Faculty of Mechanical and Manufacturing Engineering Technology

EFFECT OF FUSED FILAMENT FABRICATION PROCESS VARIABLES ON MECHANICAL BEHAVIOR OF FLAX

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Bachelor Degree of Manufacturing Engineering Technology (Product Design)

2019

EFFECT OF FUSED FILAMENT FABRICATION PROCESS VARIABLES ON MECHANICAL BEHAVIOR OF FLAX

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A thesis submitted

in fulfilment of the requirements for the degree of Manufacturing Engineering Technology (Product Design) with Honours

Faculty of Mechanical and Manufacturing Engineering Technology

UNIVESITI TEKNIKAL MALAYSIA MELAKA

2019

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **EFFECT OF FUSED FILAMENT FABRICATION PROCESS VARIABLE ON MECHANICAL BEHAVIOUR OF FLAX COMPOSITE**

SESI PENGAJIAN: **2018/2019 Semester 2**

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ABSTRACT

Fused filament fabrication is the most demanding technique in additive manufacturing which is the process that successive layer of material are deposited in CAD to create 3D product. The issue of using fused filament fabrication process in additive manufacturing application are the available of material to fabricate part is limited. Moreover the only propose to fabricate the part using fused filament fabrication is only for prototype or demonstration. This is due to the strangh of the material use in FFF process. Therefore this research describe the effect of fused filament fabrication process variables on mechanism behaviour of Flax composite. Nowdays researchers out there focus on developing material that available for fused filament fabrication process. Most of them make a research on material like metal composites, ceramic and polymer. This research is going to carried out another material composite that can be use as material to fabricate part using fused filament fabrication which is Flax composite. In addition, this research also plan to optimizing the process in order to make an improvement in mechanical properties of this Flax composite.

ABSTRAK

Proses fabrikasi filamen adalah teknik yang sangat diperlukan oleh industri pembuatan. Proses ini merupakan proses mencipta bentuk didalam computer kemudian bentuk-bentuk ini dihasilkan melalui lapisan-lapisan bahan untuk membuat 3d produk. Isu yang timbul ketika menggunakan process ini dalam aplikasi industri pembuatan adalah bahan yang tersedia untuk menghasilkan produk adalah terhad kepada beberape jenis bahan sahaja. Selain itu juga, produk yang dihasilkan oleh proses in adalah hanya untuk pameran dan demonstrasi sahaja. Ini kerana, kualiti produk yang dihasilkan tidak cukup kuat untuk menjadi product selain daripada bertujuan untuk prototaip dan pameran. Oleh itu, kajian ini mengkaji kesan pemboleh ubah proses fabrikasi filament yang bersandarkan pada tingkah laku mekanisme Flax komposit. Penyelidik masa kini di luar sana, menumpukan perhatian pada pembangunan bahan yang boleh digunakan untuk proses ini seperti komposit logam, seramik komposit dan polimer komposit. Penyelidikan ini akan menjalankan satu lagi komposit lain yang juga boleh digunakan sebagai bahan untuk menghasilkan produk iaitu Flax komposit. Di samping itu, penyelidikan ini juga menrancang untuk mengoptimumkan proses untuk membuat peningkatan sifat mekanisma Flax komposit ini.

DEDICATION

In the name of Allah, The most Beneficient, The most Merciful.

This researched study is dedicated to my beloved parents, my sister and my friends who always inspire me to finish my research study at Universiti Teknikal Malaysia Melaka (UTeM).

ACKNOWLEDGEMENTS

First and foremost, I would like to take this opportunity to express my sincere acknowledgement to my supervisor Dr. Mastura bt Mohammad Taha from the Faculty of Manufacturing Engineering Technology Universiti Teknikal Malaysia Melaka (UTeM) for his essential supervision, support and encouragement towards the completion of this thesis.

In addition, I would also like to express my gratitude to Dr. Mohd Fauzi b Mamat and Dr. Ismail b Abu Shah for evaluating my final year project. Useful inputs suggested earlier are used as an idea and guidance for improving my final year project. I would also like to thank the Faculty of Mechanical and Manufacturing Engineering Technology (FTKMP), Universiti Teknikal Malaysia Melaka (UTeM) for providing full support and allowing me to use the equipment available in laboratories.

