



BIOPLASTIC

A Better Alternative for a Sustainable Future

ABSTRACT

Bioplastics are plastic materials made of substances derived from biomass materials and/or can be broken down by microorganisms through processes that occur naturally in the environment or technologically enhanced natural processes.

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Introduction

In the year 1907 the Belgian-American chemist, Leo Baekeland, pioneered Bakelite, invented the first industrial plastic. Plastic was an amazingly great invention that solved lot of problems. But the benefits of plastic came at a cost, a cost that is too great for our planet and our own health.

Plastic is not a natural part of the environment. Humans are the only beings that use plastic, each year 8-10 million tons of plastic enter the ocean! That is about one garbage truck entering the ocean every minute! There are different kinds of plastic, designed to be used for different things. But only some kinds can be reused or recycled.

Plastic can have different qualities depending on exactly how it is made. Some plastic is strong and tough (like a



helmet!) . Plastic can be mixed with dyes to make any number of different shades



, some plastics



can be used and reused again and again

, and some plastic can stretch



There are seven types of plastic.

1. PETE, number 1 is not safe to re-use but safe to recycle.
2. HDPE, number 2 it is safe to recycle and safe to reuse.
3. PVC, number 3 it is not safe to re-use or recycle.
4. LDPE, number 4 it is safe to re-use and recycle.
5. PP, number 5 it is safe to re-use and safe to recycle.
6. PS number 6 is not safe to reuse, and you can only recycle it sometimes.
7. OTHER, number 7 it is not safe to re-use or recycle.

Humans are exposed to a large variety of toxic chemicals and microplastics through inhalation, ingestion, and direct skin contact, all along the plastic lifecycle. Plastics don't dissolve, they get broken down into minute pieces which when reaches the oceans and enters in the digestive systems of the sea life. Eventually, it enters the human body. According to WWF, an average person could be ingesting approximately 5 grams of plastic every week. The toxic chemical additives and pollutants found in plastics threaten human health on a global scale. Scientifically proven health effects include causing cancer or changing hormone activity, which can lead to reproductive, growth, and cognitive impairment.

Plastic has caused great problems in the world. One of these problems is the great pacific garbage patch. This thing is a plastic dumping ground in the middle of the Pacific Ocean. It stretches for kilometres and all you can see is plastic.

POPs (persistent organic pollutants) are poisoning the world, and this is all happening because of plastic. The POPs are evaporated into clouds, then the clouds make it rain and the POPs come back to earth, then the POPs in the arctic region get frozen within the ice. This causes the ice to be poisoned which can affect animals like arctic

wolves. But the POPs that remain in the ice make it melt. This makes the water poisonous which will affect the food chain. All because of plastic!

Bio Plastic

Bio plastic an innovative idea of the future of plastic. When I visited the futuristic museum of Dubai, I came across a section about Bioplastic. This intrigued me and that is when I started reading about bioplastic and how it can bring a positive impact to the environment.

Bio plastic is an invention that will change the world. Instead of using individual use plastic scientists have created a whole new thing called bio plastic. Bioplastics are plastic materials made of substances derived from biomass materials and/or can be broken down by microorganisms through processes that occur naturally in the environment or technologically enhanced natural processes. Bioplastics made from renewable resources can be naturally recycled by biological processes, thus limiting the use of fossil fuels and protecting the environment. Therefore, bioplastics are sustainable, biodegradable, and biocompatible. Today, bioplastics have become a necessity in many industrial applications such as food packaging, agriculture and horticulture, composting bags, and hygiene. Bioplastics have also found their use in biomedical, structural, electrical, and other consumer products. With increasing demand for global plastic consumption, a lot of research is being dedicated toward exploring green materials and new ways to process them.

While researching, I found there out are multiple types of bioplastics, there is no difference bio plastic and normal plastic's looks, but it all comes down to sustainability. Bio plastic will dissolve into the soil and function as fertiliser in a couple of days, whereas normal plastic will take around a thousand years to break down and harms the environment! Bio plastic is an eco-friendly plastic made from natural ingredients like plants, soil and much more. Bioplastics look like plastic and behave like plastic but are made of natural materials. If we can create a product that is made of naturally occurring plants or animals, then it will be quick and easy for microbes to devour. Scientists are working on ways to replace plastic products that we use every day.

Could juice from a prickly pear cactus replace petrol-based plastic? Scientists have made a chain of molecules (polymers) that act like plastic but can be broken down in nature. The sticky juices of the cactus can be reformed into products like plastic items we use today but will break down in a matter of months. Mushroom glue could be another new alternative to plastic products. The way to make seaweed plastic is remarkably simple. To make it scientists have mixed a white powder that comes from plant cells into water and heat it up. Then they add sugars that have come from plants and a few drops of plant-based food dye. Then they dry it out flat. Once the scientists have dried the plastic, they cut it out into the right shape the work is all done.

I wanted to produce a bioplastic recipe with materials that could be easily procured from home, and that is when my search for a home-made bioplastic recipe started.

My Aim

To make a sustainable plastic that will not go in landfill or harm animals, and which can break down in nature (like wood, cotton, or paper) and to make a plastic that is renewable, recyclable, and non-toxic.

Experiment 1

Bioplastic experiment #1 (Natural dry)

Hypothesis: The use of natural starch and plasticiser will help us make a strong bioplastic .

