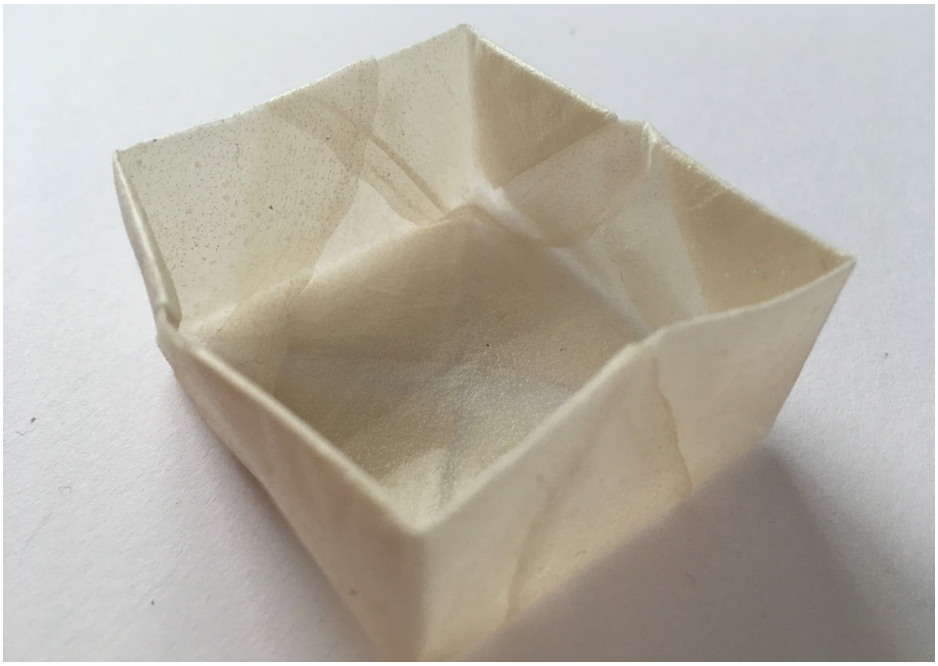
Bioplastic Research

Development for the Metachair MC project



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INTRODUCTION

My project was about using fabric waste from Textile supply chains that was destined for landfill, then experimenting in the subject of bioplastics to act as binder.

The final product was a small proof-of-concept seat, which exploits the properties of this new material, while exhibiting its architectural potential and ability to be used as a raw material resource.

HYPOTHESIS

I believed using the waste textiles as a resource, I could explored the possibility of combining the waste material with a vegetarian biodegradable binder, to transform the textiles' natural soft properties into a hard, rigid material that is structurally sound and able to support the weight of a average person.

MATERIALS

1. Water (tap)
2. Agar
3. Cornstarch
4. Sodium Bicarbonate
5. Salt
6. Alum
7. Aloe Vera
8. Dextrina

PROCEDURE

1. Measure ingredients
2. Follow bioplastic recipes
3. Set bioplastics
4. Observe and record findings

DATA - Tests & recipes

Test no.	Test	Amounts	Moulds
1a	Water & Agar	• 400ml water • 4 teaspoons of agar	1. Large patterned plastic tray
1b	Water & Agar	• 400ml water • 4 teaspoons of agar	1. Large patterned plastic tray
1c	Water & Agar	• 400ml water • 4 teaspoons of agar	1. flat tray
2	Water, Agar & Cornstarch	• 400ml water • 2 tsps of agar • 2 tsps of cornstarch	*As above*
3	Water, Agar & Salt	• 400ml water • dissolved 2 tsps of table salt • 2 tsps of agar	2. Large patterned plastic tray
4	Water, Agar & Alum	• 400ml water • & dissolved 2 tsps of alum • 2 tsps of agar	1. Large patterned plastic tray
5	Water, Agar & used Yerba Mate	• 400ml water • 4 teaspoons of agar • 5 tsps used yerba Mate	1. Small flat circular tray 2. Deep mould 3. Shaped mould
6	Water, Cornstarch & Sodium Bicarbonate	• 1/2 cup cornstarch • 1 cup baking soda • 3/4 cup water	1. Cupcake mould 2. Origami mould
7	Water, Agar, Cornstarch, Salt, Sodium Bicarbonate	• 70 ml water onto • 1/4 cup cornstarch • 1/2 cup bicarbonate sodium • 1 tsp Agar • 1 tsp salt	1. Cupcake mould 2. Flat tray 3. Origami mould
8	Glycerine, Cornstarch & Aloe Vera	• 25 g of Cornstarch • 2.5 ml glycerine (½ tsp) • 50 ml of Aloe Vera	1. Pot mould

