UNIVERSITI TEKNIKAL MALAYSIA MELAKA

FLEXURAL BEHAVIOUR STUDY OF POLYPROPYLENE AT DIFFERENT ASH FILLER LOADING

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

by

WAN HIQMAL HISYAM BIN WAN HUSSIN
B071410152
921105-11-5549

FACULTY OF ENGINEERING TECHNOLOGY
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DECLARATION

I hereby, declared this report entitled "The Flexural Behaviour Study of Polypropylene at Different Ash Filler Loading" is the results of my own research except as cited in references.

Signature	:	………………………………
Author's Name	:	Wan Hiqmal Hisyam Bin Wan Hussin
Date	:	………………………………

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering Technology (Process Technology) (Hons.). The member of the supervisory is as follow:

……………………………….

Hairul Effendy Bin Ab Maulod

ABSTRACT

Polypropylene is widely used in the plastic industry regarding of flexibility polymer properties. Natural fibre coal ash (CA) is used as an essential matrix material for a polypropylene (PP) with help of 1 wt% of stearic acid (SA) coupling agent treated of polypropylene by utilizing literature based on the formulation in search for flexural properties. The primary objective of this research study is to evaluate and determine the strength and limit of polypropylene with coal ash based on flexural strength and modulus in order to finding the appropriate formulation of compound. Coal ash was left 24 hours around 30°C - 40°C to improve compatibility and dry-out moisture content of filler with polypropylene (PP). The compound will undergo crush-press process using hot press machine and crusher machine to ensure the well-mixing of the compound. The specimen cut into dog-bone shape using water jet machine before undergo flexural testing to evaluate and determine a strength and modulus limit. The best compounding formulation of the fabricate compound will be determine and observe with different percentage formulation of polypropylene (PP) and coal ash (CA) which is 100 phg of the polypropylene (PP) and different amount percentage of coal ash (CA) at 1, 2, 5, 7 and 10 from per hundred grams of polypropylene (PP). The morphology of the sample was observed by using optical microscope. Addition of coal ash (CA) filler on polypropylene significantly increase modulus of compound but decreases the strength compound compared to the pure polypropylene. In overall, all the listed research objectives were successfully achieved from this preliminary research.

ABSTRAK

Polipropilena digunakan secara meluas dalam industri plastik berdasarkan fleksibiliti di dalam polimer. Serbuk arang batu semulajadi digunakan sebagai bahan matrik utama untuk polipropilena (PP) dengan bantuan sebanyak 1 wt% daripada ejen gandingan asid stearik yang dicampur bersama polipropilena dengan mengunakan literasi berdasarkan rumusan dalam mencari ciri-ciri kelenturan. Objektif utama penyelidikan ini adalah untuk menilai kadar dan tahap kelenturan polipropilena bersama serbuk arang batu berdasarkan kekuatan kelenturan dan modulus dalam mencari formulasi sesuai untuk campuran bahan. Serbuk arang batu akan melalui proses pemanasan dengan membiarkan selama 24 jam bagi memanaskan abu dengan suhu dalam lingkungan 35°C - 40°C bagi menyesuaikan bahan tambahan di dalam polipropilena dan mengurangkan tahap kelembapan dalam serbuk arang batu tersebut. Campuran polipropilena dan serbuk arang batu akan melalui proses kisar-mampat menggunakan mesin mampat dan kisar untuk mendapatkan campuran seragam bagi campuran bahan. Bahan campuran tersebut di bentuk mengikut "dog-bone" dan di potong menggunakan mesin pemotong air sebelum melalui beberapa ujian kelenturan bagi menilai dan menentukan kadar dan tahap kelenturan bahan dan limit modulus. Rumusan campuran yang terbaik dikenalpasti dan diperhatikan melalui perbezaan peratusan rumusan polipropilena dan serbuk arang batu yang 100 phg daripada polipropilena (PP) dan jumlah peratusan yang berbeza bagi serbuk arang batu (CA) iaitu 1, 2, 5, 7 dan 10 per seratus gram daripada polipropilena. Morfologi sampel diperhatikan di bawah mikroskop optik. Tambahan serbuk arang batu ke dalam polipropilena meningkatkan nilai modulus namun mengurangkan tahap kekuatan berbanding polipropilena asli. Secara kesuluruhan, kesemua objektif yang disenaraikan berjaya di capai daripada kajian awal ini.

