About Solving and Dissolving
Investigating the design possibilities of bio plastic

Tanja Marie Nitsche
CONTENT

1.2. Abstract 15
1.3. Keywords 15

2. Introduction 16
  2.1. Introduction to the field 17
  2.2. Design Program 21

3. Motive and Idea 25
  3.2. Aim 26

4. Methodology 27

5. Development and Design Rationale 32
  5.1. M 1: Flexible Line 33
  5.2. M 2: Solid Geometry 40
  5.3. M 3: Dynamic Stripe 48
  5.4. M 4: Ellipse in Motion 53
  5.5. M 5: Shifting Square 62

6. Result 69

7. Presentation 77

8. Discussion and Reflection 78

9. References 83

10. Appendix 85
Fig. 1: Representative image, Flexible Line, group of biomorph objects
Fig. 2: Representative image, Flexible Line, detail texture
Fig. 3: Representative image, Solid Geometry, group of geometric forms
Fig. 4: Representative image, Solid Geometry, detail playful texture
Fig. 5: Representative image, Dynamic Stripe, group of colour and loop experiments
Fig. 6: Representative image, Dynamic Stripe, detail structure
Fig. 7: Representative image, Ellipse in Motion, organically bent surfaces with openings
Fig. 8: Representative image, Ellipse in Motion, detail openings
Fig. 9: Representative image, Shifting Square, flexibility
Fig. 10: Representative image, Shifting Square, colour gradient and texture
1.2. Abstract

Translating the conceptual term of sustainability into materials and exploring bio plastics in order to generate visually and tacitly intriguing objects are the aims for this project. Other designers and previous projects in the field of textile design showed how the material works in a small scale. This project used the material’s design properties to generate groups of object elements. The three main design properties of the material, transparency, biomorph expression and flexibility, and their opposites, opaqueness, geometric expression and stiffness, were combined in different sets which resulted in the used artistic methodology. Therefore, the material properties and earlier established techniques formed the base for finding the overall forms of the installations.

The collection and a book about the surface design possibilities for plant based plastic show how the material can be manufactured. The installations focus on the interplay between colour, light and shadow, material texture and pattern in relation to the overall shape of the object. Moulding, laser cutting and the addition of other ingredients like recycled paper, fibres and mica powder influenced the material’s durability, flexibility, transparency and texture. Experiments revealed that the colours change over time and all of them are highly influenced in their intensity and shade by the light source behind the material.

This project visualises how all these factors interact and which techniques and tools are required to process the new material. Moreover, it generates new options for a new formal language and terminology for sustainable interior textiles.

1.3. Keywords

Biomorph, bio plastic, plant dye, surface design, sustainability, textile design, transparency
2. Introduction

The term “sustainability” became fashionable in the 1990s (Gatto, 1995), is printed on all kinds of products and is usually communicated as a label of something good. It is used to direct the consumer’s behaviour. Likewise, sustainability found its way into every field of research such as natural sciences, economics, art and design. In general, a sustainable decision has the ability to be sustained or confirmed and includes the factor of time (dictionary, n.d.). If a product and therefore, its design are called sustainable it could have a variety of meanings that can be connected but also inconsistent (Gatto, 1995). When a textile is classified as sustainable it could mean that it was produced in a socially sustainable way. Hence, the term describes the working conditions during the growing and harvesting of the raw materials, the manufacturing process or the improvement of the current society through the distribution of the product. Social sustainability represents the first of three pillars that the concept of sustainability relies on. The second pillar addresses the economic sector. There sustainability is defined as usage of the company’s resources in a beneficially balanced way (businessdictionary, n.d.). A sustainable decision or design in economics therefore increases sales, improves the company’s image or can be used for a long time without additional investments.

The third pillar of sustainability in textiles is the environmental friendliness of a design. An environmentally sustainable strategy starts with growing raw materials with low water consumption, avoids toxic pesticides and prohibits harmful chemicals for dying, printing and finishing the fibres and textiles (GOTS, n.d.). Therefore, planning the design with the aim of low waste production (Fletcher, 2008), long lasting product life circles and even the packaging and distribution of the finished product should be considered (GOTS, n.d.). Last, the environmental issue around textiles includes the usage and after-life phase of a textile product. Chemical colorants and micro particles of synthetic fibres are then washed out and transported to and spread in the ocean. Statistics show that sixty percent of the worldwide produced fibres are synthetic and that polyester makes the main part of it (plasticrubbish.com,n.d.). Regarding synthetic fibre production, this mainly results in plastics that are considered non biodegradable. Scientists try to analyse what this flood of non-degradable material means for our planet and how the different sectors can improve long term (Reno, 2015): more sustainable design processes.

The artistic research project ABOUT SOLVING AND DISSOLVING focuses on the environmental aspect of the complex construct of sustainability. Plant based, biodegradable and non-toxic materials are used to draft visually and tactiley intriguing surfaces in an experimental, one could say speculative, way of designing. The human desire to explore the surrounding is addressed through colours and touchable textures. This playful approach to the topic of sustainability converts the theoretical construct of (environmental) sustainability into tangible matter. The project explores the design possibilities of bio plastic and strives to define the (visual) language and tools for a new category of textiles. These originate in traditional textile thinking and design methods from digital design methods.
The following INTRODUCTION TO THE FIELD will place the concept, the artistic expression and the technical aspect of this project in its contemporary context. Firstly, the general concept of sustainability as a philosophical construct will be further discussed. Next, it will be compared how other artists from the field of textile, material and architectural design work with visually and tactiley sense-able materials.

2.1. Introduction to the field

2.1.1. Sustainability or away is not away

During the first plastic revolution in the nineteen-seventies society thought it could get rid of outdated products by flushing them (Morton, 2013). Today the general public starts to understand how the consequences of overconsumption and non-sustainable behaviour will deconstruct the close future. Humanity and therefore designers have to consider the after-life of an object before it is produced. If it is brought to existence once – what happens with it after the using phase? Flushing unwanted items transports them to the oceans where at least synthetic materials and toxic chemicals will not just disappear.

As explained before sustainability is variously defined by researchers from different backgrounds. For this project sustainability refers to non-environmentally-polluting ways of designing, this builds the ethical fundament for all experiments. Plant dyes are chosen because they are non-toxic. Likewise, plant materials like agar and potato starch are the main ingredients for the produced material because they are renewable and biodegradable. Left-over material is tested to be buried or recycled through “cooking” it again so as little waste as possible is produced. This ethical aspect of the project was established on the philosophical thought construct of “away is not away” (Morton, 2013) and is executed in every step of the design process.

Experiments by Dunne and Raby (2013) require an open mind about the future and the meaning sustainability could have then. The speculative designers propose design systems and items to open up for alternative speculative objects that humanity could need in future. Obviously, not all products have a currently necessary practical function. Nevertheless, they have a purpose: to provoke scientists, artists and the society to think about social behaviour and technical developments. For example, Dunne and Raby’s project BIOCARS (2013) proposes how grown cars could look and function like. They speculate about how the material would be grown by a computer-programmed plant and question possible material properties, behaviour and the possible function for humanity.

For their movement of Bio Liberals the best scenario seems to be a stop of all man-made, polluting items and to grow bio based technology. It is important to experiment within this alternative future to deeply question the definition of sustainability that we use today. Bio Liberals also ask how people interact with textiles that are grown, still growing or changing itself after some time.

The plant materials that are used for this project result in biomorph (organic) expressions.
Similarly to BIOCARS, the surfaces appear bodily, almost alive or still growing. This biomorph expression is used to make the audience curious about the material’s origin, the possibility to touch it and how the material behaves if it is touched.

