Hong Kong Student Science Project Competition 2022

Extended Abstract (Investigation)

Team Number: SBBC203

Project Title: Pineapple Leaf Fibre in Biodegradable Plastic

Project Type: Investigation

To our best knowledge and after thorough literature research, as at 23/6/2022 , there are/*are no similar works. If there are, the reference links are as below:**

I. Background

Pineapple leaf fibre (PALF) is rarely used, but there are uses in the clothes industry, due to stiffness while being light-weight. After harvesting pineapples, leaves are thrown away. About one-trillion single-use plastic bags are used every year, taking 1000 years to photo-degrade that pollutes the environment. Starch-based is one of the most common biodegradable plastics and decomposes naturally. However, tensile strength is low. We investigated if adding PALF into biodegradable plastic recipes with modifications made will increase the tensile strength of plastic.

Steele,S.(2019).What is pineapple fibre and how do you make textiles from it? The Sustainable Fashion Collective. Retrieved from https://www.the-sustainable-fashion-collective.com/2019/06/04/what-is-pineapple-fibre-and-how-do-you-make-textiles-from-it.
10 Facts About Single-use Plastic Bags. Biologicaldiversity.org. Retrieved from https://www.biologicaldiversity.org/programs/population_and_sustainability/sustainability/plastic_bag_facts.html.
Huda,T(2007). Physicochemical Characteristics of Biodegradable Plastic Film. Diploma three in Chemistry Analysis of Indonesian Islamic University. Vol.7, No.2.
Amin,R.,Chowdhury,M.A.,&Kowser, A.(2019). Characterization and performance analysis of composite bioplastics synthesized using titanium dioxide nanoparticles with corn starch. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6722259/.

II. Objectives

To discover if tensile strength of biodegradable plastic is surge by adding PALF, and application of it.

III. Hypothesis

PALF increases the tensile strength of biodegradable plastic. It can measured by a force sensor.

IV. Methodology

Materials: string balance, blender, heating plate, beaker, spatula, gelatin, corn starch, citric acid, glycerol, water, pineapple leaf, G clamp, plastic holder, force sensor, plastic wrap

Experiment 1: To find out which biodegradable plastic recipe has the highest strength, in order to choose the biodegradable plastic to add PALF into. And to prove that PALF can increase the tensile strength of biodegradable plastics.

Independent variables	*Dependent variables*	*Control variables*
Type of plastic (B2, B3, B4, D2, D3, D4)	Tensile strength of plastic (using a string balance)	- the size of plastic tested - Speed & force of pulling plastic

Experiment 2: To find the tensile strength of biodegradable plastic when different concentrations of PALF are added (0g, 16g, 31.25g)

Independent variables	*Dependent variables*	*Control variables*
Type of plastic (B5, B7,	Tensile strength of the	- the size of plastic tested

B8)	plastic (using a force sensor connected to a data logger)	- Direction of pulling plastic - Number of days that the plastic has been exposed to room condition

V. Results

Experiment 1

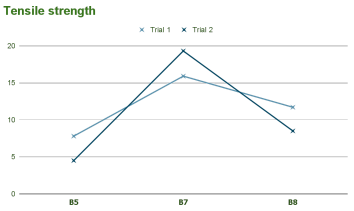
Plastic-type	Maximum tensile strength (N)	
B2, B3, B4	>20	Due to the limitations of equipment, the exact tensile strength can not be recorded. However, the plastic remains intact after pulling with a force of 20N.
D2	17	
D3, D4	>20	Due to the limitations of equipment, the exact tensile strength can not be recorded. However, the plastic remains intact after pulling with a force of 20N.

From the data, it can be concluded that adding PALF to the biodegradable plastic mixture before drying increases the tensile strength as that of plastic-type B is higher than that of D. Also molding in plastics continues for a longer time than with PALF.

Experiment 2

Plastic-type	Trial	Maximum tensile strength (N)	Time of breakage (seconds)
B5 (control)	1	7.8	10.7
	2	4.5	10.2
B7	1	15.9	9.5
	2	19.3	7.9
B8	1	11.7	7.2
	2	8.5	8.5

Conclusion



It can be concluded that biodegradable plastic with PALF is stronger as B5 shows the lowest tensile strength which is the only one without PALF. Moreover, plastic B7 (highest PALF content) has the highest tensile strength. Therefore, the higher content of PALF will increase biodegradable plastic strength.

Limitation+Application: Due to the limitations in equipment, the result tensile strength obtained is not fully accurate. The measurement is done by hand and there would be small inconsistencies between each pull. Also, the changes in accuracy and increase in drift error have been shown for prosthetic purposes. The results above provide a path to increase the strength of the biodegradable plastic. As it would be used as a plastic bag where people would carry the stuff of different weights, it should be ensured that the plastic has enough strength and would not break.

VI. Conclusion

Objectives have been met as we have found out the relationship between textile strength and content of PALF. It is found that PALF has a direct linkage with textile strength and that the higher content the better strength. As we already found out how to keep the plastic strong, our next step would be to make a real plastic bag as currently, we can only create biodegradable plastic in the form of sheets. It would also be nice if we could explore more eco-friendly substances that can also increase textile strength.