

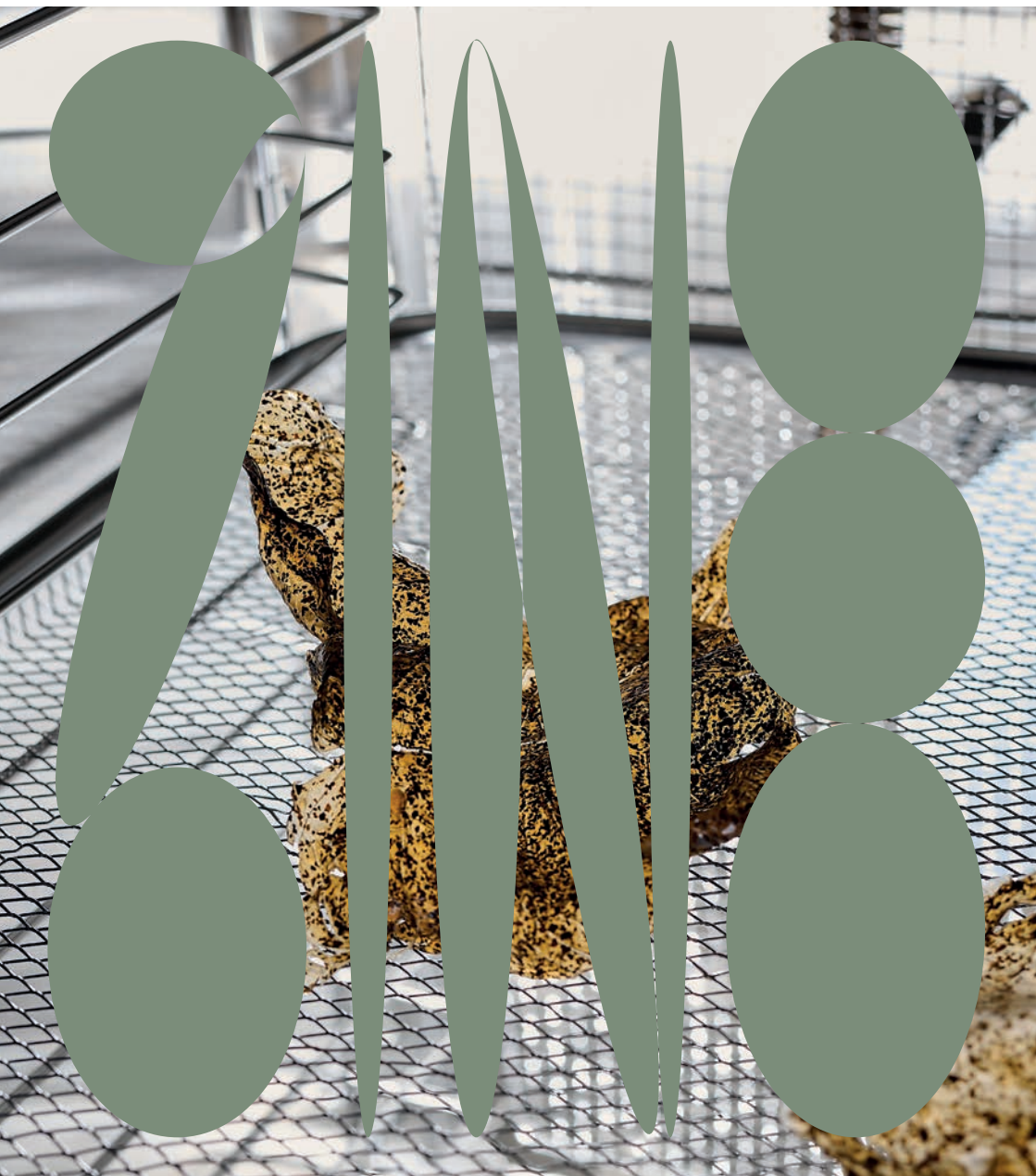


SPACE FOR BIOMATERIALS \_\_\_\_\_

Recipes

#01

07/2024



## CONTENTS



SBYD AND THE SPACE  
FOR BIOMATERIALS



SEAWEED  
by Julius Schnettger



WOOL AND STARCH  
by Riccarda Gumbinger



BIOCONCRETE  
by Maja Kaiser



ALGAE  
by Zeynep Deliomeroglu



APPLE  
by Yifei Shi



JAPANESE KNOTWEED  
by Jaqueline Lobodda



CORN STARCH  
by Isabel Lorenz



BANANA PEEL  
by Paulina Heidlberger



EGGSHELL  
by Lilli Seiler



COFFEE GROUNDS  
by Lars Feller



PLANT ASH GLAZES  
by Maximilian Moritz Müller



GRASS  
by Xenia Martin



KOMBUCHA  
by Gunilla Piltz



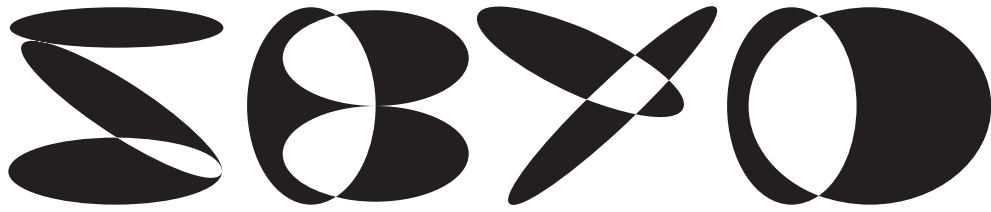
GELATINE  
by Marzieh Mokhtari Baghkomeh



MANGO  
by Ilgar Didari



SEASHELLS  
by Yifei Shi



SBYD.SPACE explores new climate-neutral and resource-light ways of living and production. It transfers knowledge from sustainability research into society and the economy through design. The capability of design in making theories and abstract concepts tangible – and transferring them into everyday life – is used to explore, discuss, and test these theories and ideas in practice.

SBYD.SPACE engages with diverse audiences and collaborators through a range of formats, including workshops, international symposia, exhibitions, an artist / designer in residence program and support for entrepreneurial endeavors. It is located at Folkwang University of the Arts' North Campus at the UNESCO World Heritage Site Zollverein, a former coal mine in Germany's Ruhr region – a location that could not be more symbolic for the transformation of industries, ways of life, and entire regions.

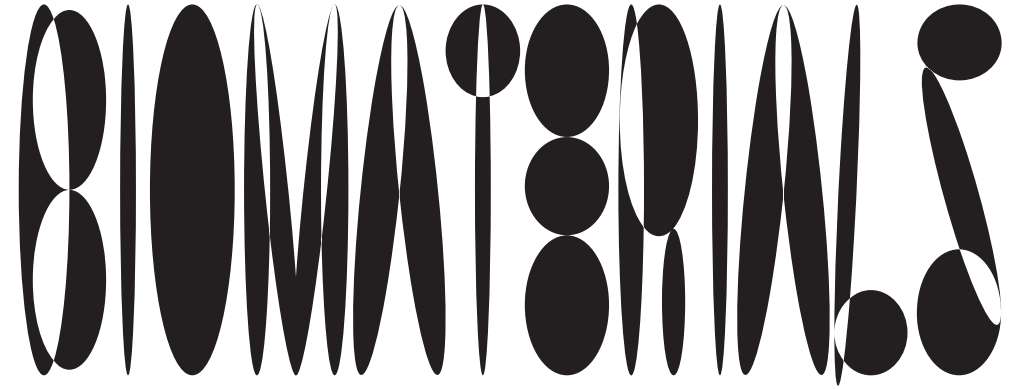


SBYD.SPACE creates SPACES of possibility for exploring sustainable alternatives. Each SPACE is composed of a different set of interdisciplinary team members – akin to a working group. In different and continuously evolving SPACES, such as the SPACE FOR REPAIR, the SPACE FOR BIOMATERIALS, and the SPACE FOR TEXTILES, room is created for projects that pursue a circular, resource-light, and regenerative design approach. The SPACES form a thematic and conceptual structure within SBYD, around which activities such as interdisciplinary workshops, design projects, and exhibitions are clustered. Each SPACE approaches sustainability with a slightly different perspective, definition, and way of working, creating a multiperspective approach within SBYD that makes different possibilities of sustainable living and production visible and tangible.

