MATERIAL REHABILITATION

I'M STAGING AN INTERVENTION

A place you can FEEL

WHAT MAKES A MATERIAL A MATERIAL?

MATERIAL REHABILITION

OVERVIEW

Material Rehabilitation is an investigation into what constitutes as a material by exploring composition and material behaviour. Bioplastic is used as a medium to explore different materiality properties ranging from colour to flexibility. The project uses two of the most recognisable fashion materials: leather and denim, chosen on the merits of a woven and non-woven material and their undisputed popularity, to play with the aesthetic and properties afforded to them. Their distinct characteristics are reimagined and subvert expectation by hybridising them to present a familiar aesthetic with unexpected material behaviours, such as a squishy denim. These experimentations will form a tactile exhibition, challenging conventional expectations, encouraging people to touch the samples and in turn create discourse about our desired material properties in our clothing rather than accepting current material choices. Its aim is to empower both designers and consumers to reclaim autonomy, from which the consumer has been so far removed, while stimulating broader discussions on materials systems change, possible upstream engagement and potential to inform UK bioplastics policy. This work is firmly grounded in UK leather and denim production practices.

MOTIVATIONS

Notoriously plastics have received considerable critical attention due to their adverse environmental impacts across the plastics lifecycle, most notably waterway pollution. However recent research (Stanton *et al*., 2024) recognizes the critical role natural fibers play in water pollution, an area previously published studies fail to consider, often overlooking natural fibers in favour of microplastics. These findings prompt important questions about what constitutes as pollution and advocates for a reassessment of longstanding material choices aside from plastics. It is evident that new material properties need to prioiritise biodegradability, a shift that has driven designer and policymaker alike towards bioplastics as a potential solution.

My dissertation evaluated the social readiness for bioplastics in UK clothing manufacturing and recommended strategies to improve social acceptance, key findings suggest that a lack of exposure is the most limiting factor of wider adoption. Policy recommendations primarily advocate for better familiarization through exposure in education and advertisements. Material Rehabilitation is an extension of my dissertation findings in actionably educating the public through exposure and places high value in tactile interaction to foster greater awareness of bioplastics.

Aligned with my design manifesto, I have prioritised its principles throughout this project, particularly the advocacy of conscious design and learning through tactility. To me, something tangible feels more real and impactful. This personal importance of tactility stems from my own design process, whereby I prefer prototyping over drawing. In part I owe it to my childhood fascinations of picking up spiders by their legs and racing bugs against one another. I would like to extend the same curiosity to others, in the way I know best, I hope this project embodies childlike wonder into adulthood.

AIMS AND OUTCOMES

AIM: To prompt discourse around material choices by subverting familiar fashion materials and questioning their non-negotiable properties and processes.

OUTCOMES: A series of bioplastic samples each showcasing different aesthetic appeal and material behaviour through varied compositions. These samples satirise and hybridise leather and denim in order to provoke curiosity and discussion. An interactive garment will allow visitors to physically engage with and experience material properties.

While not intended for functional use at this stage, these samples are designed to highlight material behaviour. They have not undergone rigorous testing for wear and washing processes, however they are verified to be safe for skin contact and made from non-toxic natural materials. If this work is progresses, further development would be guided by public feedback on the desired properties with insights collected to refine material choices. This project establishes the foundations for iterative design, with selected material recipes to be tested in smaller increments for continued material refinement.

SUBJECT MATTER – LEATHER AND DENIM

Research on leather and denim includes cultural context, material properties and processes. Their familiarity makes them ideal for exploring material relationships and tensions, presenting something both novel and recognisable.

An understanding of aesthetic and processes were integral to imitate and propose parallel processes. My firsthand visits to UK tanneries and jean factories supported by in depth research, enriched my understanding of these legacy with in-person experience which reinforces the educational aim of this project of experiential learning..

MATERIALITY

The use of bioplastics is driven by not only the environmental benefits of biodegradability but also to extend my current practice and knowledge from having previously worked with bioplastics. While previous projects contend with bioplastics in solely a compositional and accessory context, this project feels like the next progressional step in my practice to upscale into a fashion context, using my accumulative knowledge and documentation to aid my development.

I would like to assert that this project is designed to create exposure to bioplastics but not necessarily pose bioplastics as THE intervention or only alternative, especially in the face of recorded high scepticism. It is chosen as a medium to explore a range of material possibilities so that people can identify properties that are important to them. It is also chosen for the accessible and open-source nature of bioplastic resources on platforms such as Materiom, making research open-source and accessible, that allow for ongoing experimentation.

As the development of bioplastics is continual, consulting scientific papers, books and research projects is integral to the development of this project and hands-on workshops, such as those led by Sarah King of STEAMHouse Birmingham, have provided invaluable insight into starch-based binders and biopolymer profiles enriching the project's material understanding and setting a precedent for scientifically recording developments.

This project explores design possibilities of the liquid processes afforded to bioplastics over leather and denim. References range from coined bioplastic processes to other liquid mediums and artworks where the same processes have the potential to be transferred. There is a convergence where these processes parallel and imitate those traditionally used in leather and denim production.

What sets this project apart from other bioplastic projects is the value retained from each experimentation. There is not only value in 'successful' bioplastics but also the deemed 'unsuccessful', allowing the public to guide the evolution of bioplastic design rather than imposing predefined criteria. There is material value even in the commercial 'failures' providing insights for future developments.

DESIGN CONTEXT

While the projects has a material development focus, it is also deeply rooted in material experience. This involves key ideas of play pedagogy and andragogy to invite people to learn and play, using trompe l'oeil to create illusion and employing methodologies from speculative and conceptual design to incite discourse.

Application wise a clothing context seemed like an obvious choice, largely attributed to my affinity for fashion, but I also perceived merit in disruptive fashion shows such as those of Coperni with Fabrican which present an intersection of fashion and experience. For I find myself exploring a space that sits somewhere between an educational fashion show and a disruptive exhibition.

WHY ARE WE HERE?

DISSECTING MATERIAL CHOICES

REASONING FOR INTERVENTION

Notoriously plastics have long been criticized for their environmental impact from production to disposal. Both consumers and the fashion industry acknowledge the need to address this issue, so much so sustainable has become a buzzword (Kent and Morris, 2025). In terms of disposal, many studies have examined the effects of anthropogenic litter on waterway pollution through citizen science audits, with plastics accounting for 64% of waterway pollution (Stanton *et al*., 2022).

Planet Patrolling: A citizen science brand audit of anthropogenic litter in the context of national legislation and international policy

However, recent research (Stanton *et al*., 2024) recognizes the critical role natural fibres play in water pollution, an area previously published studies fail to consider, **often overlooking natural fibres in favour of their plastic analogues,** polyester and nylon.

Natural Fibers: Why Are They Still the Missing Thread in the Textile Fiber Pollution Story?

