AlgaeShape

Final Bachelor Report 2020

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SUMMARY

This report shows the design process to develop the service AlgaeShape. AlgaeShape provides designers with a different way of working and especially iterating with textiles. Through the use of sodium alginate, a salt extracted from brown seaweed, you can get a gel with a wide range of properties. This gel can be used instead of sewing seams or folds, but can also be used as coating and to create three-dimensional shapes with the fabric.

My process started with a material exploration using natural dyes such as red cabbage and turmeric. After this, I shifted my focus to Kaumera and next to sodium alginate.

Using a material driven design method, I started tinkering with the sodium alginate and created fibres, films and coating. After the midterm demo day, I decided to focus on using the alginate as a way to shape fabrics.

At this moment in time, I also started collaborating with Minne Zeijdner, a fellow student. She was in need of a material that could be used to temporarily shape garments. The material should be easy to apply and remove. Sodium alginate seemed the perfect material for this.

In this collaboration, I focused on the more technical aspects of the behaviour of the material, while Minne focused on creating clothing with it.

Based on the requirements I received from Minne I did multiple experiments to determine the shrinkage of the alginate and to test how it could be kept flexible. Besides, this I also conducted a user test to see how people perceived this material since it is unknown.

I translated this knowledge into the platform AlgaeShape. Through three iterations, a platform was developed that provides both detailed information for users with a clear goal in mind, as well as photos and projects for users in search of inspiration.

The goal of AlgaeShape is to reduce the amount of fabric used during iterations and to inspire designers to use textiles in innovative ways.

PROLOGUE

Nature is often a place for me to recharge and to get inspired. The little wonders in nature can give me energy and show how beautiful the world can be. Those little moments of wonder are also something I want to achieve with design. Inspiration can come from nature in the form of colours, patterns and solutions.

With my Final Bachelor Project, I aimed at designing a product that would allow people to experience a somaesthetic experience. To create such an experience, it is important to consider all the senses and use an embodied way of designing.

From a previous project, I knew that the Crafting Everyday Soft Things squad greatly values working from and with materials. You experiment with them and see what the material might be suited for. This way of working appeals greatly to me since it involves your whole body.

Starting my FBP, I had no clear direction for my project. Knowing from my previous project in the CEST squad that you first had time to explore materials and start your design from there, I did not want to start with a fixed concept in my head. Over time, my project evolved and gradually took shape. While I often felt lost, it has led me to a project and a result I could not have come up with beforehand.

INTRODUCTION

The textile industry is an example of an industry that has changed drastically since 1900 (Claudio, 2007). Before the first world war, clothes were worn for a long period and this period was extended as long as possible by mending the clothes. With the industrial revolution, fabrics became cheaper and chemical dyes were invented (Science museum, n.d.).

Clothes could now be dyed in multiple colours without the use of plants. However these dyes were harmful to the environment and while the dyes have changed since then, textile dyeing and treatment is still accountable from 20% of the water pollution worldwide (Science museum, n.d.).

Not only dyeing fabric is polluting also the fabrication of fabric can be harmful. Synthetic fibres such as polyster are made from petroleum and natural crops such as cotton require much water (Claudio, 2007). On top of that, the work has been shifted to countries with no strict rules and low wages.

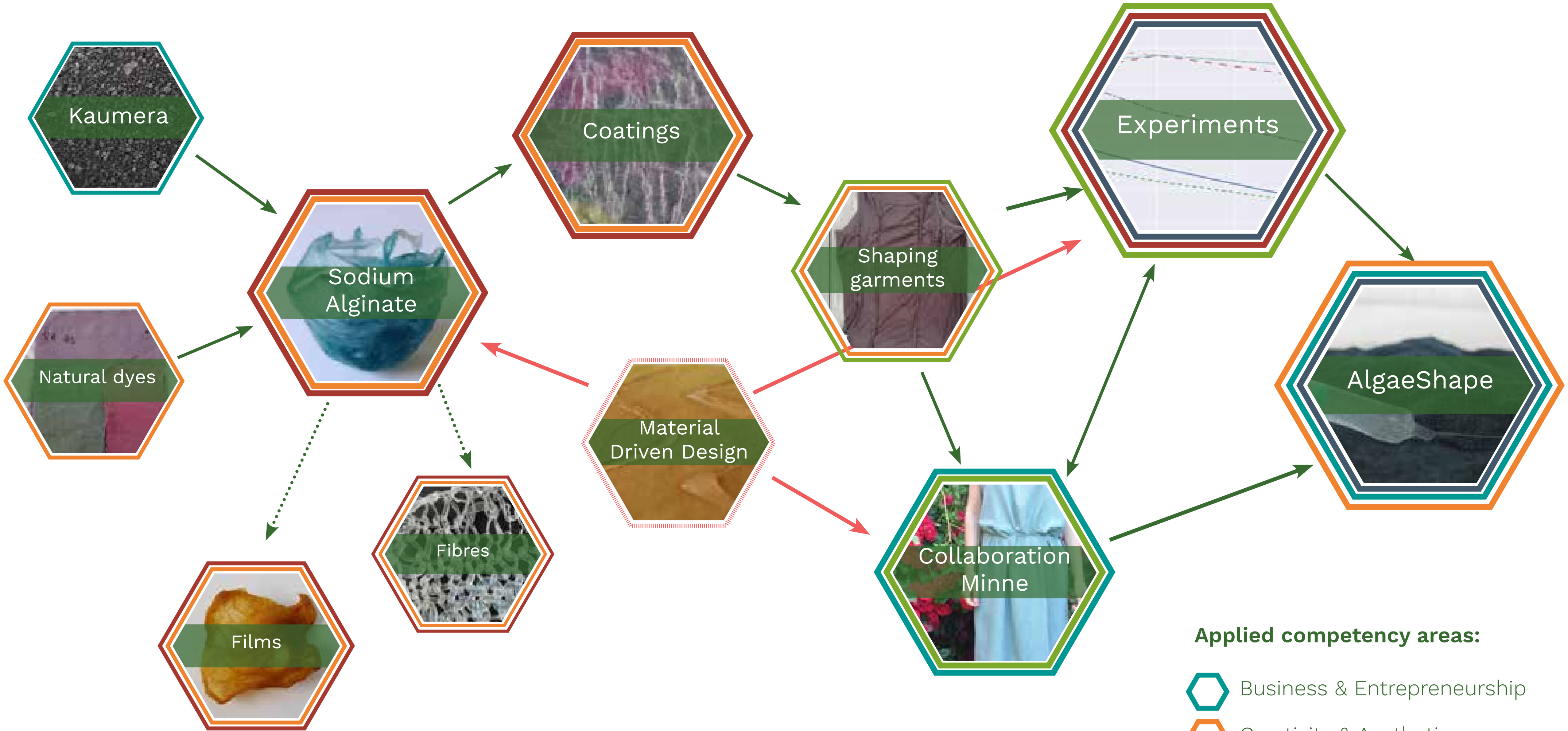
Taking all that into account, it seems ridiculous that we can buy fabrics so cheap that we do not even consider extending their lifetime because it is often cheaper to buy something new.

You may wear your clothes for a longer period of time, but when designing with textiles you are constantly iterating. The life-time of a textile prototype can be very short. Small adjustments can be made, but if something needs to be very different the textile ends up as waste. If you are aware of this problem, you might unpick seams to use it again when needing a smaller piece of fabric but this requires time and effort.

Since I have designed with fabrics before, I have had first-hand experiences with this problem. During the material exploration in this project, I have found a method that makes it easier to assemble and disassemble fabric. My hopes are that if it is easier to disassemble the fabric might be used more than once which reduces a bit of waste.

In this report, you can read my process towards finding this method and developing a service around this method. Where possible, I have used unbleached cotton and reused my samples to diminish the impact of this project on the environment.

DESIGN PROCESS



Applied competency areas:

- Business & Entrepreneurship
- Creativity & Aesthetics
- User & Society
- Technology & Realization
- Math, Data & Computing
- Design & Research process

Image sources:
Kaumera: (Poort, 2018)
Collaboration Minne: (Zeijdner, 2020)

CHAPTER I

From biomimicry to natural dyes and Kaumera

BIOMIMICRY

One important aspect of design and my vision is the influence of our design on nature. We as designers are in the ideal position to change the way products are made and hence if and how they can be recycled. While consumers start to get more aware of their ecological impact, they do not always act accordingly.

Through biomimicry, we as designers can learn from nature, since nature has been designing for a long time. When applying a biomimetic approach, one looks at nature for strategies and mimics or learn from them to solve human challenges (Biomimicry Institute, n.d.).

TEXTILES

My focus during this project will lay on textiles and other soft materials. Textiles were initially used by humans for the purpose of protection (Das, Bhowmick, Chattopadhyay, & Basak, 2015). In the beginning, humans used what they could find in nature; leaves, feathers, animal hides etc. However, even before our recorded history, humans seem to have made their own fabrics.

The inspiration for making fabrics might already have been an example of biomimicry. The structure for weaving can be seen in a nest of a weaverbird and also the bark of coconut trees have a woven texture (Das et al., 2015; Eadie & Ghosh, 2011).

In more recent years we have also used biomimicry to make textile water repellent by mimicking the microstructure of duck feathers, decreased the drag by looking at shark skin and also the well-known velcro is inspired by nature (Das et al., 2015; Eadie & Ghosh, 2011).

Also for colouration, we can look at nature for inspiration. All kinds of plants, algae and bacteria can be used as a dye. To me, it is even more interesting than nature is capable of creating the illusion of colour with photonic crystals (Eadie & Ghosh, 2011). These crystals influence the way the light is reflected and this influences how we perceive the colour. The animal or plant itself has no colour but due to its structure, we perceive them as having a certain colour. By changing the micro-structure of these crystals you can change the colour.

This concept is promising for textiles since it would mean that no dye would be needed and chemical dyes are polluting for the environment.

However, having an idea that is inspired by nature does not directly means it is sustainable. The concept from Velcro is inspired by nature, but it is made from non-renewable sources such as oil.

NATURAL DYES

Inspired by the photonic crystals and their ability to change the perceived colour, I started to look into natural dyes that might produce the same effect.

In chemistry, one uses the colour change of litmus paper to determine the pH of a solution. Litmus paper is made from red cabbage, which could also be used as a textile dye.

By making a dye bath of red cabbage and turmeric powder I was able to dye unbleached cotton purple and yellow respectively. In Table 1 an overview of my exploration can be found

As can be seen, the simmering time and soaking time (off-heat) has a great influence. The effect of the pre-mordant is not directly visible, but might become visible over time.

Both dyes faded quickly when placed in the sun (Figure 2, Figure 3).

The samples were made using two dyes baths. From another test it also became apparent that the concentration red cabbage or turmeric in the dye has a great influence on the colour (Figure 4).

Both the red cabbage and turmeric reacted on a change in pH. The more extreme the pH, closer to zero or fourteen, the brighter the colours of the fabric (Figure 1).

Figure 1. Effect of pH on red cabbage dye

Figure 2. Red cabbage dye samples (RK #1; RK #3; RK #4; RK#5)

Sample	Dye	Pre-mordant	Co-mordant	Simmer time	Soaking time	After treatment
Ku #1	Turmeric	-	-	30 min	0 min	-
Ku #2	Turmeric	Vinegar	-	30 min	0 min	-
Ku #3	Turmeric	Vinegar	-	30 min	18 h	in sun
RK #1	Red cabbage	-	Salt	-	18 h	-
RK #3	Red cabbage	Vinegar	Salt	30 min	18 h	-
RK #4	Red cabbage	-	Salt	30 min	-	in sun
RK #5	Red cabbage	Vinegar	Salt	-	18 h	-
RK #6	Red cabbage 2	-	Salt	30 min	20h	-

Table 1. Overview dyes and mordants

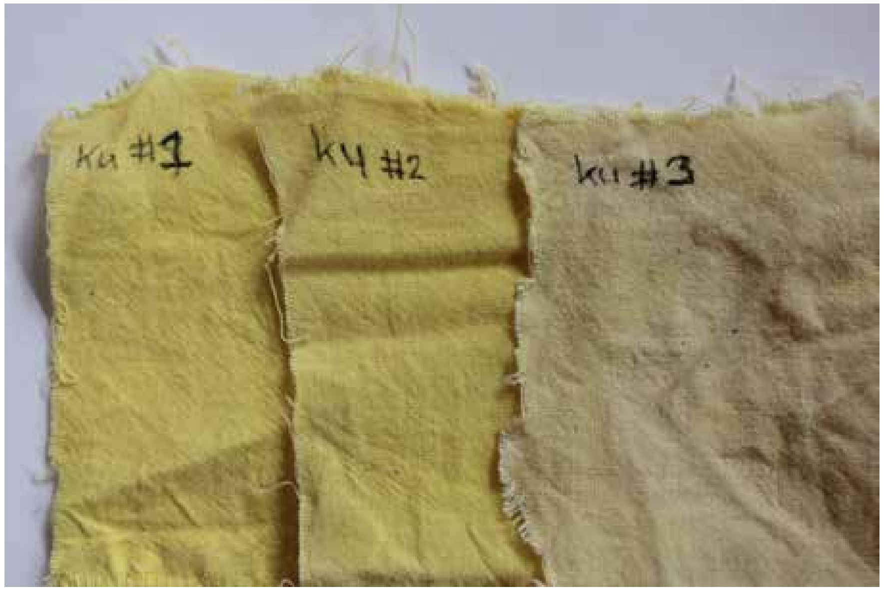


Figure 3. Turmeric samples (KU #1; KU #2; KU #3)

Figure 4. Red cabbage sample with higher and lower concentration dye (RK #3, RK #6)

BENCHMARKING

Natural dyeing has been done for centuries and an extensive list of plants is available for every colour(Flint, 2010). However, because it is not colour-fast it is not used in the dying industry.

More recently, people started experimenting with bacteria and algae to dye fabrics (Hobson, 2014; 'LABORATORIUM', n.d.).

Nienke Hoogvliet (n.d.-a) dyed fabrics with herbs and found out that the essential oils of those herbs can be transmitted when dying the fabric. This gives dying a new dimension; not only transmitting colour but also oils that spread a certain smell and may even have medical effects (Hoogvliet, n.d.-b).

A change in pH can be an indicator for several processes in the human body, your pH can tell something about your health and whether or not you are sweating.

Sweat is acidic and would change a red cabbage fabric to a more pinkish colour. In various literature pH monitoring with red cabbage or other solutions is done to check one's sweating and/or health (Chigurupati, Saiki, Gayser, & Dash, 2002; Coyle et al., 2009; Curto et al., 2012).

Food spoilage also results in a pH change and hence fabrics or other material dyed with pH-sensitive materials can be used as smart packaging to monitor food spoilage (Ebrahimi Tirtashi et al., 2019; Liu et al., 2018; Ma, Liang, Cao, & Wang, 2018).

KAUMERA

Through the website of Studio Nienke Hoogvliet, I discovered Kaumera, a bio-based polymer extracted from wastewater (Hoogvliet, 2018). She experimented with this and used dyes extracted from the wastewater and the Kaumera to make the fabric absorb the dye better.

The extraction of Kaumera in wastewater is a very new process and is currently only done in Zutphen, the Netherlands (Kaumera, n.d.). In March 2020, the first batch was produced and they are still doing research for new applications.

Working with such a new product and being able to explore both broad and deep appealed to me. I like exploring new fields and where natural dyes have been explored for a long time, this material is still very much unexplored.

Through the Waterschap Rijn en IJssel I came in contact with two people working at the installation in Zutphen and I was invited to come and visit. Unfortunately, this meeting was cancelled because of the COVID-19 pandemic and they forgot to send me a small test batch before closing the factory for maintenance.

During my preparation for this meeting, I learned that Kaumera resembles sodium alginate and I had already started experimenting with that to get a head-start with Kaumera. After hearing that it was not possible to work with Kaumera I decided to focus on sodium alginate.

Reflection

This first exploration helped me to find an interesting direction. In the beginning I was stuck in reading literature and did not know what to make. Once I started experimenting with the dyes, the ideas started coming and I become more productive. Because research is something that I enjoy doing, this is a known pitfall for me and the best way to get out of this mode, is start making.

CHAPTER II

Material driven design approach and Material tinkering

MATERIAL DRIVEN DESIGN

After deciding to work from a material and not with a problem statement or user-centred design, I was in search of a suited framework that could give guidance and structure to my design process.

Through research, I found the Material Driven Design (MDD) method (Karana, Barati, Rognoli, & Zeeuw van der Laan, 2015). This method uses a four-stage framework, as can be seen in Figure 5, and this method can be applied in three scenarios:

Scenario 1: working with a relatively well-known material of which a fully developed sample exists.

Scenario 2: working with a less-known material but there is a fully developed sample

Scenario 3: working with a material proposal or a material of which the sample is still in the exploratory phase.

Sodium alginate belongs in scenario three, which means that I first have to identify all its characteristics. In this second chapter, I started exploring the material in order to get a better feeling for its properties and possibilities.

Reflection

Using a framework always helps to give structure to the design process. Finding this specific method helped me because the RTDP and other frameworks I have used before are not specifically made for designing with a material. During my process, I will use this a base guideline and combine it with the reflective and iterative aspects from the RTDP.