The SPACE FOR BIOMATERIALS works at the intersection of design and materials science. It experimentally develops and explores bio-based materials. How can the use of bio-based materials foster regenerative design approaches, for example through the use of waste materials or materials from paludiculture? How can designers engage with microbiology to develop alternative materials and colours?

## »SPACE FOR BIOMATERIALS: RECIPES«

This zine presents sixteen material recipes from the inaugural project of the SPACE FOR BIOMATERIALS. The project involved design students from Folkwang University of the Arts who were guided through a research-through-design process to experimentally create bio-based materials in the university's new Bio Lab.



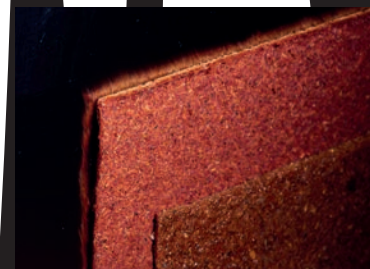
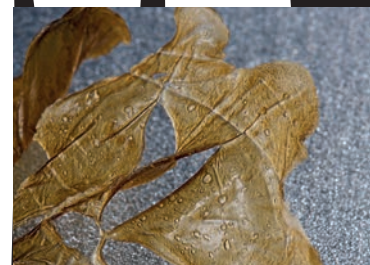
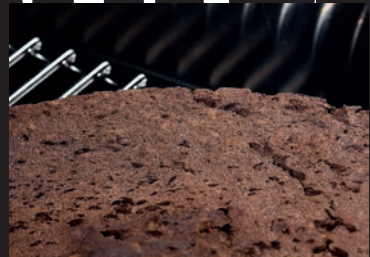
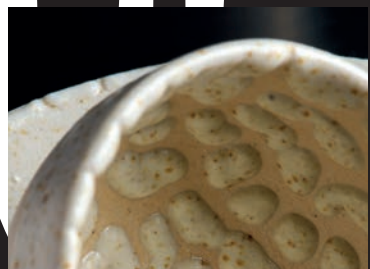
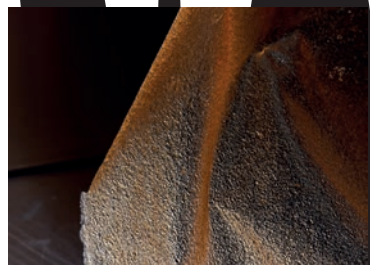
Aiming to explore alternatives to the petroleum-based materials prevalent in contemporary design, the project investigated bio-based materials not only for their structural qualities but also for their potential to contribute to more ecologically friendly and resource-light design and production methods. Some recipes repurpose resources typically discarded as waste, such as coffee grounds, eggshells, or cut grass. Others explore using invasive plants, algae, or bacterial cellulose to create materials.

With these materials, new aesthetics and new potential uses emerge. What if a product is not meant to last, but designed to decompose after a short period of time? Could it then become beneficial to bacteria, fungi, and plants in soil? How can such a regenerative, post-human use be incorporated into a product's design from the outset? And by embracing bio-based materials, can designers develop an aesthetic that celebrates imperfection and ephemerality where appropriate, thereby fostering and communicating the existence of alternatives – not just of producing, but of living and interacting with the world around us?

We invite anyone interested to experiment with the material recipes in this zine. Most of the materials can be made in your own kitchen, using common kitchen tools and easily available ingredients.

Johanna Schmeer & Tom Baffi (Editors)









## SEAWEED

by Julius Schnettger

### INGREDIENTS

125 ml Water  
25 g Cornstarch  
5 g Seaweed powder

### TOOLS

Teabag  
Blender  
Smooth surface, e.g., glass  
Stove  
Syringe  
Baking paper

### INSTRUCTIONS

1. The production of algae-based bioplastic requires only cornstarch, water, and a brown algae of your choice. In this example, the native German bladderwrack is used.
2. To produce a clear material, grind the seaweed into a powder using a blender. A mortar and pestle can be used to produce an even finer powder.
3. The prepared seaweed powder can now be boiled in a tea bag with 75 ml of water. Once the water takes on a brown-green hue, the tea bag can be removed.
4. Meanwhile, mix the remaining 50 ml of water with the cornstarch. Then, carefully pour the starch water into the hot seaweed water while stirring continuously. It is important that the water does not boil vigorously, as the mixture will become lumpy.
5. By heating and stirring continuously, a thick, sticky mass is created. This can be extruded in a warm state using a simple tool such as a syringe, or spread out between baking paper or on a smooth surface such as glass, to form a flat material.



This recipe can be modified to produce a material which includes visible pieces of algae. To do so, don't grind the seaweed into a powder, but grind it into small pieces with a size of 1-2 mm. Then boil these algae granules with 75 ml of water, without using a tea bag, and leave the granules in the mixture. Then, continue with step 4.



## WOOL AND STARCH

by Riccarda Gumbinger

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### INGREDIENTS

Long wool fibres  
350 g Corn starch  
175 ml Vinegar  
2100 ml Water  
175 ml Glycerol  
5 tsp Turmeric

