MATERIAL REHABILITATION

Visual Research and Design Development

File 2

A place you can FEEL

DEVELOPMENT OF IDEAS

OVERVIEW

This project explores the material language of bioplastics, with a particular focus on how colour and texture influence interaction. From the outset, I was interested in making bioplastics feel more familiar, borrowing visual and tactile cues from leather and denim whilst championing the behaviours of bioplastics.

Colour was integral to the development of this project and, as such, became the starting point. The colour work involved using plant waste to make natural dyes, important in retaining the environmental integrity of biodegradable bioplastics. This involved researching, finding, and documenting viable sources locally available, seasonal and easily accessible. The colour palette, inspired by contextual research, signifies the synonymity of indigo and denim and the tanning colours of leather, both of which comprise the make-up of my colour palette. Indigo proved to be the most challenging to source naturally, prompting experimentation with PH shifts in natural dyes, alternate dye stuffs and the inclusion of pre-extracted indigo.

Visual research focused on signs of wear inspired by both denim and leather, recorded by photography of material samples, microscopy and distressed surface studies. These images are categorised into: Distress, Speckled & Grain, Cracks and Distortion, to inform design direction. This is aided by moodboards, drawings, rubbings and mark making to translate these references into material outcomes, with an exploration of liquid mediums and their behaviours also.

Material experimentation focused on testing different ratios within bioplastic compositions, solvents, biopolymers and plasticisers, across different biopolymer bases. Working with the properties naturally afforded to these bioplastic compositions and how to best translate them into a design setting. I paralleled traditional denim and leather processes, for example flattening sheets under pressure, mirroring denim sanforisation, or warming and hand-working surfaces akin to leather staking. These parallels aren't just about imitation but learning what bioplastics can offer as it's own responsive material when actively considered as one.

Rather than replicating leather or denim, the goal was to reinterpret their aesthetics and associations into a new material language, where tactile and visual familiarity prompts re-engagement. Which is why there is such a big focus on tactility and processes. Translation of familiar material cues ranges from literal development of trompe l'oeil prints and to loosely based 3d relief uniquely attributed to bioplastics, guided by the principles from material experience design.

Samples are upscaled and adapted for exhibition, as outlined in the contextual file. This transition is supported by sketches and the development of structural frames that enable the upscaling.

CONTENTS

OVERVIEW

COLOUR

NATURAL DYES AND WORKING TOWARDS A COLOUR PALETTE

FORAGING FOR NATURAL DYESTUFFS

QUEENS PARK, LOUGHBOROUGH, UK.

To ensure the bioplastics remain safe and biodegradable, natural dyes were prioritised over synthetic alternatives. Natural dyes are suited to bioplastics as the colour is suspended within the material composition, unlike fabric dying where there is a significantly lower colour yield and the need for mordants. After defining a targeted colour palette, I began foraging plant debris with permission from the landscaping team, focusing on materials that could align with my chosen colours. All gathered materials were cross-referenced using the Picture This platform and verified by the team to ensure non-toxicity. **This process also involved cataloguing the viable plant matter, including location and identifying the species type.** Because of season availability, batch collection was necessary to maintain dye consistency across samples.

Silver Maple
Acer Saccharinum

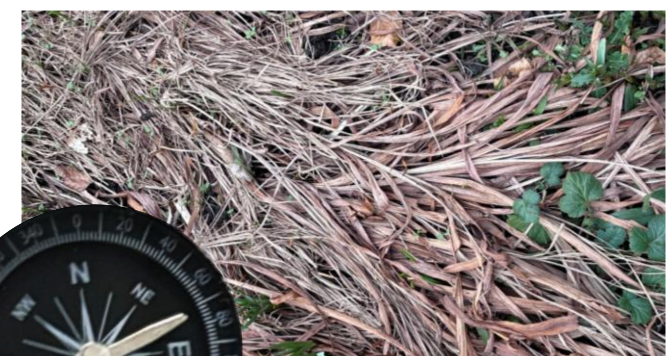
Lawsons Cypress
Chamaecyparis Lawsoniana

Common Yew
Taxus Baccata

Bilberry
Vaccinium Myrtillus

Apricot
Prunus Ameriaca

Slate
Tabula Rasa



Assessing resource viability

PARALLEL PROCESSES

- In terms of agricultural origins, I collected plant debris and waste streams to avoid extracting virgin resources like cotton used in denim.
- Manual assessment of the natural matter parallels the sorting of cotton during ginning in denim production. Natural matter was prepared, cleaned and categorised by colour and impurities.
- Unsuitable samples, due to mould, insect presence or contamination risk, were returned to their natural environment. Washing the remaining materials helped to standardise the dying process, bettering the consistency in pigmentation.
- While additional natural matter was surveyed beyond the six sources presented, many were excluded due to insufficient quantity or biological interference.

EQUIPTMENT

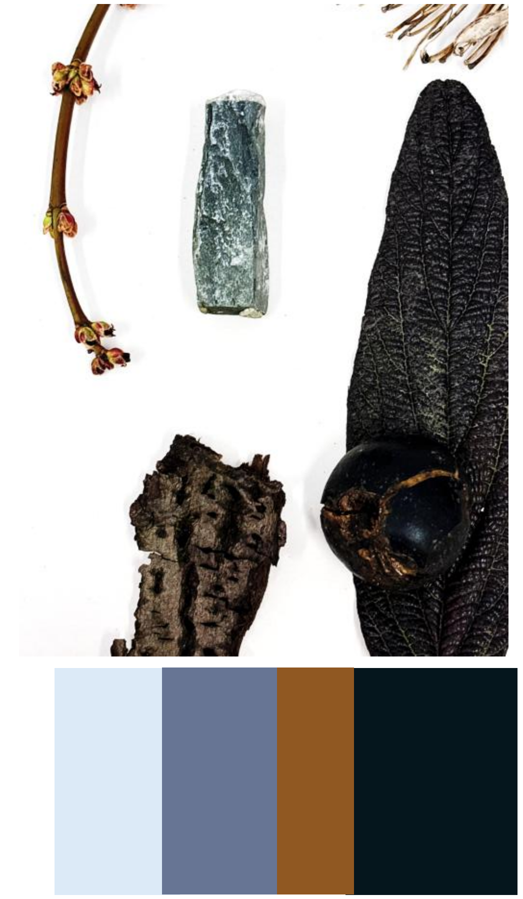
- Compass
- Picture This App
- Notepad
- Pen
- Gloves
- Camera
- Magnifying Glass
- Ziplocks
- Sharpie
- Watering Can
- Tweezers
- Anti-Bacterial Wipes

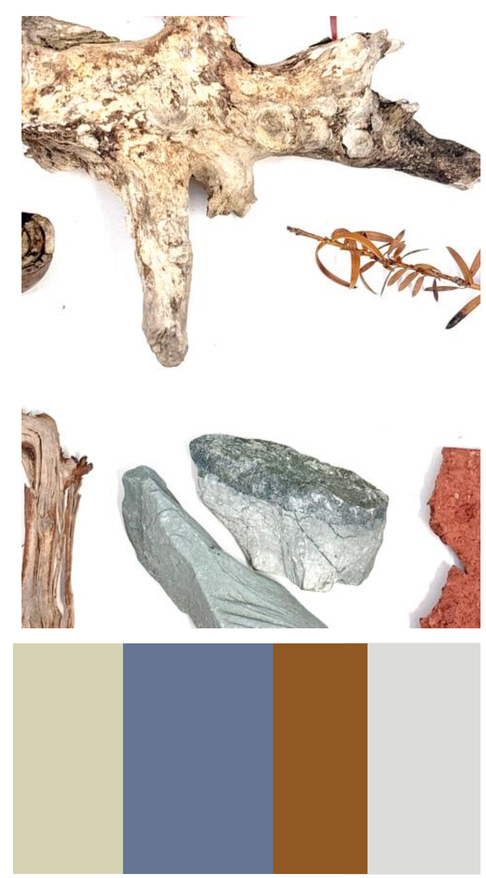
FOUND OBJECT COLOUR PALETTE

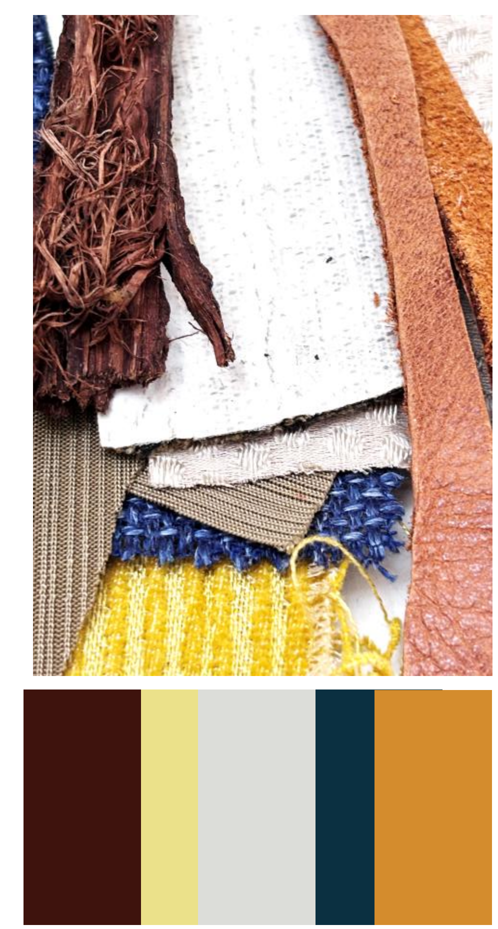
COLOUR CONSIDERATIONS

Other natural materials were collected to inform the physical colour palette, selected for their visual and textural qualities rather than dye potential due to limited quantity. These create compositional studies aiding the development of proportional colour relationships to guide the palette. The chosen composition best encompassed denim and leather like colours and best play on the notions of the two materials. Lighter compositions seem to stray from the initial research.

CHOSEN COLOUR PROPORTION







PROCESSING BIOMASS

EXPERIMENT APPROACH – MAKING NATURAL DYES

Previous experience with natural dyeing informed the process, which follows a similar method across plant matter, through colour yield and extraction time vary depending on biomass. All materials require pre-preparation to maximise dye output. Dyes were produced from the foraged materials above as well as additional food waste such as onion skins and mussel shells, aiming to fully utilise organic waste streams for both natural dyes and coloured additives.

METHOD

1. **Preparation:** Chop or grind natural matter to increase surface area, to accelerate pigment diffusion and improve colour yield. Add natural matter to a saucepan with enough water to submerge the matter.

2. **Extraction**: Submerge matter in water in a saucepan, bringing the water to a boil before reducing to a simmer, adding salt to aid extraction. If pigment is taking considerable time to surface, a ricer may be used to aid the extraction.

3. **Filtration and Storage:** Once desired colour is reached strain to separate the dye solution from solids. I have categorised the dyes, based on straining, into the following : D1 dyes contain no biomass, D2 contains partial biomass, D3 is solely blended or powdered biomass. Store extracted dyes in labelled containers and freeze for longevity.

4. **Biomass Additives**: Retain strained solids, blend into a pulp and oven-dry to produce biomass, D3 dyes.

EQUIPTMENT

- Natural Matter
- Water
- Stove
- Saucepan
- Wooden Spoon
- Blender
- Scissors
- Pestle and mortar
- Salt
- Sieve
- Containers
- Sharpie

D1 – Dye with no biomass

D2 – Dye and partial biomass

D3 – Blended or powdered biomass

OBSERVATIONS AND CONCLUSIONS

Colour Modulation: Dye intensity is easily adjusted by altering solvent ratios, more solvent (water) produces lighter tones, allowing for tonal variation within a single dye batch.

Material Limitations: Slate yielded minimal pigment, even when mechanically broken down with a hammer, producing only subtle granular texture.

Blue Dye Challenges: Achieving a deep blue or true blue remains difficult. Current closest result is bilberry which produces a purple hue, whilst muscle shell powder offers a pale blue tone but lacks depth. Further experimentation is needed, possibly through PH adjustments or layering pigments.

Colour Depth: The final shade of colour depends on the concentration but also the depth of colour is affected by the thickness of the bioplastic.

PREPERATION

EXTRACTION

FILTRATION

BIOMASS – MUSCLE SHELLS

BIOMASS ADDITIVES

BIOMASS ADDITIVES

RESOURCE CATALOGUE

NATURAL DYES AND BIOMASS

LOOK ON THE BRIGHTSIDE

COLOUR CHANGE AND DYE CASTING

Natural dyes function as PH indicators, shifting in colour when exposed to acidic or alkaline environments due to structural changes in the pigments. This property was strategically used to alter dye outcomes and push colours closer to the project's intended colour palette, especially **blue, which proved the most challenging to achieve.** Bilberry yielded a purple hue, while apricot (D2) produced a more neutral tone. Both were adjusted using acid (lemon juice) and alkali (sodium bicarbonate) in attempts to shift towards denim-like blues. This approach also prompted trials with diluted indigo pigment to replicate the recognisable denim colour more effectively.

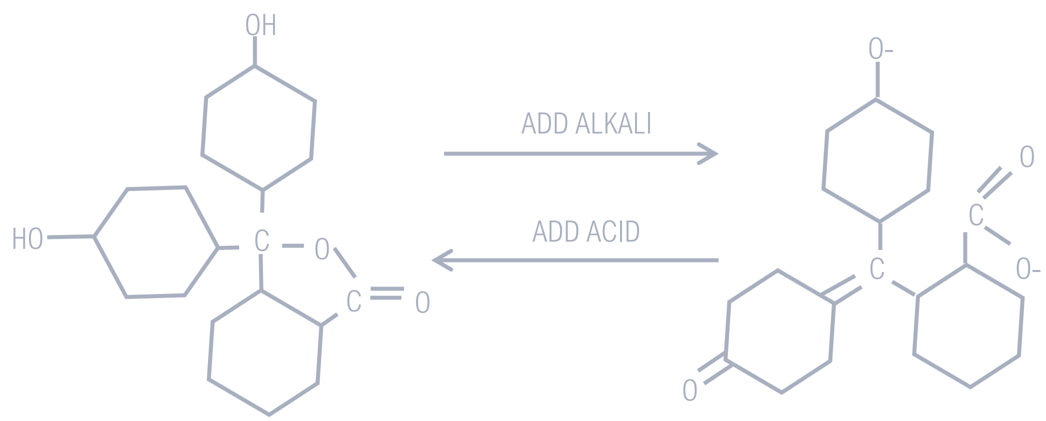


Diagram depicting the structural change in natural dyes by altering PH

EQUIPTMENT

- Natural Dyes
- Water
- Bowls
- Spoon
- Measuring Spoons
- Sieve
- Containers
- Lemon Juice
- Baking Soda

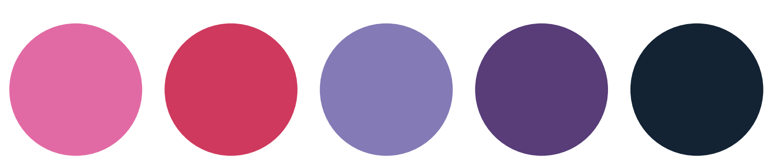
METHOD

1. **Select Dye Bases:** Begin with natural dyes closest to target colour (e.g. Bilberry dye (D1) and Apricot dye (D2)).

2. **Determine Adjustment**: Choose to add either acid (lemon juice) for warmer, lighter hues or alkali (sodium bicarbonate) for cooler, darker tones based on the dye's starting shade.

3. **Incremental Adjustment:** Add acid or alkali in 1.25ml increments of dye, recording colour shifts at each stage. Continue until the desired tone is achieved or the solution becomes oversaturated and resistant to further colour change.

4. **Filter and Refine:** Sieve the final solution to remove any undissolved additives, ensuring a smooth and consistent dye.



Bilberry Oxidisation Samples

OBSERVATIONS AND CONCLUSIONS

Texture Impact: The addition of baking soda alters the texture of the dye, unlike lemon juice which has minimal textural effect.

Reaction Speed and Separation: Baking soda induces quicker colour shifts, but once saturation is reached excess remains undissolved, limiting further change.

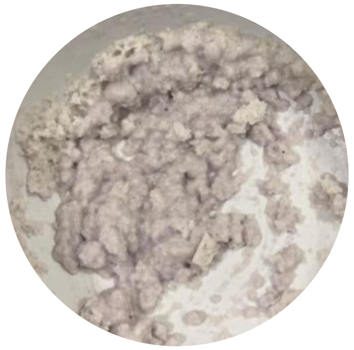
Solvent Ratio: There needs to be enough water content in the solution to compensate for the saturation of baking soda otherwise the solution will reduce.

Sequential Adjustment: It's much easier to darken a colour first (alkaline) and then fine-tune using acids afterwards.

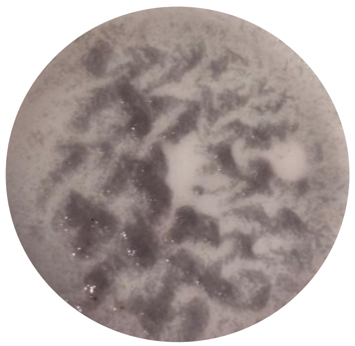
Bilberry Oxidisation: Bilberry dye develops a bluer hue over time through oxidisation, suggesting the need for pre-oxidisation before use in bioplastics.

Indigo Efficiency: Only small amounts of indigo pigment are required to create an opaque colour yield. Full dissolution, facilitated by heating , is essential for an even application.

RANGE OF BLUES

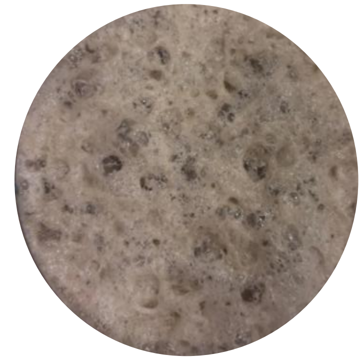


12.50g



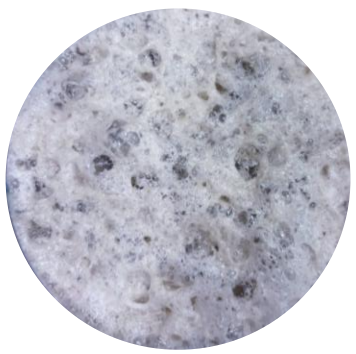
12.50g

12.50g

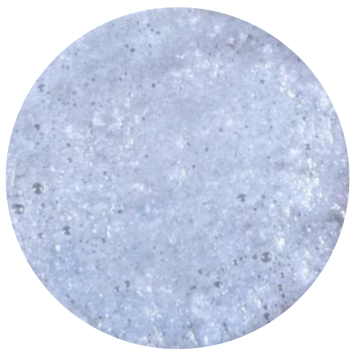


15.00g

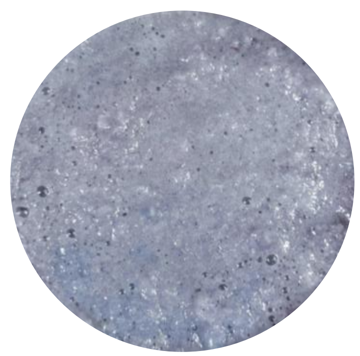
18.75g



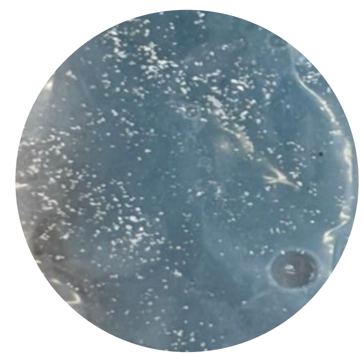
3.75g



3.75g + 2.5ml

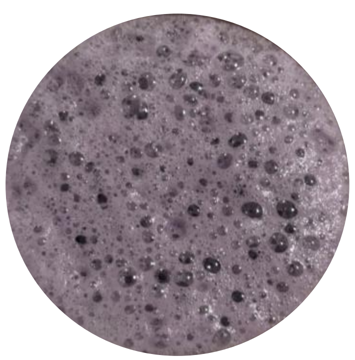


3.75g + 6.25ml

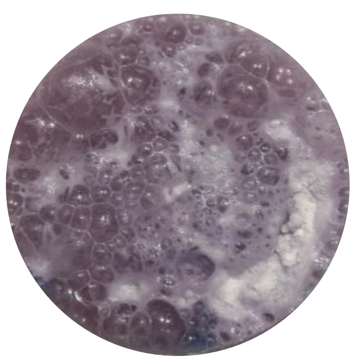


3.75g + 8.75ml

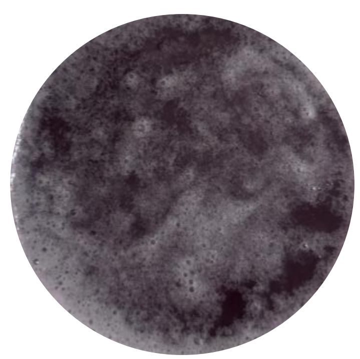
3.75g + 10ml



3.75g

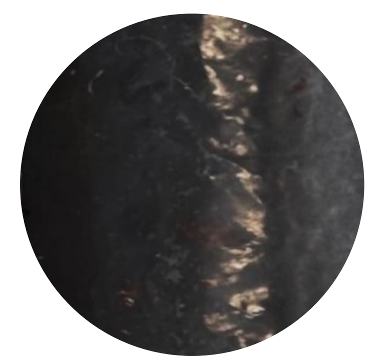


6.25g

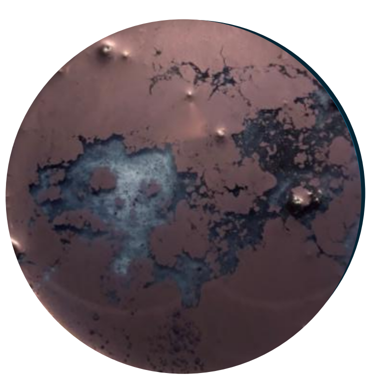


7.5g

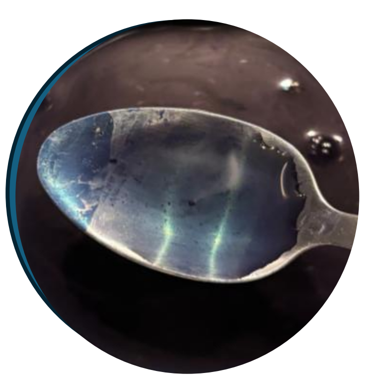
10g



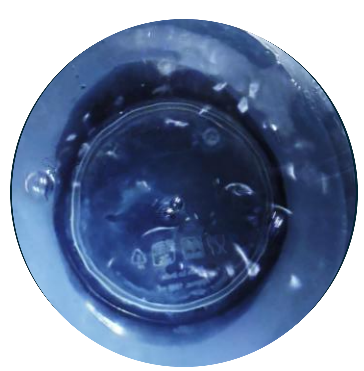
13.75g



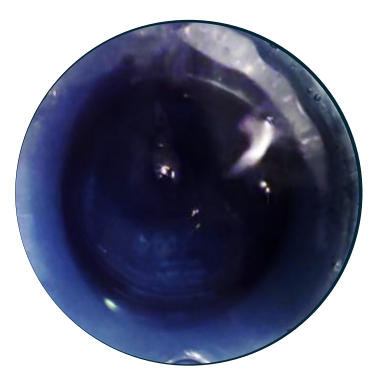
1.25g + 50ml



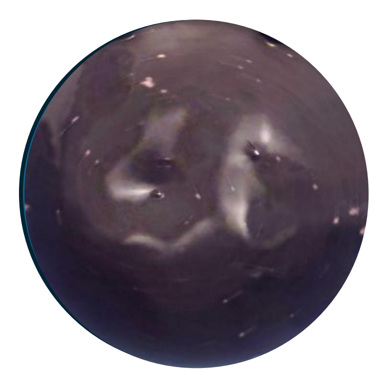
1.25g + 50ml heating



1.25g + 50ml heated



2.5g + 50ml heated



3.75g + 50ml heated

REF ADJUSTED COLOUR 1
APRICOT D2 BASE – ALKALI 18.75g

The first 2 attempts were carried out on 15ml and 30ml of dye, respectively before scaling up to 50ml. The following signify key colour changes until saturation. Although not blue the final colour is similar to a greencast denim and has potential uses.

