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MECHANICAL ANALYSIS FOR A POLYSTYRENE-BASED POLYMER MATERIAL AS A SOLUTION FOR PLASTIC WASTE RECYCLING

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Introduction

Over the past 50 years, the use of plastics has significantly increased, making them an essential part of our daily lives due to their high functionality, hygiene, lightweight nature, and affordability. One key reason for the growing consumption of plastics is their ability to replace traditional materials, such as ceramics and wood, in a wide range of applications.

The recover-and-recycle rates for plastics are extremely low at present owing to the inefficiency of mechanical recycling. State-of-the-art sorting technologies are limited in their ability to differentiate between polymers. This is the reason why it is necessary to create composites in the laboratory that mimic plastic waste and to be able to perfect the separation of the component polymers and their characteristics in order to reuse them.

The highest amount of plastics adding up worldwide is made from polypropylene (PP), polystyrene (PS), and acrylonitrile butadiene styrene (ABS).

The GPPS and OPPS polystyrene-based plastics are rigid thermoplastic polymers, highly versatile, and easy to process. The analyzed plastics exhibit excellent electrical insulation properties, are lightweight, and have good dimensional stability. They are commonly used in a wide range of applications, such as packaging, household items, and office supplies, as well as in the manufacturing of various components in household appliances.

Materials and methods

The polystyrene used in our experiments is white in color and was obtained through extrusion, to which a 3% colorant was added.

The **GPPS** materials—composed of 40% crystal polystyrene (GPS), 20% polypropylene with 40% calcium carbonate, and 40% glossy polystyrene ABS (Figure 1)—and **OPPS** materials—composed of 40% crystal polystyrene (OPS), 20% polypropylene with 40% calcium carbonate, and 40% opaque polystyrene ABS in equal proportions (Figure 1)—were obtained through the injection molding process.

a.Polystyrene granules b.Glosy polystyrene (GPS) c. Opaque polystyrene (OPS)

Figure 1. Materials used in the injection molding process

The analyzed plastic materials were obtained using polymeric material granules purchased commercially, according to the following codes: glossy polystyrene, white color ARCP1, code 3% percentage, opaque polystyrene ARC1150, code black SMY9686-PS (SISAN), 1% percentage, natural ABS RAL9001, ROMBEST BEIGE SAN 60-0286 (Romcolor), 4% percentage.

The technological process is an injection molding process, where the mixture of compounds is brought to a flowable state and injected, under pressure, into a molding cavity. After filling the mold, the material is maintained at a constant temperature under pressure and hardened through cooling. The advantages of injection molding include the ability to produce objects with complex shapes and various sizes.

The temperature of the molds used in the injection process ranges from 20 to 70°C, the melting temperature of the components of the materials used is between 180 and 260°C, and the pressure under which the materials are injected into the mold varies between 40 and 170 bar.

Results and conclusions

The lifespan of parts made from various polymeric materials, which have applicability in different fields, is limited by the modification of their physical and mechanical properties under certain conditions.

This paper describes the characteristics of polystyrene-based plastic materials used in the manufacturing of subassemblies for household appliances.

The paper presents the stress-strain behavior of the analyzed plastic materials by determining various parameters, such as structural characteristics, impact resistance, tensile testing, and temperature of deflection under load.

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