Project Freiia

Design guide

Freiia team 1:

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Introduction

Freiia is a international project and stands for Facilitating Resilience Embracing Islands Innovation Approaches. Freiia is funded by the European Interreg group, aims to make North Sea coast islands self-sufficient.

As six dedicated students of Industrial Product Design at Hanze University of Applied Sciences, we seized the opportunity to contribute to the resilience of this unique island. As part of Freiia I, our role within this project is to create a souvenir entirely crafted from local (residual) material streams. This project is a collaboration with VVV Schiermonnikoog, Natuurmonumenten, Interreg, and Hanze University of Applied Sciences.

Schiermonnikoog is making significant strides towards becoming a self-sufficient island. Until recently, this progress was not reflected in its souvenirs. The souvenirs we made showcase the island's identity using locally sourced materials, including waste streams, in line with the Freiia project, increasing the island's autonomy and promoting the circular economy.

In this document, you will find the waste stream map, which will lead you to the streams of waste we used. After that, we will go deeper into our four materials: pulp, bicycle tires, coffee ground and mycelium. The products we made are shown at the beginning of each chapter. Those four material streams are researched and tested and those results are to be found at each material. Then our contact list and follow up research is showcased.

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Souvenirs

Pulp lighthouse

The 1:1 replacement of the Chinese souvenir that the VVV is selling now. See the proces by Chapter 01: Pulp.

Schierzicht

An extra souvenir. In the future, Schierzicht will be made from pulp. You can read about this in Chapter 01: Pulp.

Bicyle keychain

A souvenir made from bike tires. See Chapter 02: Bicycle tires.

Meet Freiia team 1

Rune Pronk

Ronja Wieggers

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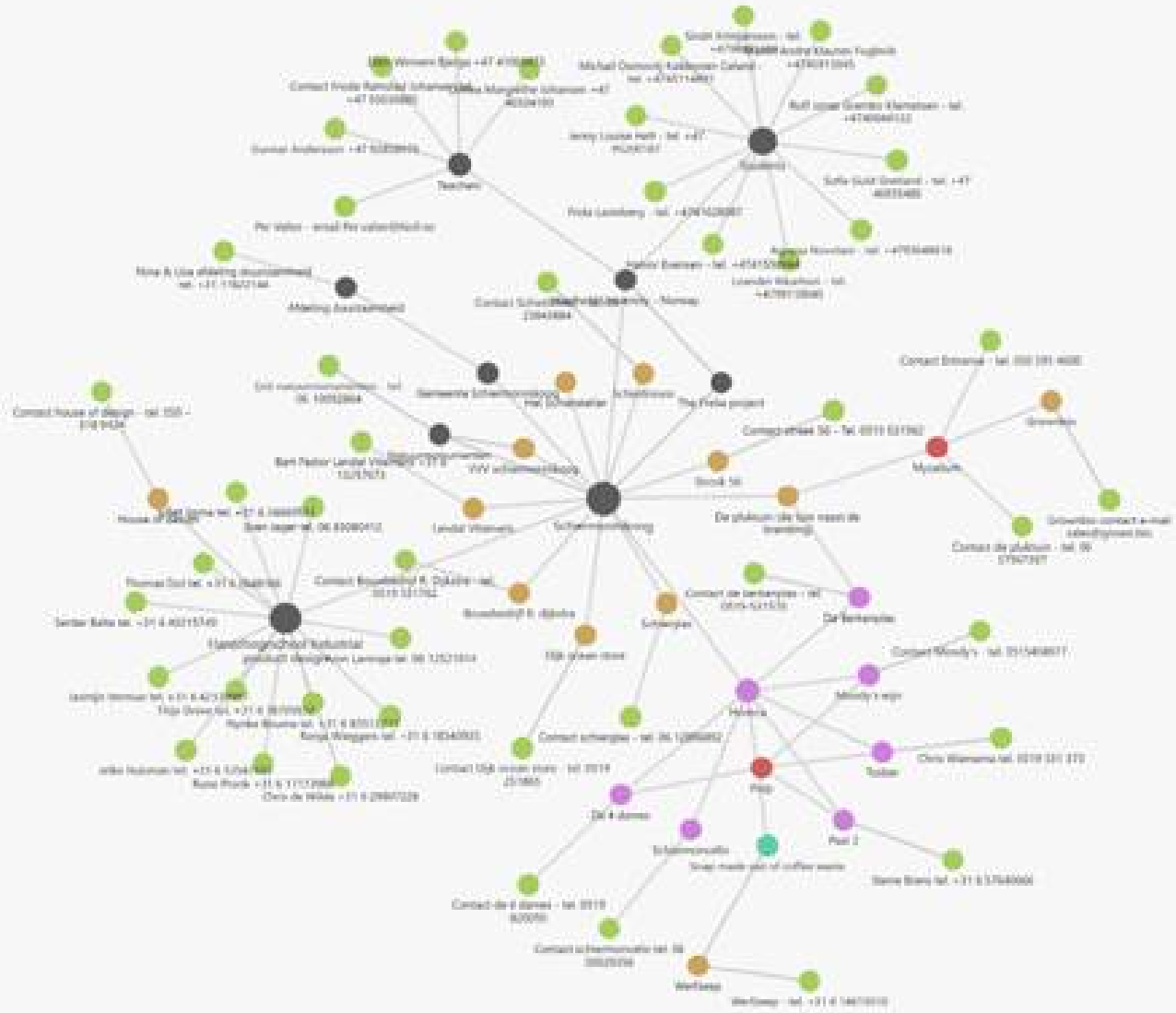
Network

In this visualisation (full size image in the appendix) you can see all the different company's and people we have spoken to. The network is important because it holds all the information needed to get the right materials for the right product. For example, the pulp is made out of cardboard and pruning waste. To get these materials you can take a look inside the visualisation and contact the right person or company. You can find a lot of cardboard at all the different restaurants on the island.

The next companies which led to a dead end:
- Grownbio
- Entrance
- Grondstoffen fabriek



