



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**Mechanical Behaviour & Water Absorption Of Metal Matrix Composite (Tin+Rice Husk) Fabricated Via Permanent Mould Casting : ( Experiment with 10% wt And 25% wt Rice Husk)**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Design Department) (Hons.)

by

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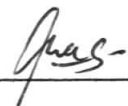
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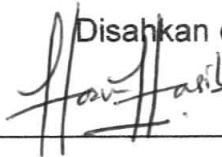
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## DECLARATION

I hereby, declared this report entitled “Mechanical Behaviour & Water Absorption  
Of Metal Matrix Composite (Tin+Rice Husk) Fabricated Via Permanent Mould  
Casting : ( Experiment With 10% wt And 25% wt Rice Husk)  
” Is the results of my own research except as cited in the references.

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## **APPROVAL**

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfilment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Design) (Hons.). The member of the supervisory is as follow:

.....

(Project Supervisor)

## ABSTRAK

Kajian ini membentangkan 'Mengkaji Sifat-Sifat Mekanikal dan Kadar Penyerapan Air untuk Komposit Matrix Logam (Timah + Serkam Padi) di buat Dengan Menggunakan Teknik Tuangan Acuan Kekal: Ujikaji Terhadap ( 10% wt dan 25% wt Serkam Padi) '. Tujuan kajian ini adalah untuk menggunakan semula bahan buangan untuk mengurangkan kos dalam membentuk *production tooling*. Satu siri tegangan, kekerasan, lenturan dan ujian penyerapan air telah dijalankan dengan menggunakan radas yang sesuai berdasarkan prosedur ujian standard ASTM. Ujian telah dijalankan ke atas 10%, 25% daripada Serkam Padi (RH) sebagai bahan tambah dan bahan utama adalah Timah (Sn). Kemudian, sifat-sifat mekanik kekuatan tegangan, tarikan tegangan kepada kegagalan, dan *Young Modulus* telah di analisis daripada keputusan eksperimen. Hasilnya dibandingkan dan disahkan antara komposisi gentian yang menunjukkan potensi untuk diaplikasikan. Spesimen telah direka menggunakan proses tuangan kekal. Dalam kajian ini, akan menerangkan terperinci tentang bagaimana untuk mencampurkan serat semulajadi dengan logam bukan ferus. Spesimen yang hendak direka adalah berdasarkan standard ASTM. Spesimen telah dibahagikan kepada dua kategori iaitu ujian mekanikal dan ujian penyerapan air. Beberapa parameter dalam melaksanakan proses tuangan telah diklasifikasikan dan dibincangkan. Tujuan kajian ini adalah untuk menggunakan bahan komposit sebagai *production tooling*. Seterusnya, untuk menggantikan fungsi getah dalam *production tooling* menggunakan serat semula jadi iaitu Serkam Padi.

## **ABSTRACT**

This research presents the ' Mechanical Behaviour & Water Absorption Of Metal Matrix Composite (Tin+Rice Husk) Fabricated Via Permanent Mould Casting : ( Experiment with 10% wt And 25% wt Rice Husk)'. The purpose of this research is to reuse waste material in order to reduce the cost in fabricating production tooling. A series of the tensile, hardness, flexural and water absorption tests were conducted by using the appropriate apparatus based on the ASTM standard testing procedure. The testing was conducted on the 10%, 25% of the Rice Husk (RH) as the reinforcement material and based material is Tin (Sn). Then, the mechanical properties of tensile strength, tensile strain to failure, and Young's Modulus were calculated from the results. The result is compared and verified between the composition of the fibres that showing distinctly promising potential. The specimens were fabricated using permanent mould casting process. In this study it will explain detail about how to mix the natural fibre with the non ferrous metal. The specimens are being designed based on the specimens standard based on ASTM standard. The specimen was divided into two categories one subjected to the mechanical testing and one for the water absorption testing. A few parameter in performing the permanent mould casting has been classified and discuss. The application doing this study is to apply the composite material for the production tooling. Next, to substitute the function of rubber in production tooling using the natural fibre it is Rice Husk.

## **DEDICATION**

*For my beloved family:*

FATHER

MOTHER

SIBLINGS

*For my adored friends:*

BMFR STUDENTS

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## **LIST OF ABBREVIATION, SYMBOLS AND NOMENCLATURE**

Sn	- Stannum (Tin)
CAD	- Computer Aided Design
B. C.	- Before century
m	- meters
cm	- centimetres
mm	- millimetres
kg	- kilograms
g	- grams
MPa	- Mega Pascal
GPa	- Giga Pascal
HV	- Hardness Vickers
HRB	- Hardness Rockwell B Scale
J	- Joule
UV	- Ultraviolet
SCS	- Silicon carbide fibers
W	- Tungsten
C	- Carbon
Al	- Aluminium
ASTM	- American Society for Testing and Materials
UTS	- Universal Testing Machine

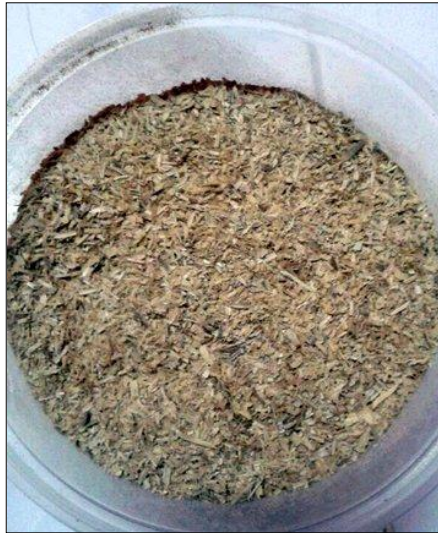
- N - Newton
- YS - Yield Strength

# CHAPTER 1

## INTRODUCTION

### 1.1 Background

Nowadays, everybody really concern about environmental such as global warming, energy consumption and the desire to obtain products from renewable sources have guide to the researcher interest in plant products. Plant fibre have their own interesting properties such as cost effectiveness, renewable, available in high quality, have low fossil- fuel energy requirements, and some of the cases can offer good mechanical properties has attracted its use of composite materials. (Sinha & Panigrahi, 2009). There are a lot of natural fibre outside. For example natural fibre that have been widely used are jute, kenaf, hemp, and flax, the leaf fibres abaca and sisal and also the fruit husk fibre coir. Since, the University Technical Malaysia Melaka is located at the Malaysia, and Malaysia is one of the biggest rice supplies in Asea, rice husk fibre (**Figure 1.0**) has been proposed as the reinforcement for this study.