Materials for experiment

1. 7 tablespoon waters
2. 1 tablespoon cornstarch
3. 2/3 tablespoon vinegar
4. 2/3 tablespoon glycerine
5. 1 mould
6. 1 double boiler

Method

1. Add 1 tablespoon cornflour.
2. Add 7 tablespoons water.
3. Add 2/3 tablespoon vinegar.
4. Add 2/3 tablespoons glycerine.
5. Stir the mixture on a double boiler for 6 minutes.
6. Transfer the liquid to a mould.
7. After 8 days un-mould your plastic !

Results

Observation one

Before the double boiling the mixture, the cornstarch kept sinking to the bottom of the pan.

Observation two

During double boiling the liquid slowly became thicker.

Observation three

When the liquid dried there were plenty of cracks on the bioplastic.



What problems did you encounter ?

While the plastic was drying, I realised that the plastic was slowly cracking.

Conclusion

In the case of dehydration, contraction the outer parts start to shrink while the inner parts are still moist. It results to deeper cracks over time. Due to high water content the inter-molecular force was weak.

Experiment 2

Bioplastic experiment #2 (Using Dehydrator)

Hypothesis: The use of natural starch and plasticiser will help us make a strong bioplastic .

Materials for experiment

1. 7 tablespoon waters
2. 1 tablespoon cornstarch
3. 2/3 tablespoon vinegar
4. 2/3 tablespoon glycerine
5. 1 mould
6. 1 double boiler

Method

1. Add 1 tablespoon cornflour.
2. Add 7 tablespoons water.
3. Add 2/3 tablespoon vinegar.
4. Add 2/3 tablespoons glycerine.
5. Stir the mixture on a double boiler until the mixture becomes thick.
6. Transfer the liquid to a mould .
7. Put the mould into a dehydrator for 80 minutes.

Results

Observation one

When we took the plastic out of the dehydrator it was still moist on the inside.

Observation two

While in the dehydrator the plastic was becoming thinner.

Observation three

When the plastic was dried the plastic was smooth and flexible.



What problems did you encounter ?

The plastic was still moist on the inside when we took it out of the dehydrator so we could not unmould it immediately.

Conclusion

With the use of dehydrator, the drying process temperature was increased by 20-30 °c when we compare it to experiment #1. Using the dehydrator made the outer and the inner layer of the bio plastic dry evenly. Due to this I was able to unmould the bio plastic effortlessly.

Experiment 3

Bioplastic experiment #3 (Oven dry)

Hypothesis: The use of natural starch and plasticiser will help us make a strong bioplastic .

Materials for experiment

1. 7 tablespoons of water
2. 1 tablespoon cornstarch
3. 2/3 tablespoon vinegar
4. 2/3 tablespoon glycerine

5. 1 mould
6. 1 double boiler
7. 1 oven

Method

1. Add 1 tablespoon cornflour.
2. Add 7 tablespoons water.
3. Add 2/3 tablespoon vinegar.
4. Add 2/3 tablespoons glycerine.
5. Stir the mixture on a double boiler for 6 minutes.
6. Transfer the liquid to a mould.
7. Put the mould into an oven.
8. Heat the oven at 180 ° celsius with fan for 30 minutes.
9. Unmould your bioplastic!

Results

Observation one

While the mixture was in the oven it was turning into a bubbly substance.



Observation two

The bioplastic was very sticky, and it was exceedingly difficult to unmould.

Observation three

The bioplastic was very rough and was not flexible.

What problems did you encounter ?

When I dried the plastic in the oven it was still sticky after drying.

Conclusion

The oven drying process increased the temperature of the drying process by another 30-40 ° c. After a while I could notice that the outer layer dried faster whilst the inner layer was still moist. Due to this, I could notice that there were bubbles on the surface of the bio plastic.

At the end of this experiment, I was not able to un mould the bio plastic as the matter was sticking to the base. Hence, I can conclude that the increase in temperature did not help me with the hypothesis.

Discussion

In plastic, plasticiser plays an important role in making it stronger and more flexible. To have similar properties in bio plastic, we used corn starch.

Oven drying process contracted my product. It made it difficult to un mould the bioplastic in one single piece. Apart from high heat, another reason of contraction might be is, my experiment didn't have the right quantity of starch and had more moisture content.

Out of the three experiments (oven dry, natural dry and dehydrator), I found that bioplastic is best made in an environment which provides steady low heat, in my case it was the dehydrator. Exposure to extreme heat conditions does not provide satisfactory results. On the other hand, room temperature drying took longer than expected time to dry and due to uneven drying, it developed several cracks all over the surface.

Use of corn starch provided plasticiser properties to my experiments. My experiments lacked exact properties like normal plastic. My hypothesis to have similar properties of plastic in bioplastic is, there is a need to add more starch e.g. seaweed powder or arrowroot starch to enhance the strength and flexibility of bioplastic.

Acknowledgements and References

- ✚ The Plastic Problem by [Aubre Andrus](#)
- ✚ Oceans of plastic by [Tracey Gray](#)
- ✚ Quitting plastic by [Clara Williams Roldan with Louise Williams](#)
- ✚ Why plastic is a problem by [Matthew Oldham and Lizzie Cope](#)
- ✚ Giestas YouTube channel
- ✚ <https://www.genevaenvironmentnetwork.org/resources/updates/plastics-and-health/>
- ✚ Museum of the future (Dubai)

