space holder. The effect was investigated taken into account different space holder sizes. It is also aimed to determine different pore size and in cooperation of a central pillar towards aluminium foam. In this research work, the Gibson-Ashby model with different sizes and modified geometry were used subsequently subjected to compression simulation using CATIA software is presented. Next, the mould is designed and fabricated in advance of casting replication processing set up. It was then followed by optimization parameters processing in term of temperature, argon gas flowrate and material weight. Aluminium foam with and without central pillar with different sizes were prepared based on the abridged optimization chart and further water leaching took place to remove the space holder completely. The space holder and aluminium properties were determined by using Thermogalvametric Analysis (TGA) and Spectrometer correspondingly. The characteristics of the aluminium foams were then characterized by density and porosity percentage, stereoscopic, 3D aluminium foam modeling, Scanning Electron Microscopy (SEM) and its mechanical behavior by uniaxial compression. Aluminium foams with the porosity in the range of 59 – 72% and aluminium foams with central pillar in the range of 50 – 63% were achieved. Increasing the size of the NaCl particle increases the foam porosity and at the same time decreases the foam density. Aluminium foam 1 mm with central pillar with the smallest pore size and lower mean porosity percentage of 49.85% presented the highest mechanical properties; compressive strength (215.12 MPa), Young's Modulus (4.22 GPa) and high energy absorption (33.90 MJ/m^3). The present work specimens are believed capable to be applied for functional and structural applications as the present work samples improved significantly in terms of its mechanical properties.

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CHAPTER ONE
INTRODUCTION

1.1 INTRODUCTION

Aluminium alloy have been known as a non–ferrous metal, present in nature in the shape of metal due to the great chemical attraction for oxygen. Oxide in forms of several purities is widely distributed in nature (E.Totten & Mackenzie, 2003). Furthermore, aluminium in this form is the most plentiful metallic element on Earth's silicon (The Aluminum Association, 2011).

In Figure 1.1 shows the comparison of the World primary aluminium production in 2013 and 2012 indicating an increase of 3% with China dominated the World production. World inventories of metal held by producers, as reported by the International Aluminium Institute, declined gradually to about 2.2 million tons at the end of August from about 2.3 million tons at year end of 2012 (U.S Geological Survey, 2014).

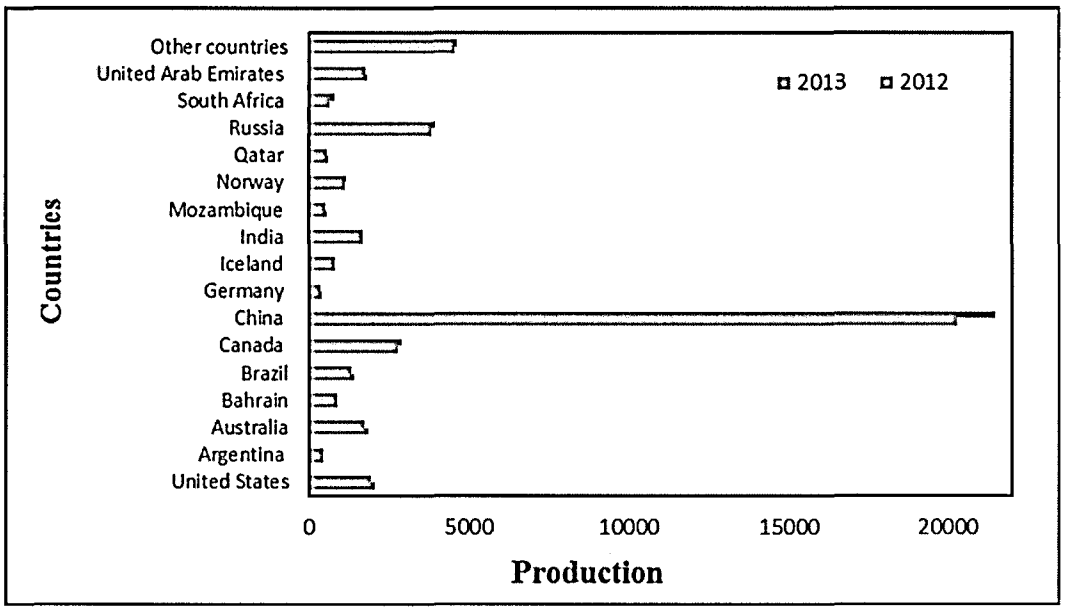

Figure 1.1: World Smelter Production of aluminium for 2012 and 2013 (U.S Geological Survey, 2014)

Aluminium can be referred in the periodic table as the chemical element, third group and has the atomic number of 13 with the density of 2.7 g/cm^3 (Cobden, et al.