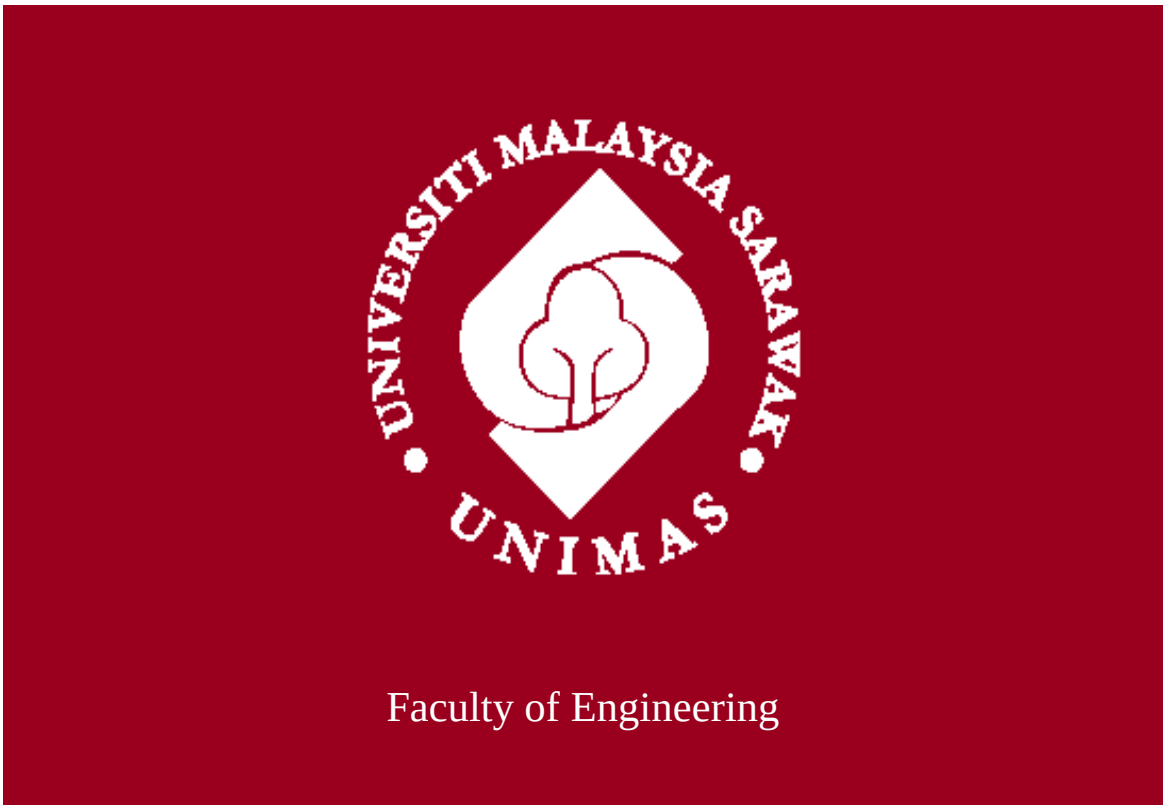

TENSILE STRENGTH OF POLYESTER WITH DIFFERENT COMPOSITION OF ALUMINUM FILLER

Chong Sia Onn

Bachelor of Engineering with Honours
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APPROVAL SHEET

This project report, which entitled "Tensile Strength of Polyester with Different Composition of Aluminum Filler", was prepared by **Chong Sia Onn** as a partial fulfillment for the Bachelor's Degree of Engineering with Honours (Mechanical and Manufacturing Engineering) is hereby read and approved by:

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TENSILE STRENGTH OF POLYESTER WITH DIFFERENT COMPOSITON OF ALUMINUM FILLER

CHONG SIA ONN

Thesis Is Submitted To
Faculty of Engineering, Universiti Malaysia Sarawak
In Partial Fulfillment of the Requirements
For the Bachelor Degree of Engineering
with Honours (Mechanical and Manufacturing Engineering) 2008

Dedicated to my beloved family and friends

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ABSTRAK

Kini, penggunaan pelekat merupakan salah satu kaedah yang penting untuk melekat bahan. Maka, adalah penting untuk mengetahui cirri-ciri gum untuk mereka produk yang menggunakan kaedah gum untuk melekat bahan. ‘Polyester resin’, salah satu gum yang paling banyak kegunaannya, telah digunakan untuk membuat eksperimen. Tujuan projek ini adalah untuk menentukan kekuatan ‘polyester’ dengan peratusan serbuk aluminium yang berlainan dalam polyester resin. Tiga eksperimen telah dibuat iaitu eksperimen dengan menggunakan bentuk gabungan yang berlainan, eksperimen dengan panjang lekatan yang berlainan dengan sambungan dan eksperimen untuk ‘bulk specimen’. Keputusannya diterjemahkan dalam carta untuk membuat perbandingan tentang kekuatan, ketagangan dan daya retakan bahan ujian. Melalui projek yang dibuat, pelbagai kaedah yang digunakan telah membawa kesan kepada kekuatan ‘polyester’. Daya retakan bagi polyester menjadi berbeza apabila diuji dengan beberapa eksperimen kerana daya retakan telah dipengaruhi oleh perubahan dalam pelekat semasa eksperimen. Keputusannya, ujian ‘bulk specimen’ untuk ‘polyester’ menunjukkan kekuatan yang lebih rendah daripada ujian yang menggunakan ‘simple single lap joint’. Sebenarnya, ujian ‘bulk specimen’ menunjukkan keputusan yang lebih jitu dibandingkan dengan ujian menggunakan ujian sambungan ‘joint’. Maka, data ‘bulk specimen’ adalah lebih sesuai untuk dijadikan sebagai rujukan untuk membuat jangkaan bacaan semasa mereka sesuatu.

