UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LARGE SCALE HEAT TREATMENT OF ALUMINIUM ALLOY 1050 H24 FOR FORMING PROCESS

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

by

NORAZLIN BINTI AJALI

B050910188

900420015852

FACULTY OF MANUFACTURING ENGINEERING

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I hereby, declared this report entitled "LARGE SCALE HEAT TREATMENT OF ALUMINIUM ALLOYS 1050 H24 FOR FORMING PROCESS" is the results of my own research except as cited in references.

Signature	:	…….
Author's Name	:	……
Date	:	……

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 (Process) (Hons.). The member of the supervisory is as follow:

……

(Project Supervisor)

ABSTRAK

Penggunaan Aluminium Aloi sangat meluas di bahagian industri disebabkan oleh kekuatan dan ketahanan bahan tersebut, tetapi satu ciri terbaik yang dimiliki oleh bahan ini adalah kekemasan permukaannya. Rawatan haba telah dilaksanakan dengan menggunakan Furnace 1300 ke atas bahan tersebut dengan suhu yang berbeza-beza, dalam lingkungan 350°C - 660°C. Setiap suhu mempunyai masa pemanasan yang berbeza, dalam lingkungan satu jam hingga dua jam, kemudian diikuti oleh proses pernormalan pada suhu 170°C selama 15 jam. Selepas itu, spesimen disejukkan di dalam suhu bilik. Semua spesimen diuji dengan ujian rengan menggunakan mesin ujian regangan. Specimen juga diuji dengan ujian mikro kekerasan menggunakan mesin uji Vickers. Berdasarkan eksperimen yang telah dijalankan, Aluminium Aloi H24 yang tidak melalui proses rawatan haba menghasilkan nilai yang lebih tinggi di dalam ujian regangan dan mikro kekerasan berbanding dengan Aluminium Aloi H24 yang telah melalui proses rawatan haba. "Optical Microscope" atau juga dikenali sebagai OM telah digunakan untuk mengkaji grain size yang dipunyai oleh Aluminium Aloi H24 sebelum dan selepas rawatan haba dijalankan. Kajian mendapati bahawa, saiz "grain" menjadi lebih besar selepas melalui proses rawatan haba. Kesimpulannya, rawatan haba boleh mengubah sifat mekanikal dan juga saiz "grain". Kajian ini sangat penting untuk melembutkan struktur bahan bagi proses pembentukan seperti proses "stamping". Apabila struktur bahan itu lembut, kerosakan produk dapat dikurangkan.

ABSTRACT

Aluminium Alloy is widely used in industry because of high strength and hardness of the material, but one great characteristic is the surface finish. Heat treatment was performed using Furnace 1300 on the material with different temperature, ranging from 350°C - 660°C. Each temperature have different time of heating, ranging from one hour to two hour, and followed by normalizing process at 170°C for 15 hours duration. After that, specimens have been cooled at room temperature. All the specimens were test using tensile testing machine and microhardness testing using Vicker's microhardness testing machine. From the conducted experiment, it shows that non-heat treated Aluminium Alloy 1050 H24 produce high value of tensile and hardness compared to heat treated Aluminium Alloy 1050 H24.Optical Microscope has been used to observe and calculate the changes of the grain size before and after heat treatment process. It was found that grain size increased after the heat treatment process. In conclusion, heat treatment can alter the mechanical properties and the grain size. This study is important in order to make the materials softer for forming process, such as stamping process. As the material being soft, the product defects can be reduce.

DEDICATION

Ajali Bin Abd Rahim

Noraini Binti Ahmed

Dr. Nur Izan Syahriah Binti Hussein

Norazirah Binti Ajali

Mohammad Azwan Bin Ajali

Norfaizah Binti Ajali

Noraishah Binti Ajali

Mohd Azmi Bin Ajali

Mohd Safwan Bin Hamzah

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

Al	-	Aluminium
HV	-	Vickers Hardness
OM	-	Optical Microscope
UTS	-	Ultimate Tensile Strength
YS	-	Yield Strength

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CHAPTER 1
INTRODUCTION

This chapter presents the background of study, problem statement, aim and objective, scope, planning, and the structure of the whole report. Background of study describes generally about Aluminium Alloy 1050 H24. Problem statement describes the problem heading. Aim and objective states the main point of this study and scope describe the topic cover for this study.