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### TOOLS

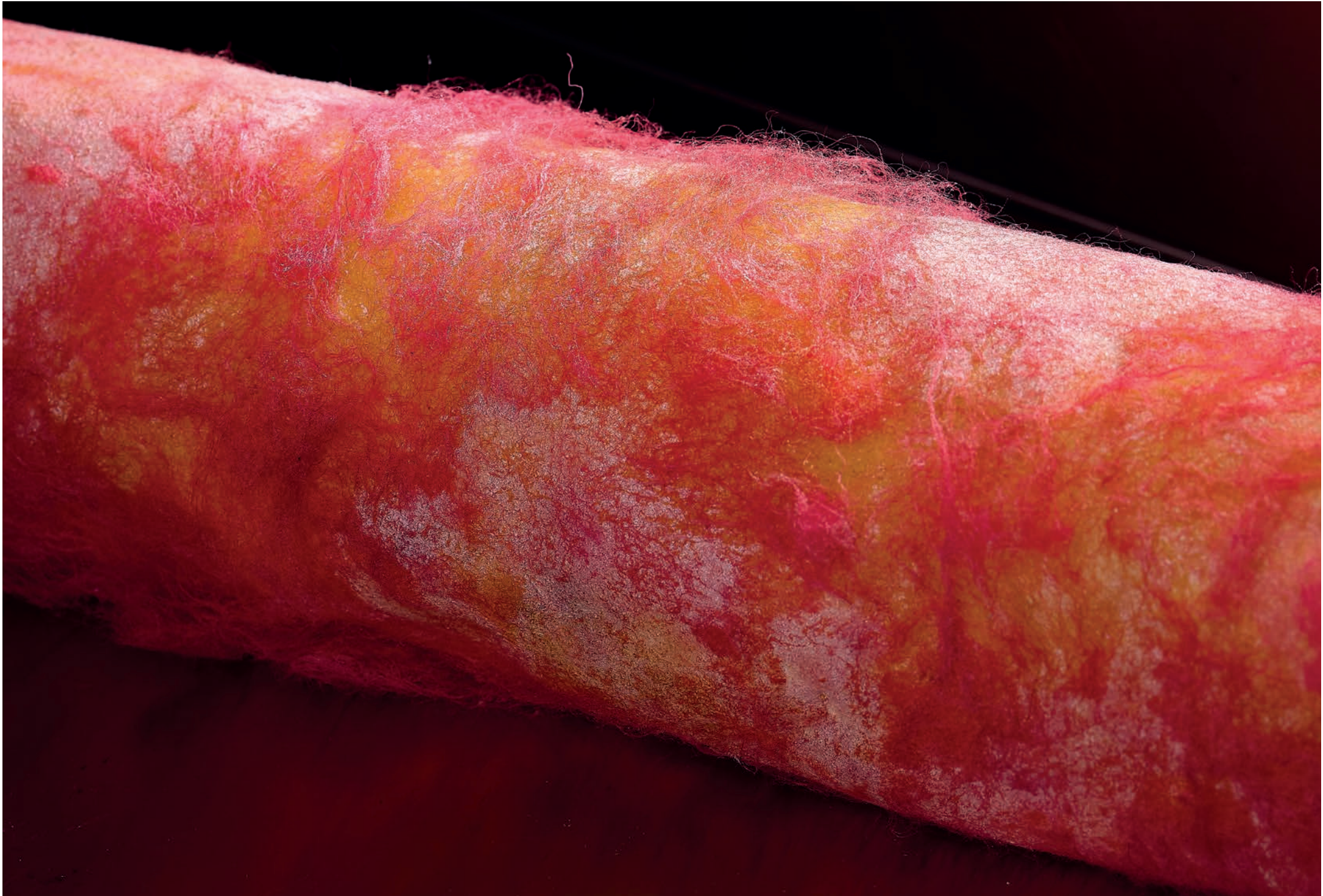
Mixing bowl  
Pot  
Measuring cups and spoons  
Stirring spoon  
Acrylic glass plates

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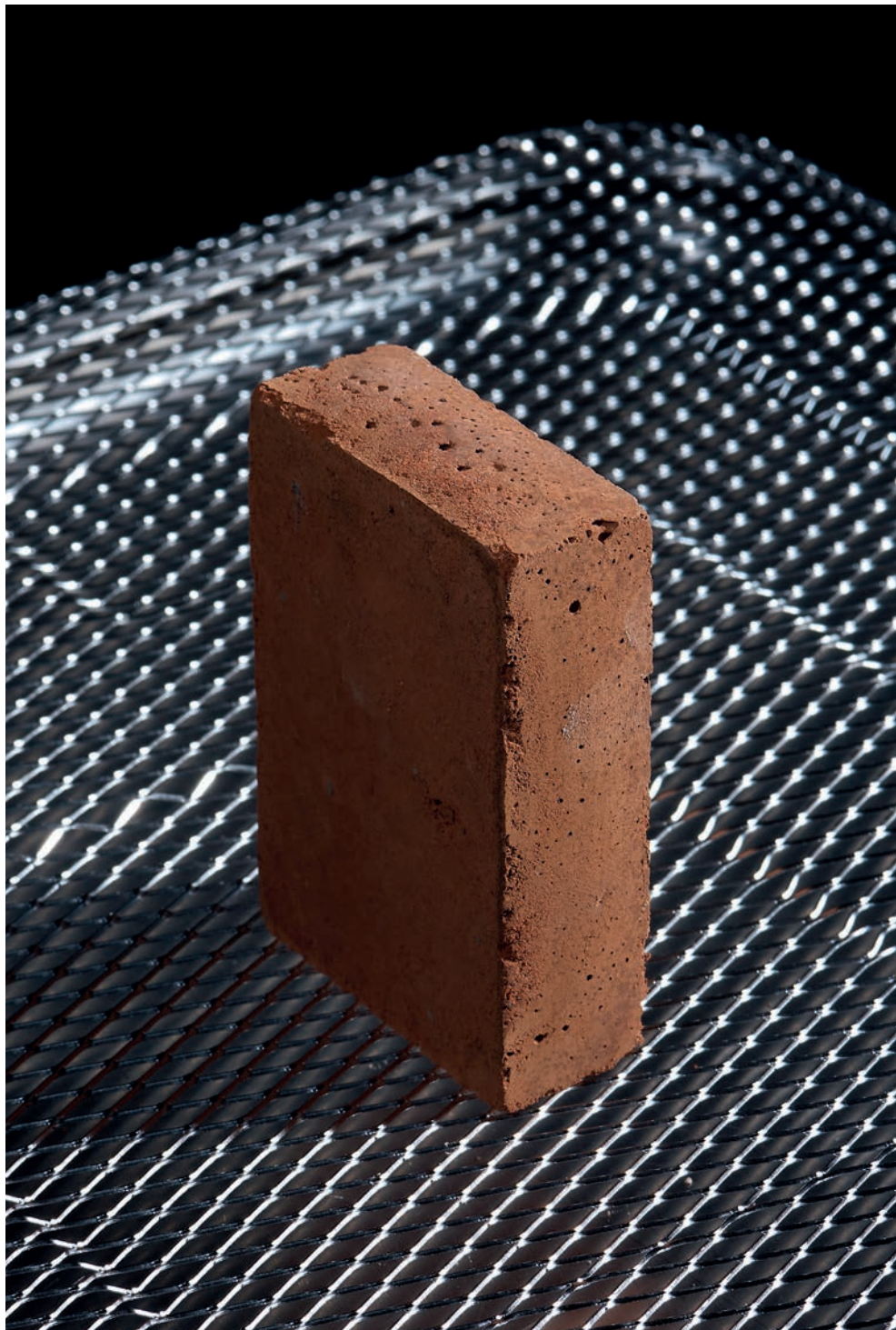
### INSTRUCTIONS

1. Stir the corn starch into cold water, add vinegar, glycerol, and turmeric. Bring to a boil for about 3 minutes.
  2. Spread the now thickened mixture onto an acrylic glass plate while still hot.
  3. Distribute the wool fibres on top and press them into the material using a second acrylic glass plate.
  4. After about 4–5 hours, remove the top plate and let the material dry for about a week.
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## BIOCONCRETE

by Maja Kaiser

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### INGREDIENTS

One part (by volume) wood ash

One part (by volume) crushed pottery shards (e.g., broken terracotta flower pots)

Water

Untreated wood for making fire

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### TOOLS

Hammer or mallet

Fire pit or fire bowl

Fireproof bowl

Mixing spoon

Solid mould (e.g., made of plaster)