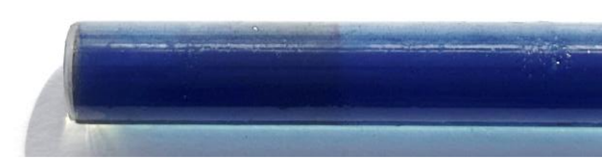
REF ADJUSTED COLOUR 2
BILBERRY BASE – ALKALI (3.75g) + ACID (10ml)

Initial increments of alkali (Sodium Bicarbonate) to make the bilberry lean cooler. Following which there was increments of acid (lemon juice) to alter the colour until this lighter blue shade was reached. Creates a range of usable shades to reference.

REF ADJUSTED COLOUR 3
BILBERRY BASE – ALKALI (13.75g)

Increments of alkali (sodium bicarbonate) increase. Purple hue is darkened and produces a colour way for darker denim variations, closer to the dark blue of the colour palette.

REF ADJUSTED COLOUR 4
INDIGO – WATER DILUTION (50ml + 3.75g)



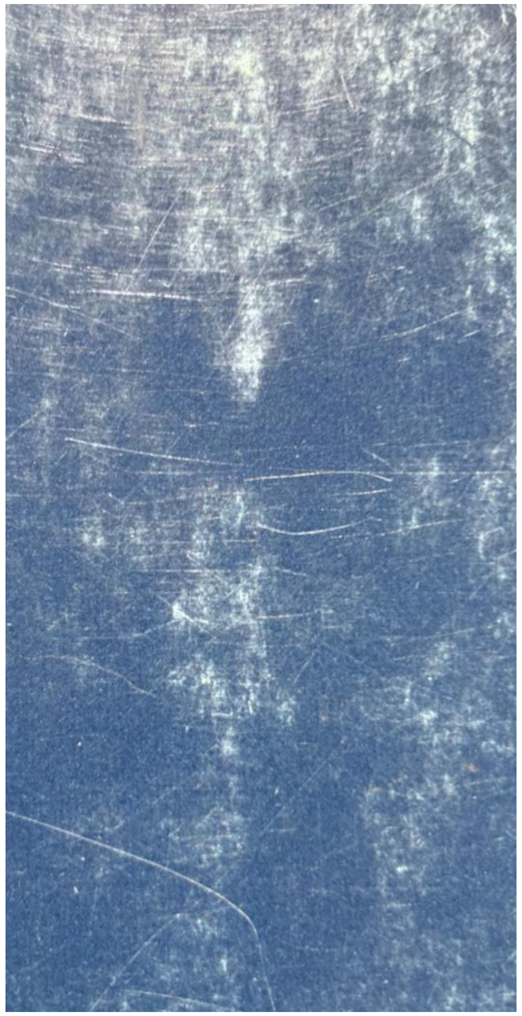
Dissolving Indigo powder in water and adding indigo incrementally to darken the colour to achieve the desired colour yield. Initially the surface layer doesn't represent the colour of the solution accurately, before heating to help dissolve and produce the colouring of denim by using the same colourant.

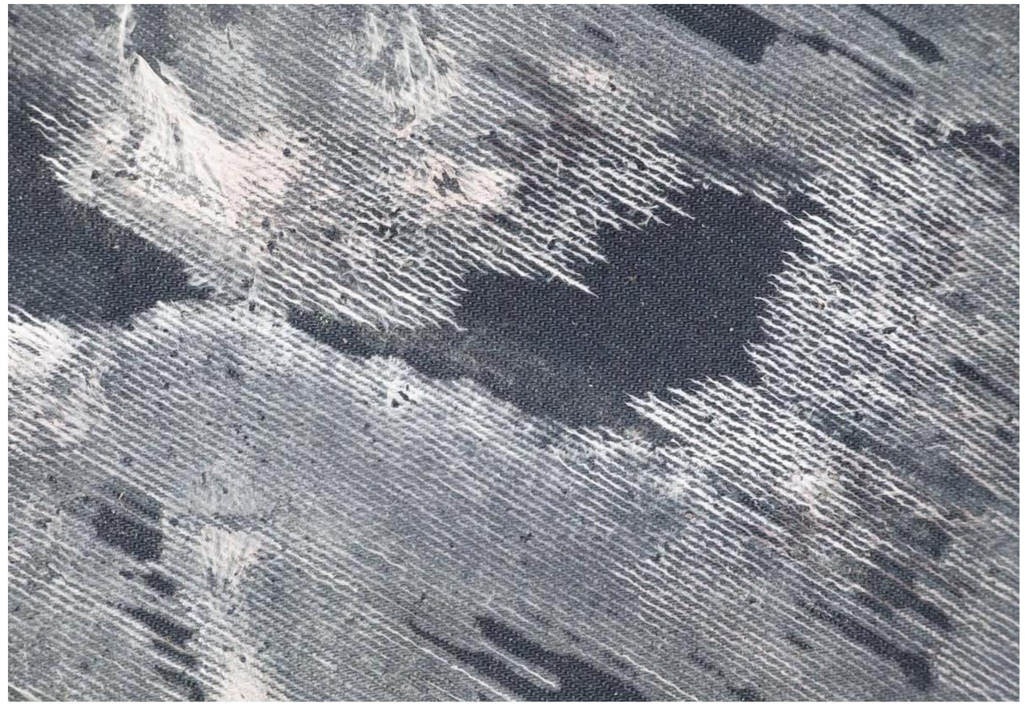
VISUAL RESEARCH

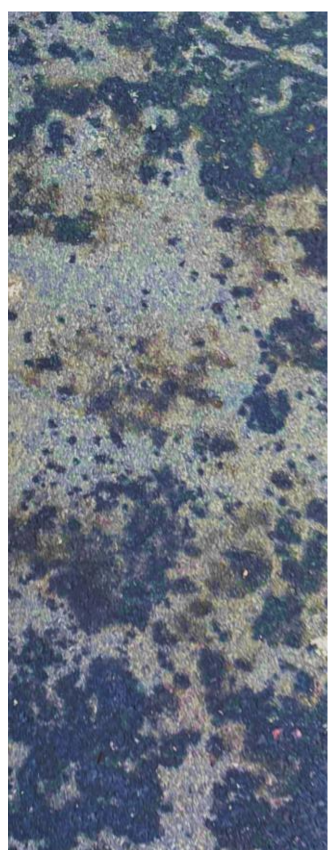
CREATING AND ESTABLISHING A VISUAL LANGUAGE

DISTRESSED

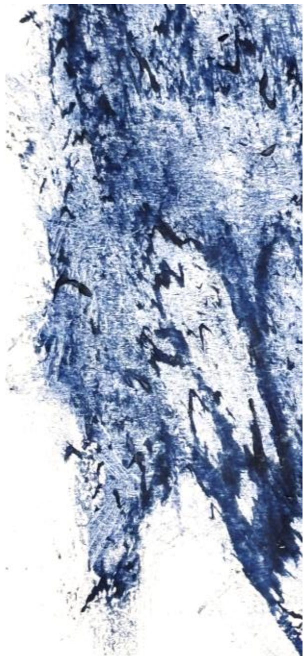
FIRSTHAND PHOTOGRAPHY

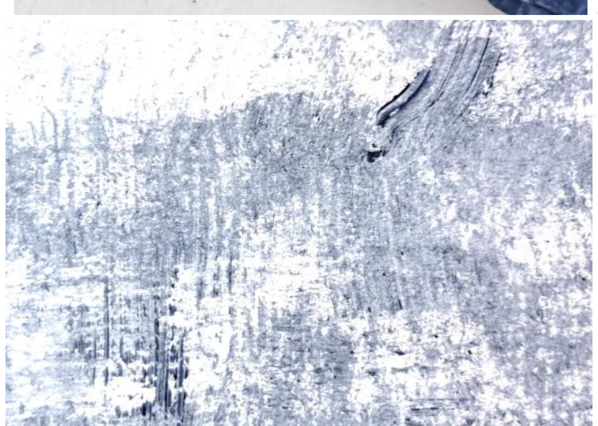


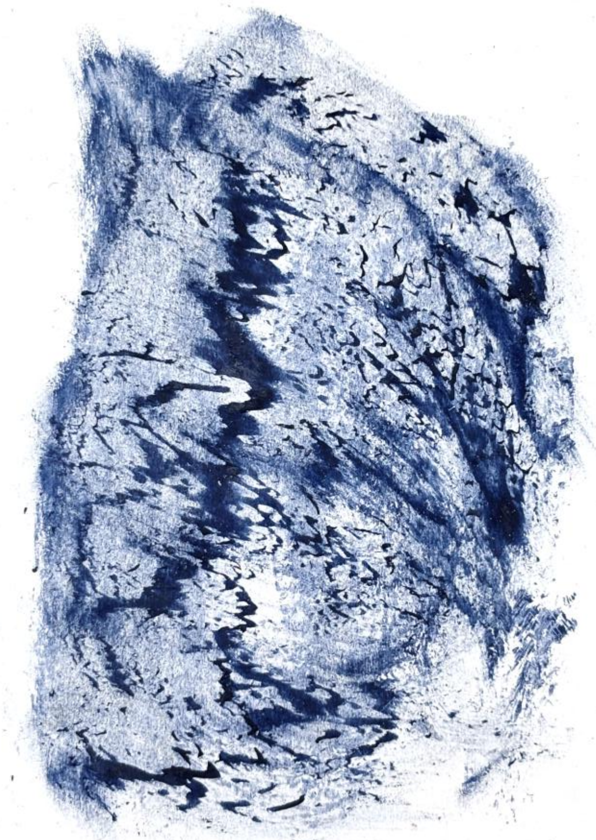




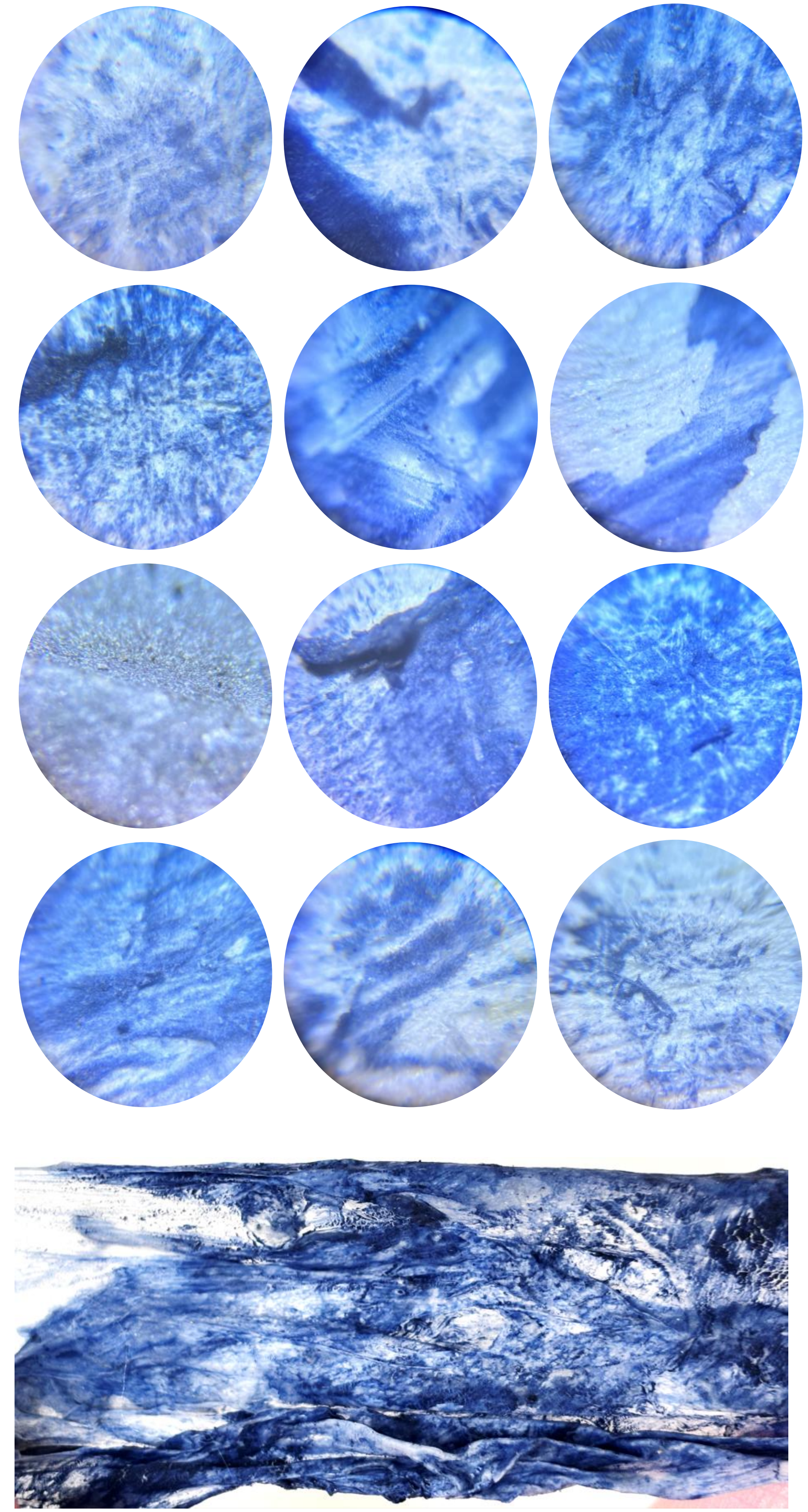
DISTRESS
IN MASKING FLUID







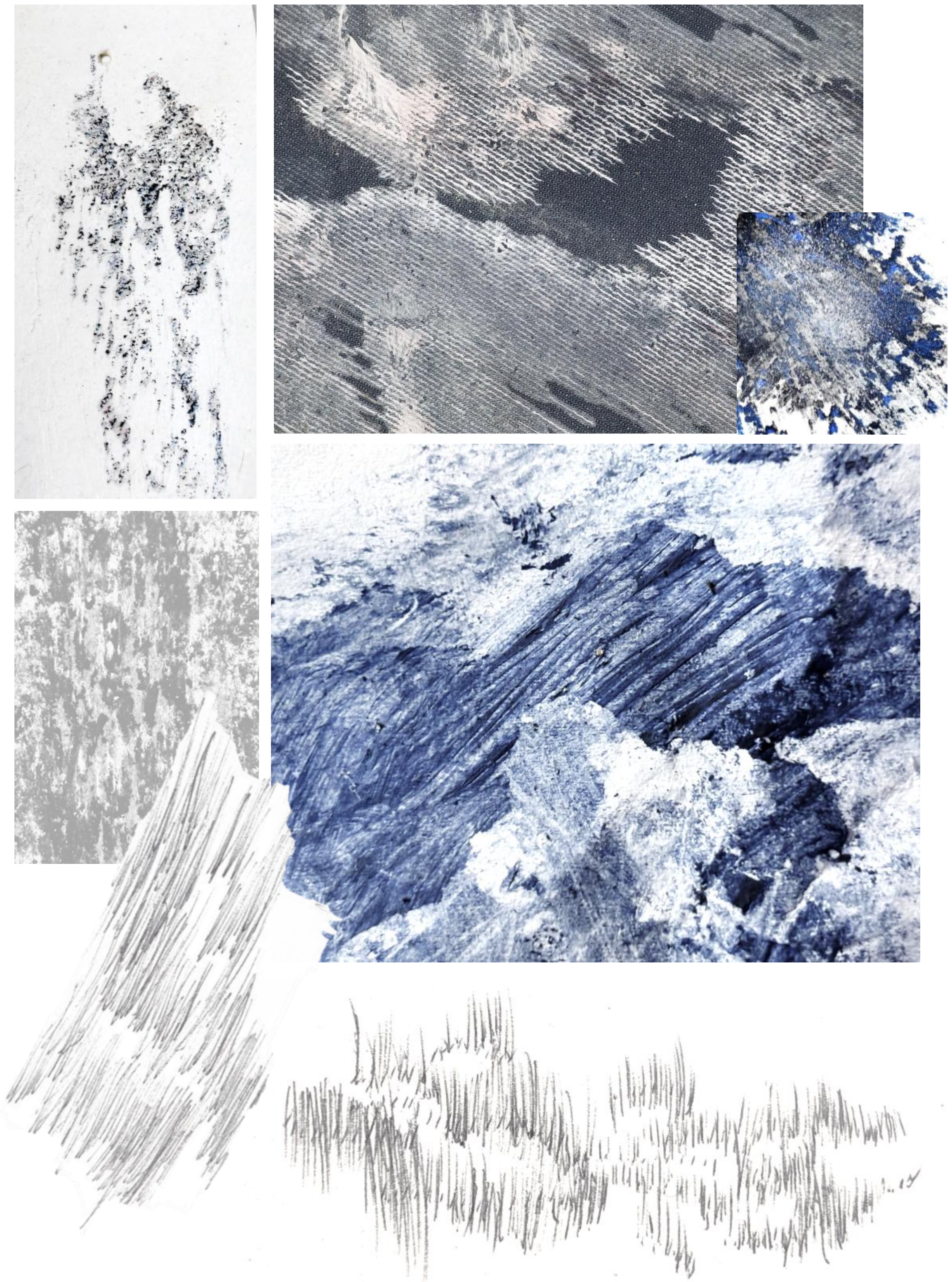
Ink Studies: This series explores layering ink on masking fluid to mimic scratches and distress. Emphasizes liquid on liquid interactions and treating the surface as a test for flow and liquid properties. These experiments serve as a visual and material rehearsal for translating such distressed surface qualities directly onto bioplastic compositions.



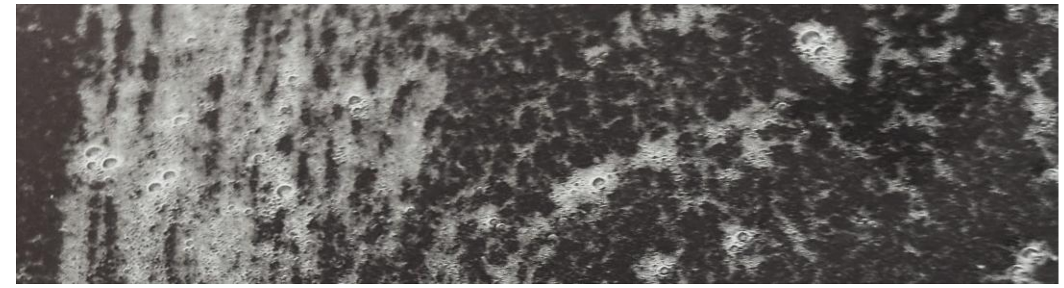
Masking fluid sculpture and closeups

DISTRESSED

RECORDING DISTRESS PATTERNS



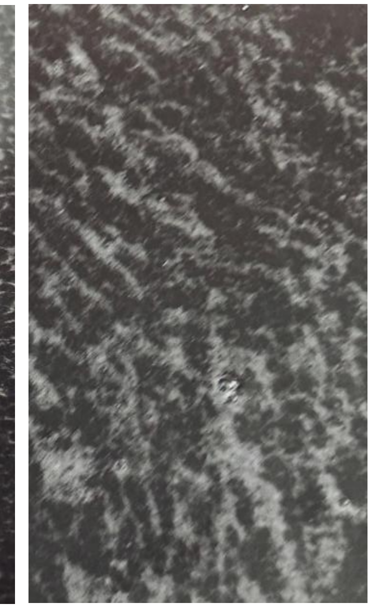
Establishing Visual Language: Distress patterns recorded through sketching and inking techniques, forming the foundation for a visual language rooted into wear.



10CM AT 75 DEGREES

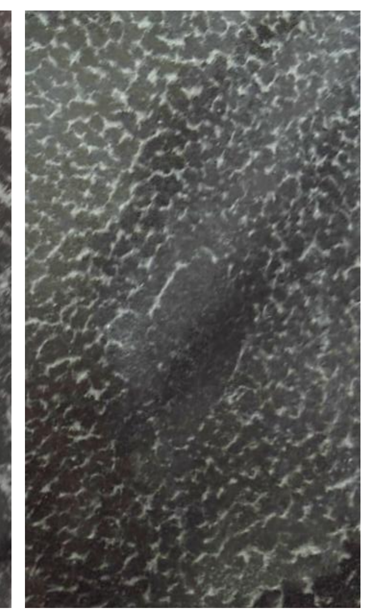
45CM AT 60 DEGREES

30CM AT 110 DEGREES

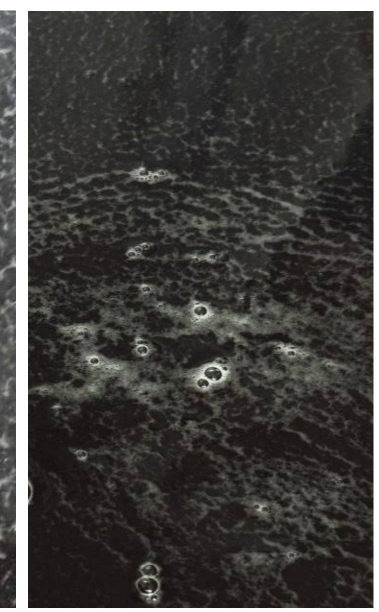


15CM AT 60 DEGREES

15CM AT 75 DEGREES



45CM AT 30 DEGREES



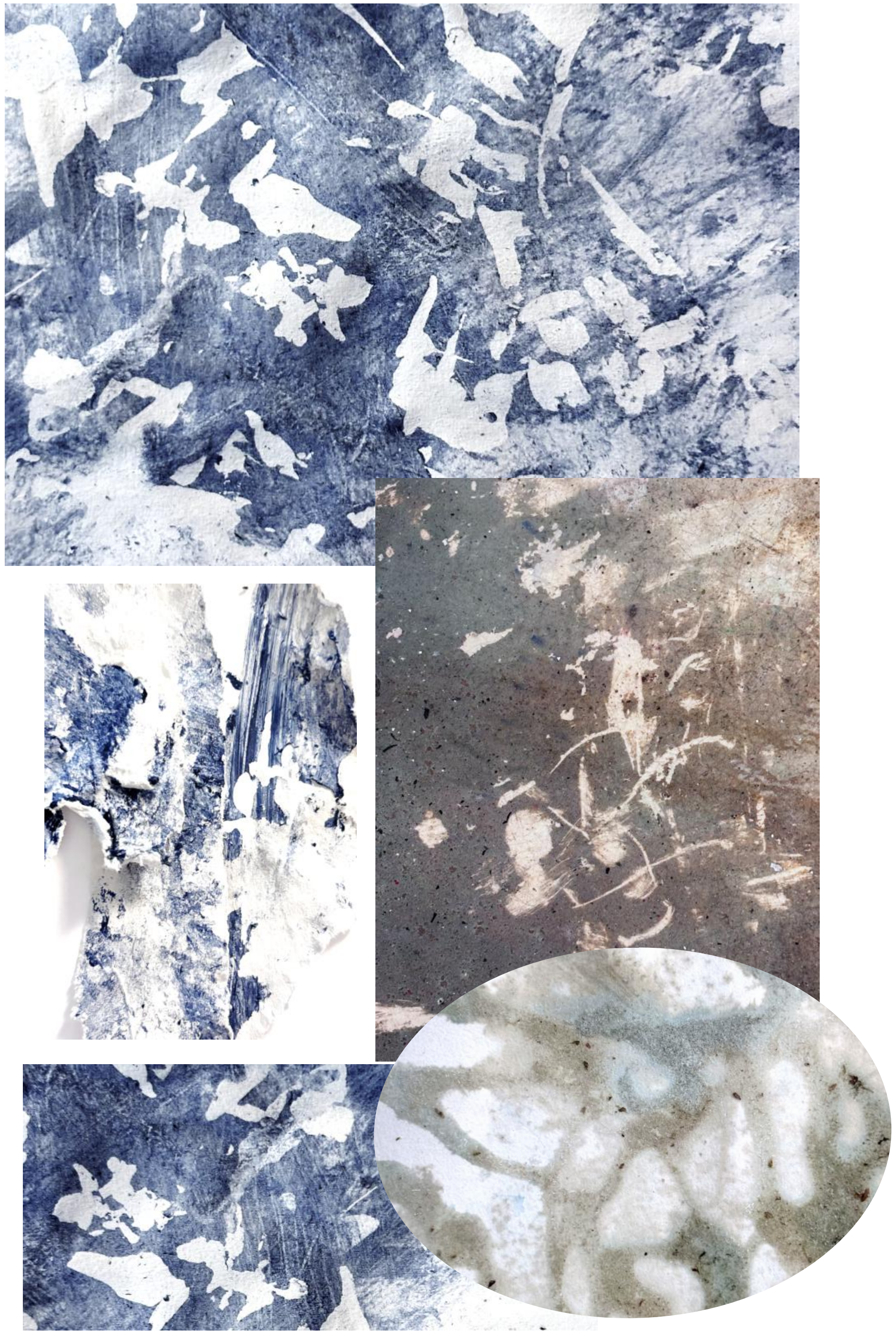
10M AT 120 DEGREES

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.

