ABSTRACT

Plastic waste represents one of the most serious environmental challenges worldwide due to its extensive use and long degradation time. At the same time, additive manufacturing technologies, particularly Fused Deposition Modeling (FDM), have rapidly expanded and rely heavily on thermoplastic materials. Recycling plastic waste and preparing it for reuse in manufacturing applications offers a sustainable solution that reduces environmental impact and material costs.

This project focuses on the design, construction, and mechanical validation of a low-power plastic shredder intended for shredding thin household plastic waste. The developed machine is based on a dual-shaft cutting mechanism using counter wise rotating shafts equipped with circular cutting blades. The design emphasizes simplicity, low cost, availability of components, safe operation, and suitability for educational and small-scale recycling applications.

Detailed mechanical design calculations were performed using actual measured dimensions of the constructed machine. These calculations verified the safety and reliability of the power transmission system, cutting mechanism, shafts, gears, and bearings. A single-phase washing machine motor rated at 120 W was successfully used to drive the system, providing sufficient torque and cutting force without mechanical overloading.

The shredder was manufactured and assembled using standard workshop tools and materials, and experimental testing was conducted using different types of plastic waste, including PET, HDPE, and ABS. The machine successfully shredded all tested materials into small, uniform pieces. Further manual melting and reshaping experiments showed that ABS plastic exhibited favorable behavior for recycling, allowing the production of a solid filament with a diameter close to the standard 3D printing filament size.

The results confirm that the developed plastic shredder is an effective and reliable solution for preparing plastic waste for recycling processes. The project demonstrates that low-cost mechanical systems can play a vital role in sustainable plastic recycling and can serve as a foundation for future development of complete plastic recycling and 3D printing filament production systems.