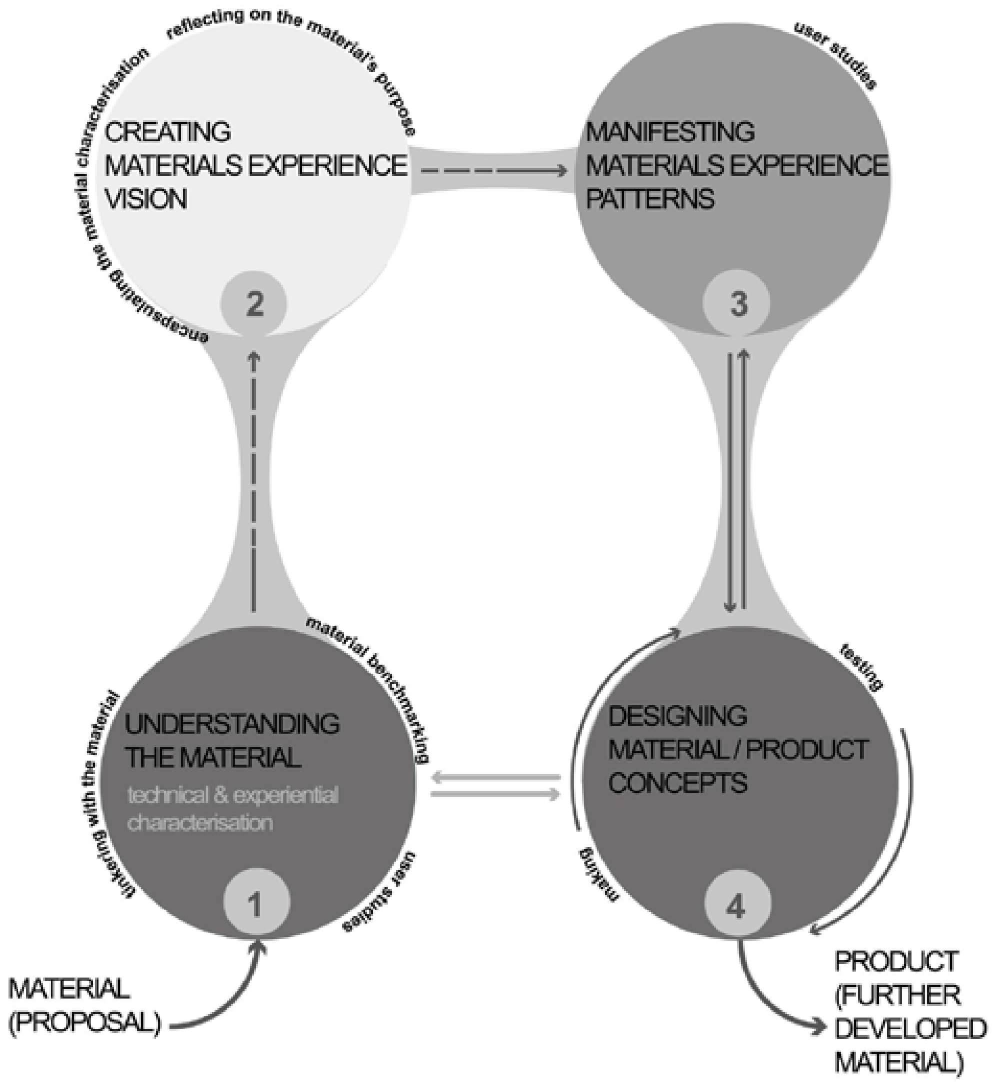


Figure 5. Material Driven Design Method (Karana et al., 2015)

RESEARCH ALGINATE

Before tinkering with the materials I have read several scientific papers that discuss the properties and methods of making fibres or films with sodium alginate. Based on this information I was able to choose the right ingredients and proportions.

SODIUM ALGINATE

Sodium alginate is a salt made from sodium and alginic acid. The alginic acid is often extracted from a brown seaweed but can also be made by bacteria (Lee & Mooney, 2012).

It is used in a diverse range of products; from stabilizer in food to wound dressings (PubChem, n.d.).

Sodium alginate is waterproof in neutral or acidic water and can withstand temperatures until 150 degrees Celsius (Raspanti, 2019).

In the rest of this report, I will use the word alginate instead of sodium alginate for readability.

CALCIUM CHLORIDE

When mixed with water, alginate will form a gel. If this gel comes in contact with a calcium salt, the alginate gel starts to polymerize (Silva, Bierhalz, & Kieckbusch, 2009). Calcium chloride (CaCl2) has been proven to work best for this purpose.

This process of curing the alginate gel can be done in multiple ways. Rihm (2003) has compared three ways of creating alginate films with calcium chloride.

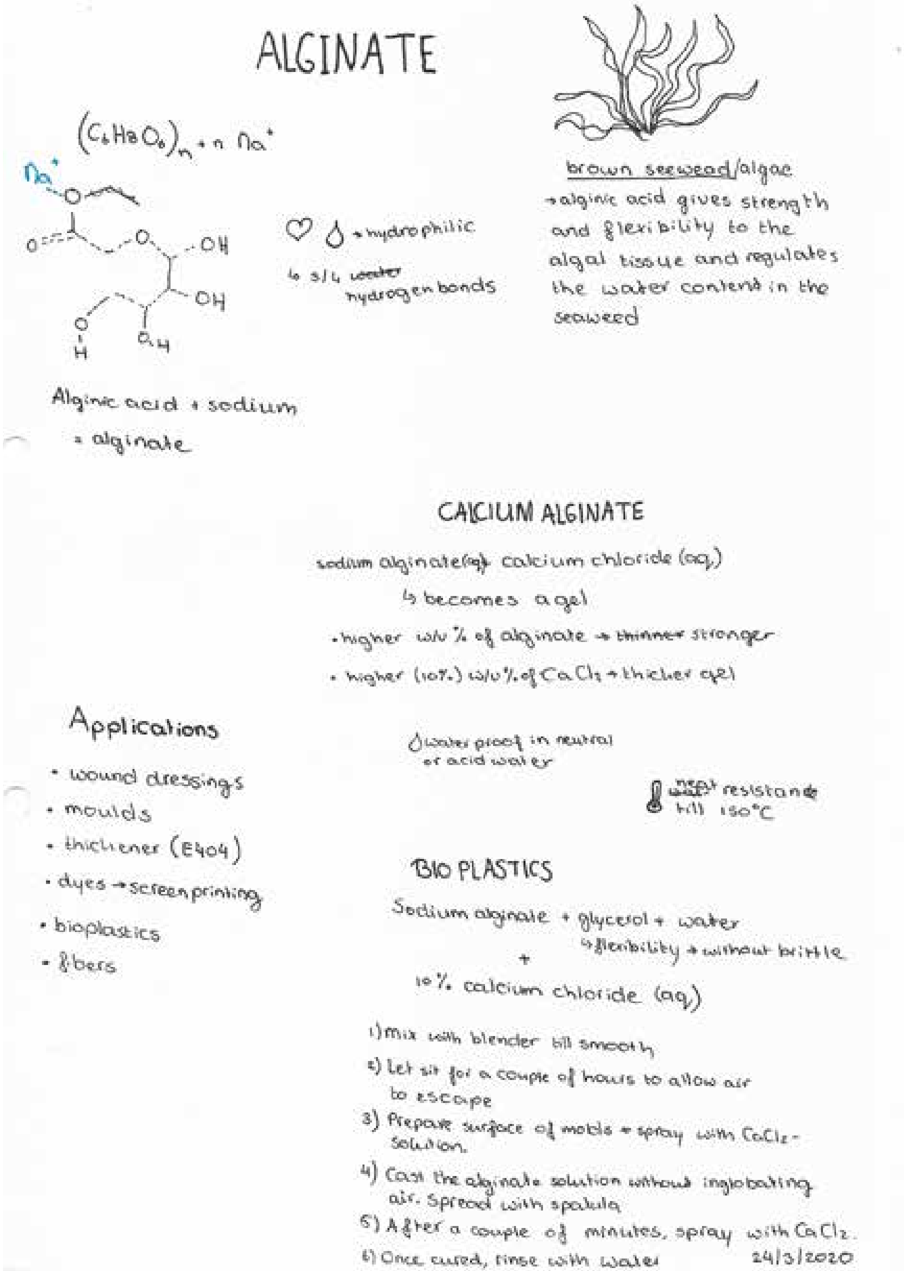


Figure 6. Overview of properties and applications for sodium alginate

Technique 1: Mixing the CaCl2 into the alginate gel and leaving the film to dry.

Technique 2: Casting a film of alginate gel and immersing it in a CaCl2 solution.

Technique 3: Using no CaCl2 but leaving the film to dry.

Comparing these techniques, Rihm (2003) showed that the films made with technique two were thinnest and had the highest tensile strength. The thickness of these films increased when the concentration CaCl2 increased. Another important difference for me was that the films from technique two required less time to dry. Once they touched the CaCl2 solution they would cure. When making fibres, this would be more convenient.

Different concentration CaCl2 has been used to cure alginate. The higher the concentration the thicker the films. In the course Bio Fabricating Materials they use 10% CaCl2 (Raspanti, 2019).

PLASTICIZER

Plasticizers in bioplastics are needed to perform their mechanical properties (Vieira, da Silva, dos Santos, & Beppu, 2011). A plasticizer will position itself in between long strands of polymers, making the material often more flexible and less brittle.

Since alginate is a biobased product, it is preferable to add a non-toxic plasticizer. Glycerine is often used for this purpose. Adding glycerine to the alginate mixture will increase the water solubility, the moisture content and flexibility while decreasing the tensile strength (Silva et al., 2009).

A concentration of 10% glycerine seems the best option (Silva et. al, 2009). Less glycerine will not improve the brittleness of the film and more glycerine can result in a separation of the glycerine at its surface. The thickness is also dependent on the concentration glycerine and will increase when the concentration glycerine increases.

DEGRADATION

Alginate can not be degraded by mammals but it can be broken down in nature through a combination of factors such as light, fungi, micro-organisms and light (Blackburn, 2005).

When the cured alginate is left in alkaline water the gel will dissolve and can be rinsed off (Raspanti, 2019). Alginate can also be degraded with UV-radiation (Wasikiewicz, Yoshii, Nagasawa, Wach, & Mitomo, 2005)

CONCLUSION

Based on this desk research I decided to use a 10% CaCl2 solution and use the immersion technique since this resulted in the strongest films and they dried and set the fastest, which is better when creating fibres or casting plastics in a mould.

When tinkering with the material I will experiment with different concentrations of alginate and glycerine to see what works best in each context and application

Reflection

Doing desk research before starting to work with the material myself, provided me with a lot of knowledge beforehand which proved to be valuable because the first material did not behave as it should. Without the gained knowledge of this research phase I would not have known that it was not the right material.

Furthermore, because of this knowledge. I could get a better understanding of the behaviour and start already at a deeper level.

ALGINATE MOULD POWDER

I started experimenting with alginate mould powder from Pipoos (n.d.). A little bit of alginate powder resulted in very thick gel or almost pudding-like substance.

Sodium alginate should cure when in contact with calcium, but this powder seemed to cure already in normal tap water and in distilled water it sunk. Also when submerged in a calcium chloride solution the material did not change. This indicated to me that it was not 100% sodium alginate.

With a new batch of sodium alginate, I restarted experimenting (Jojoli, n.d.). As a starting point for the recipes, I used the recipes from the course BioFabricating Materials from Fabricademy (Raspanti, 2019). All my recipes can be found in Appendix A.

ALGINATE FIBRES

To create fibres I used three different methods. The alginate gel was made with 3 weight/ volume % alginate and no glycerine.

Method 1

To create thin fibres I used a five-millilitre syringe. Because it could only contain five millilitres the length of the fibres was limited. Using the syringe resulted in fibres with a relatively even thickness. The key was applying constant pressure on the syringe.

Method 2

To increase the length of the fibres, I poured the gel directly from its mixing container. Since the gel had some lumps into it, it was much harder to control the flow of the gel. The fibres produced with this method varied in thickness but could become longer than with the syringe.

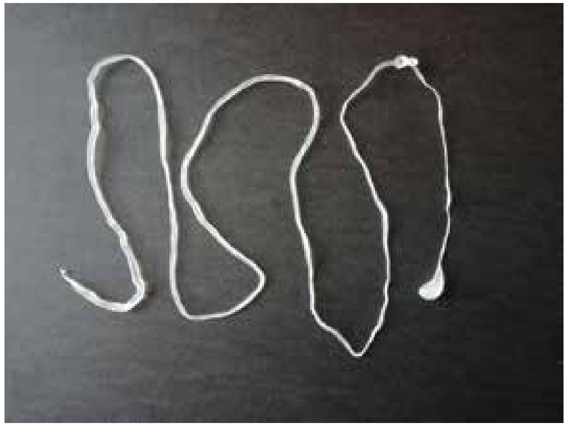


Figure 7. Method 1: syringe

Figure 8. Method 2: pouring

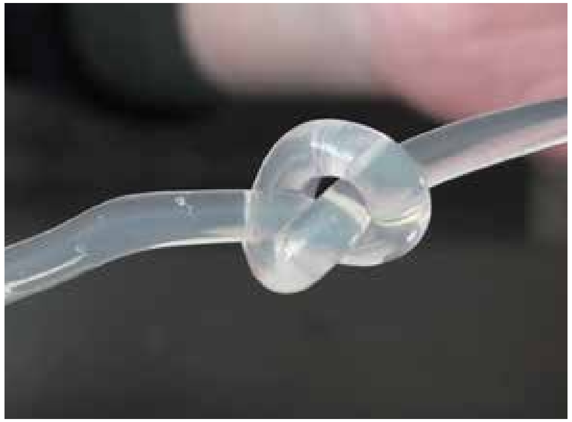


Figure 9. Method 3: large syringe

Method 3

Both using a syringe and pouring resulted in thin fibres. I used a large syringe, normally used for piping frosting and batter, to get thicker fibres (Bol.com, n.d.). This syringe can contain 200 ml and has nozzles with larger openings. The different shapes of the nozzles had no influence on the shape of the fibre. The alginate gel shrinks when in contact with the calcium and forms a round fibre in this process. While not influencing the shape, the different nozzles resulted in thicker fibres.

Results

All the fibres were poured in a 10% calcium chloride solution. The alginate fibres cure directly when in contact with calcium. However, with the pouring method, it could happen that the gel gathered on a little island and formed a big lump of gel (Figure 11). Another problem would occur when the fibres became very long and got strangled. Both these problems were caused by the home set-up I used and could be prevented with a better set-up.

The tensile strength of the fibres is high enough to knit with it (Figure 10). The thicker pieces would not bend as easily and I was afraid that they could burst open. The thin pieces neither felt flexible, a bit like floss thread. The knitted piece was not elastic, which could be because of its small dimensions.

Figure 10. Knitted sample with alginate fibre

Figure 11. Alginate fibres clustered together into a ball

ALGINATE CASTING

Through casting the alginate gel, I could make films of different thickness and also use moulds to get the alginate gel in a specific shape. See Figure 12, Figure 13, Figure 14 for examples.

Figure 12. Shrinkage of an alginate film dyed with turmeric

Figure 13. An uneven film of alginate dyed with red cabbage and turned pink iwith lemon juice

Figure 14. A cup of alginate dyed with red cabbage

ALGINATE COATING

Besides fibres and films, the alginate gel can also be used to coat textile or fibres. I have tried both double-sided coatings and coatings on only one side. In Figure 15 a small overview can be seen of the samples and how they were coated.

Figure 15. An overview of coated samples

ALGINATE SEAMS & PATTERNS

The alginate can also be used to glue pieces of fabric together (Figure 16) or to create patterns (Figure 17). The glue method produces seams that are able to withstand some force but not heavy pulling. The patterns create a more intricate shrinkage pattern.

Figure 16. Two pieces of cotton attached with alginate gel, placed on the black stripes

Figure 17. Alginate gel applied in multiple zigzag patterns

TACTILE EXPERIENCES

The tactile experience differed greatly depending on the time it had to dehydrate. After curing the fibres, films and coatings all felt very cold. When holding them for a longer period they continued to stay cold.

Depending on the environment the alginate started to dehydrate. Fibres and thin films left on the radiator would dehydrate within several hours. Thickers pieces kept inside an egg box would stay hydrated for a longer period, around 2 days.

Once dehydrated the alginate did no longer felt cold. Besides, it shrunk a lot and became very hard. The thin fibres remained flexible because they were so thin but all the films became stiff.

Due to the social distancing, I was not able to let other people experience how it felt. I used a first-person perspective to get some insights and created a small survey to analyse my own feelings. To be able to wear it close on my skin I applied the alginate gel on a jersey singlet (Figure 19) and on a cotton jacket (Figure 18).

I wear those twice one hour, once when the alginate was hydrated and once when dehydrated. During that hour I wrote down after five, fifteen and 60 minutes how it felt. I also wrote down what I expected beforehand, how it felt trying it on and how it felt after wearing.

From this first-person perspective, I could conclude that the hydrated alginate continued to feel cold and this made me reluctant to move since I did not want to feel the coldness. After an hour my skin was used to the cold but when I moved it would touch new skin and it would feel cold again.

The dehydrated alginate was very hard and stiff but it did not irritate my skin, neither did it limit my movements. Only when it broke, it became sharp and this could stick into your skin. This was not pleasant but not painful.

My completed survey can be found in Appendix C.

Figure 18. Jacket with alginate

Figure 19. Jersey singlet with alginate lines

ALGINATE & NATURAL DYES

The alginate gel can be dyed before curing. In Figure 20, a film was dyed with turmeric. The alginate can also be died with red cabbage and this colour can be changed (Figure 21).

When dyed fabrics are coated with alginate, they are still capable of changing colour.

Figure 20. A dehydrated film of alginate dyed with turmeric

Figure 21. A timeline of an alginate cup

APPLICATIONS

During this material tinkering, I came up with a few applications which can be found in Figure 22. Using sweat or the pH of food to change the colour were my main areas of interest because it has the potential of making people wonder and reflect for a moment.

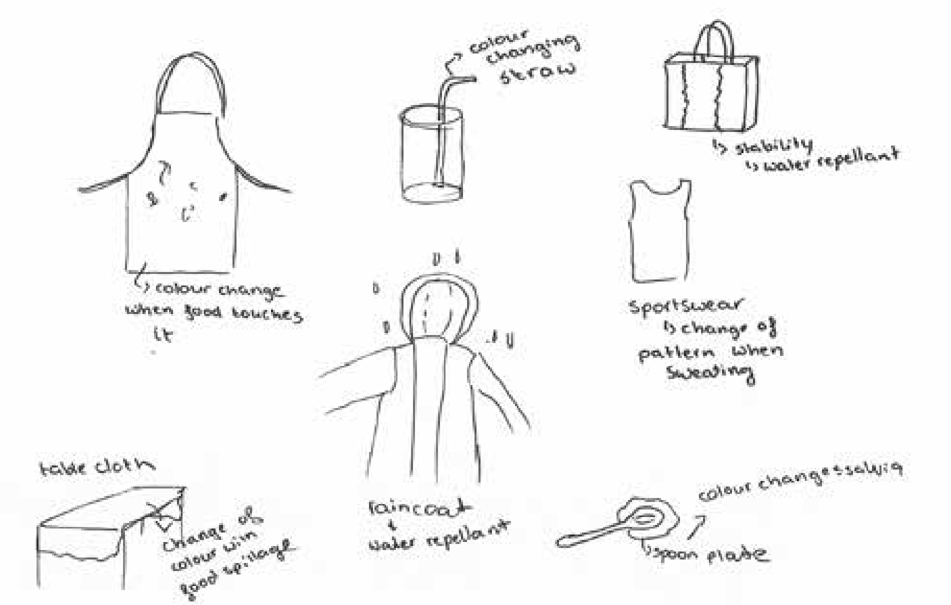


Figure 22. Applications for alginate and natural dyes

Reflection

During this phase of my project, I struggled with what I exactly wanted to make. I enjoyed experimenting with the material but did not saw one fantastic application. Using the first-person perspective during the experiments really helped to get a better understanding. However, this neither provided me with a lot of ideas. To me, it felt as though too little was known to start developping and not exploring.