9	Water, Cornstarch & efervescente salts	• 70 ml water • 1/2 cup salts • 1/4 cup cornstarch	1. Cupcake mould 2. Origami mould
10	Water, Cornstarch, Sodium Bicarbonate & used barbecue Charcoal	• 70 ml water • 1/2 cup Sodium bicarbonate • 1/4 cup cornstarch • 1 tsp of Charcoal ground from used BBQ coal	1. Flat mould 2. Cupcake mould
11	Water, Cornstarch, Sodium Bicarbonate & Gum arabic	• 70 ml water • 1/2 cup Sodium bicarbonate • 1/4 cup cornstarch • 1 tsp of Gum Arabic	1. Flat mould 2. Cupcake mould
12	Test 6 + pigments 1. Blue 2. Red clay 3. Activated Charcoal	• 1/2 cup cornstarch • 1 cup baking soda • 3/4 cup water 1. 1 tsp of blue screenprint ink 2. 1 tsp Red clay for beauty 3. 1 tsp of ground activated charcoal sticks	1. Flat mould 2. Cupcake mould

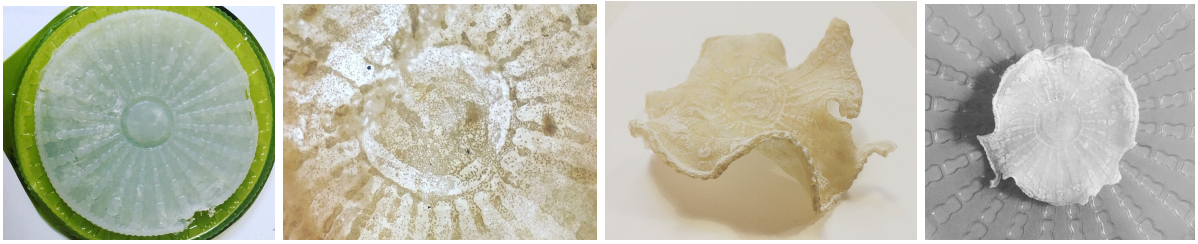
RESULTS & insights

Within my project, I have collected many different results, therefore I'm choosing to show them in both a visual way as well as written data results. Each Test result will show:

1. A visual comparison
    a. When I first created the bioplastic test
    b. Throughout the drying stages
2. What it's properties are
3. It's degradation (to be completed), though note that as this documentation was completed in April 2018, none of the bioplastic recipes had begun to mould or biodegrade after 4 months plus.

Test 1a: Water & Agar

- This mixture of water and agar was the very first one I tried and really inspired me to continue looking at bioplastics in general.
- It's now 5 months later and the piece is fairly unchanged from the images taken in December.

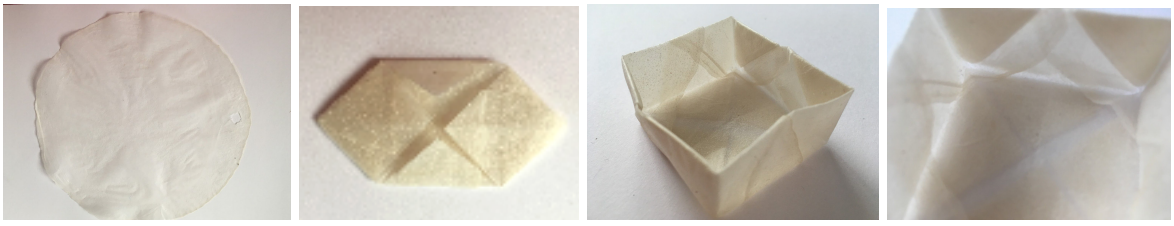


Test 1b: Water & Agar

- I created several Tests simultaneously including Test 1, 2, 3 & 4.
- Several of this variable changed which it why I restarted the tests and continue sections which are less textured, the bioplastic is actually quite clear.

