

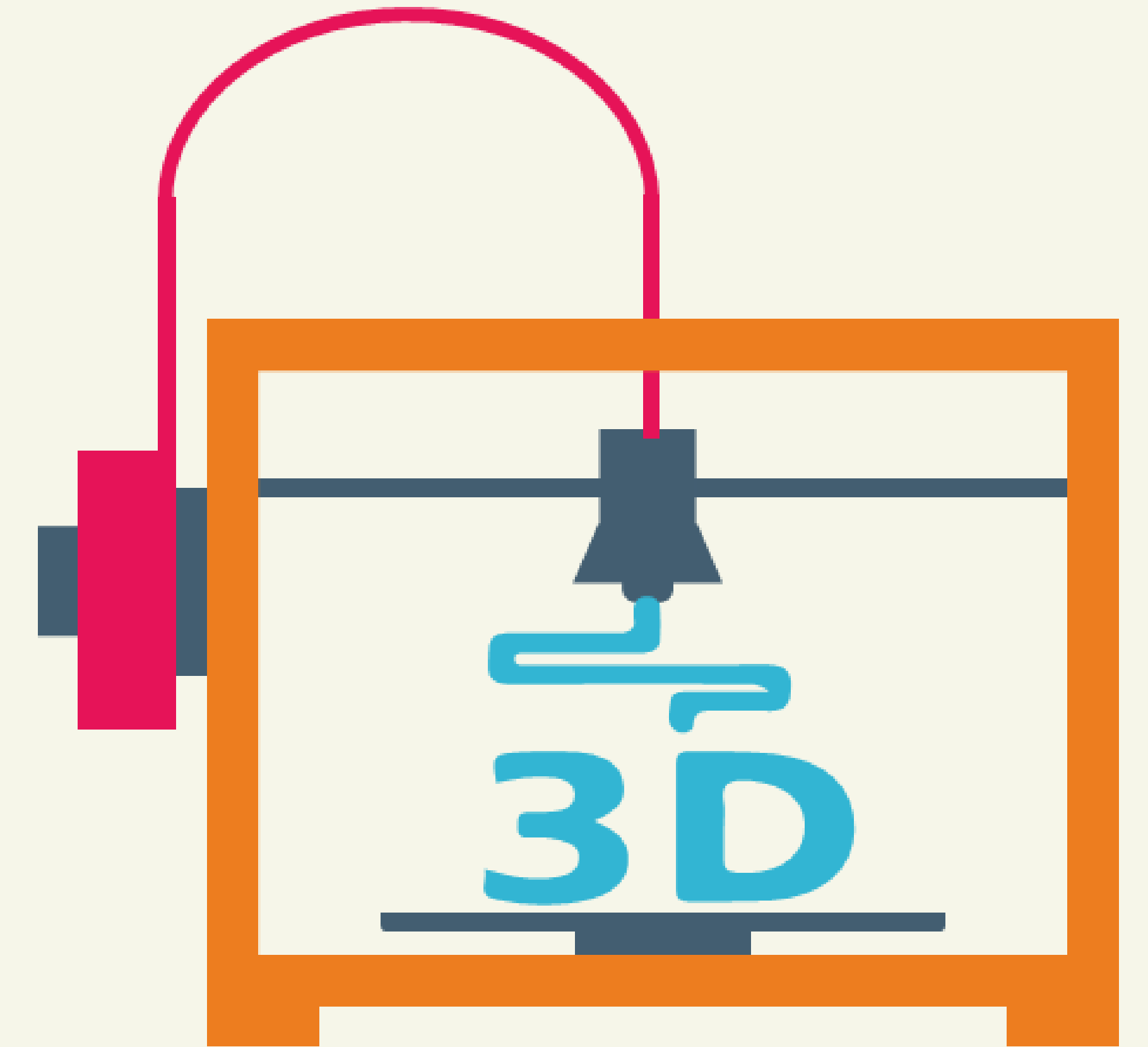
POLYLACTIC ACID/ EPOXIDIZED NATURAL RUBBER-BASED TPE FILAMENT FABRICATION FOR 3D PRINTERS

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SUMMARY OF INVENTION

This research work aims to enhance the properties of PLA by blending it with epoxidized natural rubber (ENR) and fabricating it into a thermoplastic elastomer (TPE) filament. TPE filament (thermoplastic elastomer) is a novel filament for 3D printing. The elasticity, ease of processing, and degradability of the TPE make it unique. The printed PLA/ENR TPE components will be less rigid, durable, and have superior thermomechanical properties. In developing TPE filament with good printing ability, the compatibility between PLA/ENR is important. Poly (ethylene-co-glycidyl methacrylate) (PEGMA) will be used as a compatibilizer for PLA/ENR blend. The effect of the compatibilizer on the mechanical and thermal properties investigated.