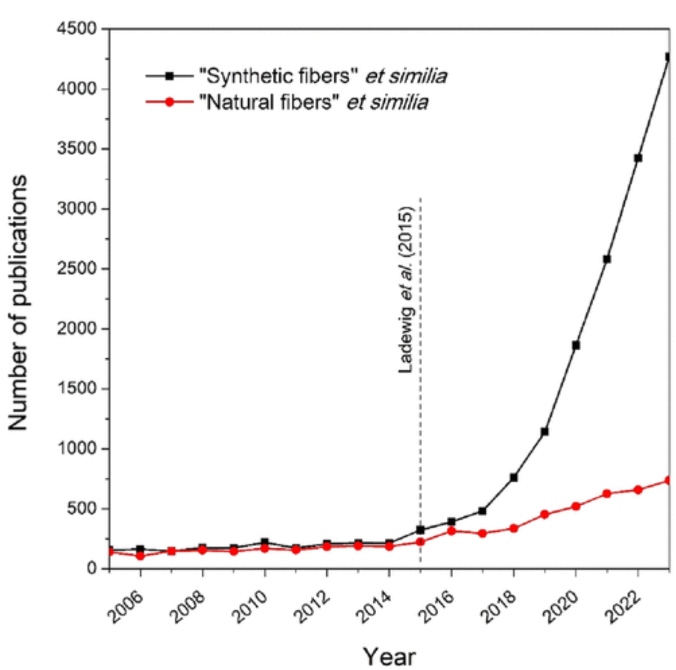
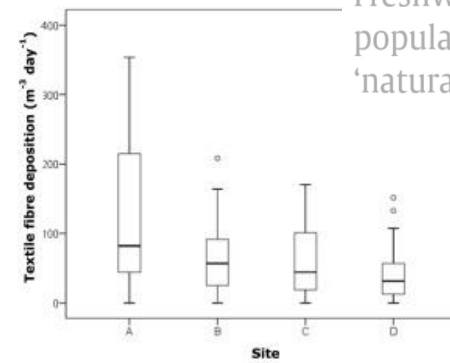


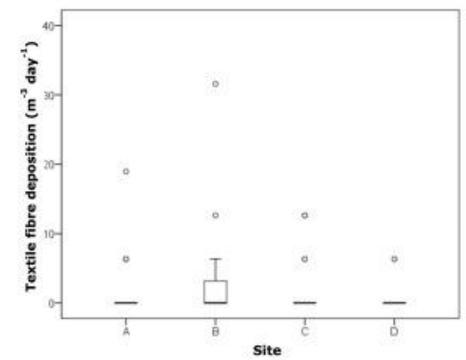
Figure 1 - A graph to showing a comparison of the number of publications involving synthetic and natural fibres in environmental sciences. (Stanton et al., 2024).

Stanton critiques the environmental science community's flawed assumption that natural textile fibres biodegrade into harmless components. Natural fibres often undergo polymeric structural changes, such as the mercerization of cotton (cellulose 1 to cellulose II), which is not commonly occurring in nature. Research shows that natural fibres can entangle organisms' gut contents (Lusher et al., 2013), and their larger surface area to exacerbates their chemical effects. Furthermore, ecotoxicological studies reveal that natural fibres degrade faster than microplastics, releasing toxic compounds from dyes and chemical finishes into the environment (Ladewig et al., 2015).

Freshwater and airborne textile fibre populations are dominated by 'natural', not microplastic, fibres (Stanton et al., 2019).



	A	B	C	D
Mean	128.4187	64.9988	64.8043	41.6834
Median	82.1037	56.8411	44.2097	31.5784
Std. Deviation	109.4514	53.4113	57.0708	41.8140
Minimum	0	0	0	0
Maximum	353.6800	208.4200	170.5200	151.5800



	A	B	C	D
Mean	1.8045	2.8947	1.6476	0.5053
Median	0	0	0	0
Std. Deviation	4.5292	6.9632	3.9106	1.7487
Minimum	0	0	0	0
Maximum	18.9500	31.5800	12.6300	6.3200

Figure 2 - The Paper's boxplots documenting median and range of natural and extruded textile fibre concentrations at each site. (Stanton et al., 2019).

IMPACT

Findings raise crucial questions about what constitutes as pollution and advocates for the reassessment of **longstanding material choices**. There is a clear consensus that new materials must prioiritise biodegradability. This shift has sparked growing interest from both consumers and policymakers in bioplastics as a potential solution (Ismayil, 2023), **marking a departure form the plastic-centric discourse typically surrounding bioplastics.**

It is important to address these findings meaningfully, shifting the focus from the narrow plastic pollution narrative to include existing materials in discourse. To encourage people to consider biodegradability and other desired material properties, familiar materials are to be reinterpreted to designers and the wider public. The widespread use of these designated materials present an opportunity for more significant intervention and change.

SETTING AN EXAMPLE

MATERIAL CASE STUDIES

"What makes a product timeless?" 'Classics are classics because as well as reframing reality, they address and existential need. And they are often also the product of an accumulation of knowledge and techniques' – Ilse Crawford, 2024, Heimtextil's Future Continuous Report

EIJKELBOOM, 2014

LANGE, 1939

What can we learn? What can be transferred to a bioplastics context?

GRANGER, 1901

EIJKELBOOM, 201

KEY AREAS OF INVESTIGATION

Cultural Significance

Factors to Attributed Popularity

Processes

Contemporary Fashion References.

Recognisable Visual Elements

REASONING

To foster acceptance of a new way of thinking, incorporating familiar elements can act as a strategic design tool (Berni and Borgianni, 2024). Innovation, while often framed as aspirational, tends to provoke skepticism, particularly when it challenges deeply embedded consumer habits or aesthetics. **Familiarity anchors new materials in known visual or tactile references**, making them feel more credible and accessible. This dynamic is echoed in Eijkelboom's (2014) photographic work, which documents the unconscious uniformity in how people dress, suggesting that material choices are often driven by shared cultural codes rather than individual expression.

Building on this, I will analyze the widespread success of denim and leather, two materials that hold cultural weight and have endured the test of time. By identifying the characteristics that contribute to their ongoing relevance, this project aims to **uncover transferrable principles** that could inform the development of bioplastics. The objective is not only to improve public reception but also to provoke critical discourse around how new materials are framed and what we value most when consciously designing.

WHY DENIM AND LEATHER?

1. Rethinking Material Values – These materials invite people to reconsider the desired properties in **existing** materials. What do we value today?

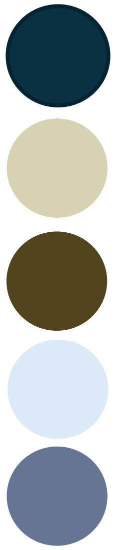
2. Widespread Popularity = Broader Impact – Cultural and commercial popularity provides a wider scope for intervention.