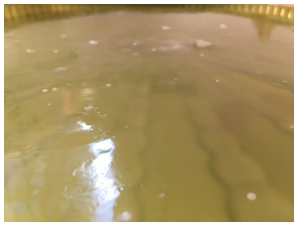
Test 1c: Water & Agar

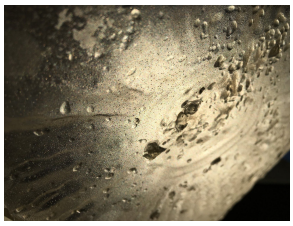
- Initially all my tests were created in trays which had patterns in the base.
- This test is completely soluble in water. This has not yet started to mould



Test 2: Water, Agar & Cornstarch

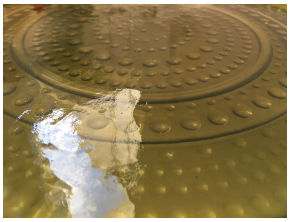
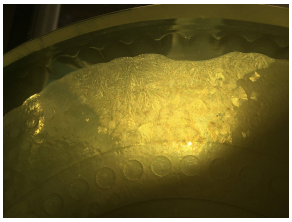
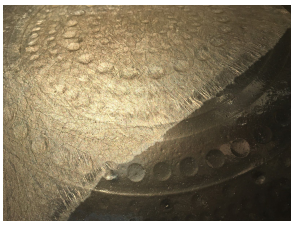
- As you can see, from the start, the addition of of cornstarch into the mixture creates a much cloudier aesthetic.
- It is also very difficult to get a mixture without any lumps Once it has dried it has several nice properties as it holds the shape of the mould much better than the agar on it's own.





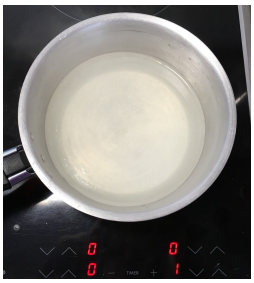
Test 3: Water, Agar & Salt

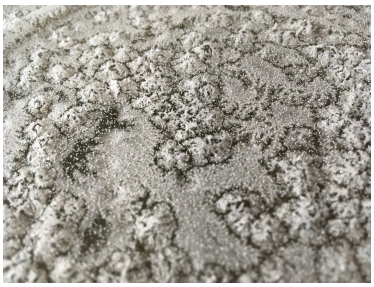
- Again, from the Textile Scaffold we, I knew that it was possible to grow crystal with salt, albeit very slowly.
- Eventually the test dried. It is still a little flexible though under force it would be brittle.


Test 4: Water, Agar & Alum

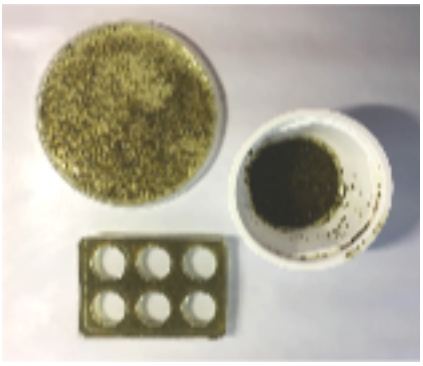
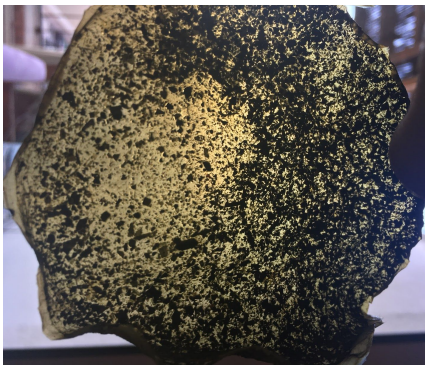
- Also during the 'Textile scaffold' week at Fabricademy, I managed to grow some giant Alum crystals. This inspired me to look into what would happen when adding slum into a bioplastic mixture.



