EFFECT OF TEMPERATURE ON THE MECHANICAL PERFORMANCE OF JOINTS BONDED WITH ELECTRICALLY CONDUCTIVE ADHESIVE

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A thesis submitted in fulfillment of the requirements for the degree of Bachelor of Mechanical Engineering

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DECLARATION

I declare that this report entitles "Effect of Temperature On The Mechanical Performance of Joints Bonded With Electrically Conductive Adhesive" is the result of my own research except as cited in the reference. The report has not been accepted for any degree and is not concurrently submitted in candidature of any degree.

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APPROVAL

I hereby declare that I have read this dissertation/report and in my opinion this dissertation/report is sufficient in terms of scope and quality as a partial fulfillment of Bachelor of Mechanical Engineering.

Signature : ....

Name : Dr. Mizah Binti Ramli

Date : ....

DEDICATION

This report work is dedicated to my beloved mother and father, whose has been support physically, emotionally and financially during the challenges to graduate school and life. I also truly thankful to my friends whose always helpful and been there to support and helped me. I am sincerely thankful for having you in my life.

ABSTRACT

An electrically conductive adhesive is glue which is used in method of joining and it's widely used in the electronic industry. An electrically conductive act as a medium for electric current to pass through them. The function of electrically conductive adhesive same as soldering process. However, due to the sensitivity of the electronic part to the temperature, the application of the electrically conductive adhesive is more compatible compared to the soldering process. There are a lot of factors that must be considered to design the adhesive joints. One of the factors is the effects temperature on the strength of the adhesive joints. In this study, the characteristic of the electrically conductive adhesive on the temperature was studied. In order to carry out this experiment, single lap joints of the specimen were used. The specimens were exposed to the room temperature, low temperature and high temperature. The specimens were tested using tensile test machine and the strength were of these three condition were compared. Then, the fractures of the specimens were examined using 3D Profilometer and the results of the degradation of the electrically conductive adhesive due to the temperature were compared.

ABSTRAK

"Electrically conductive adhesive" ialah sejenis gam yang mana digunakan dalam kaedah penyambungann dan digunakan secara meluas dalam industri elektronik. "Electrically conductive adhesive" akan bertindak sebagai satu medium untuk arus elektik lalu melepasi mereka. Fungsi "electrically conductive adhesive" adalah sama dengan proses pematerian. Walau bagaimanpun, disebabkan oleh bahagian elektonik yang sentsitif pada suhu, penggunaan "electrically conductive adhesive" dilihat lebih sesuai berbanding proses pematerian. Untuk mereka bentuk peyambungan gam, banyak faktor yang perlu dipertimbangkan. Salah satunya ialah kesan suhu keatas keatas penyambungan gam. Dalam pembelajaran ini, kesan suhu keatas ciri-ciri "electrically conductive adhesive" disiasat. Untuk menjalankan eksperimen ini, "single lap joints" specimen digunakan. Specimen-spesimen akan didedahkan kepada suhu bilik, suhu rendah dan suhu tinggi. Specimen-spesimen akan diuji menggunakan mesin ujian tegangan dan kekuatan specimen untuk ketiga- tiga keadaan akan dibandingkan. Selepas itu, pematahan spesimen akan diuji menggunakan "3D Profilometer" dan keputusan untuk kemerosotan "electrically conductive adhesive" akan dibandingkan.

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LIST OF ABBREVIATIONS

ICA	Isotropic Conductive Adhesive
SMD	Surface Monitoring Device
ACA	Anisotropic Conductive Adhesive
LCD	Liquid Crystal Display
PCB	Printed Circuit Board
RFID	Radio Frequency Identification
SLJs	Single Lap Joints
RT	Room Temperature
TAST	Thick Adherent Shear Test
RTV	Room Temperature-Vulcanizing
DMA	Dynamic Mechanical Analysis
GFRP	Glass Fibre Reinforced Polymer
AT	Ambient Temperature
DCB	Double Cantilever Beam
MW	Microwave
ACF	Anisotropic Conductive Film
DSC	Different Scanning Calorimetry
EDS	Energy Dispersive Spectroscopy
CFRP	Carbon Fibre Reinforced Polymer
DLJs	Double Lap joints