3. Diverse Textile Categories - Chosen on the basis of addressing both woven (denim) and non-woven (leather) materials as categorized by Juliet ash and Lee Wright (2006).

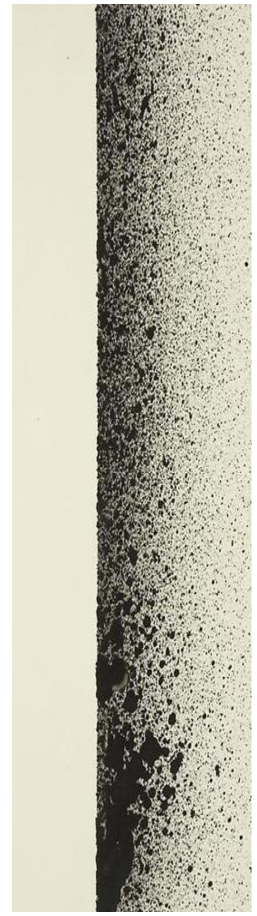
4. Familiarity as a Design Tool – Their recognizability and rich heritage allows **for playful subversion and experimentation of both aesthetic and behavioral properties**. Elements of familiarity can help better reception of novel materials by bridging the gap between traditional and innovative design (Lannilli, 2023).

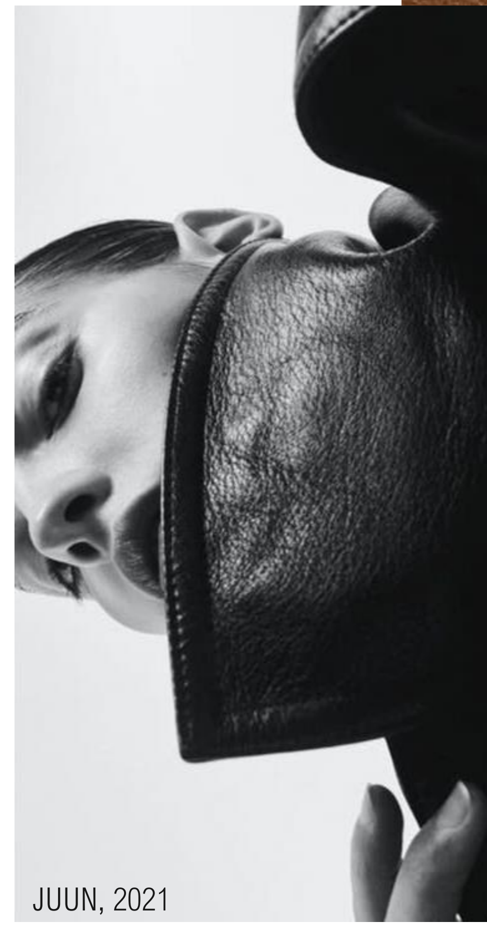
5. End-of Life Challenges – While environmental concerns like water use (denim cotton) and methane emission (leather) are well known, this projects focuses on **disposal and biodegradability.** That includes analysing how finishing processes and treatments affect materials end-of-life and considers how we may create parallel processes that support rather than inhibit biodegradability.