Last, I would like to send my appreciation to my family, housemates and friends for their continual encouragement, recognition and support over long months during preparation of this project.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The review of research will be clarified in this chapter. It will start with a brief on the foundation of study, and pursued by the issue explanation, objective, extent of study furthermore, assumption made for the examination. The ramifications of the study elucidate about commitment and the significance of research to the field of business. The extent of study will be featured to enhance the structure of research.

1.2 Background of Study

Despite the fact that the additive manufacturing industry started around 25 years earlier, it has completely changed from its initial days, when the main showcase was the rapid prototyping of additive manufacturing technologies that can currently use plastics, metal and composites to manufacture a wide range of solid and practical items. Additive manufacturing item may have complex structures that other techniques may not be able to effectively manufacture. Additionally, the quality of additive manufacturing stems from its one of a kind ability to make individual explicitly tweaked items on interest.

Fused filament fabrication produces parts by joining selectively deposited track, in layer, to form 3D objects based on 3D CAD file. An improved understanding of the process is essential in order to realis functional parts, a more robust process, increased accuracy and higher production rates. As a result, various modelling techniques have already been used to predict, optimize and improve the final print result. The FFF printer firmware and slicer program are open source and therefore allow for user modification and optimization. Furthermore, the slicer algorithm assumes an adaptable model of the FFF machine process, which is modified by a set of configuration values. These parameters define for example,

the diameter of the feed stock material (FFF filament), printing speed or temperature. A significant aspect in the FFF process is therefore the choice of these parameters and their values. This parameter need to set a vast array of factor to learn how mechanical behavior of Flax composite.

There is a growing awareness of the need for materials in an increasing world population and increasing inequality A composite is defined as a material made of two or more component materials separated and distinct within the composite system. Composites reinforced by high-strength synthetic fibers such as carbon fiber are widely used on airplane and automobiles due to their high specific strength and modulus. However, these fibers are from non-renewable resources. After their service life, these fibers are difficult to dispose and become potential threat to the environment. In contrast, natural fibers are extracted from renewable resources and are more eco-friendly. The large family of natural fibers includes plant fibers (wood or vegetable) and animal fibers such as silk.. Commonly used high-strength natural fibers are bast fibers which include flax, kenaf, and hemp fibers. Natural fibers bring advantages compared to carbon and glass fibers, including high specific mechanical properties, lower cost, sustainability, biodegradability, and less environmental impact.

Flax (Linum usitatissimum L.) is the oldest natural fiber used by our ancestors as early as 10 000–8000 bc (Neolithic period), when they changed their way of life from nomadic hunting and gathering to a more sedentary, agrarian style of living. Until the eighteenth century, flax was the dominant fiber in Europe, but later on cotton, cultivated in America and India, began to systematically replace linen. Flax composites is changed into filament, so that it can be used to produce a product using fused filament fabrication process

1.3 Problem Statement

According to industry additive manufacturing, fused filament fabrication is significantly use in industry. Additive manufacturing technologies now can use Flax composite to manufacture aa product. Optimization of parameter is important in industry as it involve costing of the production and quality of the product. Therefore, industry should be awareness about how different setting of parameter process can affect the mechanical behavior of flax product. However obtaining information about the effect of mechanical behavior of flax composites is a quite challenging task as the large variety of possible combination of parameter. In respond to this problem, our study proposes to study the effect of fused filament fabrication process variable on mechanical behavior of flax composite. This study plan to investigate mechanical behavior of Flax composite to analyses the quality of product produce by Flax composite.

1.4 Objectives

The main goal of this research is to rapidly and systematically identify significant process factors that affecting mechanical behavior of flax composite on fused filament fabrication process. The objectives of this study are:

- To study effect of fused filament fabrication process variable on mechanical behavior of flax composites
- To determine the variable of fused filament fabrication process
- To characterization the mechanical behavior of Flax composite

1.5 Scope of Research Work

To achieve the objective of this research, there are two scopes that have been identified:

- To study variety of combination parameter of fused filament fabrication process variable
- To determine the different between mechanical behavior of wood and flax filament

1.6 Project Planning

This studies were divided into 2 levels to make certain this research continues well and easily. All the levels have been deliberate nicely with a purpose to make sure the venture might be finished beyond the due date. Phase 1 is the Projek Sarjana Muda 1 (PSM 1) section which specifically centered at the discover the technique of this research. In PSM 2, it'll greater awareness on the outcomes of this research and result. It also will be mentioned at the task end and advice.

