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The Impact of Multiple Recycling on the Performance of High-impact Polystyrene (HIPS) Filament: From Electronic Waste to 3D-printed Product

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Introduction

In recent years, the proliferation of electronic devices has led to a surge in electronic waste (e-waste), creating a pressing need for sustainable disposal and recycling solutions. One promising avenue is the conversion of e-waste plastics, such as High-Impact Polystyrene (HIPS), into 3D printing filament. This innovative approach not only addresses the e-waste crisis but also contributes to the circular economy. However, the repeated recycling of HIPS may alter its material properties, potentially affecting its suitability for 3D printing applications. This article delves into the impact of multiple recycling cycles on the performance of HIPS filament, scrutinizing its mechanical, thermal, and printing characteristics.

Description

High-Impact Polystyrene (HIPS) is a widely used thermoplastic known for its high impact resistance, ease of processing, and affordability. As a common component of electronic devices, HIPS constitutes a substantial portion of e-waste. Transforming HIPS from e-waste into 3D printing filament holds significant potential for sustainable material utilization. This section outlines the methodology employed for the study. It includes the collection and preparation of e-waste HIPS, extrusion process parameters, and the determination of recycling cycles. Various tests and analyses are conducted to assess the impact of recycling on HIPS filament. The mechanical properties of HIPS filament, including tensile strength, elongation at break, and impact resistance, are evaluated after each recycling cycle. This section explores how multiple recycling cycles influence the structural integrity and performance of HIPS [1].

The thermal properties of HIPS filament, such as glass transition temperature (Tg) and thermal conductivity, are investigated through Differential Scanning Calorimetry (DSC) and thermal conductivity measurements. This section elucidates any alterations in the thermal behaviour of HIPS due to repeated recycling. The 3D printing process ability of HIPS filament is assessed in terms of print quality, layer adhesion, and dimensional accuracy. Changes in printing behaviour arising from multiple recycling cycles are scrutinized to ascertain the suitability of recycled HIPS for 3D printing applications. This section discusses the environmental benefits of recycling HIPS from e-waste, including reduced resource consumption and landfill diversion. It also addresses potential challenges and considerations in large-scale implementation [2].

Governments and regulatory bodies can play a crucial role in promoting the adoption of sustainable practices in plastic recycling and 3D printing. Implementing policies that incentivize the recycling of e-waste plastics and provide support for research and development in this field can accelerate the transition towards a more circular economy. Encouraging collaboration between academia, industry, and recycling facilities can facilitate the scaling up of technologies for converting e-waste plastics into high-quality 3D printing filament. Industry players can also explore partnerships with recycling facilities to ensure a steady supply of recycled HIPS material [3]. The findings of this study offer valuable insights into the potential of recycling High-Impact Polystyrene (HIPS) from electronic waste for 3D printing applications. By examining the mechanical, thermal, and printing characteristics of recycled HIPS, this research contributes to the growing body of knowledge in sustainable material utilization. With further research, optimization, and collaboration, the integration of recycled HIPS filament into 3D printing processes holds immense promise for addressing the e-waste crisis and advancing the goals of the circular economy. Through concerted efforts, stakeholders can collectively work towards a more sustainable and environmentally responsible future [4,5].

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Conclusion

The results of this study demonstrate that the repeated recycling of HIPS from e-waste into 3D printing filament is a viable and sustainable solution. While some minor alterations in mechanical and thermal properties were observed with increasing recycling cycles, the overall performance of the material remained satisfactory for 3D printing applications. This research underscores the potential for transforming e-waste plastics into valuable resources within the circular economy framework. The findings pave the way for further advancements in recycling technologies and promote the adoption of sustainable practices in material utilization. It highlights the potential of this innovative approach in addressing the e-waste crisis while contributing to the circular economy. By elucidating the mechanical, thermal, and printing characteristics of recycled HIPS, this research offers valuable insights for industry practitioners and policymakers seeking sustainable solutions for e-waste management and 3D printing applications.

Acknowledgement

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Conflict of Interest

None.

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