COLOUR AND INSPIRATION



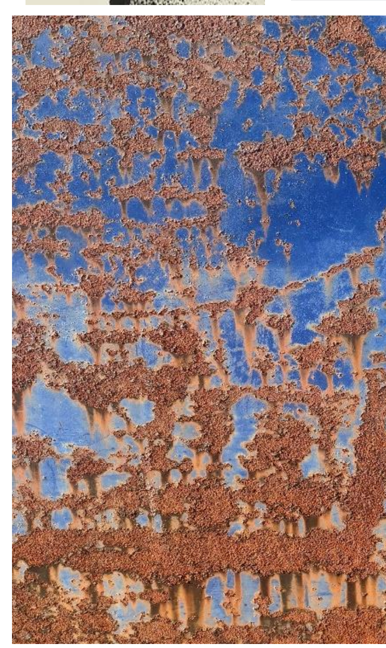
HISHINUMA, 1993



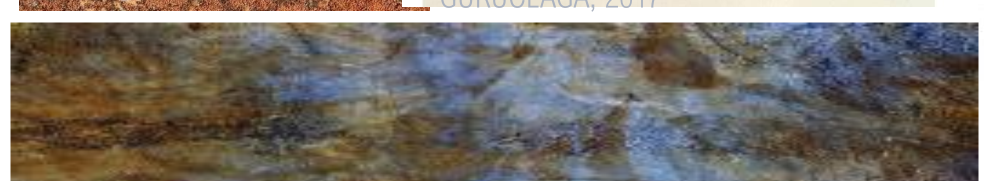


JUUN, 2021

WANG, 2019



GURUCEAGA, 2017

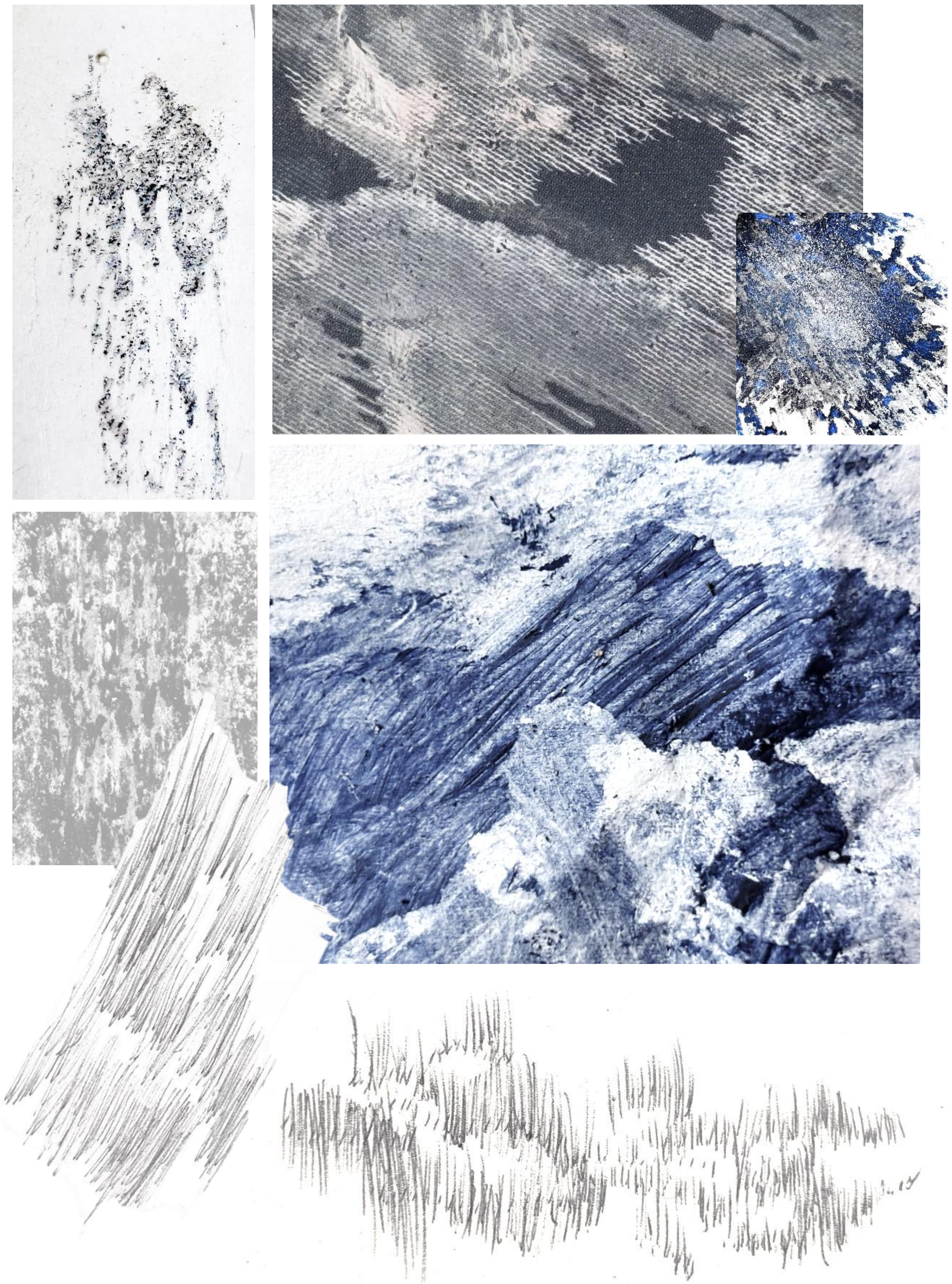


RESOURCE CATALOGUE

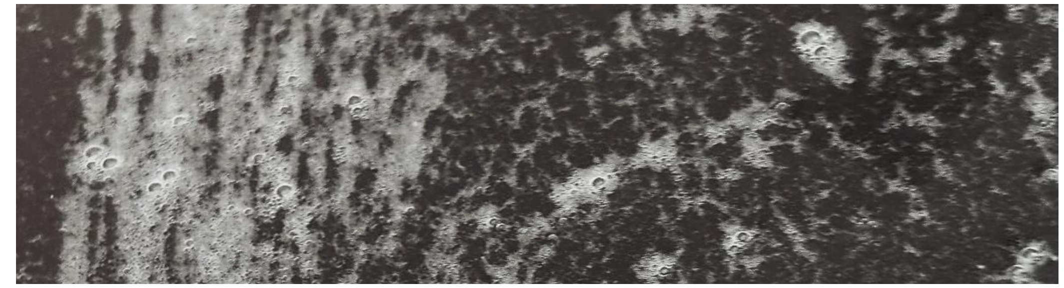
NATURAL DYES AND BIOMASS

DISTRESSED

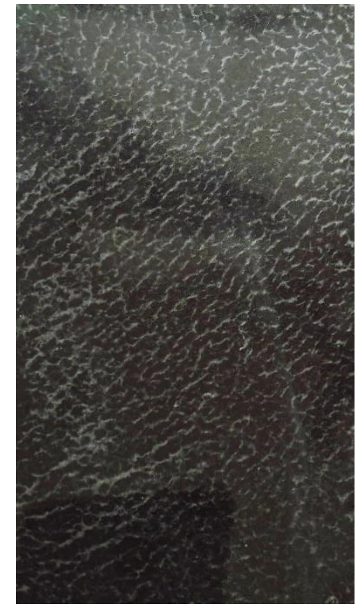
RECORDING DISTRESS PATTERNS



Establishing Visual Language: Distress patterns recorded through sketching and inking techniques, forming the foundation for a visual language rooted into wear.

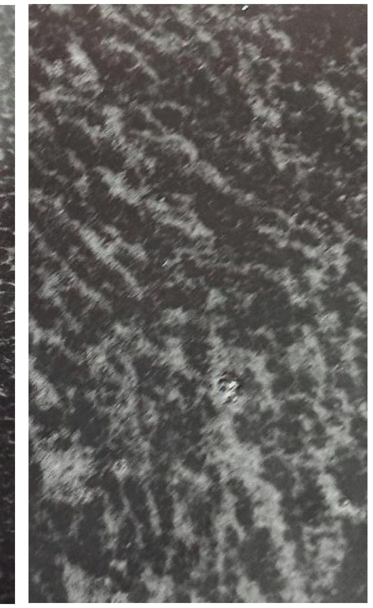


10CM AT 75 DEGREES



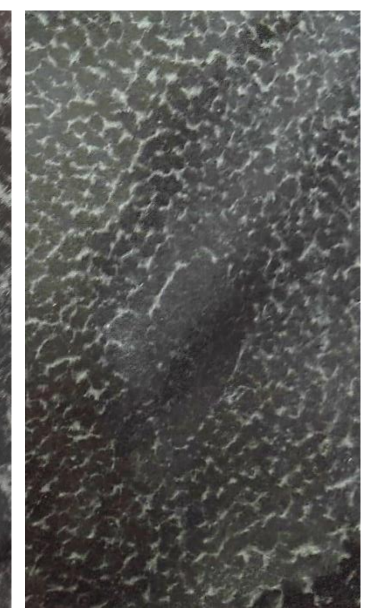
45CM AT 60 DEGREES

30CM AT 110 DEGREES

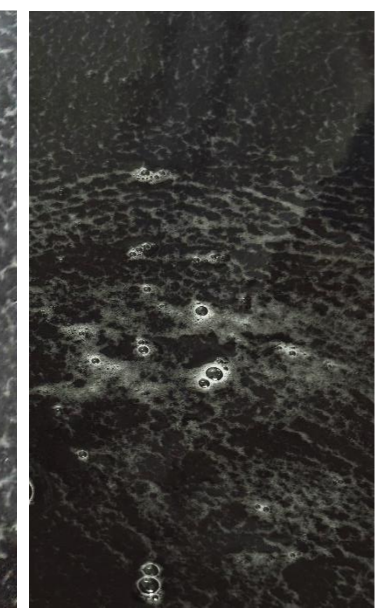


15CM AT 60 DEGREES

15CM AT 75 DEGREES



45CM AT 30 DEGREES



10M AT 120 DEGREES

WIND DISTORTION PATTERN TESTING

Translating initial recordings into larger repeating patterns, in this set of experiments. It tests the visual impact of wind direction on liquid surfaces to trial distortion patterns, to later inform bioplastic manipulation in a viscous, pre-curing state. Patterns were developed by varying wind angles in 15 increments (up to 180) and distances in 5cm increments (up to 80cm) using a hairdryer setup base don the Fluctuant City methodology. These tests focus on developing a visual and procedural language for directional patterning, prior to committing to bioplastic material outcomes. Those most relevant to the material language are selected above.