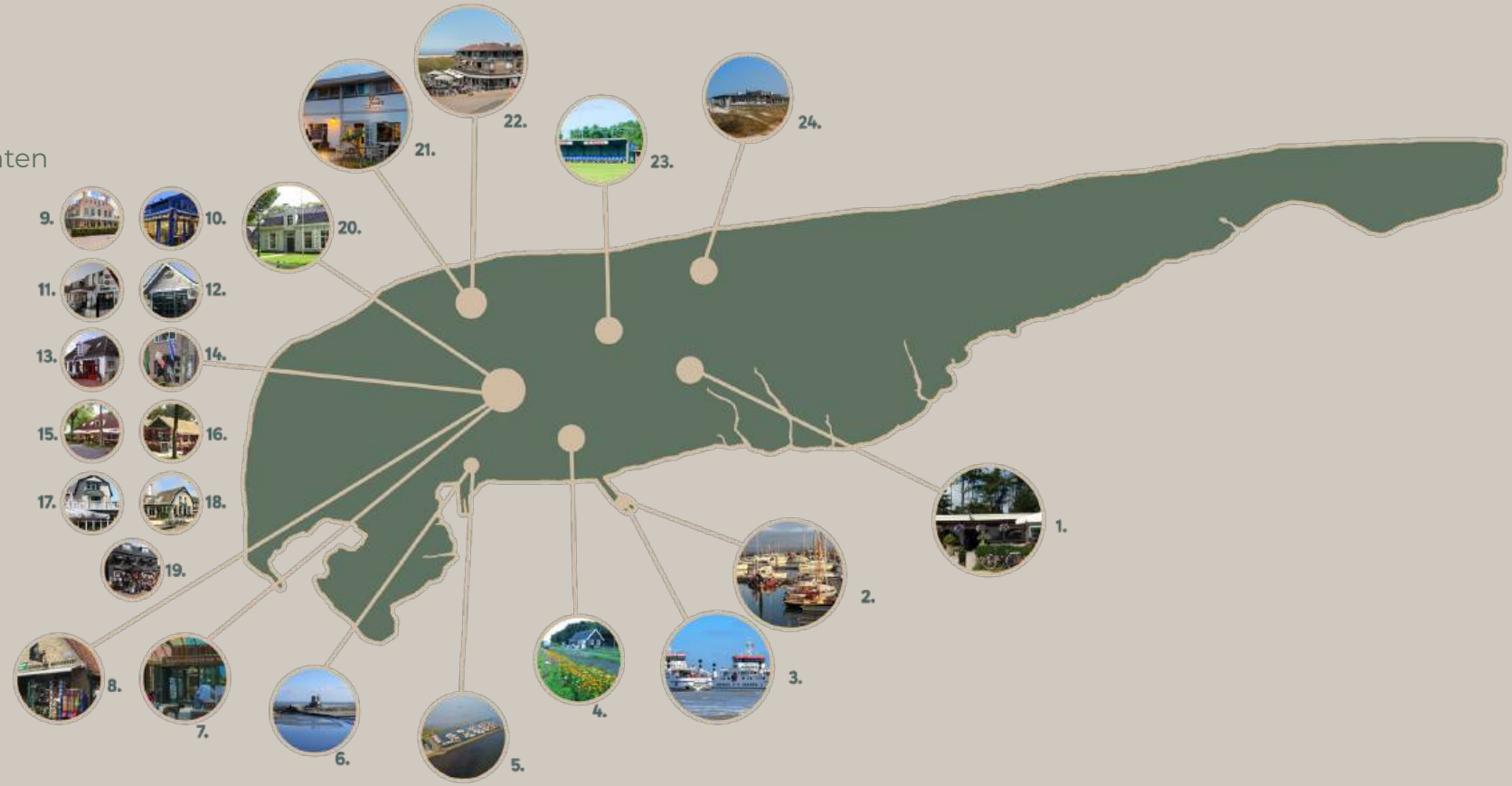
Legend

Red = Material
Yellow =Company
Green = Contact
Pink = Horeca
Turquoise = product

Wastestream map

A list of all the locations on the island where a waste residual stream originates.

1. Berkenplas
2. Haven
3. Wagenborg
4. Pluktuin
5. Jachthaven
6.Bagger depot
7. VVV / Natuurmonumenten
8. Spar
9. Bernsdorf
10. Vishandel
11. 4 Dames
12: Bootshuis
13. De halte
14. Koffiekajuit
15.De Ambrosijn
16. Het wantij
17. De Warejacob
18. Hotel Duinzicht
19. De Toxbar
20. Om de Noord
21. Noorderstraun
22. Vv De Monnik
23. De Marlijn
24. Gemeentehuis



Wastestreams that we used and researched.

(The numbers indicate where on Schiermonnikoog you can find the residual stream.)

Pruning waste
(1, 7)

Used with combination with card for pulp production.

Coffee grounds
(8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23)

Used by soap production and pulp testing.

Bicycle Tire
(Soepboer)

Used by keychains and charms for bracelets.

Mycelium
(4)

Used by testing lighthouse production.

Orange peels
(8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23)

Used by colour testing and soap combination.

Cardboard & Paper
(3, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23)

Used for pulp production

Wastestreams that we used and researched.

(The numbers indicate where on Schiermonnikoog you can find the residual stream.)

Coffee/Tea Cups
(8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23)

Glas
(3, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23)

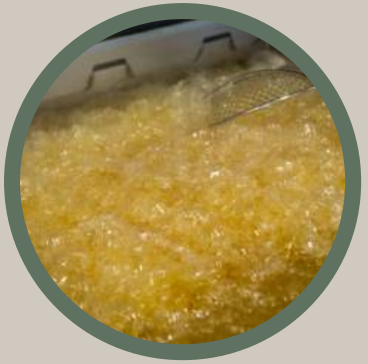
Sand/Silt from the Harbor
(6)

Group Freiia 2 worked with it.

Mussels/Oysters/Seashells
(9, 10, 11, 12, 13, 16, 18, 23)

Group Freiia 2 worked with it.

Flax and Linen Thread
(House of Design idea)



Frying fat
(8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23)

Plastic
(3, 7,8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23)

Group Freiia 2 worked with it.

Beachcomber waste *(such as the beachcomber factory on Terschelling)*

Group Freiia 2 worked with it.

Sigarets
(3, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23)

01
Pulp material

Pulp is a composite made from cardboard and pruning waste. The cardboard and paper waste from all catering companies on the island are collected in large containers at the industrial site, totaling 165.000 kg of cardboard waste annually. Natuurmonumenten undertakes significant pruning of vegetation, resulting in 600.000 kg of pruning waste each year. Islanders can also deposit their pruning waste at various locations, making it one of the island's largest waste streams.
Through the process of shredding and soaking these two waste streams, we produce pulp. This material works excellently as sheet material and can also be used as eco-friendly alternative for the iconic Chinese figurines from the Tourist Information Office, such as the lighthouse.

1.1 Lighthouse Pulp material

Requirements

Wastestream materials
Paper
Cardboard
Pruning waste
Sawdust

Extra material
Cornstrach

Tools
Lighthouse mold
measuring cup
Masher

Contact
The municipality of Schiermonnikoog

Dimensions
13 cm x 7,5 cm x 3,5cm to 1,5 cm

Purchase price
In consideration of production time, material, transportation, packaging, and labor costs, we have conducted a cost calculation for the lighthouses, assuming a production run of ten units. This results in a total cost of €25.85 for a batch of ten units, equating to €2.59 per unit. Taking into account a profit margin of 2.5 percent, the selling price of the lighthouse is set at €7.99 including btw.
(See appendix)

A lighthouse can be created from pruning waste and old paper, making it naturally biodegradable. The purpose of this lighthouse is to raise awareness among people that souvenirs are originally manufactured in factories on the other side of the world, as opposed to the lighthouse currently in the tourist information center, which is made on Schiermonnikoog using their own waste stream.

1. Material collecting: Collect pruning waste, paper, and cardboard and deliver them to the production site. Dry the pruning waste to remove water, similar to the process of making firewood. Storage requirements are simple – a dry location. **2. Preparation for processing:** Once the pruning waste is sufficiently dried, initiate the production processShred or chip the pruning waste into sawdust, using a shredder or chipper. Paper and cardboard can also be finely crushed with this equipment. Soak paper and cardboard shreds in water for 24 hours, possibly in large containers or old water barrels/reservoirs. **3. Mix:** Combine the materials, including water, either manually in a large bath/reservoir or through an automated process using an industrial blender or mixer. Machine mixing may provide a better finish, but manual mixing is also feasible. **4. Pressing in molds:** Press the blended material into molds, ensuring a good, compact fit. The pressing process should expel water, leaving behind the pulp for the desired strength of the final product. **5. Drying:** Allow the filled molds to dry. For faster production, consider heating the drying space, although drying at room temperature is also possible.The drying process typically takes around a week. **6. Painting:** Apply paint to the dried products. Acrylic paint can be used, but there is a consideration for a more sustainable alternative.Explore adding the sustainable paint during the mixing process, reducing the need for extensive painting to only the details. 7.

Side note: The simplicity of the process is emphasized.Production time/speed depends on industrial versus manual processes, the number of molds available, warmth in the drying area, the availability of personnel, and the accurate execution of the step-by-step plan.