INTRODUCTION

Demand for polylactic acid (PLA) filament for 3D printing is increasing as it is a biopolymer and satisfactory mechanical properties. However, PLA has lower flexibility with poor toughness behavior which restricts its use for high-impact applications.

To enhance the qualities of PLA and suppress the restriction of PLA, epoxidized natural rubber (ENR) can be blended. Poly (ethylene-co-glycidyl methacrylate) (PEGMA) compatibilizer needed for compatibility between PLA/ENR.

NOVELTY

The research is for producing TPE filament from ENR will be novel in the 3D printing industry and it will have higher attributes than 3D printing materials filaments made of a single substance. The goal of this study is to evolve PLA/ENR TPE material that have enhanced the qualities than PLA alone.

PROBLEM STATEMENT

- PLA is not thermally stable for 3D printing due to low Tg.
- Exhibits **poor toughness** due to its high rigidity nature.
- Lack of experiments performed on implementing PLA-based TPE material as filament for 3D printers. Some research works **did not focus on improving the compatibility** of TPE material despite the different polarities that exist in thermoplastic and elastomer.
- Research works which applied TPE did not fully evaluate the effect of printing parameters on the 3D printed part properties.
- Most researchers did not perform assessments about the printing ability of material under different parameters.

OBJECTIVE

A NEW FILAMENT MATERIAL
FABRICATION FROM POLYLACTIC ACID
(PLA) / EPOXIDIZED NATURAL RUBBER
(ENR)



PROJECT FUNDING

Fundamental Research Grant Scheme
(FRGS) (9003-00798)



CONCLUSION

- PLA-based TPE material exhibits outstanding **mechanical and thermal properties** making it appropriate for the FDM printer.
- PLA based TPE must have **compatibility characteristics** to produce a miscible blend.
- The approach of **fabricating TPE filament** using biodegradable sources such as **PLA and ENR will be novel** and will have better qualities.
- **Optimization of extrusion parameters** is important to obtain 3D printing filament with good qualities for 3D printer.
- Finding the **optimum FDM parameters** is necessary to achieve **excellent interaction** across each parameter which will eventually affect the quality of printed 3D part.

METHODOLOGY

The PLA/ENR blend will be blended using the melt blending technique using a twin-screw extruder.

the blended PLA/ENR pellet will be extruded to filament and 3D printed part will be printed using 3D printer.

PUBLICATION

Musa, L., Krishna Kumar, N., Abd Rahim, S. Z., Mohamad Rasidi, M. S., Watson Rennie, A. E., Rahman, R., Yousefi Kanani, A., & Azmi, A. A. (2022). A review on the potential of polylactic acid based thermoplastic elastomer as filament material for fused deposition modelling. Journal of Materials Research and Technology, 20, 2841–2858.