2.1.2. Material perception –
Addressing the brain
Creating intriguing and appealing designs to reconnect the audience and the plant material through touch and look plays an important role in ABOUT SOLVING AND DISSOLVING. This is a similar approach as Rouillon discusses in her work DAILY HAPTICS (n.d.). The pottery artist stages the everyday life product cup as an exciting object that offers a tactile experience for the consumer in addition to its conventional function. Addressing the human craving to sense and touch its surrounding causes the audience to wonder about the objects’s origin. One wants to feel it, see if the structure breaks if it was bent and how it feels on the skin. In this way a connection between the audience and the design is established just like in in Rouillon’s work.
Beside the human sense of tactility, the designs in ABOUT SOLVING AND DISSOLVING address the visual sense through an intense colour and light palette. Colour and light are inseparable and not just properties of an object. They are defined as a quality and perception by the human brain. Therefore the phenomena include objective and subjective aspects (Mahnke, 1990). Colours and light change significantly the way the surrounding is perceived, directly stimulate human feelings and influence the perception of an architectural environment as much as tangible input does. This can be used by the designer to play with expectations evolving around objects (or rooms), confuse or surprise the audience with transparency and colour.

2.1.3. Textile Thinking
What is a textile? The term is defined as a knitted, woven or felted cloth (dictionary.com, n.d.). Steward (2017) questions this definition and states that his composition of wooden blocks is a textile because it is build based on the rules of a knitting construction. Borrowing techniques or systems from other fields is a helpful first step for exploring a new material. Similar to the translation of a knitting construction into a wooden surface by Steward, the design methods of ABOUT SOLVING AND DISSOLVING deal with the abstraction of textile techniques. One example therefore is the group of objects in FLEXIBLE LINE, which is a translation of traditional weaving into a bio plastic foil. The main rule in weaving is that two systems are connected right-angled to each other. This rule got abstracted and applied to the bio plastic design through a wire skeleton. It is treted like a warp and filled with a bio plastic membrane, the weft.
In addition to the underlying abstracted textile-system the final characteristics of the new material evoke traditional textile properties like flexibility or softness.
According to Steward’s (2017) design methodology it is reasonable to have an idea of the desired outcome even though the design process is based on experimentation. This initial idea affects the used method and the final form.
2.1.4. Future Materials
In what way a future user would handle her designs is a substantial topic for Schmeer (n.d.). BIOPLASTIC FANTASTIC explores scientific, material related and social cultural aspects of technical devices in an utopia future. Bio resin, bio plastic and bio plastic composites are combined to gain intriguing structures and colours for a bright and playful space. Likewise, ABOUT SOLVING AND DISSOLVING starts with a material research. Schmeer then brings in a speculative scientific phenomenon and synthetic bacteria designs are constructed to produce nutrition and air in domestic future spaces. Her additional research in scientific fields enables her to rethink traditional production and usage phases to generate futuristic interior products. In comparison, ABOUT SOLVING AND DISSOLVING continues to work with the material’s natural design properties. Translucency and the biomorph expression of the material are emphasized through enlightened three-dimensional textile structures that explore the material’s natural forms, further elucidated in chapter 6.RESULT.

Another approach to sustainability is shown by 3D-printing architect Oxman (2010). Naturally grown shapes and functions of objects and nature informed material structures are the main topics of her work. She observes how nature develops its objects and claims that the ideal way of designing would be to grow objects seamlessly. However, at this point digital design methods based on geometric calculations are not satisfying when it comes to the planning and fabrication of grown material-object combinations. Oxman translates physical design properties of materials like transparency or flexure into computer coding systems. This enables her to plan, simulate (test), visualize and manufacture her designs digitally. Her materials are highly customized to form shapes that are purely informed by the functionality and behaviour of the material. One could say about her designs that form follows matter. This also guides the construction systems for the object sets of ABOUT SOLVING AND DISSOLVING. Each object group illustrates through their form what technique and material has been used and demonstrates the bio plastic’s various natures, and material behaviours.

In the design works of Buet (n.d.) and Lohman (n.d.) nature is primarily seen as a high quality source of materials. Likewise, both projects use seaweed in its visually raw form as their main working material. In contrast, the processing techniques and final expressions vary significantly. The founder of the DEPARTMENT OF SEAWEED at the V&A Museum in London, Lohman (n.d.), works on spacial concepts and installations like her several metres high Oki Naganode (2013). She uses seaweed in combination with wooden and metallic frames, applies seaweed stripes like fabric to lampshades and stresses translucency and natural colour of the material. An organic expression is generated in her unique pieces. Buet (n.d.), on the other hand, adds textures and tangible aspects like fringes to the otherwise plain seaweed through laser cutting, dyeing, weaving, pressing and other textile techniques. The textile designer cooperates with multidisciplinary teams to work on algae designs for arts and the industry. Similarly, ABOUT SOLVING AND DISSOLVING is sustained by techniques from the textile design field.
Principles from leather treatment (moulding with heat), weaving and pleating were applied to the bio plastic material. Seaweed powder (called agar) instead of raw algae strings provide a greater range of design (colour) possibilities and is chosen for this research project because of its availability and reliability in quality.

Another, more speculative, approach to bio plastic is displayed by textile innovator Disney (2013) in SYNTHETIC PROTECTION: BIOINTELLIGENT MEMBRANES. She implements lifesaving material properties into her materials. Disney draws a picture of the year 2100, when bio plastic as an adaptive textile material needs to replace conventional clothes in order to protect the human body from extreme weather conditions. Designing flexible structures, textures and scales is already possible with currently available design tools. Whereas, the smartly reacting functions of the materials are just suggested at this point and will need to be realised by future scientists. This interplay of material science and design proposal for a material opens up the discussion about sustainable textiles and their applications. Concerning ABOUT SOLVING AND DISSOLVING sustainability in textiles mainly focuses on the raw material’s origin, the possibility to design a closed product life circle and to raise the audience’s awareness for environmental issues. However, in speculative future scenarios the meaning of sustainability could shift to something yet unknown. Our future could hold grown, lifelong-lasting, adapting skin garments (Disney, 2013) or nourishing furniture objects just as Schmeer (n.d.) introduces. Alternative futures, products, ways of consuming, sustainability, perception of colour and textures, materials and tools also meet in Lee’s book MATERIAL ALCHEMY (2014). She builds up an archive of these experimental materials with the help of designers and artist from different disciplines. They state that new sustainable materials require new tools. Simultaneously, they propose to borrow them from other art and craft disciplines or from traditional textile techniques. Nevertheless, the outcome will still be considered new because of the unconventional material-technique-expression-combination. In that way Lee introduces the audience to numerous possibilities for a more sustainable future.

As an aside she provides recipes and ideas to create beautiful, weird (in a good way), nauseate or highly functional textiles and objects with the aim to provoke thought about future spaces. Lee explores different techniques and raw materials to deal with various topics within (textile) design in the twenty-first century. Her team explores living matter as a design material, 3D printing, and the cultivation and growth of new materials. The results in MATERIAL ALCHEMY are mainly presented as small lab swatches (material samples) and strengthen the motivation to explore bio plastic in another scale in ABOUT SOLVING AND DISSOLVING.
2.2. Design Program

The topic of sustainability in textiles includes a social, environmental and economic factor (GOTS, n.d.). This design program focuses on the environmental aspects of a sustainable future and how it can be translated into materials. The embedded projects push the limitations of plant materials like durability, stability and colour variation. Furthermore, they question what environmental sustainability means for designers and a possible future consumer. The core is to create textures and touches that are able to make the audience curious about its origin and ingredients. The created two- and three-dimensional designs are used to raise the awareness of designers and the audience about local production and plant materials through representing installations.

A playful approach to the contemporary topic of sustainable textiles is important for the five performed projects that are embedded in this design program. The practice based design research is founded on test and try experiments in a laboratory (Koskinen, 2011). The first project, entitled ROOM2.0, was based on cellulosic fibres which were interwoven to generate room scaled designs. The second project SMART (RE)ACTIONS included unusual material combinations and interactive functions in the design process in order to create temporary colour and light changes. During MATERIAL TRANSFORMATIONS, the third work, traditional textile materials and plant dyes were coated with epoxy resin and bio plastic to add surprising characteristics like translucency, transparency and stability to the woven and felted textiles. Finally, the fourth project RESEARCH PROJECT: BIO PLASTIC explored bio plastic as a pure material in senses of colour, thickness, texture, stability and durability. The experiments provided first information about the plant based compound material and its perception by the audience. ABOUT SOLVING AND DISSOLVING takes this exploration further.