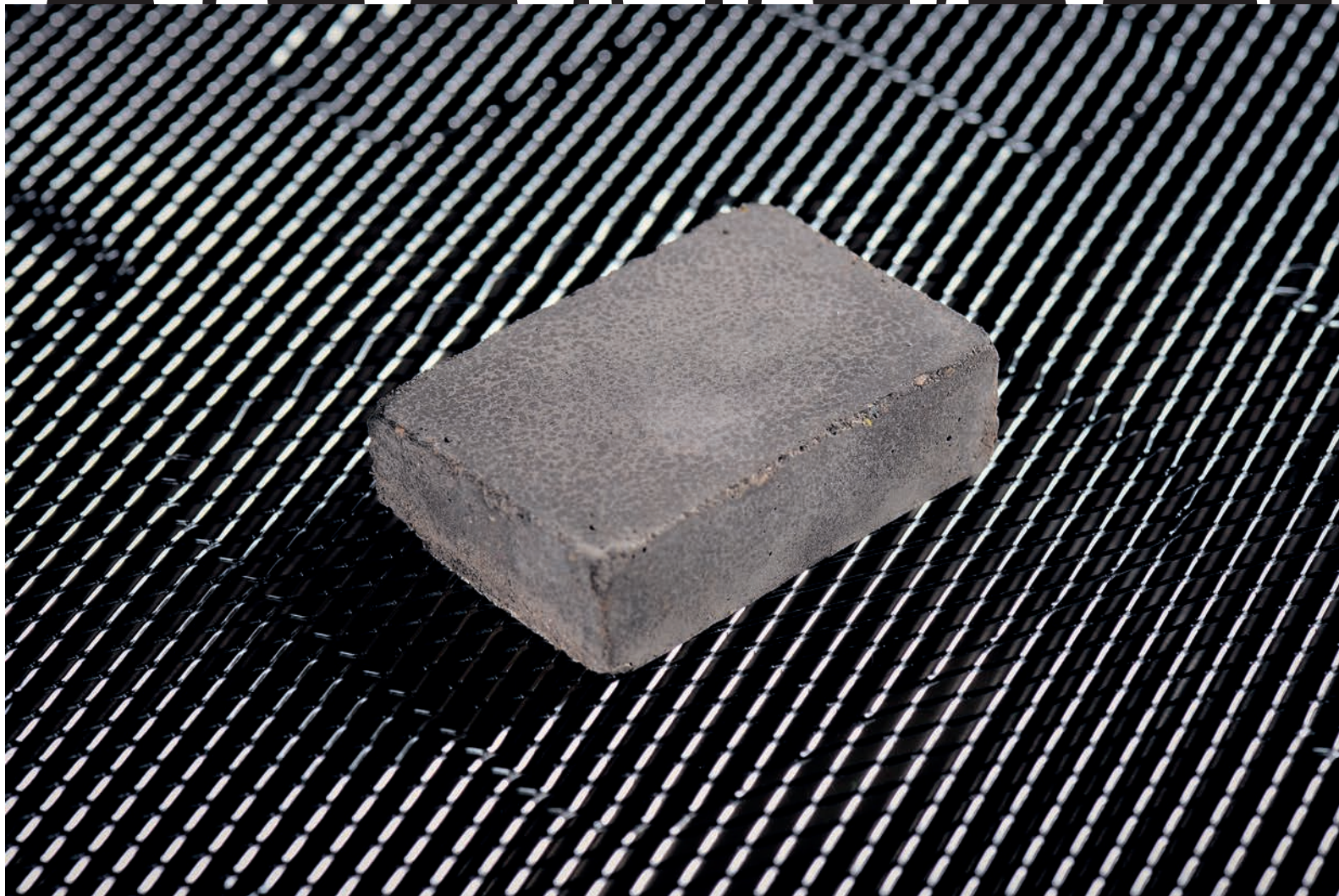
Measuring container

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### INSTRUCTIONS

1. Thoroughly clean and dry the pottery shards. Then crush them finely, e.g., with a hammer or mallet.
  2. Mix the wood ash with water, pour off the excess water, and let the ash slurry dry until a mouldable but firm mass is formed. When forming the mass into a ball, it should neither crumble nor lose its shape.
  3. Make a fire in a fire pit using untreated wood and place the ash ball into the flames. Gradually add more wood to keep the fire burning. Let the ash ball burn for about 30 minutes.
  4. Cover the bottom of a fireproof bowl with water and place the cooled ash ball in it. Stir well and add a bit more water if necessary until a homogeneous slurry is formed.
  5. Mix the ash slurry with the crushed pottery shards.
  6. Place the mixture into a solid mould (e.g., made of plaster) and let it harden in the air for at least 2 days.
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## ALGAE

by Zeynep Delimeroglu

### INGREDIENTS

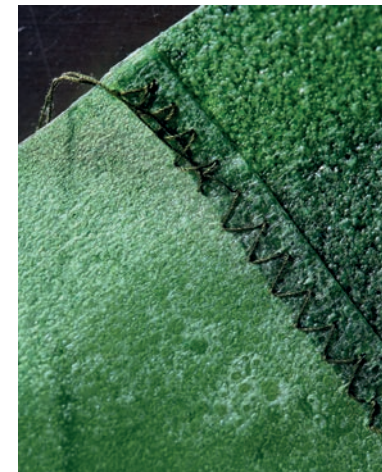
350 ml Water  
4 ml Glycerol  
16 g Carrageenan kappa  
0.5 – 2 g Spirulina

### TOOLS

Scale  
Syringe  
Measuring cup  
Cooking pot  
Whisk  
Stove  
Silicone mould  
Spatula  
Dehydrator or oven

### INSTRUCTIONS

1. Measure the carrageenan and spirulina using a scale.
2. Measure the glycerin with a syringe and the water with a measuring cup.
3. Mix the water, carrageenan, and spirulina in a pot using a whisk. The amount of spirulina can vary between 0.5 and 2 g, depending on the intended colour of the material.
4. Bring to a boil over high heat. After 1.5 minutes, add the glycerin.
5. Boil for 2 minutes until the mixture is homogeneous..
6. Pour the mixture into the silicone mould using a spatula and spread it evenly.
7. Place the mixture in the silicone mould into a dehydrator or oven (70°C – about 5 hours – until dry).
8. Moisten the dried material with water and smooth it out again.  
The dried material can now be sown and folded.







## APPLE

by Yifei Shi

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### INGREDIENTS

250 ml Water  
5 g Citric acid  
10 g Tapioca starch  
4 Apple slices or peel

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### TOOLS

Pot  
Measuring cup  
Scale  
Spoon for stirring  
Sieve  
Mould

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### INSTRUCTIONS

1. Put the apple slices or peel in a pot with 250 ml of water and bring to a boil.
  2. Add citric acid and stir constantly.
  3. Once the apples are fully dissolved, add the tapioca starch solution and continue stirring until the mixture is uniform.
  4. Then, strain through a sieve to obtain a clear liquid.
  5. Finally, pour thinly into a mould and wait for the material to dry at room temperature.
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## JAPANESE KNOTWEED – LEAF COMPOSITE by Jaqueline Lobodda

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### INGREDIENTS

7.5 g Leaves – coarsely chopped  
7.5 g Leaves – medium chopped  
6 g Agar agar  
120 ml Water  
2 ml Glycerol

