Name(s)

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Project Number

S1112

Project Title

Creating a Renewable and Biodegradable Bioplastic from Bambusa multiplex

Abstract

Objectives

The objective is to create a biodegradable and renewable plastic foam from the cellulose of Bambusa multiplex, a species of bamboo.

Methods

Commercial microcrystalline cellulose was immersed in a sodium hydroxide solution to make it amorphous, and the amorphous cellulose was combined with different amounts of a plasticizer. The plastics were cured in the oven. After plastic had been successfully made with the commercial cellulose, the same procedure was used to make plastics out of cellulose extracted from bamboo.

To extract the cellulose from bamboo, stalks of Bambusa multiplex were cut and grated to break them down into small pieces to dry. Then, the cellulose was isolated by submerging the bamboo particles in ethanol, and nitric acid, sodium hydroxide and sodium sulfite, and sodium hypochlorite solutions. With this cellulose, the procedure used to make plastics from commercial cellulose was repeated. Finally, biodegradability, compression, and insulation tests were performed on the plastic samples.

Results

The biodegradability tests suggested that the plastics made with bamboo cellulose degraded at a higher rate than those made with commercial cellulose, and that plastic samples with a higher cellulose content degraded faster than those with a lower cellulose content. The compression test suggested that the plastics made with bamboo cellulose had a compression rate similar to that of a polyethylene foam with the same open-cell characteristics. Finally, the insulation test suggested that the plastic foams made with 10% cellulose insulated better than those created with 20% cellulose.

Conclusions

A biodegradable plastic foam was created using cellulose from bamboo. Through tests, it was determined that the ideal percentage of cellulose in these plastic foams is in between 10% and 20% because the samples with 20% cellulose do biodegrade faster, but the samples with 10% cellulose have better insulation properties and have a higher rebound rate after they are compressed. The experiments and studies suggest that the plastic foams created could be a solution to the world's problem of plastic waste, however, further testing is necessary to confirm this. Future studies include testing the biodegradability of the plastic foams in soil, testing the tensile strength of the plastics, and testing the ability of the plastics to insulate hot objects. A promising application for the plastic foams created from bamboo is a packaging material, in which the plastic foams could protect or insulate an object, and after their use, they would biodegrade.

Summary Statement

A biodegradable plastic foam was created by extracting cellulose from bamboo and combining it with a plasticizer; the biodegradability, compression, and insulation characteristics were determined through testing.

Help Received

Guidance and help while handling chemicals and creating solutions was received from Cathy Messenger, teacher and mentor at Los Gatos High School, and Jeff Kraus provided an Insteon tensile/compression tester at the company TE Connectivity for compression testing.