MATERIALS AND APPLICATION

SANDER, 2023

NIKE, 2024

CABRA, 2023

CABRA, 2023

GURUCEAGA, 2017

WINT Design Lab, 2025

TOVAR, 2018

MUNRAI, 2022

IMPACTS EXPERIENCE, 2021

Interactive Materials Exhibition – Exhibition space designed to encourage people to interact with bioplastic within a fashion context.

1. Corn Starch
2. Ground Biomass
3. Glycerine
4. Ground Muscle Shells
5. Ground Eggshells
6. Vinegar
7. Calcium Chloride
8. Natural Dyes
9. Agar
10. Honey
11. Potato Starch

BIOPLASTIC BREAKDOWN

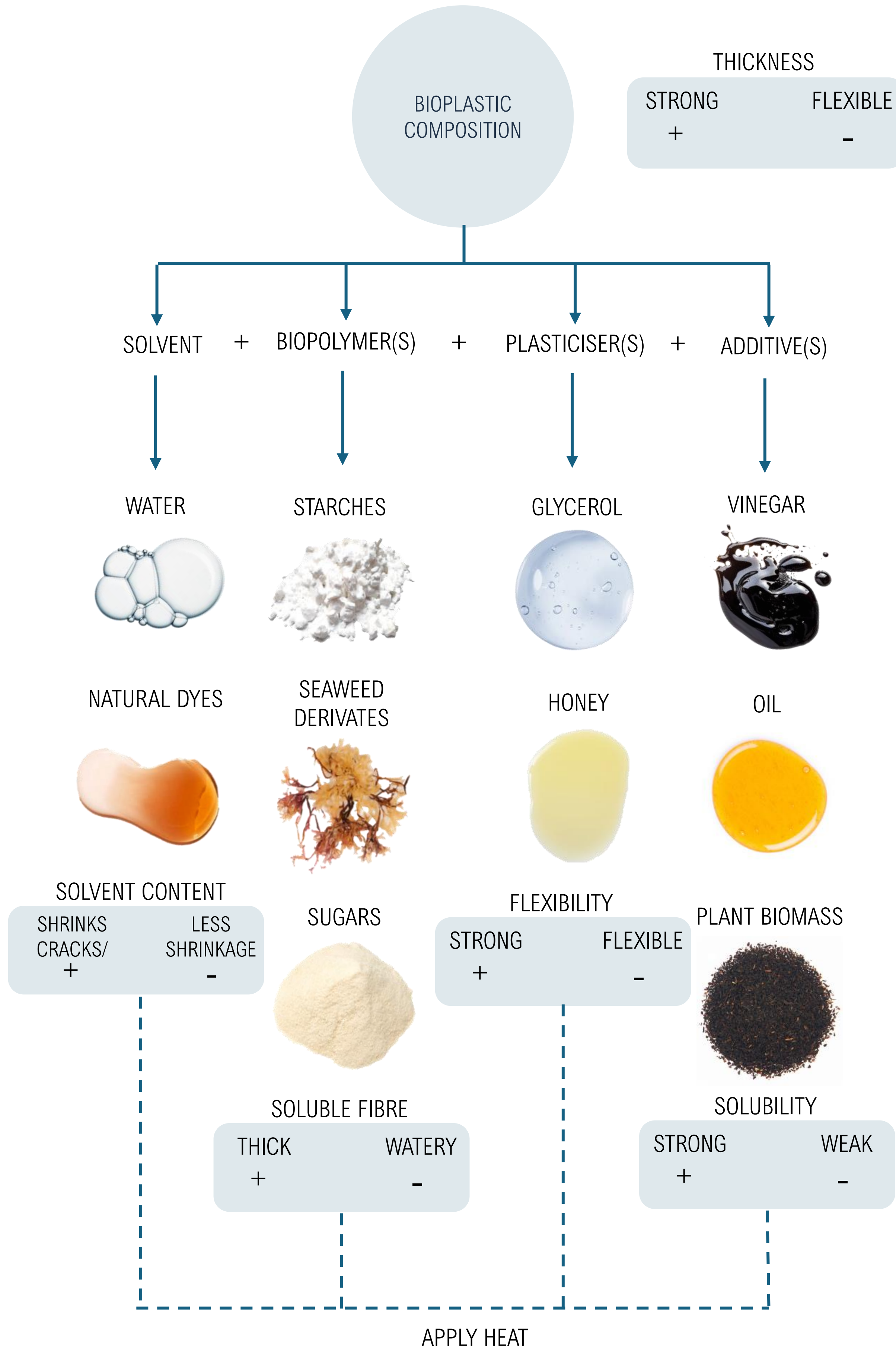


Figure 6 -A diagram depicting chosen bioplastic feedstock and the recorded effect on material behaviour.

POTATO STARCH
COMPOSITION TESTS

B : 2/3G : 7W :2/3V
15 : 10 :100 :10

REF NUMBER: 1
REASONING: Control
KEY OBSERVATIONS: Manual distortion patterns are visible and have become more prominent through drying.

B : 2/3G : 7/2W :2/3V
15 : 10 : 50 :10

REF NUMBER: 2
REASONING: ½ Water Content
KEY OBSERVATIONS: Rubbery feel.

B : 2/3G : 14W :2/3V
15 : 10 : 200 :10

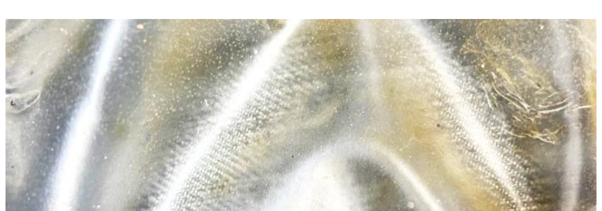
REF NUMBER: 3
REASONING: X2 Water Content
KEY OBSERVATIONS: Water separation when drying creates perforations.

B : 2/3G : 7W :1/3V
15 : 10 : 100 : 5

REF NUMBER: 4
REASONING: ½ Vinegar Content
KEY OBSERVATIONS: Separation around heavier areas of potato starch.

B : 2/3G : 7W : 4/3V
15 : 10 : 100 : 20

REF NUMBER: 5
REASONING: X2 Vinegar Content
KEY OBSERVATIONS: Smooth finish, soft even pour, slight coloration in oven drying approach.



B : 2/3G : 7W : 8/3V
15 : 10 : 100 : 30

REF NUMBER: 6
REASONING: X3 Vinegar Content
KEY OBSERVATIONS: Slightly tacky but retains a smooth even finish.