ABSTRACT

Adhesive bonding is one of the most important joining methods available nowadays. So, it is important to know the properties of the adhesive in designing the product that required adhesive bond. Polyester resin, one of most widely used adhesive is tested in the project. The purpose of the project is to determine the strength of the polyester with different composition of aluminum filler in polyester resins. Three tests were conducted which are tested with different joint geometry, different overlap joint length and bulk specimen test. The results are interpreted in the diagram to make the comparison based on the strength, strain, and load to failure of test specimen. From the project, different methods has shows influence to the strength of polyester adhesive. The load to failure of polyester is varying from test to test because the load to failure is influenced by the changes in adhesive during testing. From the test, bulk specimen test for polyester resin shows lower strength than simple single lap joint test. Bulk specimen test show more precise reading than joint test. So, the data from bulk specimen test is more convenient to use as reference during designing.

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E	-	Young's Modulus
F	-	Load to failure
W	-	Weight
w	-	Weight fraction
ε	-	Strain
σ	-	Tensile Strength
ρ	-	Density
ν	-	Poisson ratio
υ	-	Volume fraction

CHAPTER 1

INTRODUCTION

1.0 Introduction

The word ‘adhesion’ comes from the Latin word adhaerere to stick to. The word ‘adhaerere’ is mixed of ad (means to) plus haerere (means to stick). [1] According to Kinloch (1987), an adhesive may be defined as a material which when applied to the surface of materials can join them together and resist separation.

From the earliest days, adhesives have been applied in the human lives. The materials likes glues, cements gums, resins, pastes are all can be categories as adhesives. [2] Nowadays, adhesive joining method had been used extensively in many scientific and technological areas. This technique is preferable compared to the classical joining methods like mechanical fastening. Adhesive bonded joints have advantages over other joining methods which is light weight, more uniform stress distribution over joint area, ability to join thin and thick materials of any shape and ability to join similar and dissimilar materials. (Pizzi, A., 1994) Polymeric adhesives may be used to join a

large variety of material combinations: metal-metal, metal-plastic, metal-composite, composite-composite, plastic-plastic, metal-ceramic, and so on.