2.2.1. Room 2.0

The first project of the design program examined weaving in a spacial context (Fig. 11). Dyeing fibres with plant colorants and processing them into threads and loose fibre constructions exposed new possibilities of manufacturing techniques for interior textiles. Influenced by the slow design principles plant based materials and resource saving techniques were chosen (Fuad-Luke and Strauss, 2017). Minimising water pollution, using a low amount of material and no-waste-production methods lead this project’s experimentation and later on the whole design program. The patterns were designed geometrically and therefore set the premises for the following structures like the ones of MATERIAL TRANSFORMATIONS.

![Fig. 11: Room 2.0; Woven space](image-url)
2.2.2. Smart?
The series of experiments during the second project SMART? was conducted to find connection points between natural materials and dyes with an additional material palette called smart materials (Fig. 12). Adding conductive metal threads and fibre optics to the material palette and working with the combination of indigo dye and thermochromic inks visualised the reciprocal (re)actions of the materials. The project dealt with different functions and properties of these combinations. The aspect of (re)acting, which describes a change in the textile, could also be found when working with pure plant material. Plant dyes, for instance, change their shade and intensity within several months. The experiments helped to understand how reacting textiles are designed and that the potential for planning the change (or action) lays in time, temperature and electricity. Additionally, sketches and visualisations showed smart materials placed in a room and if they could be processed into environmentally and socially sustainable designs.

2.2.3. Material Transformations
The third project had the intention to build up an archive of plant dyed materials like paper, wood and various plant fibres. A focus on emphasising plant dyes as a valuable but almost forgotten tool (Lundin, 2014) runs through the entire design program and also regains more interest in the textile industry.

“The predominance of synthetic dyes hindered a continuous development and adaptation of natural dyeing to the changing requirements of modern dyehouses. As a result, now a considerable gap exists, separating the knowledge about natural dyes from the demands of commercial dyeing processes. […] An estimation of the chemical load that would be released into the waste water from different dyeing processes in use today indicates that the use of the proposed dyeing process will result in ecological improvements.”
(Bechtold, 2003, p.499)

Finally, the design possibilities of bio plastic coatings on traditional textile materials (like cloth and fibres) were looked into. It was exposed that these combinations held characteristics like stability and translucency as well as smoothness and bend or drape abilities which reminded of traditional textiles (Fig. 13-14). During these first bio plastic experiments it was applied as a coating to generate geometric patterns in imperfect repetition (Koren, 1994). Regarding the Japanese philosophy Wabi-Sabi the imperfectness of repetitions and materials are a precious part of a design’s expression.
Construction parts and cracks should not be hidden so the viewer can enjoy the pureness of material and object–its so called nature (Koren, 1994). Bio plastic demonstrated its unique nature and held a surprise factor within the design process, it changed the textile material in a biomorph way and never resulted in the exact same design.

2.2.4. Research Project: Bio plastic

In order to understand the behaviour and full potential of bio plastic tests with the pure material were done, in the fourth project. This unfolded the material’s design properties and their control from the first step on. Colour, scale/thickness, texture, embedded construction systems and later on combinations with other materials (to strengthen the stability and biomorph expression) were tested and analysed with the help of photos and hand drawn sketches. Weave-thinking in sense of (imperfect) repetitions and adding a contrast to the biomorph bio plastic material in form of a geometric constructions formed three-dimensional textiles (Fig. 15-16).

Besides the material’s behaviour, it was observed in what way an audience reacted to the material at an exhibition and during small presentations. This clarified that the surface designs were only touched if the visual appearance was vibrant and the designs were presented in an easily approachable (low, stable, modifiable) way.

Afterwards, the two-dimensional surface designs were transformed into three-dimensional objects. The colours and overall expressions changed significantly because of the bio plastic’s transparency and layering. Crawford (2003) states that the two-dimensional and three-dimensional expressions of art works are closely connected but that they offer different experiences for the viewer. In MATERIAL TRANSFORMATION’s case the surface patterns became more or less visible. Bright plant colours with an artificial appearance were found to be challenging to produce but intensified when applied to the transparent bio plastic. Material layering, coloured backgrounds and coloured light were able to provide remedy for this challenge.
2.2.5. Conclusion Design program

The objective to create diverse plant-based designs originate in the belief that future interiors should not only be flat and white. The audience should get in touch with experiencing that sustainable textiles consist out of more than organically grown plain cotton. The field of sustainable interior textiles is in need of a bridge between speculative design and the audience. Addressing the human urge to explore, touch and interact with its environment and try to reconnect the consumer with the (raw) material is essential to fill this gap.

The design program frames projects like MATERIAL TRANSFORMATIONS, which explored the technical and visual potential and limitation of plant based materials to generate a new category of future textiles. Reintroducing the plant as a valuable material and exposing sustainable interiors as exciting and playful, represent two more design objectives for this program. All in all, the program deals with the design possibilities of plant based materials seen as a part of the field of sustainable future textiles in relation to the human curiosity to explore and touch their surroundings.

The embedded series of experiments and projects are guided by questions like: How do people perceive textiles and plant materials and how do they react to new surface textures? What makes the audience curious about a new material- the transparency, the drape, the colour, the flexibility or is it the association with something else? What factors are important when it comes to the dissolving or “breaking” of the design, caused by, for example, colour-change, over time or usage? What role does a surprise factor play in the design process?
3. Motive and Idea

3.1. Playful tools for playful textiles

Analysing current artistic research projects in the field of speculative interior textiles outlined the missing part between the limited bio plastic texture and colour palette in projects like DEPARTMENT OF SEAWEED (Lohman, n.d.), the desired interior scale and the audience. The primary motive for ABOUT SOLVING AND DISSOLVING is to bring those factors—material, scale and human—together.

The experiments in the book MATERIAL ALCHEMY (Lee, 2013) avoid technical difficulties with natural materials like low stability, durability or evenness since the focus lies on the visual expression and material innovation in a temporary, small scale. In contrast, ABOUT SOLVING AND DISSOLVING is driven by the interest in interior space related design possibilities for bio plastics. The most promising recipes for the plant based compound materials are tested, tried and then used to calculate the ingredients and optimum size of modules that are arranged to form the final designs.

Additional material like metal wire is used to strengthen the three-dimensionality of the collection. Similarly, Lohman (n.d.) installs seaweed sheets and threads on frames out of metal and wood to overcome the difficulty of self holding but translucent materials on a big scale. ABOUT SOLVING AND DISSOLVING additionally works with the tactile aspect of the textile.

The five groups of material explorations are placed in the context of interior textiles. Emphasised through their presentation in combination with light, this helps the audience to see what the material can or could do. Therefore, ideas for applications, other needed material characteristics and finally ideas for more speculative textiles are provoked.

“[…] potential applications. The point of such uses is not always evident, but mentioning them is crucial. After all, a material without context is no more than a boring toy.”

(Van Hinte, 2003, p.2)

This provides the audience with an association of a new material to something already known and therefore helps to understand it. A similar approach is discussed in Rouillon’s (n.d.) project DAILY HAPTICS. ABOUT SOLVING AND DISSOLVING aims to create textiles that make the audience wonder about its origin, touch and stability. It uses the same principle to increase the haptic aspects of designs, to catch the audience’s attention and to create a more exciting setting to live in. In this project “exciting” is mainly addressed through colour and tactility. Tactility is defined as an uneven surface through differences in heights or textures within each piece.

What role will colours play in sustainable future rooms? Layering translucent bio plastic, coloured light, geometric and biomorph textures and patterns influences the overall colour expression of the pieces. This expressions indicate alternative design options for speculative future interiors, which are too often illustrated as plain hygienic white surfaces.

Geometric systems are incorporated in the biomorph textures to please the eye and make the structures more comprehensible.
Unevenness is emphasised, the perfection of imperfection in relation to honesty of material and time like Koren describes it in WABI-SABI (Koren, 1994) are used to remind the audience about material origins and the natural environment. Plants are shown as a valuable, modifiable and exciting future material. Simultaneously questions about the value of self-transforming (colour changing, breaking, dissolving) textiles like Talman (2017) mentions in her lecture, are opened up and seen as a possibility to modify the designs further after they are dried and shaped.

