

Title: Compostable clear cups? Do they break down?

Abstract:

The purpose of this experiment was to find out if compostable clear BioCups breakdown. The cups are promoted as biodegradable, and this experiment sets out to test this claim. Three types of disposable cups (plastic, paper with silver lining and BioCups) were tested in various mediums – soil, water, salt water and bleach water to measure their biodegradability over a 13-day period. The medium was chosen to mimic those found in our environment. Photographs were taken to document the changes made over the 13 days. This experiment clearly showed that the cups do not breakdown in soil, water, and salt water in the provided time and show a 20% or minimal change in bleach water as shown in the table and graph.

Aim: To find out if compostable clear cups break down.

BioPak are the only company that claim they meet the AS4736 standards for compostable cups because the cold cups are made from Ingeo (a trademark brand for PLA – a polymer made from renewable resources). Contrary to other thermoplastics, which are petroleum-based, Ingeo (PLA) are derived from corn, cassava sugar cane or beets that capture CO₂ into long chain sugar molecules. These plants are then milled separating the starch from other materials. Adding some other chemicals to ferment and make lactic acid after a lot of transforming and adding of chemicals the sugar is clear and moulded into pellets that are melted down and used in everyday products like yogurt containers, computers, cups, and coffee capsules.

It was decided to see if these cold BioPak cups really do biodegrade, the aim was to replicate what conditions cups and rubbish end up in, such as the sea, normal water, compost, and bleach. Bleach was used because BioPak say the cups are tested in labs meaning that other types of chemicals may impact how long or fast the cups decompose.

BioPak abide by the AS4736 standards for their clear cups. The guidelines say that 90% of the PLA (Ingeo) needs to degrade within 180 days. This is equivalent to 6 months which is how long an orange peel takes to break down.

Hypothesis: If the cups are in different types of liquid then it will change how long it takes the cups to break down.

Independent variable: The different types of materials (water, saltwater, compost, bleach).

Dependent variable: How long the cups take to break down.

Controlled variable:

- Cups
- Containers

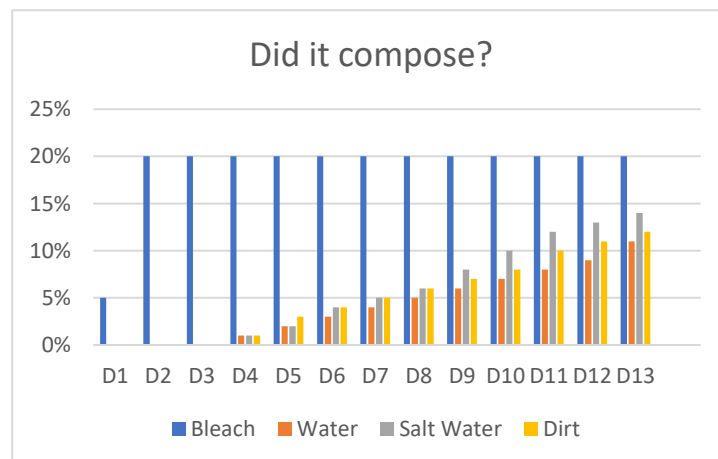
- liquid
- time in the liquid

Materials:

- Water 1 cup
- Salt
- Compost
- Bleach
- Compostable clear Bio cups, Normal plastic cups, Paper cups with plastic and silver outside lining
- 4 small bowls

Method:

1. Get 4 medium sized bowls that are ok to get ruined and place them on a table.
2. Fill bowl one with 1 cup of water, bowl two with 1 cup of salt water, bowl three with 1 cup of diluted bleach and bowl four with 1 cup of wet dirt (not mud).
3. Measure and line 2.5x1 inch on your silver cup then repeat with the two other cups four times.
4. Cut along the lines.
5. Place one of each cup cut out part in the bowls making sure that they are covered in the liquid or dirt.
6. Record the changes over one week/till next science lesson by photo.



Decomposed Mediums	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13
Bleach	5%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Water	0%	0%	0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	11%
Salt Water	0%	0%	0%	1%	2%	4%	5%	6%	8%	10%	12%	13%	14%
Dirt	0%	0%	0%	1%	3%	4%	5%	6%	7%	8%	10%	11%	12%

Discussion:

The hypothesis states *“If the cups are in different types of liquid then it will change how long it takes the cups to break down”*, the results were very clear, diluted bleach had the greatest effect and major impact on the paper cup with silver lining demolishing the silver sparkle in two days. But did not change the appearance or thickness of the plastic and BioPak cup.

Saltwater took second place, having the second greatest effect on decomposing the various cups (plastic, paper with silver lining and BioPak cup). When cleaning up after the experiment, it was noticed that a shimmery ink colour was in the saltwater bowl from the silver in the paper cup that got separated. This silverly was still visible on the paper itself, but some had also gone into the water. As was shown with the bleach experiment saltwater did not change the appearance or thickness of the plastic or BioPak Cup.

Dirt took third place with no degrading or other influences on the plastic and BioPak Cup except slight staining of the paper cup.

