The Amazing Polymers

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INTRODUCTION

The importance of both natural and synthetic polymers in our lives cannot be overestimated. The desirable properties of these macromolecules, such as tensile strength and flexibility, make them extremely useful both in nature and in the manufacture of products that we use every day.

Examples of naturally occurring polymers include such things as wood, cotton, paper and silk as well as proteins and DNA. Plastics, Teflon®, Plexiglass™, and Mylar™ are all examples of commercially available synthetic polymers. Polymers are made up of smaller repeating units, called monomers, which are linked together by covalent bonds.

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OBJECTIVE

In this project, the focus is to find out on which sets of these macromolecules, will produce a desirable properties such as tensile strength and flexibility, and make them extremely useful both in nature and in the manufacture of products that we use every day.

This project will be implemented in Spring 2022 to 12th grade students at South Early College HS enrolled in Environmental System and Adv Honor Physics class.

METHODS

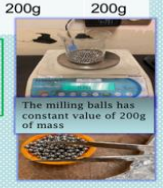
In this project we used the PMMA -Chitosan and nano carbon.

Nano Carbon- CNTs are well-suited for virtually any application requiring high strength, durability, electrical conductivity, thermal conductivity and lightweight properties compared to conventional materials. Currently, CNTs are mainly used as **additives to synthetics**

Chitosan- as antibacterial polymer. Chitosan is a **partial deacetylated derivative of the parent polymer chitin.** It comprises random repeating units of N-acetyl-d-glucosamine and d-glucosamine. Due to presence of large number of amine groups (-NH_2), it is polycationic in nature.

Polymers	SET 1	SET 2	SET 3	SET 4
PMMA (20g)	75%= 15g	80%= 16g	95%= 19g	85%= 15g
CHITOSAN (20g)	15%= 3 g	10%= 2g	5%= 1g	15%= 3g
NANO CARBON	10%= 2 g	10%= 2g	none	none
MILLING BALLS	200g	200g	200g	200g

Polymethyl Methacrylate (PMMA), a **synthetic resin produced from the polymerization of methyl methacrylate**. A transparent and rigid plastic, PMMA is often used as a substitute for glass in products such as shatterproof windows, skylights, illuminated signs, and aircraft canopies.



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STEP BY STEP PROCESS — STEP I: MIXING OF POLYMERS AND DRY GRINDING

DATA CHART

SET 1, PMMA 20g + Chitosan 3g + Nano carbon 2g

WARNING
Do not mix different milling ball sizes to achieve consistency.

The retsch or the planetary ball mills requires a tight fastening

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STEP BY STEP PROCESS — STEP II: SIFTING (SEPARATION PROCESS) AFTER DRY GRINDING

DATA CHART

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STEP BY STEP PROCESS — STEP III: SHAPING AND COMPACTING BY ADDING MORE FORCE AND PRESSURE

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STEP BY STEP PROCESS — STEP IV: HARDNESS TEST

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RESULTS

Polymers	SET 1	SET 2	SET 3	SET 4
PMMA (20g)	75%= 15g	80% =16g	95% = 19g	85%=15g
CHITOSAN (20g)	15%= 3 g	10% =2g	5% =1g	15%=3 g
NANO CARBON	10%= 2 g	10%= 2g	none	none
MILLING BALLS	200g	200g	200g	200g

PHYSICAL OBSERVATION

Set 1: soft and has deep indention when tested
Set 2: hardest amongst with shallow dent
Set 3: Softer than set 1 and 4 due to less chitosan and no added nano carbon
Set 4: a balance of softness and hardness due to 15% added Chitosan and the absence of Nano Carbon.

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DISCUSSION

After the tedious process and successful testing in Dr. Robles' lab, set 2 has the hardest result.

And this will be used in the Spring of 2022 for the EnviSystem's Project Based Learning activity on recycling using plastic polymers.

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