The primary motivation for this project is to find a playful approach to the topic of (environmental) sustainable interior textiles. Through a comprehensible and exciting outcome the audience is encouraged to explore themselves what future interiors could look and feel like.

Adding this playful approach to sustainability will catch people’s awareness about their natural environment on another level and will open up discussions about the communication of material origins and uses in other disciplines like architecture. An increasing number of scientific books and articles about environmental issues like micro plastic and chemicals that are destroying the oceans climates inform an audience that is aware about the topic and willing to change for example (textile or water) waste reduction (GOTS, n.d.).

Since we spend the most of our time indoors textiles and textile interiors are a part in everyone’s life (buildinggreen.com, n.d.). Therefore a broad audience can be reached through textiles and textile installations that exemplify how sustainable materials could improve the future.

ABOUT SOLVING AND DISSOLVING offers the knowledge for designers to replicate bio plastic materials, spreads this know-how and raises awareness for textile production, consumption, textile waste and recycling of materials. “Away is not away”, Morton (2013) states in his book HYPEROBJECTS and thereby means that flushing or brining depleted materials to landfills may have seemed as a good option after the plastic boom but is definitely outdated. The drive of this research project is to work towards a more environmental and social friendly future and textile design practice. The urge for this change of practice is underlined by scientific research projects like Reno’s (2015). He lays out categories of waste, their polluting effects and their after-lives far away from human sight and health. The materials, the actual matter as well as the dyes, used for ABOUT SOLVING AND DISSOLVING are disposable or at least recyclable and reusable. The bio plastic is mixed with recycled paper or cellulosic fibres so the remains of unsuccessful experiments can easily be dissolved in water or decomposed.

The project invites the audience and other designers to explore origins and after-lives of raw materials and critiques mass produced plastic and the involved polluting processes.

3.2. Aim
Exploring the design properties of bio plastic to generate visually and tactilely intriguing textile objects.
4. Methodology

Artistic research includes a broad variety of practice based design methodologies. For this project methods like sketching models (Lucci and Orlandini, 1990), digital design (Adams and Yelavich, 2014) and low tech parametric design based on dynamic geometric repetition (Ednie-Brown, Burry and Burrow, 2013) were used to generate the designer’s own methodology for each object in the final collection. All experiments and therefore methods were conducted based on Koskinen’s theory of constructive design research (2011). Knowledge about a new material and its design possibilities was developed through practical experiments in the laboratory. The chronological adaption during the processes and combination of methods will be further discussed in 5. DEVELOPMENT AND DESIGN RATIONALE.

Firstly, ABOUT SOLVING AND DISSOLVING started with collecting and testing different plant materials for dyeing (Fig. 17). Those experiments resulted in an archive of sketches (material samples) which lead to the ideas for the following material exploration. Aspects such as tangible changes in texture, height differences within one design, light transmission (translucency), biomorph expression, possible scale, durable modifiability (ability to be bend) and colour intensity (Fig. 18-20) of the small samples were analysed. These factors and the scientific approach of looking for underlying behavioural rules of findings (Swann, 2002) built the overall strategy for the analysis of the before mentioned materials samples. Spontaneous associations of the sketches to parametrically designed architecture initiated the following experiments.

Fig. 17: 1. Collect; f.e. beet root peel

Fig. 18: 2. Archive; first experiments: thickness

Fig. 19: 2. Archive; mix solid and flexible Bp

Fig. 20: 2. Archive; first experiments: thickness
Thirdly, prototypes ensued by sketches on and with paper to plan systematic constructions were made (Fig. 21). These were then looked at from Berger’s (1972) perspective on visual research. He claimed that looking at our surrounding either ends with stimulating our imagination by reminding us of something already seen or creating a new expectation.

Finally, the designs could be scaled up. Documented recipes of the first experiments were used to calculate the needed amount of material and the possible shapes and sizes for the final object arrangements.

The five material-methods that were developed and tested in this artistic research project evolved from the basic method 4.1.SKETCH. From there on they were split into five different groups that demonstrated the variety of bio plastics. Each material(-method) was then taken further and also used as a form-method. The five methods are described in 5. DEVELOPMENT AND DESIGN RATIONALE. The form giving series of design methods was established through Oxman’s (2010) idea of material properties informing the object’s shape in order to design the most sustainable processes. She states that form dominating matter is an outdated concept.

It needed to be replaced in nature’s manner of adapting the material, function and form of an object simultaneously even if we, as humans cannot yet grow but only assemble our creations.

During the sketching process (4.1.) the main design properties of bio plastic were found and defined as transparency, biomorph expression and flexibility (defined as bending like fabric).

Therefore, the following design methods were formed around them and their contrasts.
Fig. 22: Methodology, chronological decisions
To reveal the most intriguing combinations the three main design properties, also called parameters, were combined with each other in the next step of the methodology (4.2., table). This ensued in eight combinations of the defined properties. Results from the previous experiments provided recipes and processing techniques that were predicted to lead to these material characteristics (Fig. 22, all possible decisions). Five combination possibilities were picked to produce a range of different expressions.

After this, texture was created with the liquid material and defined a visual and tangible expression. Pattern described an additional layer of visual effect on the dried material with, for example, the laser cutter.

4.1. Sketch

4.1.1. Collect
Food waste, local plants, plant materials, things for moulding, structures from the surrounding environment

4.1.2. Archive
Explore the new material (bioplastic) by mixing a basic recipe with collected things, produce swatches for the following groups: colour, thickness, manipulation (liquid material), modification (dried material), addition (of items or clearly visible materials), combinations of these; begin with low-tech techniques and start to use it when the material’s behaviour seems to become predictable

4.1.3. Analyse
Take photos and redraw what is seen, ask: What are common shapes, patterns and lines? Why do they happen? What are the main material properties and what is their opposite?

4.2. Solve and Dissolve
The three main design properties of the material are defined as A, B, C and their opposites. There are eight possible combinations of these material characteristics.

A: Translucency (+), contrast: Opaqueness (-)
B: Biomorph expression (+), contrast: Geometric expression (-)
C: Flexibility (+), contrast: Stiffness (-)

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>Combination</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Combination 1</td>
</tr>
<tr>
<td>+</td>
<td>+</td>
<td>-</td>
<td>Combination 2</td>
</tr>
<tr>
<td>+</td>
<td>-</td>
<td>+</td>
<td>Combination 3</td>
</tr>
<tr>
<td>+</td>
<td>-</td>
<td>-</td>
<td>Combination 4</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Combination 5</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>+</td>
<td>Combination 6</td>
</tr>
<tr>
<td>-</td>
<td>+</td>
<td>-</td>
<td>Combination 7</td>
</tr>
<tr>
<td>-</td>
<td>+</td>
<td>+</td>
<td>Combination 8</td>
</tr>
</tbody>
</table>

4.2.1. Method 1: A-, B+, C+
Material: Agar foil (low amount of agar), mica, stainless steel wire
Object: Dynamic repetition of “lines”
Colour: Dark blue, angle dependent mica in blue, red and yellow
Light: Inside and box, RGB LED (red, white)
Planned process: The metal thread is used as formable metal skeleton, like a warp building the base system in weaving. The bio plastic base is mixed with additional material and fills in like a weft thread. The foil is shaped biomorphically around the light source when dried.
The metal lines show a traceable geometric system that underlies the biomorph form; Material effect: Textured (bubbly), 50% translucent bio plastic mica foil that is modifiable into an biomorph object, oily shimmer in colour;

4.2.2. Method 2: A-, B-, C-
Material: Starch board, paper
Object: Dynamic repetition of geometric base shapes
Colour: Yellow, blue, red
Light: Box, RGB LED
Planned process: The dried bio plastic boards are heat pressed, laser etched (grid pattern) and cut into shapes. The elements are then bent in different angles with the help of a heat gun and a straight mould, cooled down to room temperature;
Material effect: Flaky surface, geometrical pattern, 50% translucent design; the geometric pattern and construction system form an overall systematic and straight expression; the paper helps the stiffness of the material, therefore stable three-dimensional designs are formed;