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### TOOLS

Pot  
Stove  
Thermometer  
Mixing spoon  
Mould  
Oven or dehydrator

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### INSTRUCTIONS

1. Stir agar agar and glycerol into a pot with water and heat until it lightly bubbles. Measure the temperature, continuously stirring. Agar gels at about 90 degrees Celsius.
  2. Remove the pot from the stove and stir in the solid material. Mix quickly so the solid material is well coated with the agar gel. If the mixture cools too quickly, reheat it on the stove.
  3. Press into a mould and leave it pressed for at least 1 hour. Then let it continue to dry in the mould until the surface feels dry.
  4. Remove from the mould and dehydrate in the oven or dehydrator at 30–50 degrees Celsius. It dries very slowly in the air.
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JAPANESE KNOTWEED  
— RED CHIPPY SPAN COMPOSITE  
by Jaqueline Lobodda

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INGREDIENTS

25 g Wood chips  
20 g Bone glue  
60 ml Water  
3 g Carmine red or other natural dyes  
1 g Alum + 30ml Water

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TOOLS

Stainless steel pot  
Measuring cup  
Mixing spoon  
Mould  
Oven or dehydrator

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INSTRUCTIONS

1. Dissolve the pigment in water. Then let the bone glue swell in the solution for about 1 hour, stirring occasionally.
  2. Slowly heat the mixture in a stainless steel pot until it reaches about 50 degrees Celsius. Dissolve the alum in boiling water. Turn off the stove and add the alum to the bone glue. Stir vigorously until a smooth consistency is achieved. Then quickly spread in the wood chips evenly.
  3. Immediately pour into a mould. Demould once it is stable enough, and dry or dehydrate it below 40 degrees Celsius.
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## CORN STARCH

by Isabel Lorenz

### INGREDIENTS

10 g Corn starch  
10 ml Vinegar  
10 ml Glycerol  
100 ml Water

### TOOLS

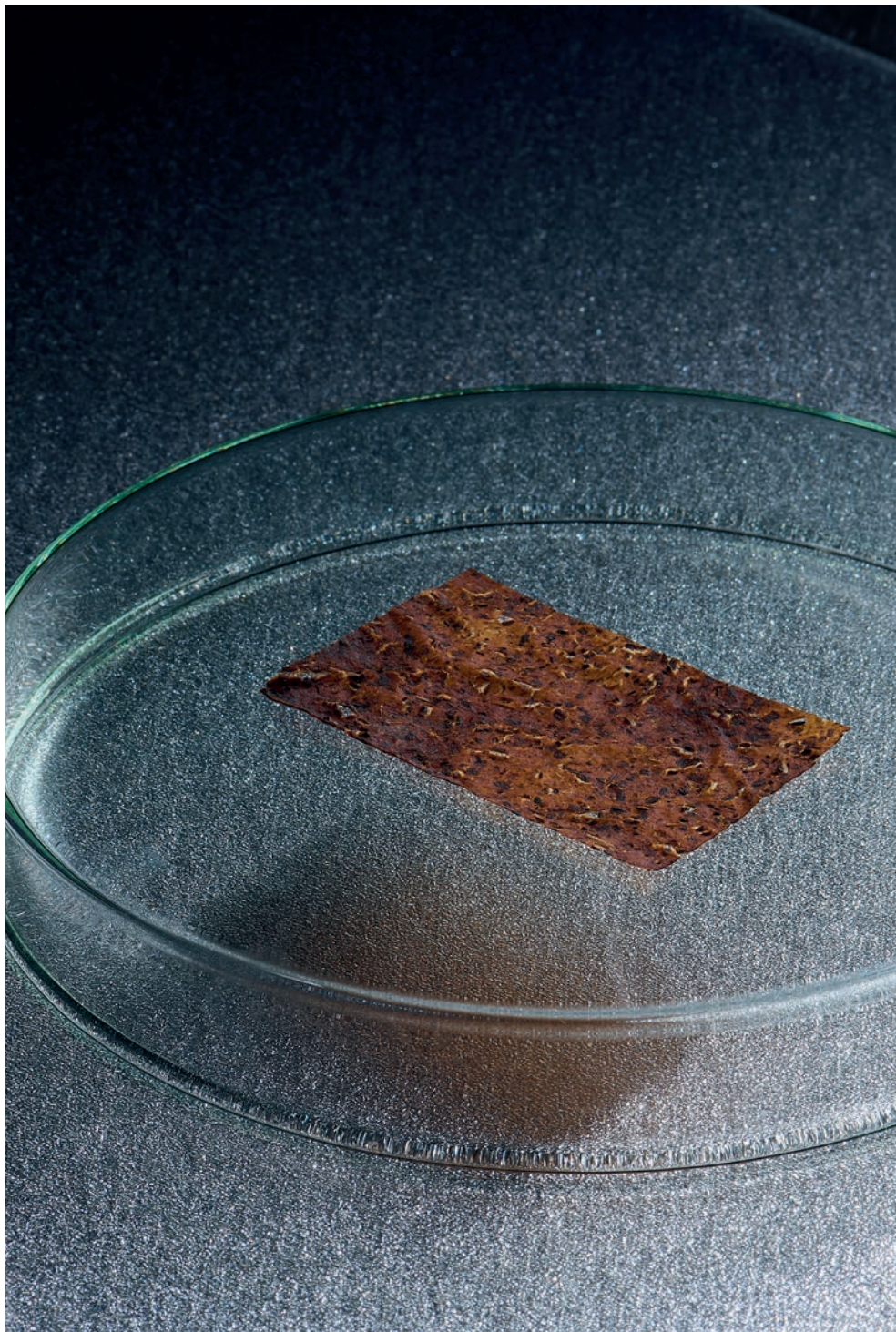
Cooking pot  
Stove  
Measuring cups  
Mixing spoon  
Baking paper  
Spatula

### INSTRUCTIONS

1. Mix all ingredients together in a pot.
2. Heat the mixture on high heat on the stove, stirring constantly.
3. After about 3 minutes, the mixture will thicken. Spread it thinly on baking paper while it is still hot.
4. After about 3 days, carefully peel the material off the baking paper.  
You will receive a delicate, film-like material.







## BANANA PEEL

by Paulina Heidelberg

### INGREDIENTS

80 ml Cold water  
80 g Fresh banana peels  
1 g Acetic acid (vinegar essence)  
2.5 g Glycerol  
1.5 g Cornstarch

### TOOLS

Knife and cutting board  
Scale  
Bowl  
Measuring cup  
Blender  
Microwave  
Spoon  
Old cloth  
Baking paper  
Rolling pin

### INSTRUCTIONS

1. Cut fresh banana peels into small pieces and weigh them.
2. Put the cut banana peels and cold water into the blender, and puree thoroughly until a smooth mixture forms.
3. Weigh the acetic acid, glycerin, and cornstarch using the scale and mix them in a bowl. (Adding more glycerin will make the final product softer; less glycerin will make it harder but also more brittle.)
4. Add the mixed ingredients to the pureed banana peel mixture and blend thoroughly again.
5. Place the bowl with the mixture in the microwave and heat at 700 watts for about 2–3 minutes, stirring occasionally to ensure even heating.
6. Remove the heated mixture from the microwave and let it cool slightly.
7. Put the slightly cooled mixture onto an old cloth and squeeze out the excess water.
8. Place the mixture between two pieces of baking paper and roll it out evenly with a rolling pin to the desired thickness.
9. Carefully peel off the top layer of baking paper after half an hour.
10. Let it dry openly for several days (approximately 1 week). Alternatively, the bioplastic can be dried in the oven at 60 degrees Celsius for about 5 hours.
11. Once the banana peel bioplastic is fully dried, it can be cut as desired.