Finally, the medium with water only, made the paper cup go soggy and like my other tests it did not influence the plastic and BioPak Cup.

When comparing these results to the background research the following was found. AS4736 guidelines mark that 90% of the PLA (Ingeo) needs to degrade within 180 days. For this experiment the cups were in for 13 days, which is 7.2% of the time outlined in the guideline. This would mean that the cups should have degraded increasingly less than AS4736 states, which is evident in this experiment and presented in the graph above. It would be reasonable to assume that if the experiment continued for a longer period of time, the results could have been more in line with the research on their decomposition.

Limitation/Problems

On the second day of the experiment a problem was faced. The Bleach bowl was unknowingly knocked over. This meant the bleach medium only had 2 days of results. This accounts to why 20% degradation continues from Day 2 to Day 13 in the bleach column. To manage this problem, in future it is suggested that a bleach bowl medium be put in a safer location.

In order to fit the three various cups (paper cup with silver lining, plastic clear cup, and BioPak Cold Cup) into the separate bowls, the cups needed to be cut, ensuring they were all the same size and part of the cup. This limitation was managed by ensuring the size of each was the same and the portion of the cup was from the same part of the cup for each.

During research AS4736 standards, gave inconsistent information. Some references to the standard were different to others. It was challenging to find out exactly what AS4736 standard was and how it was

managed with the cups. It was also found that the length of time tested in research varied from 120 days to 180 days. To manage this limitation, it is suggested that clear communication between businesses and the Government standards we implemented.

Real life application of experiment

If any bioplastics are improperly discarded, then the research suggests it is likely to degrade in 180 days, it needs to be noted that it may move/change location. Like getting stuck in a tree, that will discourage the breaking down process to happen. The experiment showed some decomposition in bleach and water, suggesting that chemicals might need to be used to break down the BioPak Cold cup in the suggested timeframe. Chemicals in the natural world are not favourable and adding chemicals to waste or compost is not a sustainable practice. For this reason, the use of the BioPak cups should be minimal and discouraged. To truly know the results over a 180-day period, it is suggested a similar experiment be conducted for the entire duration.

Conclusion: (Answer your aim. Was the hypothesis supported or rejected?)

The aim *to find out if compostable clear cups break down*, was supported through the experiment and testing various types of cups in different mediums. – bleach and water, water, dirt, and saltwater. It was found that there was some break down of the cups in the bleach water, suggesting environmentally safe chemicals might need to be used to help the process.

The hypothesis, *“If the cups are in different types of liquid then it will change how long it takes the cups to break down,”* was supported as shown in the experiment. The bleach clearly had the greatest effect on breaking down the various cups followed by the salt water, dirt, and finally plain water.

Citing the web:

Bioplastics frequently asked questions, (2019), Australian Bioplastics association, <https://bioplastics.org.au/resources/faq/#toggle-id-1-closed>

How is Ingeo Made, (2020), NatureWorks, <https://www.natureworksllc.com/What-is-Ingeo/How-Ingeo-is-Made>

BioPak cold cups, (2020), BioPak, <https://www.biopak.com.au/products/cold-cups>

How Long Does it take Garbage to Decompose?, (2020), https://www.keepcasscountybeautiful.com/images/PDF/Recycling/how_long_does_it_take_garbage_to_decomph

**SCIENCE AND ENGINEERING INVESTIGATION AWARDS
RISK ASSESSMENT**

Student's name's: Maddie Hassell

Year level: Year 6

Teacher: Mrs Thorp

Title of Project: Compostable clear cups do they decompose?

You will need to answer Question 1 and 4 for all projects. You will need to and answer Questions 2 and 3 if you are using hazardous materials, equipment or potentially hazardous biological agents.

You must include a copy of this form with your investigation or design project report.

1: Investigation/ Design project risks

- a. List the risks involved in your project

Accidentally drink the bleach ,saltwater, dirt, and water.

Cut finger when cutting the parts out of the cups.

- b. Describe the safety precautions and procedures that you will use to reduce these risks.

Put the containers in a stable and secure place.

Be mindful when using siziors.

2: Specific hazards (if applicable)

- a. List all hazardous chemicals, activities, and/or equipment that you will use.

4 Black bowls, Salt, Water, Bleach, Dirt, measuring cup, pencil, ipad, desk,

- b. List and potentially hazardous biological agents that you will use.

N/A

- c. Describe the safety precautions and procedures that you will use to reduce the risks associated with hazardous chemicals, activities, equipment, and/or any potentially hazardous biological agents listed above.

Make sure when diluting the bleach that I ware dish gloves, so I do not get concentrated bleach all over the place. Not having eletrics near the water, saltwater, and bleech bowls.



I/We have talked with my/our teacher about the risks associated with this project and how I/we will manage these.



I/We have discussed with my/our teacher about any specific hazards associated with this project and how I/we will manage these, including safe disposable of any hazardous materials.

Signed:Maddie Hassell

Date: 15/9/2020