4.2.3. Method 5: A+, B+, C-
Material: Piped Starch threads and stainless steel wire
Colour: Yellow, red, blue
Object: Dynamic repetition of “stripes”
Light: Box, RGB LED (white)
Planned process: The liquid material is filled in a piping bag, cooled down to room temperature, piped into strings, dried and interwoven with wire in order to produce emerging floating/fringes;
Material effect: Carpet-like fringes in dynamic lengths, layering and mixture of transparent colours, biomorph movement of fringes;

4.2.4. Method 3: A-, B+, C-
Material: Starch board, fibres
Object: Dynamic repetition of curved cuts, “ellipses”
Colour: Yellow, blue
Light: Box, RGB LED
Planned process: The dried plastic boards are heat pressed, laser cut (curved) and bent around objects with the help of a heat gun. When cooled down to room temperature the outline of the surface is heated up again and shaped around a round object to make it stand on its edges;
Material effect: Hairy and plain textured objects with biomorph expression through bending;

4.2.5. Method 4: A+, B-, C+
Material: Agar foil, white/natural mica
Colour: 45 shades of blue, 3 shades of red
Object: Dynamic layering of “squares”
Light: Box, RGB LED
Planned process: The liquid material is poured on a textured plastic board, peeled off, dried on wrinkled foil; the foils are cut into squares, then the layers can be arranged on top of each other or draped into three-dimensional shapes;
Material effect: Dynamically changing form and colour gradient made out of textured foils, different view for the audience from every side and height, layering of colour and texture;
5. Development and Design Rationale

The material archive from the previous research course built the base for the following experiments as described in SKETCH 4.1. Thus, textures, patterns and materials were categorized and the archive was extended before paper models with visual references to parametric design methods were assembled. This was done to find forms and systems that later could transform into three-dimensional shapes based on the bio plastic’s natural tendencies. LED light sources were chosen to emphasize the material’s visual expression without heating it to its low melting point.

Paper was selected as the main sketching material for forms since it has similar bending behaviours as (heated) bio plastic. It could easily be transformed from its two-dimensional appearance into a three-dimensional object - like the bio plastic that was used later on. Some models focused on the structure of a design, some were used as working models to predict the expressions of the object arrangements and their influence on each other in a model room in scale 1:10 (Fig. 23).

First sketches in the workbook (Fig. 24-8) focused on colour, texture and pattern, construction, scale, light, tools for the manufacturing process and terms that needed to be defined for this new category of textiles. All materials were produced in the laboratory that was equipped with a laser cutter, stove, mixer, squeegee, ladle, scale, measuring jug, fans and an aquarium air pump.

The five material methods were chosen because of their suitability for their specific paper models. This will be further discussed for every object-material-combination in the following chapters.
5.1. M 1: Flexible Line

O1: 16l Water + 720 g Glycerol + 756g Agar + 3g Indigo powder + 2,2g Mica blue + 1,8g Mica red + 36g Dish soap
O2: 12l Water + 720 g Glycerol + 756g Agar + 3g Mica yellow + 36g Dish soap
O3: 8l Water + 480g Glycerol + 504g Agar + 2g Mica yellow + 24g Mica white

Flexible, half translucent (mica), bubbly structured and therefore biomorph bio plastic, was developed in contrast to the planned strict, parallel construction lines of FLEXIBLE LINE (Fig. 29). Experiments (Fig. 30-38) with the two base recipes (agar and starch) in connection with texture (bubbles) and embedded wire and the idea of bending the surface into a three-dimensional objects after drying resulted in this method. A stable but modifiable recipe based on agar with a high amount of glycerol, soap and mica was chosen. The addition of coloured, angle dependent silicate glitter (stone powder) resulted in an intriguing, reflecting and oily shimmer on the surface. In the course of the previous research project artificial glitter powder was used but plastic glitter seemed incompatible with the demand of environmental sustainability of this project. Artificial glitter is not biodegradable and likely to be washed into the water system like micro plastics. Powdered mica replaced the synthetic glitter in the following material experiments. It was also used in the final pieces for this method and even produced a stronger (more durable) foil in the end.

The indigo was chosen as first colour for the palette since it was the most reliable colorant.
Fig. 29: Workbook, M1
Fig. 30: Material test, bubbly

Fig. 31: Bubbly

Fig. 32: Bubbly, wire

Fig. 33: Bubbly, wire

Fig. 34: Wire

Fig. 35: Twisted wire

Fig. 36: Mica

Fig. 37: Copper wire

Fig. 38: Starch, wire
This applied when it came to colour intensity in the transparent material and durability according to previous tests. Wire served the construction because it was a strong but flexible material (Alesina and Lupton, 2010, p.182) and could easily be separated from the bio plastic through pulling or melting. This was significant for the final material’s decomposability. Stainless steel wire showed a better stability and more satisfying (artificial) colour combination than copper wire in the same thickness. The thickness of the wire was chosen because of the planned overall size of the surface (210cm x 80 cm and 60cm). The bio plastic foil needed to be thick enough to hold itself in this dimension without ripping and without letting the wire break through too much. This resulted in thicker foil and therefore a higher weight which also demanded a stiffer metal wire. Computer visualisations helped to illustrate different scales for the object, a medium size was chosen to make the surface easily modifiable/ foldable for the designer and approachable for the audience.

After a series of paper experiments (Fig. 39, 40) stainless steel wire was span on a board. The spaces between the wire lines, which represented an abstracted weft, varied in size and were closed with a tabby selvedge of two repetitions in the rectangular pieces. This additionally strengthened the bio plastic foil and formed a flexible skeleton for the bubbly bio plastic membrane (Fig. 41-43).

Next, the ingredients were mixed together and slowly heated up till boiling. Constant stirring kept the material from crumbling, which was important for the later on created texture.
As soon as the liquid material turned transparent air was blown in the fluid with an aquarium pump (Fig. 44). The foam was skimmed off with a ladle and spread thickly on the metal selvedge. This was iterated from the edges to the middle till the metal skeleton was completely covered. Fans shortened the drying time, after thirty minutes the wire was cut on the edges of the board to minimize the cracking of the bio plastic surface. If the metal wire and the base foil did not move with the bio plastic or if it covered a too large area, and therefore became too heavy for pulling itself to its centre, the material cracked.

After two hours it turned out that the rectangular pieces were too heavy to pull themselves while shrinking and therefore broke (Fig. 45). Those cracks were filled with the bio plastic mixture in a lighter shade of blue (less indigo powder) to emphasize the organic unevenness and perfect imperfectness of the material (Koren, 2014) (Fig. 46, 47). After seventy-two hours of drying the bio plastic foils were turned around to fully cure for another week (Fig. 48). The used agar bio plastic recipe shrank between twenty-five and fifty percent during this time.

Experiments with light sources, white LED wires and a RGB light bulb, followed. If the material was placed flat on them the bubbly texture got more visible. But the material’s potential for shaping and holding itself in a three-dimensional form was not utilised (Fig. 41-43). A strong light source that underpinned the desired shape and the texture was created (Fig. 49). Therefore, the wire ends of the material's selvedge were cut, twisted and the bio plastic surfaces were draped around RGB LED lights.

The final shapes resulted from folding the dried materials (with different wire directions) to generate three-dimensional biomorph forms. The light sources were integrated from an early stage on so it could be tested if all the material properties (texture and reflection, flexibility) were emphasised through their form. The three-dimensional pieces could be examined and touched from all angles and had a biomorph, almost breathing expression through texture, their dynamic folding and coloured light source (Fig. 50-52).
Laser Configuration (+Air)
Etching: Speed 75, Power 30, PI 1001
Cutting 3-5 times: S 15, P 95, PI 1001

Fig. 53: Workbook, M2
5.2. M 2: Solid Geometry

Yellow: 12l Water + 600 g Glycerol + 900g Vinegar + 1200g Potato starch + 5g Turmeric powder + ½ bucket yellow, wet paper pulp
Blue: 3l Water + 150 g Glycerol + 225g Vinegar + 300g Potato starch + 3g Indigo powder + 1/8 bucket blue, wet paper pulp
Red: 1,5l Water + 75 g Glycerol + 110g Vinegar + 150g Potato starch + 5g Madder powder + 1/16 bucket red, wet paper pulp

Paper was a suitable material for quick sketching models because only one fold could transform the two- into a three-dimensional form (Lucci and Orlandini, 1990). Product designers like Lucci and Orlandini (1990) saw model making as an important design method even if CAD programmes would replace material models more and more. Some models could not be replaced entirely by digital sketching methods, examples were material combinations like paper and wire. Improving models and understanding their underlying behavioural patterns through remaking the same objects helped to generate reliable working models for the cutting pattern, the bent angles and side lengths in METHOD 2 (Fig. 53).

