RESEARCH PROGRESS IN MECHANICAL AND MANUFACTURING ENGINEERING
e-ISSN: 2773-4765

RPMME

Vol. 5 No. 1 (2024) 8-11
https://publisher.uthm.edu.my/periodicals/index.php/rpmme

Design and development PolyLactic Acid (PLA) recycling machine for 3D printer

Amali Firdaus Saini[1], Sia Chee Kiong[1*]

[1] *Faculty of Mechanical and Manufacturing Engineering,Universiti Tun Hussien Onn Malaysia, Batu Pahat, 86400, Malaysia*

*Corresponding Author: sia@uthm.edu.my
DOI: https://doi.org/10.30880/rpmme.2024.05.01.002

Article Info

Received: 31 January 2024
Accepted: 19 June 2024
Available online: 15 September 2024

Keywords

Design, PolyLactic Acid (PLA), 3D Printer

Abstract

This study explores the PLA Filament Recycling Machine. The main purpose of this study is to design and develop a filament recycling machine for indoor usage that is user-friendly, low in pollution, and simple to maintain. In order to accomplish the goal and solve the waste filament issue, a new design idea must be developed. The design method of G.E. Dieter has been selected for this study. It includes a number of significant processes, including idea creation, concept evaluation, configuration design, and detail design. Concept development is a way for diverging the concept. Then, the concept evaluation selects the most efficient idea. The role of the design idea is discussed throughout the configuration design process. In the last step, which is detail design, Solidworks 2021 CAD software is used to create all the detail drawings. Finally, it is hoped that this innovative design for a filament recycling machine would take the filament recycling machine to the next level.

1. Introduction

Polylactic Acid (PLA) recycling machine for 3D printer filament is a machine that turn your waste or failed product of 3D printer into a new filament. Plastic waste is a huge challenge for humans to deal with. In a year alone thousands of animals in the ocean face death due to plastic waste and others face the risk of plastic ingestion. Population growth, intensive use of resources, and uncontrolled environmental pollution forced the implementation of another economic closed-loop system, based on the principles of 3Rs: Reduce, Reuse, and Recycle. The broader methodology includes additional three approaches: Recover, Redesign, and Remanufacture [1]. For users and fans of 3D printers who are meticulous and love the earth, they will surely find a way to reduce the use of filaments of failed products. Digital sculptors need to understand how to use their PLA well if they want to reduce consumption. The presence of recycled plastic materials for the 3D printing process expects that the production process will be more environmentally friendly and solve the problem of plastic waste globally [2].

1.1 Problem statement

To start the idea of inviting people to recycle failed products and or waste into a recycle. In Malaysia the recycling campaign has been introduced for a long time but it is not implemented well and is not continued by the people of Malaysia. Probably, at least 5000 tons of 3D printing waste will be generated. 3D printing is one of the most promising manufacturing methods. [3]. By developing this filament recycling machine can reduce the use of plastic and reduce waste. It can save consumers from buying new filaments and can recycle from materials that have not been used. The attention was paid to the recycling potential, existing commercial

Research Progress in Mechanical and Manufacturing Engineering Vol. 5 No. 1 (2024) p. 8-11

solutions, and programs related to the promotion of the idea of reuse of waste materials [4]. Probably, at least 5000 tons of 3D printing waste will be generated. 3D printing is one of the most promising manufacturing methods. This has a significant impact as the use of 3d printers is increasing. It is estimated that the use of 3D printers will almost double by 2025 [5].

2. Materials and Methods

Before any project or research project can begin, a problem statement must be defined. After defining the problem, the objective can be defined. The process of journal selection may begin with identifying the research or study's objectives. Following the journal selection, a basic sketch of the product can be generated. Following the completion of the product drawing, the machine function or process must be published before product design development can begin. Finally, the study's findings, as well as the product's development, can be used to make inferences and draw conclusions.

2.1 Methods

This research fully utilizes Solidworks 2021 CAD Software to complete this research. This CAD Software will be designing every part of the idea and design. Static analysis also run thru this cad software. All tables should be numbered with Arabic numerals. Every table should have a caption. Headings should be placed above tables. Only horizontal lines should be used within a table, to distinguish the column headings from the body of the table, and immediately above and below the table. Tables must be embedded into the text and not supplied separately. Below is an example which the authors may find useful.

