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THE USE OF SEASHELL POWDER AS A SOURCE OF BIOGENIC CALCIUM CARBONATE IN STYRENE-ISOPRENE-BUTADIENE-STYRENE COMPOSITES

Marius Bumbac[1], Cristina Mihaela Nicolescu[2], Cosmin Stefan Gherghinoiu[2], Cristiana Elena Sava[2], Costel Bumbac[3], Elena Elisabeta Manea[3], Traian Zaharescu[2], Bogdan Catalin Serban[4], Octavian Buiu[4]

[1]Valahia University of Targoviste, Faculty of Sciences and Arts, 13 Sinaia Alley, 130004 Targoviste, Romania
[2]Valahia University of Targoviste, Institute of Multidisciplinary Research for Science and Technology, 13 Sinaia Alley, 130004 Targoviste, cristiana.sava.mo@valahia.ro, Romania
[3]National Research and Development Institute for Industrial Ecology-ECOIND, 57-73 Drumul Podu Dambovitei, district 6, 060652, Bucharest, Romania
[4]IMT Bucharest, National Institute for Research and Development in Microtechnologies, 126A Erou Iancu Nicolae, 077190 Voluntari, Romania

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Introduction

Shells can be a viable alternative for bio-fillers in the polymer industry. Clams are an abundant and renewable resource because they are a by-product of the seafood industry. Using seashells powder as biofilm materials can help manage waste and reduce the environmental impact of clam disposal. They are mainly composed of calcium carbonate ($CaCO_3$), a filler commonly used in the polymer industry. Calcium carbonate can improve the mechanical properties of polymers, such as stiffness and impact resistance, and improve processing characteristics. As natural materials, shells are biocompatible and more environmentally friendly compared to synthetic fillers. On the other hand, using seashells as bio-filling materials can be cost-effective because they are often considered waste and can be obtained at a low cost. This can reduce the overall cost of polymer production. Appropriate processing techniques are required to transform clams into a form suitable for use as a filler. This includes grinding, purification, and surface treatment to ensure compatibility with polymer matrices.

The aim of the study was to evaluate the effect of calcium carbonate incorporation (in various mass ratios) in styrene-isoprene-butadiene-styrene (SIBS) copolymers polymer matrices, on the physico-chemical properties of the final biocomposites. Three different mass percentages of biomass additions and different mass in different mass percentages of the composite were prepared.

Materials and methods

For the present study, a composite containing SIBS and cockle shells from the *Cardiidae* family was prepared. Although it was aimed to incorporate as much powder as possible, it was not possible to add a percentage higher than 15% due to the agglomeration of the powder in the material.

The materials prepared according to the recipes were first homogenized using a heated blade homogenizer (Nanjing Haisi Extrusion Equipment Co. Ltd., China) for uniform mixing and complete dispersion in the mixture of solid and liquid powders. The raw material is first loaded and then passes through a Nanjing Haisi TSE 65 L/D 44 extruder equipped with two corotating screws. Finally, the pelletizing operation is carried out with an underwater cutting system (water ring). For comparison, SIBS samples were prepared with the same powder content, but this was replaced with calcium carbonate 5 VO - Omyacarb® (purchased from Omya International AG) available as a polymer filler with particles having an average size of 50 µm.

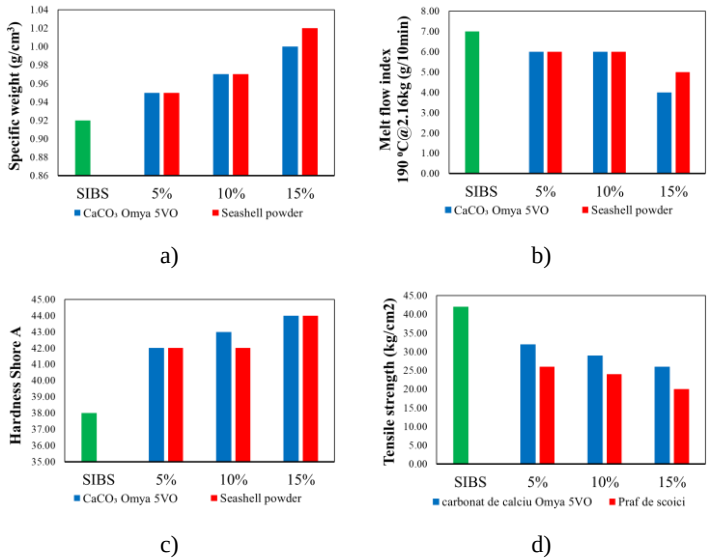

Figure 1. Physico-mechanical test results for SIBS (green bar), Omya 5VO $CaCO_3$ composite (blue bar), and seashell powder composite (red bar)

Physico-mechanical tests of the composites can provide valuable information on the interactions between the polymer matrix and the two types of calcium carbonate ($CaCO_3$ 5 VO - Omyacarb® with an average size of 50 µm and seashell powder). By comparing different mechanical properties, we can deduce how well the fillers are dispersed in the polymer matrix and how they affect the overall performance of the composite (Figure1).

Results and conclusions

As demonstrated by the study results, maintaining consistent particle size, shape, and distribution within the polymer matrix is essential for achieving reliable and predictable material properties. The compounds produced with seashell powder exhibited quality comparable to those manufactured with CaCO3 5 VO - Omyacarb®, a high-grade filler used in polymers. To improve outcomes, investment in infrastructure for processing seashell powders is necessary to facilitate their integration into the supply chain. This includes establishing appropriate facilities equipped for cleaning, grinding, and potentially surface modification of the filler materials, enabling the expansion of bio-calcium carbonate filler production