## EGGSHELL by Lilli Seiler

### INGREDIENTS

100 ml Water  
11 g Potato starch  
38 g Eggshell  
2.5 tsp Gum arabic

### TOOLS

Mortar and pestle  
Sieve  
Cooking pot  
Plaster mould  
Corresponding ceramic  
Baby powder  
Brush  
Oven  
Stove  
Freezer  
Cleanroom workbench (if available)



### INSTRUCTIONS: PREPARATION OF THE EGGSHELLS

1. Wash the collected eggshells with water.
2. Boil for about 15 minutes to kill bacteria. Remove white foam with a spoon if necessary.
3. Dry the eggshells in the oven for 15–20 minutes at 120°C.
4. Grind the eggshells into a fine powder and sieve if needed.



## PREPARATION OF THE BIOMATERIAL

1. Add potato starch and water to a pot and stir well until there are no lumps and the starch is completely dissolved.
  2. Heat the solution over low heat, stirring constantly, until it becomes a thick, translucent paste (about 5 minutes).
  3. Remove from heat and add the eggshell powder, followed by the gum arabic. Mix well until there are no lumps and a fluid, sandy paste is formed.
- 

## MOULDING

1. Ensure the plaster mould is completely dry. Thoroughly brush the mould with baby powder and blow out any excess powder.
  2. Evenly distribute the eggshell mixture in the mould, using a spoon if necessary. Press the ceramic cup into the mould so that the mixture is evenly distributed between the plaster mould and the ceramic.
  3. Place the mould in the freezer for about 5 hours until the mixture is completely frozen.
  4. Let it thaw slightly until the ceramic cup can be removed. This process can be accelerated by filling the cup with hot water and then pouring it out after a few minutes.
  5. Let it dry for at least half a day in the air or in a cleanroom workbench to prevent mould formation. Carefully release the still soft mixture from the plaster mould using some compressed air.
  6. Allow it to dry for at least two days in a well-ventilated space or in a cleanroom workbench.
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The material was used to design plant pots that decompose and add calcium to calcium-depleted soils.





## COFFEE GROUNDS

by Lars Feller

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### INGREDIENTS

275 ml Water  
15 ml Glycerol  
20 g Agar agar  
75 g Coffee grounds  
15 g Waste paper (e.g., old newspapers)

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### TOOLS

Cooking pot  
Blender  
Measuring cup  
Mixing spoon  
Mould  
Oven

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### INSTRUCTIONS

1. Boil the water with the waste paper.
  2. After simmering for 10 minutes, blend the mixture.
  3. Add the coffee grounds and glycerol, and simmer for 10 minutes.
  4. Quickly stir in the agar agar.
  5. Pour the hot mixture into a mould.
  6. Bake at 100°C for 15 minutes.
  7. Remove from the mould once it is stable in form.
  8. Dry with the oven door slightly open at 50°C until completely dry.
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## PLANT ASH GLAZES

by Maximilian Moritz Müller

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### GLAZE 1

40 g Japanese maple ash  
40 g Cornish stone  
20 g Quartz powder

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### GLAZE 2

40 g Japanese maple ash  
55 g Cornish stone  
30 g Quartz powder

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### GLAZE 3

30 g Japanese maple ash  
50 g Cornish stone  
20 g Quartz powder

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### GLAZE 4

40 g Hydrangea ash  
40 g Cornish stone  
20 g Quartz powder

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### TOOLS

Mixing bowls  
Measuring scale  
Stirring stick or brush  
Kiln

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### INSTRUCTIONS

1. Mix the plant ash, Cornish stone, and quartz powder in the desired amounts with water until the consistency of liquid cream is achieved.
  2. Let the glaze rest for at least 1–2 days before use. Stir well before each application, sieve if necessary, and stir again with a brush.
  3. The oven temperature should increase by 80 degrees Celsius per hour until 200 degrees Celsius is reached, and then by 120 degrees Celsius per hour until the maximum possible temperature of 1250 degrees Celsius for the chosen ceramic material.
  4. After reaching the maximum temperature, let the glaze soak for an additional 15 minutes at full temperature.
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## GRASS

by Xenia Martin

### INGREDIENTS

1 part Grass  
30 parts Water

### TOOLS

Pot  
Deckle and mould  
Large container  
Blender  
Drying cloths  
Rolling pin

### INSTRUCTIONS

1. Cook grass and water in a pot at a ratio of 1:30 for 2 hours, stirring well every 20 minutes.
2. Pour the grass and water mixture into a blender and blend until it forms a pulp.
3. Transfer the pulp to a large container and add the remaining water. Mix well to ensure the pulp is evenly distributed in the water.
4. Lay out a drying cloth before starting to scoop. Dip the deckle and mould into the water and scoop the first layer. Place this layer onto the drying cloth by flipping it over. Repeat this process as many times as needed, layering to increase the material thickness.
5. Place another drying cloth on top and press with a rolling pin to remove excess water.
6. The material can be dried in the sun or on a heater. Alternatively, it can be placed in the oven at 80°C (convection) for 30–90 minutes, depending on the material thickness. Open the oven every 20 minutes to let the steam escape.
7. When the material has dried, it can be sewn like thick fabric.







## KOMBUCHA

by Gunilla Piltz

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### INGREDIENTS

10 g Wool fibres (long)  
 1000 ml Water  
 50 g Spirulina  
 180 g Kombucha scoby  
 12 g Sodium alginate  
 42 g Glycerol  
 5 g Coconut oil  
 2-3 Sprays of calcium chloride

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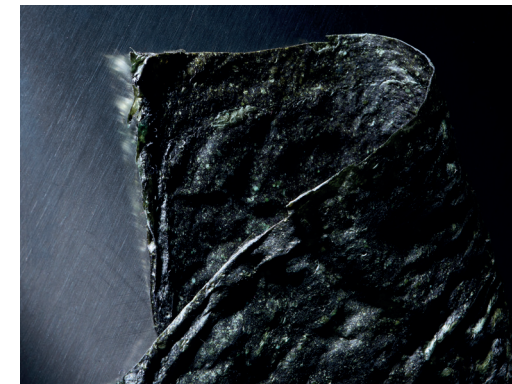
### TOOLS

Immersion blender  
 Pot  
 Spoon  
 (Cake) scraper  
 Baking paper  
 Baking tray  
 Wooden board  
 Spray bottle