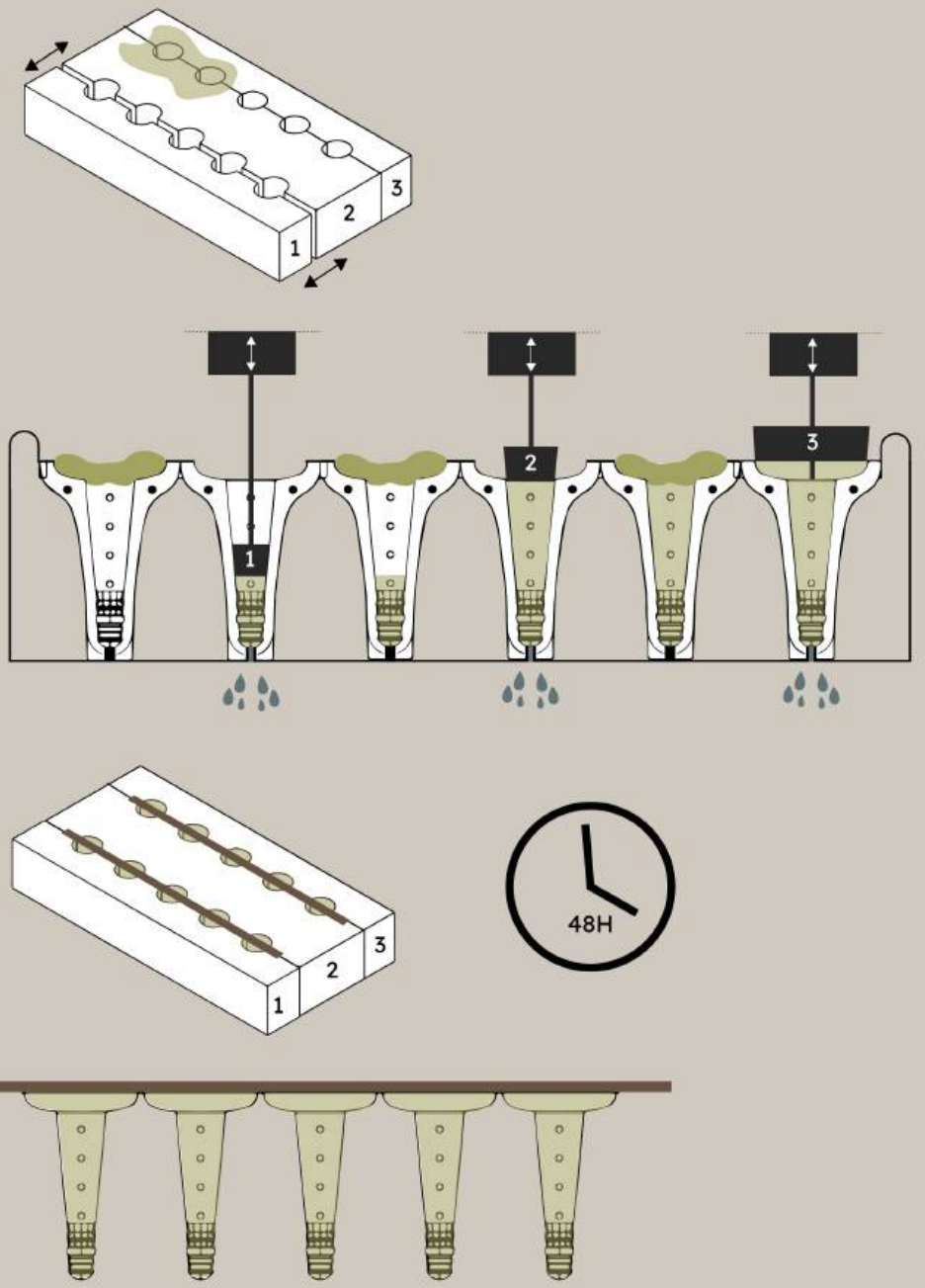
Display
Pulp lighthouse

For the lighthouse display, we have meticulously opted for the incorporation of pulp in its design. The choice of pulp as a medium, coupled with the precision of laser engraving, imparts a remarkable finish to the display. The continuity of the pulp material, from which the lighthouse is crafted, seamlessly integrates into the overall composition, ensuring a cohesive and visually appealing representation.


De Lokaal Gemaakte Vuurtoren
Gemaakt van lokale reststromen op Schiermonnikoog

Production pulp lighthouse

The proces will be the same as Chpater 1.1: Lighthouse but this is a production for more pulp lighthouses. The mold is made for 10 pieces with 3 parts. Number 1 and 3 are parts to open and close the mold before and after drying. You put the pulp into the mold and after it you need to mash the pulp multeple time to release the water. After 48 of drying you can open the mold and you have 10 pulp lighthouses.



Next steps lighthouse

Our goal has been achieved in creating a locally-produced replica of the lighthouse using waste streams from the island. However, the lighthouse is not yet complete; here are the next steps for its development:

Design and Testing:
It is important to reconsider various designs for the lighthouse and test them with the target audience. By placing different versions in the tourist information (VVV) shop, it can be determined which design appeals most to customers. Possible adjustments include adding or omitting details, testing different colors, and experimenting with designs where part of the material is left unpainted, giving, for example, the base a natural look resembling the dunes or the beach.

Bio-paint Research:
Further investigation into bio-paint is necessary, with a specific focus on using food waste to create paint for decorating the lighthouses. Previous tests with swill and agar agar showed that it is possible to develop bio-paint with vibrant colors, but applying it to the pulp proved challenging. Further study may reveal methods for effectively applying bio-paint to the lighthouses.

Scaling Up Production:
For the lighthouses, it is crucial to research methods for scaling up production. The manual production of lighthouses is time-consuming, so developing a mold for mass production is essential. Additionally, exploring how to reduce the drying time of the pulp, possibly by creating a warmer environment, is important. Efficient large-scale post-processing, including sanding, finishing, and painting, must also be investigated to streamline the process.

1.2 Schierzicht Pulp material

Requirements

Wastestream materials
Esca cardboard
Plate of pulp
MDF wood

Extra material
None

Tools
Lasercutter
Computer with Photoshop/illustrator/ Solidworks/Rhino

Contact
Eska

Dimensions
18 cm x 22 cm x 4 cm

Purchase price
For calculating the cost price, it is essential to know the material from which it is made. Costs for the panels—pulp, esca, and MDF—vary. Drawing comparisons with similar products, we estimate Schierzicht's selling price to be €14,99.
(See appendix)

Schierzicht is a decorative construction kit. It is a kind of diorama, a decorative piece that provides a sense of depth. With Schierzicht, you build your own perspective of the island. On the Schierzicht, you can see all the well-known landmarks of Schiermonnikoog, such as the Noordertoren, The Baken, The Monnik, The Church, and the Typical Island Houses.

1. Collecting material: Collect the materials to create pulp panels. This involves gathering sawdust from pruning waste and cardboard. You can choose to use either MDF wood or gray cardboard sheets from Eska. **2. Design:** Create an outline of a famous building on Schiermonnikoog using your preferred design software. You need to design on 3 plates. The background, middle part and the frot part.. **3. Laser cutting and engraving:** After completing your design, the cardboard/ pulpplate/ mdf plate can be placed in the laser cutter and is ready to be cut and engraved. **4. Assembly kit:** After laser cutting and engraving, you will have separate components: a backplate, a middle plate, a front plate, and 8 connecting pieces. Use the 8 connecting pieces to assemble the kit. Ensure that you arrange the plates in the correct order.