MIDTERM DEMO DAY

The feedback I received during the midterm demo day was in general positive, the aesthetics looked great but it was of great importance to specify my project. I needed to choose an application and context of use.

One of the ideas I had was using sweat to trigger the colour change, but the feedback was that you needed to think thoroughly about it since it is something very personal. While this could be an interesting topic to explore, it was not the direction I wanted to take with this project.

Another important tip was that you needed to listen to the materials and not fight with them. With clothing based application I had found that the alginate often became very hard, which was not pleasant when in contact with your skin. However, I did saw potential in using it in other areas when applied to textiles. I continued exploring how the alginate gel can be used to shape textiles.

CHAPTER III

Collaboration with Minne, technical and sensorial characterization and the development of AlgaeShape

COLLABORATION

During the midterm demo day, I saw the presentation of Minne Zeijdner, a fellow final bachelor student. She was trying to temporarily shape fabrics by using smocking but had trouble finding a technique that could be easily applied and removed. This triggered my attention because alginate meets these requirements.

In a meeting, we decided that we could add value to each others project. Minne would be my client/ user and I would be her expert. This way Minne could use sodium alginate for her project, and I could focus on creating recipes and methods instead of an application.

Our project goals were different enough and the collaboration was approved.

Translating this to MDD method, Minne would take the short-cut from step one to step four because she was already inspired and had an application. I, on the other hand, would continue working in step one and perhaps step two.

INPUT MINNE

The input or feedback I received from Minne can be found in the green blocks throughout the rest of the report.

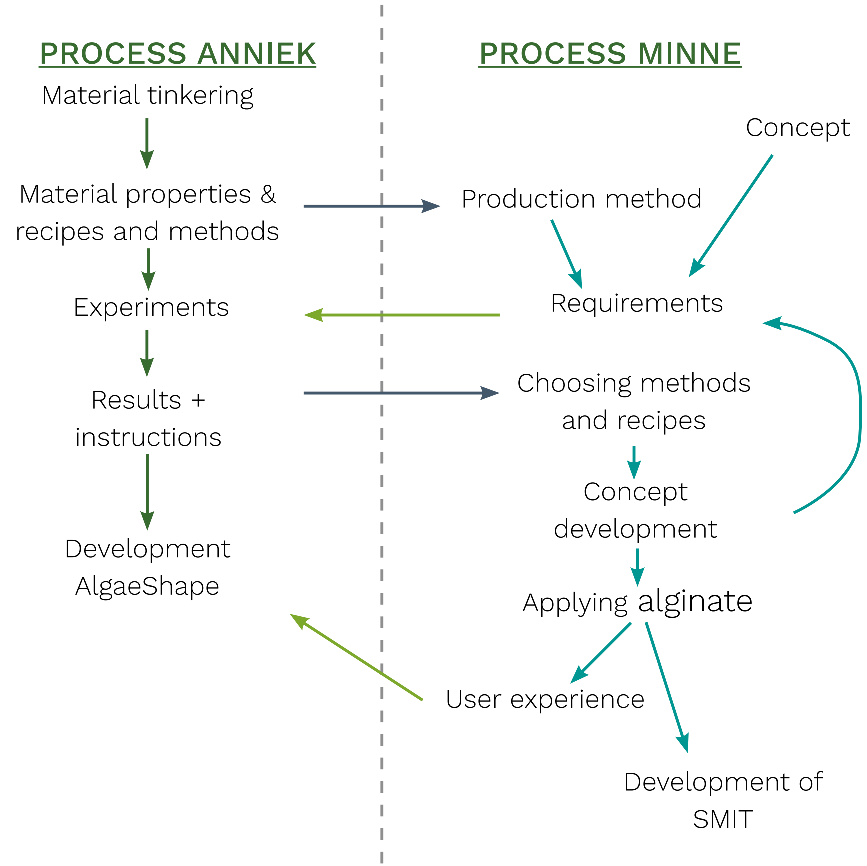


Figure 23. Overview collaboration with Minne (Zeijdner, 2020)

Reflection

Because little was known, I wanted to first get a good and more scientific understanding of the material's behaviour in combination with textiles. This is also in line with the MDD method but to me, it felt as though I had nothing expect knowledge. However, during coach meetings, it also became clear that this is one of my interests and strength. While not the standard ID project, I still could focus my product around the research I have done. The collaboration with Minne also made this possible because she could apply the knowledge into a tangible application.

In line with the first step of the MDD method, I started to quantify the properties since these are not known. All tests are now described together but were done sequential based on the requirements I received from Minne.

If possible, the tests which dealt with shrinkage were based on a ISO-test method: ISO 3759 (HMS, 2014). However, some test could not be accessed for free and due to limited material availability, the tests were slightly adjusted

METHODOLOGY

Sample preparation

For all tests, washed fabrics were used that had been resting for a longer period (>2 day) at ambient conditions. For test I, different sorts of fabrics were used. From each fabric two squares of 10*10 cm were cut. For test II-V unbleached cotton was used cut into 5*10 cm rectangles.

The samples for each test were cut with one side straight from grain and at least 5 cm from the selvedge. After cutting, the samples' width and height were measured in two significant numbers.

Sodium alginate gel

In Table 2, the weight and volume percentages of the ingredients can be found for each test. The alginate gels used in test I, II and III were made by mixing the alginate and tap water with a blender. For tests IV and V, the alginate was dispersed in the glycerine and the water was added while stirring. All gels were left overnight to let the air escape.

The gel was applied using a 5-ml syringe. In test I the alginate was applied in a plus sign. The 3 weight/volume (w/v) % alginate gel was applied on of the two squares and the 5 w/v% alginate gel on the other sample of the same fabric.

In the other tests, one straight line of 10 cm was applied in the middle of the fabric.

Test	Alginate gel recipe	Amount of gel (ml)/ 10 cm
I	3 w/v% alginate + tap water 5 w/v% alginate + tap water	Unknown
II	3 w/v% alginate + tap water	0.2; 0.4; 0.6; 0.8; 1.0; 1.2; 1.4; 1.6; 1.8; 2.0; 2.5; 3.0; 3.5; 4.0; 4.5; 5.0
III	3 w/v% alginate + tap water	2.0
IV	4 w/v% alginate + 5/10/20/30/40/50 % glycerine tap water	0.4; 0.6; 1.0; 1.5; 2.0
V	2 w/v% alginate + 10% glycerine + tap water	0.2; 0.4; 0.6; 0.8; 1.0; 1.2; 1.4; 1.6; 1.8; 2.0; 2.5; 3.0; 3.5; 4.0; 4.5; 5.0

Table 2. Recipes used for the different tests

Curing

To cure the samples a 10% CaCl2 solution was prepared. The curing time can be seen in Table 3 . After curing the samples were rinsed in cold water and placed on a radiator to dry.

Test	Curing time
v	0.2-3.0 ml: 1 minute, 3.5- 5.0 ml: 1.5 minute
II	1 minute
III	30 sec ; 1 min; 2 min; 3 min; 4 min
IV	1 minute
V	1 minute

Table 3. Curing time for the different tests

Measurements

The samples were left to dry for at least two days to have them completely dehydrated. The height and width were measured again and tested for flexibility. If a sample could be rolled up tightly without breaking the alginate, it would be classified as flexible.

The fabric samples in test I were also weighed on a kitchen scale.

The shrinkage was calculated using the formula from ISO 3759 (HMS, 2014):

DC % = 100 (B – A) / A

DC = Dimensional Change

A = Original Dimension

B = Dimension after

Influence time

Sodium alginate is a biopolymer and gels made with it can expire or can grow mould over time. Furthermore from the material tinkering, it became clear that the properties changed over time because the material dehydrated.

To investigate the influence of time, a gel made with 2 w/v% alginate and 10% glycerine was left uncovered in an ambient environment.

The cured samples will be analysed directly when dried and after a few days when dehydrated.

Folds & strength

Minne asked if I could find a good method of creating folds in fabric and to test whether it could handle some weight. For this test I used a piece of cotton with at the bottom a tube. In the top a fold was made and attached with 2 w/v% alginate and 10% glycerine.

A bottle of 500 g was placed in the tube for 24h (Figure 40 on page 34).

Analyses

The analyses of the results was done in a Jupyter notebook. A link to the notebooks and datasets can be found in Appendix D.

Figure 24. Workspace outside

RESULTS

Percentage alginate

The mean shrinkage for the 3 w/v% gel is -17.94% and for the 5 w/v% gel -24.04%. The difference between the 3 w/v% and 5 w/v% alginate gels in test I were analysed using a paired t-test. This showed there was a significant difference (p=0.042).

Figure 25. Linen fabric with 3(left) and 5 (right) w/v% alginate

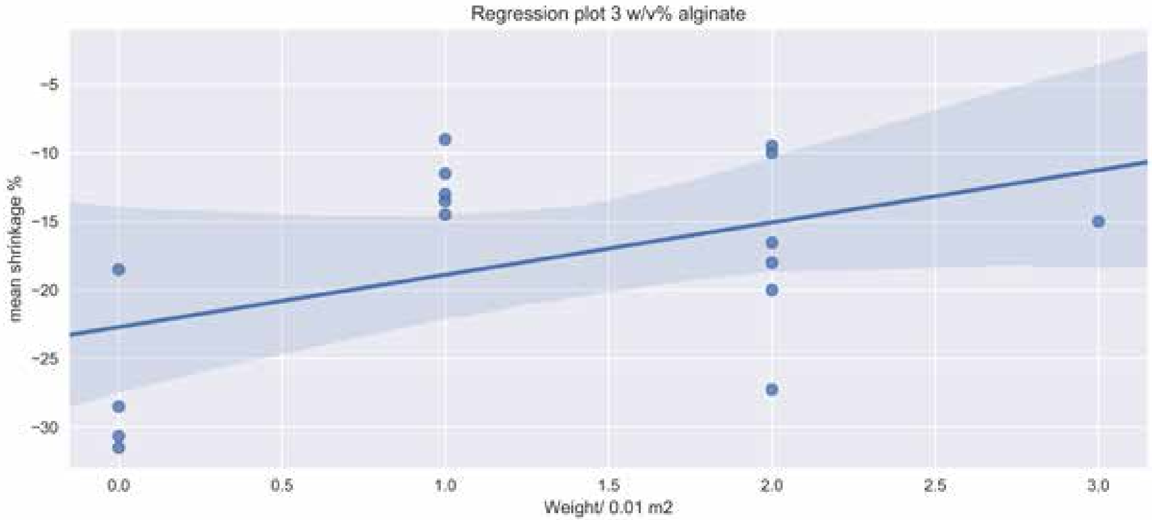


Figure 26. Regression plot of the shrinkage of 3 w/v% alginate dependent on the weight of the fabric

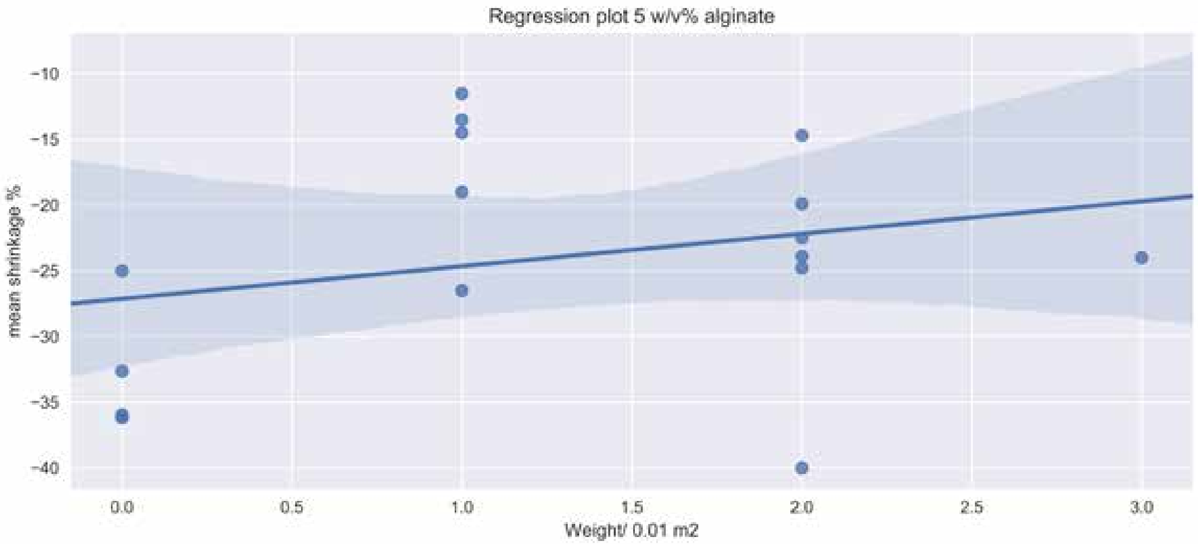


Figure 27. Regression plot of the shrinkage of 5 w/v% alginate dependent on the weight of the fabric

Input Minne

I need a method that is easy to apply and also very easy to remove. Besides, users should be able to do it themselves.

Weight

Linear regression was performed on the results from test I to determine whether a correlation exists between the weight of the fabric and the shrinkage (average of height and width). While a slight correlation seems to be present, this correlation is not significant ($p=0.069$ for the 3 w/v% alginate and $p=0.318$ for the 5 w/v% alginate).

All samples were also classified manually with light, medium or heavy and the scatter plot in Figure 28 shows that there is a clear distinction between lightweight and medium/heavy.

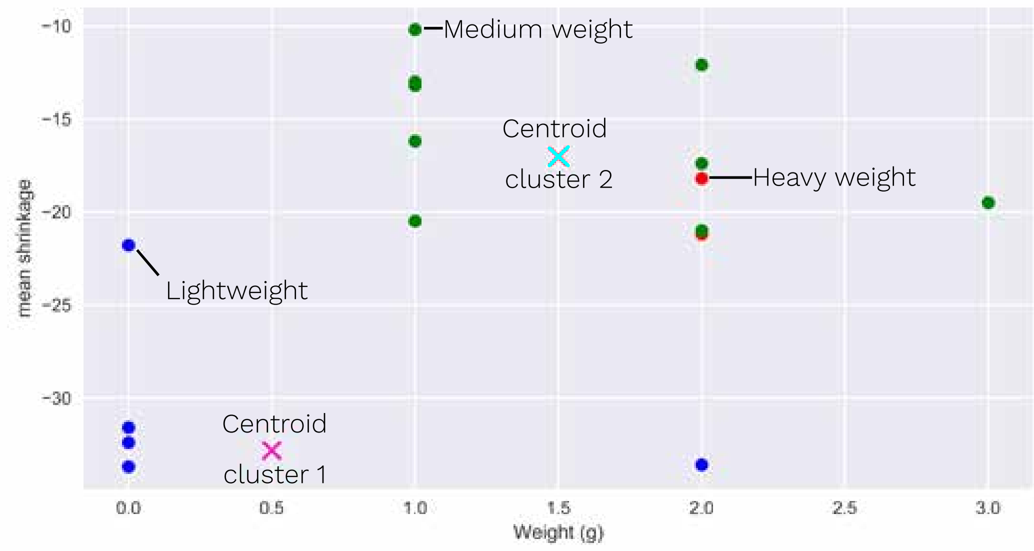


Figure 28. Scatterplot for the shrinkage and weight.

	Weight (g)		mean shrinkage	
	mean	median	mean	median
Weight				
light	0.400000	0	-30.62	-32.4
medium	1.555556	1	-15.90	-16.2
heavy	2.000000	2	-19.70	-19.7

Table 4. The mean and medium weight and shrinkage of the fabrics labelled light, medium and heavy

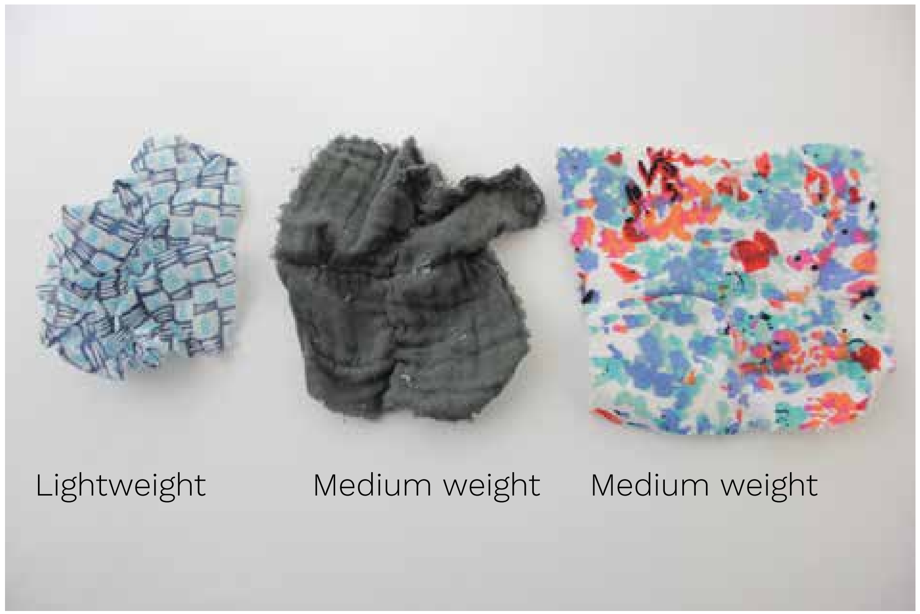


Figure 29. Three types of fabric (light, medium and medium weight) with an alginate cross

Volume/ 10 cm

In tests II, IV and V different volumes of alginate gel were applied per 10 cm. The results from test II (3 w/v% alginate) and test V (2 w/v% alginate and 10% glycerine) showed a significant correlation at a $p<0.05$ value for both the shrinkage in height ($p=0.000$ for both tests) and width ($p=0.000$ for both tests).

Test IV showed a correlation at some percentages of glycerine (5%: $p=0.001$; 10%: $p= 0.013$; 20%: $p= 0.692$; 30%: $p=0.002$; 40%: $p =0.036$; 50%: $p= 0.855$).

