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

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This report is written in order to fulfill the terms in achieving the award for Bachelor of  
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“I admit that this report is all written by myself except for the summary and the article which I have stated the source for each of them”

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To my beloved parents, siblings, friends and best friend.

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## ABSTRAK

Laporan ini adalah merupakan penyelidikan terhadap adunan antara polimer iaitu Polyvinyl chloride (PVC soft), Acrylonitrile butadiene styrene (ABS) and Polypropylene (PP) selepas melalui beberapa proses pemesinan di mana tahap yang paling penting adalah peringkat pengadunan bahan. Proses- proses yang terlibat adalah proses penyemperitan, proses penghancuran, proses penekanan panas isostatik dan ujian yang dijalankan adalah ujian ketegangan. Data yang diperolehi daripada proses penyemperitan adalah daya kilasan terhadap setiap adunan bahan manakala ujian ketegangan akan menampilkan sifat-sifat sesuatu bahan seperti Kekuatan Regangan, Kekuatan Regangan Muktamad, Modulus Keliatan dan daripada pengiraan serta pemerhatian, tahap kemuluran sesuatu adunan polimer dapat dikenalpasti. Melalui eksperimen, diketahui juga bahawa polimer yang terbaik adalah PVC di mana ujian yang dijalankan terhadap bahan juga membuktikan bahawa PVC mewakili nilai tertinggi dalam Kekuatan Regangan Muktamad berbanding bahan lain.

## **ABSTRACT**

This report is a research of polymer blend behavior between Polyvinyl chloride (PVC soft), Acrylonitrile butadiene styrene (ABS) and Polypropylene (PP) after it is applied through few machining processes where the most crucial part is the mixing stage. The processes include is the extrusion process, crushing process, hot isostatic process and tensile test. The data to be determined from the extrusion process is the torque for each composition where the data from the tensile test will represent the material properties of the tested material such as the Tensile Strength, Ultimate Tensile Strength, Modulus of Elasticity and also from the calculation and observation, the ductility behavior of the polymer material will be determined. Through the experiment, it is known that the best material is turned out to be pure PVC and from the above tests also, the most ductile material is found out to be the PVC as it represent the highest value of Ultimate Tensile Strength compared to other materials.

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## CHAPTER I

### INTRODUCTION

Polymer is one of the three classifications of a matrix composite besides metal matrix composites and ceramic matrix composites. It consists of polymer resin as the matrix and it is divided into three aspects that are thermosetting, thermoplastics and rubber. Polymer is widely used due to the characteristic that is ease of processing, light of weight and desirable mechanical properties.<sup>[1]</sup> Polymer or plastics extrusion is a high volume manufacturing process in which raw plastic material is melted and formed into a continuous profile. Raw thermoplastic material in the form of small beads which is often called as resin in the industry is gravity fed from a top mounted hopper into the barrel of the extruder.<sup>[1]</sup> Extrusion technique is very versatile and it can be adapted to produce wide range of products. Some of the applied polymer extrusion processes are a co-extrusion moulding in which two or more polymers are combined in a single process to produce a multi-layer film of the required mechanical properties.<sup>[2]</sup>

A polymer that is applied under different processes will result a different characteristic. In some applications, the mechanical properties will be the prime of interest while others of the physical properties will be the major concern.<sup>[3]</sup> Tests such as tensile tests will be applied onto the polymer in identifying the changes in the characteristics and the observation will be done on the surface morphology. The tensile test properties that are to be considered in this research are the Ultimate Tensile Strength, elongation and modulus of elasticity.<sup>[4]</sup>

## 1.1 Objectives

The objective of this research is to examine the characteristic of polymer after it is extruded into different composition between polymers which is also known as polymer blend. The purpose of this research is also to figure out the behaviours of plastic after applied process by different composition. The material will undergo through tensile test that will be done in a required experiment based on the reference standard of American Standard Testing Material (ASTM D638).

## 1.2 Background

Polymer is found out to be a solution as an alternative in many aspects these days. The specialty and benefits of a polymer especially for human beings these days has widened the use of it in variety of ways. The criteria that synchronized with its benefits such as it requires lower costs compared to the other matrix composite apart from it is lighter in weight, friendly user, easy to manufacture and a lot more. <sup>[1]</sup>

Methodology is being done until nowadays to establish the use of a polymer in ensure the better quality from many aspects such as the strength and appearances. Inventions have been done since years in obtaining the best research in engineering of polymer.

### 1.3 Problem statement

Compared to other material, polymer is one of a material that has the behaviour which can not stand too high temperature in almost all applications. Some polymers have the high appearance properties of plasticity which really suitable in most processes.

The problem for this experiment is that the raw materials to be used must be in particle shape. This is due to the required procedure and some circumstances of the machine itself. The experiment will be done by referring to the Thermo Haake table.

After materials are extruded, the extrudate might need to be crushed before hot isostatic press process is to be applied. This is due to the requirements of the added compositions and also, values for new mass must be calculated so that there will be enough materials to be pressed.

Tensile strength is also the process to be applied onto the specimens after extrusion process and the problem occur since the tensile strength of polymers tends to degrade with increasing temperature. Since the materials have been through hot isostatic press also, the structure might not perform well since there might be void for some parts of the plate being hot pressed and this will affect the tensile strength.

#### 1.4 Scope

This research is to analyze and to determine if variations in specific extrusion processing variables or parameters had a statistically significant effect on some given mechanical properties. The extrusion method will be applied under referred temperature as stated by the Thermo Haake standard of extrusion. In obtaining the result, the material will be tested under tensile test which will be done according to the American Standard Testing Material (ASTM D638) standard. The materials involved will be Polyvinyl chloride-Rigid (PVC-Rigid), Polypropylene (PP) and Acrylonitrile butadiene styrene (ABS). The composition of the materials will be the one to be tested through the mentioned tests.

## CHAPTER II

### LITERATURE VIEW

Polymers are substances containing a large number of structural units joined by the same type of linkage. These substances often form into a chain-like structure where the polymeric solid can be thought of as a material. The material that contains many chemically bonded parts or units which themselves are bonded together to form a solid.<sup>[1]</sup>

#### 2.1 Polymer

The word polymer literally means "many parts" and it is characterized by long chains of repeated molecule units known as "mers". The long chains are combined to form the bulk of plastic and the nature by the process itself will determine the plastics' microscopic properties. Man-made polymers have been studied since 1932.<sup>[5]</sup>

### 2.1.1 Classifications of polymer

The polymer plastics can be classified into two cases that are thermoplastics and thermosetting plastics. The properties are depending on how they are structurally and chemically bonded. <sup>[1]</sup>

#### i. Thermoplastic polymer

Thermoplastic polymers consist of the four most important commodity materials that are polyethylene, polypropylene, polystyrene and polyvinyl chloride. There are also a number of specialized engineering polymers. This type of polymer is normally defined as linear, one-dimensional polymers which have strong intra molecular covalent bonds and weak intermolecular Van de Walls bonds. These polymers are capable of flow at elevated temperature, can be remolded into different forms and easily dissolved. <sup>[6]</sup>A thermoplastic polymer is one which melts or flows when heated. Thermoplastic polymers are usually not highly cross linked, and act much like molecular solids such as low melting and boiling points, low strength and ductile. The term ‘thermoplastic’ indicates that these materials melt on heating and may be processed by a variety of molding and extrusion techniques. Thermoplastics offer many advantages over traditional materials including: low density, low energy for manufacture and low processing costs. <sup>[1]</sup>