Fig. 1 *PLA Filament Recycling Machine*

3.0 Results and Discussion

This is the most crucial section of the entire investigation. It focuses mostly on the process of designing a PLA Filament Recycling Machine for a 3D printer, including the design of the process and the product, as well as simulation and analysis.

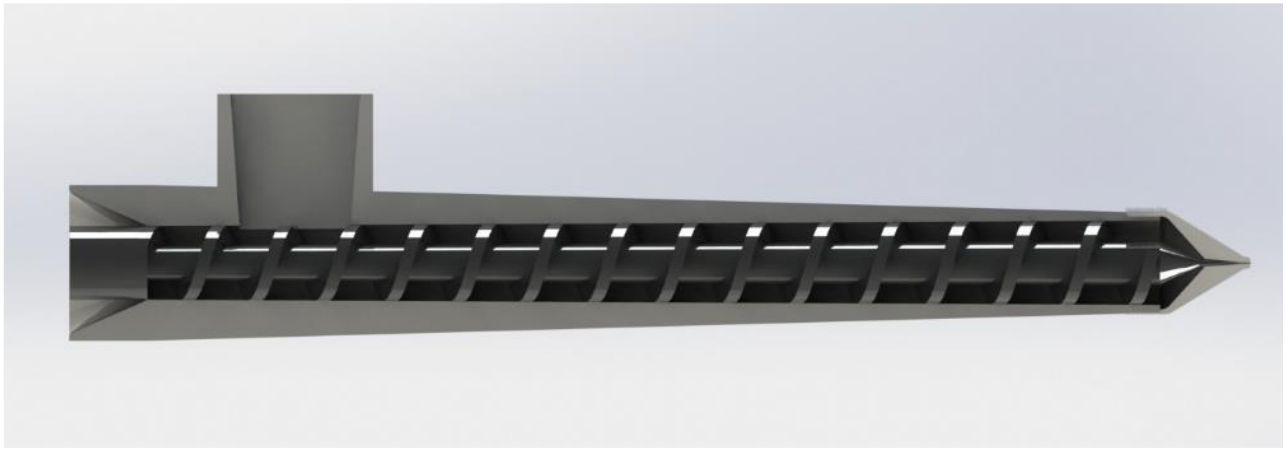

Fig. 2 *Extruder system*

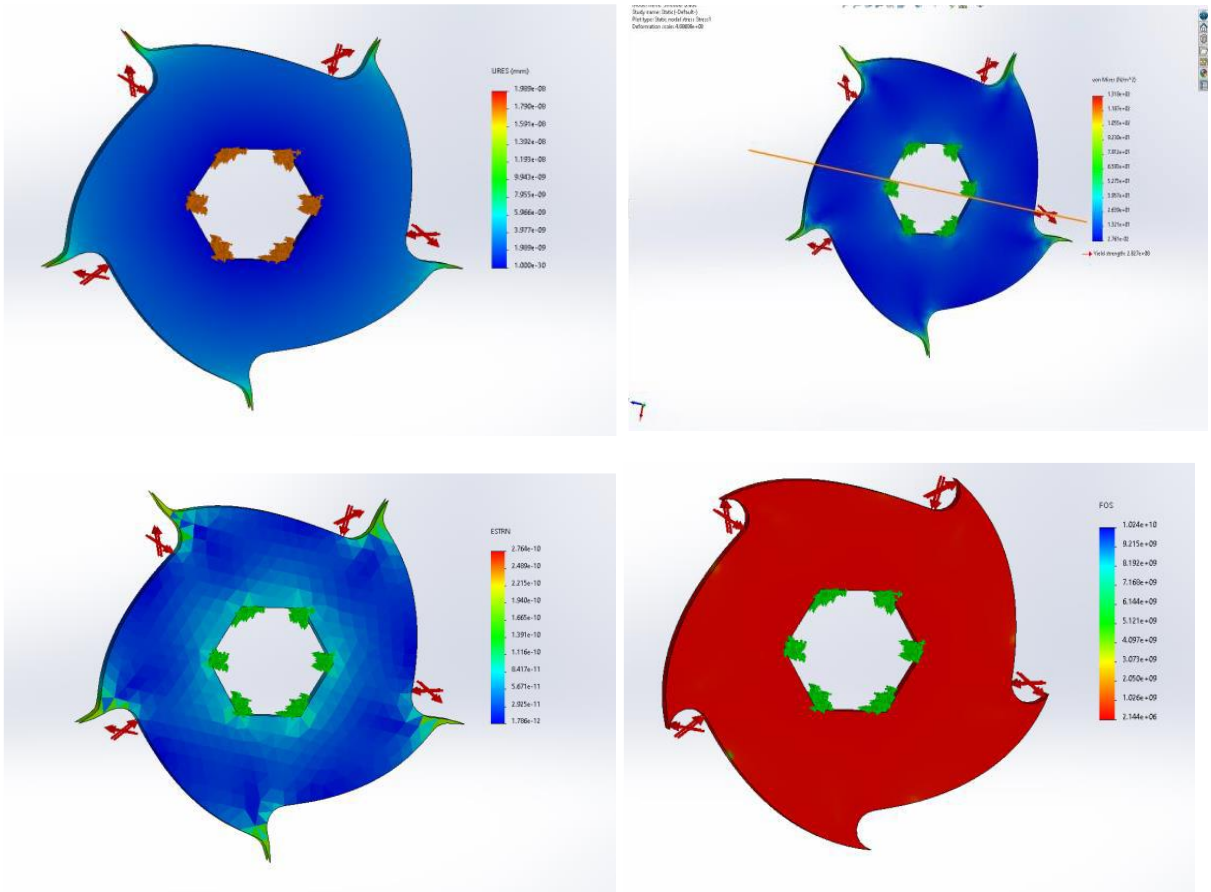

Fig. 3 *PLA Static analysis on Shredder Blade with testing pressure*

PLA Filament Recycling Machine's configuration design after all of the new concept's components have been built and assembled using the Solidworks 2021 software.

Conclusion

Product design is key to client satisfaction. A new design idea may boost a product's appeal and sales. Combining user-friendly goods resulted in a new idea PLA filament recycling machine. This machine has a built-in shredder, unlike the previous one. No shredder is incorporated in the present product and design. Shredders speed up the process. First, waste or failed product is washed and dried to be recycled. The shredder's blades shatter and flake the trash or unsuccessful product. Flakes travel via the feeder. Next is the extruder chamber. In order to melt, the flakes convert from solid to liquid. PLA flakes are melted in the extruder chamber. Four heating zones precede the extruder's nozzle. 1.75mm is the nozzle's diameter. All 3D printers can use 1.75mm filament. After extrusion, fans cool the filament. Cooling filament preserves its size. Fans help cool the filament. After cooling, it's delivered to a spool through a roller.