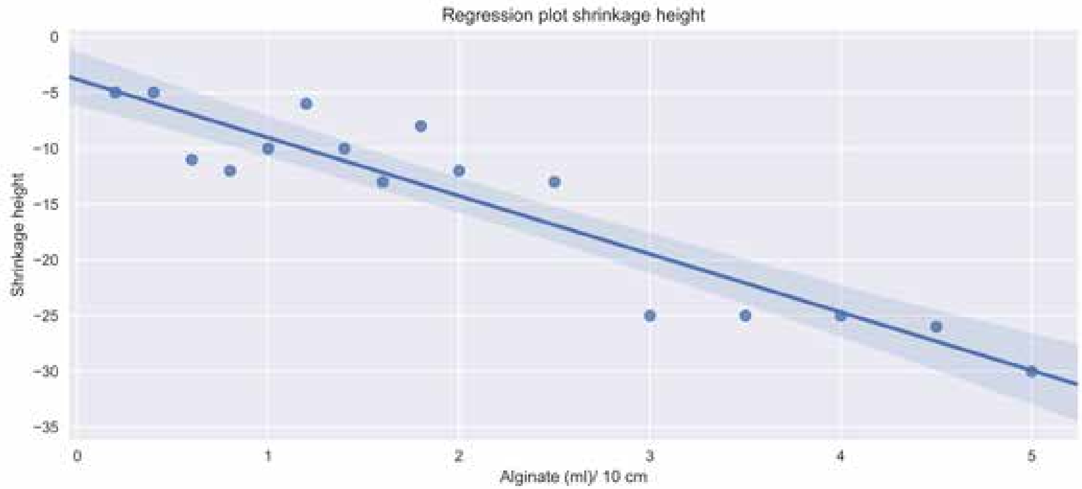


Figure 30. Regression plot of the height shrinkage when more alginate (3w/v%) is applied per 10 cm

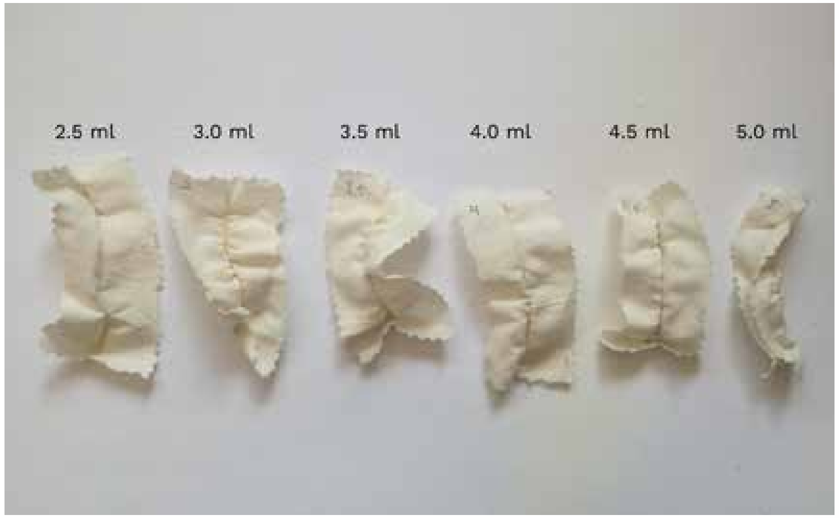


Figure 32. 3w/v% alginate gel applied in different quantities on cotton samples

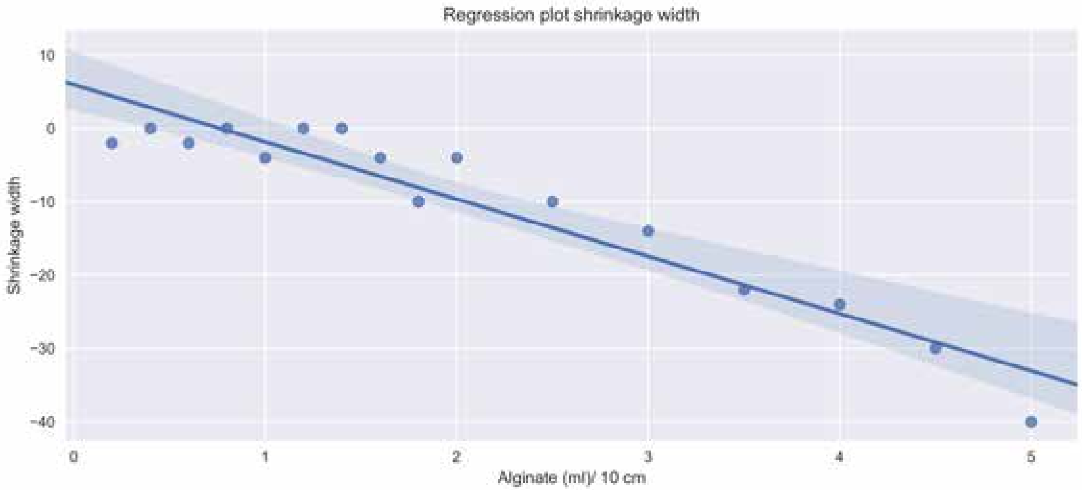


Figure 31. Regression plot of the width shrinkage when more alginate (3w/v%) is applied per 10 cm

Input Minne

For my application I prefer something that does not shrink and is flexible.

Curing time

In test III, the effect of the curing time was analysed using linear regression. The shrinkage along the long side, the height, has a negative correlation with the curing time (p=0.027).

No correlation can be found between the shrinkage of the width and the curing time (p=0.173).

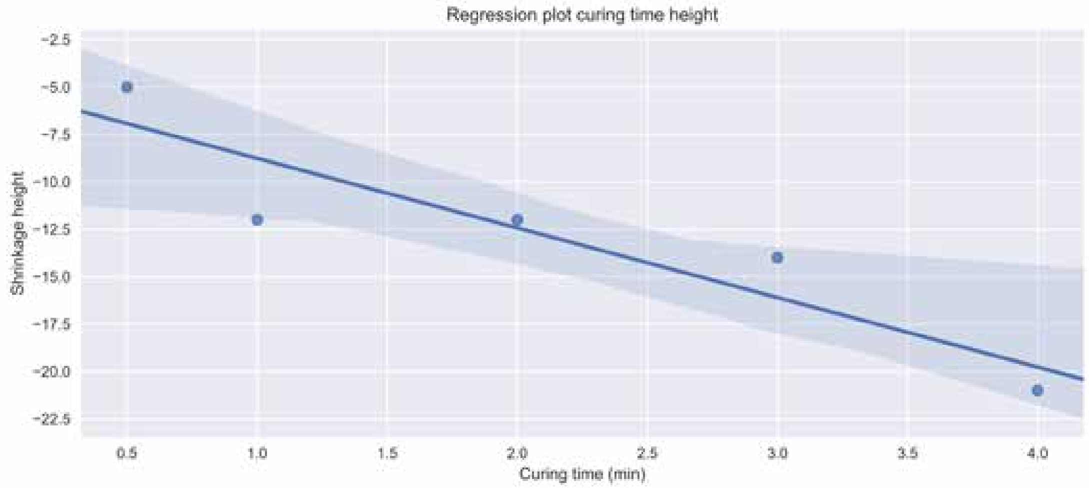


Figure 33. Regression plot of the height shrinkage when 2ml alginate cured for a longer time

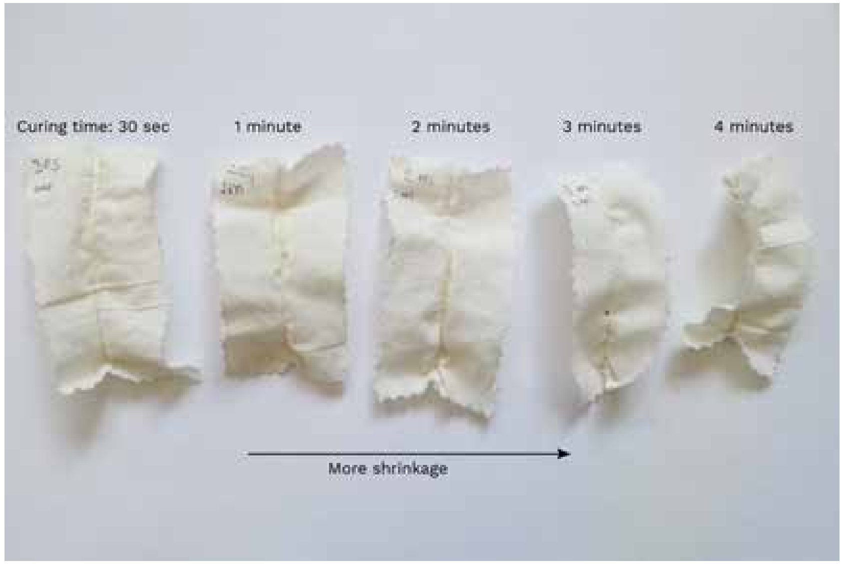


Figure 35. The effect of the curing time on 2 ml alginate

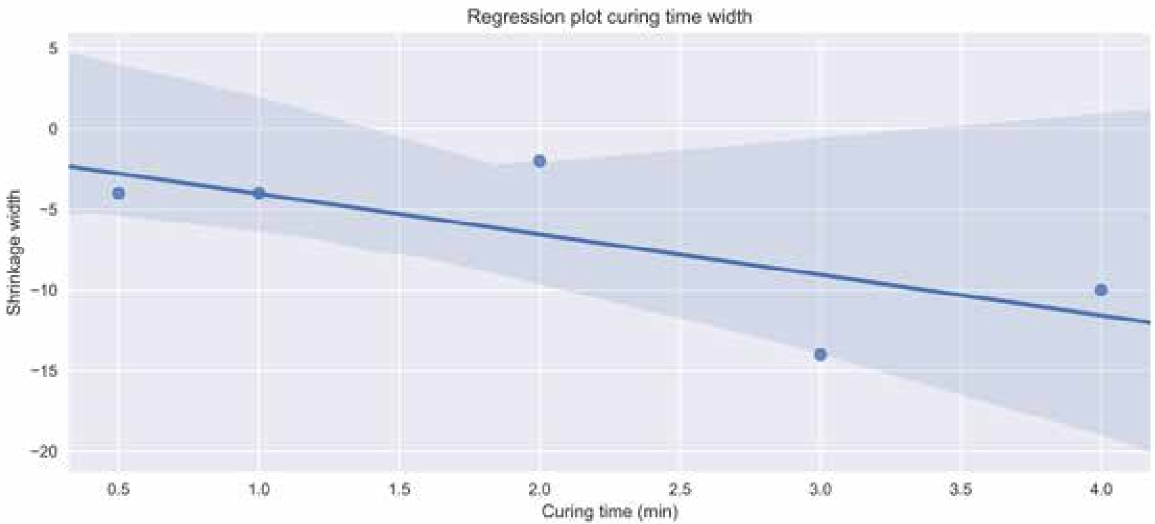


Figure 34. Regression plot of the width shrinkage when 2ml alginate cured for a longer time

Percentage glycerine

The results from test IV were analysed using paired t-tests between the different percentages of glycerine. Only the differences between 5% and 50% ($p=0.0078$); 10% and 50% ($p=0.0004$) and 20% and 50% ($p=0.0413$) are significant. All others are not significantly different at a 95% confidence interval.

A paired t-test between the result from test II and test V showed no significant difference (height: 0.0053; width: 0.1920).

Another observation is that gels with a higher percentage of glycerine will attach less well to the fabric.

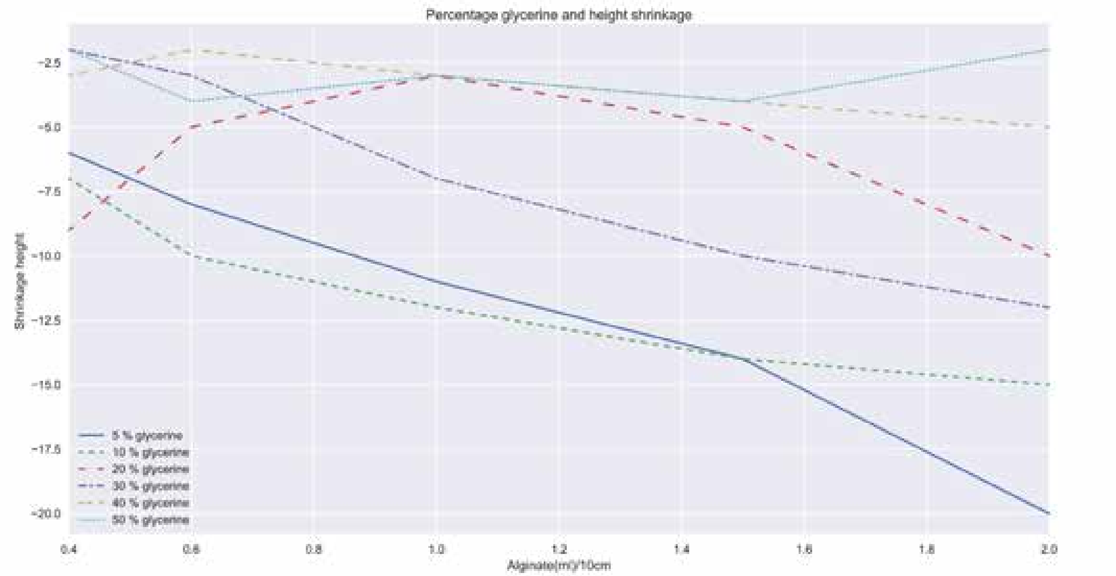


Figure 36. An overview of the height shrinkages when different percentages of glycerine are used

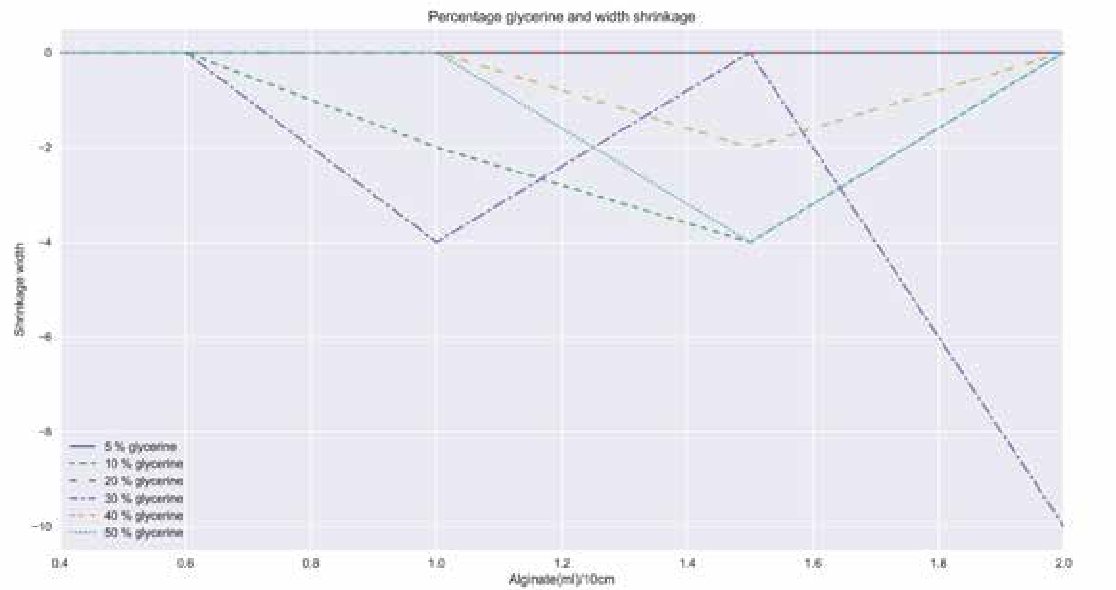


Figure 37. An overview of the width shrinkages when different percentages of glycerine are used

Input Minne

Great that is possible to have a gel that stays flexible. I am using it to create folds, what is the best way to apply it and how much weight can it handle when the fold is vertical?

Influence time and temperature

The gel left in ambient environment showed small patches of mould after 14 days (Figure 38). The consistency of the gel also changed when left open, the water evaporated and the gel started to thicken. Thin layers even became a dry film. When covered, the gel stayed thin for a longer period.

The properties of the samples without alginate changed drastically over time. In the beginning, these would be cold to touch, flexible and smooth. Once they were dehydrated, they became very hard, stiff and rough. The coldness also disappeared and the gel had shrunk even more. After this stage of dehydration was reached, the samples did not change during a period of a month after making.

Gels made with glycerine showed fewer differences before and after curing. The material did not feel cold and stayed flexible. However, the glycerine does have a tendency to become more greasy in warm environments.

Figure 38. Mould in alginate gel

Folds & strength

The easiest way to create a fold was to fold the fabric when dry and make marks on the edge of the fold (Figure 39). Open the fold and spread a thin layer of alginate between the marks. Refold and place in a CaCl2 solution.

A fold created this way could easily handle 500 g and did not open.

Figure 39. Creating a fold with alginate gel

DISCUSSION

All measurements were done using home equipment; such as a kitchen scale and a measuring tape. The kitchen scale only read one significant number and the test samples from test I are relatively small. The findings have therefore a relatively large chance on errors, but since these numbers are only used to compare the samples it is less of a problem.

CONCLUSION

Based on these experiments I can conclude that a higher percentage alginate results in more shrinkage. A longer curing time and more ml alginate/ 10 cm also increase the shrinkage. More glycerine on the other hand, will result in less shrinkage.

The weight of the fabric is of influence, but no significant results were found. However, the scatter plot gives a clear indication that light weight fabrics shrink more.

Figure 40. Setup for the strength test of a fold

Reflection

Doing these experiments in a home environment was challenging because I was not capable of doing it very accurate. However, I also knew that Minne had no access to a proper scale and hence my exact results were hard to reproduce for her. Performing the data analysis was very informing because it often confirmed my own observations and having this analysis makes it more than just an observation.

Besides the technical characterization, an experiential characterization might be as important. An important part of my vision is designing for your soma and not only for your rationale. The technical characterization only speaks to your ratio, but in my opinion it is at least as important to know and experience how things are experienced with all of your senses.

The best option is to have physical samples available, but if this is not possible an experiential characterization is the best alternative. It makes it easier to choose a recipe or a sample without feeling it.

METHODOLOGY

Study design

To investigate the experiential quality of the alginate when attached on textile, a survey design was designed. In this survey two of the four experiential levels will be addressed; the sensorial and performative levels (Karana et al., 2015). This choice has been made because the user tests need to be conducted while respecting the social distancing; meaning the study will be conducted without supervision. It is expected that the sensorial and performative levels of the materials can be investigated with a questionnaire, while the interpretative and affective levels need more guidance.

Samples

Six samples were made for each household. The samples are cut out of unbleached cotton in rectangles of 5*10 cm and labelled A to F. In Table 5 an overview of the treatments for each sample can be found.

Sample	Alginate
A	0.4 ml 3 w/v % alginate
B	5 ml 3 w/v % alginate
C	1.0 ml 2 w/v% alginate + 10% glycerine
D	1.0 ml 2 w/v% alginate + 10% glycerine
E	thin coating of 3 w/v % alginate
F	thin coating of 2 w/v% alginate + 10% glycerine

Table 5. Recipes used for the user test samples

Figure 41. Samples A, B and E of the user test

Participants

The tests were done at three different households with participants in the age range 20-25 and 50-60. In total 8 participants participated.

Setting

The user studies were done at the users home environment unsupervised and therefore there is no further knowledge about the settings.