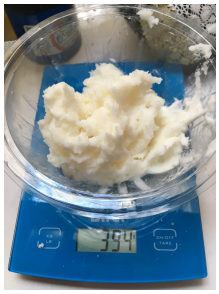
Test 5: Water, Agar & used Yerba Mate

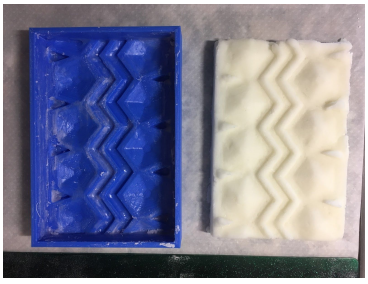
- After experimenting with coffee as a natural dye in the Fabricademy Bioplastics week, I wondered what other teas and drinks I could use as dyes or within bio-binders.
- Yerba Mate is such a strong particular taste and as you can see it gives a wonderful dark green colour.

Test 6: Water, Cornstarch & Sodium Bicarbonate - BiSoCo / Not-so-dough

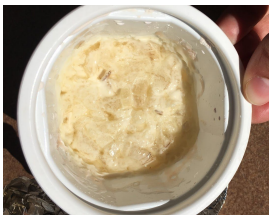
- Through my research, I found a few recipes online which involved making a safe clay in which children could use to mould shapes and art projects.
- This recipe requires adding the water into the dry ingredients and stirring the mixture until in creates a mashed-potato-like consistency.



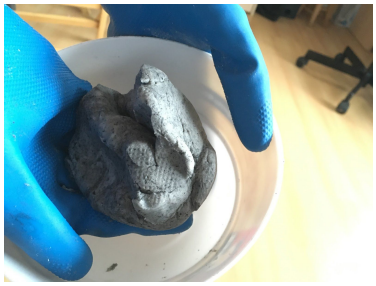



Test 7: Water, Agar, Cornstarch, Salt, Sodium Bicarbonate

- I decided I would also try a mixed recipe of many of the ingredients.
- The effect was very similar to Test 6, but it took much longer to dry.
- I don't have a photographic example of this without textiles in.

Test 8: Glycerine, Cornstarch & Aloe Vera
• I mixed and cooked the ingredients together before putting it into a silicone tray mould. It baked similarly to Test 6, but took twice as long because of the size. It had chunks and the edges cracked a lot.
 

Test 9: Water, Cornstarch & efervescente salts
• This was actually a mistake as I got the salts mixed up with the Bicarbonate of soda. I used the exact same method as Test 6, but the mixture started to fizz when I added the water! It settled in the silicone mould but then bubbled up again in the oven. It did eventually set when cooling, but was crumbling.
 

Test 10: Water, Cornstarch, Sodium Bicarbonate & used barbecue Charcoal
• I decided to crush some already used charcoal into a powder and add this into the same mixture as the recipe in Test 6.The right image is the mixture after baking so you can see there was virtually no colour change.
 

Test 11: Water, Cornstarch, Sodium Bicarbonate & Gum arabic

- Via researching natural glues and resins, I came across Gum Arabic.
- I used a very small amount in the same recipe as Text 6.
- When moulding it into the shape, it became a lot more malleable, but after it had been baked, it had the same consistency as the other baked sample with bicarb in. The colour was also slightly more brown.

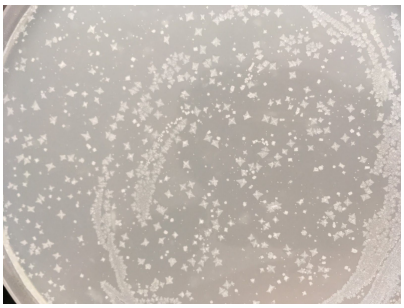
Test 12: (Test 6) + pigments

1. Blue
2. Red clay
3. Activated Charcoal

- These tests were carried out in the same way as the previous two tests, using the same recipe as Test 6. I made 2 lots of the mixture and split it over the 3, mixing and baking them simultaneously.
- After they were dry, I later sanded them to dive them a flat edge and to test how the mixture looked throughout, which you can see in the case of the blue as it cracked, that the pigment runs evenly all the way through.






Pretty interesting, but total failures
• Using Cornstarch, salt and vinegar and a small amount of water, this was a test which was easy to prepare and it made pretty crystals on top • But it never set! So I had to wash it off in the end.
 

CONCLUSION

After these tests, I decided it was best to go with the strongest and most durable of the bioplastic experiments to adapt to my original brief of creating a textile-bioplastic composite material suitable enough to make a seat or support a chair.

REFERENCES

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