DISTRESSED

NEGATIVE SPACE



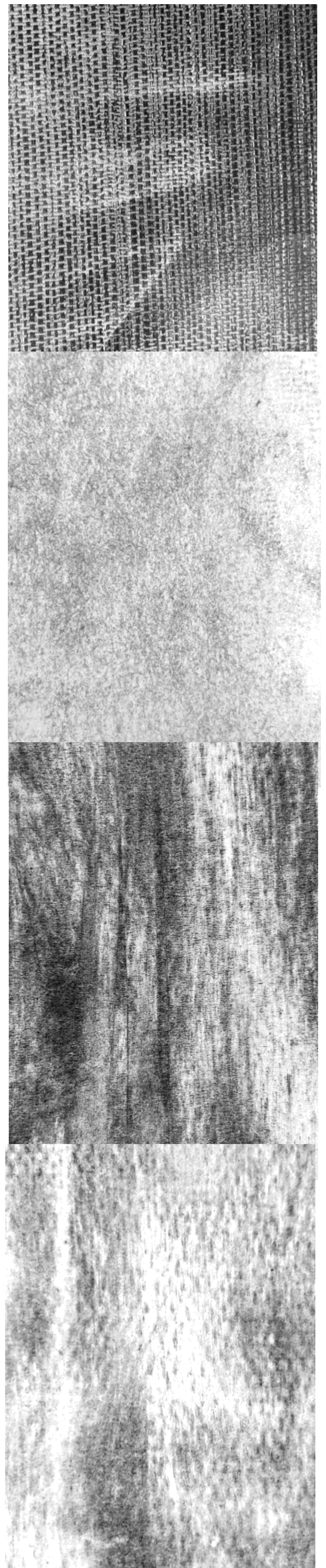
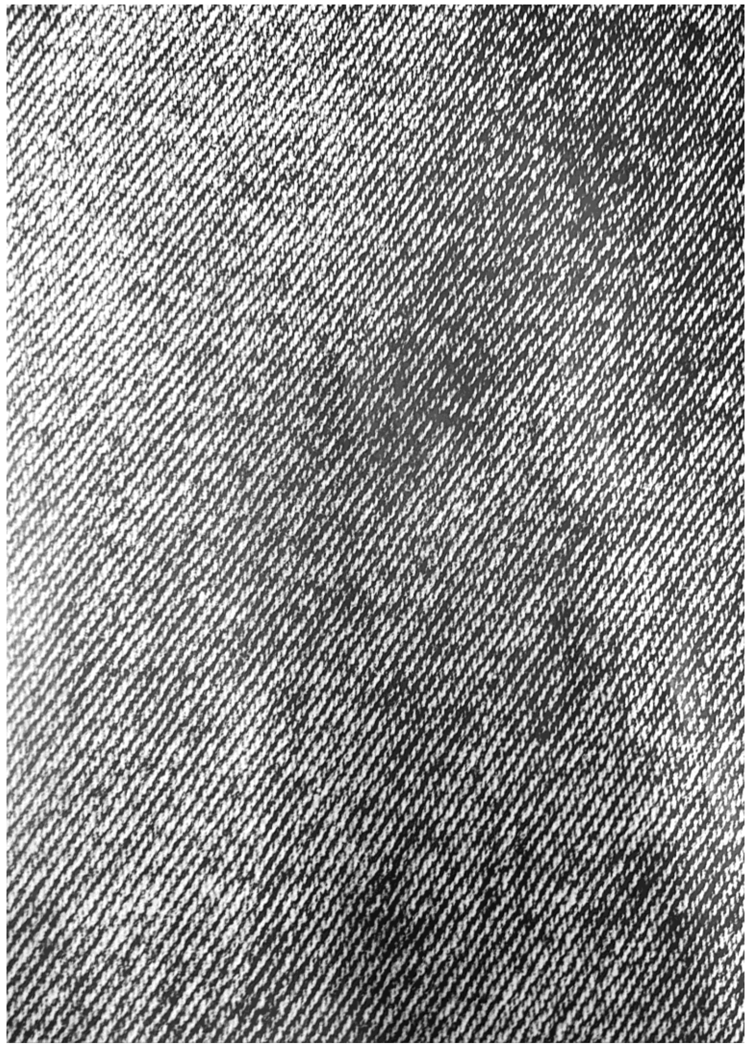
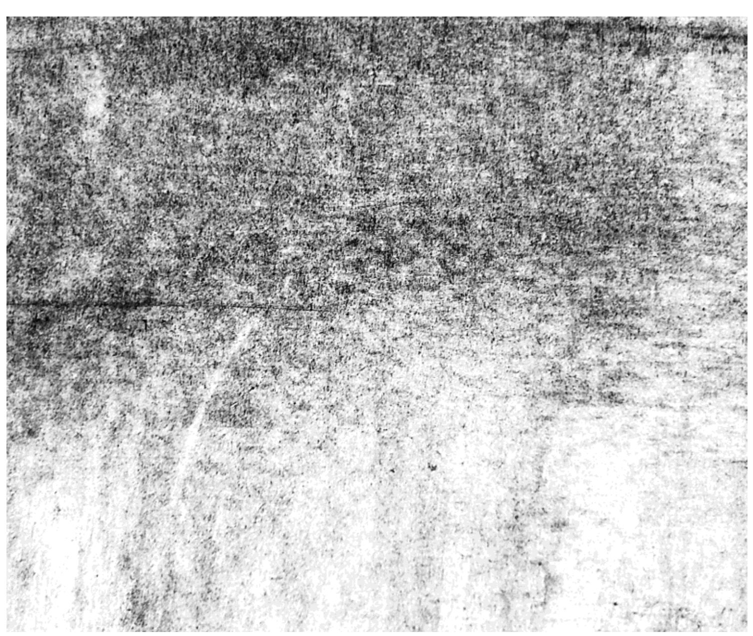
A series of line sketches for focusing on the negative spaces and idea of fragments.

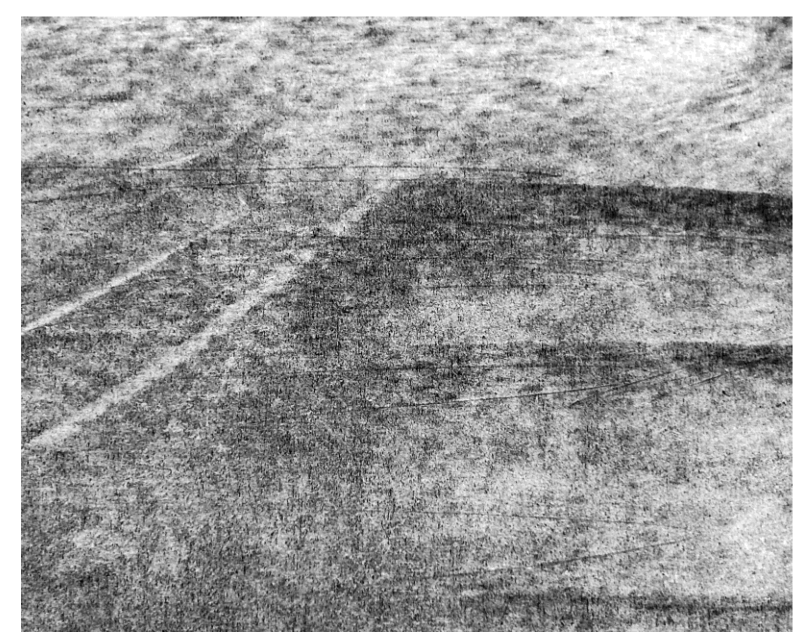
DISTRESSED

FURTHER DEVELOPED MOTIFS AND SCREEN DESIGNS

SPECKLES AND GRAIN

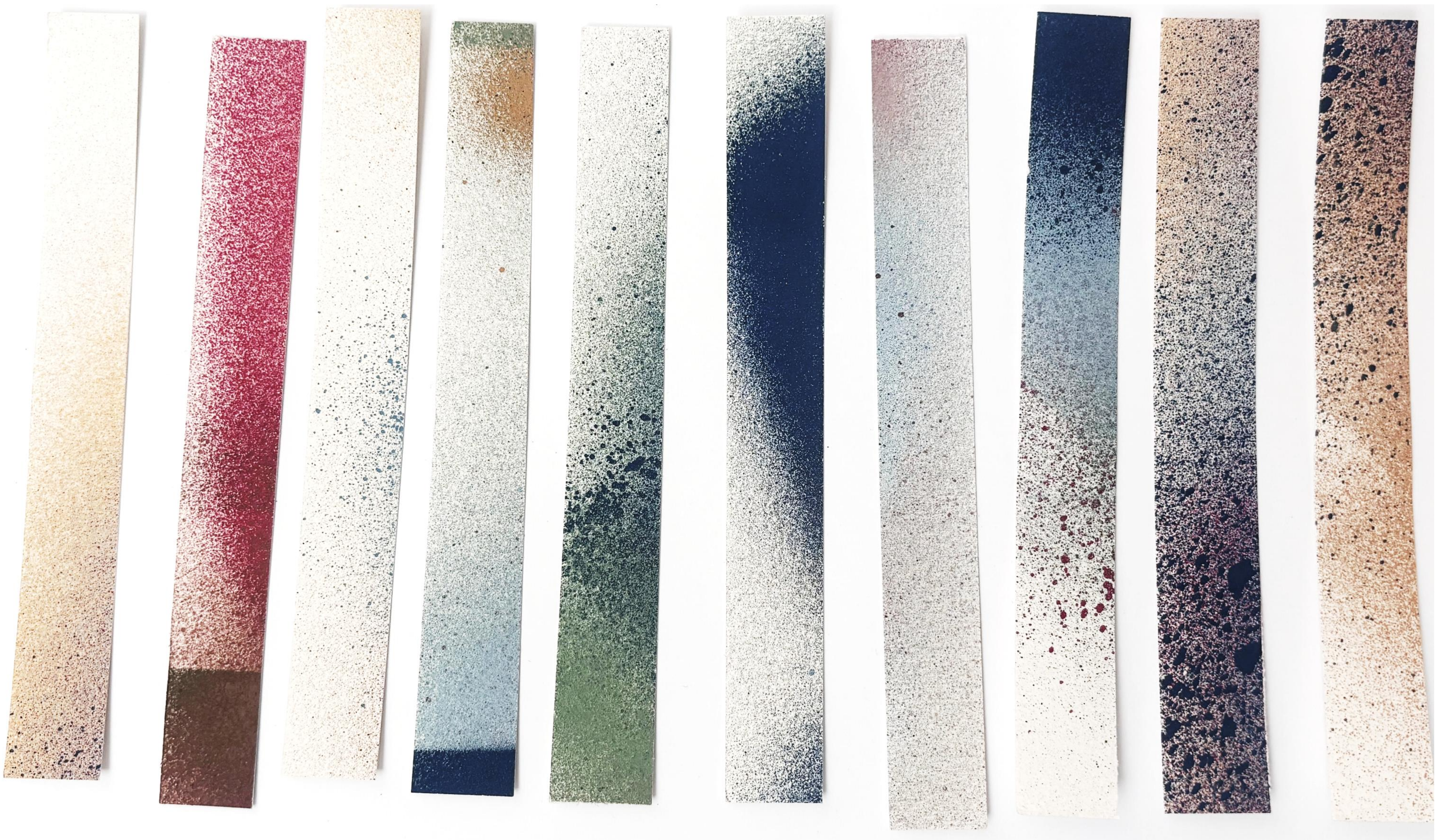
CHALKRUBBINGS AND SKETCHES OF DENIM GRAIN

SPECKLE GRADIENTS

PAINT ON CARD SERIES EXPLORING SPECKLE DISTRIBUTION



COMPOSITION

TESTING BIOPLASTIC RATIOS AND BIOPOLYMERS

BIOPOLYMER COMPOSITION TESTING

DIFFERENT RATIOS

This series of experiments focused on testing the ratios of bioplastic biopolymer, solvents and plasticiser to assess compositional integrity, tactility and aesthetics. Informed by He, Wang and Zheng's paper recommendation of multivariable testing, I adjusted the ratios systematically alongside investigating the capability for visual distress. This approach also incorporated testing for dye compatibility. Measurements were standardised using the tablespoon measure (15 ml) for base volumes and measuring spoons for smaller increments to ensure consistency across samples. All components were measure in volumes instead of weight to ensure a maintained ratio across one factor. Each experiment focuses on a different visual element.

POTATO STARCH

Focus on induced textural distress through manually manipulating surfaces during the drying and curing stages.

POTATO STARCH W/ HONEY

Focus on the effect of a honey plasticiser on feel and exploring cracking mechanisms..

CORN STARCH

Focus on sampling range of natural dyes and biomass additives with an emphasis on suspension.

AGAR

Focus on textural grain and distribution. Also testing photo-transfer aesthetics for potential trompe l'oeil application.

RATIO	CHANGE
B : 2/3G : 7W : 2/3V	Base Recipe
B : 2/3G : 7/2W : 2/3V	Halve Water Content
B : 2/3G : 14W : 2/3V	Double Water Content
B : 2/3G : 7W : 1/3V	Halve Vinegar Content
B : 2/3G : 7W : 4/3V	Double Vinegar Content
B : 2/3G : 7W : 2V	Triple Vinegar Content
B : 1/3G : 7W : 2/3 G	Halve Glycerine Content
S : 4/3G : 7W : 2/3 V	Double Glycerine Content
B : 7W : 2/3V	Remove Glycerine Content
1/2B : 2/3G : 7W : 2/3V	Halve Biopolymer Content
2B : 2/3G : 7W : 2/3V	Double Biopolymer Content
2/3G : 7W : 2/3V	Remove Biopolymer Content
B : 2/3G : 7W : 2/3V	Double Base Recipe
B : 2/3G : 7W	Remove Vinegar Content

OUTINED RATIOS CARRIED OUT FOR EACH BIOPOLYMER

METHOD

1. **Measurement:** Accurately measure the biopolymer, solvent and plasticiser using measuring spoons, according to defined ratios. This ensures consistency across samples for comparative analysis.

2. **Mixing:** Add the solvent to a saucepan, followed by the biopolymer. Stir continuously until fully dissolved. Incorporate any additives (e.g. biopolymers), then add plasticiser last mixing until the solution is smooth and uniform.

3. **Heating:** Place the saucepan on medium heat (gas mark 4), stirring constantly to prevent sticking or burning. Continue until the mixture thickens and the wooden spoon is met by physical resistance.

4. **Casting and Manipulation:** Pour the solution onto the designated surface (metal trays). While still warm and malleable, manipulate or distress the sample to create surface effects before the material fully cures.

5. **Documentation:** Record all relevant variables for each sample: ingredients quantities, additives, heating duration and drying time. This enables reproducibility and informed compositional adjustments in the subsequent iterations.

EQUIPTMENT

- Agar
- Potato Starch
- Cornstarch
- Honey
- Glycerol
- Vinegar
- Water
- Lemon juice
- Stove
- Saucepan
- Wooden Spoon
- Metal trays
- Biomass
- Natural Dyes
- Measuring spoons
- Bowls
- Stopwatch

OBSERVATIONS AND CONCLUSIONS

Speed setting varied by base: Agar sets significantly faster than starch variations, requiring quicker manipulations. In contrast, starch remains workable for longer, allowing for more intricate surface distortion.

Drying Time: Starch-based bioplastics typically airdry in 7 days, whereas agar-based samples dry in 3 days. These timelines vary slightly depending on sample thickness.

Heat Curing: Low oven heat (70 degrees) can accelerate curing but prolonged exposure can lead to yellowing.

Plasticiser Impact: Honey improves strength of bioplastic but also increases internal stress , leading to cracking. Smaller quantities (e.g. 5ml) produces strong yes fragmented samples.

Natural Dye Integration: Due to the high water content, natural dyes should replace an equivalent portion of the solvent to maintain consistent ratios.

MANUAL MANIPULATION DURING CURING

STARCH-BASED

REF 1 Patterning during the curing process
16.2cm by 25.5cm

This stage of experimentation focuses on creating distressed, three-dimensional surfaces of bioplastic, directly reflecting the distress established in the visual research. Distortions varied due to the viscosity of the bioplastic composition and at which stage of the curing process. The material's inherent behaviour to guided the type of manipulation.

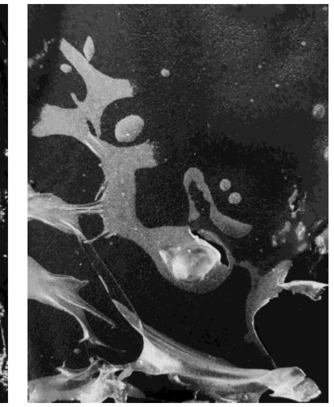
This process served dual purposes: testing the compositional integrity under physical stress and evaluating translation of the visual language into the material. While some samples fractured during manipulation, the breakages were consistent with the conceptual framework of material distress and so still had value.

These methods successfully echo the established visual language of distress and surface wear, reinforcing themes of tactility and imperfection.

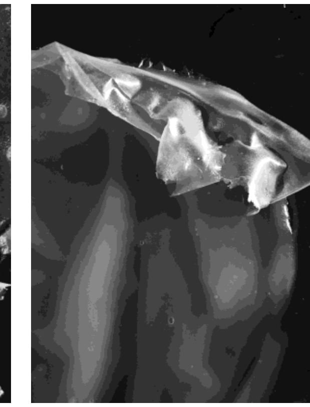
Cross-Compatibility: Techniques can be applied across multiple compositions and remain consistent with the broader aesthetic direction of the project.

REF 13

REF 8

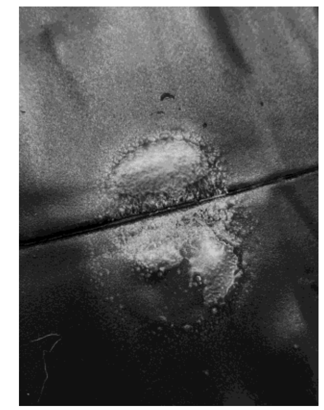


REF 4



REF 7

REF 1



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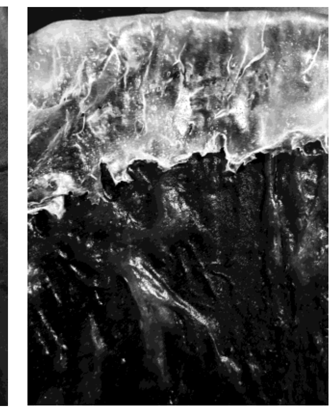
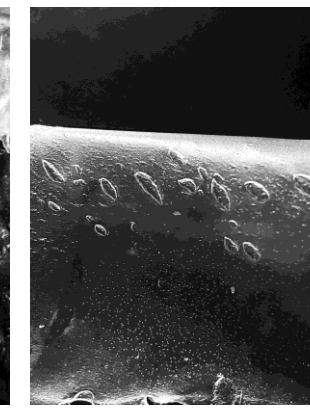
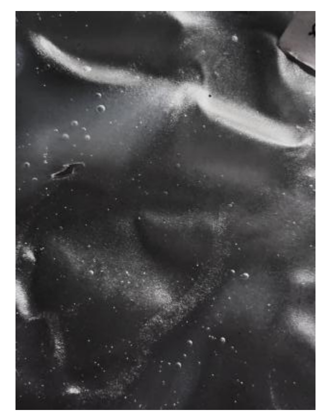


REF 2

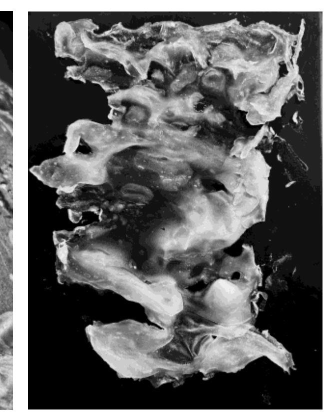


REF 3



REF 9

REF 3



REF 11

REF 2

OBSERVATIONS AND CONCLUSIONS

Colour as a Curing Indicator: Bioplastic appears blue-tinged when still curing and transitions to a more opaque white when fully dry.

Manual Manipulation is Most Effective at Two Stages: Immediately after curing, when the bioplastic is fully malleable, and mid-curing, when air gaps and subtle distortion can be introduced.

Pulling and tension-based manipulations: These manipulations require two-handed techniques, one to stabilize and one to distort, mirroring processes used in the handling of staking of leather material.

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

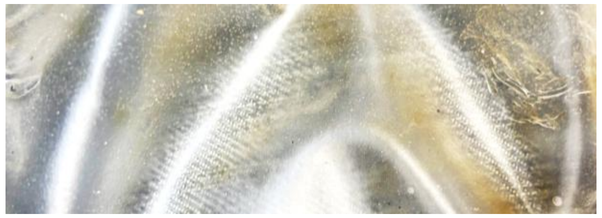
REF NUMBER: 3
REASONING: X2 Water Content
KEY OBSERVATIONS: Water separation when drying creates perforations.

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

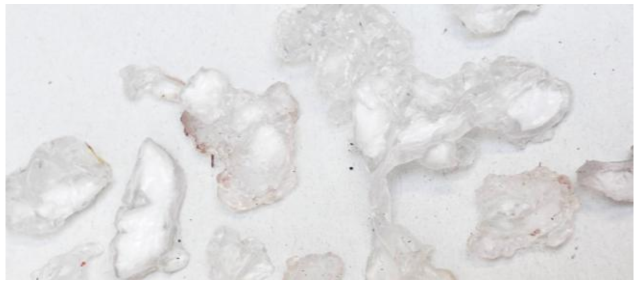
REF NUMBER: 8
REASONING: X2 Glycerine Content
KEY OBSERVATIONS: Tears easily.

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.

B : 1/12H : 7W : 2/3V
15 : 1.25 : 100 : 10

REF NUMBER: 33
ADDITIVES: Common Yew D1, Lawson's Cypress D3
REASONING: Incremental Honey Content
KEY OBSERVATIONS: Strong composition but lacks flexibility of any degree.

B : 1/6H : 7W : 2/3V
15 : 2.5 : 100 : 10

REF NUMBER: 34
ADDITIVES: Common Yew D1, Muscle Shells D3
REASONING: Incremental Honey Content
KEY OBSERVATIONS: Cracked when drying, but the individual fragments are both strong and flexible.