B : 1/3G : 7W : 2/3V
15 : 5 : 100 : 10

REF NUMBER: 7
REASONING: ½ Glycerine Content
KEY OBSERVATIONS: Manual distortion when drying creates drape like forms.

B : 4/3G : 7W : 2/3V
15 : 20 : 100 : 10

REF NUMBER: 8
REASONING: X2 Glycerine Content
KEY OBSERVATIONS: Tears easily.

B : 7W : 2/3V
15 : 100 : 10

REF NUMBER: 9
REASONING: No Glycerine Content
KEY OBSERVATIONS: Brittle to the touch but there is scope for applying the manipulation.

B : 2/3G : 7W : 2/3V
30 : 10 : 100 : 10

REF NUMBER: 11
REASONING: X2 Starch Content
KEY OBSERVATIONS: Very strong composition when dry but easily tears during curing.

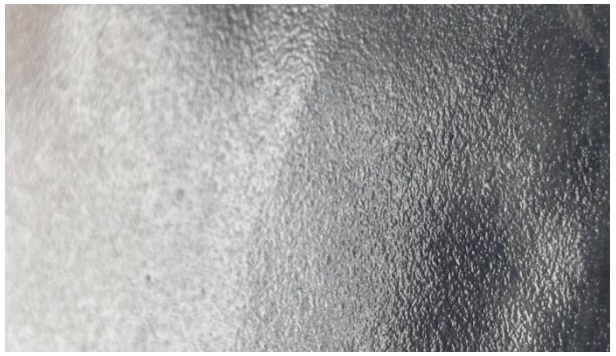
2/3G : 7W : 2/3V
10 : 100 : 10

REF NUMBER: 12
REASONING: No Starch Content
KEY OBSERVATIONS: Dropped starch into the no starch mix and instantly gelatinised.

B : 2/3G : 7W : 2/3V
30 : 20 : 200 : 20

REF NUMBER: 13
REASONING: Double Quantities
KEY OBSERVATIONS: Strongest composition yet but provides less malleability during curing process.

AGAR
COMPOSITION TESTS



B : 2/3G : 10W
12 : 8 : 120

REF NUMBER: 40
REASONING: Control
KEY OBSERVATIONS: Strong composition, creates small scale lines during the during process as composition shrinks.

2/3B : 2/3G : 10W
8 : 8 : 120

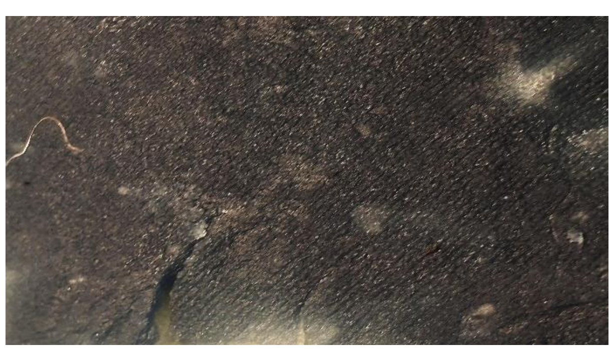
REF NUMBER: 41
ADDITIVES: Eggshell D3, Adjusted Colour 4
REASONING: 2/3 Agar Content
KEY OBSERVATIONS: First eggshell attempt.

2/3B : 2/3G : 10W
16 : 16 : 240

REF NUMBER: 50
ADDITIVES: Eggshell, Adjusted Colour 4
REASONING: Double Ref 41 Quantities
KEY OBSERVATIONS: Eggshells sink to the bottom of the solution because of weight. Able to create a reversible material.

4/3B : 2/3G : 8W
16 : 10 : 100

REF NUMBER: 43
ADDITIVES: Onion Skin D1
REASONING: 4/3 Agar Content
KEY OBSERVATIONS: Strong composition but experienced significant shrinkage.



5/2B : 5/6G : 8W :5/3V
30 : 10 : 100 :20

REF NUMBER: 46
ADDITIVES: Adjusted Colour 3
REASONING: Change in Proportion
KEY OBSERVATIONS: Soft, Matt surface finish but fragile.

5/2B : 5/6G : 8W :5/3V
30 : 10 : 100 : 20

REF NUMBER: 47
REASONING: Image Transfer
KEY OBSERVATIONS: No image transferred.

1/3B : 2/3G : 10W
4 : 8 : 120

REF NUMBER: 42
REASONING: 1/3 Agar Content
KEY OBSERVATIONS: Good colour yield, especially under direct light, gummy to the touch. Responds well to hand cutouts.

B : 1/3G : 10W
12 : 4 : 120

REF NUMBER: 44
ADDITIVES: Silver Maple D2
REASONING: ½ Glycerine Content
KEY OBSERVATIONS: Brittle edges.

B : 2/3G : 10W
12 : 12 : 120

REF NUMBER: 45
ADDITIVES: Eggshell, Adjusted Colour 3
REASONING: 3/2 Glycerine Content
KEY OBSERVATIONS: Eggshells when oven dried turn warmer in colour. Effect creates colour variation and the impression of fabric grain.

B : 2/3G : 10W
12 : 8 : 120

REF NUMBER: 48
ADDITIVES: Onion Skin D2
REASONING: Biomass Suspension
KEY OBSERVATIONS: Patterning created through biomass, potential scope for further suspension trials.

B : 2/3G : 10W
12 : 8 : 120

REF NUMBER: 49
REASONING: Texture Transfer
KEY OBSERVATIONS: Strongest composition by far, hard to discern without colour application.

B : 2/3G : 10W
12 : 8 : 120

REF NUMBER: 53
REASONING: Image Transfer
KEY OBSERVATIONS: Strong composition, minimal image transfer torn edges of ink are not discernibly visible.

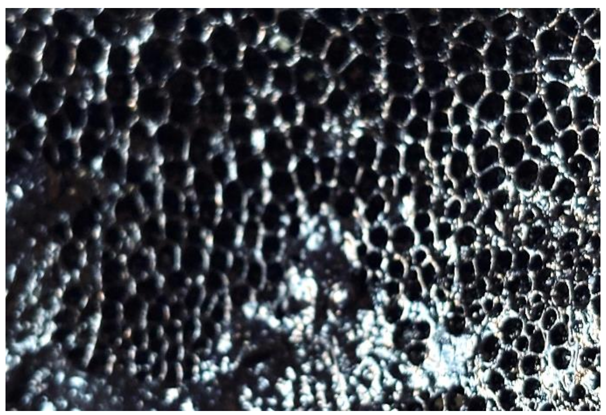
FINISHES
FOR JACKET – REF 49

B : 2/3G : 10W
24 : 16 : 240

REF NUMBER: 60
ADJUSTMENT: Double quantities and indigo introduction.
KEY OBSERVATIONS: Indigo greater improves the opacity, retains grainy feel.