SCHIERMONNIKOOG

Display Schierzicht

The Schierzicht display has not been finalized. This design question remains open as Schierzicht can be made from three different materials (Eska cardboard, pulp plate, and MDF wood). The next team will need to make the decision and, therefore, has the entire design question. Freiia team 1 does have a vision for the display, which is to highlight the dunes. The design skillfully showcases a representation of these picturesque dunes, creating a visually captivating scene within a compact display. The choice of a compact format aims to enhance the overall aesthetic while maintaining a sense of elegance and efficiency.

Jouw kijk Op Schiermonnikoog

Een lokaal gemaakte souvenir

Next steps

The material for Schierzicht has not been chosen yet. The design is ready, but testing and selection of the material for Schierzicht are still pending. The display needs to be redesigned. The display tells its own design story. We have selected the following points to proceed with:

Pulp plates:
For the Schierzicht, it is first and foremost interesting to continue the research on pulp-made panels. Developing thinner panels opens up the possibility of interlocking them similarly to how it is currently done with MDF panels. Additionally, there is a need to explore methods to prevent the panels from warping during the drying process.

Contact with Eska:
In addition to investigating pulp as a suitable material for the Schierzicht, it is also worth exploring a potential collaboration with Esca to produce the Schierzicht from gray cardboard. This material is more sustainable than MDF and aligns better with the VVV's vision.

User research:
Finally, for the Schierzicht, it is intriguing to experiment with new designs, all related to Schiermonnikoog. Testing these designs at the VVV allows for an assessment of customer preferences and needs.

1.3 Prototypes next iteration

The next prototypes are ready for an iteration. All products are made using the same pulp process as the lighthouse in Chapter 1.1. However, each prototype has a different mold. The prototypes are described, followed by suggestions for the next iteration steps.

1.3.1 Lighthouse block-tower

Context

The pulp block tower is made of cardboard, wood fiber, wood sawdust, and a dye. Each block has a different color to determine which color looks best. The molds are 3D-printed with a 1-degree angle so that the blocks can be easily stacked on top of each other.

Next iteration

The block tower looks beautiful, and the VVV as well as we are very positive about it. However, there is a need for some post-processing. When designing children's toys, you need to consider very specific requirements. Therefore, it is essential either to thoroughly research these requirements or to design the product in a way that is not specifically intended for children. Further iterations for the mold are also necessary to determine how water could drain away most effectively, as it is not doing so at the moment. The corners need to be sanded to allow the blocks to be stacked smoothly. The back of the block tower is less attractive because it was not pressed well.

1.3.2 Schiertuintje

Context

The Schiertuintje is inspired by the vegetable gardens from Albert Heijn. The Schier Gardens are filled with nutritious soil from Schiermonnikoog and local seeds, allowing you to bring a piece of Schiermonnikoog home with you. These gardens can be grown together with your entire family and arranged modularly on the windowsill or table for a cozy and communal atmosphere.

Next iteration

Many seeds are found on Schiermonnikoog. Not all of these plants will thrive in the Schiertuintje, and some are restricted from being taken off the island. Natural Monuments possesses knowledge about this, and further investigation is needed.

1.3.3 Keychain

Context

The pulp keychain is made from a pulp mix of wood fibers, sawdust, and brown cardboard. The block has been sanded to give it a refined appearance. Linseed oil has been applied to the block to make it water resistant. The rings are screwed into it so that you can attach the keychain to your bike key.

Next iteration

The keychain with the embellished piece of pulp looks beautiful. However, there is one problem: the pulp is not water-resistant. If attached to your bike key, there's a high chance it might get wet in the rain. The goal for the next iteration is to add a water-repellent layer to the product.

1.4 Research & Test pulp

This chapter focuses on research and testing, exploring the processes that led to the best results in creating the final product. It provides additional information for upcoming iteration cycles to further develop the sustainable lighthouse and prototypes.

1.4.1 Test pulp

In each measuring cup, hot water was added along with torn materials measuring 2.5 cm by 2.5 cm, and the mixture was left to soak for 24 hours. After the 24 hours, each mixture was blended in a blender to achieve a uniform substance. Some starch was added to each measuring cup for the bonding process. Subsequently, the mixtures were pressed into molds to extract the moisture.

Conclusion

The conclusion of the tests is that the thin layer of pulp works very well. It dries well, and the material is strong. For the next set of tests, there are a few areas for improvement. Firstly, the use of smaller mesh is needed, as flat pieces of pulp adhered to the mesh, causing damage to the pulp. Secondly, testing with 3D molds is necessary; this will allow the pulp to dry longer at a higher temperature, resulting in faster and better curing. Thirdly, a better blender should be acquired. Fourth, more accurate measurement recording is required. Finally, testing a wider variety of materials is essential.

Sample pulpmaterial

Grey cardboard (photo 1)

The material strength is low. In comparison to the square mold with brown cardboard, it remained much more humid. Consequently, the strength was unappealing and not feasible for use.

(photo 1)

Brown cardboard (photo 2)

We successfully bent the residual cardboard mold to achieve a round shape, similar to the paper test. The material's strength and curve resilience were satisfactory. Using a square mold with residual cardboard, we compressed the pulp and after 96 hours, the surprisingly strong block was not completely dry. We will continue drying to assess final strength.

(photo 2)

Mix (cardboard,paper, grass) (photo 4)

We used the square mold for the mixed pulp, similar to the brown residual cardboard test. Despite being not completely dry after 96 hours, it's notably drier and stronger, showing promise for souvenir production.

(photo 3)

White paper (photo 3)

The result was very positive as the form had completely hardened. The material strength exceeded our initial predictions. With this outcome, there could be potential considerations for the souvenir.

(photo 4)

1.4.2 pulp test

From the pulping research 1.1, it has been determined that pulp material holds promise for potential souvenirs. New tests were conducted, incorporating various forms of pruning waste. The different forms of pruning waste include grass/hay, ground sawdust, and coarser ground wood fibers. (The combinations always involve paper/cardboard pulp and potato starch.)

Conclusion

The conclusion of the pulp 1.2 research is as follows: A reinforcement must be added to the pulp. Without this addition, the pulp distorts, making it unsuitable for creating a souvenir. The objective is to create various molds with details, and this is not possible without an additional component. The addition of wood fibers and fine sawdust has a positive impact on both the strength and deformation of the material.

Sample pulpmaterial

Mixed cardboard + grass/hay (photo 1)

On photo 1, you can see a combination of cardboard + grass/hay. This sample has also completely dried, but it is evident that the sample has shrunk slightly during the drying process. If we were to use this material, it would deform during the drying process, which is not desirable. Therefore, the result is not very positive.

(photo 1)

Mixed cardboard + fine sawdust (photo 2)

On photo 2, you can see the sample of the combination between cardboard and fine sawdust. This block has also completely dried and did not shrink. The block is also very strong. This result is very positive.

(photo 2)

Mixed cardboard + wood fiber (photo 3)

On photo 3, you can see the sample of the combination between cardboard and wood fiber. This block has completely dried and is very strong. The block did not shrink during the drying process. This result is very positive.

(photo 3)

White paper (photo 3)

On photo 4, you can see a sample made solely from mixed cardboard. This sample has completely dried, but it is evident that the block has shrunk during the drying process. If we were to use this material, it would deform during the drying process. The result is not positive.

(photo 4)

1.4.3 Plate of pulp test

For test 1.3, we are building upon the conclusion of test 1.2. During this test, we will be experimenting with the production of sheet material, focusing on specific form tests. The emphasis will be on examining proportions to determine the strongest combination. Various lighthouse moulds have been created for this test.

Test 1 (photo 1)

The sheet material sample is strong; however, it has curved significantly during the drying process. Additionally, the sheet material exhibits good strength and is not brittle.