Acknowledgement

The authors would like to thank the Faculty of Mechanical and Manufacturing Engineering, University Tun Hussein Onn Malaysia for its support.

References

[1] Jawahir, I. S., & Bradley, R. (2016). Technological elements of circular economy and the principles of 6R-based closed-loop material flow in sustainable manufacturing. Procedia Cirp, 40, 103-108.

[2] Atsani, S. I., & Mastrisiswadi, H. (2020). Recycled polypropylene filament for 3D printer: extrusion process parameter optimization. In IOP Conference Series: Materials Science and Engineering (Vol. 722, No. 1, p. 012022). IOP Publishing.

[3] Caihan Zhu, Li Tianya, Mohamedazeem M. Mohideen, "Realization of Circular Economy of 3D Printed Plastics:," Polymers 2021, 2021.

[4] Mikula, K., Skrzypczak, D., Izydorczyk, G., Warchoł, J., Moustakas, K., Chojnacka, K., & Witek-Krowiak, A. (2021). 3D printing filament as a second life of waste plastics—a review. Environmental Science and Pollution Research, 28, 12321-12333.

[5] Kostidi, E., & Nikitakos, N. (2018). Is it time for the maritime industry to embrace 3d printed spare parts?. TransNav: International Journal on Marine Navigation and Safety of Sea Transportation, 12(3).