Procedure

The participants received an envelope with an instruction letter, consent forms, the surveys and a set of samples. The instruction to the participants was to fill in a survey for each sample considering only the properties of the alginate, not the fabric itself. After these sample-specific questions, they were asked to describe their actions and rate the samples from least pleasant to most pleasant.

When they were finished they would return the surveys in the envelope which was retrieved when the whole household was finished.

Figure 42. Samples C, D and F of the user test

RESULTS

The results were analysed in a Jupyter notebook. It became clear that on most properties there was quite some variances in how people perceived the properties. For example, in Figure 44 you can see the boxplots, representing the answers given, for sample C. People considered the alginate both as elastic and totally not elastic.

In Figure 43 the means of all the answers have been taken for each property and sample. The samples A, B and C, made without glycerine, are considered to be harder, more opaque and rougher.

A difference can also be seen in how people perceive a coating (C and F) compared to a line of the same materials. The coating C is perceived as more reflective than the lines of the same recipe A and B. Coating F is perceived as more glossy, reflective and greasy than the lines of these recipes.

In Appendix F an overview of all the results can be found for each sample.

Concerning the actions, most participants smelt (7 out of 8), bent(7 out of 8) and pulled (6 out of 8) the fabric.

Most people preferred the more flexible materials of samples D and E but disliked the greasiness of sample F. Only one person preferred the hardness because the others felt too elastic and greasy.

One remarkable comment was that the participant like the samples D and F the best because it allowed the fabric to stay authentic.

Figure 43. Results of the user test for each property and the mean of each sample

DISCUSSION

Since the user tests were unsupervised, it is not certain that the questions were correctly interpreted. The variance for the properties is quite large, which might also be due to how people interpret the property.

To test the property "elastic" I could have better used an elastic fabric because the cotton itself was only slightly elastic but not enough to see if the alginate layer was elastic. This property might be confused with flexibility since they used that word to describe the samples in the last question.

The actions most people performed were probably because of the questions and not because the material invited these actions. Hence, this cannot really represent the performative level.

CONCLUSION

It can be concluded that the recipe without glycerol is considered less pleasant in general. The participants preferred flexibility, but the greasiness of the glycerol was disliked.

On a personal level, I also discovered that doing user tests unsupervised asks for another approach. I am used to observing people's behaviour and found that as important as the answers they give. With these tests, I had to think really well about my questions beforehand and explicitly write down what was expected of the participant.

As I have written in the discussion I am not completely sure all properties were interpreted the same, this feeling is even stronger because I was not there and could not ask the participants questions during the test.

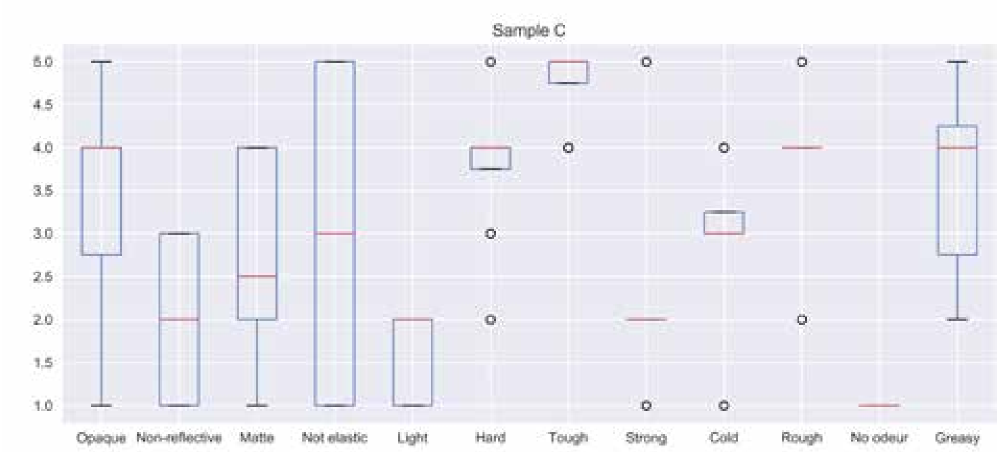


Figure 44. Boxplots of the answers for sample C

Reflection

Having only worked with the samples myself, it was very nice to read how other people perceived these samples. As written in my conclusion, doing unsupervised user tests are challenging. However, it still provided me insight in the experiential characteristics.

ITERATION I

I started this first iteration with a material benchmark (Table 7 on page 41). I compared all different (bio)materials that are similair in some ways to the alginate. From this I was able to conclude that most materials are flexible and soft. Alginate is in that sense different because it can be flexible and soft but also not flexible and hard.

I was able to find all these properties on materialdistrict.com and their site lists all the properties in a very clear way. This became an inspiration for my own concept.

To share all the knowledge I gained from the experiments and user tests, I developed three concepts.

Concept 1

A physical book with all the samples so that people can touch and feel them. The recipes and methods are colour coded and can be found both at the end of the book and online.

Concept 2

A smart program that will give you a pattern and recipe to get the desired result. So if you have a fabric of weight X and this needs on one place 10% shrinkage and a fold with no shrinkage on the other place it will provide you with instructions.

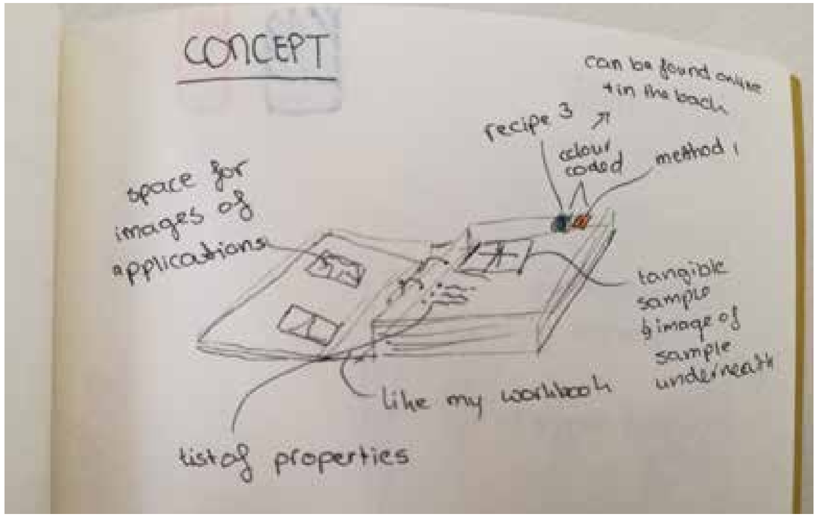


Figure 45. Concept 1: a physical catalogue

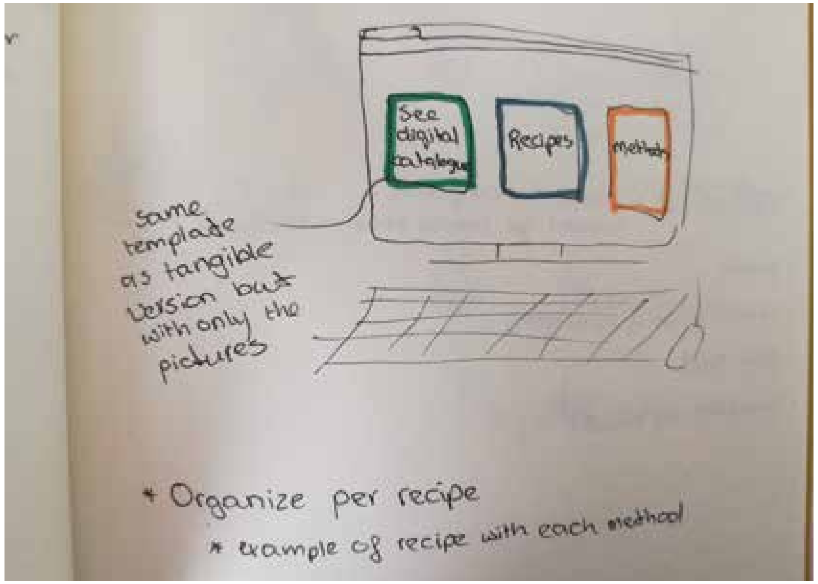


Figure 46. Concept 3: a digital catalogue

Concept 3

The third concept is an online version of concept one. All samples will be shown with a picture and their properties and you can click on the recipes and methods.

Based on the QOC matrix in Table 6 and the fact that the demo day will be held online, I have chosen to continue with concept three: the online catalogue. While it is a major disadvantage that you cannot touch the samples, it has the advantages that the database can easily be expanded and that users can also upload their own work.

TARGET AUDIENCE

The target audience of AlgaeShape is mainly (fashion) designers or (fashion) design students. For them, the need for iteration and innovative use of textile is more important than for people who like to make their own clothes.

Most of them will not be familiar with sodium alginate but are used to working with new materials and also have an intrinsic motivation to do so.

From AlgaeShape, they need technical properties to assess what is suited for their project as well as some sensorial properties to be able to imagine how it feels. The recipes and methods should be clear and explanatory but the designer still needs to have the freedom to experiment with it.

While some designers may want to use AlgaeShape for a longer period, it is most likely that it will be used project-based.

Criteria	Physical catalogue	Smart program	Online catalogue
Tactility	5	1	1
Ease of use	4	3	4
Accessibility	2	4	5
Freedom/ Creativity	5	3	4
Updatable	2	4	5
User input	2	2	5
Total:	20	17	24

Table 6. QOC matrix of the three concepts (1= lowest score, 5= highest score)

MATERIAL BENCHMARKING

Material	OCRAGELA	BLOOD BIO LEATHER	Shiro paper	Piñatext	Cocoa_001	Scoby packaging material	Nuatan	B.CORK	Dreamfield	Lace&Latex	Heve textile
Description	Ocragela is a material consisting of ochre, gelatin, glycerine, and water.	Alternative leather made from the wasted fat, bones and blood of animals	Paper made from algae	Textile made from pineapple leaf fibre	Vegan material made from 40% chocolate production waste	Biological, edible and recyclable packaging made from scoby	Plastic made from cornstarch, sugar and cooking oil	Natural and breathable coating	Micro-capsules in textile that release a fragrance overtime	Coating lace with liquid latex to create a closed fabric	Latex coating on natural canvas to create an alternative for leather
Glossiness	Variable	Satin	Matte	Variable	Glossy	Matte	Variable	Matte	Matte	Glossy	Matte
Translucence	0%	0-50%	0%	0%	0%	50-100%	0-50%	0%	0%	50-100%	0-50%
Structure	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Open	Closed
Texture	Variable	Variable	Smooth	Coarse	Smooth	Variable	Variable	Medium	Smooth	Smooth	Variable
Hardness	Soft	Soft	Soft	Soft	Hard	Resilient	Hard	Soft	Soft	Soft	Soft
Temperature	Medium	Medium	Warm	Medium	Medium	Medium	Medium	Warm	Warm	Medium	Medium
Acoustic	Moderate	Moderate	Moderate	Moderate	Poor	Poor	Moderate	Moderate	Good	Poor	Moderate
Odour	None	None	None	None	Moderate	None	None	None	Strong	None	None
Flexible	Yes	Yes	Yes	Yes	No	Semi	Yes	Yes	Yes	Yes	Yes
Fire resistance	Moderate	Moderate	Poor	Moderate	Poor	Poor	Unknown	Moderate	Good	Poor	Unknown
UV- resistance	Unknown	Unknown	Moderate	Good	Unknown	Moderate	Moderate	Good	Moderate	Good	Moderate
Weather resistance	Moderate	Poor	Poor	Good	Moderate	Poor	Poor	Moderate	Poor	Moderate	Moderate
Scratch resistance	Moderate	Poor	Moderate	Good	Moderate	Poor	Moderate	Moderate	Moderate	Moderate	Moderate
Weight	Medium	Light	Light	Light	Light	Light	Light	Medium	Light	Light	Medium
Chemical resistance	Moderate	Moderate	Poor	Moderate	Poor	Poor	Poor	Moderate	Good	Poor	Moderate
Renewable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 7. Overview of other biomaterials (MaterialDistrict, n.d.)

DIGITAL CATALOGUE

I developed a digital catalogue in the form of PDF template. Each sample would be listed on its own page and a colour code would tell you were to look for the recipe and method (Figure 47).

This idea could still also be turned into a physical catalogue if preferred. However, from Minne I often received new question and requirements that gave me new insight and I wanted to easily update the catalogue. I started looking into the possibilities of creating a database or website to provide the information.

RECIPE 1

1

Ingredients:
- 6 gram sodium alginate
- 200 ml tapwater

Preperation
1. Mix alginate and water with a blender
2. Leave overnight, or at least for 8 hours, to let the air escape
3. Use the mixture according to the described method

Figure 47. First iteration of the digital catalogue: recipes

NAME SAMPLE

3 Recipe

1 Method

PROPERTIES

- Flexible
- Cold
- Pliable
- Solvable in water with pH>10

METHOD 1

1

1. Prepare the gel according to the recipe
2. Cut prewashed fabric x times as big as the final measurments
3. Iron the fabric
4. Prepare a 10% calicumchloride solution
5. Fill a syringe with the alginate gel and apply it in a steady motion with 2 ml/ 10 cm.
6. Submerge in the calciumchloride solution for 1 minute
7. Rinse in cold water
8. Leave to dry for at least one day on the radiator, or longer at room temperature

Figure 48. First iteration of the digital catalogue: samples and method

ITERATION II

Because the focus of my research lays both on the technical and sensorial properties, I thought a database might be a suitable place to store the data gathered. However, a database does not invite you to browse.

Using a website would give me the freedom to add both photos, tables and graphs with the additional option of adding easily new tests without resending the catalogue.

Users can also upload their projects to the website to create a community and create more knowledge together.

PROPERTIES of the alginate

Glosiness	How glossy the alginate is when applied on the fabric	Glossy/ Matte/ Variable
Translucence	How well you can see through the alginate	0/ 0-50%/ 50-100%/ 100%
Structure	Whether the coating or line is of an open or closed structure	Open/ Closed
Texture	How the texture of the alginate feels	Coarse/ Medium/ Smooth
Hardness	How hard the material is when you feel it	Hard/ Resilient/ Soft
Temperature	How warm or cold the alginate feels (dependent on the environment)	Cold/ Medium/ Warm
Elasticity	How elastic the alginate is (on non stretch material it cannot exceed the 50%)	0%/0-50%/50-100%/ 100%
Weight	The extra weight of the alginate	Light/ Medium/ Heavy
Greasy	How greasy the alginate is	Yes/ Medium/ No
Dehydrated	Whether the alginate is dehydrated	Yes/ No

Figure 49. The properties list on the AlgaeShape site with explanation of each property and the possible results

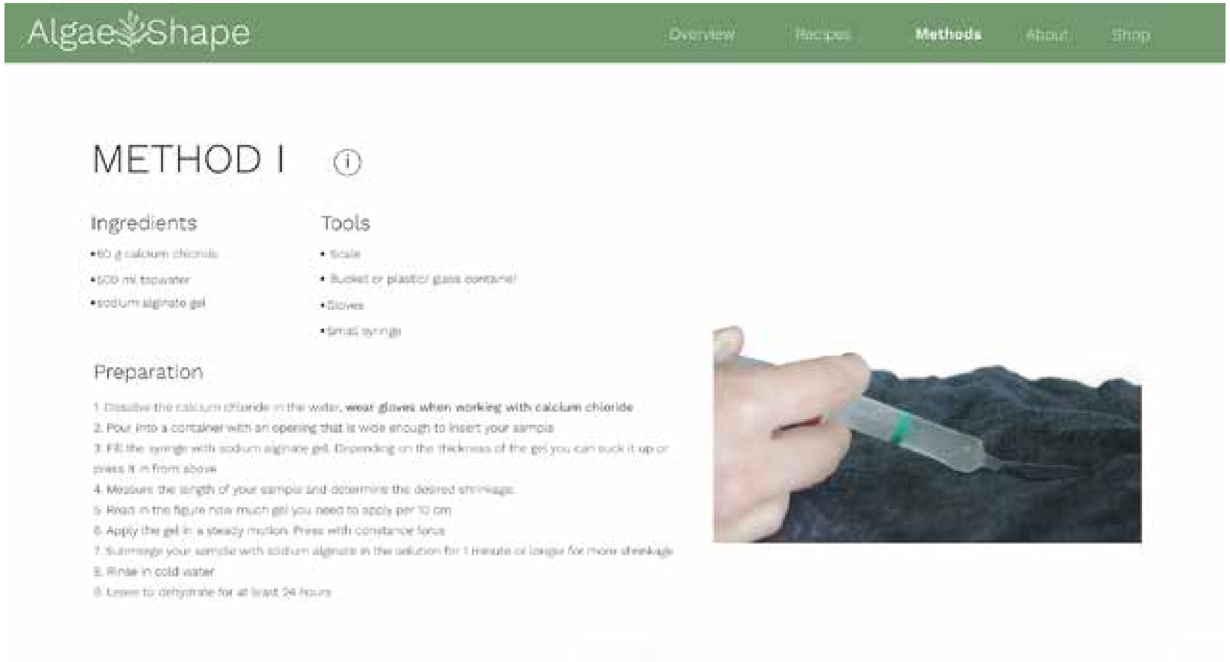


Figure 50. Second iteration: the website

Next to each recipe or method you will find an information icon. Clicking on this will show you the relevant graphs for that recipe and/ or method.

The main relevance of these graphs is giving the user an indication for the behaviour. Each material has different properties and will not behave the same way.

Input Minne

I think you have captured how people want to search when it is online and they plan on sticking to the recipe. Perhaps you can also allow the more creative exploration aspect.

BENCHMARKING

Over the last few years, biobased materials have become more popular. Especially among certain groups of society, the awareness of their impact on the climate has increased. They started trends such as zero-waste which are becoming more popular (Acaroglu, 2019). But also on a governmental level, there is an attitude change visible; disposable plastics are forbidden in 2021 (Europees Parlement, 2019).

In the Crafting Everyday Soft Things squad, you also see this reflected in the projects of students: natural dyes, biobased plastics and products to make people aware of their impact can be found in almost every semester.

The university of Aalto recently published a cookbook about biomaterials; showing that there is as well an interest in the academic world for this topic (Kääriäinen, Tervinen, Vuorinen, & Riutta, 2020).

The interesting thing is that in design now old traditional materials and knowledge are combined with new innovative techniques to create sustainable products. For example the Fossil Free Crib: made without the use of fossil fuel by using old methods to make glue and textiles, but combining it with a revolutionary piece of steel that is produced in such a way that it does not release CO_2 (Spitz, 2020).