CHAPTER 2

LITERATURE REVIEW

2.1 Literature Review

In this chapter will distinguish about all the finding obtained from a couple of composing review, which may start from research journal, reference books, online article and different sources as research purpose.

2.2 Fused Filament Fabrication process

Fused Deposition Modeling (FDM), or Fused Filament Fabrication (FFF), is an additive manufacturing process that stores a thermoplastic material layer-by-layer so as to construct a part. FFF innovation manufactures solid, tough and dimensionally stable product with an unmatched precision.

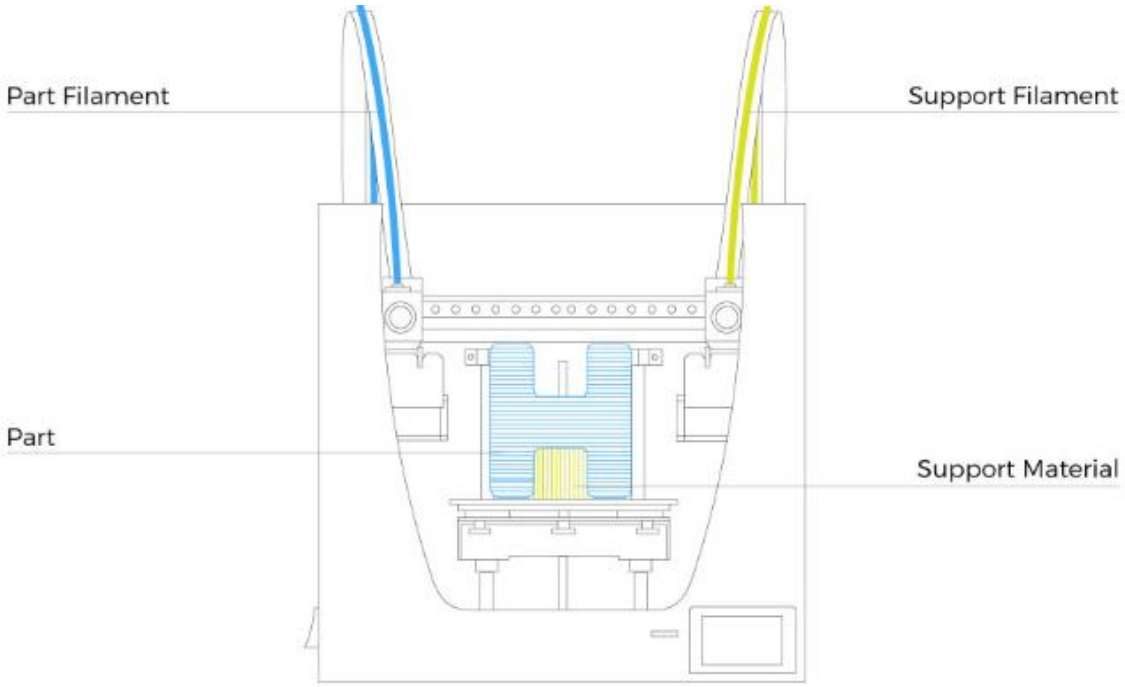

Figure 1

For several reasons, FFF is the most widely spread among the multiple 3D printing technologies on the market. First, both hardware and material are affordable, requiring a low initial investment. Secondly, there is a wide range of materials available, so the technology is suitable for multiple applications and markets. Finally, the design requirements needed and the operation of the equipment are straightforward, in particular, there is no need for specialized operators or complex training compared to other 3D printing technologies.

2.2.1 Fused Deposition Modeling (FDM)

This research is based on parameter use for printing the specimen using FDM machine. FDM was first created in 1989 by the Stratasys Inc. Eden Prairie. MN.USA. With the present piece of the overall industry of 44% thermoplastic, based additive manufacturing such as fused deposition modeling (FDM) is a common innovation. The thermoplastic filament is encouraged into the extrusion nozzle by the two filament drive wheels at that point extruded through the extrusion nozzle that follow the item model's cross-sectional geometry. The resistance heater keeps the thermoplastic filament at a temperature simply over its melting point. The thermoplastic solidify following moving through the extrusion nozzle and bond to the layer beneath. After one layer is finished the manufacture stage brings somewhat down to clear path for the following layer. In a similar guideline, each single layer is based on the other until the article model is finished.