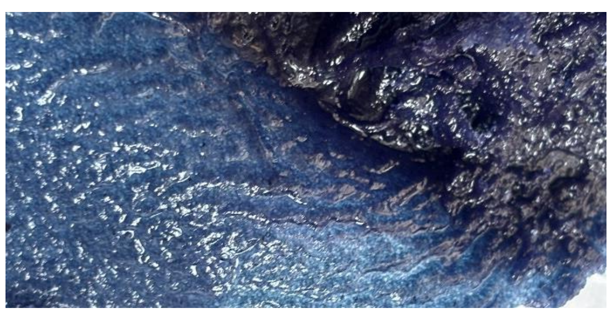
B : 2/3G : 10W
12 : 8 : 120

REF NUMBER: 61
ADJUSTMENT: Thinner pour on 3d relie.f
KEY OBSERVATIONS: Height of relief is doubled to that patterning is visible after shrinkage.



B : 2/3G : 10W
12 : 8 : 120

REF NUMBER: 62
ADJUSTMENT: Heated a stationary solution.
KEY OBSERVATIONS: Honeycomb structure that hardened while retaining flexibility, though it would be hard to reproduce at scale. It's dependent on the surface of the VAT.



5/6B : 2/3G : 10W
10 : 8 : 120

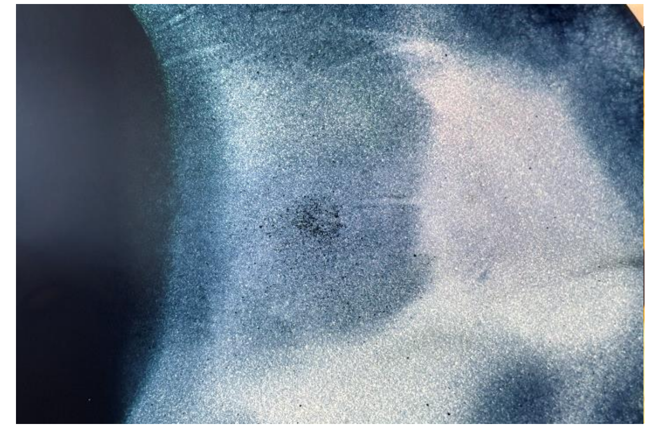
REF NUMBER: 63
ADJUSTMENT: Reduced agar content.
KEY OBSERVATIONS: Minimal change in behaviour, thinner and more easily susceptible to heat distortion.

B : 2/3G : 10W
12 : 8 : 120

REF NUMBER: 64
ADJUSTMENT: Paper Surfacing.
KEY OBSERVATIONS: Paper distorts under the water expulsion of curing, causing raised wrinkle patterns, easily replicable at scale.

5/6B : 2/3G : 10W
10 : 8 : 120

REF NUMBER: 65
ADJUSTMENT: Use of Adjusted Colour 3.
KEY OBSERVATIONS: An opaque but shinier surface as a result.



B : 2/3G : 10W
48 : 32 : 480

REF NUMBER: 66
ADJUSTMENT: Thin pour lightly mixing the solution to create uneven indigo distribution.
KEY OBSERVATIONS: Uneven colour is only visible on thinner pours, but that compromises strength.

B : 2/3G : 10W
12 : 8 : 120

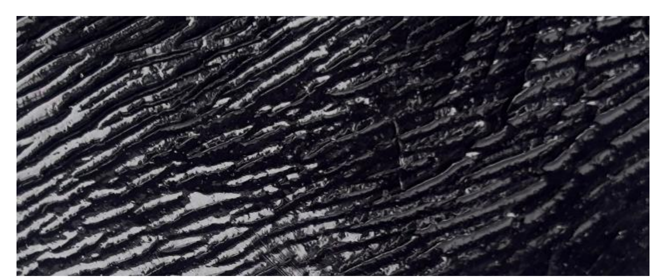
REF NUMBER: 67
ADJUSTMENT: Additional 3tsp of lemon juice.
KEY OBSERVATIONS: Reduces water content and creates more organic surface patterning.

B : 2/3G : 10W
12 : 8 : 120

REF NUMBER: 68
ADJUSTMENT: Heated a moving solution
KEY OBSERVATIONS: The constant moving of the solution whilst being heated causes these wrinkle formations. Hardened rubber-like feel.

B : 2/3G : 10W
48 :32 : 480

REF NUMBER: 69
ADJUSTMENT: Curing Manipulation
KEY OBSERVATIONS: Pouring and setting segments in intervals to create more controlled and uniform wrinkling.



B : 2/3G : 10W
12 : 8 : 140

REF NUMBER: 70
ADJUSTMENT: Increased water content
KEY OBSERVATIONS: Trialling the same method as REF 69 with a more rubbery solution.

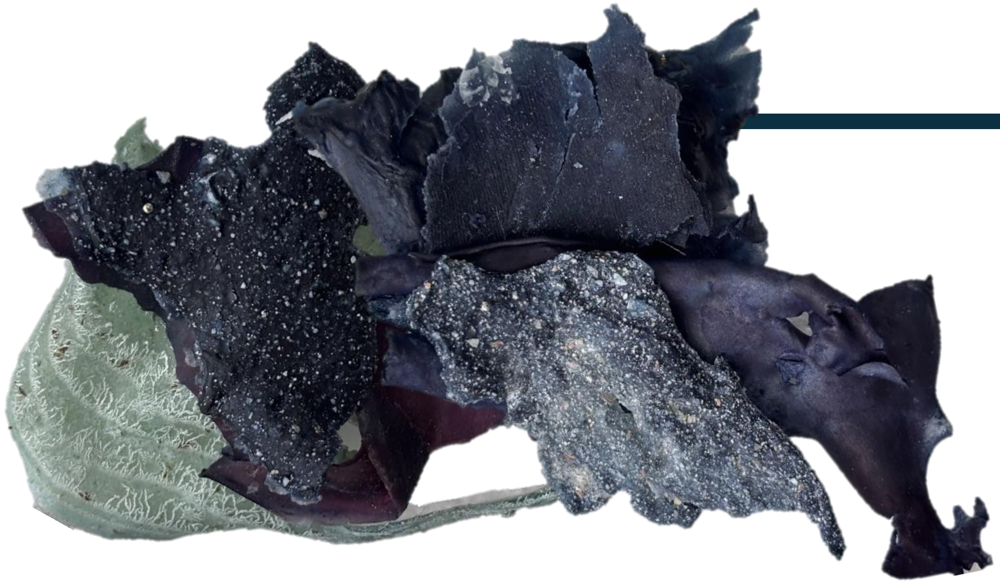
B : 2/3G : 10W
12 : 8 : 120

REF NUMBER: 71
ADJUSTMENT: Addition of 200ml of water to remelt and recast bioplastic offcuts of composition 49.
KEY OBSERVATIONS: Additional water has resulted in a shinier look and latex-like feel.