The geometric landscape was constructed with equilateral triangles first (Fig. 54-77) before it was decided that a more dynamic shape - irregular geometric forms (Fig. 78-89) suited better to the concept of a changing material. The initial idea was remodelled, changed in size, height and overall shape and started from various sides to design the geometric shapes that were finally translated into a digital cutting pattern (Fig. 90).
Fig. 90: Selection out of fifty options; last round of selecting the final forms
The modules could be varied in scale depending on the thickness of the used bio plastic and the available (laser) cutter size. Cutting the material by hand, which would enable a larger scale, was not an option since the material breaks like glass when cut with conventional scissors.

As mentioned before, paper was the dominating material for all object models that were made in the design process of this collection. Apart from that, for the material-method in METHOD 2 it also represented a substantial ingredient.
Since this material-object formation reflected the solid, geometric and half translucent design possibilities for bio plastic, the recycled paper pulp was selected to add even more stiffness and stability to the material’s characteristics. The paper bio plastic was also observed to be less porous when it came to the manufacturing step of bending (with heat). This was crucial for producing the original three-dimensional shapes of the modules in this group. With time and changes in the environment (temperature, moisture) the material transformed its rigid geometric expression in a more organic one.

Colourwise yellow, for instance, was chosen for this piece because it offered the most even and intense dyeing results on recycled paper pulp (Fig. 97). Furthermore, tests with coloured light behind blue, red and yellow paper bio plastic boards revealed surprising, light colour-, bio plastic colour- and texture colour- changes (Fig. 98, 99). Blue light seemed yellow thanks to the intense colorant.
The first step of the production process for SOLID GEOMETRY was the fabrication of recycled paper pulp. The paper was collected, shredded and soaked in water for twenty-four hours. Afterwards it was heated up and stirred with a mixer so the flakes were ripped in small pieces. Ten grams of plant powder were added to the hot paper pulp, stirred well and let sit for another seventy-two hours. Then the floating paper pulp was skimmed from the clear water underneath, squeezed and put aside. Next, the bio plastic ingredients in room temperature were mixed together and constantly stirred with an electrical mixer till the blend turned transparent and bubbles appeared (Fig. 100). Now, the wet paper pulp was added, the material was stirred once again till boiling and finally poured in a rectangular shaped board (80 cm x 110 cm). This size resulted from earlier tests with larger boards that broke during the drying process. Moreover, the available laser cutter had a limitation (55 cm x 80 cm). Therefore, the shrinking was predicted and the needed board size was calculated. A frame was marked on the plastic foil which was taped flatly on a stable background. As soon as the material was spread evenly with a squeegee, the tape was cut and the underlying foil was folded up around the material board so it would have enough space to shrink without breaking. After seventy-two hours of drying by fans (Fig. 101) the boards were turned around to completely dry for seventy-two hours before they were heat pressed (90°C). This flattened the material that tends to roll its edges during the drying processes. This behaviour could be used to produce small twisted elements but for this object group a straight visual expression was the aim. As a consequence, the boards needed to be pressed before laser cutting. Working with the laser cutter allowed the addition of an organic or geometric pattern after the material was dry. Experiments with different etching depths and cuts resulted in a geometric, rigid pattern that underpinned the strict geometrical appearance of this set. Organic patterns were discarded because they perished in the flaky paper bio plastic surface (Fig. 55). The etched lines on the bio plastic shapes enabled the audience to follow the bending sides.
The edges appeared like a trace of two-dimensional lines on a three-dimensional landscape. After the simultaneous steps of pattern etching (Speed 75, Power 30, PPI 1001, + Air) and cutting (five repetitions, Speed 15, Power 95, PPI 1001, +Air) the boards into irregular elements, they were bent to create two to three connected surfaces. The edges and angles were calculated according to the final paper models, marked and then partly heated up with a heat gun. A wooden table edge (Fig. 102) was used to generate straight lines. As soon as the material started to bend down a wooden board was used to guarantee an even edge. Afterwards the objects cooled down to room temperature and were arranged in categories of complexity for the final composition. Metal connections were tested but considered as not necessary at this point. Metal would be a good additional material because of its properties like flexibility and high melting point.

5.3. M 3: Dynamic Stripe

7 elements: 9l Water + 450g Glycerol + 375g Vinegar + 900g Potato starch + colorants
1 scaled up object (discussion): 32l Water + 1599g Glycerol + 1332 g Vinegar + 3200g Potato starch + colorants

The idea for the third material-object-method combination (Fig. 103) was born out of experiments with fringy and airy bio plastic structures. The light expression of coated and cut felt (Fig. 104), separately coloured bio plastic flakes (Fig. 105), rolled foil (106) and other materials (Fig. 108-112) summed up to the idea for a floating, airy object. Likewise, another test lead to playful hairy carpet-like objects (Fig. 107) but lost the material's intriguing translucency because of the heavy construction. The final design for DYNAMIC STRIPE was developed in METHOD 3. It worked with single bio plastic threads, their layering and the free space between them. For the demonstration of the material's lightness, fragility and thinness a loose construction was developed to connect the transparent moving strings (Fig. 112 - 118). All three colours of this collection's palette were represented in this object to show that the bio plastic colours influence each other when layered (Fig. 119). The selection of objects also showed that that natural dyes in bio plastic intensify when layered with themself. Digital drawings visualised different colour ratios (Fig. 120, 121).

Earlier in the process the plan for the used light source was either an implemented LED wire or a spot light directed to the object.
Fig. 103: Workbook, M3
Fig. 113: Layering of colour, paper model

Fig. 114: Fringes, plug in - system

Fig. 115: Stripes, fringes

Fig. 116: 3D weave

Fig. 117: Model for construction

Fig. 118: Model in room, scale 1:10
Both were discarded since the light was not strong enough. Finally, a glowing effect through a light box was added to the objects. This intensified the interplay of background weave colour and foreground loop colour. It was important to emphasise the seven different combinations of background colour and foreground colour and their influence on each other.

The bio plastic strings were used as emerging weft threads (floatings) and alternated with the stainless steel weft to stabilise the designs. Each bio plastic weft row defined one layer and therefore was kept in one colour. This construction method referred to digitally planned landscapes that were cut in slightly varying, dynamically changing, layers (Ednie-Brown et al, 2013).

The bio plastic strings in three colours were produced with the same base recipe, the amount of plant colorant changed according to the recipes. The material was cooked, filled into bags (Fig. 122) and cooled down to room temperature.
Then the material was pressed into thin strings onto a tense background foil (Fig. 123). This technique could be seen as a low-tech 3D-printing technique and therefore, could be developed further into a digitally manufacturing technique in future projects. After seventy-two hours of drying the strings were peeled off the foil and turned around. Lastly, they were interwoven with the metal warp and another metal weft (including the LED wire) in tabby weave (Fig. 124).

5.4. M 4: Ellipse in Motion

Yellow boards: 12 l Water + 600 g Glycerol + 900 g Vinegar + 1200 g Potato starch + 5 g Turmeric powder + Yellow fibres or 5 g Mica white
Blue board: 2 l Water + 100 g Glycerol + 150 g Vinegar + 200 g Potato starch + 2 g Indigo powder

Developing a new material included exploring and defining its formal language, its design properties and possibilities to shape it. In METHOD 2 it was demonstrated that the nature of bio plastic could become clean, straight and geometric depending on its recipe and manufacturing techniques. METHOD 4 (Fig. 125) focused on the biomorph design options for the plant based material (Fig. 126-131). To define the meaning of the two contrasting terms for this project a closer look at architecture was taken. Lynn claimed that symmetric repetition—here called geometric expression, helped out if information was missing (Ednie-Brown et al, 2013). Therefore, dynamic, not repeated designs were more interesting than symmetric ones.