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

REF NUMBER: 35
ADDITIVES: Lawson's Cypress D1. Lawson's Cypress D3
REASONING: Incremental Honey Content
KEY OBSERVATIONS: Cracked when drying and retained a sticky residue.

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

REF NUMBER: 36
ADDITIVES: Lawson's Cypress D1,
REASONING: Incremental Honey Content
KEY OBSERVATIONS: Tinfoil surface created relief, there is scope for further experimentation here.

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

REF NUMBER: 37
ADDITIVES: Eggshell, Silver Maple D2
REASONING: Incremental Honey Content
KEY OBSERVATIONS: Composition cracked but his composition became mouldable like clay, possible hardware application.

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

REF NUMBER: 38
ADDITIVES: Grass ,Silver Maple D2
REASONING: Incremental Honey Content
KEY OBSERVATIONS: No visible cracks but composition remained sticky.

B : 8/3G : 7W : 2/3V
15 : 40 : 100 : 10

REF NUMBER: 39
ADDITIVES: Common Yew D2
REASONING: Incremental Honey Content
KEY OBSERVATIONS: Cracked pattern across the sample, not as individual fragments, but instead became fragile to handle.

CORN STARCH
COMPOSITION TESTS

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

REF NUMBER: 20
ADDITIVES: Lawson's Cypress D1, NaCl
REASONING: Control
KEY OBSERVATIONS: High salt content in the natural dye is the suspected reason for surface cracking.

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

REF NUMBER: 21
ADDITIVES: Lawson's Cyprus D2
REASONING: ½ Water Content
KEY OBSERVATIONS: Rubbery feel.

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

REF NUMBER: 22
ADDITIVES: Silver Maple D1, NaCl
REASONING: X2 Water Content
KEY OBSERVATIONS: Oven drying trialled for wrinkle formation, initial attempt

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

REF NUMBER: 23
ADDITIVES: Silver Maple D2
REASONING: ½ Vinegar Content
KEY OBSERVATIONS: Strong and slightly abrasive.

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

REF NUMBER: 24
ADDITIVES: Adjusted Colour 1
REASONING: X2 Vinegar Content
KEY OBSERVATIONS: Crystallisation taking place because of the baking soda content in the adjusted colour.

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

REF NUMBER: 31
ADDITIVES: Onion Skin D2
REASONING: No Starch Content
KEY OBSERVATIONS Viscous:

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

REF NUMBER: 26
ADDITIVES: Adjusted Colour 2
REASONING: ½ Glycerine Content
KEY OBSERVATIONS: Crystallisation occurring because of baking soda content in the adjusted colour but behaves differently to REF 24.

B : 7W :1/3V
15 : 100 : 5

REF NUMBER: 28
ADDITIVES: Lawson's Cypress D3
REASONING: No Glycerine Content
KEY OBSERVATIONS: Hasn't Dried

1/2B : 2/3G : 7W :1/3V
7.5 : 10 : 100 : 5

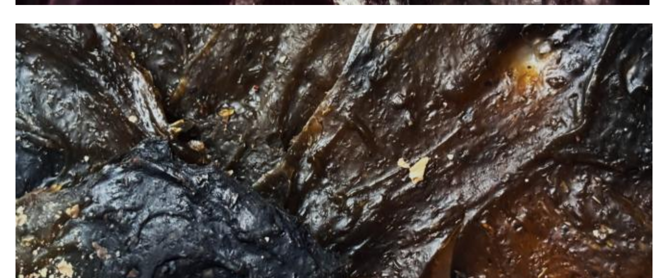
REF NUMBER: 29
ADDITIVES: Apricot D2
REASONING: ½ Starch Content
KEY OBSERVATIONS: Improved strength with a D2 Dye as opposed to a D1 Dye.

2B : 2/3G : 7W :1/3V
30 : 10 : 100 : 5

REF NUMBER: 30
ADDITIVES: Common Yew D1
REASONING: X2 Starch Content
KEY OBSERVATIONS: Texture of pour surface has transferred but relief continue to decrease

B : 2/3G : 7W : 1/2V
15 : 10 : 100 : 30

REF NUMBER: 25
ADDITIVES: Bilberry D1
REASONING: X3 Vinegar Content
KEY OBSERVATIONS: Sticky Feel.



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

REF NUMBER: 32
ADDITIVES: Common Yew D2
REASONING: Dounble Quantities
KEY OBSERVATIONS: Slight colour variation with oven drying.

AGAR
COMPOSITION TESTS

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

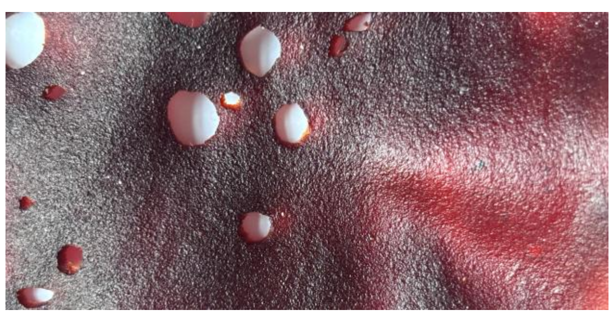
REF NUMBER: 40
REASONING: Control
KEY OBSERVATIONS: Strong composition, creates small scale lines during the during process as composition shrinks.

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

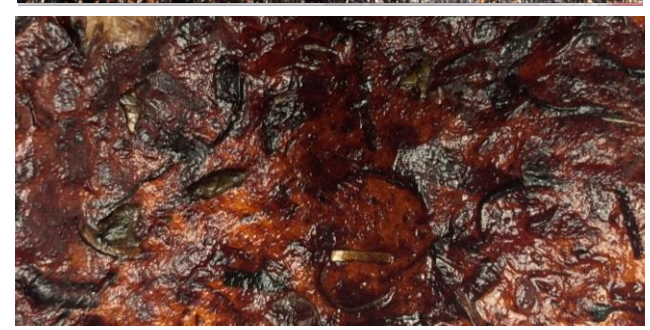
REF NUMBER: 42
REASONING: 1/3 Agar Content
KEY OBSERVATIONS: Good colour yield, especially under direct light, gummy to the touch. Responds well to hand cutouts.

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

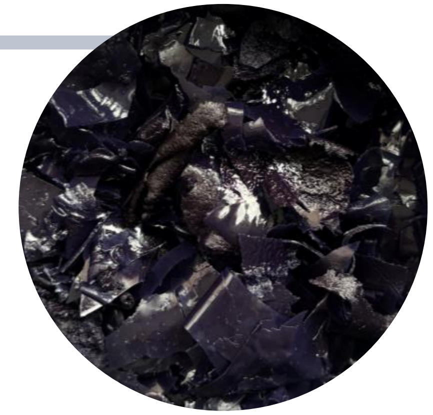
REF NUMBER: 53
REASONING: Image Transfer
KEY OBSERVATIONS: Strong composition, minimal image transfer torn edges of ink are not discernibly visible.

CONSIDERATIONS

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.



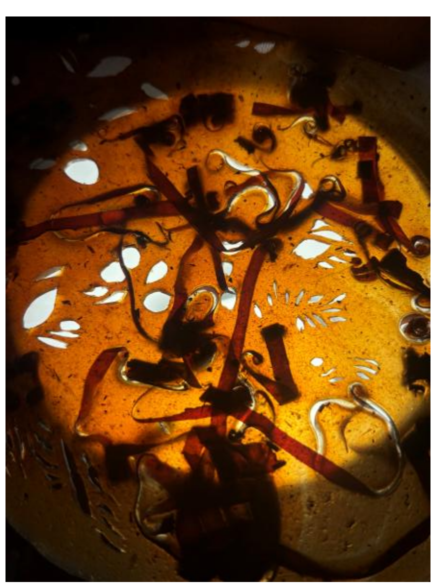
COLLECTING OFFCUTS

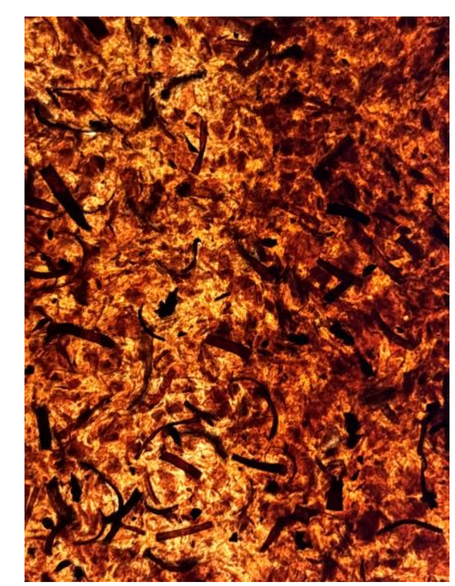
Aside from reclaiming bioplastics, scraps and offcuts can be utilised for practical reasons in sewing tests to reform bigger areas of bioplastic. Pieces are also being collected as fragments and used in an embellishment context, as the stronger compositions tend to crack and are more suitable for embellishment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

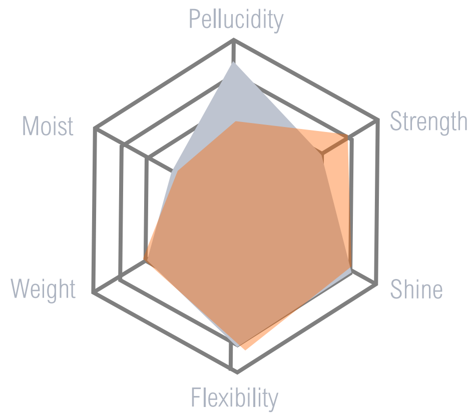




COMPOSITIONS
FOR FORMULA DEVELOPMENT

COMPOSITIONS AND DEVELOPMENT RATIONALE – Compositions were selected based on their potential for interactive application. investigations focused on adjusting quantities and incorporating additional processes to enhance material performance. These refinements are visualised in the radar charts below, where projected improvements are shown in orange. While the aim remains to offer a variety of finishes and tactile qualities, material strength and durability have been prioritised to ensure suitability for public interaction.

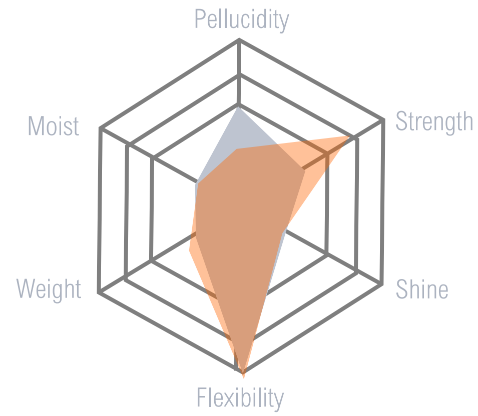
REF 1
POTATO STARCH BASED



	SMELL	CASTING	TOUCH	TIME
AIR DRY	●	Uneven	More Flexible	8 Days
OVEN DRY		Uneven	Slightly Less Flexible	2 Days

Moving forwards, the aim is to increase the opacity whilst retaining the other attributes. The manual manipulation during the curing process will be repeated, and an air-drying approach may be explored to further reduce odour, even if it requires a longer drying period.

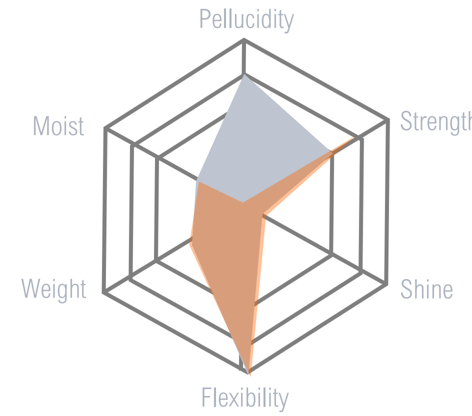
REF 3
POTATO STARCH BASED



	SMELL	CASTING	TOUCH	TIME
AIR DRY		Even	More Fragile	12 Days
OVEN DRY		Even	Less Fragile	2 Days

This composition has strong potential for patterning through holes created water separation. A key aim is to improve strength by pouring thicker layers, without compromising flexibility and the structural integrity of the perforations.

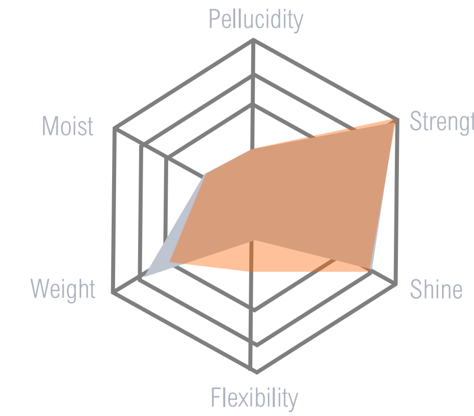
REF 5
POTATO STARCH BASED



	SMELL	CASTING	TOUCH	TIME
AIR DRY	●	Even	Soft	3 Days
OVEN DRY	●	Even	Soft	4 Hours

This composition's main draw is it's flexibility and soft smooth surface. Ideal for applications like printing and surface treatments whilst continuing to improve the opacity.

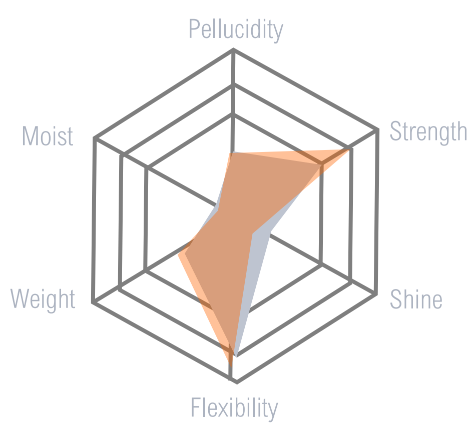
REF 12
POTATO STARCH BASED



	SMELL	CASTING	TOUCH	TIME
AIR DRY		Runny	Rigid	10 Days
OVEN DRY		Runny	Rigid	2 Days

Moving forwards this composition shows promise for embellishment application as the small drops of potato starch instantly gelatanise and become solid. There is scope for experimentation with colour variation and crystallisation.

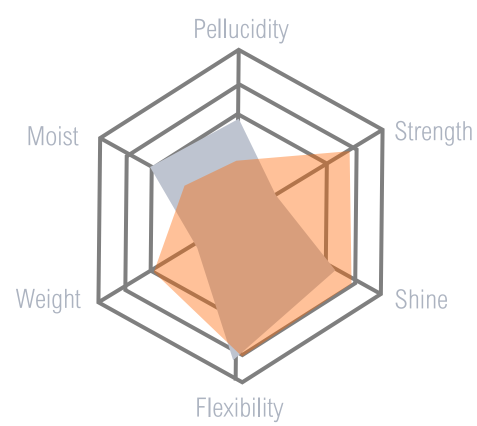
REF 20
CORN STARCH BASED



	SMELL	CASTING	TOUCH	TIME
AIR DRY		Uneven	Sticky	5 Days
OVEN DRY		Uneven	Rough	1 Day

Further experimentation is to be carried out with a focus on achieving a more even application to better showcase the surface texture and enhance it's subtle visual qualities.

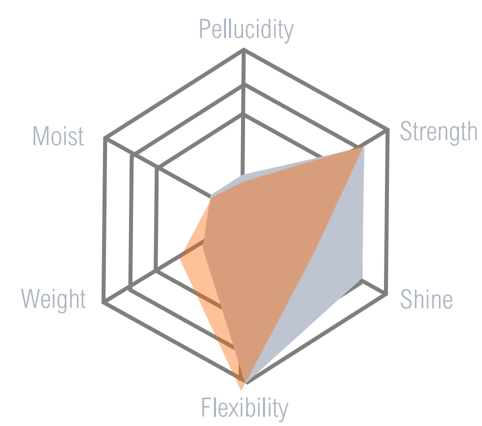
REF 22
CORN STARCH BASED



	SMELL	CASTING	TOUCH	TIME
AIR DRY	●	Even	Sticky	14 Days
OVEN DRY		Even	Sticky	7 Days

Development of wrinkle formation is to continue whilst improving the composition's strength, as it currently tears easily and is sticky to the touch.

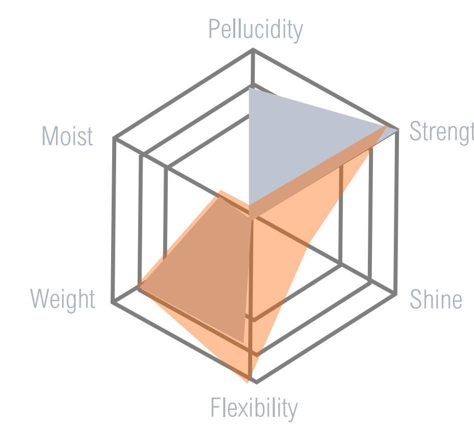
REF 41
AGAR BASED



	SMELL	CASTING	TOUCH	TIME
AIR DRY	● ●	Even	Matt	6 Days
OVEN DRY	●	Even	Matt	1 Day

This composition produced a dual-surface material, the eggshells sunk to the bottom of the mix providing a denim facing and a leather facing side, one matt whilst the other preserves shine. The goal moving forwards is to better control the dispersion of the grain.

REF 49
AGAR BASED



	SMELL	CASTING	TOUCH	TIME
AIR DRY	●	Even	Matt	5 Days
OVEN DRY		Even	Matt	7 Hours

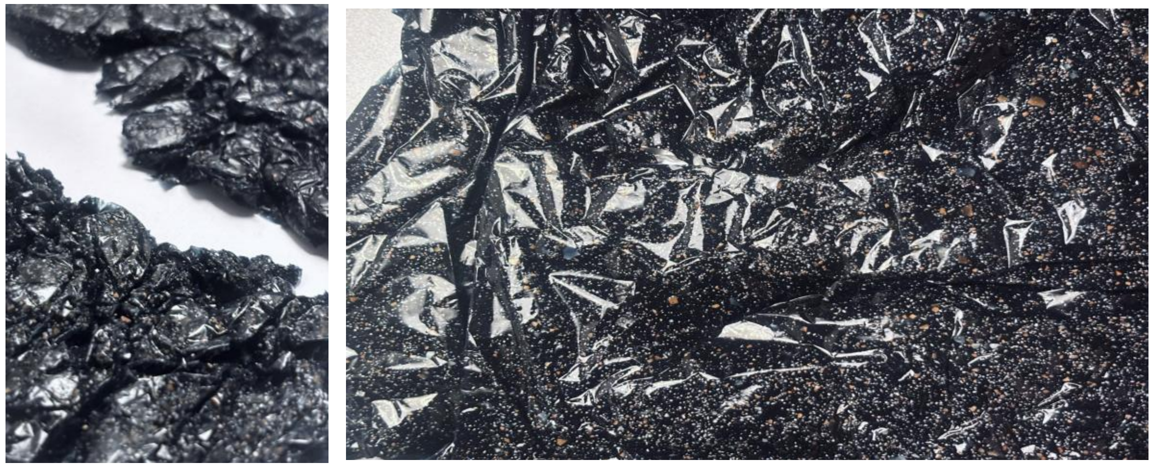
The main goal is to reduce the material's translucency by incorporating natural dyes and biomass to improve opacity. This feels like the strongest composition so far and a promising candidate for jacket development.

MATERIAL SYSTEMS

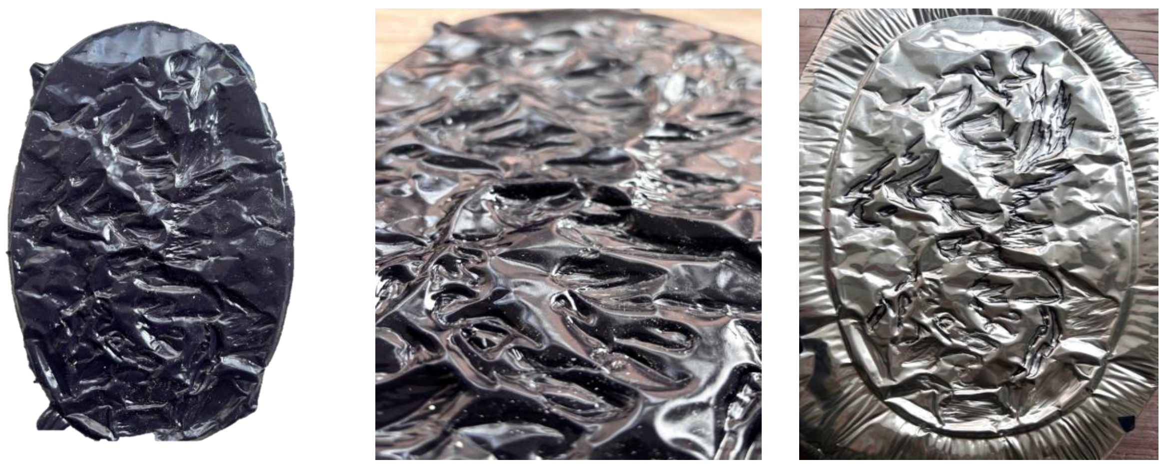
IMPROVING MATERIAL PROFILE VIA COMPOSITION AND PROCESSESING

CREATING RELIEF – FAUX WRINKLING

REF 41 COMPOSITION AS A BASE

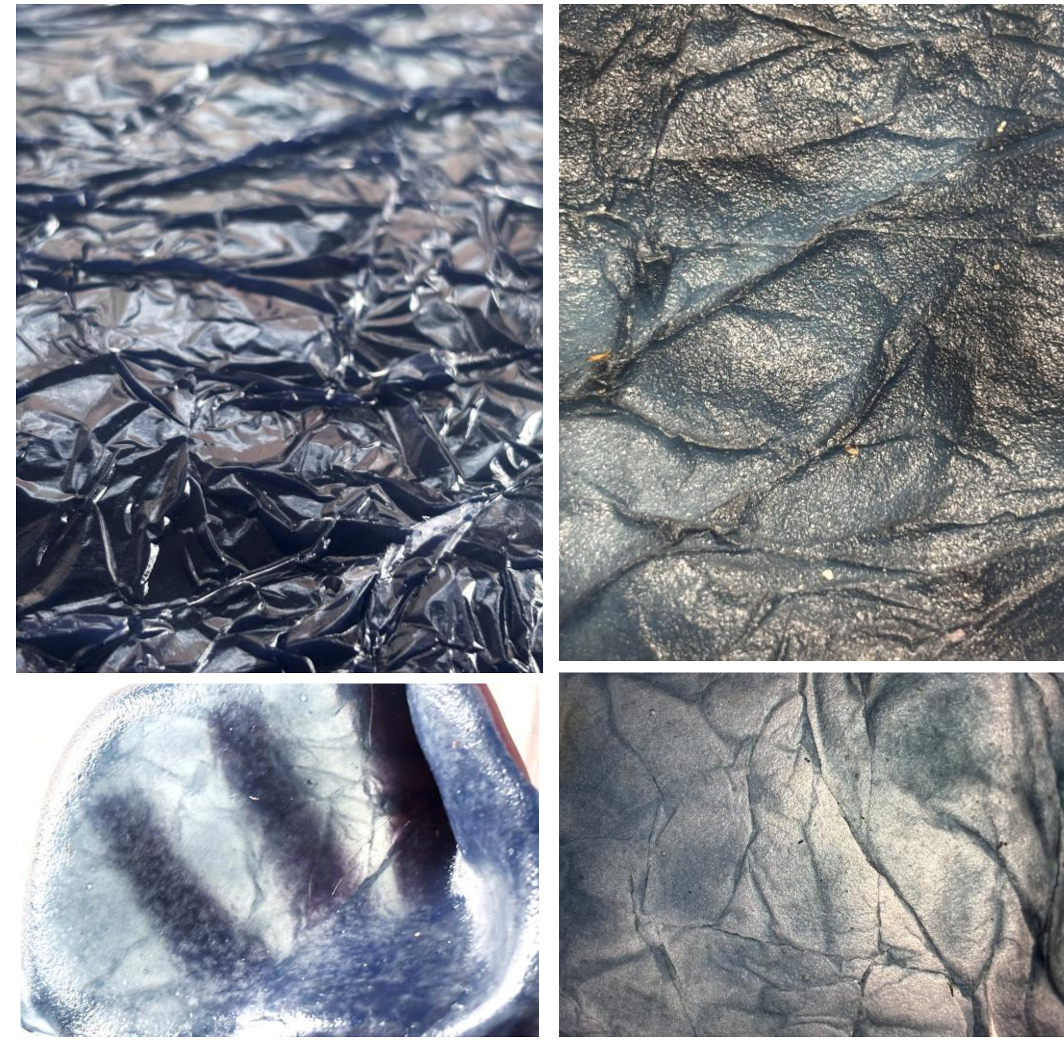


REF 54 – Same composition as Ref 41, poured into a tinfoil mould. Lines in the relief were too fine and closely spaced, resulting in cracking. Highlights the importance of spacing and depth in mould design.