1.1 Background of Study

Aluminium Alloy 1050 H24 is mostly pure aluminium that has a high strength and hardness. That is one of the reasons why Aluminium Alloy 1050 H24 is rarely being used. But, the surface finish of this material is great, and makes the industry attract to use them. Actually, a camera company has faced a problem in forming the material due to the high strength and hardness. Aluminium Alloy 1050 H24 will be form as housing of camera after undergoes stamping process. This study wants to observe if the high strength and hardness can be reducing using heat treatment process to make the forming process flow smoothly.

1.2 Problem Statement

Murakami *et al.* (2006) states that the aluminium alloys are increasingly utilized recently. It is to improve fuel consumption of vehicles by reducing their weight, and their excellent workability, corrosion resistance, and recyclability. Lim *et al*. (2012) it can be easily fabricated. Compared to stainless steel, Al 1050 Al 1050 has better electrical resistance than stainless steel, and the thermal conductivity of Al 1050 is 8.5 times greater than that of stainless steel. Due to Jimenez *et al.* (2009) the ultimate tensile strength is 105 MPa, the yield strength is 75 MPa, and the Vickers hadrness is 44. While undergo stamping process, it is a little bit difficult due to the high strength and hardness. It will make many step of stamping process needed and also lead to defects. Heat treatment process is used to reduce the high strength and hardness of Aluminium Alloy 1050 H24.

1.3 Aim and Objective

The aim of this study is to reduce the strength and hardness of aluminium alloy 1050 H24. This reducing of strength and harness will make the step of forming process being reduced. The objectives of this study are:

(i) To characterize the microstructure and properties of Aluminium Alloy 1050 H24 before heat treatment.

(ii) To observe the effect of heat treatment parameters to microhardness of Aluminium Alloy 1050 H24.

(iii) To investigate the effect of heat treatment parameters to tensile properties of Aluminium Alloy 1050 H24.

1.4 Scope

The scope of this study is to investigate the effect of microstructure of Aluminium Alloy 1050 H24 before and after heat treatment and microhardness processing. Heat treatment that will be used is heating in the furnace. Parameters of heat treatment process also important to achieve the objective. The parameters that will be included are temperature for heat treatment, time of heating and cold process.

1.5 Planning

Planning make our work systematic and arranged. Here, Gantt Chart have been build for my progress of my report. There are only 12 weeks to complete this first report. The presentation of the report will occur at the weeks of 13. As i get my title in week one, then, the discussion about the title was held in week two. Then, a little bit of time is needed to search as much information to make more understanding in this topic.

At week three and four, this is the time to refer to the journal, articles, standards and brainstorming for what to do in this report. Find the other research to study and investigate how they conduct the experiment. The journal and articles will be as references to do this report.

At week five, discuss how to make the actual report, such as format, standard, planning, and so on. After the discussion, at the week six and seven, start to do the chapter 1 of the report. Following week eight, nine and ten, planning to do the chapter 2, and week ten, eleven, and twelve do the chapter 3. The actual presentation will be held on the week of thirteen. The Gantt chart can be seen at Appendix A.

For second phase, the experiments started and finish the entire report. The Gantt Chart as shown in Appendix A. Planning the experiment in first week and start the

experiment until week 11. After that, week 12 until week 15 to do analysis and report writing. Lastly, checking for the entire report.

1.6 Structure of report

The summary of each chapter is described in the structure of report. The structure of the report includes Chapter 1 until Chapter 5 of the report.

Chapter 1: Introduction
Include the background of the study, problem statement, experimental design, objectives, scope and study management of the whole report.

Chapter2: Literature Review
Literature review on composition, properties, application, heat treatment, and testing of Aluminium Alloy.

Chapter 3: Methodology
The methodology of the study contains a brief explanation about the preparation of the experiments including the equipment used measurement on specimen preparation, heat treatment process, testing, and microstructure analysis.

Chapter 4: Result
The result presented.

Chapter 5: Discussion
Discussion for the result. The data will be analyzed.

Chapter 6:Conclusion and Recommandations
The conclusion for a whole of the study and the suggestion for future work not only used for the extension of the study, but also share the relevant information to others.

CHAPTER 2
LITERATURE REVIEW

This chapter presents the literature review on material, which is Aluminium Alloy 1050, properties of Aluminium Alloy, temper designations, heat treatment process and other related subjects. This chapter describe the properties of material, application, heat treatment process, tensile testing and microhardness test.