Test 1 recipe	
1.Cardboard/paper	1. 50%
2.Wood fiber	2. 25%
3.Fine sawdust	3. 25%
4.Starch	4. 7%
5. Water	5. 1L

(photo 1)

Test 2 (photo 2)

The sheet material sample is very strong. The material was somewhat rougher than the material in test 1, but it is easy to work with. The sheet material hardly deformed during the drying process.

Test 2 recipe	
1.Cardboard/paper	1. 25%
2.Wood fiber	2. 37,5%
3.Fine sawdust	3. 37,5%
4.Starch	4. 7%
5. Water	5. 1L

(photo 2)

Test 3(photo 3)

The sheet material was very brittle, leading to reduced strength compared to previous tests. The result is disappointing.

Test 3 recipe	
1.Cardboard/paper	1. 10%
2.Wood fiber	2. 10%
3.Fine sawdust	3. 80%
4.Starch	4. 7%
5. Water	5. 1L

(photo 3)

Test 4 (photo 3)

The sheet material is very strong. However, during the drying process, the sheet material deformed significantly. As a result, the quality of the material is lower.

Test 4 recipe	
1.Cardboard/paper	1. 75%
2.Wood fiber	2. 12,5%
3.Fine sawdust	3. 12,5%
4.Starch	4. 7%
5. Water	5. 1L

(photo 4)

Conclusion

The conclusion of pulp test 1.3 is as follows: during this test, it has been determined that an optimal ratio of 25% cardboard/ paper and 75% pruning waste results in the highest strength, toughness, and minimal deformation during drying. This ratio also proves to be the best for the lighthouse moulds.

Test 1.4.4 colour test

To achieve the goal of turning pulp into a lighthouse, a mold has been created. The mold was made in the MakerSpace at Hanze University of Applied Sciences using a Formlabs Rigid 10K. The mold consists of two parts in which the pulp is pressed; subsequently, the mold is closed, and the pulp is left to dry. The mold contains holes to squeeze out the water. In each mould, a pulp mixture of wood sawdust and cardboard was used. (Lighthouses are from left to right, 1-4).

Lighthouse 1:
The lighthouse is warping, and the two halves cannot fit together. Additionally, the lighthouse does not have the intended color.

Lighthouse 2:
Beet juice has been added to the pulp mix to achieve the color of the lighthouse. Unfortunately, the color does not come through well, and the two halves do not fit together properly.

Lighthouse 3:
Beets and beet juice have been added to the pulp mix. The color is still not coming through nicely and does not match the intended lighthouse color. The two halves do not fit together well.

Lighthouse 4:
A mixture of agar agar and beet juice was spread over the lighthouse. However, this method is not effective as it results in crumbling.The twgo halves do not fit together well.

Test 1.4.5 lighthouse mold

For this research, we created various molds to test their effectiveness. As shown in Pulponderzoek 3.0, we tested the initial mold, which yielded successful results. Our next step is to explore the production of larger lighthouses and work towards a 1:1 replica of the current lighthouses. Below are the molds that were used.

Test 1 (photo 1)

We tested a two-part mold for creating larger pulp-based products, such as a lighthouse. Pulp is pressed from the bottom, and the top part of the lighthouse is added later. The result was positive, yielding a strong and durable material. Although the product is not yet to scale, our test for producing larger items from pulp was successful. However, the drying process for this mold is lengthy, taking about two weeks for complete drying.

Test 2(photo 2)

The second mold, designed for filling in details and assembling in two parts, did not yield the desired result. The attempt to add the top part was unsuccessful, as the pulp proved difficult to compress, resulting in a lack of sturdiness. This production method is deemed not viable

Test 3 (photo 2)

The third mold, composed of two halves for filling details on both sides and subsequent assembly, has proven to be highly successful. The resulting lighthouse displays excellent strength and sturdiness. The mold is easy to compress, ensuring the desired strength, and it allows for a quicker drying process due to increased air exposure. It's essential for the lighthouse to remain in the mold until fully cured to prevent potential warping of the two halves.

(photo 1)

(photo 2)

(photo 3)

02

Bicycle tires

On Schiermonnikoog, cycling is the most common mode of transportation. Almost everyone visiting the island explores it on a bike. With the 300.00 tourists every year, bike tires collectively wear out. Every two years, the municipal yard accumulates fifteen m3 of tires that are no longer suitable for use, this equivalent to a shipping container full. These tires are made of vulcanized rubber, which cannot be melted. However, the material can still be upcycled.


Fietsen

2.1 Keychain Bicycle-tires

Requirements

Wastestream materials
Metal from outer tire
Outer tire bike
Inner tire bike

Extra material
White powder paint
White acrylic paint
Wood to staple on

Tools
Lasercutter
Computer with Photoshop/illustrator/ Solidworks/Rhino
Stapler gun

Contact
Freiia team 1

Dimensions
Size S: 45 x 28 mm
Size M: 62 x 30 mm
Size L: 73 x 31 mm

Purchase price
In consideration of production time, material, transportation, packaging, and labor costs, a cost calculation is made for the keychains of a producting of twenty units. One keychain costs €0,69. For a batch of twenty pieces this amounts to €19,22. Taking a profit margin of 2.5 percent, the selling price of one keychain is €2,90 incl. btw. No workspace and machine cost.
(See appendix)

A keychain hanger made of tire can be made from outer tires of bikes that are no longer in use, and of inner tires that are not useful anymore as tire. It is a local wastestream, making the price of the material incredibly low and making the wastestream into something useful as well. A true upcycling process. The purpose of this keychain is to raise awareness among people that most souvernirs are originally manufactured in factories on the other side of the world. This needs to change to local materials and it makes quite a difference if they are wastestreams.

1. Material collecting: collect tires at Soepboer fietverhuur and clean the tires with water and soap. Keep the tires in a dry box until they are needed. **2. Preparing lasercutter:** Once the new keychains are needed, the tires need to be cut into size for the lasercutter. First the tire needs to be cut horizontally. After, the metal strips that exist on the side of the tire, need to be cut off. Suggested to use a Stanley knife to carefully cut the rubber. After the removal of the metal, the rubber needs to be cut to size, about 15 to 20 cm. The parts need to be tacked onto the wood. **3. Laserengraving and cutting:** Put the wood with the rubberparts in the lasercutter and let the program run. It takes about 3 minuts to engrave 5 keychians. **4. Cleaning:** clean the freshly engraved parts with water and soap. Dry off as well. **5. Take parts and paint:** Take the rubber parts that are cut and engraved and clean. Put the amount of one pea of white paint and spread on the rubber with a small amount of tissue. Take off any excess paint. Let dry. Explore other paint options, like chalk paint. **6. Connect with ring:** Open bottom ring with pliers and close around the hole in the top of the keychain.

Side note: The process is an exact explanation of how it is done right now. Production time and speed can be way higher in a more industrial versus manual process. This will also reduce the costs when the sales are higher. The costs are also dependant on the life of the lasercutter, so it should be cared for and cleaned often. The accurate execution of especially the painting is very important as well.

Display Bicycle Keychains

In our pursuit of encapsulating the spirit of exploration inherent to the island, we have embraced the “biking” aspect in our bicycle-themed product. Recognizing the widespread use of bicycles as a preferred mode of exploration, the display for this product is carefully crafted to evoke a sense of personal connection with one’s own bicycle journey on the island. The design invites users to reminisce about their experiences, fostering a connection between the product and the unique, immersive adventures facilitated by island biking.