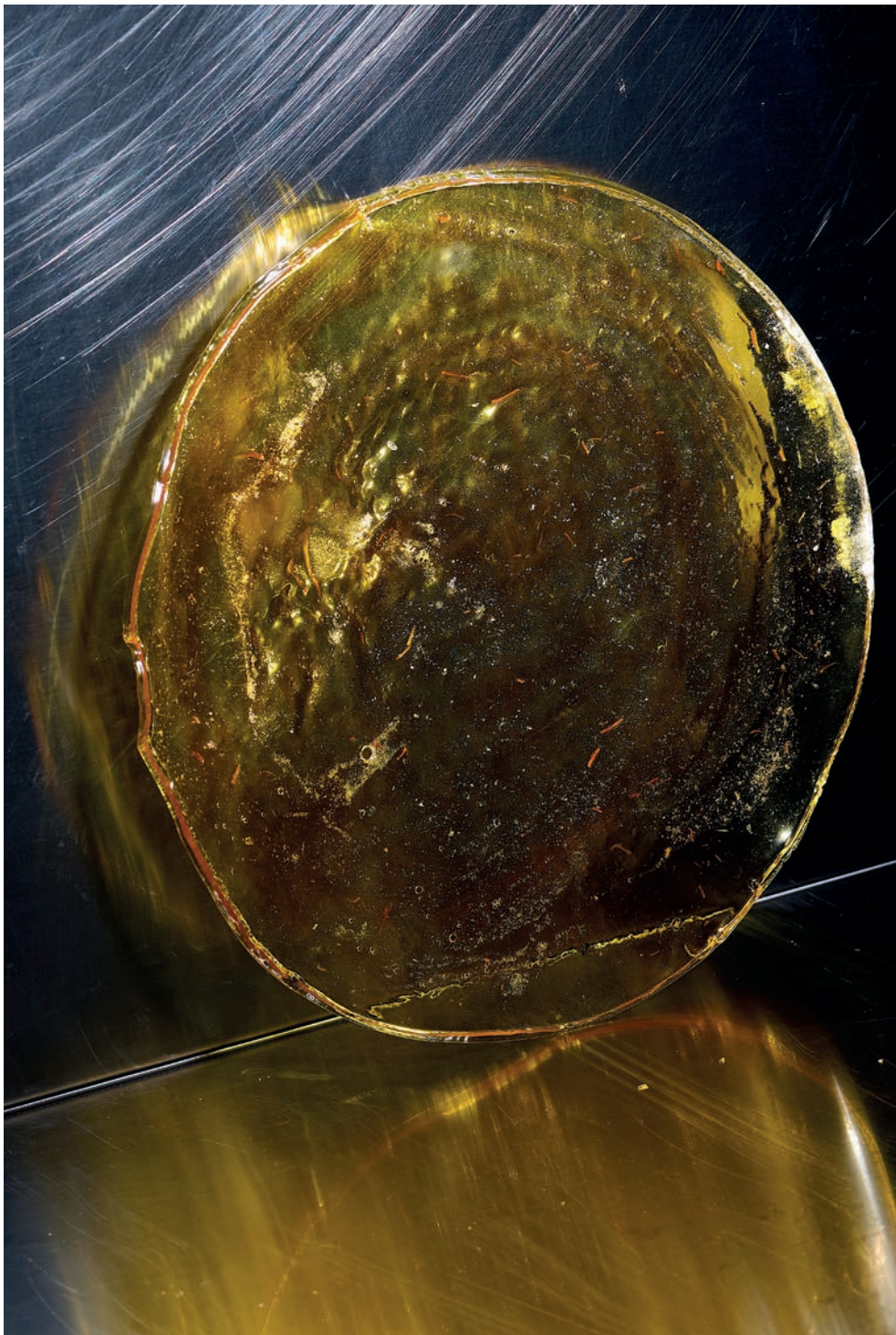
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### INSTRUCTIONS

1. Neutralise the odour of the kombucha scoby. Boil it with detergent for about an hour over low heat, then rinse with cold water.
  2. Combine the kombucha scoby, sodium alginate, coconut oil, spirulina, glycerol, and water in a pot and blend until a smooth mixture forms.
  3. Let the mixture cool overnight outside or in the refrigerator.
  4. Add the wool fibres individually and mix well.
  5. Spread the mixture evenly on a baking sheet. The layer should be 1-2 cm thick.
  6. Dehydrate in the oven at 60 degrees Celsius (convection) for 12-24 hours. Turn after 8 hours.
  7. Spray the semi-dry material lightly with calcium chloride and finish drying it over a heater.
- 







## GELATINE

by Marzieh Mokhtari Baghkomeh

### INGREDIENTS

96 g Gelatine powder

16 g Glycerol

380 ml Water

A large round coffee filter for absorbing foam

Colour (optional)