2.1 Aluminium Alloy

Ambroziak and Korzeniowski (2010) stated that aluminium as a pure metal is known since the beginning of the 18th century. It was extracted and isolated by Oersted (1825). Although the massive production method of extraction aluminium from its ore bauxite was discovered in the second half of 18th the century, the process in its basis is has been using until today. The mechanical strength of pure aluminium is relatively weak; this is the reason that for constructional purposes is used rarely. To increase the mechanical strength of pure aluminium some alloy elements are added, mainly silicon, magnesium, copper and zinc. Currently, aluminium alloys are common used in aircraft, military industry and automotive industry.

2.1.1 Properties of Aluminium Alloy

Ambroziak and Korzeniowski (2010) also said that aluminium and its alloy are a silvery white which have density from 2.6g/cm^3 up to 3.0g/cm^3. Although pure aluminium is light metal, the mechanical strength of some its alloys exceeds the strength of mild steel. It has high thermal and electrical conductivity, high reflectivity to both heat radiation and the light. It is non-magnetic material. The characteristic feature of aluminium is that there is no color change during heating. The melting temperature of pure aluminium is 660 ºC (1220 ºF). Aluminium alloys have approximately melting range from 480 ºC (900 ºF) up to 660 ºC (1200 ºF), it depends of the composition of alloying components.

It was mentioned the pure aluminium is not used as a material for mechanical constructions. To make it stronger alloying ingredients as copper, zinc, manganese, magnesium, silicon are applied. The designation of aluminium alloys indicates directly the form and composition of alloys and main alloying elements. The first digit identify the main alloying elements, the last three the composition of alloy. There are two forms of aluminium alloys which are:

(a) wrought alloys
(b) casting alloys.

2.1.2 Aluminium Alloy 1050

Material that will be used in this experiment is Aluminium Alloy 1050 H24. It is a wrought alloy. According to Jimenez *et al.* (2009), the chemical composition of Aluminium Alloy 1050 as the table below:

Table 2.1: Chemical composition of Aluminium Alloy 1050 H24 (Jimenez *et al.*, 2009)

Alloy	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti
1050 "H"	0.12	0.21	<0.005	0.02	0.01	<0.010	<0.005	<0.010

Lim *et al*. (2012) stated that it can be easily fabricated. Compared to stainless steel, Al 1050 has better electrical resistance than stainless steel, and the thermal conductivity of Al 1050 is 8.5 times greater than that of stainless steel.

2.1.3 Temper Designation Systems for Aluminium Alloys

Callister and Rethwisch (2011) says that composition for both cast alloy and wrought alloy are designated by a four-digit number that indicates the principal impurities, and in some case, the purity level. For cast alloy, a decimal point is located between the last two digits. After these digits is a hypen and the basic temper designation – a letter and possibly a one – to three – digit number, which indicates the mechanical and/or heat treatment to which the alloy has been subjected. For example, F, H, and O represent respectively, the as-fabricated, strain-hardened, and annealed states.

Benedyk (2009) said that as the arose in the aluminium industry to describe standard temper treatments and establish uniform temper designations, The Aluminium Association has served as the main body registering aluminium alloys and temper designations in its ANSI H35.1 standard. Wrought aluminium alloys in the strain hardened (H temper) class are generally 1xxx, 3xxx, and 5xxx alloys, which those classified as thermally treated or heat treatable (T temper) are generally 2xxx, 6xxx, and 7xxx alloys.

The basic temper designations in this system consist of the letters F, O, H, W, or T including the general process of product manufacture or heat treatment. Table 2.2 explain the meaning of each letters.

Table 2.2: Basic temper designations (Bendeyk, 2009)

Letter	Meaning
F	As fabricated and no mechanical properties specified (F stand alone).
O	Annealed to obtain lowest strength temper (O may be followed by a digit to indicate an annealed condition with special characteristics).
H	Strain-hardened wrought products with or without additional thermal treatment to reduce strength (H always is followed by two or more digits).
W	Solution heat-treated to produce stable tempers other than F, O, or H (T always followed by one or more digits).
T	Thermally heat-treated to produce stable tempers other than F, O, or H (T always followed by one or more digits).

Subdivisions of the basic tempers are indicated by one or more digits that follow the letter, such as 1100-H14, 3003-O, and 3004-H38 are example for strain hardenable aluminium alloys of the 1xxx, 3xxx, and 5xxx series. 2024-T62, 6061-T451, and 7075-T7351 are example for heat treatable aluminium alloys of the 2xxx, 6xxx, and 7xxx series.