REF 55 – Used the same Ref41 composition, with indented tin sheets reflecting shapes in visual research. Relief and patterning were much more controlled and intentional. However, significant shrinkage occurred, highlighting a need to adjust the composition. Questions also arise about the scalability of this method and the need to procure larger sheets.

REF 56 – Same ratio as Ref 41 but in a cornstarch composition. Tested creating a scale like imprint, designing each shape for relief. This approach caused bioplastic to crack due to excessive height.



REF 57 – Adjusted the composition by increasing agar by 2g. Poured bioplastic on a negative relief with mire widely spaced lines, resulted in an outcome with better structural integrity and definition.

OBSERVATIONS AND CONCLUSIONS

Negative Moulding: It became apparent that moulds need to be the negative of the desired imprint. This applies across all mould types but is most noticeable with tinfoil where the inverted relief can unintentionally crack the bioplastic.

Tinfoil Moulds: To create an effective relief, pinch and manipulate the tinfoil similar to the manipulation carried out on Ref 4, then flip it over before pouring the bioplastic. This ensures the intended texture is on the correct side..

Suitability: Tinfoil moulding works best with agar-based bioplastics, which dry quickly and can be removed before full curing to avoid shrinkage. However, it is not suitable for starch-based compositions, as these must fully dry before removal, leading to shrinkage and breakage on tinfoil dents.

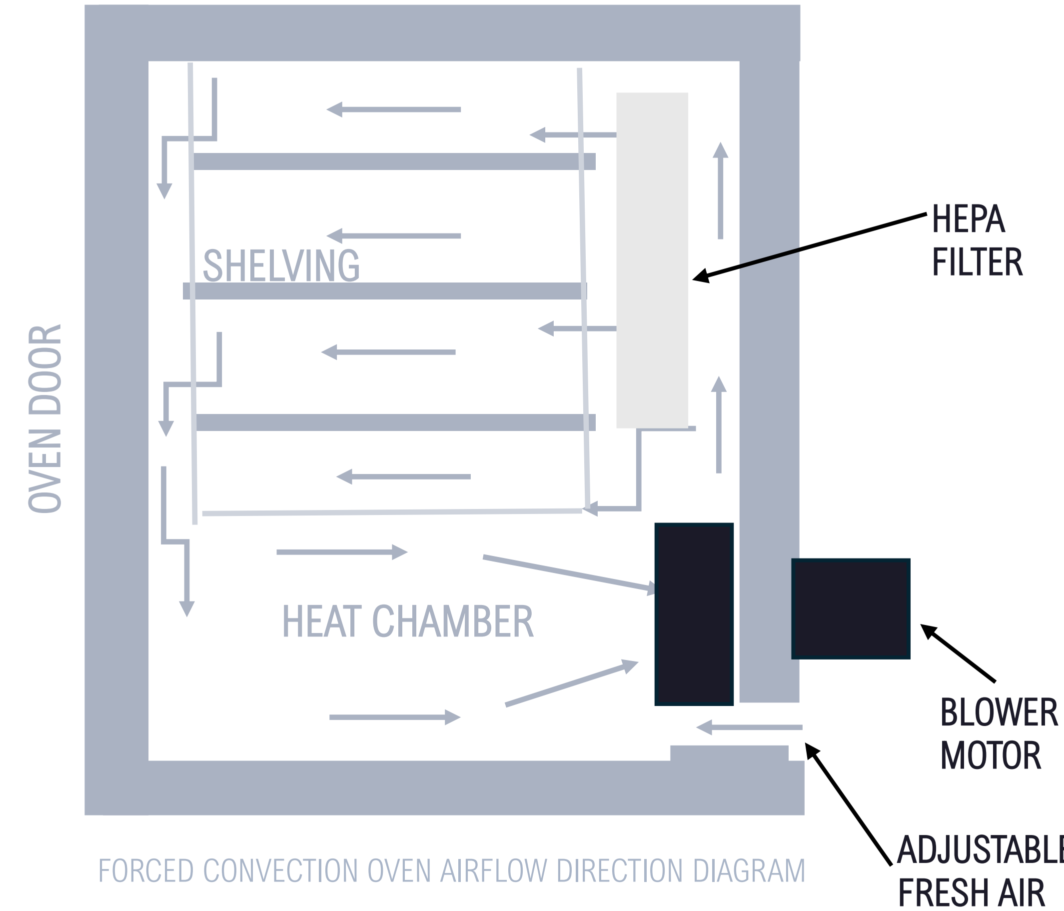
Composition: Adjustments made to the base mix (ref 41) in ref 57, reduce shrinkage by increasing the agar content. This also changes the feel of bioplastic, creating a firmer and less gummy texture more suitable for skin application.

HEAT AND WRINKLING PROCESSES

SERIES OF TESTS

A series of tests was conducted to explore how heat exposure and wind direction influence the wrinkling patterns and surface properties of bioplastic samples. Previously explored compositions were repeated, the selected compositions were chosen as they started to wrinkle during low-heat oven drying and were therefore more susceptible to further wrinkling. Compared how duration and biopolymer impact on the final texture. Due to infrastructure limitations, the tests were carried out using a forced convection oven at a set temperature of 100 degrees Celsius.. The airflow direction inside the oven was mapped to help visualize the direction of distortion.

As shown in the diagram, the oven's airflow circulates through the filter over the shelving and moves towards the oven door,. If facing the oven, air flows from the back towards you. This directional airflow causes the bioplastic to distort forward during curing. The air then recirculates underneath the shelves via the motor, creating a secondary downward flow near the oven door. This could suggest that bioplastic samples positioned closer to the door may experience a slight downwards distortion also, and as a result would mimic the rotational behaviour seen in nematic systems. The working hypothesis is that increased airflow and airflow exposure would amplify this rotational distortion effect.



FORCED CONVECTION OVEN AIRFLOW DIRECTION DIAGRAM

METHOD

1. **Measurement:** Measure the amount of biopolymer, solvent, and plasticiser according to the defined composition.

2. **Mixing**: Add the solvent into a saucepan, followed by the biopolymer, and mix continuously until fully dissolved.

3. **Heating:** Place the saucepan on medium heat (gas mark 4), stirring constantly to prevent sticking or burning. Continue until the mixture thickens and the wooden spoon is met by physical resistance.

4. **Casting:** Pour the solution onto the designated surface. Let the bioplastic solution dry and fully cure.

5. **Return to Heat:** Place tray of bioplastic into the oven, fan setting on, and temperature pre-heated to 100 degrees.

6. **Documentation**: At 12-minute intervals, open the oven door and record the wrinkling pattern photographically. Repeat until the desired finish is achieved or the bioplastic is beyond recovery.

EQUIPTMENT

- Agar
- Potato Starch
- Glycerol
- Vinegar
- Water
- Stove
- Saucepan
- Wooden Spoon
- Metal trays
- Natural Dyes
- Measuring spoons
- Bowls
- Stopwatch
- Camera

OBSERVATIONS AND CONCLUSIONS

Wrinkle Pattern Varied by Base: Different biopolymer bases (e.g. starch and agar) react differently to identical heat and airflow conditions, resulting in different patterns and curing times.

Point of no Return: Prolonged exposure to heat can cause the bioplastic to burn and revert to a semi-liquid state. In these cases, the bioplastic often does not dry and becomes unusable.

Most Suitable: Potato Starch was the most reactive to wrinkling in previous composition tests and remained highly responsive in this round, making it the most suitable base for achieving pronounced wrinkles..

Wrinkles Improve Strength: It was observed, particularly in potato starch samples, that increased wrinkling appeared to enhance the structural strength of the material without compromising its flexibility.

Reproducibility: Reproducing results on this scale is relatively easy, problems lie in the upscaling of this process, as the sampling is restricted to the size of the oven. Ideally I would need access to an industrial oven.

WRINKLE PROTOCOLS

SERIES OF TESTS


12 Minutes


24 Minutes


36 Minutes


48 Minutes


60 Minutes

REF 16

POTATO STARCH
B : 2/3G : 2/5 W :2/3V
15 : 10 : 40 : 10
Lawson's Cypress D1

Optimal patterning at 48 minutes in the oven at 100 degrees. The resulting sample dries to be matt. Beyond that, the bioplastic burns and reverts back to a liquid.


12 Minutes


24 Minutes


36 Minutes


48 Minutes


60 Minutes

REF 22

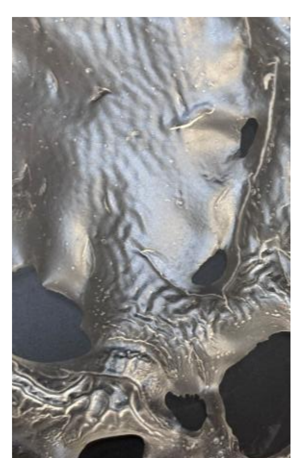
CORN STARCH
B : 2/3G : 14 W :2/3V
15 : 10 : 200 : 10
Silver Maple D1

Best results at 20 minutes in the oven at 100 degrees. Beyond which the bioplastic burns and glycerine is secreted, resulting in a bioplastic that does not dry.


12 Minutes


24 Minutes


36 Minutes


48 Minutes


55 Minutes

REF 10

POTATO STARCH
1/2B : 2/3G : 7 W :2/3V
7.5 : 10 : 100 : 10
No Colour

Slightly reduced the time to prevent burning and found 55 minutes produced a distortion that improved the strength of the material.

MUSCLE SHELL TREATMENT

MULTI-USE APPLICATION

The application of muscle shell powder offers several surface benefits, it can absorb moisture to create a matte finish, softening the material, be used to highlight textural relief and can be used in combination with watercolour pigment to achieve colour variation. Each of these applications parallels a process in leather treatment, the softening effect parallels leather tanning and staking processes, which alter the feel and flexibility of the material. Similarly, the addition of surface pigment mirrors recolouring treatments, not to be confused with redyeing, as redyeing permeates the material depth to change colour, not just the surface.

MATERIAL FEEL

HIGHLIGHT RELIEF

SURFACE COLOUR

EXAMPLE OF HIGHLIGHTED RELIEF

METHOD

1. **Muscle Shell Preparation:** Use a mortar and pestle to grind the muscle shells into a very fine pale blue powder. The finer the grind, the more evenly it will apply to a bioplastic surface.

2. **Material Feel:** To improve feel, apply a small amount of muscle shell powder directly to the surface to wick the moisture. Apply in small quantities and massage into the surface in circular motions. Avoid overapplication as excess powder may leave visible residue..

3. **Highlighting Relief:** To enhance raised surfaces, use a dusting brush or a brush with loosely packed bristles to pick up a small amount of powder. Lightly dust the surface, and the powder will naturally cling to the raised areas. Build up gradually until the desired coverage is achieved.

4. **Surface Colour:** To tint a surface, use a scalpel to scrape a small amount of pigment from dry water colour. Mix the pigment with the powder while dry and observe the colour transfer. Use a painting brush to control the application of colour and apply slight pressure to press the colour, this works like a dry-brush painting technique.

EQUIPTMENT

- Bioplastic Samples
- Muscle Shells
- Mortar and Pestle
- Watercolour pigments
- Scalpel
- Paintbrush
- Dusting brush

OBSERVATIONS AND CONCLUSIONS

Moisture absorption: Previous samples that retained a slight moisture and or gummy feel can be altered through the application of muscle shell powder. Gently massaging a small amount into the bioplastic surface produces a softer, matte finish, making the material better suited for on the body applications. The powder itself is colourless when massaged in, only removing the appearance of shine and so is difficult to capture photographically.

Impermanence: Beyond the use for changing the material feel, aesthetic treatments of muscle shell powder is largely impermanent. The powder sits on the surface for visible effect rather than being absorbed into the top layer, meaning that the effects can wear off with frequent handling. This poses a great challenge when pigment is added, as any colour rubbing off onto skin or clothing becomes an issue, especially in the context of an interactive exhibition.

Recolouring and Recolouring: One benefit of the impermanence is the ability to recolour the bioplastic multiple times. Pigments applied to the surface can be washed away, allowing for the sample to be dried and recoloured multiple times. This makes it a versatile surface for ongoing colour experimentation.

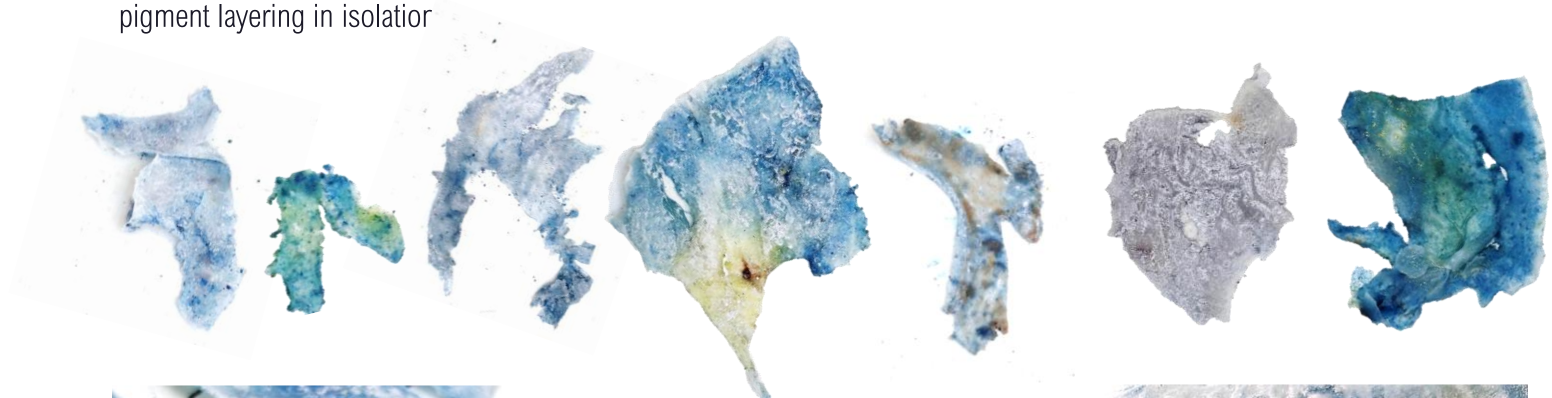
MUSCLE SHELL TREATMENT
RECOLOURING

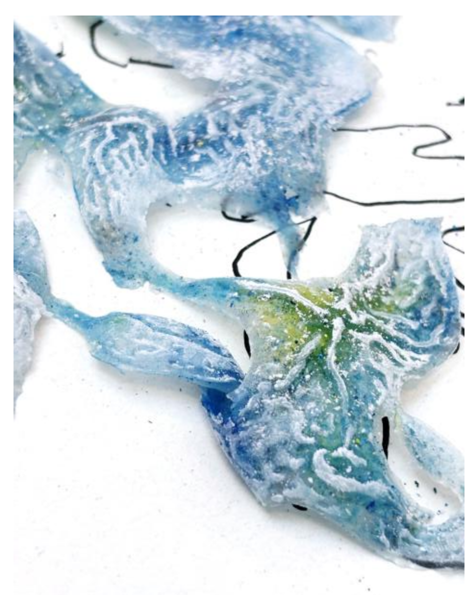
BEFORE

AFTER

Colouring can drastically influence material perception. This is particularly evident in the recolouring of Ref 23, from brown to blue. The new colouring highlighted the texture of the biomass whilst completely transforming the visual impact.

The first trial using muscle shell powder combined with pigment showed promising control over colour placement and gradation. However a key issue emerged as colours began to turn muddy, particularly where darker colours were layered, it seemed apparent that it was caused by the layering of colours. In response I washed the colour off of the bioplastic surface, returning it to a clear sample. This also led to a series of small tests with smaller offcuts of the same composition to trial pigment layering in isolatior





Recolouring Progress – The recoloured sample is much more successful in terms of colour layering, following the testing. Whilst deliberate placement and gradation is possible, blending pigments to create intermediary tones remains challenging. It requires time-consuming layering. ideally, developing custom colour dry pigment would allow for better control over tone and coherence to the colour palette.

IMAGE TRANSFER ANTHOTYPES AND IMAGE TRASNFER

PAPER AND BIOPLASTIC SURFACES

Anthotype Exploration and Trompe L'oeil Application- An anthotype is a photographic image created using photosensitive pigments that fade when exposed to sunlight. The process involves applying a positive image to a surface treated with an emulsion, when exposed to UV light, the unprotected areas are bleached while the covered areas retain the original pigment. In this project, this technique is explored as a method for achieving a trompe l'oeil effect. Patterns were developed from earlier visual research and applied using posca pens onto Codatrace to act as a screen for exposure. The goal is to investigate whether this process is transferrable to bioplastic applications. This could provide a low-impact image transfer technique if successful without compromising the biodegradability of bioplastics.

METHOD

1. **Pigment Preparation:** Add a teaspoon of turmeric into a bowl and mix with 4 - 6 teaspoons of vodka (or ethanol). The curcumin pigment in turmeric dissolves in the alcohol so, ensure to mix thoroughly. Filter out excess using filter paper and pour liquid into another container.

2. **Application:** Using a brush apply the filtered dye to the chosen surface (bioplastic or paper). Allow the layer to dry away from light and repeat the layering process until the coating is even and opaque.

3. **Printing:** Once dry place the surface down in direct sunlight and position an object or image on Codatrace on top.. Apply weights like a sheet of glass or using stones to apply pressure and limit movement. Leave in high UV for several hours, time will vary depending on sun intensity.

4. **Developing:** Once the colour has lightened remove the object or print. Mix two teaspoons of baking soda into half a cup of warm water. Coat the surface in this solution and leave to dry in a dark area.

EQUIPTMENT

- Turmeric
- Vodka
- Codatrace
- Water
- Bowl
- Baking Soda
- Posca
- Weights (stones)
- Teaspoon
- Paintbrush
- Filter paper
- Funnel

OBSERVATIONS AND CONCLUSIONS

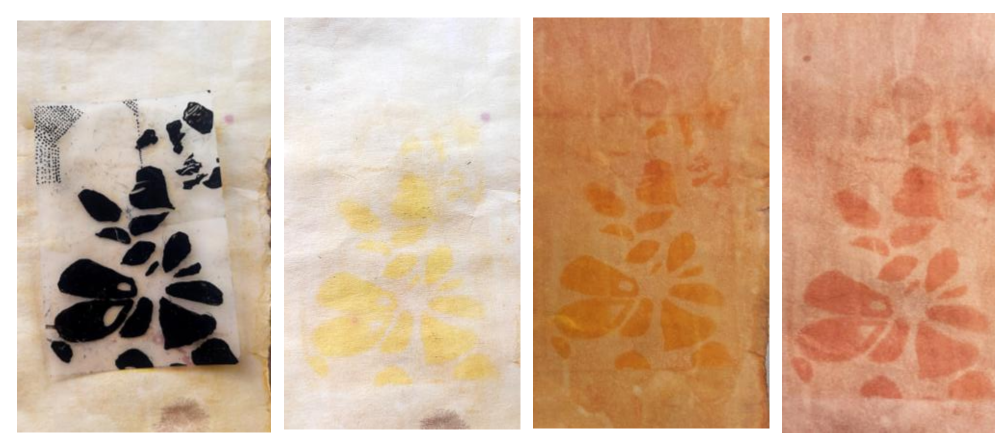
Objects VS Prints: Both options proved effective for creating anthotype imaging. Using Posca pen on Codatrace gave greater creative control, allowing for patterns to be developed in line with the visual language.

On Bioplastic: When applied to bioplastic, the process yielded faint results, visible only under direct lighting. While this shows potential, the outcome would not be distinguishable in an exhibition context especially when being viewed from afar or intended printing of rubbing to imitate denim texture.

Sunlight Exposure: For the best results, samples must be placed in direct sunlight. The approach of attaching samples against a window, proven ineffective , despite shielding from rain, the reduced UV exposure limits the development of the print itself.

INITIAL TESTING ON PAPER

Tests were carried out using turmeric and indigo based emulsions, both photosensitive pigments. Two blocking methods were trialled, the Codatrace used as screens and the use of physical objects. Findings proved that turmeric developed well and produced clear image under UV exposure, whilst indigo experienced no change, suggesting it may need a longer exposure time or is simply not suited to this method.



POST PROCESSING WITH BAKING SODA SOLUTION

The baking soda emulsion was applied to the turmeric-exposed anthotype and significantly enhanced the image clarity. A colour change was also observed from yellow to a burnt orange. One mdrawback remains however as the surface remains photosensitive after developing, so continued exposure to sunlight would cause the imagery to fade and gradually disappear. To preserve the print a coating such as beeswax may help maintain the imagery.

PROGRESSED ANTHOTYPING
ON BIOPLASTICS

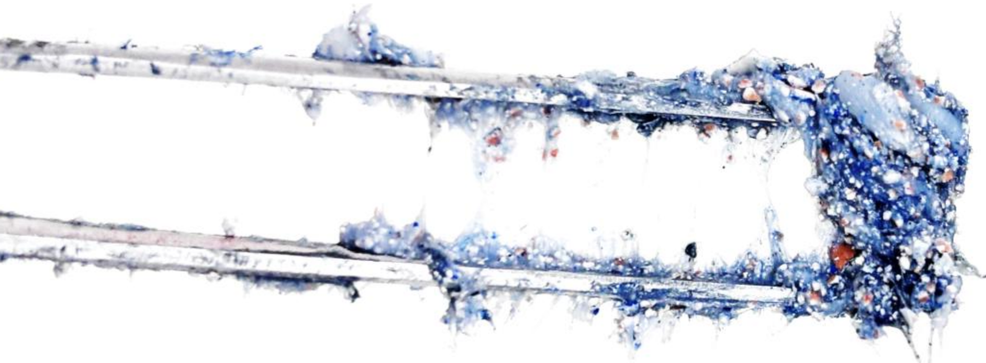
TRIAL – PIGMENT INTEGRATED INTO BIOPLASTIC COMPOSITION

This iteration of anthotyping involved incorporating the photosensitive pigment (in this case bilberry dye) directly into the bioplastic composition instead of applying the emulsion post curing. The aim was to produce a more uniformly opaque surface to achieve a greater contrast in imaging. The outlined method was followed resulting in a bioplastic with minimal colour variations, only visible with backlighting, the bioplastic feel retained moisture and stuck to the Codatrace proving removal to be difficult and resulting in tearing. Future iterations could trial different base compositions to see which may be more suited to this process if any.

TRIAL – MULTI-LAYERING TUMERIC EMULSION

This attempt involved applying 15 layers of turmeric-based emulsion onto the bioplastic surface to increase opacity and improve the visibility of the resulting image. These additional coatings improved the opacity of the bioplastic in general allowing for a greater appreciation of the surface quality. After sun exposure and processing with a baking soda solution the added layers didn't show discernible change. The image remained faint and didn't undergo any observational colour change (as experienced by the paper trial).