On the internet, there are several sites that provide an overview of (new) materials. Sites as MaterialDistrict (https://materialdistrict.com/) and Material Connexion (https://www.materialconnexion.com/) list products that are available for purchases. Other sites such as Materiom.org and the course from Fabricademy (Raspanti, 2019) are open source and provide you with recipes to make the materials yourself.

Besides the digital material library, you can also visit physical material libraries such as Broeinest in Eindhoven and other cities in the Netherlands (broeinest.nl).

Reflection

I was surprised at the start of this project how many people are working with biomaterials but how hard it was to find good information. During this benchmark I noticed this again. By benchmarking my project I got a better sense for the direction I could take and where there are still opportunities. In my case, that is giving the information to make the product yourself with a great level of detail.

BUSINESS MODEL

The Business Model Canvas

Designed for: AlgaeShape | *Designed by:* Anniek Jansen | *Date:* 20/05/2020 | *Version:* 1

Key Partners

Companies selling sodium alginate

Companies selling CaCl2

Material libraries

Universities and art/ fashion schools

Key Activities

Platform management
Research: new recipes and methods
Development of new samples

Key Resources

Platform
People (software developers, material researchers)
Brand
Input from users

Value Propositions

AlgaeShape gives designers all the necessary information to use sodium alginate to shape textiles to their liking. This allows designers to reuse textiles and to get new ways of designing with textiles since the sodium alginate can do more than only seal textiles together.

Customer Relationships

Get: Through social media and material websites

Keep: The continuous development and extension of the database of examples, recipe and methods

Grow: When customers are enthusiastic they can get other designers to use it as well

Channels

Direct: The own website with all information

Indirect: Material libraries such as BroeiNest, MaterialDistrict

Customer Segments

Free users (90%) mainly B2C:
- design students
- (Industrial) designers
- fashion designer
- anyone who likes working with textiles

Paid users (10%) mainly B2B2C:
- (Design) companies working with textiles
- Institutions such as universities and art schools

Cost Structure

Fixed costs (platform, staff expense, accommodation)
Service costs for free users (very little)
Service costs for premium users
Customer acquisition costs

Revenue Streams

Free basic services (limited options)
Paid subscription (10% of the users)
Webshop (ingredients & kits)

Figure 51. Business model canvas for AlgaeShape

AlgaeShape is a knowledge-based service platform. According to me, it would be ideal if everybody has free access to this knowledge and could contribute to the database to acquire new knowledge and innovate together in a sustainable way. However, a completely free service is not feasible if you want to provide service and continue the research. Some sort of revenue stream should be part of the business model.

On the previous page (Figure 51), the business model canvas for AlgaeShape can be found. The model is based on the Freemium model where the basic service is free and you have to pay to get access to all the services (Osterwalder & Pigneur, 2010).

The most important elements are explained in more depth.

Customer segment

The majority of the users, around 90%, will be using the free service which allows users to only see the properties and photos of the material and access only two methods or recipes. This segment of users also corresponds to the B2C segment of the service. The B2B and/or B2B2C segment of the service will focus more on institutions such as universities and design companies who are willing to pay the subscription fee and get access to all information and receive more services.

Value proposition

AlgaeShape is an example of a technology push, or more precise a material push. There has not been a specific demand for other ways of shaping textiles, but designers such as Minne are enthusiastic to tailor it to their application.

AlgaeShape is able to tap into the pain of the customer on two points. The first is that it is very time-consuming to reuse textiles with traditional methods.

The second pain is that if they want an alternative, it can be hard to find the right information on the internet. Some trustworthy information can be found when you search well, but it is hard and the information is often scattered.

Other sites do have a nice broad overview of possible materials such as materiom (materiom.org), but their knowledge is mainly broad and not in-depth. They often give only one or two recipes and do not explicitly state what their properties are.

AlgaeShape can, partially, solve those two problems. AlgaeShape contains in-depth information about the usages and properties of the different recipes. This makes it easier for designers to start using an alternative method for iterating with textiles.

Furthermore, AlgaeShape sells also the ingredients and starter kits. Selling these starter kits really makes it easier for the user to get started; there is no doubt whether they have ordered the right ingredients and equipment.

Customer relationships

For the customer relationships, the get-keep-grow strategy can be applied.

To get customers, awareness and interest can be raised through social media platforms as well as through institution partners, who have a subscription to the service, and material libraries who have samples in stock. Once they are interested, it is easy to consider and “purchase” because the basic service is free. A free service generates a demand many times higher than the demand when providing the service for a small price (Osterwalder & Pigneur, 2010).

Another strategy to get, especially premium, users in the future is by giving students the opportunity to have free access to all premium functions. To get this free access they have to contribute with samples, recipes, methods or photos of applications. By getting them now acquainted with the premium version they might be more willing to pay for a premium account in the feature. Newsletter and services like Spotify also offer special subscriptions fee for students (Sutcliffe, 2019).

To keep the customers, the database with samples, methods and recipes should be constantly extended and improved. This is partly done by material researchers from AlgaeShape, as well as by users who have the possibility to upload their samples.

AlgaeShape can grow by attracting either more premium users or having more purchases in the webshop. More purchases are likely to happen when there are more (free) users.

Revenue Streams

Most of the basic services are provided for free (90%) and will not result in revenue. The Premium accounts will pay the monthly or yearly subscription fee.

For students a special subscription is possible. They can get a premium account if they contribute with either methods/ recipes or photos of how they used the sodium alginate in an application. Students are often very experimentative with materials and can create valuable input for the platform.

Furthermore, there will be several kits and ingredients available in the webshop. The ingredients can be both in larger quantities when you buy them separately, or the user can choose for one of the kits, for example, the starter kit:

Starter kit:	**€ 20.00**
- 20 g sodium alginate	€ 1.00
- 100 g $CaCl_2$	€ 0.33
- 50 ml glycerine	€ 0.40
- small syringe	€ 0.10
- templates	€ 0.05
- premium access for 1 month	€ 5.00
Total cost price	€ 6.88

Cost Structure

hosting (including domain name):	€28/month
webdeveloper	€3000/month
material researcher	€2500/ month
Total:	~ €5500/month

For an individual, a subscription would cost €5/month. The subscription costs for more people or companies/ institutions depend on the size of the group. To have a sustainable business there should be at least 1100 premium subscribers or 420 starter kits being sold every month.

ITERATION III

EXPERT FEEDBACK

I approached two experts in the field of material design. Both have experience with designing products starting with the material.

One of them have worked with glycerine before and was able to give me useful feedback on how it was used in their project and what the limitations were. It became clear that the glycerine will always feel a bit greasy and that people are usually not fond of that.

Furthermore, the tip was given to look also into other areas besides the clothing industry since this might not be the best option. The stiffness and three-dimensional structure might be more applicable in for example filter systems.

The other expert gave feedback when I had already a more developed website and concept. She really liked the idea of a temporary 'hinge/fringe' from alginate. However, she was missing some inspiration for applications on the website. The ingredients and properties were clear but it giving suggestions for applications might give more directions for designers.

USER FEEDBACK

Minne has been using the alginate during her project and this provided me with a long term user study. She asked me to test specific properties such as the strengths of folds and the best method for that.

Although she was not able to have accurate measurements, Minne felt very involved throughout the whole process. Making everything from beginning to end added for her an extra level of satisfaction to the process of creation.

"When everything is mixed and ready to be used the options are endless. Since it's easy to remove, reverse and clean everything you work with, you feel no boundaries when experimenting." - Minne

ADAPTATIONS

After the feedback from these experts and Minne, I adjusted the design of the site and looked into the balance between exploration and information.

Finding the balance between exploration and information is challenging. On the one hand, AlgaeShape is made to be a resource for people who have a clear target. On the other hand, it should also be usable by people who are looking for inspiration and/ or have an ill-defined goal.

All samples are listed on one page, but when the platform grows, this is no longer practical. Subcategories with search options should be used to keep it clear. However, this makes it harder to explore through the samples when you do not have a clear defined target.

Using the three dimensional model for information exploration (Figure 52) can help to determine the differences (Waterworth & Chignell, 1991).

The users with a clear goal in their mind are more likely to use navigational querying. Here the user is in charge of the structure and has a clear target. Because it is often hard to describe exactly what you are searching, suggestions are made (referential).

The other group of users is more likely to use navigational browsing. The user still gives the structure but has no clear goal in their mind (browsing). In this case it is important to provide all possible next steps because the user will not be able to describe the goal, since it is not present.

A menu with all properties and their possibilities can help both users. For the navigation querying a window descriptive querying should provide the possibility to directly find a specific sample without going through the whole menu.

For the navigational browsing, suggestions can be made when they have selected a certain sample. For them a project gallery can also help to get inspiration. Users who have used a recipe or method from AlgaeShape can upload their project here and this will provide inspiration for others.

These adaptations have been implemented in the new version of AlgaeShape (Figure 53, 54).

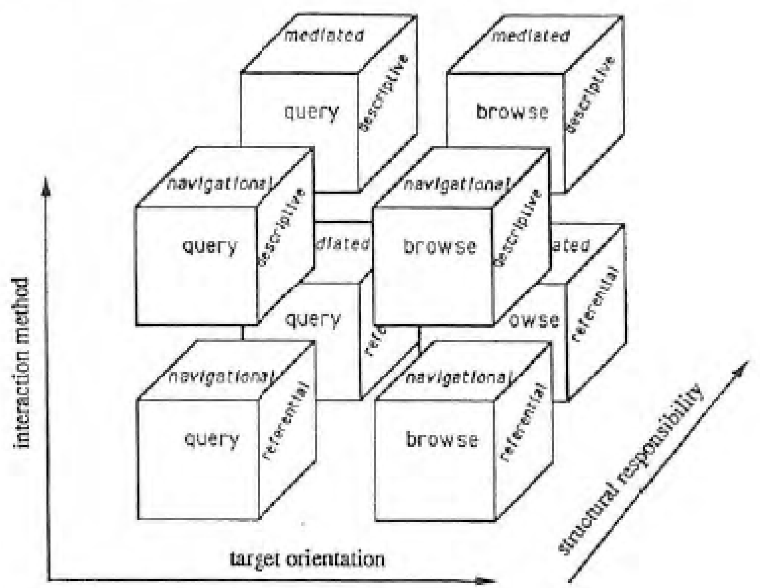


Figure 52. Three dimensional model for information exploration (Waterworth & Chignell, 1991)

Reflection

The feedback from Minne was an eye opener. Because I was mainly focussed on getting accurate results while she was experimenting very free without accurate measuring. In this redesign of the site I have already taken this more into consideration by adding the project gallery. However, more user feedback would be needed to see how you facilitate both the information and exploration.

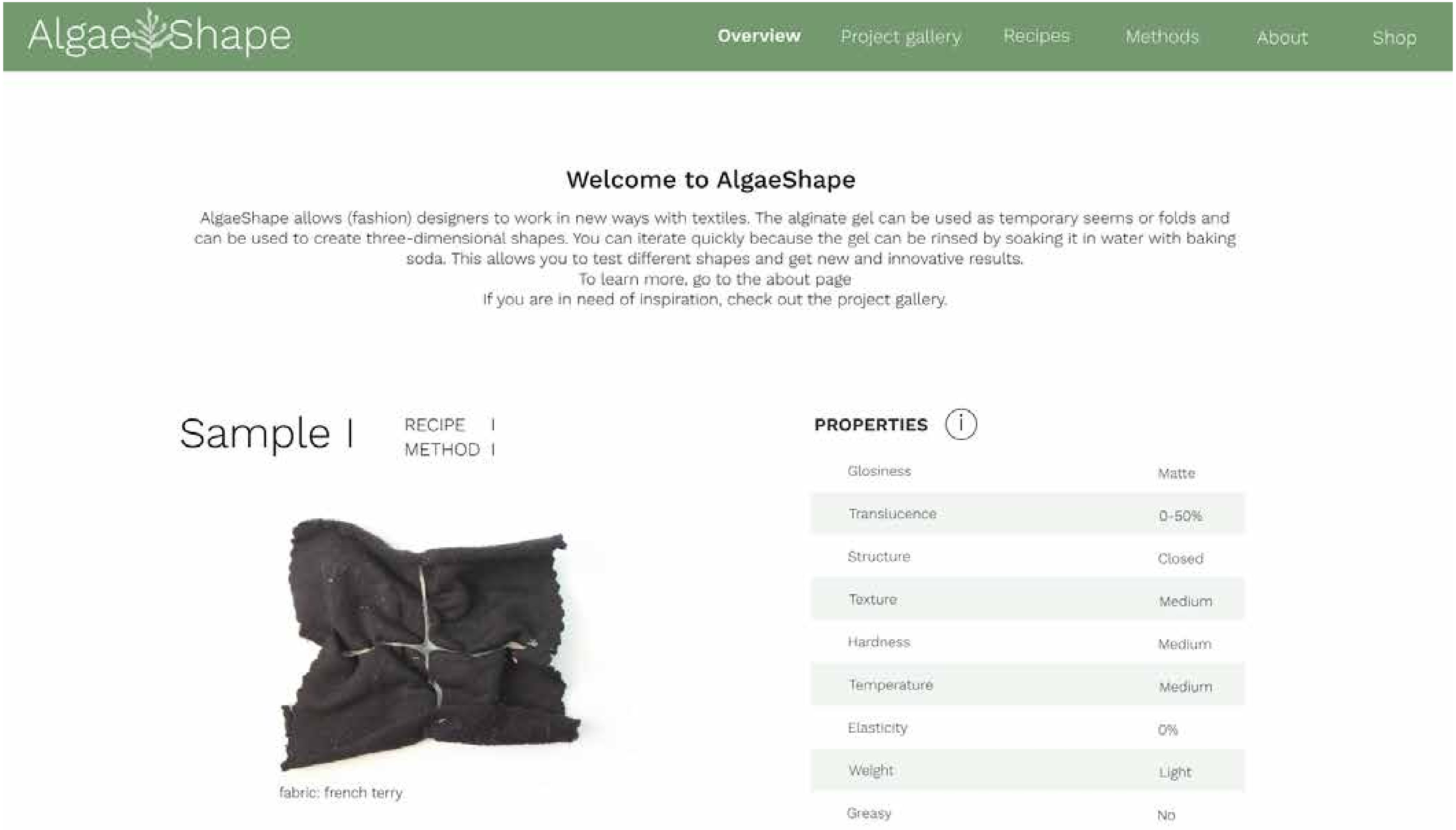


Figure 53. Homepage of AlgaeShape
https://anniekjansen.nl/?page_id=380

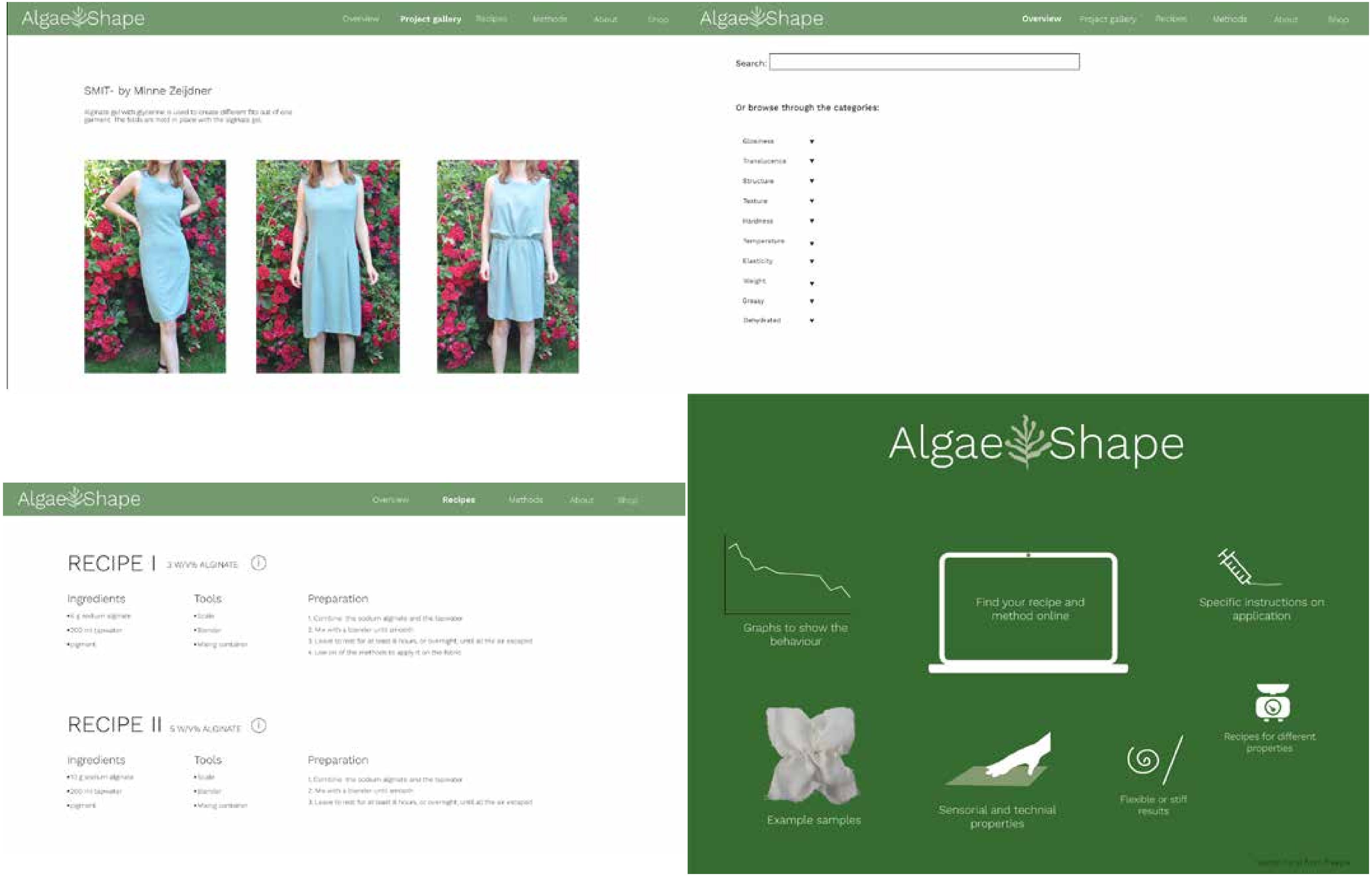


Figure 54. Overview of screenshots from the website and a promotional poster

SUSTAINABILITY & SAFETY

Since the lifespan of alginate is very short when used for iterating. I find it very important it does not harm the environment. For the main components of AlgaeShape, I have done research into their sustainability and/ or safety.

Production of alginate

Alginate is extracted often from brown seaweed. Seaweed is renewable source which does not require farmland or sweet water. The transformation from seaweed to alginate has the most impact. A life cycle analysis showed that the impact of the growth of the seaweed is less than 1% (Langlois, Steyer, & Hélias, 2012). The electricity has the largest impact (39%) on the environment followed by the use of chemicals(26%).

