DETERMINATION OF EFFECTS ON DIFFERENT COMPOSITIONS OF POLYMER BLEND THROUGH EXTRUSION PROCESS AND THE MECHANICAL PROPERTIES OF AN ABS-PVC-LD PE

MUHAMMAD IZHAR BIN ABDUL RAOB

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

I approve that we have read this thesis thoroughly and through I/ our opinion, this thesis is good enough from the aspect of scope and quality to be awarded for Bachelor of Mechanical Engineering (Material & Structure).

Signature :

Supervisor : Miss Nortazi binti Sanusi

Date :

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This report is written in order to fulfill the terms in achieving the award for Bachelor of Mechanical Engineering (Material & Structure)

Faculty of Mechanical Engineering

Universiti Teknikal Malaysia Melaka

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"I admit that this report is all done by me except for the summary and the article which I have stated the source for each of them"

Signature :

Author : Muhammad Izhar Bin Abdul Raob

Date : 27th March 2008

To my beloved mother, father and best friend, Afzan Ranai

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ABSTRAK

Proses penyemperitan ialah satu proses dimana satu daya dikenakan pada bahan termoplastik sehinggalah ia keluar pada acuan. Dalam proses penyemperitan, bahan plastik diletakkan didalam bekas untuk dilakukan proses peleburan didalam silinder penyemperitan, putaran skru melalui acuan dan akan dapat diketahui bentuk yang akan dihasilkan berdasarkan acuan. Proses ini dilakukan untuk membuat paip, pembuluh, batng bulat, helaian, batang segi empat, gelongsor rumah dan pelbagai bentuk lagi. Proses Penekanan Panas adalah satu proses pembuatan dimana ia digunakan untuk mengurangkan keadaan berliang pada material and mempengaruhi ketumpatan untuk banyak bahan. Ini akan memperbaiki sifat-sifat mekanikal, keupayaan kerja dan ketumpatan setiap bahan. Acuan untuk mesin ini adalah dalam lingkungan 2 mm sehingga 3 mm. Untuk projek ini proses penyemperitan dan proses penekanan panas akan memberikan suhu kepada bahan dan kita akan lihat ia akan mergubahkan sifat-sifat mekanikal bahan untuk semua komposisi yang diberikan. Untuk kes ini proses pencampuran ini boleh memperbaiki komposisi untuk semua gabungan-gabungan polimer. Proses penyemperitan untuk kombinasi bahan campuran ABS dengan PVC telah menunjukkan nilai ricihan yang tertinggi berbading bahan yang lain. Kombinasi yang berbeza menunjukkan ia mengikat lebih baik antara satu sama lain berbanding bahan utama. Ini kerana proses penyemperitan boleh mengawal keadaan suhu dan kelajuan suhu cairan berdasarkan pada bahan yang digunakan. Pada eksperimen ini bahan utama ABS merupakan bahan yang paling bagus sifat-sifat mekanikalnya berbanding kombinasi yang lain.

ABSTRACT

Extrusion is a process for making continuous forms by forcing a thermoplastic material in the plastic state through a die. In Extrusion, plastics are fed through a hopper to a heated plasticizing cylinder where they are melted, then driven by rotating screws through a shaped die that determines the shapes of the extruded part. The process is used for the fabrication of pipe, flexible tubing, rods, sheets, tubes, house siding and other shapes. Hot isostatic pressing is a manufacturing process used to reduce the porosity of material and influence the density of many materials. This improves the mechanical properties, workability and density of the material. The mold for hot isostatic press is 2 mm thickness and 3 mm thickness**.** For this project the extrusion process and hot isostatic press would give a temperature to the material and we can see it will change the mechanical properties for the all composition material. In this case the mixing process it can improve all the composition of the combination polymers. The extrusion process for this combination material the ABS blends with PVC make a higher torque compare to other material. The different composition makes it better bonding compare to main material. It's because of the extrusion process can set the parameter for the speed and temperature melting point based on material. This experiment for the main material ABS is the good mechanical properties compare to the others combination.

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σ	= Stress, N/m^2
F	= Force, N
A	= Area, m^2
ε	= Strain
l_i	= instantaneous length, m
l_o	= original length, m
Δl	= amount of elongation, m
E	= modulus of elasticity, psi or Pa
m	= mass, kg
ρ	= density, kg/m^3
v	= volume, m^3

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CHAPTER I

INTRODUCTION

1.1 Background

Engineering polymers comprise a special high performance segment of synthetic plastics material. They may be shaped into mechanically functional, semi-precision parts or structural components. The term mechanically functional implies that the parts will continue to function even if they are subjected to factors such as mechanical testing. As substitutes for metal in the construction of mechanical apparatus, engineering plastics offer advantages such as corrosion resistance, lightness and economy. Replacement of metal by plastics improves the cost of metal and their fabrication increases.

Plastic application in transportation, a major growth opportunity, has been greatly accelerated by the current awareness of the interplay of vehicle weight and fuel requirement. The ability to replace metals in many areas has resulted growth in engineering thermoplastics. A significant driving force behind the growth in engineering thermoplastics is the continuing expansion of electrical markets. In addition the same requirement is driving the automotive market segment. Original equipment manufacturers strive towards lower production cost, style flexibility, lower maintenance and more efficient, lower polluting vehicles that utilize better performing materials under the hood and in exterior components. The consumption

of engineering plastics increased from 10 million to more than 15 billion pounds from 1953 to 1999. Engineering polymers are the fastest growing segment of the plastics industry with an anticipated growth rate from 12 to 15%. (Clara and Charles, 2000)

1.2 Objective

To analyze and determine whether extrusion process has a statistically significant effect with different composition and to study mechanical properties obtained from the applied test. In this experiment we should have the procedure to follow from extrusion process then goes to crusher machine followed by hot isostatic press and sample cutter for dog bone and lastly do the tensile test to measure the mechanical properties of the material test.