HTA	High Temperature Adhesive
LTA	Low Temperature Adhesive
CTE	Coefficient of Thermal Expansion
ABS	Acrylonitrile Butadiene Styrene
PLA	Polyactic Acid
ASTM	American Society for Testing and Materials
ECA	Electrically Conductive Adhesive

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

An electrically conductive adhesive is glue which is widely used in electronic industry. An electrically conductive adhesive will act as a medium for electric current to pass through them. There are a lot of advantages why conductive adhesive is widely used in the industry instead of soldering processes. Based on the research, some of electronic parts cannot be soldered due to the sensitivity of temperature. Therefore, conductive adhesive is the best problem solving for electronic parts that sensitive to the temperature because it proves that the temperature of the soldering process is higher than conductive adhesive [1]. In addition, ability of conductive adhesive to withstand vibrations is better compared to the solder. Besides, conductive adhesive is more flexible and easy to use compared to the solder. Electrically conductive adhesive is divided into two types which is isotropic and anisotropic. Isotropic conductive adhesive (ICA) is define as the electrically conductive in all directions. For an example, isotropic is used for a chip contacting and bonding electrically conductive surface mounting device (SMD). Anisotropic conductive adhesive (ACA) are electrically conductive only in one direction and it's contain special conductive particles in the µm range. For an example, liquid crystal display (LCD) connection, contacting flexible printed circuit board (PCB) and bonding antenna structures on radio-frequency identification (RFID) are used anisotropic because they contain sensitive structure on circuit boards [2].

Adhesion usually used in method of joining. Adhesion tends to suffer from the degradation of the joint at elevated temperature and in water compared to the other method of joining, such as welding, brazing, soldering, and fastening. There are a lot of factors must be considered to design the adhesive joints. One of them is the effects temperature on the strength of adhesive joints. Therefore, in order to improve the temperature of adhesive joints, a lot of work has been made. Cure shrinkage, the coefficient of thermal expansion (CTE) and different adhesive mechanical properties are the most important factors to measure the strength of adhesive joint when it applied under extreme temperature range. However, due to polymeric nature of adhesives, generally the most significant factor must be consider to design bonded joint is the variation of the mechanical properties of the adhesives with temperature. At low temperature the high thermal stresses and the brittleness of the adhesive are the origin of such behaviour, while at high temperature the adhesive strength is low [3].

1.2 PROBLEM STATEMENT

Temperature is a significant factor that must been considered while designing and manufacturing adhesive joint because temperature can contribute a major effect to the electric circuit and adhesive joint. High temperature and heat has always been a problem to the electric circuit because it can lead to the damage circuit components. For an example, high temperature will lead to the overheating of the chip and melted the plastic casing of the chip. In addition, damage of adhesive forces between substrate, damage of adhesive layer and changing mechanical properties of adhesive glue may occur if there are any changes in environmental condition.

1.3 OBJECTIVE

The objectives of this project are as follows:

1. To investigate the mechanical properties of the adhesive joints under low temperature and high temperature.
2. To examine surface fracture of an adhesive joints taken by 3D Profilometer.

1.4 SCOPE OF PROJECT

The scopes of this project are:

1. This project is design according to the ISO standard of single lap joint. This project involved joining between two metals using an adhesive.
2. The changing of mechanical properties was observed and mechanical testing was conducted under high temperature and low temperature.

1.5 GENERAL METHODOLOGY

The actions that need to be carried out to achieve the objectives in this project are listed below.

1. Literature review

   Journals, articles, or any material regarding the project will be reviewed.

2. Design specimen

   Design specimen according to ISO standard of single lap joint.

3. Fabrication

   The fabrication process will conducted at Makmal 2 Bahan Termaju. This process involved joining an adhesive joint according to ISO standard of single lap joint.

4. Experiment

   Experiment will be presented on how the experiment of mechanical properties of an adhesive joint under high temperature and low temperature.