DEDICATIONS

To my lovely parents,

With love, sacrifice and their unconditional support throughout my life,

To my family, fiancée, and friends,

Who are always willing to help to prepare and complete this report,

Also,

For those who always pray for my success

And last but not forgotten,

For project supervisor who has given guidance for me produce this report.

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TABLE OF CONTENT

LIST OF TABLE

LIST OF FIGURE

LIST OF EQUATION

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

PP	-	Polypropylene
CA	-	Coal Ash
SA	-	Stearic Acid
MA	-	Maleic anhydridegrafted
%wt	-	Percentage of weight
°C	-	Degree Celcius
%PP	-	Percentage of Polypropylene
%CA	-	Percentage of Coal Ash
FA	-	Flexural Analysis
DMA	-	Dynamic Mechanical Analysis
OM	-	Optical Microscopy
S	-	Stress
N	-	Number of Cycle
HCF	-	Highest Common Factor
Phg	-	Per hundred grams
Php	-	Per hundred polypropylene
HDPE	-	High-Density Polyethylene
CC	-	Calcium Carbonate
EG	-	Eggshell
TA	-	Talc
KF	-	Kenaf
RHA	-	Rice Hush Ash
iPP	-	Isotactic Polypropylene
sPP	-	Syndiotactic Polypropylene
aPP	-	Atactic Polypropylene

CHAPTER 1

INTRODUCTION

This chapter will explain the overview of the study and the purpose of this study. The chapter includes the background of the study, problem statement, objectives that are expected to be achieved and the scope of the study that is going to be conducted.

1.0 Background of Study

Polypropylene (PP) is one of the most common types of material used in Malaysia due to their reasonable cost and several of utilization. In Malaysia, the use of polypropylene (PP) in so many applications results in growing volume of plastic products. This study is about flexural behaviour study of polypropylene (PP) at different ash filler loading. The effects of different loading of fillers on polypropylene (PP) compounds are been studied, in search of flexural properties. Thus, this study is aimed at the potential use of coal ash (CA) in polypropylene (PP) compound.

1.1 Problem Statement

Polypropylene development currently focuses more on the strengthen structure that related to the type of filler used as a binder material to ensure polypropylene (PP) can be achieved as good material in its lifecycle in finding flexural strength and modulus of flexural.

This research study is to evaluate the formulation of coal ash (CA) to improve the type of filler in mixing with polypropylene (PP) compounds. In order to get the appropriate formulation on the mixing of polypropylene (PP) compound with coal ash (CA) as a mixing material, some research studies on the flexural properties of polypropylene (PP) and coal ash (CA). The appropriate formulation on the mixing of polypropylene (PP) compound with coal ash (CA) will be interpreted in the industrial applications.

1.2 Objectives

The imprecise objective of this project is to enhance the study of polypropylene. The objective of the project is to:-

i. To study the current formulation of polypropylene (PP) compound coal ash (CA) filler from literature.
ii. To prepare compound with polypropylene (PP) and coal ash (CA).
iii. To study the flexural behaviour of polypropylene (PP) with coal ash (CA).

1.3 Scope

This research study is focusing on the flexural properties of the polypropylene compound with coal ash (CA) through the melting of the compound by mixing material using a hot press machine followed by several testing such as flexural test and microstructure of mixing compound polypropylene (PP) with coal ash (CA).

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter explains about all findings obtained from many literature reviews, which may come from the internet, journals, article and books about the topic related to this study. This section includes findings of the overview of polypropylene (PP), properties of polypropylene (PP), structure and characteristics of polypropylene (PP).

Every year the usage of plastics has been increasing significantly for the lifestyle of the society. With the increase of usage of plastic, the plastic product has increased in developed and less developed countries. There is various type of plastic that is needed in order to create and enhance either a new or existing product (Impacts, 2011).

Composites determined as materials that comprising of at least two identifiable constituents of different background nature. As an example, polypropylene (PP) is a comprises of synthetic filaments or mineral molecule that consists of high modulus augmentation in a relatively lower modulus matrix which give the dynamic thought towards industry especially plastic industry (Toro, Quijada, Yazdani-Pedram, & Arias, 2007).