1.3 Scope

Scope for this case study is to analyze and evaluate the extrusion process manufacturing on some given mechanical properties for ABS-PVC–LD PE with a given composition. The analysis will be done at different temperature, dimension and the different combination of the polymer. The combinations that have been decided is ABS (Acrylonitrile-butadiene-styrene) + LD PE (Low-density polyethylene, PVC (Polyvinyl chloride) + ABS (Acrylonitrile-butadiene-styrene) and ABS (Acrylonitrile-butadiene-styrene) + PVC (Polyvinyl chloride) + LD-PE (Low-density polyethylene).

This experiment are very important for analysis in order to decide if the polymer combination has a effect in this extrusion process and shows different mechanical properties in combination of these types of polymer. In this experiment five specimens as required in standard material (ASTM D638) will be tested with different dimension.

ABS (Acrylonitrile-butadiene-styrene) have been choose as the one main for this extrusion process because of the highest melting point compare with the PVC (Polyvinyl chloride) and LD PE (Low-density polyethylene). Then, the changing for the mechanical properties of this type of combination and know about the strength of the material with the tensile testing.

1.4 Application

Polymer blend are defined as a mixture of polymeric materials and consist of at least two polymers. The main reason for blending is for economy. The performance of an engineering resin can be extended by mixing with a lower cost polymer. In this way, the new material can be developed. In addition industrial polymer scrap may also be recycled.

The polymer blend currently dominates the market like ABS (Acrylonitrile-butadiene-styrene). ABS blend process has a good mechanical strength, with their useful mechanical properties being due to the contributing properties of each of their components.

Acrylonitrile provides chemical resistance, heat resistance and toughness, while butadiene provides impact strength and styrene provides rigidity and easy processing. ABS blends are used for piping, electrical and automotive engineering. Some examples commercially important polymer blends are ABS/PVC and ABS/PET, as mentioned by Stuart, (2002).

1.5 Problem Statement

The major problem confronting scientists when designing testing techniques for fiber was the design of a technique able to operate for all different types of fibers. The two basic problems were differences in diameter and problem regarding the gripping of the fiber to the testing apparatus. Typically glass, Kevlar, carbon and ceramic fibers have similar small diameter (6μm to 12μm). However, boron and Sic fibers have larger diameters (100μm to 140μm) and high modulus (400 GPa). Hence they cannot sustain bending loads without failure.

In contrast, polymer fibers with diameters between 30μm to 40μm and modulus between 50 GPa and 100GPa, can be deformed without damage. Additionally, it should be noted that testing techniques based on axial tension may only provide adequate amounts of information for isotropic fibers like glass and boron. For anisotropic fibers like carbon, Kevlar and polyethylene, simple axial tests are far from sufficient in providing information about their transverse properties and poison's ratio. For this purpose, estimating techniques using indirect measurement from the axial testing are usually used.

CHAPTER II

LITERATURE REVIEW

2.1 Raw Material

In this experiment the ABS (Acrylonitrile-butadiene-styrene), LD PE (Low-density polyethylene) and PVC (Polyvinyl chloride) as a raw material. Then, this material will be mixing and will blend with the extrusion machine to see the mechanical properties for this combination ABS (Acrylonitrile-butadiene-styrene) + LD PE (Low-density polyethylene, ABS + PVC (Acrylonitrile-butadiene-styrene) and ABS (Acrylonitrile-butadiene-styrene) + PVC (Polyvinyl chloride) + LD PE (Low-density polyethylene).

2.1.1 ABS (Acrylonitrile-butadiene-styrene)

ABS is the name given to a family of thermoplastic. The acronym is derived from the three monomers used to produce ABS: acrylonitrile, butadiene and styrene. ABS materials are noted for their engineering properties such as good impact and mechanical strength combined with ease of processing. The ABS contains the following three chemical structural unit's polyacrylonitrile, polybutadiene and polystyrene. (Smith, 2004)

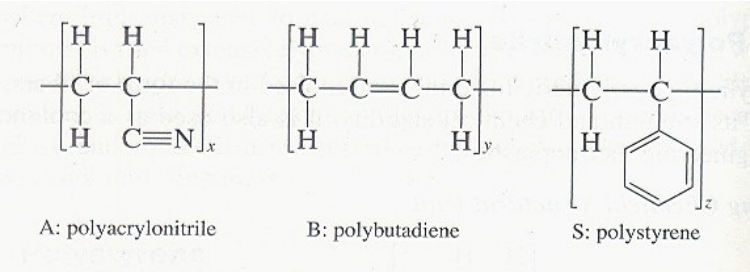

Figure 2.1: Chemical Structural Units ABS

(Source: Smith, 2004)

Structure and properties of ABS is useful in engineering properties exhibited by ABS due to contributing properties of each of its components. Acrylonitrile contributes heat and chemical resistance and toughness, butadiene provides impact strength and low-property retention and styrene provides surface gloss, rigidity and ease of processing. This information refers from Smith (2004).

Table 2.1: Some typical properties of ABS plastics

(Source: Smith, 2004)

	High Impact	Medium Impact	Low Impact
Impact Strength (Izod)			
Ft. Ib/in	7-12	4-7	2-4
J/m	375-640	215-375	105-320
Tensile Strength:			
X 1000 psi	4.8-6.0	6.0	6.0-7.5
(MPa)	33-41	7.0	41-52
Elongation (%)	15-70	10-50	5-30