Mooi Fietsen
Jouw BAND met Schiermonnikoog
Sleutelhangers gemaakt van oude fietsbanden op het eiland

Next steps

Our goal has been achieved in creating a locally-produced replica of the lighthouse using waste streams from the island. However, the lighthouse is not yet complete; here are the next steps for its development:

Production alternatives:
For the keychains, it is first and foremost important to investigate the fastest and most cost-effective production methods. Currently, bicycle inner tubes are cut into pieces, attached to a plate, and then laser-cut. The goal is to explore how the number of steps can be reduced and if alternative production methods can be implemented. This may involve considering the use of a die-cutting process instead of a laser cutter, which can not only reduce production time but also lower costs.

Explore new designs:
Secondly, for the keychains, it would be interesting to explore new designs and potentially develop a collection of various designs under the same theme. This exploration could also involve assessing whether a diverse range of designs contributes to expanding the target audience.

Use everything:
Finally, for the keychains, it is intriguing to investigate the possibility of creating the entire product from recycled bicycle inner tubes. This means replacing the metal hanger with old inner tubes. Thin strips could potentially be created and then intertwined to form a rubberized hanger.

2.2 Prototypes next iteration

The next prototypes are ready for an iteration. The production is the same as chapter 2.1. Ideas have been generated for both the inner and outer tire. There is potential in the prototypes, but they have not been completed.

2.2.1 Shape keycord

Context

For children, it's enjoyable to create keychains featuring a cool seal or a happy sea dog, adding emotions to the keychain. This can also be achieved through embroidering the island's boat or its outline.

Next iteration

For the next iteration, the goal is to create a series of categories for seals. For example: sports seals, emotion themed seals, and seals in different colors. This concept can also be applied to bicycles, boats, or other typical aspects of Schiermonnikoog.

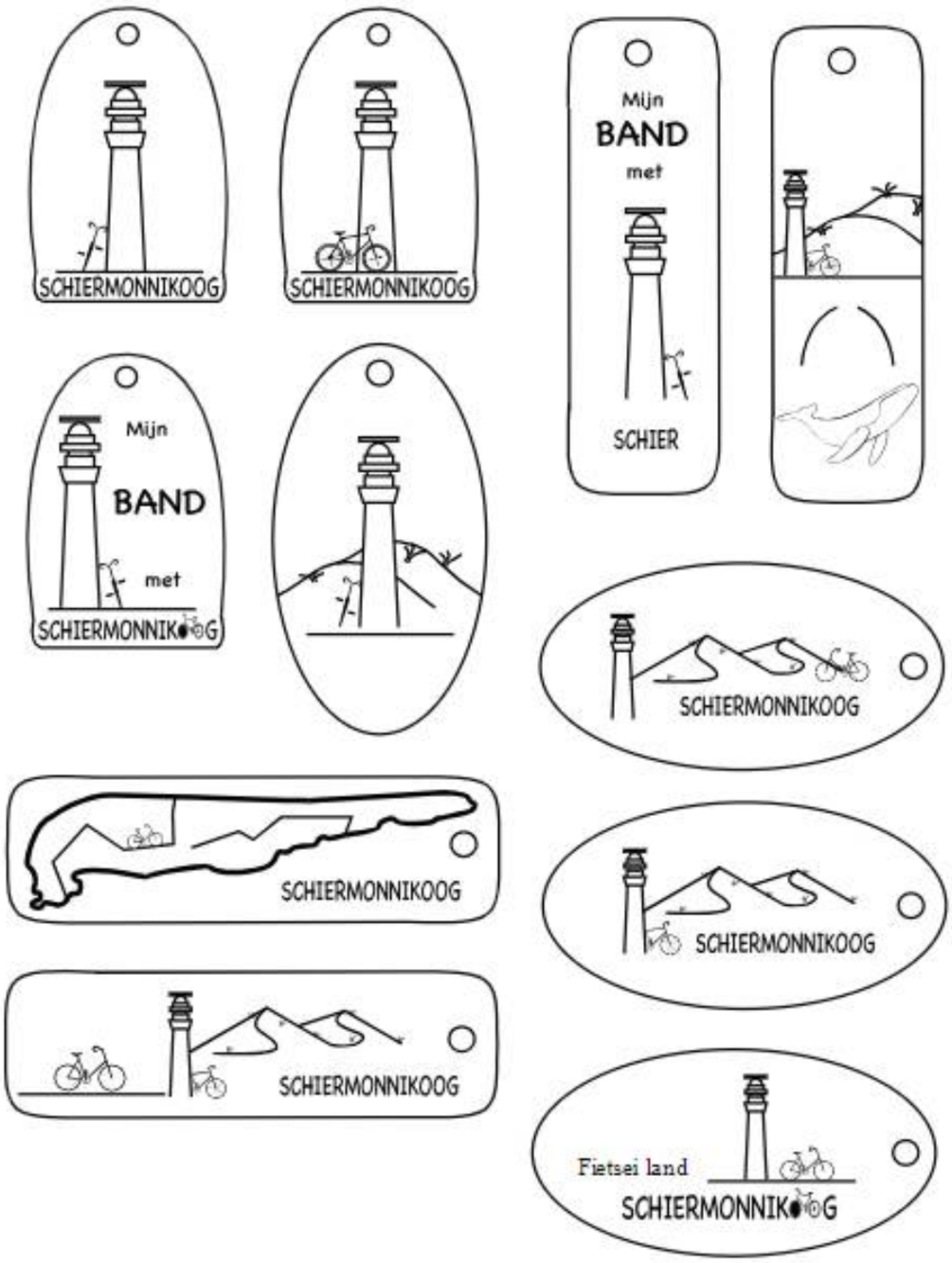
2.2.2 Fish keycord

Context

The inner tube has been tested for flexibility, being folded and rolled. Attempts were made to cut out a fish shape using a laser cutter and then fold the ‘lips’ to create the illusion of thick lips on the fish.

Next iteration

For the next iteration, the aim is to design a less realistic fish where the ‘lips’ stand out effectively. Currently, a realistic fish doesn’t align with the design. The material is easy to roll, opening up many more possibilities in terms of shapes and forms.



2.3 Research & Test Tires

This chapter focuses on research and testing, exploring the processes that led to the best results in creating the final product. It provides additional information for upcoming iteration cycles to further develop the tire keychain and prototypes.
For every hanger, an old tire was used. Because every tire from every brand is different, the first solution was to try inner tires. That cancels the problem of different tires, as the inner tires are way more similar.

Samples and tests done to get to results are first three different sources of vulcanized rubber, those sources are: Inner tires car, Inner tires bike and outer tires bike.
The tests with those samples include embroidery, cutting with scissors, laserengraving and lasercutting, using paint, using a sailing ring and using metal keychains or rubber hangers. Also using the material itself as a shape instead of processing the material.

Conclusion: The best results are booked when we use the outer tires of a bike, because that shows the connection between biking, the island and the souvenir. When white paint is added to highlight the laserengraved details, and the outer shapes are lasercut, the details stand out. Then the metal keychain finishes the product.

03

Coffee-ground

Coffee grounds represent a significant waste stream due to the substantial amounts generated by restaurants/cafés and, of course, the boat. The coffee ground is already used for the production of oyster mushrooms, but also has a lot of potential to combine with other materials, for example with soap to make a nourishing scrub.

3.1 Prototypes next iteration

We made coffeesoap. A combination of Coffeeground and soap base. Als we add with same tests oranges peels and vanille extract. This is our way to make coffeesoap, there are multible other ways. Coffee contains anti-oxidants which the skin absorbs, also because of the grounds the soap naturally has a scrub effect.