### TOOLS

Cooker/Stove/Hot Plate

Measuring cup

Cooking pot

Scale

Stirring spoon

Mould

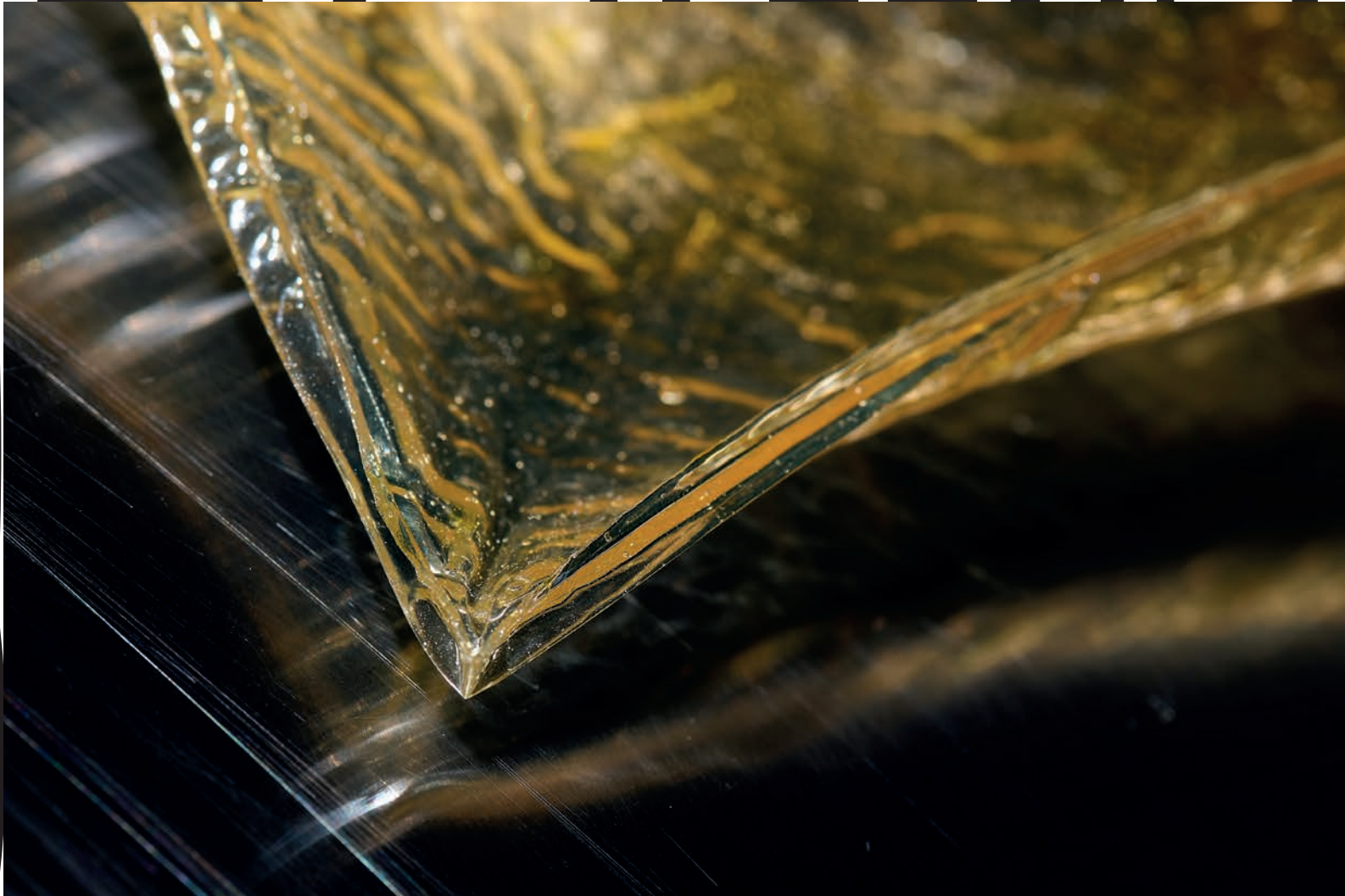
Dehydrator or oven

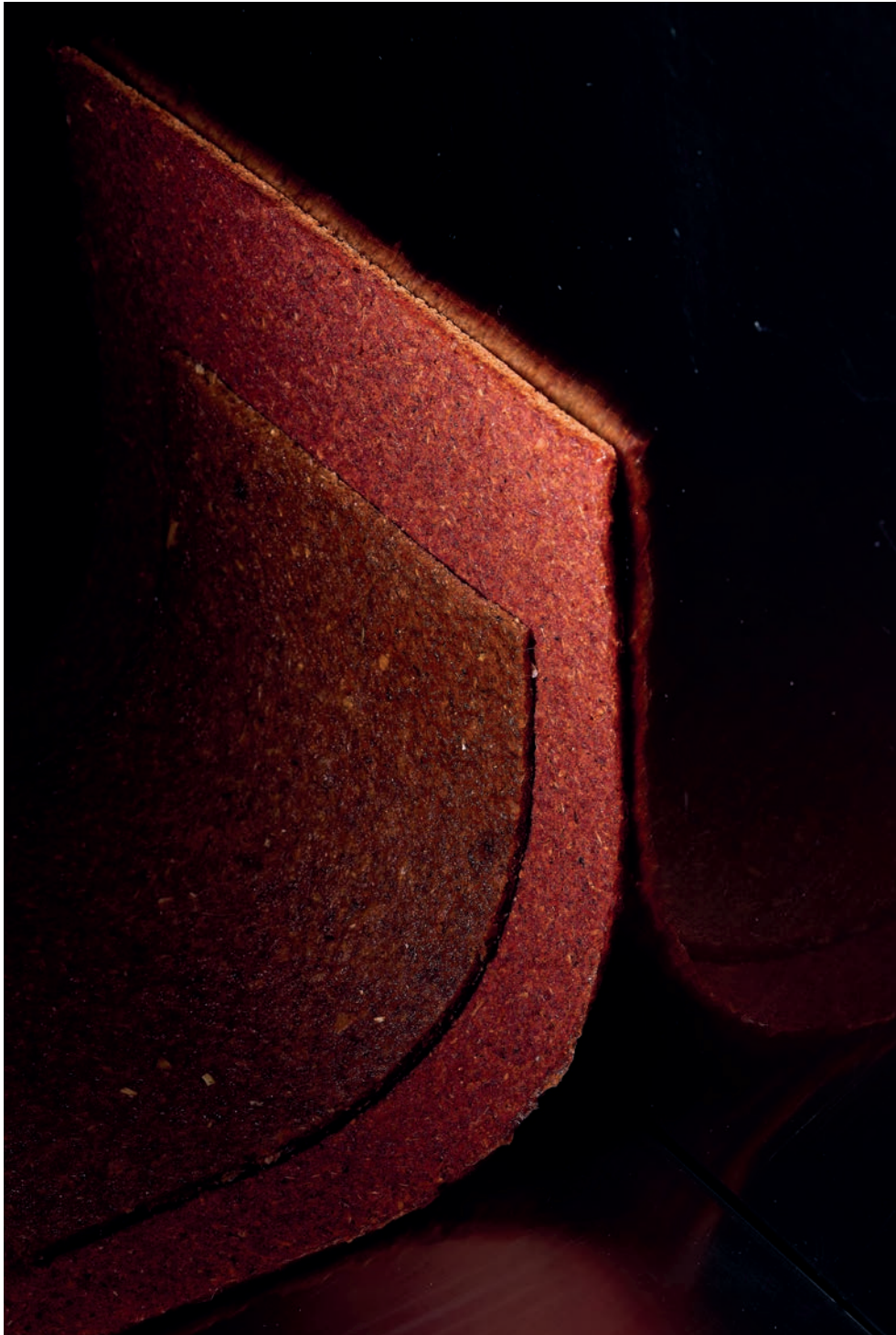
### INSTRUCTIONS

1. Weigh your ingredients.
2. Bring the water to a boil.
3. Add natural dye if you want to use colour.
4. Add the glycerol, then the gelatine.
5. Keep the temperature below 80 degrees Celsius and stir very slowly and carefully to avoid bubble formation.
6. Let the mixture simmer for at least 20 minutes to an hour at 60–80 degrees Celsius, stirring slowly. Reduce the temperature if bubbles form; you don't want the liquid to move, it should not boil. Longer cooking time can evaporate more water and drastically reduce the shrinkage of the cast object. You will get a thicker liquid. To cast larger volumes and solids with this recipe, evaporate a lot of water until the liquid is very thick.
7. If foam forms on the liquid and doesn't disappear, you can use a coffee filter to absorb it by covering the surface with it and then removing it.
8. Pour into the desired mould from the centre and keep still to allow the liquid to spread by itself.
9. Dry in a dehydrator at 30 degrees Celsius for 8 hours. To achieve a flat surface, place a counterweight on it as the edges tend to curl during drying.

This material was developed to be optically similar to pine resin materials (colophonium), but without the allergenic potential and brittleness.







## MANGO

by Ilgar Didari

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### INGREDIENTS

1 Whole mango  
50 g Sawdust  
120–150 ml Syrup

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### TOOLS

Blender  
Mixing bowl  
Mould (e.g. silicone)  
Oven

---

### INSTRUCTIONS

1. Blend the mango using a blender.
  2. Add 50 g of sawdust and 120–150 ml of syrup to the crushed mango.  
In this example, raspberry syrup was used and gave the mango leather its colour.
  3. Mix the raw mixture well and then pour it into a fireproof mould.
  4. Dry the mixture slowly and gently in the oven, initially at 50 degrees Celsius.  
After one hour, increase the temperature to about 120 degrees Celsius.
  5. Once the mass is dry, it can be cut and sewn like leather.
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## SEASHELLS by Yifei Shi

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### INGREDIENTS

1 g Alginate  
1 g Chitin  
1 g Collagen  
40 g Seashell powder

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### TOOLS

Measuring scale  
Hammer  
Mortar and pestle  
Mixing container  
Spoon  
Mould

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### INSTRUCTIONS

1. Collect the desired shells, such as mussel, oyster, or snail shells.  
Wash the shells and let them dry.
  2. Use tools to crush and grind the shells into granules and set aside.  
A hammer and subsequently a mortar and pestle can be used, or any other tools to help crush hard materials.
  3. Measure 35 g of warm water and combine it in a container with 1 g of sodium alginate. Let the mixture sit for 30 minutes.
  4. Add 1 g of chitosan and 1 g of collagen. Let the mixture sit for 90 minutes.
  5. Measure 70 g of the ground shell powder and combine it with the mixture until a consistent texture is achieved. At this point, natural dyes can also be added.
  6. Pour the material into a mould or shape it by hand.
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