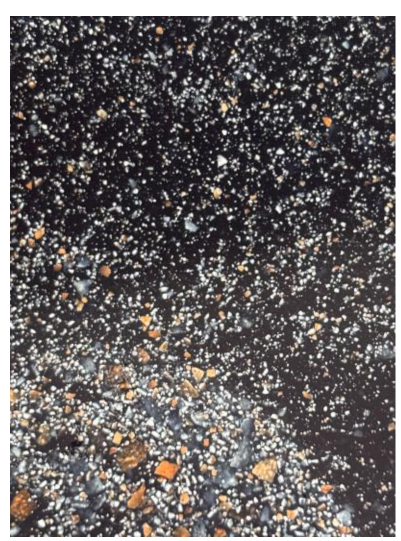
GRAIN DIRECTIONAL



Reheating and recasting scraps of agar based bioplastic to test grain distribution and the different approaches to creating both a uniform speckled appearance and a gradient. Finely ground eggshell was used in order to achieve this effect. It is important to note that eggshell sinks to the bottom of the composition if the solution is not constantly stirred, this could be an intentional design choice to create two distinct surface finishes.

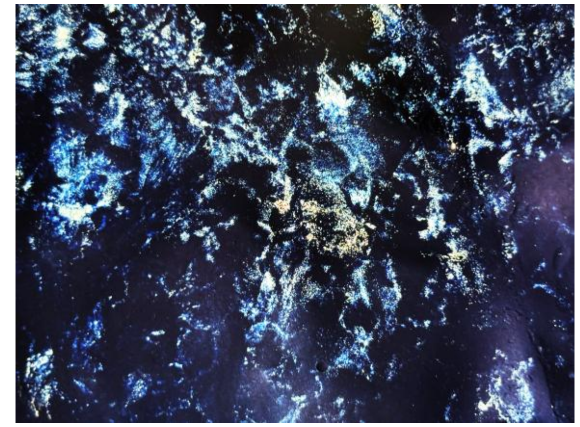




EMULSIONS AS COATINGS

Despite the minimal effectiveness of anthotype emulsions for printing images, the emulsions do improve the opacity of the bioplastic and even present design possibilities with uneven applications. The emulsions can also be used to highlight relief in the same manner that the muscle shell powder was used previously.





POTENTIAL APPLICATIONS:

-Full Opaque Coating
-Highlighting Relief
-Patterning with uneven distribution
-Direct Painting application
-Layering

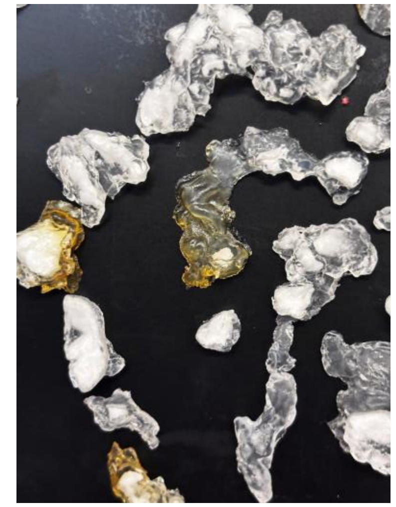
EMBELLISHMENT

PLANNING AND PATTERNING

REF 5 EMBELLISHED WITH REF 12
USING A SEWING MACHIENE

CLOSE -UP



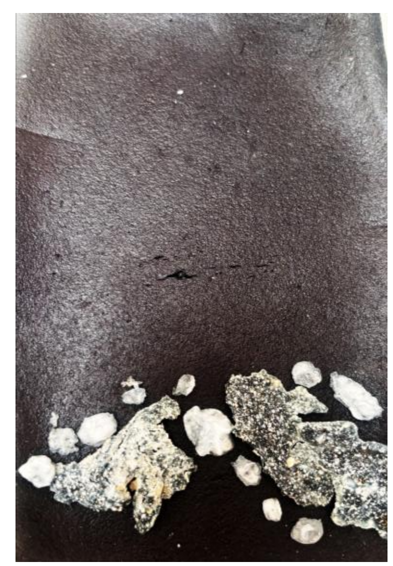


After identifying that REF 12 had potential for an embellishment application, I conducted a small sewing test, attaching the fragments to bioplastic Ref 5. As the sewing process encountered minimal tears and showed promise, I began to create different patterns with these fragments mirroring the fragmented sketches conducted previously. Fragments that had undergone oven drying had experienced yellowing, a feature that introduces an element of colour variation. I decided to carry out the same composition but added natural dyes to the solution before adding the starch to gelatanise, providing more options of colour variation.









With the additional colours now provided I tested additional pattern options on coloured bioplastic bases and began to incorporate fragments of previously cracked samples to offer them a second opportunity in design..

OUTCOMES

FINALS PLANNING AND DEVELOPMENT

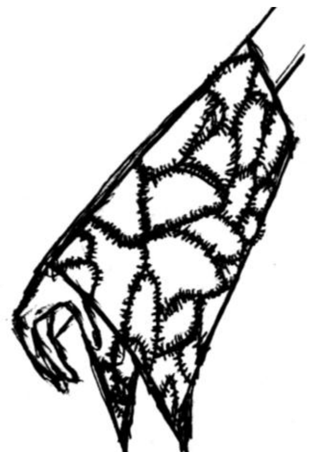
FINALS SKETCHES - SLEEVES

USING SAMPLING AS INSPIRATION FOR DESIGN APPLICATION

ANTHOTYPE

TIN MOULD

TINFOIL



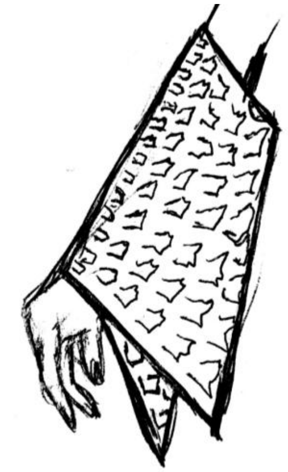
PATCHWORK

EMBELLISHED

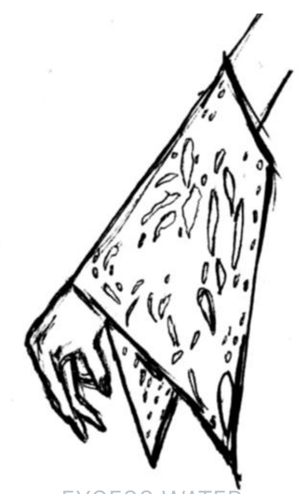
HEAVY WRINKLE

LIGHT WRINKLE

CRACKED - SALT



EMBELLISHMENT



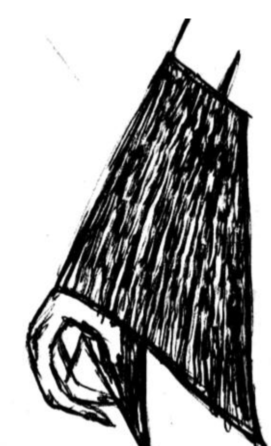
EXCESS WATER PERFORATIONS

HAND MANIPULATED REF 9

HAND MANIPULATED REF 1

WARPED

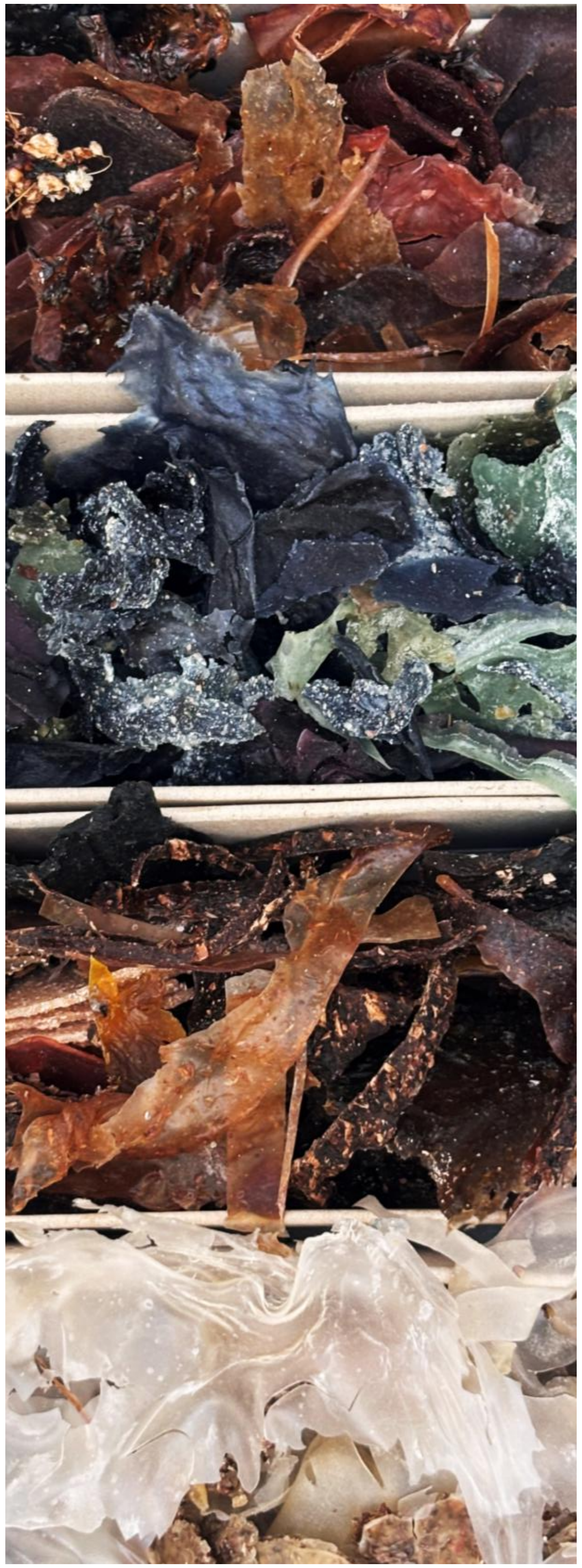
EGGSHELL GRAIN



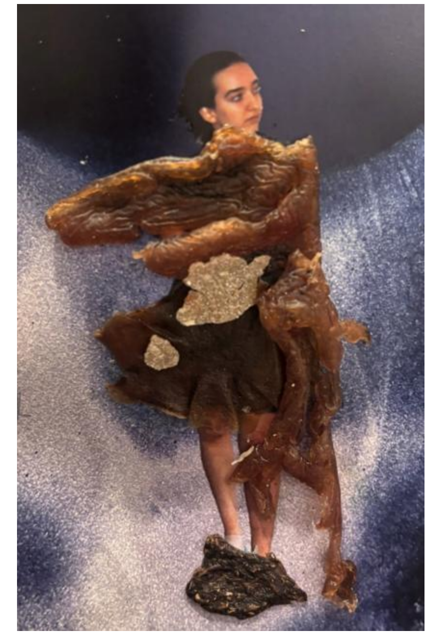
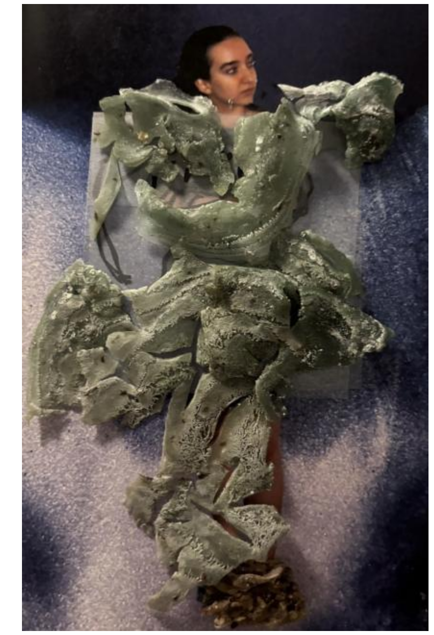
BIOMASS

FINALS SKETCHES – LOOKBOOK

TRIALLING DIFFERENT LOOK BOOK COMBINATIONS

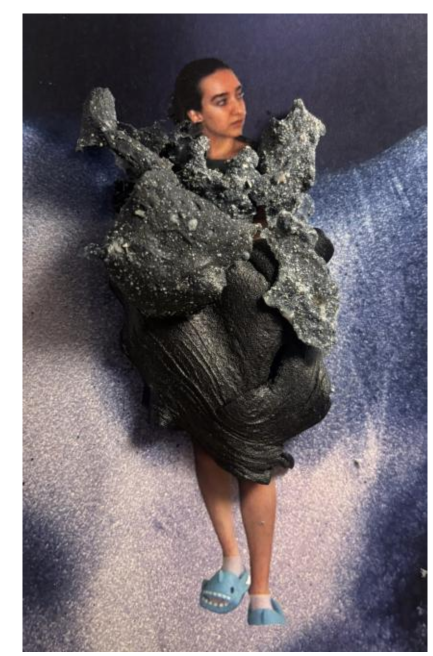


BIOPLASTIC OFFCUT COLLECTION





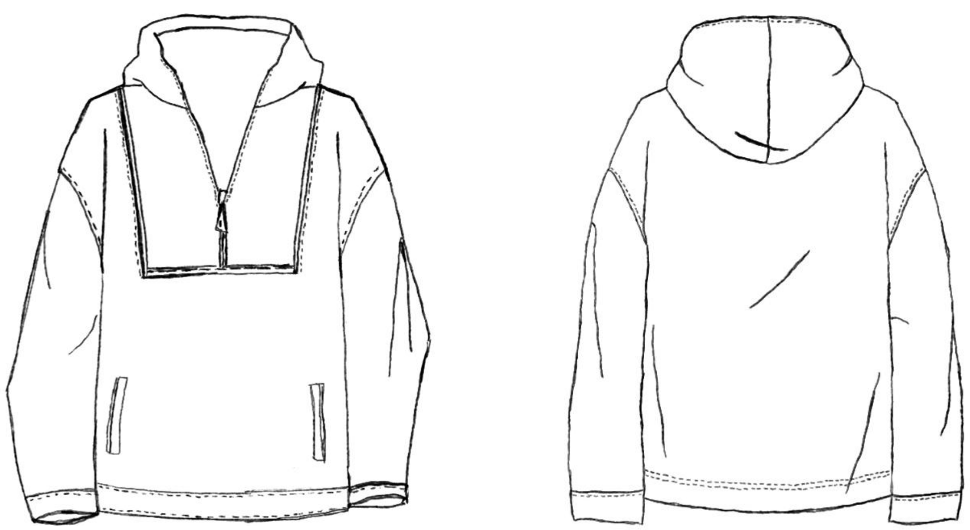


FINALS SKETCHES – JACKET

COMBINING SHILOUETTES

SKETCHING DIFFERENT JACKET SHILOUTTES

Sketches incorporate different elements from leather jacket, denim jackets. Playing with proportion, collars, lapels, pockets and panelling. Hoods developed as an extension of the collar, immersing the wearer further and playing with that notion of kids being in oversized clothing.



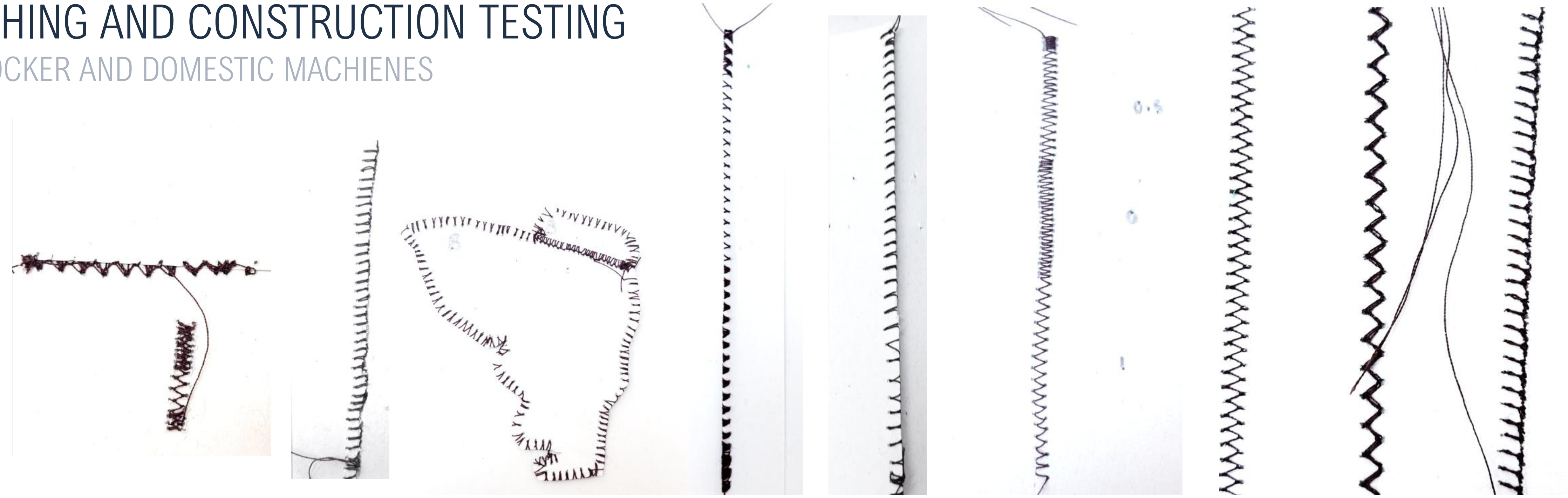
FRONT AND BACK

This design was chosen because it has elements that are referential to denim and leather jackets but also has an aesthetic of it's own and can stand on it's own design wise, beyond a imitation. The stitching is highlighted here as possible areas for contrast stictching to again reference denim practices but final placement is dependent on the construction of the garment and ease of application.

JACKET SKETCH

STITCHING AND CONSTRUCTION TESTING

OVERLOCKER AND DOMESTIC MACHIENES



Initial construction testing was carried out using paper on the domestic machine in order to test a range of joining techniques and stitching types. These served as a reference point before sewing on bioplastic counterpart. Paper was chosen as the test material as it easily tears and would behaviour similarly to bioplastic if caught.

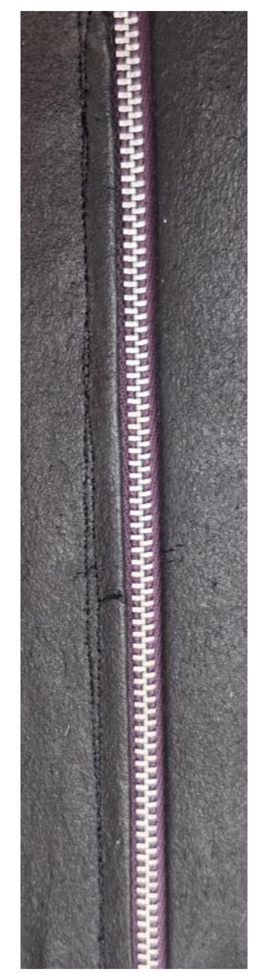
OBSERVATIONS AND CONCLUSIONS

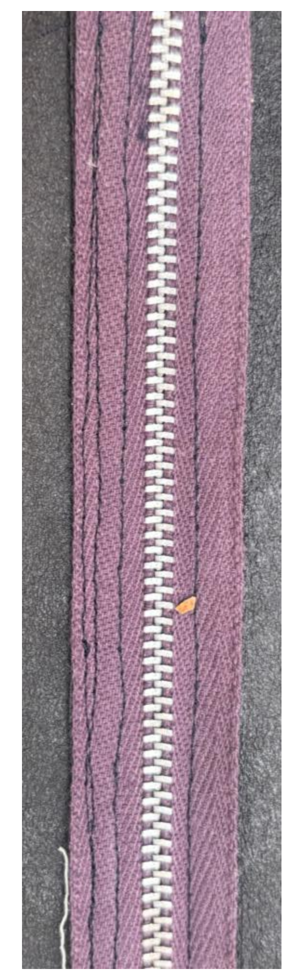
Zigzag Stitching Reminiscent of Leather: The reinforced nature of the zigzag stitching made for more robust joining of paper and bioplastics. It also mimics the heavy thread stitching of leather pieces, another ode to leather as a case study.

Right Sides Together: Joining right sides and leaving a seam allowance of half a centimetre proved most effective for creating discreet joins, where the stitching is only visible on the inside.

Zip Insertion: When attaching the zip the bioplastic has a tendency to move sideways when sewing. A slower speed and additional guidance of the bioplastic under the foot would help achieve cleaner lines.

Top Stitching: The tendency for the bioplastic to slip under the foot continues when topstitching. Found it was easier to apply weight to the folded bioplastic for a few hours to create a crease to sew on top of.





INFRASTUCTURE FOR UPSACLING

PLANNING

To accommodate the shrinkage that occurs during bioplastic curing, samples were measured against their original mould dimensions. Results showed an average shrinkage rate between 20% and 40%, requiring scale adjustments of X1.2 to X1.4 depending on the biopolymer, starch (S) and agar (A). These shrinkage ratios inform the minimum sizes of the infrastructure for jacket and sleeve outcomes. The largest pattern piece of the jacket was used as a benchmark and ensures fit of all subsequent pieces.

SAMPLE	BASE (A/S)	LENGTH (CM) Wet/Dry	WIDTH (CM) Wet/Dry	DIFFERNCE (%)
1	S	29.7 | 22.6	21.0 | 16.0	0.24
2	S	29.7 | 24.4	21.0 | 17.2	0.18
3	S	29.7 | 25.0	21.0 | 17.6	0.16
4	S	21.0 | 17.0	14.8 | 12.0	0.19
5	A	29.7 | 18.4	21.0 | 13.0	0.38
6	A	29.7 | 17.5	21.0 | 12.4	0.41
7	A	21.0 | 12.0	14.8 | 8.4	0.43
8	A	21.0 | 13.2	14.8 | 9.3	0.37

TAKING SHRINKAGE INTO ACCOUNT

Shrinkage is calculated from the size difference from the original sample moulds and is worked out as a ratio. The ratio is converted into a multiplier. E.g. average shrinkage for starch base is 20%, converted into a multiplier of 1.2, and agar base is 40% converted into a multiplier of 1.4, so that the fames can allow for that extra 20% shrinkage.