Glycerine

Glycerine is a mixture of glycerol and water. Glycerol can be made from oil or bio-based, for example used cooking oil and animal fats (European Commission, 2015). There are even experiments to produce glycerol from micro-algae oils. The production of glycerol has mainly an impact on the eutrophication of the freshwater.

Calcium chloride

Calcium chloride is not dangerous but in it is dehydrated state should be handled with care since it produces heat when in contact with water (De oplosmiddelspecialist, n.d.). Therefore it should not be ingested or come in contact with your eyes since this can result in internal burns. Once dissolved it is best to still wear gloves to get no skin irritation.

AlgaeShape

The sustainability of AlgaeShape depends largely on how much gel is applied and for what period of time the gel stays on the fabric.

Little energy is needed to mix and apply the gel. A blender of 550 watt was used for around 1 minute to mix 200 ml of gel. This results in 33 kJ = 0.0092 kWh electricity used, a very small amount.

The gel can be ripped off by hand but does require some force. Since its main purpose is short-term use, a long-life term is less important. However, for Minne's application, it should be able to withstand some force and washing. It can deal with the weight of garment hanging on a seam, but would not survive stronger pulling.

The main impact will be water usage. Water is used for creating the gel, curing the gel and dissolving the gel. To cure the gel, little water is needed since it can either be sprayed upon or submerged in a bath. The fabric can be squeezed after curing to return the excess water.

To dissolve the gel, the gel should be covered with water. However, this can be done in multiple iterations to remove the gel on other places.

DEMO DAY

At demo day I presented my concept with a poster (Figure 55), video, annotated images and the link to the website. Here I received positive feedback, but also some questions/ tips. There were some questions about how sustainable the project is as well as the tip of adding more examples to make it more graspable. Based on this feedback I have extended the sustainability section in this report and the new example gallery can help to make it more graspable.

Reflection

Having a digital final product helped at the demo day because it was online. However, it would have been helpful to let people feel the samples. Now the feedback was mainly on the site and not so much on the tactility, which is logical. However, I really would have liked to see how people experienced all the samples because it is hard to imagine it based on photos.

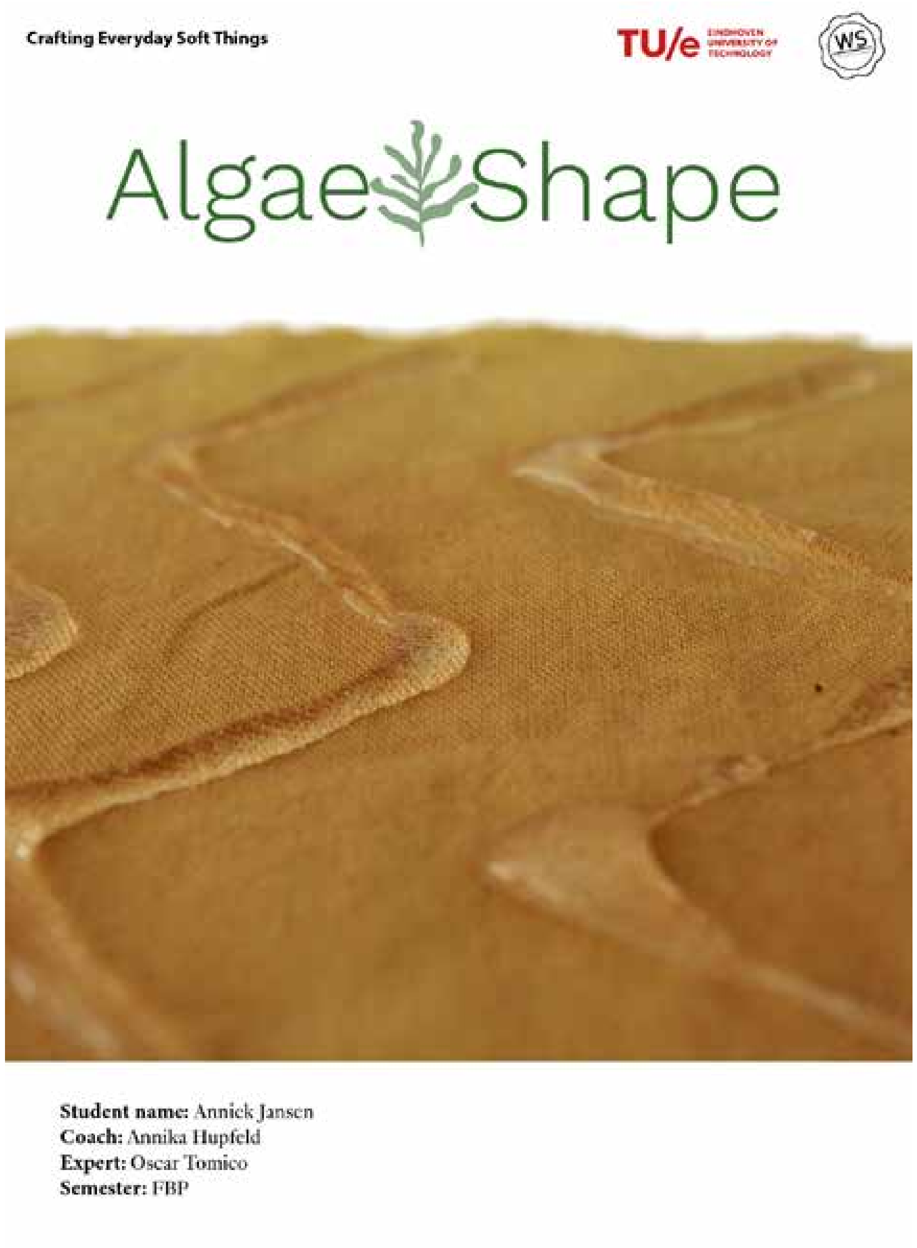


Figure 55. Poster for demo day

FUTURE

The AlgaeShape platform needs to gain more samples and especially more examples of application before it could be launched. Collaborations such as with Minne could help to gather more example projects. Students at design schools could be approached and asked if they would like to try to work with the alginate receiving a free starter kit. In return, they need to upload their projects.

Furthermore a fully working site should be developed with special attention to the information exploration balance.

The idea behind AlgaeShape can also be extended to other materials. Creating one place where you can find all the information and materials can be useful for many other materials. Examples are projects made in this squad during this and previous semesters: the Apple Leather from Daniele Ooms and the kombucha leather from Zeno van Dooren (Ooms, n.d.).

It could also be used as a database to gather knowledge about natural dyes and their colours on different materials, with different mordants and concentrations.

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APPENDIX

A: RECIPES

3 w/v% alginate:

- 6 g sodium alginate
- 200 ml tap water
- pigment

5 w/v% alginate

- 10 g sodium alginate
- 200 ml tap water
- pigment

2 w/v% alginate & 10% glycerine

- 4 g sodium alginate
- 180 ml tap water
- 25 g glycerine

Preparation I:

1. Combine all ingredients and mix with a blender until smooth
2. Leave to rest for at least 8 hours/ overnight to let all the air escape

Preparation II (only possible when working with glycerine)

1. Disperse the alginate in the glycerine
2. While stirring, slowly add the water and stir until smooth
3. Leave to rest for at least 2 hours or longer if not yet smooth

4 w/v% alginate & -50 % glycerine

Ingredients

% Glycerine	Sodium alginate (g)	Glycerine (g)	Tapwater (ml)
5	8	12.6	190
10	8	25.2	180
20	8	50.4	160
30	8	75.6	140
40	8	100.8	120
50	8	126	100

Figure 56. Ingredients for 4 w/v% alginate and 5-50% glycerine

B: METHODS

Method I

1. Dissolve the calcium chloride in the water, wear gloves when working with calcium chloride
2. Pour into a container with an opening that is wide enough to insert your sample
3. Fill the syringe with sodium alginate gel. Depending on the thickness of the gel you can suck it up or press it in from above
4. Measure the length of your sample and determine the desired shrinkage.
5. Read in the figure how much gel you need to apply per 10 cm
6. Apply the gel in a steady motion. Press with constant force
7. Submerge your sample with sodium alginate in the solution for 1 minute or longer for more shrinkage
8. Rinse in cold water
9. Leave to dehydrate for at least 24 hours

Method II

1. Dissolve the calcium chloride in the water, wear gloves when working with calcium chloride
2. Pour into a container with an opening that is wide enough to insert your sample
3. Spread a thin or thicker layer of alginate on the sample
4. Submerge your sample with sodium alginate in the solution for 1 minute or longer for more shrinkage
5. Rinse in cold water
6. Leave to dehydrate for at least 24 hours

Method III

1. Dissolve the calcium chloride in the water, wear gloves when working with calcium chloride
2. Pour into a container with an opening that is wide enough to insert your sample
3. Fold the fabric according to your pattern and mark the edges with a pencil
4. Open the fold and spread a thin layer of gel on the inside of the fold, between the marks from step three
5. Close the fold and press the fabric with your hands
6. Submerge your sample with sodium alginate in the solution for 1 minute or longer for more shrinkage
7. Rinse in cold water
8. Leave to dehydrate for at least 24 hours

C: FIRST PERSON PERSPECTIVE

Describe the product:

Is the alginate dehydrated?

How do I wear it:

What are my expectations:

Experience when trying it one:

Experience after the first minute:

Experience after five minutes:

Experience after 15 minutes:

Experience after 1 hour:

Experience after wearing:

Singlet

Describe the product: An old tricot singlet which has a slim fit but does not fit very tight. The singlet is made of 95% cotton and 5% elastane. On the front of the body, there are two vertical strokes of alginate (left on photo: 5% alginate, right: 3%) and several horizontal (left: 5% and right 3%). Furthermore two strokes on the shoulders in the front (both 3%). Piped (?) on the garment with a large syringe with a flat nozzle and cured by spraying 10% CaCl2 on it + once set also submerged. Left to dry for +_ 2 hours.

Is the alginate dehydrated? No

How do I wear it: On my bare skin with a BH underneath and long sleeve shirt over it.

What are my expectations: I expect it to be cold in the beginning but that it will take up my body heat and heat up. Besides, I expect the singlet to fit tighter.

Experience when trying it one: You hear tearing sounds of the fabric. The alginate feels very cold to your skin and the singlet is harder to put on, less elastic.

Experience after the first minute: The alginate is especially very cold on your belly even though there is a piece of fabric in between. Because of my BH, you do not feel the cold there. No limitations in movement. Very aware of the singlet and the cold.

Experience after five minutes: Still very aware of the coldness on my belly and I am now also more aware of the "thickening". No limitation in movement, but I do am more careful with moving because then the cold fabric will touch another place on my skin.

Experience after 15 minutes: The thickening starts to irritate, but I start to get accustomed to the coldness.

Experience after 1 hour: The thickening is now really irritating me, especially on my belly. I am completely accustomed to the coldness, but when it changes place or if I place my hand on top of it, it still feels cold.

Experience after wearing: I found it very pleasant that the thickening was gone and that I did not have to be afraid that the cold stroke would touch another part of my skin when moving. Only now when I stopped wearing it, I realized how I was unconsciously aware of this possibilities and tried to prevent it by not moving my upper body.

Describe the product: An old tricot singlet which has a slim fit but does not fit very tight. The singlet is made of 95% cotton and 5% elastane. On the front of the body, there are two vertical strokes of alginate (left on photo: 5% alginate, right: 3%) and several horizontal (left: 5% and right 3%). Furthermore two strokes on the shoulders in

the front (both 3%). Piped (?) on the garment with a large syringe with a flat nozzle and cured by spraying 10% Ca

Is the alginate dehydrated? Yes

How do I wear it: On my bare skin with a bh underneath and a sweater over it.

What are my expectations: I expect that the alginate will be much stiffer and will break when trying it one. This will result in sharp edges that might stick in my skin when moving. The stiffness might also limit my movement when bending forwards. However, I do not expect it to be cold anymore.

Experience when trying it one: The alginate breaks when stretching it to much, so I am very careful when putting it on. The broken bits are also quite sharp and they prick in my skin. It does not feel cold.

Experience after the first minute: It tickles a bit on my belly, especially when moving. Because most of the alginate broke into little pieces it does not limit my movement either provide support to sit straight.

Experience after five minutes: I am already a bit more accustomed to it, but due to this survey I do pay extra attention to how it feels. When you move it still tickles a bit and now it starts to feel more like irritating.

Experience after 15 minutes: I still feel the vertical alginate gels but they are not in the periphery of my attention and therefore I do not perceive it as tickling or irritating anymore. Because the stripe broke into several pieces, I find it tempting to hold those pieces and break them.

Experience after 1 hour: Almost completely accustomed to it, but because I knew that I had to write about it, I kept paying more attention to it than normal. But it does not feel cold, it does not irritate, you feel the hard bits when moving but it not annoying. The singlet still fits well and is flexible and elastic enough. At one moment a piece of alginate stuck in my skin and this felt like a sting, but when I moved it went away.

Experience after wearing: No irritated skin. The first few minutes it still felt like I was wearing it, but after a few minutes that feeling disappeared and it was just as before.

Test jacket

Describe the product: A "jacket"/ shirt from unbleached cotton with a zipper in the back.

Is the alginate dehydrated? No alginate

How do I wear it: With a long sleeve shirt underneath

What are my expectations: I think it will be wide enough to not limit my movements, but the fabric is a bit stiffer so it not move very easily/ does not drape loosely.

Experience when trying it one: The shoulders are a bit tight and because the fabric is not super smooth, it attaches to my shirt underneath it.

Experience after the first minute: The neckline is a bit high so if I look a bit down I feel this in my neck. If I bend my arms the sleeves are little bit tight, especially with a shirt underneath it.

Experience after five minutes: I already got used to the higher neckline, I only feel the tightness at my elbows a bit when typing. Furthermore, it does not really work well with my shirt underneath, when one moves the other moves too.

Experience after 15 minutes: Completely used to it and don't notice it when working on my computer. But when I write about it, I start paying extra attention and feel some limitation in my movement at my shoulders/

Experience after 1 hour: The same as after 15 minutes

Experience after wearing: Nothing noteworthy

Jacket I

Describe the product: The test jacket with alginate on the back and the left sleeve (see picture). Made with 3% alginate with a bit of turmeric

Is the alginate dehydrated? No

How do I wear it: With a singlet underneath it

What are my expectations: To be cold on the place where it touches my skin and to have shrunk a little bit.

Experience when trying it one: Cold on my back and high neckline.

Experience after the first minute: Still cold on my back, making me reluctant to move. Little notice of the stripe on my wrist.

Experience after five minutes: One of the round circles on my right side keeps feeling cold. I am not aware of the others anymore when I sit still. The experience of the cold circle on my back also gives the feeling that I am cold in general while when I focus on specific body parts I can feel that they are warm.

Experience after 15 minutes: I changed my position and therefore felt the left side of the jacket more prominent and this was still very cold. I also have a cold stripe along my vertebra although there is only alginate on both sides but it feels centred there.

Experience after 1 hour: It still is a bit cold when moving. The cold feeling along my vertebra disappeared.

Experience after wearing: Nothing noteworthy.

Describe the product: The test jacket with alginate on the back and the left sleeve (see picture). Made with 3% alginate with a bit of turmeric

Is the alginate dehydrated? Yes

How do I wear it: With a singlet underneath it

What are my expectations: I think it might limit my movements and I don't think it feels cold.

Experience when trying it one: It makes some breaking noises and it is a little bit tighter

Experience after the first minute: The alginate has hardened and I can feel this on my back and the right arm hole is a bit smaller because of the shrinkage on the back.

Experience after five minutes: The hard alginate itches a bit on the back especially on my right side (the circles) and on the top left (end of the stripe, in my neck).

Experience after 15 minutes: When bending forwards (working behind laptop) I feel the high neckline but it is not irritating me. I am still aware of the hard patches on my back but they are not annoying or irritating. I do not notice the bit on my left wrist.

Experience after 1 hour: I only notice it when moving or when I direct my mind to how my back feels, but when my focus is on something else I do not notice it.

Experience after wearing: Nothing noteworthy

D: NOTEBOOKS AND DATASETS

The jupyter notebooks and csv files (not from the user tests) can be found on github: https://github.com/A-Jansen/AlgaeShape

A-Jansen Update README.md — Latest commit 800f3cb 5 minutes ago

Datasets Material tests	Add files via upload	10 minutes ago
README.md	Update README.md	5 minutes ago
Samples alginate cross-checkpoint.ipynb	Add files via upload	2 days ago
Samples alginate ml-checkpoint.ipynb	Add files via upload	2 days ago
Samples curing time-checkpoint.ipynb	Add files via upload	2 days ago
User tests-checkpoint.ipynb	Add files via upload	2 days ago
glycerine tests-checkpoint.ipynb	Add files via upload	2 days ago

README.md

AlgaeShape

This is a final bachelor project for the study Industrial Design at the TU/e. The notebooks are used to analyse the data gathered during experiments with sodium alginate and textiles. If no units are given the following are used: cm, g, min, %

The datasets used in the notebooks for material analysis can be found in the folder Datasets Material Tests. The dataset gathered from the user tests cannot be found here due to privacy reasons. If you want to run the code, you must make a folder with both the notebook and csv files in there. The needed csv files are listed in the notebooks.

E: USER TEST QUESTIONNAIRE

Sample (zie de letter op de stof): ________ **ID:** ________

Geef aan hoe je de samples ervaart door één van de rondjes in te kleuren. Wil je je antwoord wijzigen zet er dan een kruis doorheen en kleur een ander rondje in. Mocht je nog andere ervaringen hebben dan kan je die hieronder opschrijven.

ondoorzichtig	○	○	○	○	○	doorzichtig
niet reflecterend	○	○	○	○	○	reflecterend
mat	○	○	○	○	○	glanzend
niet elastisch	○	○	○	○	○	elastisch
licht	○	○	○	○	○	zwaar
hard	○	○	○	○	○	zacht
bros	○	○	○	○	○	buigzaam
sterk	○	○	○	○	○	zwak
koud	○	○	○	○	○	warm
ruw	○	○	○	○	○	glad
geen geur	○	○	○	○	○	sterke geur
vettig	○	○	○	○	○	droog

____

____

____

ID: ______

Actie/ handelingen:

Tijdens het beantwoorden van de voorgaande vragen heb ik de volgende handelingen gedaan (bijvoorbeeld ruiken, het materiaal buigen, etc):

____

____

____

Samples vergelijken:

Vergelijk alle samples met elkaar en leg ze op volgorde van het minst prettig naar het prettigst. Leg vervolgens uit waarom je deze volgorde hebt gekozen.