Compatibilizer

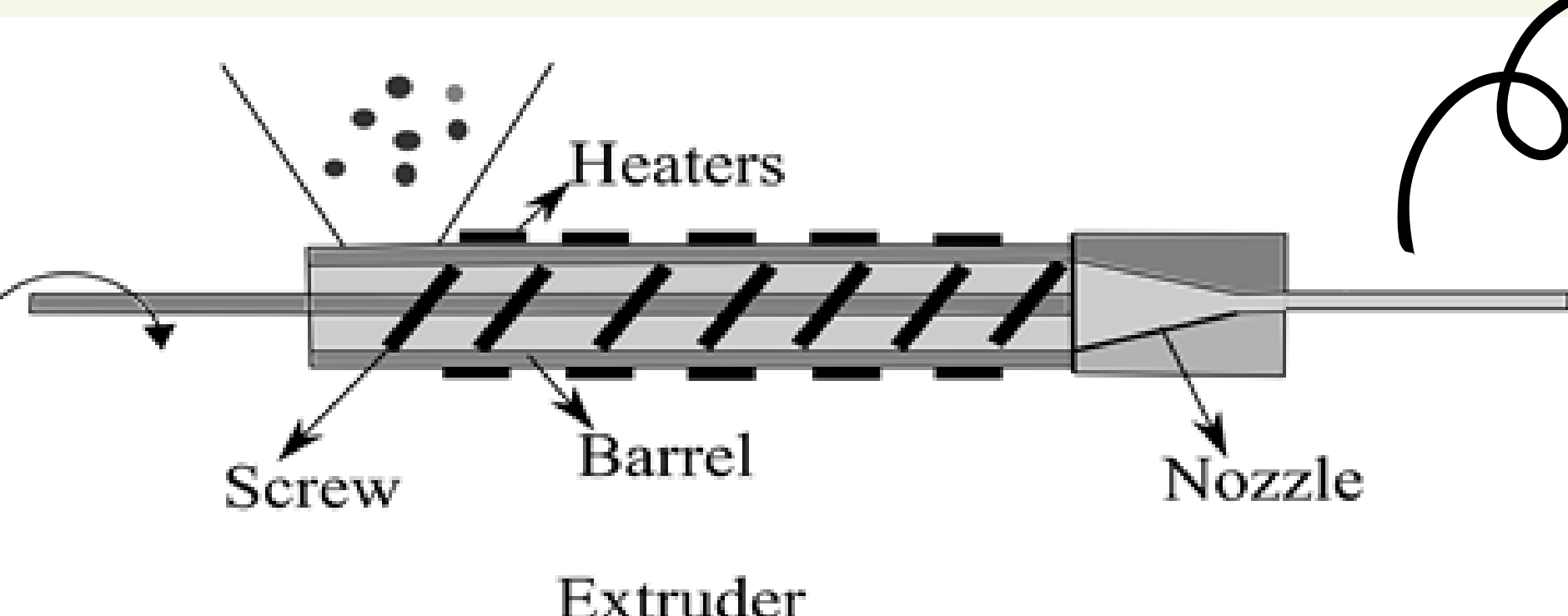
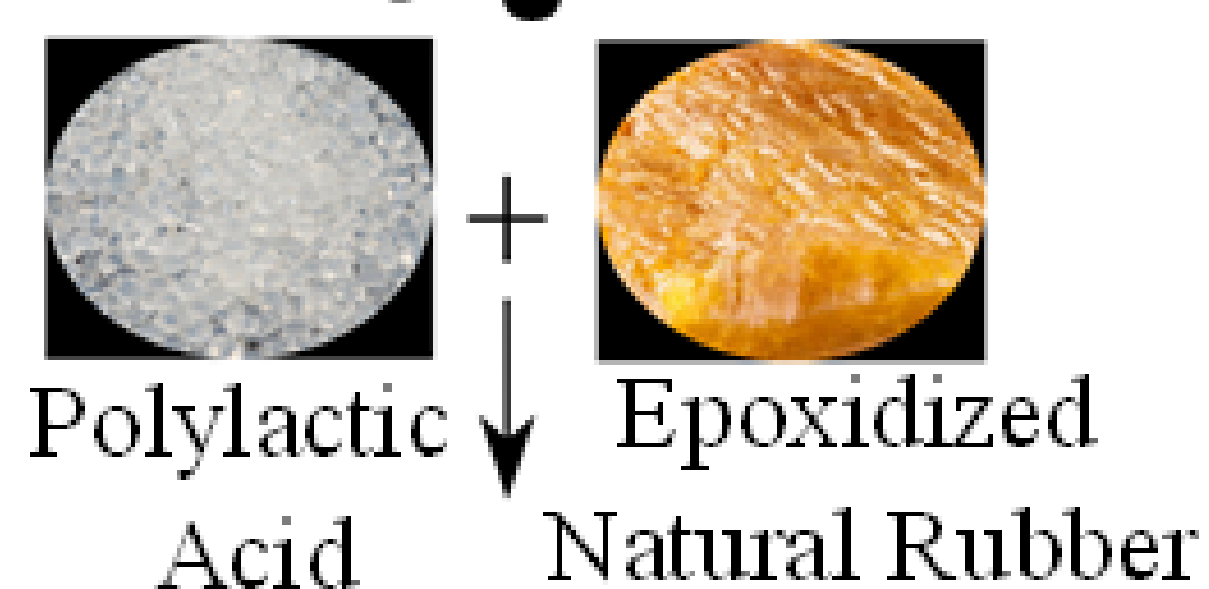


Figure 2: Blended of PLA/ENR TPE material



Figure 3: 3D printed part using PLA/ENR TPE material

Figure 1: Blending of PLA/ENR TPE material using twin screw extruder