2.1 Polymer

Nowadays, natural resources and synthetic polymer are definitely important in our daily life. In addition, the outstanding properties of these macromolecules give an advantage towards community and social which greatly useful both in nature and in product manufacturing. Probably, polymers can be identified as monomers, or we called smaller repeating units that linked together applied by a covalent bond. Two categories of polymerisation process are addition polymers and condensation polymers.

Addition polymers are generated by addition reaction which is link mutually of monomers that consisting multiple bonds. As an example of the process is polymerisation between styrene generated in the form of polystyrene.

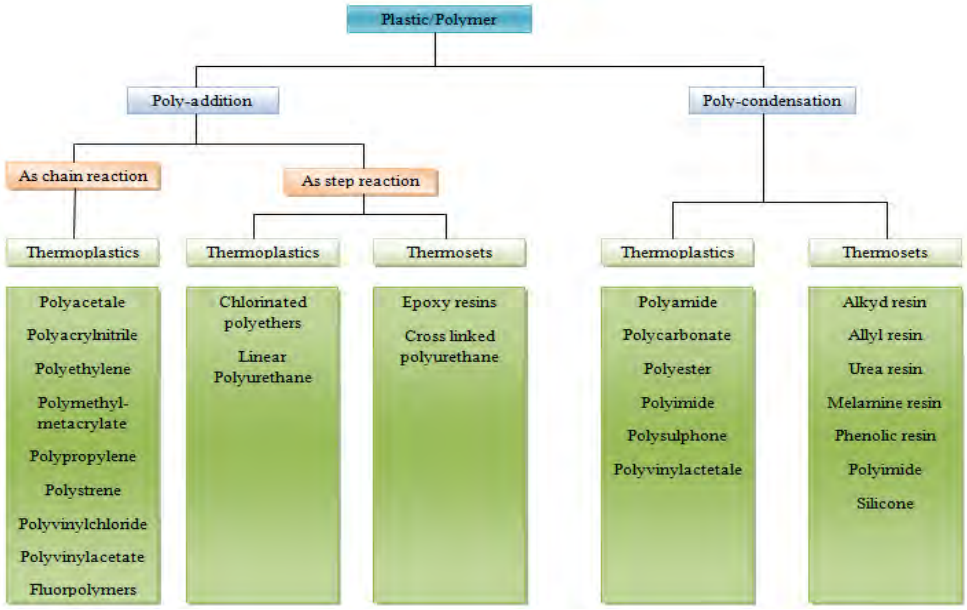

Figure 2.1: Processes for generating plastics and examples (Rolf Klein, 2011).

Other than that, poly-addition can be acknowledge as made of chain reaction which has a huge number of monomer molecules, and also from consolidation process of chemical, which the consolidation between monomers to chains either by the introduction of the dual bond or splitting of the ring.

Furthermore, identification of poly-addition can be evaluated when a combination of monomer units process without a reaction, either double bond or low molecular compounds separation. The position of hydrogen composition atom can be changed through this process which is no presence of product will be detached and no presence of hydrogen atom will moved inside the chain amid the response of the process itself and (Rolf Klein, 2011). However, using catalyst is one of the energy requirements needed in order to preceding the process compared to the natural sources such as light, heat or radiation (O'Connell, 2014).

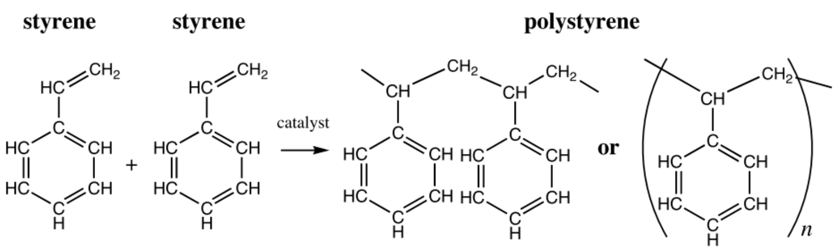

Figure 2.2: Reaction scheme for the preparation of polystyrene (O'Connell, 2014).