SLEEVES

A3 Measurements (Rounded to the nearest cm): 42cm X 30cm
Starches Ratio : A3, 1.2 : 1 | 42 X 1.2 = 50.4cm | 30 X 1.2 = 36cm
Agar Ratio : A3, 1.4 : 1 | 42 X 1.4 = 58.8cm | 30 X 1.4 = 42cm
Final measurements, Starch 50cm X 36cm, Agar 59cm x 42cm

JACKET

Biggest pattern piece (Minimum bioplastic size) 99.4cm X 54.4cm
Agar Ratio : Minimum, 1.4 :1 | 71 X 1.4 = 99.4cm | 54.4 X 1.4 = 72.6cm
Final measurements, 99.4 cm X 55.4 cm

APPROACH

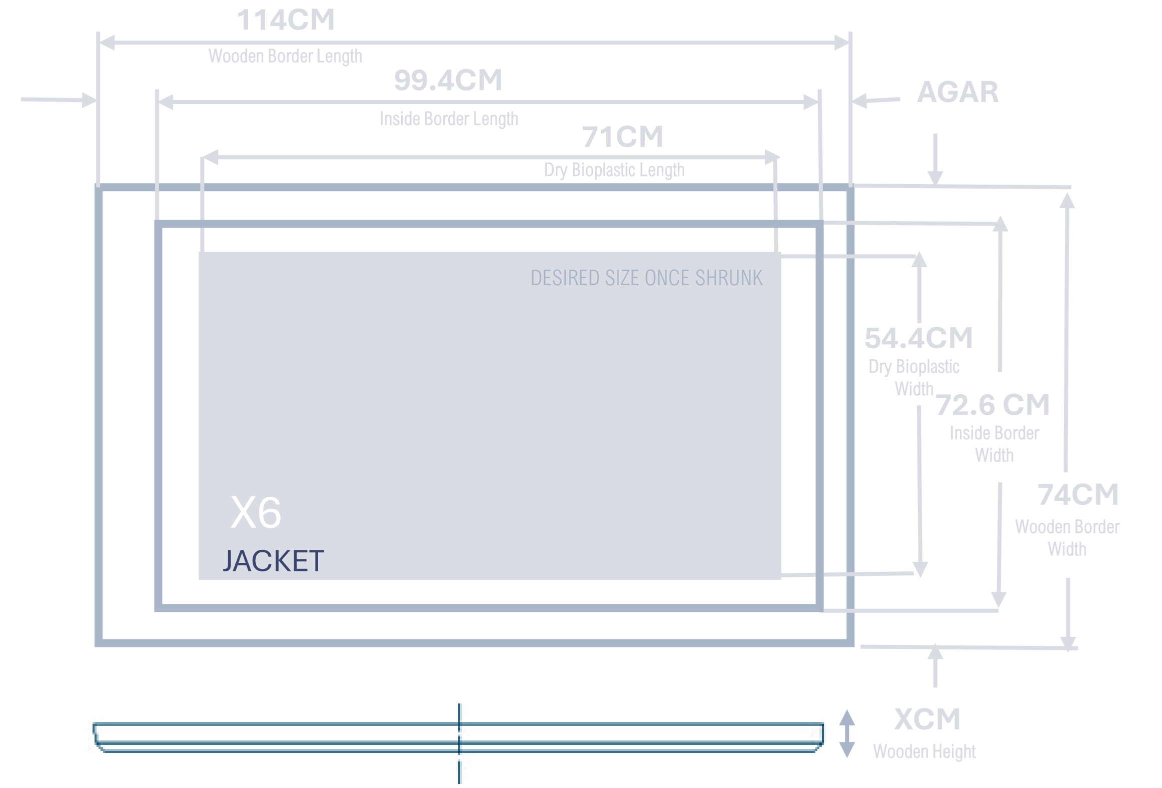
Framing and Moulding Methods Explored

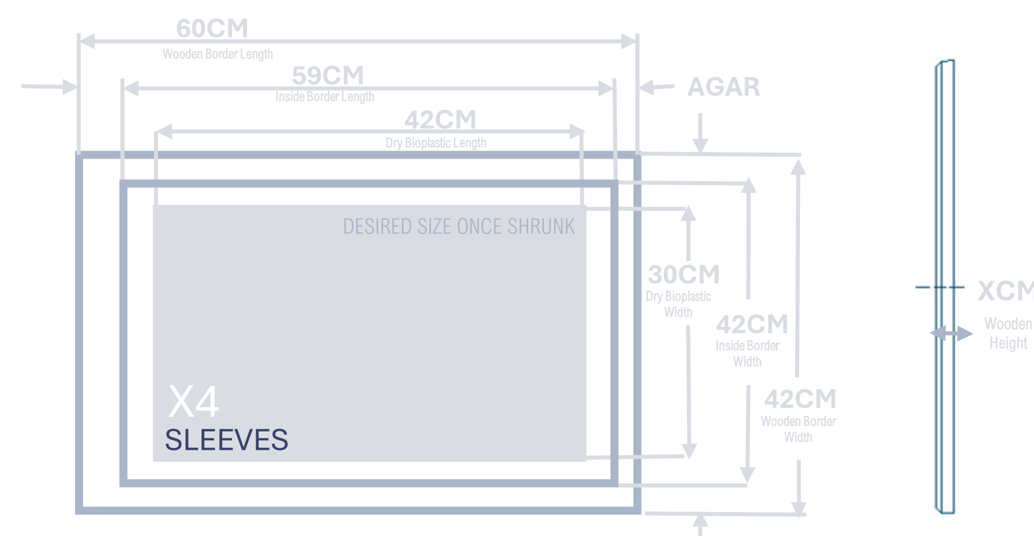
Fine art canvas making was considered for its custom sizing potential. However, it was ruled out due to the time and cost involved, as well as limited reusability. After consulting Priscilla, the untreated wood absorbs moisture released during curing, risking distortion and breakage of the frames. While treating the wood was an option, it conflicted with the project's low-impact efforts/

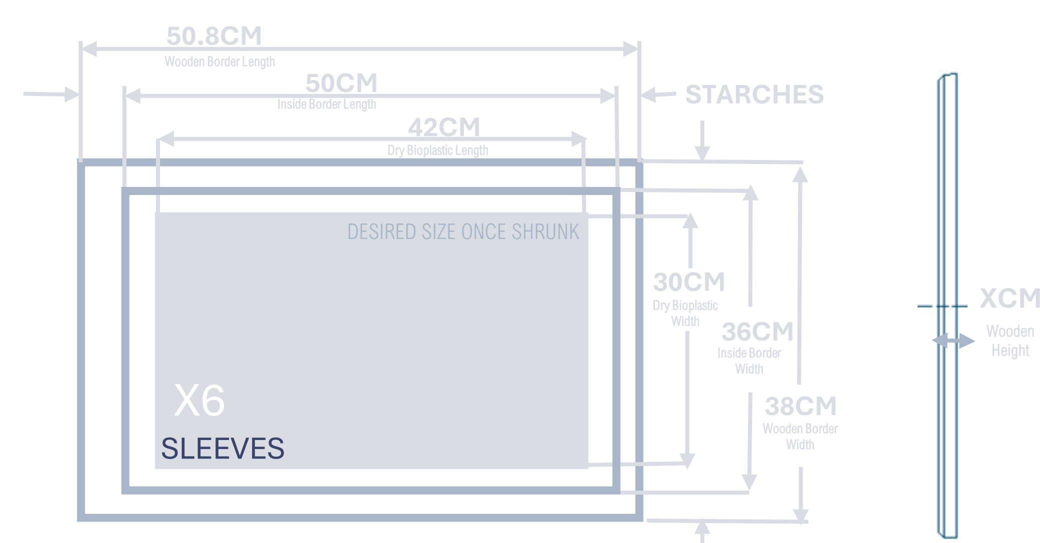
Vacuum forming was also considered. I consulted Darren and found that the vac forming is restricted to A3 size, and whilst my sleeves will dry to A3, the intended frames need to be bigger to account for the shrinkage. Moreover, the thin plastic sheets would deform under the heat of bioplastic when poured, leading to potential leakages and uneven surfaces, making this method unsuitable.

Turned to using existing hardware surfaces that prioiritise reusability. Dog kenneling trays were chosen for the larger agar samples and catering trays for smaller starch and agar samples. These options aligned with the project's scale requirements and sustainable approach, ensuring structural fit.

Agar Finals	Number of Sheets	Total Area (cm^2)	Agar (g)	Glycerine (ml)	Water (ml)
Jacket	6	23,174	1122	1392	11220
Sleeves	4	5.040	240	160	2400







UPSCALING AGAR

Size (cm)	Area (cm^2)	Agar (g)	Glycerine (ml)	Water (ml)
Sample 28 (X X Y)	X	12	8	120
A4 (x X y)	X	30	20	300
A3 (42 X 32)	1260	60	40	600
A2 (X X Y)	2478	120	80	1200
Dried Bioplastic (71 X 54.4)	3,862.4	187	232	1870

Table of Measurements and corresponding quantities

WATER PROPORTION
A2 Area = 1200ml Water
2478 cm^2 = 1200ml Water
(Divide both sides by 1200)
2.1 cm^2 = 1ml Water
1ml Water per 2.1 cm^2

Dried Sheet Area / 2.1 cm^2 = Water
3862.4 cm^2 / 2.1 cm^2 = 1839ml
Rounded to 1870ml Water

AGAR PROPORTION
A2 Area = 120g Agar
2478 cm^2 = 120g Agar
(Divide both sides by 120)
20.7 cm^2 = 1g Agar
1g Agar per 20.7 cm^2

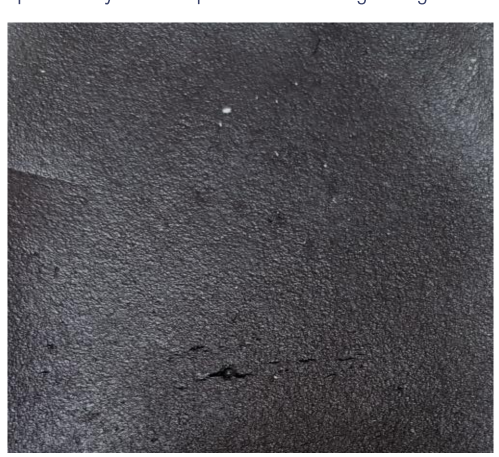
Dried Sheet Area / 20.7 cm^2 = Agar
3862.4 cm^2 / 20.7 cm^2 = 186.6g
Rounded to 187g Agar

GLYCERINE PROPORTION
A2 Area = 80ml Glycerine
2478 cm^2 = 80ml Glycerine
(Divide both sides by 80)
31.0 cm^2 = 1ml Glycerine
1ml Glycerine per 31 cm^2

Dried Sheet Area / 31 = Glycerine
3862.4 / 31 = 124.6ml
Rounded to 125ml

SCALING FOR SHRINKAGE AND SHEET PRODUCTION

Size refers to the final dimensions of the bioplastic once fully cured. To ensure accurate fitting of pattern pieces, I measured the intended dimensions of each pattern piece and applied a multiplier of 1.4 to account for expected shrinkage during drying. This ensures that the initial bioplastic pour (defined by the inned border) fits within the surface side (the outer border). Quantities calculated from A3 scale trials were scaled up proportionally for the production of larger aagar bioplastic sheets.



Pattern Pieces

PATTERN CUTTING AND ADJUSTMENTS

Using Butterick Pattern No. 5621 – Top C as a base, I selected six key pieces: front and back panels (cut on the fold), sleeves (cut twice) and the hood(cut twice), resulting in six sheets for the final garment.

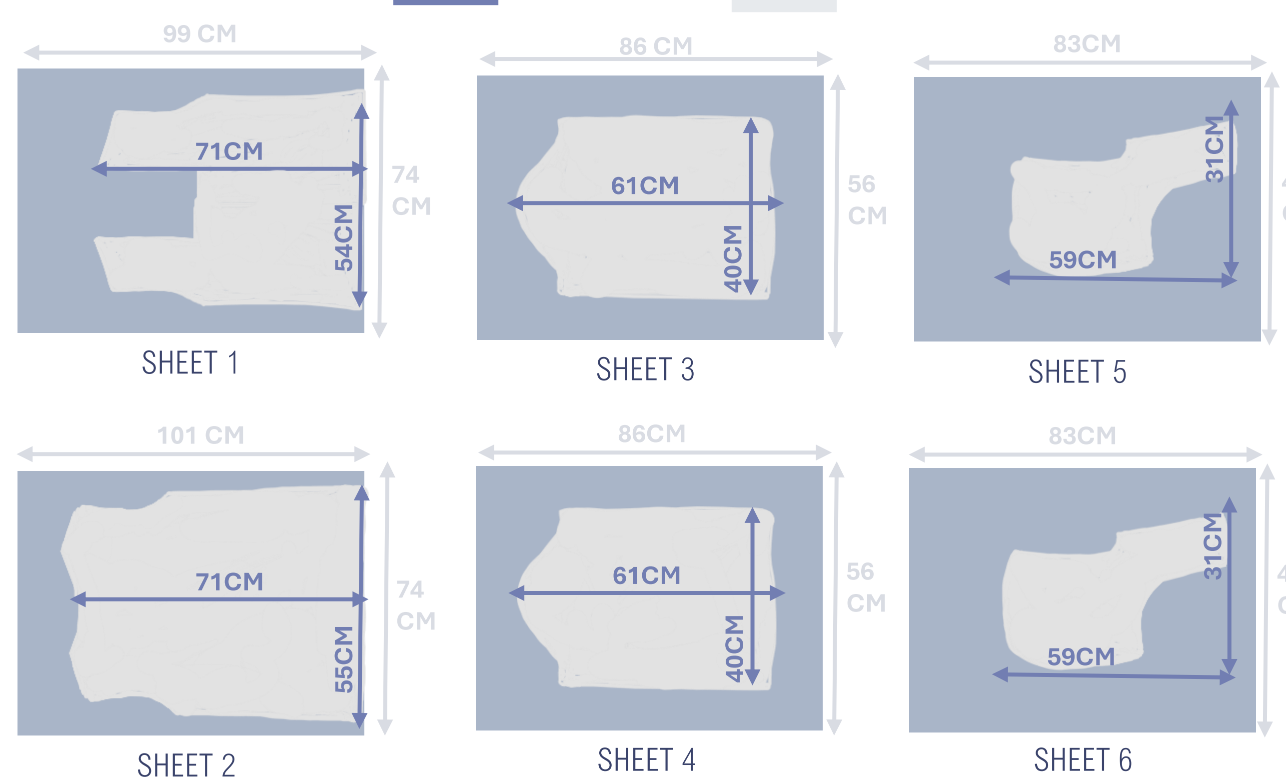
To better align with my own design sketch, I modified the original pattern by removing the elastic elements at the hood opening, sleeve cuffs and garment base, allowing the bioplastics inherent weight difference drape the final shilouette. These alterations also ensured better material performance and avoided unnecessary structural stress points

Agar Finals	Number of Sheets	Total Area (cm^2)	Agar (g)	Glycerine (ml)	Water (ml)
Jacket	6	23,174	1122	1392	11220
Sleeves	4	5.040	240	160	2400

JACKET LAYPLAN

Pattern Size

Pattern Size X 1.4



FINALS PLANNING

OUTCOME	STATUS	BIOPOLYMER	COMPOSITION	COLOUR	ACCENT COLOURS	PRE/POST CURING	KEY PROCESS
1, 'Deather' (reversible denim/ leather)	DONE	Agar	REF 43			PRE	Grain Gradient with Eggshells
2. 'Cracked"	DONE	Cornstarch	REF 20			PRE	Calcification Repeat Mold
3. 'Perforated'	FAILED	Potato Starch	REF 3			POST	Perforations and Softening
4. 'Wrinkled'	CRACKED	Agar	REF 40			PRE + POST	Tin Mold and Brushing Raised edges
5. 'Warped'	FAILED	Potato Starch	REF 1			PRE	Heat Distortion
6. 'Embellished'	COMPLETE	Potato Starch	REF 12			PRE + POST	Machine Sewing
7. 'Membrane'	FAILED	Potato Starch	REF 10			PRE +POST	Heat Distortion Powder Colour Application
8. 'Lenim'	DRYING	Agar	REF 45			PRE	Egg Shells Heat Distortion
9. 'Warped'	DONE	Potato Starch	REF 5			POST	Opaque Emulsion Coating
10. 'Faux Distress'	DONE	Agar	REF 17			PRE	Hand Painting with Emulsion
11. 'Jacket'	DONE	Agar	REF 49			PRE + POST	Construction

TIMELINE

- Pour 11
- Prepare pre-treatments
- Pour Starch Based
- Prepare pre-treatments
- Pour Agar Based
- Jacket Construction
- Perform post-treatments
- Photography

FINISHES

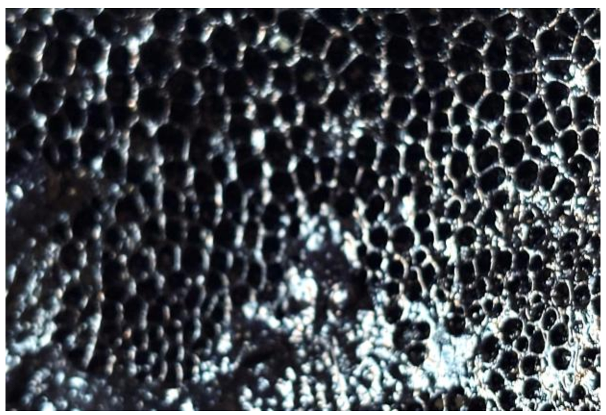
FOR JACKET – REF 49

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.

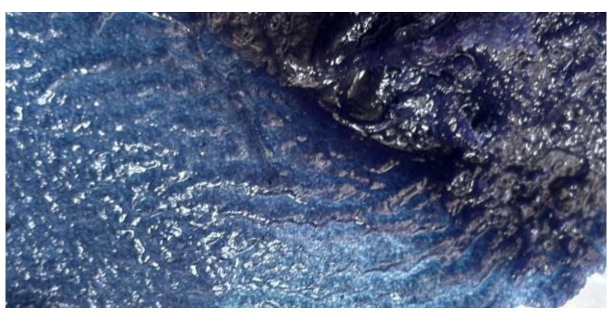
B : 2/3G : 10W
12 : 8 : 120

REF NUMBER: 61
ADJUSTMENT: Thinner pour on 3d relief
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

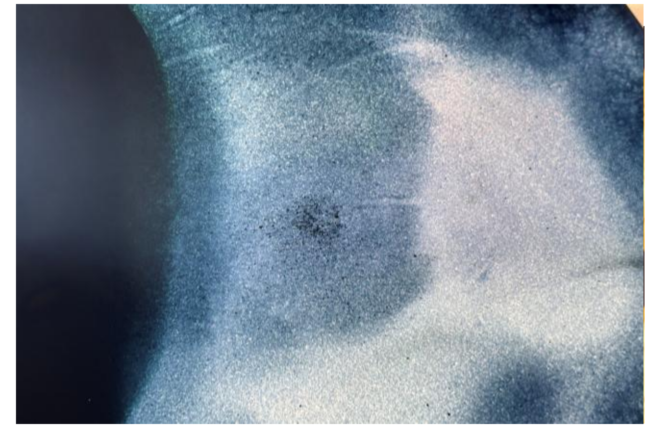
REF NUMBER: 63
ADJUSTMENT: Reduced agar content.
KEY OBSERVATIONS: Minimal change in behaviour, thinner and more easily susceptible to heat distortion.

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.

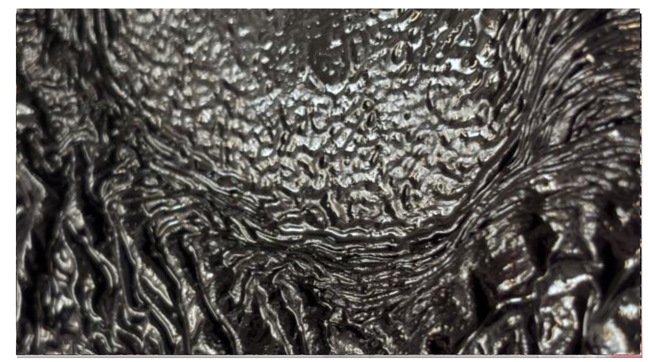


B : 2/3G : 10W
48 : 32 : 480

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.

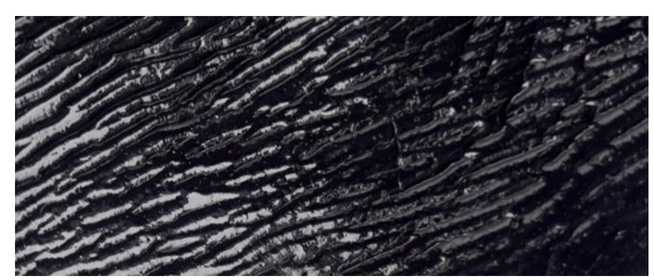


B : 2/3G : 10W
12 : 8 : 120

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.



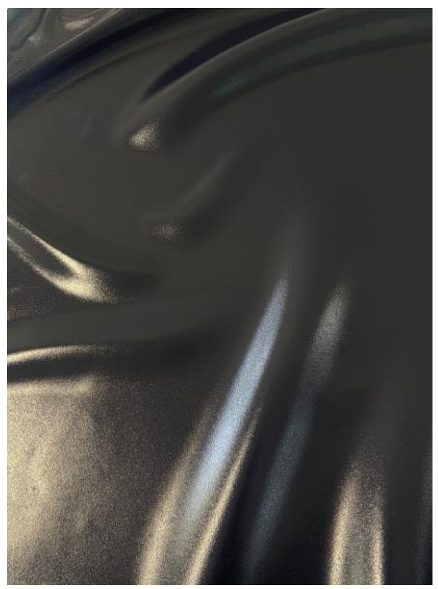
B : 2/3G : 10W
12 : 8 : 140

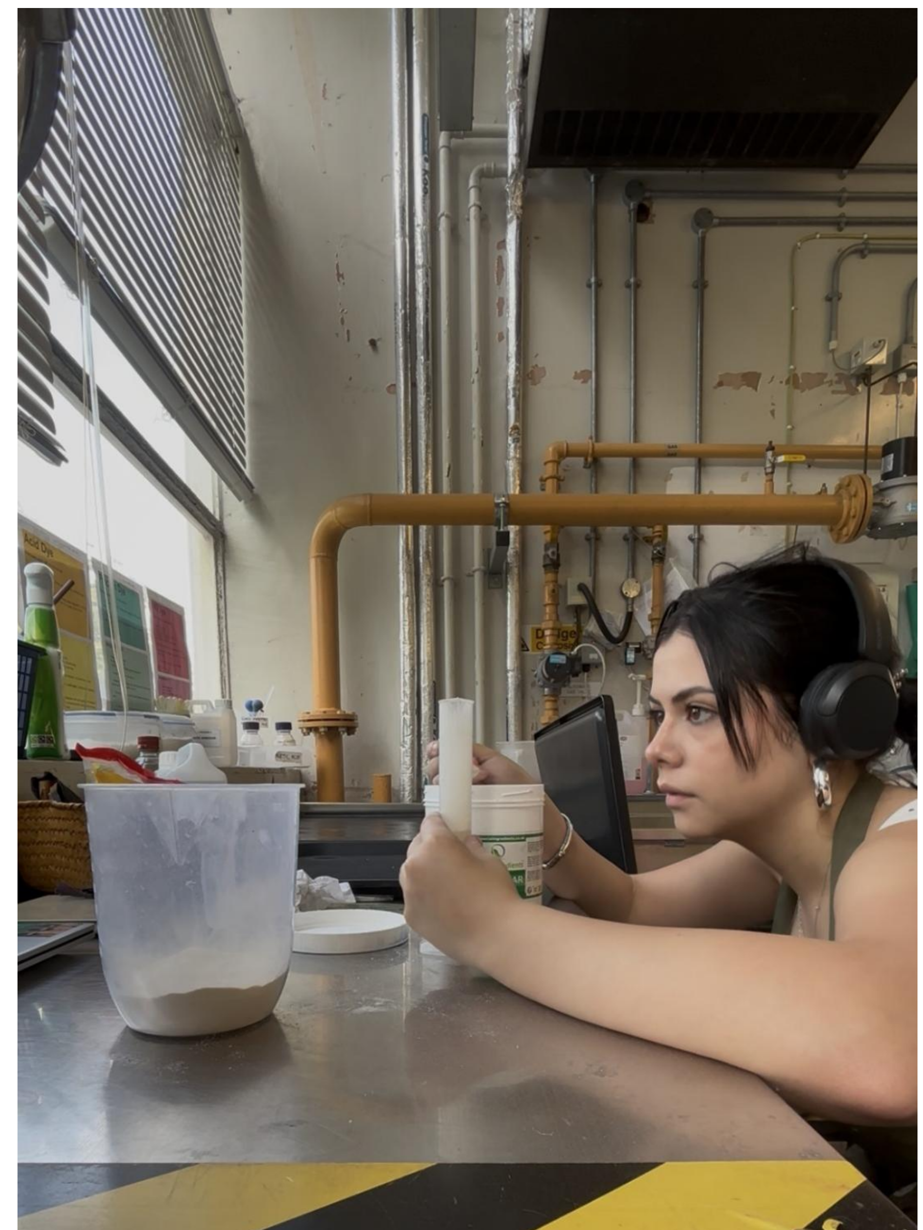
REF NUMBER: 70
ADJUSTMENT: Increased water content
KEY OBSERVATIONS: Trialling the same method as REF 69 with a more rubbery solution.

