COMPARISON OF SAND CASTING SURFACE ROUGHNESS AND DIMENSION ACCURACY BETWEEN ALUMINIUM SILICON CARBIDE AND TIN SILICON CARBIDE

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This report submitted in accordance with requirements of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Manufacturing Engineering (Manufacturing Process)

by

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DECLARATION

I hereby, declared this report entitled "Comparison of Sand Casting Surface Roughness and Dimension Accuracy between Aluminum Silicon Carbide and Tin Silicon Carbide" is the results of my own research except as cited in references.

Signature	:	…….....
Author's Name	:	Abd Halem Bin Abd Razak
Date	:	20 May 2011

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Process). The members of the supervisory committee are as follow:

……

Principle Supervisor

……

Co- Supervisor

ABSTRAK

Tuangan pasir adalah proses tuangan logam lebur yang akan dituang kedalam acuan. Dalam kajian ini, mengkaji antara aluminium silicon carbide dengan tin silicon carbide untuk mengetahui kekasaran permukaan dan ketepatan dimensi (mm). Objektif utama perlaksanaan kajian ini adalah untuk mengkaji kekasaran permukaan dan ketepatan dimensi (mm) manakah yang baik melalui proses tuangan pasir untuk alat pengeluaran. Dalam kajian ini, bahan utama yang digunakan ialah aluminium LM6 dan tin sebagai bahan utama dan 'silicon carbide' sebagai bahan yang digunakan untuk penetulang. Sebelum melakukan proses tuangan pasir, bahan ini akan di komposisikan antara aluminium dan tin dengan 'silicon carbide' mengikut pembolehubah yang ditetapkan. Daripada analisis antara aluminium dan tin akan mengkaji antara bahan yang berlainan akan mempengaruhi prestasi produk akhir dalam kontek ketepatan dimensi (mm) dan kekasaran permukaan.

ABSTRACT

Casting process basically involves pouring molten metal into a mould cavity. In this study, aluminum and tin with reinforcement with silicon carbide to determine affected surface roughness and dimensional accuracy (mm). The main objective of the implementation of this study was to investigate the different material aluminium and tin reinforcement with silicon carbide on dimensional accuracy and surface roughness using sand casting for manufacturing equipment. In this study, the main material used is aluminum LM6 and tin as the main material and the silicon carbide as the material used to reinforcement. Before the process of sand casting, this material will be composition between aluminum and tin with the silicon carbide. From the analysis of aluminum and tin with material composition will be affect the performance of the final product in the context of dimensional accuracy (mm) and surface roughness.

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DEDICATION

This thesis is dedicated to my parents Abd Razak Bin Md Yatim and Awa Bte Che Mat who introduced me to the joy of reading from birth, enabling such a study to take place today.

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LIST OF ABBREVIATIONS

ABS	-	Acrylonitrile Butadience Styrene
Al	-	Aluminum
AlSic	-	Aluminum Silicon Carbide
BOM	-	Bil of Material
CMM	-	Coordinate Measurement Machine
CO2	-	Carbon Oxide
FDM	-	Fused Deposition Machine
LCD	-	Liquid Crystal Display
Mm	-	Millimeter
MMC	-	Metal Matrix Composite
m/s	-	meter per second
Pa	-	Pascal
Ra	-	Roughness Average
RSM	-	Root Mean Square
SiC	-	Silicon Carbide
SiO2	-	Silicon Oxide
TinSic	-	Tin Silicon Carbide

CHAPTER 1

INTRODUCTION

1.1 Background

In this study, production tool is produced by using sand casting process. The important element in this study is how to build the accurate dimension accuracy production tool using and surface roughness by sand casting process. The conceptual model of part is created by using software SolidWorks for produce pattern. Typically, these processes involve the design of the production tool part using Solid Works because easy for the designer to interpreted their design and not only fitted with 2Dimensional axis only. Using SolidWorks, the design can be drawn in 3-dimensional (3D) and also drawn in full scale measurement.

The master pattern from SolidWorks and then transferred to Fused Deposition Machine (FDM) machine rapid prototype to create a final part. The pattern is made up from ABS material using FDM machine. The next process is sand casting process and is done by melt the actual master pattern in carbon dioxide (CO2) sand mold. The quality characteristic such as dimensional accuracy will be analyzed using Coordinate Measure Machine (CMM) and portable surface roughness tester.

Apart from that, the reason to conduct this study is to compare the dimension accuracy and surface roughness between aluminum and tin material composition produced by sand casting. Several literature reviews, generally from published journal, are undertaken into this study to identify the significant effect of dimensional accuracy and surface roughness of produced parts. Casting process is the basically involves pouring molten metal into a mould cavity where upon solidification its takes the shape of cavity. A wide variety of the product can be cast. This process is capable of producing intricate shape in one piece including those with internal cavities. The fundamental is essential for the production of good quality and economical casting and for establishing proper technique for mould design casting practice. Solidification and cooling of metals in the mould are effected by several factors including the metallurgical and thermal properties of the metal. The type of mould also has important influence because it affects the rate of cooling of the metal in the mould (Kalpakjian and Schmid, 2006). The reinforced with silicon carbide (SiC) particulates between aluminium and tin produce a homogenous distribution of reinforcement in the matrix. While other methods of production like casting have the problems of reinforcement segregation and clustering, interfacial chemical reactions, high localized residual porosity and poor interfacial bonding (Khairaldien *et al*., 2007).