Earlier experiments showed that bio plastic altered around objects when heated up. Different thicknesses, temperature and gravity transformed the surfaces irreversibly into objects. Tests with straight (Fig. 132-145) and curved (Fig. 146-155) cuts and different pressures evinced which openings added the most dynamic, irreproducible, growing expression and therefore information. The combination of thin and thick stripes in a concave arrangement was found to be the most satisfying to capture the movement from the bending process without breaking the material (Fig. 156-163).
Fig. 125: Workbook, M4
Fig. 126: Starch, mica

Fig. 127: Round agar Bp

Fig. 128: Shiny side of pure Bp, starch

Fig. 129: Flax fibres in Bp, starch

Fig. 130: Influence of heat on Bp

Fig. 131: Dried shape
Fig. 144: Organic pattern

Fig. 145

Fig. 146: Curved cuts

Fig. 147: Curved outline

Fig. 148

Fig. 149: Folding

Fig. 150: Openings

Fig. 151: Concave cuts

Fig. 152

Fig. 153: Convex cuts

Fig. 154

Fig. 155
Fig. 156: Pattern tests on stripes

Fig. 157: Open ends of cuts

Fig. 158: Emerging from rectangle

Fig. 159: Straight cuts, bent out

Fig. 160

Fig. 161
The overall shape of the connected ellipses was developed because experiments had revealed that a rectangular base did not give the inner laying cuts enough space or game for expansion. The group of four elements was made out of the same base recipe, one of them with a hairy texture to strengthen the biomorph tactility in this method. After dyeing tests with different materials like viscose, hair, paper and flax the last one was selected because of its availability and colour trapping. Flax fibres were soaked in water for twenty-four hours. Turmeric powder (10g) was mixed with water (5l) and simmered for ten minutes in a stainless steel pot. The wet fibres were added and set for seventy two hours before they were spread to dry without rinsing. The dyed fibre strings were combed, cut in strips (110 cm) and laid out before they were placed overlapping on one wet bio plastic board. The other material was produced like the boards in METHOD 2, excluding the paper pulp (Fig. 164).
Next, the hairy board was laser cut (seven repetitions, Speed 30, Power 87, PPI 1078, + Air) with the shiny side up to reduce the risk of burning and leaving a brown trace on the fibres. After cutting the stripes, they were heated with the heat gun and the surfaces were placed on random metallic objects (Fig. 165-167). This way the stripes could adapt, cool down and cure in their new shapes. In the next step the background was heated up and bent around a round form to create a group of organic three-dimensional objects.

To enhance the visibility of the texture of the bio plastic and to highlight the dynamic openings in the material, a light source was planned to be installed in the middle of each element. Unfortunately the sketches revealed that a light in the middle would be too dominant and prevented the direct view through the openings to the inside of the object. Finally, an illuminated background (light box) for the group of four elements was added.
Fig. 168: Workbook, M5
5.5. M 5: Shifting Square

Blue layers (45): 250ml Water + 18 g Glycerol + 9 g Agar + a slightly varying trace of Indigo powder

Red layers (3): 250ml Water + 18 g Glycerol + 9 g Agar + a slightly varying trace of Madder powder

Questioning the material design practice through parametric design, defined as a digital design tool that controls geometric variation in structures, enabled Adams and Yelavich (2014) to design new textile structures on an architectural scale. They suggested that the great formal freedom of textiles, their adaptability and scales could be realised more efficiently through computerised design. Their digital design method connected scale and material behaviour during the computerized planning process. Similarly, METHOD 5 used a digitally planned cutting pattern for each layer (Fig. 168). In contrast, human judgement was needed as intermediate step to categorize the layers (size and colour) after they were cut. Each layer had its own surface structure, size and colour that was produced through a slight variation in the recipe and drying process. The laser was adjusted individually for every layer. Once again the material informed the final shape of its object.

This series started with the idea of producing thinner and thicker areas of the same material (recipe) to gain differences in height, texture, translucency and colour intensity (Fig. 169-192). These textures were created through pouring bio plastic on, in or underneath textured surfaces, called moulds (Fig. 193-204).
The textured foils were analysed through a strategy that rated 1. if the moulds worked technically, 2. in different scales, 3. ecologically and 4. expression wise (tangible and visual). The nobbed texture (Fig. 194), which was moulded from a board with holes (Fig. 195), was chosen because of its reproducibility, stability and evenly visible and tangible texture. Textures like a grid (Fig. 191) showed great potential for reproducibility and tangible and visual texture but bent too much because of its extreme variation in thickness.
Fig. 199: Coated fabric
Fig. 200: Glue gun
Fig. 201: Plastic grid

Fig. 202: Plastic net
Fig. 203: Plaster imprint
Fig. 204: Clay

Fig. 205: Silicone imprint
Fig. 206: Bubble wrap
The initially planned laser cutting pattern was created through a set of chronologically applied rules that were tested through paper modelling. The rules for every new layer were defined as 1. moving (+10 clicks), 2. rotating (+5°), 3. must stay inside the limiting outline (5 cm frame). The base shape was a square and an organic shape was moved alongside its outline and according to the rules (Fig. 207-211).
Blue (indigo) as the leading colour was chosen beforehand but its shades were created through the slight variation (amount of indigo powder and white mica powder) of the recipe for every layer. Leftovers of the previous layer were reused for the mixture of the following layer to minimize waste in the process. Seeing the forty-five layers in blues it was decided that a highlight of contrasting red (madder) was needed. This trace of another colour was also added to point out that the modules of this arrangement consisted out of separate sheets that were slightly different in material and form; that they were repeated dynamically (Ednie-Brown et al, 2013) and in perfect imperfection (Koren, 1994). The first step was to cook the bio plastic like in METHOD 1. The liquid material was poured on the board (Fig. 212), after five minutes the textured foils were peeled off and dried on both sides for one week (Fig. 213). Then they were categorized by colour and size (Fig. 214). Categorizing the produced layers in size and shades showed their great range of outline shapes. Because of this finding the dynamic laser cutting pattern was discarded and the naturally dried shapes were cut into squares to generate the dynamic repetition for this design.
After laser cutting (Speed 15, Power 95, PPI 1086, + Air) the sheets were draped and layed out in various ways (Fig. 215-217). The aim for this task was to clearly illustrate the material’s properties flexibility, geometric texture and semitransparency. Therefore, the sheets were placed in a strict order and a maximum of four sheets were layered on top of each other. The folded pyramids showed the flexibility and that the three-dimensional form was significantly influenced by the material’s thickness.

Fig. 215: Draping, discarded layer pattern

Fig. 216: Draping, five layers, texture blurring

Fig. 217: Draping, layering test
6. Result

The collection of five illuminated textile objects groups (220-224) and the book ABOUT SOLVING AND DISSOLVING: A MATERIAL INVESTIGATION (Fig. 218, Appendix) suggested how a sustainable - less environmentally polluting, plant based, bio degradable and closed design loop for interior textiles looks like. It was concluded that the balance or ratio between artificial, controlled, geometric, repetitive forms and biomorph, organic, dynamic appearance was the most important factor for the overall expression of bio plastic materials.

Scaling up the designs showed the sensibility of the material during further processing steps. For instance, when the liquid material dried too slow it moulded, therefore fans were used to accelerate the drying process. This helped the material to dry quick enough to not attract mould spores but the electricity consumption during the manufacturing process was notably increased.

Increasing the size of a bio plastic design from a small lab sample to an object arrangements was experienced as the most difficult challenge within this project. Indeed, material designer Rowley says about her material explorations, “the biggest challenge within the field of material design was the translation of a small sample in an actual [design]” (Devos, 2018). Small scaled swatches were not as sensible to their surrounding, broke less when handled because of their lower pressure from their own weight. They shrank less and therefore did not need as much game on the background foil during the drying process. During experimentation it was decided that the size of 110 cm x 80 cm for boards that were going to be processed in the laser cutter was ideal.

