Name(s)

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Project Number

38018

Project Title

Bio.fiber.plastic: The Effect of Lignocellulosic Fibers in Enhancing the Formation & Tensile Strength of Rice Bioplastic

Abstract

Objectives/Goals

To enhance the formation and tensile strength of rice bioplastic using lignocellulosic fibers from garbage/recycled materials in bio.fiber.plastic.

Methods/Materials

Rice bioplastic formula was modified from last year's project with broken rice as a control in preliminary stage. Four lignocellulosic fibers (3 different grade recycled paper-UOP#36, SMP#2, OCC#11, 3 different old cotton t-shirts, corn husk, rice husk) went through hydro-pulping and soda ash pulping. Six different ratios of fiber to broken rice for each type of lignocellulosic fiber were tested. Tensile strength of each sample was calculated. Maximum force was measured using digital force gauge and its thickness with digital Vernier caliper. Flexibility was tested by bending the sample 180 degrees repeatedly for 3 data points (crease, tear, and break)

Results

The results showed that bio.fiber.plastic's tensile strength increases as the ratio of fibers increases, ranging from 36% to 734% improvement compared to control (to a certain ratio and depends on the type of lignocellulosic fiber). Paper fiber had the highest tensile strength and was not affected by paper grade and/or fiber length. Cotton fiber had higher tensile strength at lower ratio of fiber to broken rice. Corn husk fiber's tensile strength increased steadily as the ratio increased. The flexibility was affected by the length and type of lignocellulosic fiber. Rice husk was unsuccessfully broken down through soda ash pulping due to high lignin content. Tensile strength equation was derived for each type bio.fiber.plastic based on linear regression trendline. Anomaly was found and possible sources of error were addressed.

Conclusions/Discussion

My hypothesis was partially proven correct because the recovered cellulosic fiber, not hemicellulose or lignin, improves the tensile strength. Flexibility has an inverse correlation to tensile strength. I concluded that recovered cellulosic fiber provides the structure and enhances the tensile strength, while amylose and amylopectin in broken rice works as a "glue" and gives the plastic-like quality of bio.fiber.plastic. Ratios and types of fiber determine the intended application of bio.fiber.plastic products. Plant-based garbage/recycled materials can be a source of lignocellulosic fibers and reusing these fibers otherwise thrown away, into bio.fiber.plastic helps to reduce the landfill and plastic problem. Prototypes were successfully created.

Summary Statement

I developed a fusion of rice bioplastic and lignocellulosic fibers from garbage to enhance the formation and tensile strength, by upcycling cellulosic fibers to extend their useful life as a new product/material, bio.fiber.plastic.

Help Received

Thanks to Mr. Lee, my science teacher, for support and feedback; special thanks to my parents for providing the materials and adult supervision.