1.2 Problem Statement

This study is aimed to find out the answer for the following question which is the dimension accuracy using sand casting produced part is not same as the master pattern. Dimensional accuracy is very important when sand casting is applied because if the final product not accurate, so the product will malfunction. However, the study review of casting process by using different material aluminium and tin reinforcement silicon carbide with indentifying the effect surface roughness. The manufacturer needs to recreate back the casting process and it will cost more for making the product.

1.3 Objective

The objectives of this research are:

i. To investigate the different material aluminium and tin reinforcement with silicon carbide on dimensional accuracy and surface roughness using sand casting.

ii. To identify the effect dimension accuracy and surface roughness using sand casting.

1.4 Scope of the Project

This research will emphasize on the casting quality with surface roughness and dimensional accuracy of aluminium and tin with reinforcement silicon carbide in sand casting. The effect of surface roughness and dimensional accuracy according to the different material through sand casting process with studied and explained in this research. In this research used aluminium and tin reinforced with silicon carbide composites in different structural applications. Other than that, production tool is an important component of manufacturing which contributes to a process of designing and developing the tools, methods and techniques necessary to improve manufacturing efficiency and productivity.

The scopes study this project about the:

a) Material composition (Aluminium and Tin with reinforcement Silicon carbide)

b) Casting quality (surface roughness and dimensional accuracy)

CHAPTER 2
LITERATURE REVIEW

2.1 Casting

2.1.1 Introduction

In this study, the basic casting principle of the most popular methods of producing parts in metal is by casting. Casting is the process of forming objects by pouring liquid metal into a cavity having the same shape as the finished article (the mould), and then letting it solidify and cool. When removed from the mould, the casting produced should be an exact replica of the mould (Frederick, 1996).

The casting process is little metal is wasted. In most early casting processes many which are still used that be must destroyed in order to remove the product after solidification. The used for permanent mould, which could be used to produce component in endless quantities, was the obvious alternative (Edward, 2003).

The casting and solidification process involve pouring and cooling the liquid metal. The information of the heat transfer and fluid mechanic occurring during pouring and cooling is also necessary (Bibby and Beddoes, 2003). Often, the casting process are important and extensively used manufacturing methods, enabling the production of very complex or intricate parts in nearly all types of metals with high production rates, average to good tolerances and surface roughness, and good material properties (Alting, 1994).

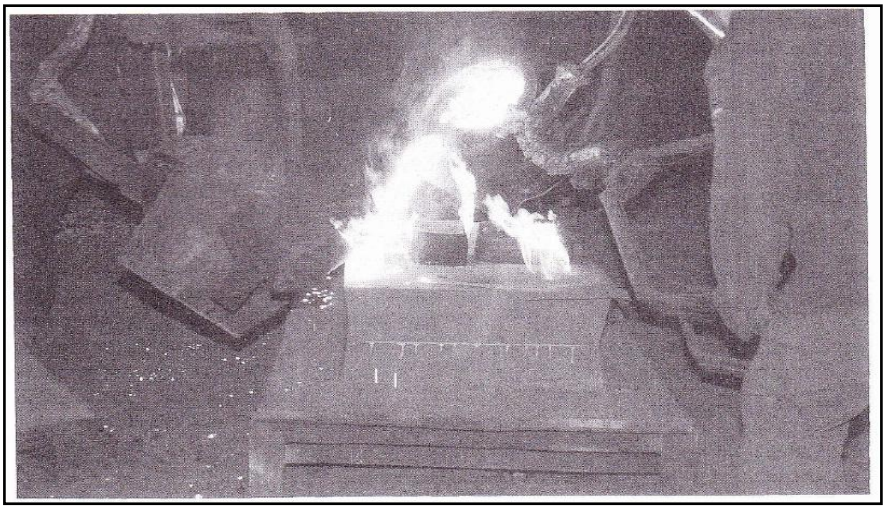

Figure 2.1: Pouring molten metal into mould (Parashar and Mittal, 2007).

2.1.2 Sand casting

In this study, the type of casting method used the sand casting technique process .In foundries; sand is used for making moulds. Natural sand found on the bed and banks of rivers provides an abundant source, although high quality silica sand is also mined. Sand is chemically SiO2 (silicon dioxide) in granular form. Ordinary river sand contains a contain percentage of clay, moisture, non-metallic impurities and traces of magnesium and calcium salts besides silica grains.