3.1.1 Coffeesoap

1.Material Collection: Gather dried coffee grounds, a fragrance extract, and if you want to add an additional waste stream, consider including orange peels. Purchase soap base made of a composition of glycerin and natural fatty acids. **2. Prepare for Melting:** If you plan to melt the soap base in the microwave, use a container; otherwise, use a saucepan if melting on the stove. Take approximately 100 grams of soap base. **3. Combining:** Once the soap base is melted, add coffee grounds and stir together. Use about 100 grams of coffee grounds. **4. Add Extra Materials:** If you have vanilla extract, add it to your preference for a pleasant fragrance. You can also incorporate blended orange peels. Add approximately 25 grams. **5. Cooling Down:** Pour the mixture into silicone molds and let it dry until it hardens. This process typically takes between half an hour and an hour. Once complete, your soap is ready for use.

Next iteration

Find a way to make the coffeesoap more attractive. Use the colour black as a design, or the orange. An idea is the night of Schiermonnikoog.

3.2 Research & Test Coffee

3.2.1 ratio test

We've tested the best ratios for making coffee soap.

Test 1 (photo 1)

We have used the next ingredients: Soap base: HB cosmetics Soap base SLS Free, Coffee grounds We tested the shape and what the best ratio is. The conclusion is that the soap looks like candy.

Test 1 recipe	
1.Soap base 2.Coffeeground	1. 60 g 2. 50 g

(photo 1)

Test 2 (photo 2)

We found out that the combination of soap bases and coffee grounds makes the soap smelly. To overcome this problem we needed to add another ingredient(s).

Test 2 recipe	
1.Soap base 2.Coffeeground 3.Vanille extract	1. 100 g 2. 50 g 3. 10 drop

(photo 2)

Test 3 (photo 3)

The ratio was not what we wanted so we tried diffrent ratio.

Test 3 recipe	
1.Soap base 2.Coffeeground 3.Vanille extract	1. 100 g 2. 100 g 3. 10 drop

(photo 3)

Test 4 (photo 4)

After finding the right ratio, we added a new wastestream to it, orange peels. Conclusion is that the colour changed whichis good. The smell is not good.

Test 4 recipe	
1.Soap base 2.Coffeeground 3.Vanille extract 4. Orange peels	1. 100 g 2. 100 g 3. 10 drop 4. 50 g

(photo 4)

Test 5 (photo 5)

Adding anise bolls to the soap to create a starry night. Conclusion, this looks disgusting.

Test 4 recipe	
1.Soap base 2.Coffeeground 3.Vanille extract 4. Orange peels 5. Anise	1. 100 g 2. 100 g 3. 10 drop 4. 10 g 5. 5 g

(photo 5)

3.2.2 Other products

You can also use coffee grounds to make other products that have the potential to be sold as souvenirs.

Coffee Grounds Face Scrub:

Revitalize your skin with our Coffee Grounds Face Scrub—a simple, effective DIY exfoliation. Natural ingredients leave your skin refreshed and rejuvenated. Ingredients: 2 tbsp Coffee Grounds, 1 tsp Olive Oil, 1 tbsp Honey. Procedure: 1. Mix ingredients into a paste. 2. Gently apply, then rinse.

Body Scrub with Coffee Grounds:

Elevate your routine with our invigorating Body Scrub. Blending coffee grounds, sugar, coconut milk, and cinnamon, this scrub awakens your senses, leaving your skin smooth and energized.

Unwaste:

Proudly offering sustainable products: Shampoo Bars, Soap Bars, Scrub Bars, Hand & Body Wash. Ingredients: Coffee Grounds (Exfoliation, Cleansing, Nourishing), Orange Peels (Exfoliation, Cleansing, Nourishing), Coffee Oil (Nourishing, Antioxidant, Protective, Conditioning), Orange Oil (Nourishing, Antioxidant, Protective, Refreshing), Coconut Oil (Nourishing, Hydrating)

Kaffeeform:

Repurposing coffee grounds for eco-friendly cups. Utilizing recycled coffee grounds, wood fibers, and a plant-based polymer for sustainable, lightweight materials. In our latest material: Blend of plant-based polymer and recycled wood residues. No coffee aroma, subtle natural wood scent. Colorable with health-safe pigments.

Next steps Coffeeground

We have been in contact with the company Werfzeep, which already sells Schierzeep at the VVV. We have proposed the idea of whether they are open to collaboration.

They yield 150 soap blocks from a single batch. The cost of a soap block ranges between 3.10-3.60 euros, covering additional startup and registration costs. Currently, they produce soap blocks at a substantial annual scale, amounting to thousands. The soap production involves purchased lye and pure variants of olive or coconut oil. The entire production to delivery process, including ripening, spans approximately 12 weeks for obtaining samples, and the minimum order quantity remains unspecified. They have a dedicated packaging designer, and there is a commitment to maintaining this design approach. Schierzeep expressed concerns about the wastefulness of molds, suggesting that certain molds might be inefficient and could increase production costs. She proposed the idea of using molds made from recycled materials or waste products. Soap production requires EU registration, with ingredient registration costs falling within the range of 50 to 100 euros per ingredient. In the case of collaboration, Schierzeep prefers having a dedicated contact person throughout the entire process, from initiation to completion.

04

Mycelium material

On Schiermonnikoog, there is a growing awareness for self-sufficiency. The Pluktuin on Schiermonnikoog currently cultivates oyster mushrooms using the residual stream of coffee grounds from the hospitality industry and the boat. The root network of a mushroom is mycelium. Daily, there are eight bags of 4,5 kg mycelium extracted as a ‘waste stream’ since they no longer grow efficiently enough for the mushroom production. This ‘waste stream’ currently serves as compost for the garden but other purposes may also be considered.
Since the growing popularity and various applications of mycelium, we are seeing great potential in the material.

4.1 Prototype Lighthouse

4.1.1 Mycelium lighthouse mold

As wood fibers proved to be a good base material, and a waste stream we wanted to use, we created a block from the wood fibers and mycelium mix that could potentially be used as filling for a 3D mold. Unfortunately, the tests did not yield the expected results, likely due to the low humidity and high temperature in our greenhouse. It was also probably too light. Due to the precision required in the production process with mycelium, it is not an ideal material for a consistent souvenir.

4.2 Research & Test mycelium

4.2.1 Growing

Mycelium is a sustainable product, but its longevity depends on the environment. Indoors, it will remain intact for a lifetime. Outdoors, it will gradually break down. The material is not waterproof or suitable for outdoor use. As a result, it loses its stiffness and may break down quickly.

Mycelium can be sustainably dyed in two ways: using biobased paint or milk paint. Additionally, mycelium can be post-processed, for example, by cutting with a saw, drilling holes, or covering with laminated wood. We also recommend sealants, as the intention is for the material not to introduce toxic substances to the environment.

The material will be at least 1.5 cm thick and up to 10 cm thick. The mycelium can be made softer by removing it from the mold after 4 days and allowing it to grow in a sealed bag for an additional 2 days.

To achieve a solid form, mycelium needs to be baked in the mold used. You can use a regular oven for this process. Here are the steps for mycelium with a thickness of >2.5 cm:
Place the product in the oven for 3-4 hours at approximately 40°C with the door slightly open to allow moisture to escape.
Bake at 80°C for 2 hours.

For products with a thickness <2.5 cm:
Place the product in the oven for 2-3 hours at 80°C.

Test 4.2.2 growing test

Process how we did it with testing the myceliumgrowing.

1.Material Collection: Gather the following materials: Mycelium spawn, coffee grounds/wood fiber, a mould/ container/bag, a humid space. **2. Clean workspace:** Clean the workspace, including the mold in which you will cultivate the mycelium. **3. Mix mycelium:** The ratio of the added substrate (coffee grounds or wood fiber) should be equal to the mycelium spawn. Use the white portion of the mycelium spawn. Mix them together, using your hands and wearing latex gloves. **4. Add water:** Add water to the mixture until it reaches a dark chocolate color. **5. Add to a mould:** We placed the mixture in a sterile empty water bottle with three holes cut into it. This was done to allow oyster mushrooms to grow, but it is not necessary for the process. **6. Spray water:** Spray a small amount of water into three holes daily, and within 7 days, you will notice the mixture turning white. Once it becomes a frim white, you can use the mycelium.