5. Analysis

   Analysis will be presented on how to analyse the problem of an adhesive joint under high temperature and low temperature.

6. Report writing

   A report on this study will be written at the end of the project.

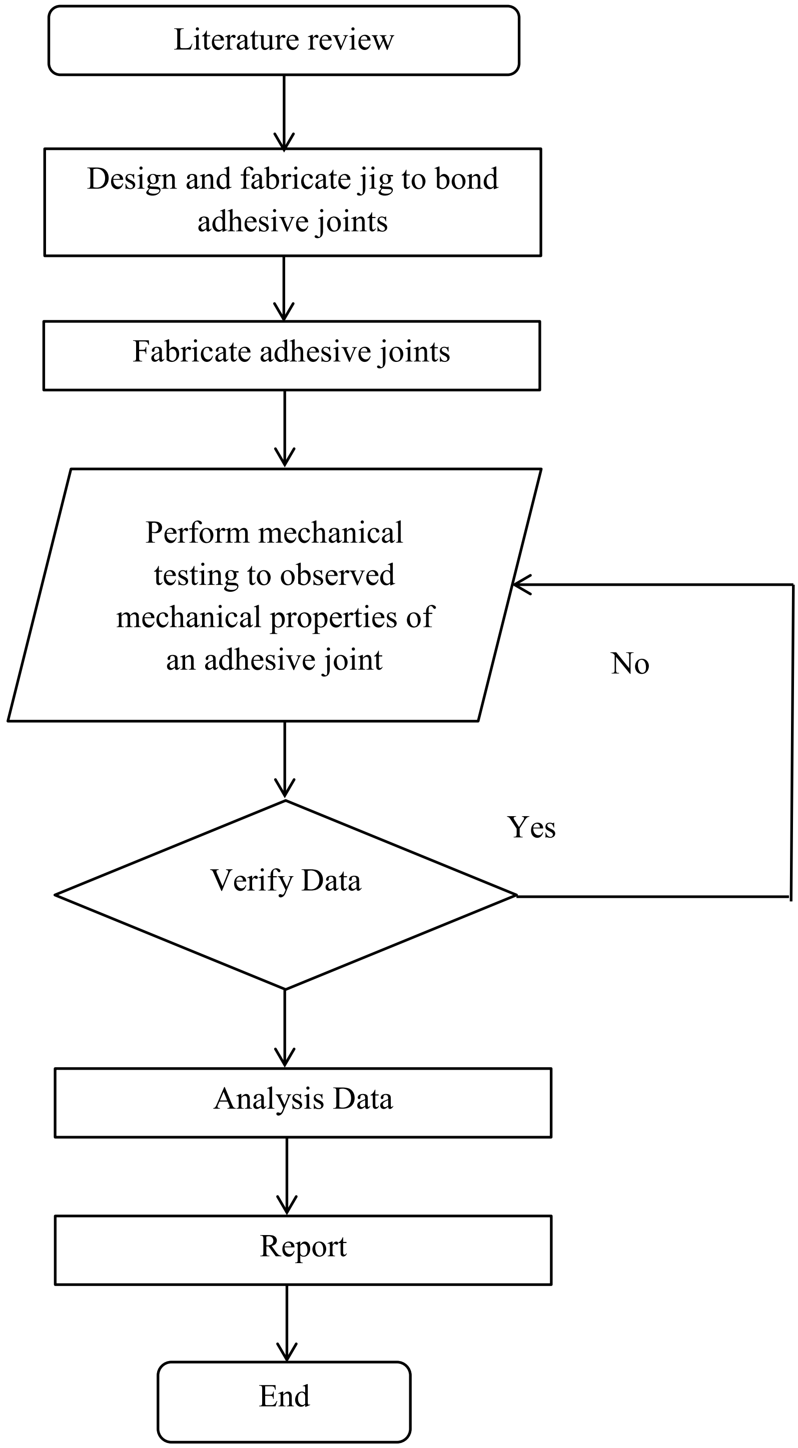

Figure 1.1: Flow chart of the methodology.