



REUSE OF EPS FOR 3D PRINTER FILAMENT PRODUCTION IN A UNIVERSITY EXTENSION PROJECT

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Abstract - An extracurricular activity (AEX) was developed with the main objective of promoting the valorization of plastic waste that is not easily recyclable, such as Styrofoam and red or pink PET bottles, which generally do not have a commercial outlet in cooperatives, as is the case of COOPERVIDA (São Carlos). Participating students will be trained to guide processes for reusing these materials, involving cleaning, selection, crushing and hot extrusion steps to produce 1.7 mm plastic filaments. These filaments will be used in 3D printers to manufacture objects, generating products with added value and encouraging the circular economy. The proposal has a multidisciplinary nature and seeks to involve students of Chemistry, Engineering, Architecture and Computer Science, strengthening the integration between theory and practice. The success of the initiative may enable its expansion to other cooperatives, contributing to environmental education, technological innovation and sustainability.

Keywords: *sustainability, social inclusion, innovation, recycling, circularity*

Introduction

The global increase in plastic waste has become a serious environmental concern, with materials like expanded polystyrene (EPS) presenting major challenges due to their low recyclability and lack of market demand [1–3]. In Brazil, less than 5% of plastic waste is mechanically recycled, with most being discarded improperly or sent to landfills [4]. EPS, commonly found in food packaging, is lightweight, bulky, and economically unattractive to recyclers, especially in small cooperatives. The circular economy model encourages rethinking this logic by transforming waste into raw materials for new products [5]. In this context, 3D printing emerges as an innovative and accessible technology to repurpose plastic waste into customized, high-value objects [6]. This project integrates concepts of sustainability, social inclusion, and technological education through the reuse of EPS for the production of filaments used in 3D printing, in partnership with the COOPERVIDA cooperative in São Carlos, SP. 3D printing technology has gained prominence as a tool for the valorization of plastic waste, enabling the transformation of recycled materials into useful objects with added value. According to Hopewell et al. (2009) [7], emerging technologies can enable the reuse of low-demand commercial waste when associated with educational and social innovation practices. In addition to the technological aspect, the importance of social inclusion in the recycling chain is highlighted. Waste picker cooperatives play an essential role in the sorting and reuse of solid waste in Brazil, and their valorization is provided for in the National Solid Waste Policy (Law No. 12,305/2010). Projects involving cooperatives, such as the one developed with COOPERVIDA (São Carlos), promote not only the reuse of waste, but also the strengthening of citizenship, the local economy, and environmental education.

Experimental

The activity was developed as a university extension action, with an interdisciplinary nature, involving mostly students from Chemistry courses. The work was conducted in partnership with the

cooperative COOPERVERIDA, located in São Carlos (SP), and guided by the professor in charge, Prof. Sergio A. Yoshioka.

The methodology adopted can be divided into five main stages:

Theoretical and practical training of students

Initially, the participating students received technical and conceptual training on the types of plastics used (Styrofoam and colored PET bottles), their physical-chemical properties, recyclability challenges and possibilities for reuse. They were also introduced to the basic operation of extruders and 3D printers, with a focus on the production and use of recycled filaments.

Material Selection and Preparation

The EPS used came from post-consumer food packaging (food trays) previously collected and stored in the university laboratory. The material was cleaned, dried and compacted with a household iron at temperatures between 100°C and 200°C to eliminate air and partially fuse the structure.

Grinding and Mixing

After cooling, the compacted EPS was ground with a household blender [Fig 1]. A plasticizer was added to improve flow characteristics and facilitate extrusion.

Extrusion Process

The resulting fragmented mixture was fed into a benchtop extruder (Filmaq 3D) set at 245°C. The machine parameters were adjusted to produce filaments with an approximate diameter of 1.7 mm.

3D Printing

Initial tests were initially performed with PLA filaments for training purposes. Each student printed two objects: one for educational use and one of their own choosing. The printed models served as prototypes to evaluate the performance of the recycled EPS filament. After theoretical training and production of EPS filaments, tests were carried out to test the efficiency and operability of the material produced.

Results and Discussion

EPS-based filament production has proven to be viable, with over 300 meters produced [Fig 2]. However, challenges remain regarding the uniformity of the filament diameter and the strength of the material. Although the filament production was successful, printing of objects was not efficient and positive. It is necessary to increase the temperature of the printing table to around 100 °C when using EPS filament, different from the temperature applied to printing in PLA. The project demonstrated strong engagement of the students involved and highlighted the educational potential of sustainability practices. It also drew attention to the reality of cooperatives, such as COOPERVERIDA, which often discard valuable materials due to a lack of processing options or knowledge. By offering a way to reuse EPS, the project promotes environmental awareness and provides an opportunity for income generation. Furthermore, the activity is aligned with the UN Sustainable Development Goals (SDGs), including SDG 4 (Quality Education), SDG 9 (Industry, Innovation and Infrastructure), SDG 12 (Responsible Consumption and Production) and SDG 17 (Partnerships for the Goals). This integration of environmental, social and technological dimensions illustrates the strength of extension activities in higher education.



Figure 1: Sample of material crushed in the extruder



Figure 2: Sample of the EPS filament produced.

Conclusions

Reusing EPS to produce filaments for 3D printing is a promising alternative to reduce plastic waste and stimulate circular economy initiatives. The project has proven effective in promoting interdisciplinary learning and social engagement. The next steps involve improving the extrusion process, adjusting the thickness of the material to promote the printing of objects, and expanding the initiative to other educational institutions and recycling centers. The activity developed demonstrated great potential for articulating theory and practice, integrating concepts of sustainability, circular economy, and social inclusion through an interdisciplinary approach. The strong engagement of the participating students reveals the positive impact of the proposal, especially because it involves practical activities that go beyond the classroom and provide direct contact with waste transformation technologies, such as extrusion and 3D printing.

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