Next steps Mycelium

Due to the unsuccessful outcome of our test, significant improvements are necessary in the growing process. Creating an ideal climate is crucial for mycelium growth, and acquiring a greenhouse along with a humidifier is essential. Additionally, we observed that mycelium requires ample space to thrive, so avoiding excessive compaction in the mold is crucial. Once these adjustments are implemented, we can explore subsequent steps. Despite the setbacks, we still see a lott of potential in the material.

Epoligue

With the completion of Project Freiia, we look back with pride on the journey we have undertaken. This project, funded by Inntereg North Sea, challenged us as students of Industrial Product Design at Hanze University to discover new materials and embrace innovation. Our goal was to design a locally produced product, a souvenir made entirely from local (waste) material streams, to contribute to the self-sufficiency of the island.

Throughout this process, we collaborated closely with our client, the VVV, and learned a great deal. Delving into local materials, conducting tests, and exploring sustainable alternatives were all challenges we faced. Engaging with organizations such as the inspiring Pluktuin on Schiermonnikoog expanded our network and deepened our understanding of sustainability.

A particularly significant highlight of our project was the discovery of new applications for materials such as mycelium, coffee grounds, and pulp, which were previously considered ‘ waste.’ Recognizing the potential in these materials and contributing to the circular economy further motivated us.

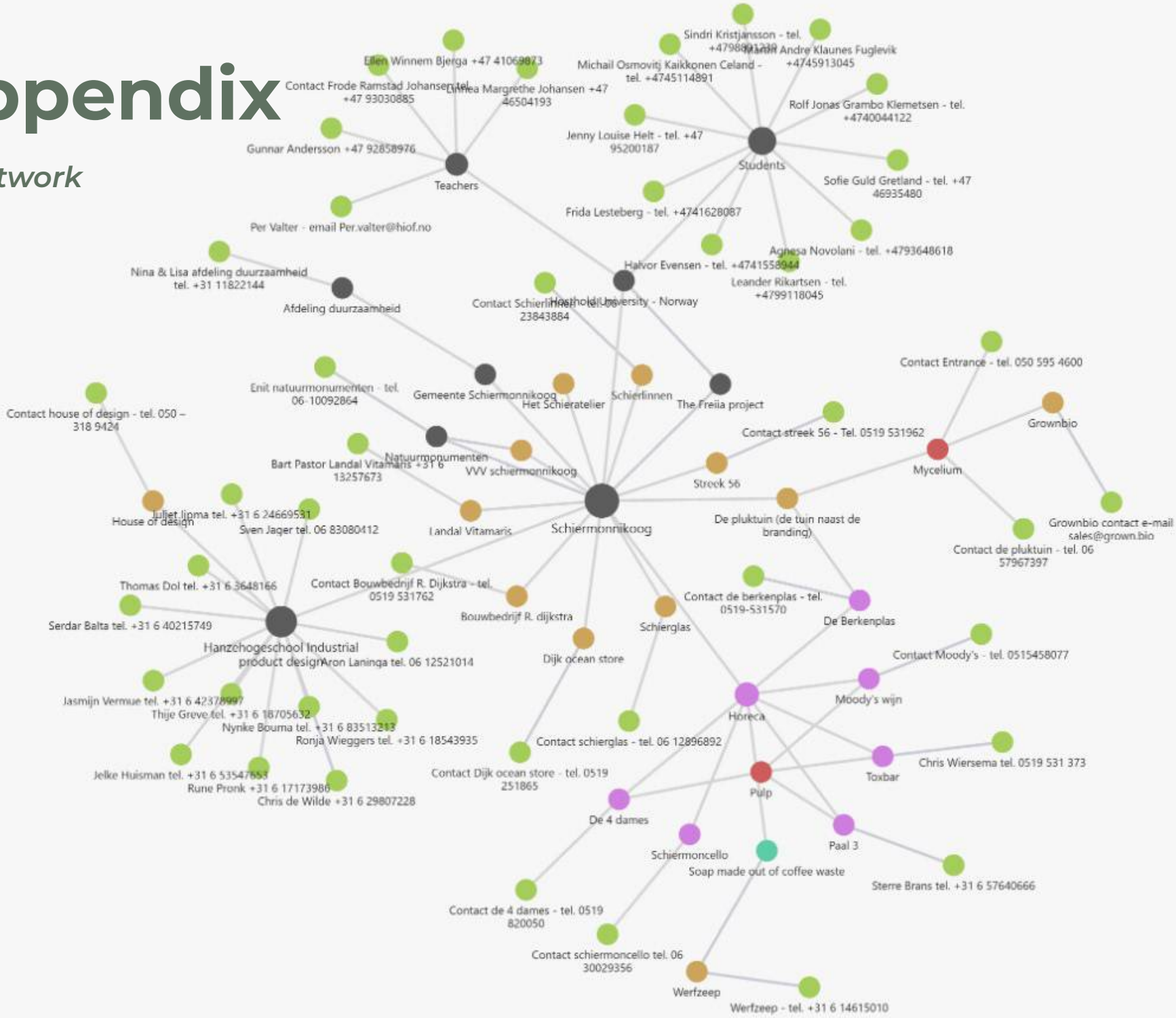
We would like to express our sincere thanks to all involved parties, teachers, fellow students, and local communities who supported and informed us during this adventure. Their insights, feedback, and enthusiasm enriched and further propelled our project.

Although this project is coming to an end, we hope that the ideas and solutions arising from Freiia will have a lasting impact on sustainability and self-sufficiency. We look forward to a future where innovation in biobased materials becomes increasingly important, not only on Schiermonnikoog but worldwide.

Thank you to everyone who was part of Project Freiia!

Appendix

Network



Purchase price

Lighthouse purchase price

Step:	**Time (production of 10)**
Shred old paper, pruning waste	5 min
Put shredded material in a large container	1 min
Add water	1 min
Soak (24 h)	-
Fill molds 1	5 min
First pressing head	5 min
Fill molds 2	5 min
Second pressing head	5 min
Fill molds 3	5 min
Third pressing head	5 min
Drying (48 h)	-
Post-processing	20 min
Painting (red base)	5 min
Painting (details)	20 min
Total:	82 min (1 h 22 min)

Costs:	**€**
Material costs	
Pruning waste	**€ 0**
Old paper	**€ 0**
Paint	**€ 2 ,00**
Transportation	*
Packaging	**€ 0,43**
Labor costs (€17.74/h)	**€ 23,85**
Total:	**€ 25,85**

Purchase price

Keychain purchase price

Step:	**Time (production of 20)**
Cut metal from the tire	8 min
Cut tire into shorter pieces	3 min
Staple tire onto plank	10 min
Place in laser cutter	-
Set up and turn on laser cutter	10 min
Remove from laser cutter	-
Wash on the plank	5 min
Detach hangers	2 min
(If necessary) Trim edges neatly	10 min
Paint	7 min
Add ring	5 min
Total:	**Around 60 min**

Costs:	**€**
Material costs	
Inner tube	**€ 0**
Outer tube/tire	**€ 0**
Paint	**€ 0,05**
Rings	**€ 1,00**
Transportation	*
Packaging	**€ 0,43**
Labor costs (€17.74/h)	**€ 17,74**
Total:	**€ 19,22**