**Figure 1.0:** Rice Husk

Composites material is now very familiar with the "fibreglass" also known as glass fibre reinforced polymer. Composite material has been used widely in the various fields such as aerospace, automobile and others. Metal matrix composite is the result a combination of different material between metal clas and other material based on their suitability. (Alexander et al, 2003). The parameter that designer should consider are, the method how to mix the composition, and the determination of the suitable process in producing the metal matrix composite. The composition of the natural fibre and metal is selected based on the application of the product that desire to fabricate. The product that want to fabricate in this project are production tooling using sand casting process.

Tooling is an important area in the manufacturing of the products. This aspect can be extremely expensive as well as time consuming. In order to get the suitable production tooling based on the applications, there are some important concepts that should be followed. The primary objective of tool design is to reduce manufacturing cost while maintaining the quality and increasing the production. There are various types of production tooling; jigs and fixtures are one of the production tooling. Basically, jigs and fixtures are work holding devices that are used to manufacture duplicate parts accurately or as supporting part to hold the product. Manufacturing of jigs and fixtures can be done using a lot of processes such as machining, casting, rapid prototyping and by using different materials. Jigs and fixtures can be divided

into two categories. A jig is a special device that holds, supports, or is placed on a part to be machined. (Edward G. Hoffman 2004)

Joshi (2001) said that current jigs are fitted with hardened steel bushing as a guide for the drills or other cutting tools. A fixture is a production tool that functions as a locator, a holder or a supporter that helps to hold the work securely so the process can be done efficiently. To manufacture the production tooling, the designer should make sure that the material matrix composite must meet standard property, such as high strength, high durability, corrosion resistance and can be recycled.

In order to get the result, a few experiments and testing will be set up. The 3 point flexural, tensile and hardness testing have been selected for the mechanical testing and water absorption testing to study the effect of the fibre act with the water during machining operation. Composites test specimens were manufactured using the same composition, mixture techniques and process with the process to make the production tooling. The experiment will set up using the appropriate ASTM standard. The specimen size is based on the ASTM specimen standard which is ASTM E 8 for tensile test specimen, ASTM E 855 for flexural test specimen and ASTM E 18 for hardness test specimen, ASTM D 570 for water absorption test specimen.

## **1.2 Problem Statement**

In the industry, there are a lot of problems in order to make sure the sustainability for environment in producing a product. One of the problems that have been justified is to make the jigs and fixture can be recycled. Typically, in industry the cost to make a brand new jig is quite expensive because of the accuracy of the jigs itself, the durability, and so on. In order to get the green manufacturing is by apply the suitable tools and material from the early process until the end. In produce the jigs, the function of rubber that prevent the part from scratch have been highlighted. The method is to replace the function of the rubber with the natural fibre. Rice husk has been proposed to counter this problem. Generally, rice husk is a one of the natural fibre type, to make a product using the natural fibre it required a suitable mixture. Because of their properties itself, it is impossible to make it as a jig in the industry. Tin have been proposed as the main material and rice husk as the support material. Normally, Tin is a non ferrous metal, which is can be recycled, high strength and high toughness as their basic properties. The detail will be explained in the next chapter.

### **1.3 Scope of Research**

In this sub topic, it will describe the outline of the study. In order to get the accurate result the process in making the specimen is used exactly the same process with the applied techniques. The casting process is being used to produce the specimen. The casting process is determined based on the process selection technique. The main material for the composite is selected using the material selection tools by using CES Edupack. The research only focuses on the 10% and 25% composed of Rice Husk and the composition for the Tin (Sn) are 90% and 75%. The process in making the specimen for metal matrix composite is using the Solid Works and the machining process to make permanent mould by using the CNC laser cut machine.

The experiment that will cover in this study are the water absorption test, tensile test, flexural test and hardness test. The experiment setup will be set up by using ASTM standard. The data will be discussed and make the comparison between the composition.

### **1.4 Research Objectives**

The objectives of this research are

1. To fabricate the permanent mould for the MMC specimen fabrication
2. To fabricate mechanical testing specimen from different material composition
3. To analyse the water absorption, tensile, flexural and hardness properties by applying the mechanical testing

## **CHAPTER 2**

### **LITERATURE REVIEW**

The literature review is where the information and data that have been established on a topic is defined. The discussion on the problem issue, research objectives and the methodology used are supported by the established information that reviewed from books, journals, articles and related website. Chapter 2 of this project report provided the introduction to the metal matrix composites. Furthermore, this chapter has a review of the material selection of the metal matrix composites which are consist of Tin and natural fibre. The material properties of each material which are general properties, mechanical properties, thermal properties, electrical properties and Eco properties also be considered . The method that has been used in mixing the mixture are by using sand casting process. Basically, sand casting process has three parameters that the engineer should consider for example temperature, pouring speed and time. For this project the specimen of the composition must be tested using appropriate testing. There are several types of mechanical testing and one water absorption testing for specimen will reviewed in this chapter.