Minst prettigst ____ ____ ____ ____ ____ ____ Prettigst

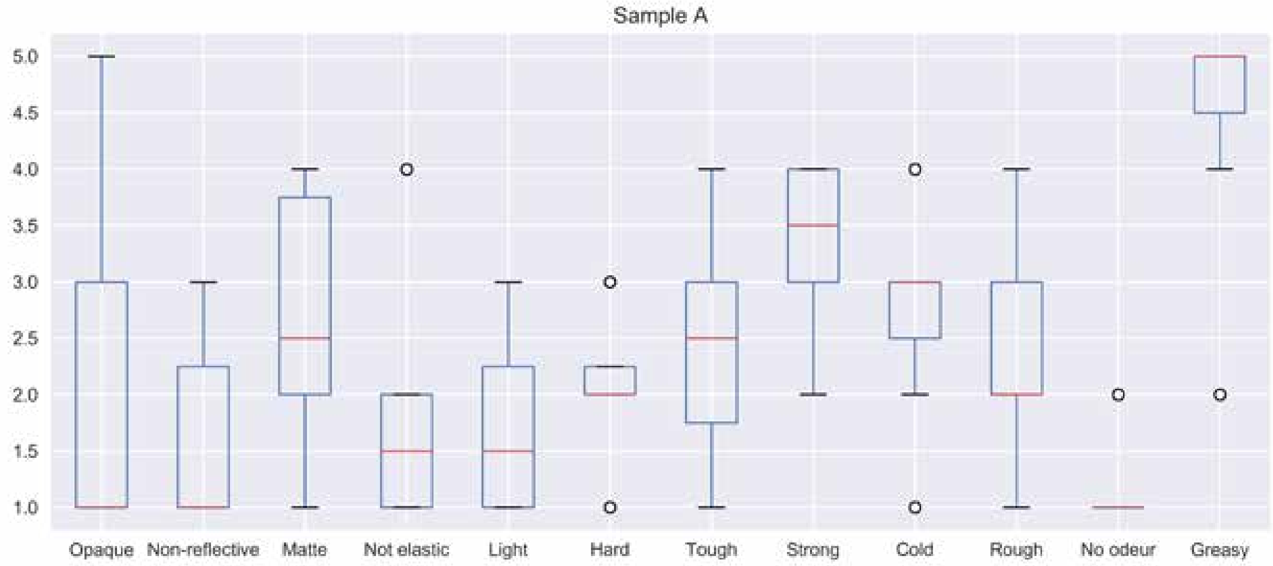
____

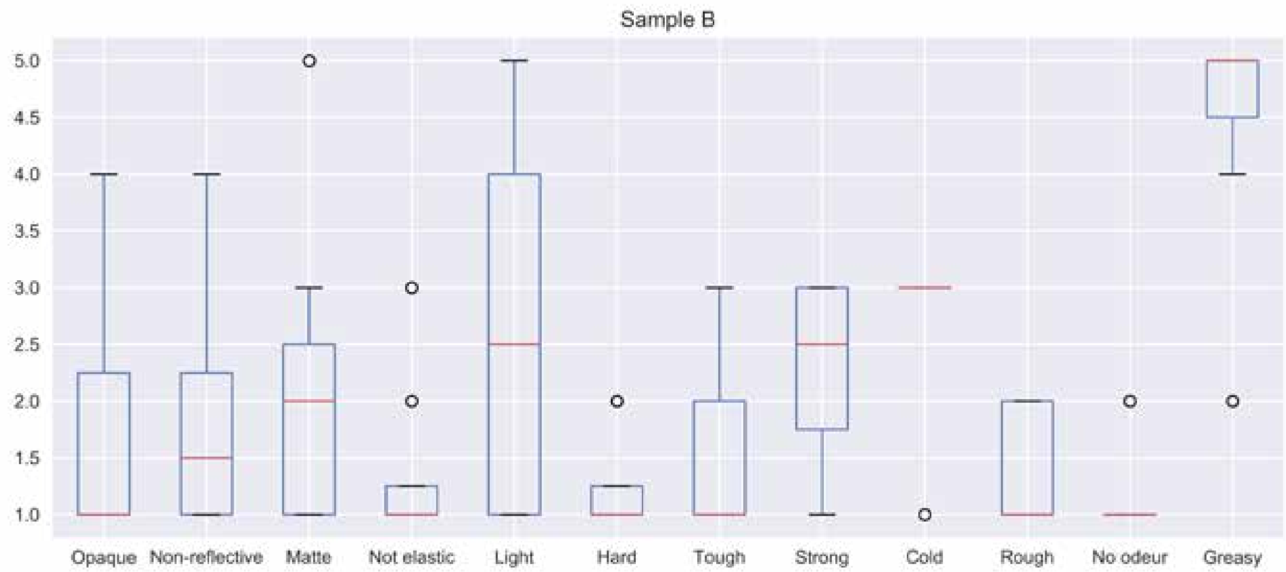
____

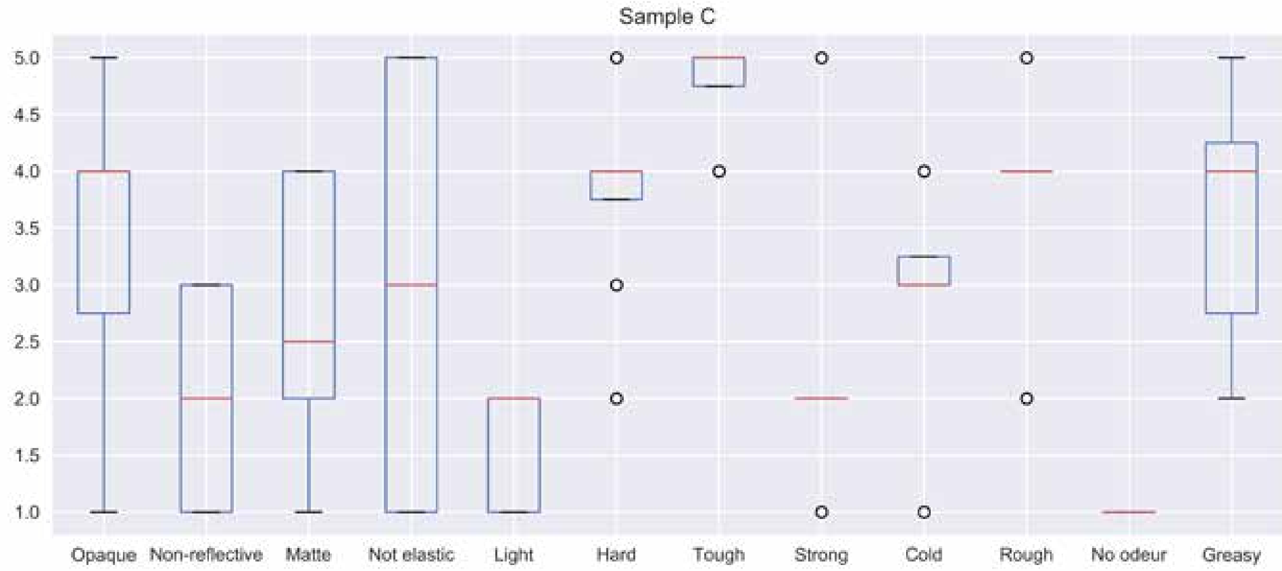
____

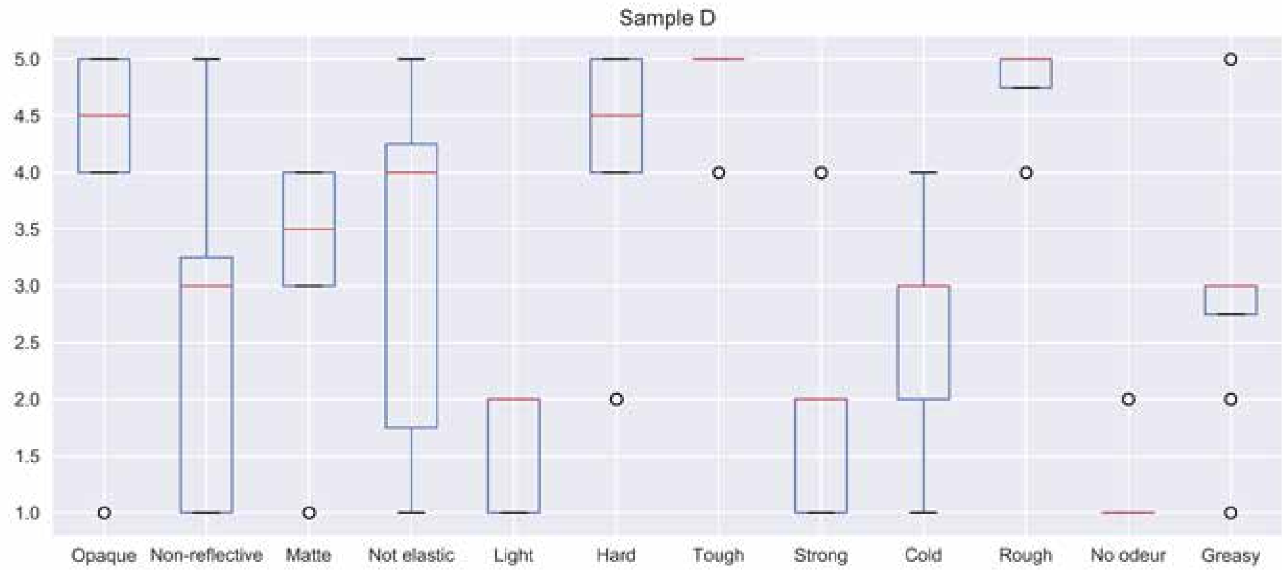
____

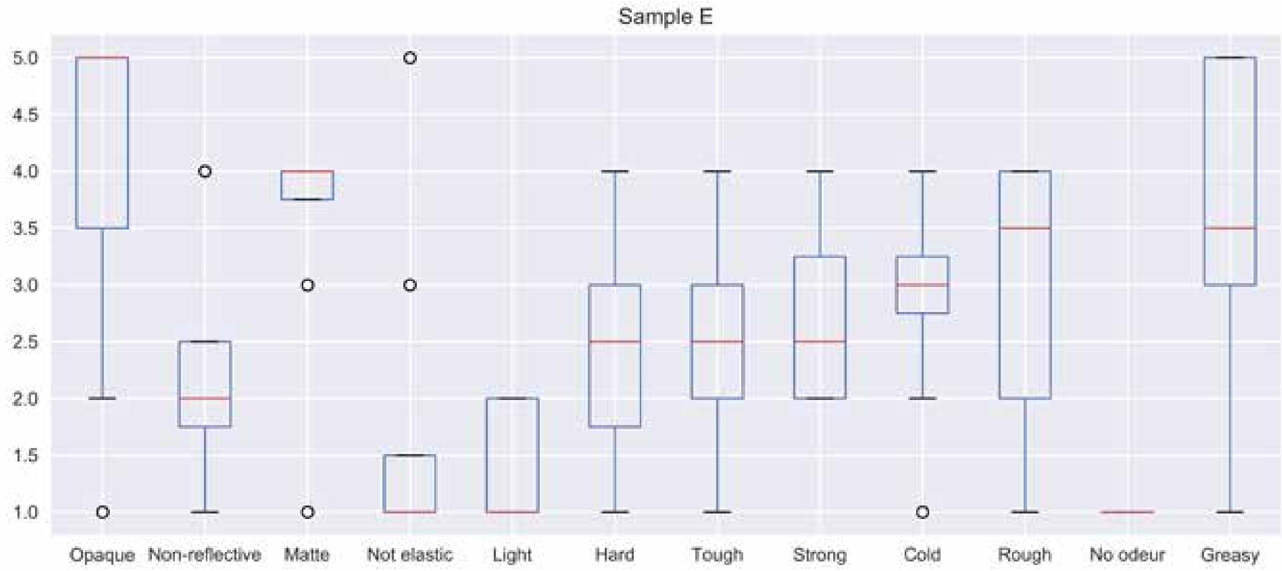
F: USER TEST RESULTS

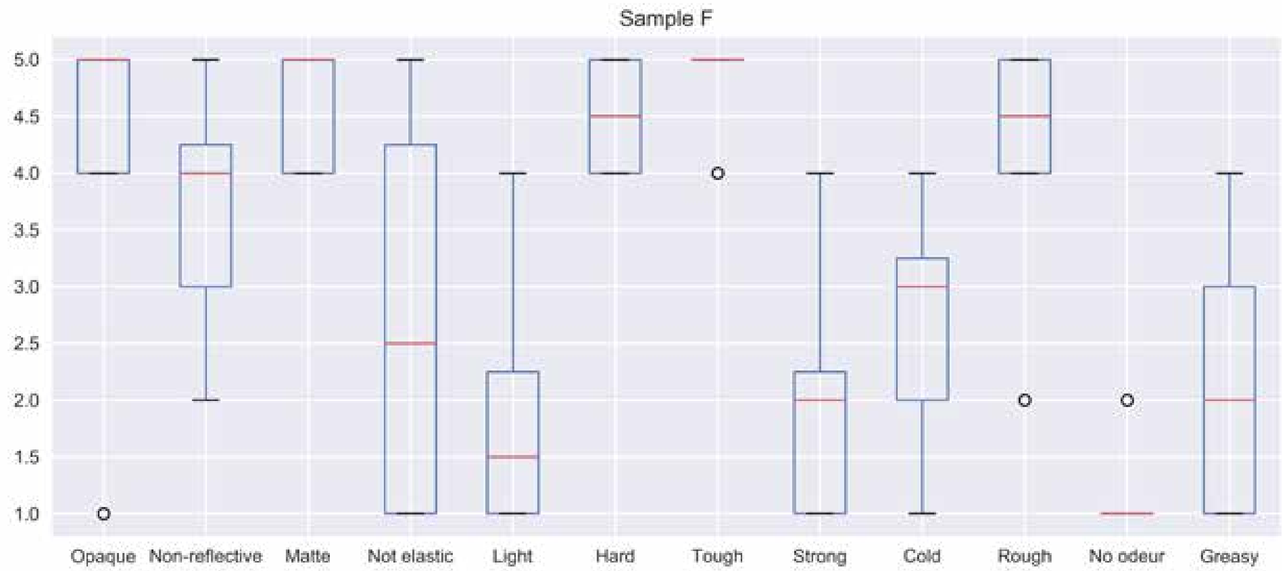





Sample C
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
Opaque
Non-reflective
Matte
Not elastic
Light
Hard
Tough
Strong
Cold
Rough
No odeur
Greasy


Sample D
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
Opaque
Non-reflective
Matte
Not elastic
Light
Hard
Tough
Strong
Cold
Rough
No odeur
Greasy


Sample E
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
Opaque
Non-reflective
Matte
Not elastic
Light
Hard
Tough
Strong
Cold
Rough
No odeur
Greasy


Sample F
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
Opaque
Non-reflective
Matte
Not elastic
Light
Hard
Tough
Strong
Cold
Rough
No odeur
Greasy

Acties handelingen	Count
ruiken	7
trekken	7
vouwen	2
tegen mijn wang houden	1
vinger erover strijken	2
rollen	2
in de zon spiegelen/ tegen het licht houden (glanzen)	2
kijken	3
voelen	2
bewegen	1
tussen duim en wijsvinger wrijven	1
buigen	6
breken	2
kreuken	1
wrijven	1

Table 8. Actions (in dutch) performed during the user test

ID	V1: less pleasant	V2	V3	V4	V5	V6: most pleasant	Uitleg
1	B	E	F	A	C	D	Hardheid voelt niet fijn, niet flexibel ook niet. Een was wat vettiger dat was ook minder prettig. Zacht flexibel en mat was D- dat voelde fijn
2	B	E	A	C	F	D	Het meest zacht en soepel vind ik het prettigst
3	B	E	D	A	C	D	Te hard, the kreukelig, the zweterig, the geplooid --> minder hard, kreukelig, zewetiger, geplooid
5	D	F	C	E	A	B	D, F, C vond ik erg plakkerig aan voelen. Ook voelde deze samples erg elastisch aan. Ik merk dat ik de samples die harder aanvoelen prettiger vind. Deze voelen minder vettig aan.
7	B	E	A	C	F	D	B is heel hard en stug, E is ook stug en stroeg, A is redelijk hard en bros en het woordt steeds zachter en buigzamer
8	B	E	A	C	D	F	F is het meest soepel. B=hard. A plakt raar aan elkaar, C laat los komt (misschien door vorige tester)?
9	E	B	A	C	D	F	Ik denk dat via deze volgorde de oorspronkelijk stof het meest “authentiek” blijft
10	B	E	A	F	C	D	Ik vind het onprettig wanneer ik verwacht dat het materiaal gaat breken. Dus hoe meegaander/ flexibeler/ elastischer hoe prettiger. Echter F voelt heel vettig en dat ervaar ik als minder pretigger, dan de wat rubber-achtige substantie van D.

Table 9. The rating from less pleasant to most pleasant samples and the explanation for why

Participant's ID:

Technische Universiteit Eindhoven
University of Technology

Informed consent form

This document gives you information about the "**Alginate and fabrics'** study. Before the study begins, it is important that you learn about the procedure followed in this study and that you give your informed consent for voluntary participation. Please read this document carefully.

Aim and benefit of the study

The aim of this study is to explore the properties and associations of the material sodium alginate when it is applied on fabrics. This can help to shape further applications and provide a reference for designers when designing with the material.

Procedure

The study lasts for around 20 minutes. The participation will receive several samples of the material and is asked to fill out a questionnaire for each of the samples. Furthermore, the participants are asked to add pictures of materials or products for certain properties or characteristics.

Risks

The study does not involve any risks or detrimental side effects.

Duration

The data collection will be done through a questionnaire on paper or digital.

Voluntary

Your participation is completely voluntary. You can refuse to participate without giving any reasons and you can stop your participation at any time during the study. You can also withdraw your permission to use your data up to 24 hours after the study is finished. All this will have no negative consequences whatsoever.

Confidentiality

For your information, this study involves data. Only the research team will be able to view your data and they will be used only for scientific analysis.

The information that we collect from this study also is used for writing scientific publications and will only be reported at group level. It will be completely anonymous and it cannot be traced back to you. Neither your name nor any other identifying information will be used in presentations or in written products resulting from the study without your written consent.

Participant's paraph ____

Further information

If you want more information about this study, please contact Anniek Jansen. (Contact email: a.jansen1@student.tue.nl).

If you have any complaints about this study, please contact Anniek Jansen. (Contact email: a.jansen1@student.tue.nl).

Certificate of Consent

I, **(NAME)**……………………………………… have read and understood this consent form and have been given the opportunity to ask questions.

I have the following responsibilities: perform experimental tasks, participate in the group interview, and answer the questionnaire to the best of my ability.

________________________________ Participant's Signature

_________________________ Date