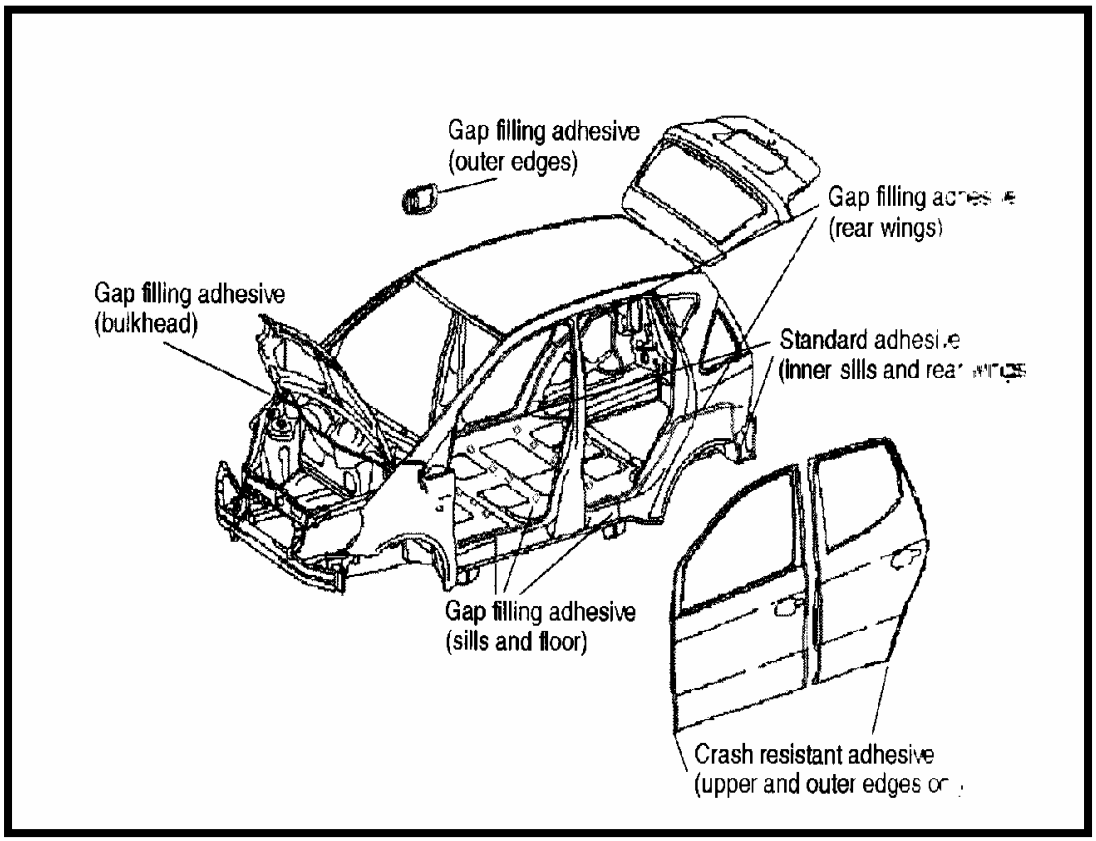

Figure 1.1: Application of Adhesives in Car (Adams, R. D., 2005)

Adhesives can be classified into four, which are thermosets, elastromers, thermoplastics, and natural products and modified natural polymers. [1] Polyester resin is one types of resin in thermosetting class. Polyester resin, which is also called as unsaturated polyester resin are one of the most widely used resin systems. There are many types of polyester resin exist nowadays such as chemical resistant resin, cold press type resin, hot press SMC resin, and hot press BMC resin and so on. [3] Due to

the low cost of resin and easy to use of it, they have applied in a lot of industry and field. Some of the applications of polyester resin are in aerospace applications, agricultural applications, aircraft applications and etc. (www.ides.com, 20 April 2008)

Filler is the additives adding to the adhesives to achieve a specific properties required in application. Usually, the properties desired by adding fillers is to increase viscosity, improve abrasion resistance and gap-filling properties, impart specific electrical or mechanical properties, or reduce cost and shrinkage. [1] By adding aluminum filler to the adhesive, the substrate will show improvement in the dimensional accuracy, tensile strength, wear resistance and thermal conductivity. (Chung, S. I. et al, 2001)

The project is about to determine the tensile strength of polyester with different composition of aluminum filler, which are 0%, 5% and 10%. The strength of polyester adhesive is tested with three methods. These methods including testing with different types of joint geometry, different overlap joint length and bulk specimen test. Single lap joint is one of the most common joints encounter in practice and is the configuration most often used for testing adhesives. So, it is chosen for the testing. For the testing with different joint geometry, the strength of polyester adhesive is checked by simple single lap joint and scarf joint. For the test with different overlap joint length which are 12.7mm, 25mm and 50mm, it is also applying simple single lap joint. Direct loading to the bulk specimen without lap joint is to be applying to the polyester bulk specimen in

the bulk specimen test. The entire tensile tests are doing at the room temperature by using Shimadzu Autograph machine.

The objective of the project is to analyze the effect to the strength of polyester with different composition of aluminum filler for bulk specimen test, different joint geometry and different overlap joint length.

1.1 Importance of Study

From the test, the limit of the strength of adhesive can be determined. The strength of adhesives is important to verify the properties of the material to which application the material can be applied to, either in normal environment condition, mild environment condition or critical condition. The load to failure, percentage elongation, modulus of elasticity and other properties which required in design criterion of the product also can be achieved from the test. Addition of filler to adhesives and different overlap length of bond joints have show their important in many applications. So, it is the necessary to know the effect of them to the strength of the adhesives which is one of the significant requirements in design and manufacture products.

CHAPTER 2

LITERATURE REVIEW

2.1.1 Applications of Adhesive Joint

Nowadays, adhesive joint is widely use in the engineering field such as automobiles, marines, electrical and electronics and so on. [4]

In automobile application, the hem flanges is filled with different types of adhesive and sealer in the suitable quantity to achieve good corrosion resistant. Usually hot-curing one-part epoxy adhesive with high modulus and good adhesion to oily sheets are used to enhance the stiffness body under static and dynamic loads.

Adhesives used for marine application should provide high moisture resistance. Direct immersion is expected only in underwater parts, bilges and tanks, but humidity is usually high in any case. Heat resistant and Ultraviolet (UV) resistant should be taken into consideration in all areas on decks and free board because the strength and stiffness of adhesives can significantly with these two parameters.

For electrical and electronic field, adhesives can be applied either for electrical conductive or isolating. Polymers can be operating as insulator in condition of varying voltage from few (in communication equipment) to a million volts in power distributed system. An electrical field involves heat dissipation so polymers must have a certain degree of thermal conductivity linked to a heat resistance. [4]

2.1.2 Advantages and Disadvantages of Adhesive Bonding

There are the reasons why adhesives are used for joining. Below are the benefits of using adhesives to such joining methods as riveting, bolting, spot-welding, ultrasonic welding, welding or mechanical clipping [1]:

1. Reduction in weight
2. Ability to join thin and thick materials of any shape
3. Provides more uniform stress distribution over joint area
4. Improvement in joint strength
5. Ability to join similar and dissimilar materials
6. Scope for sealing as well as joining
7. In some cases repairs are more readily effected
8. Increased flexibility in choice of component material
9. Elimination of extra components such as keys
10. Elimination in some cases of machining operations