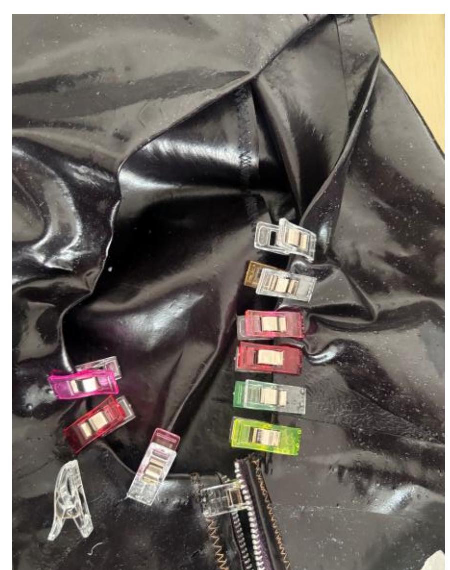
B : 2/3G : 10W
12 : 8 : 120

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.

JACKET PROCESSES



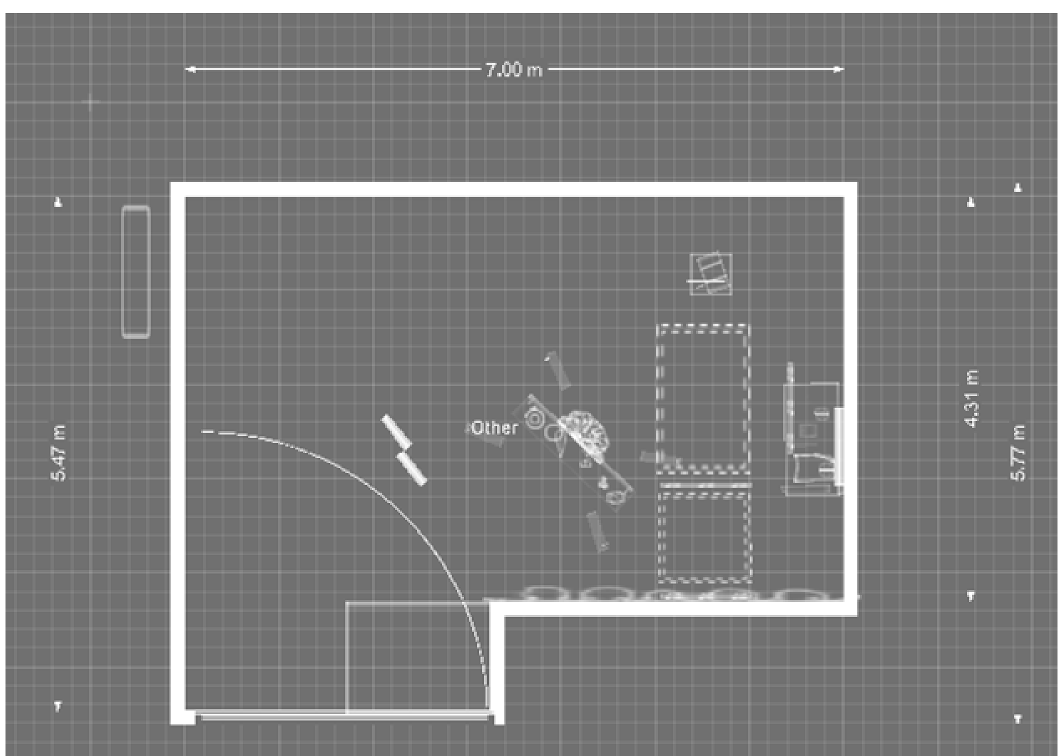




DEGREE SHOW PLANNING

3D MODELLING THE SPACE

Degree show layout based on entry, there is a slight turn to the right so everything is to be positioned on the diagonal otherwise it faces the sink.



MATERIAL REHABILITATION

WELCOME TO THE MATERIAL RECOVERY PROGRAMME

I'm staging an intervention.

Material Rehabilitation challenges what we consider to be viable fashion materials. Current materials, both natural and synthetic, have been heavily documented in regards to waterway pollution. These findings raise crucial questions about what properties we should be imbuing in our materials and advocates for the reassessment of longstanding material choices. There is a clear consensus that for the prioritisation of biodegradability and this shift has sparked growing interest in bioplastics as a potential solution.

This project consciously designs with bioplastics in aims to better improve receptiveness of bioplastics beyond a novelty and start the conversation around consciously designing. Stop and think about how you want your materials to behave?

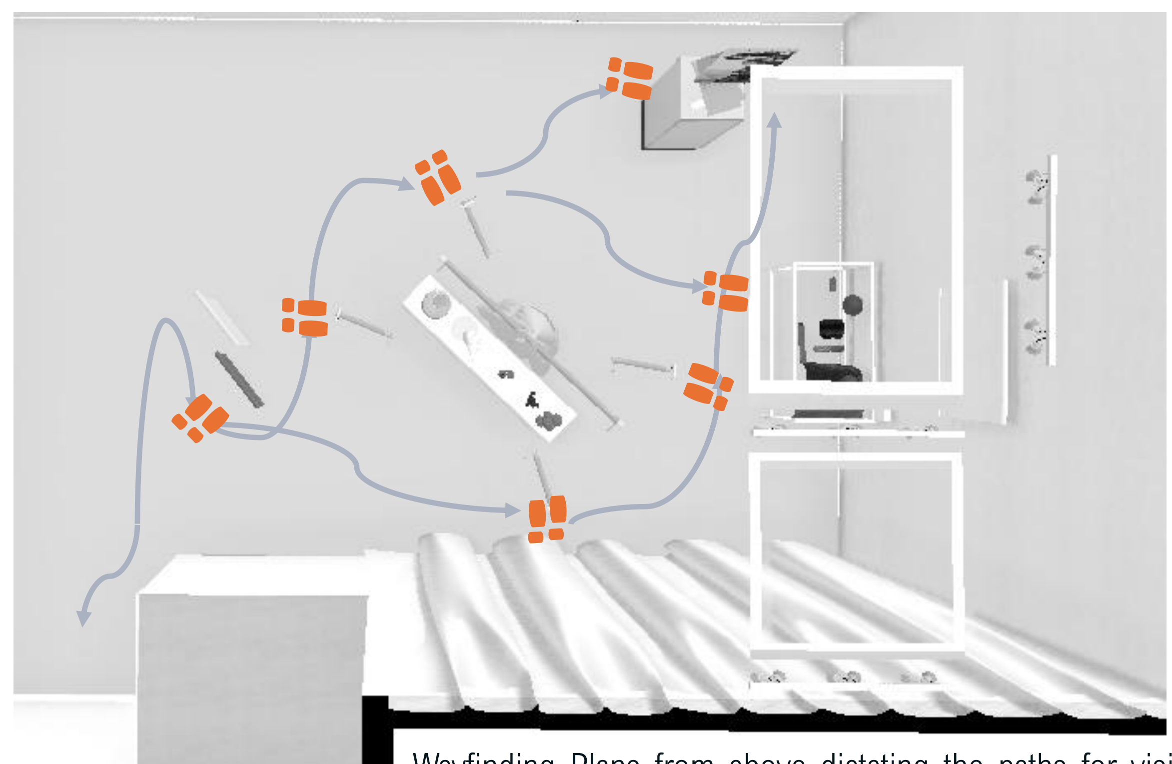
This work is underpinned by research into popular materials, Denim and Leather, investigating factors that have attributed to their popularity and apply transferrable principles such as: physical properties, processes and aesthetics, to inform bioplastic development. Familiarity is used as a design tool, the recognizability and rich heritage allows for playful subversion and presents bioplastics as not entirely new.

Here is your invitation to rethink and experience different material possibilities. Discover favourite denim and leather jackets reinterpreted, try on bioplastic sleeves, feel free to FEEL.

Important to note that not all bioplastics are biodegradable but all these bioplastics are

MARIA VARNEY

SIGNAGE FOR THE EXHIBTION



Wayfinding Plans from above dictating the paths for visitors to each touchpoint indicated by the vinyl footprints on the floor, signifying an area of interaction.

1. DEATHER

REVERSIBLE DENIM LEATHER
AGAR

Dimensions
H: 38.0 cm
W: 26.0 cm
D:1.5.0 cm

Completion: 9 Days

2. CRACKED

LEATHER LIKE FINISHING
CORNSTARCH

Dimensions
H: 42.0 cm
W: 29.0 cm
D: 0.5 cm

Completion: 18 Days

3. EMBELLISHED

DECORATIVE
AGAR

Dimensions
H: 36.0 cm
W: 25.0 cm
D: 1.2 cm

Completion: 15 Days

4. WARPED

LEATHER LIKE FINISHING
POTATO STARCH

Dimensions
H: 35.0 cm
W: 25.0 cm
D: 1.0 cm

Completion: 9 Days

5. FAUX DISTRESS

DENIM LIKE FINISHING
POTATO STARCH

Dimensions
H: 40.0 cm
W: 26.0 cm
D: 1.0 cm

Completion: 9 Days

6. I CAN'T BELIEVE IT'S NOT LEATHER

JACKET
AGAR

Dimensions
H: 75.0 cm
W: 58.0 cm
D: 4.0 cm

UK SIZE 8 WOMENS

Completion: 28 Days

7. LOOKBOOK

TACTILE
AGAR, CORNSTARCH, POTATO STARCH

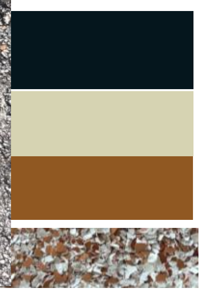
Dimensions
H: 21.0 cm
W: 14.8 cm
D: 12.0 cm

Completion: 15 Days

1. DEATHER

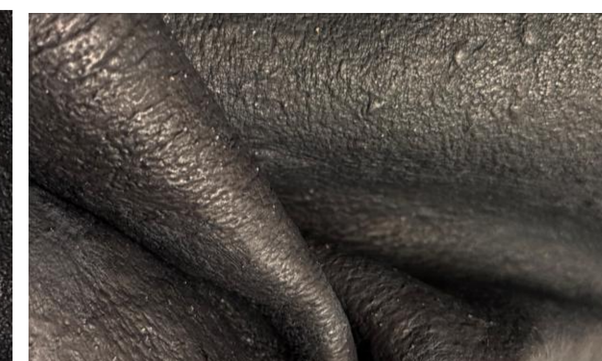
REVERSIBLE DENIM LEATHER

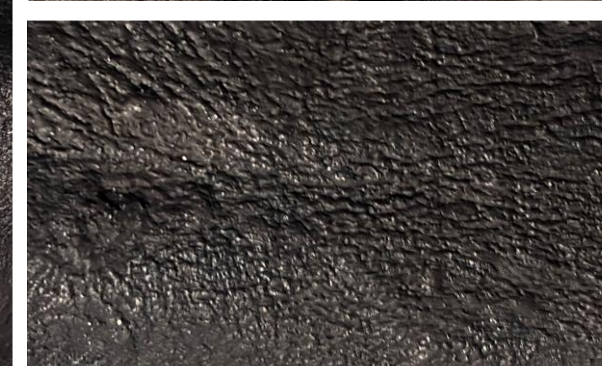
SAMPLE REF:
43



FRONT – DENIM FACING

BACK – LEATHER FACING





2. CRACKED

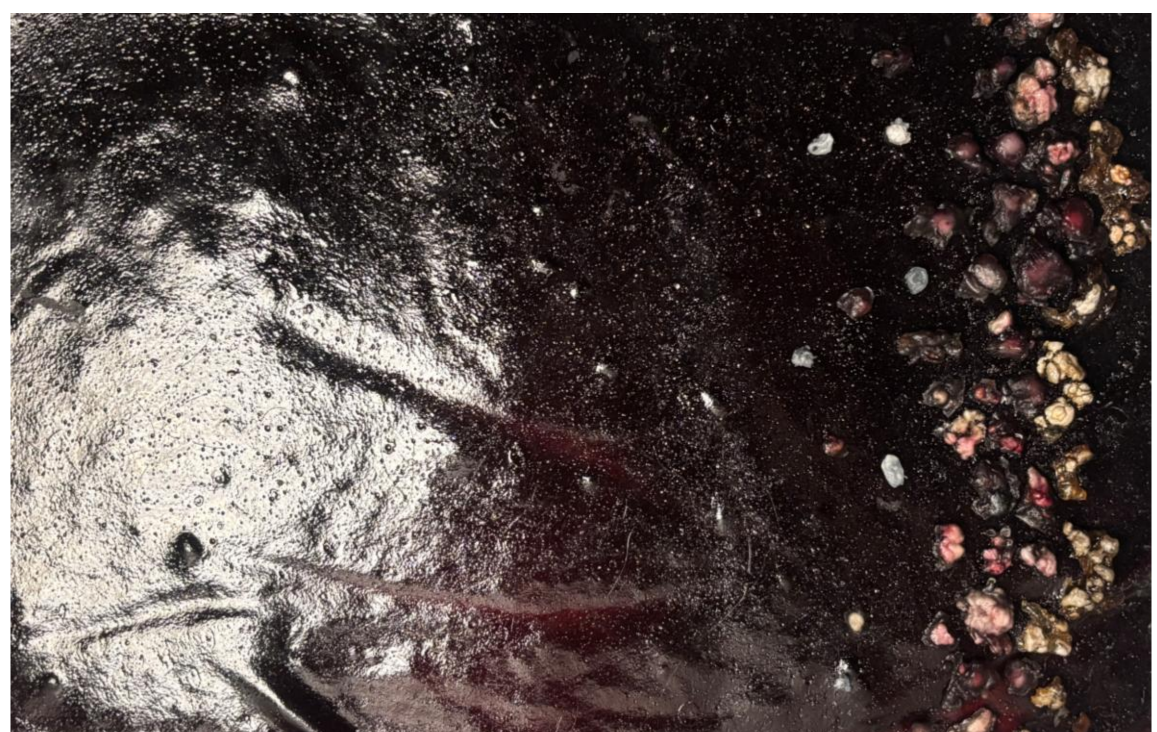
LEATHER LIKE FINISHING

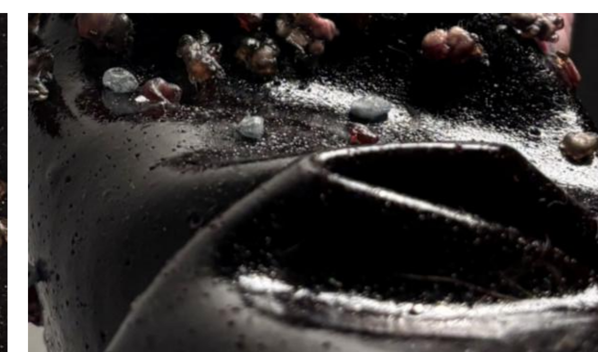
SAMPLE REF:
20

6. EMBELLISHED

PATTERNING

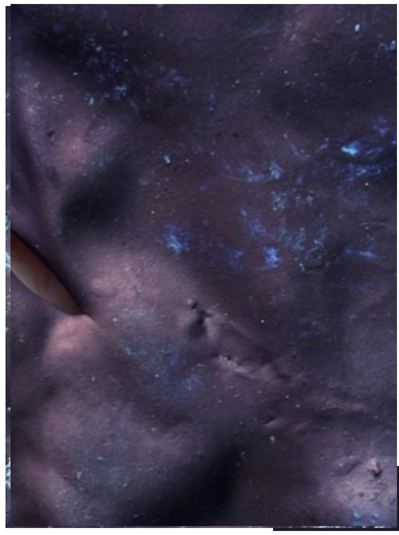
SAMPLE REF:
5 + 12





9. WARPED

LEATHER LIKE FINISHING

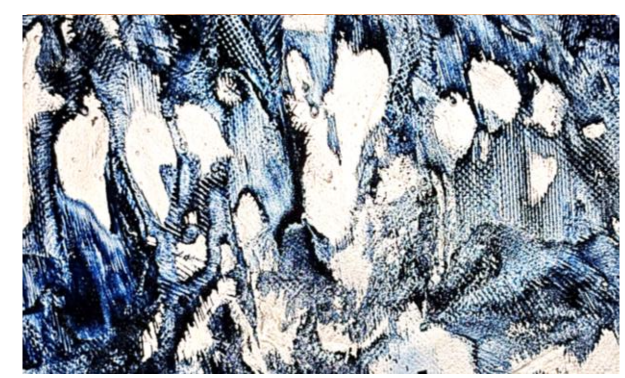


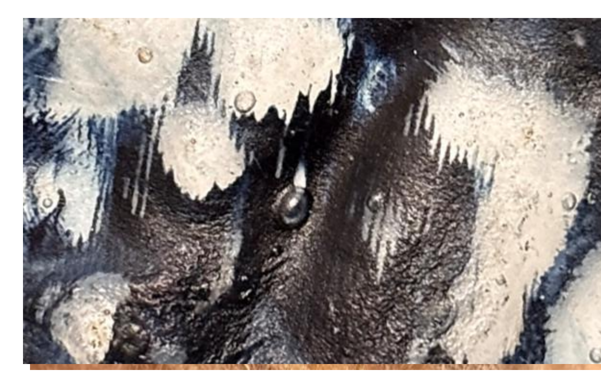
SAMPLE REF:
5

10. FAUX DISTRESS

INSERT SUBTITLE HERE

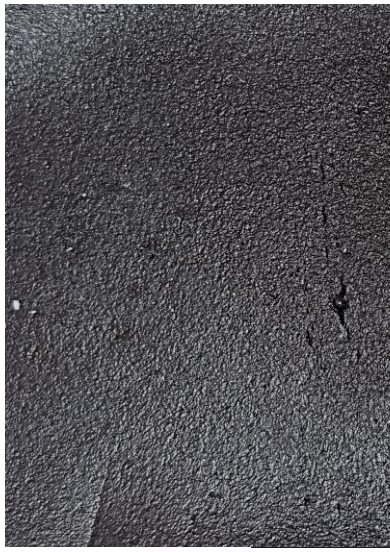
SAMPLE REF:
17





OUTCOME 11

JACKET



SAMPLE REF: 60

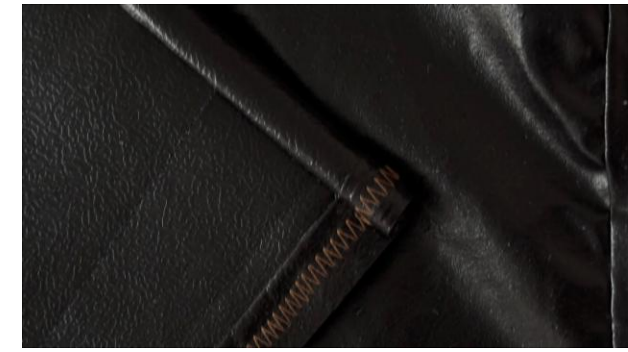
SLEEVES

SAMPLE REF: 61

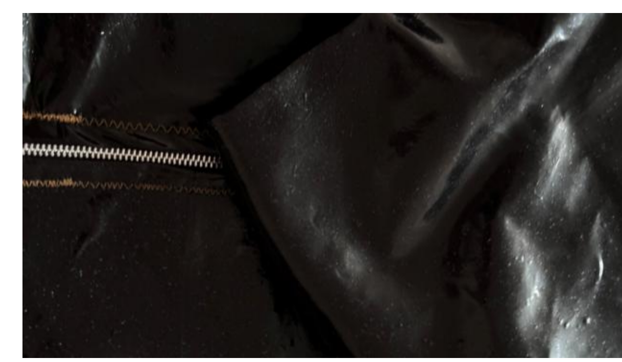
BODICE

SAMPLE REF: 70

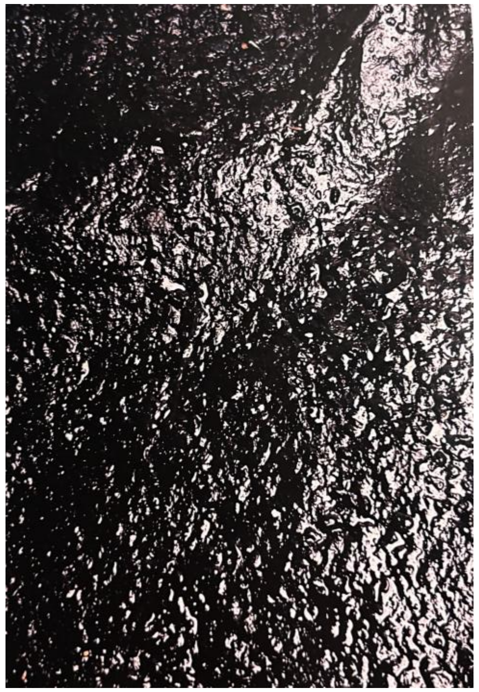
HOOD PANEL

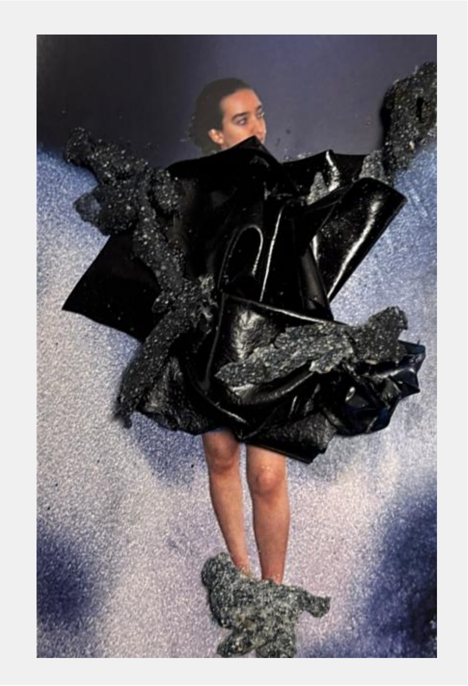


CLOSEUPS



OUTCOME 12
LOOKBOOK


FRONT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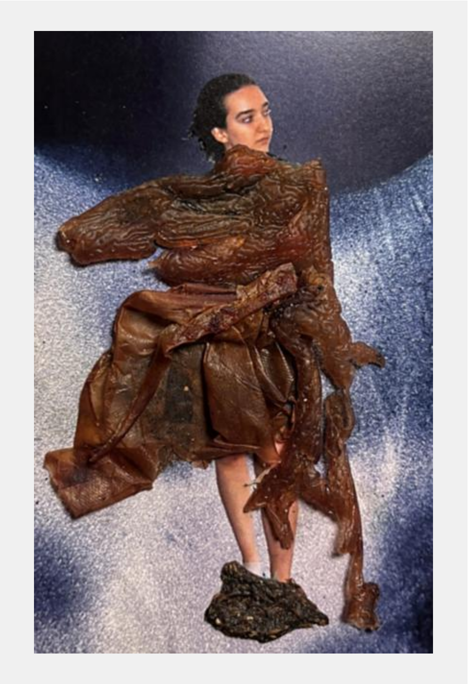
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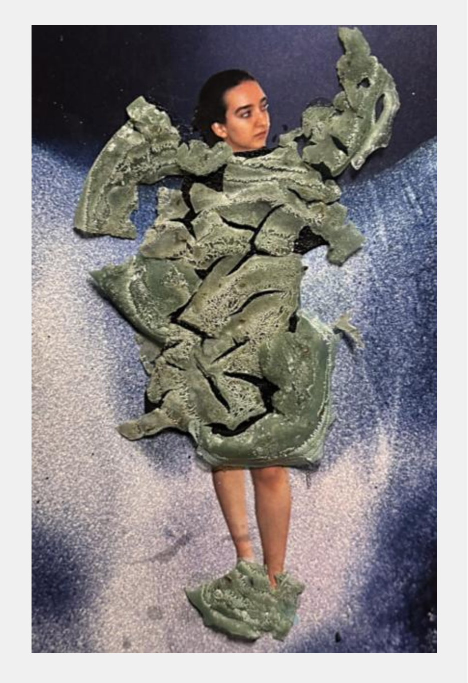
3


4


5


6


BACK