Smaller molecule release through water or hydrogen chloride which consists of monomers that attached together to generated a condensation polymer. Formation of laminating resin generally known as glyptal is identifying as a polymerisation type that generated via reaction of glycerol and phthalic acid. Amid the process of polymerisation, water molecules will be dissipated and eliminated (O'Connell, 2014). Also, poly-condensation is generally enhanced poly-functional compounds in the plastic invention which usually small molecules such as water set free through the reaction of the process (Rolf Klein, 2011).

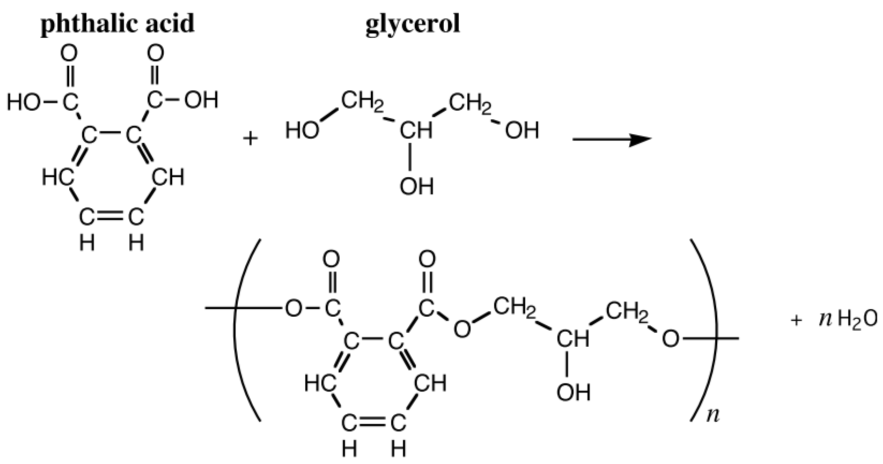

Figure 2.3: Reaction scheme for the preparation of Glyptal (O'Connell, 2014).

Several elements are added to glyptal and it can change the properties of glyptal which are known as a crosslinking process. The process of the crosslinked polymer is only determined by a long chain of molecules that attach each other which are covalent bonding (O'Connell, 2014).

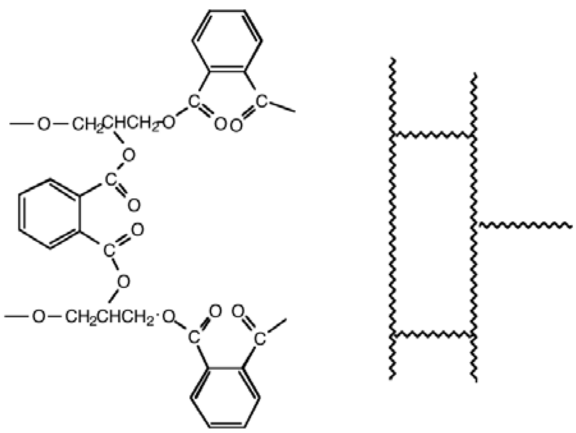

Figure 2.4: Crosslinking of the Glyptal resin (O'Connell, 2014).

Through this cross linking process and addition of glyptal resin , some of a number in different processes are used to turn synthetic and natural polymers into useful objects such as molding products (toys, kitchen utensils), extrusion (toothbrush fibers, weather stripping), foaming (coffee cups, cushions) and casting (medical devices) (O'Connell, 2014).

2.2 Thermoplastic

Thermoplastics is commonly known as a rigid or higher elasticity that can be melted through energy input such as mechanical, thermal or energy forms by radiation (Rolf Klein, 2011). Nowadays, mostly of thermoplastics is used frequently in automotive, electrical, and building industries depended on their advantages such as economic cost, low of density, high corrosion resistance, and extensive range of accessible properties (Parenteau, Ausias, Grohens, & Pilvin, 2012).

The family of thermoplastics can be divided into two groups which are amorphous and semi-crystalline materials (Parenteau et al., 2012). In addition, thermoplastics can be determined as a least complex structure which the macromolecules are artificially free by heating either melted or softened. Then all the machining process such as molded, shaped and welded can proceed to next phase where it hardened after cooling process. Probability the cycle of heating and cooling can be repeated without damage to their properties and it also allows the process of reprocessing and reusing of the compound. However, some particular properties of thermoplastics can be enhanced with a few added substances or fillers which increase strengthens of the compound such as UV resistance probably evaluating through a thermal and chemical stabilization (Material Automobile, n.d.).