RECLAIMING BIOPLASTICS

Reclaiming bioplastics is taking cured bioplastics and reheating them as they are reversible reactions. It will remelt at a temperature at least ten degrees higher than the initial melting temperature and will take longer to come to a boil. The extra energy is needed to overcome the hydrogen bonds already formed but can be a continuous process.

This process reduces waste by reusing cured bioplastics and bioplastic offcuts instead of throwing them away. This also allows for a composition to be recast into a different mold or finish until it reaches the desired look.



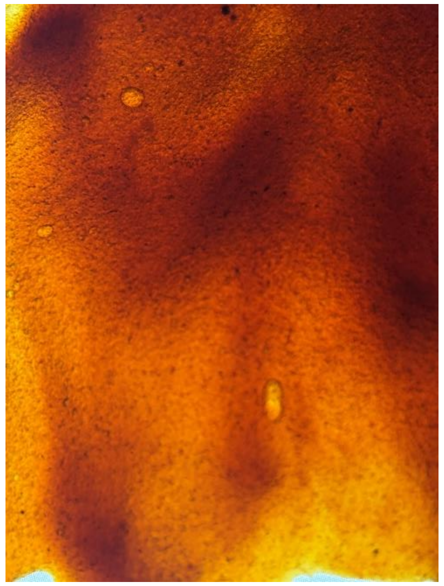
COLLECTING OFFCUTS

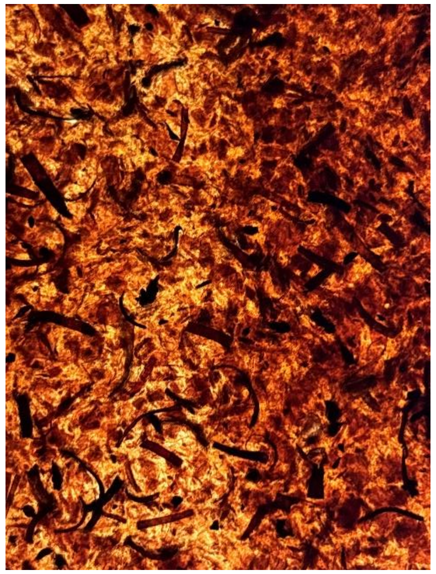
Aside from reclaiming bioplastics, scraps and offcuts can be utilised for practical reasons in sewing tests to reform bigger areas of bioplastic. Pieces are also being collected as fragments and used in an embellishment context, as the stronger compositions tend to crack and are more suitable for embellishment applications.

This further reduces production waste and provides a bank of smaller pieces to be used in my lookbook final, as all the samples are directly from the development of this project.

BACKLIGHTING SAMPLES

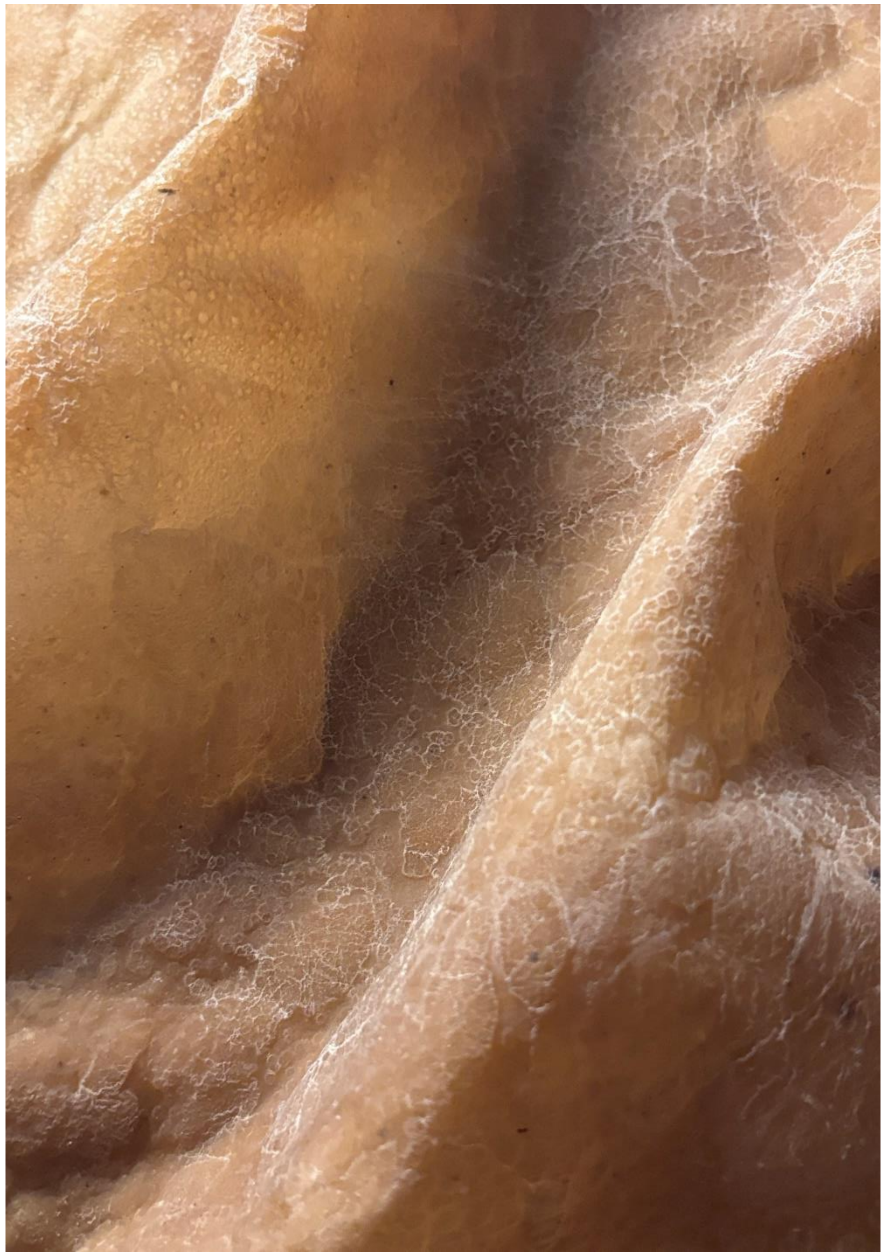
To fully reveal the intricacies of texture and relief in the bioplastic samples, backlighting, natural or artificial, is essential and must be taken into account. This mirrors the approach of Guruceaga,, whose work embraces celebrating material intricacies, particularly evident in the samples below.





DEATHER – REVERSIBLE DENIM LEATHER

CRACKED – LEATHER IMITATION



I CAN'T BELIEVE IT'S NOT LEATHER - JACKET


I CAN'T BELIEVE IT'S
NOT LEATHER
JAKCET


REVERSIBLE
DEATHER
DENIM-LEATHER HYBRID

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