Although cracks could be filled they were always visible since it was neither possible to create exactly the same colour nor the same texture - also if the recipe seemed to be the same. The exploration about the material’s behaviour during the drying process could be combined with a computerized 3D printing technique in a future project. This could evince more how the material changed from a geometrically produced item into a three-dimensional biomorph one because of its ingredients, thickness and drying. 

Fig. 218: Book about material exploration

The selection and analysis criteria for the final results were summarised in a table (Fig. 119). Other construction experiments like bio plastic sequins or quilt inspired objects were discarded during the process because they did not clearly embody the material’s design properties mentioned earlier.

The technical result of the project was dominated by the experimentation with different raw materials, their qualities, amounts, the drying process of the materials and manufacturing the bio plastic into textured and patterned surfaces.
<table>
<thead>
<tr>
<th></th>
<th>Flexible Line</th>
<th>Solid Geometry</th>
<th>Dynamic Stripe</th>
<th>Ellipse in Motion</th>
<th>Shifting Square</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solid - Flexible</strong></td>
<td>flexible/ soft, self holding through wire</td>
<td>solid</td>
<td>porous (solid), moving and flexible through construction</td>
<td>solid, only flexible when heated</td>
<td>flexible</td>
</tr>
<tr>
<td><strong>Translucent - Opaque</strong></td>
<td>50% mica</td>
<td>50% paper</td>
<td>100% transparent</td>
<td>100% pure material, 50% fibres</td>
<td>50% mica</td>
</tr>
<tr>
<td><strong>Biomorph - Geometric</strong></td>
<td>geometric construction + biomorph draping/ folding</td>
<td>geometric construction + geometric pattern</td>
<td>irregular, biomorph</td>
<td>hairy, round construction, biomorph bending</td>
<td>geometric texture and overall shape, transformed by thickness</td>
</tr>
<tr>
<td><strong>Tactility</strong></td>
<td>foamy</td>
<td>flaky</td>
<td>fuzzy</td>
<td>hairy, skin like</td>
<td>nobbly</td>
</tr>
<tr>
<td><strong>Colour</strong></td>
<td>shades of blue, oily shine</td>
<td>yellow, red, blue with flakes</td>
<td>yellow, red, blue</td>
<td>yellow, blue, natural flax</td>
<td>shades of blue, shades of red</td>
</tr>
<tr>
<td><strong>Process Result</strong></td>
<td>1. mica reflects surrounding colours and light - angledependent colour shift</td>
<td>1. etched pattern is more visible when illuminated</td>
<td>1. bio plastic can be used for traditional textile techniques</td>
<td>1. solid material can be bent with heat, it captures the applied motion irreversibly</td>
<td>1. material and object design need to be done simultaneously - the bio plastic has a strong nature</td>
</tr>
<tr>
<td></td>
<td>2. possibility of big self holding surface (with the help of wire)</td>
<td>2. the colour of translucent material is highly influenced by the light colour underneath</td>
<td>2. light and floating expression</td>
<td>2. overall surface shape and inner surface cuts influence the final three-dimensional form</td>
<td>2. cut offs can be recooked</td>
</tr>
<tr>
<td></td>
<td>3. geometrically bent bio plastic transforms with time</td>
<td>3. colour intensity in thick material (without moulding), colour mix of background and loops</td>
<td>3. dynamic repetition</td>
<td></td>
<td>3. dynamic repetition</td>
</tr>
</tbody>
</table>

Fig. 219: Results
Flexible Line
Material: mica agar bio plastic, stainless steel wire
Technique: embedding, pouring, folding
Size:
Object 1 - 1 mm thick, diameter 60 cm, height 7 cm
Object 2 - surface unfolded: 90 cm x 210 cm x 1 mm; shaped: diameter 70 cm, height 25 cm
Object 3 - surface unfolded: 90 cm x 210 cm x 3 mm; shaped: diameter 45 cm, height 70 cm
Fig. 221: Result, M2, assortment of twelve geometric objects

Solid Geometry
Material: paper starch bio plastic
Technique: laser etching, laser cutting, bending
Size: element sizes vary between 10 cm x 10 cm x 2 mm and 40 cm x 40 cm x 30 cm
Fig. 222: Result, M3, selection of seven fuzzy objects

**Dynamic Stripe**

Material: starch bio plastic, stainless steel wire  
Technique: piping, weaving  
Size: 30 cm x 30 cm, heights vary between 2 cm and 10 cm
Fig. 223: Result, M4, group of four morphed objects

**Ellipse in Motion**

Material: starch bio plastic, flax fibres, mica starch bio plastic  
Technique: dyeing, laser cutting, bending  
Size:  
- Object 1 - 25 cm x 33 cm  
- Object 2 - 35 cm x 42 cm  
- Object 3 - 33 cm x 40 cm  
- Object 4 - 48 cm x 75 cm
Fig. 224: Result, M5, compilation of forty-eight layers

Shifting square
Material: mica agar bio plastic
Technique: moulding, folding, layering
Size: 16 cm x 16 cm x 1 mm
During the cooking process of both bio plastic recipes (agar and starch) it was found that it was not just possible to dissolve the material in water but also that old or broken material could be recycled, recooked into new material. This exploration was used frequently for the process of SHIFTING SQUARE since small pieces that fell off a board could easily become a part of the recipe for the next one. This enabled the designer to close the product loop: Starting with the production of new material, proceeding with the construction of an object and finally recycling the cut-offs.

Broken, outdated or old material could then function as the next generation of new material (Fuad-Luke, 2002). Moreover, burying leftovers of the bio plastics was found to be another solution for the material’s afterlife (Fig. 225-230).

Transparency was one of the main design properties of bio plastic and therefore should have been addressed and used from an earlier stage on. As soon as the focus for designing the final objects was set on the translucency of the material it became much easier to formulate and design the final collection, which was closely connected to interior design elements without becoming a product. Through this insight, light and more controlled layering of the material (colour and texture-wise) were introduced to the design process. Finally, it lead to the implementation of a light source underneath the selections of objects instead of leaving it as a presentation factor for later.
7. Presentation

The collection (Fig. 231) will be shown at EXIT 18, an exhibition at the Fashion Gallery at the Swedish School of Textiles in Boras. It will be displayed for one week, the location provides a dark grey background and natural light from a large front window. Spotlights will be directed to the experimental arrangements. Some objects need a connection to electricity since they have implemented LED (RGB) light sources, the others will be placed on RGB light boxes to emphasize the texture, colour and transparency of the bio plastic materials. The book and the main ingredients will be placed in a “process” area to provide background information for the audience. Small models and material assortments from previous experiments could accompany the final collection additionally. Uniform material samples will be placed close to the exhibited object sets to clarify that they can not only be looked at but also touched (Fig. 230). The plant will be displayed in a glass pot so the bio plastic layer in the soil is visible and communicates the biodegradability of the designed materials. The exhibition should evoke the audience’s curiosity, illustrates the conducted material research and leads up to more possibilities for future experiments.

Fig. 231: Collection, digital sketch
8. Discussion and Reflection

The aim of this project was to explore the design possibilities for bio plastic in order to generate visually and tactiley intriguing textile objects. The practice-based methodology resulted in a collection of five illuminated installation groups and a material archive. Hence, processing techniques, the material’s natural behaviour, limitations and formal language were investigated. All experiments were driven by the belief in the need of a more playful, colourful and intriguing approach to environmentally sustainable interior textiles.

The unresolved question that motivated this project was: What could sustainable textiles look like? Presumed unbleached eco cotton was not the perfect solution for a sustainable textile industry, bio plastic was not either. However, it represented another option in the diverse world of speculative future materials. Alesina and Lupton (2010, p. 133) for example, opposed that eatable plants were processed to make bio plastic and therefore, the global food shortage could be named as a counterargument against its usage.

Similarly, the produced bio plastic could not be biodegraded after its usage phase in an industrial scale. Conventional landfills could hardly deal with the material. It would not decompose there because it needed a special climate (Alesina and Lupton, 2010), in this project’s case soil and humidity. On the other hand, potential consumers would be able to recycle the material themselves, to return it to the factory that could reuse it or bury the bio plastic in their own gardens.

After all, the sustainability of bio plastic needs to be questioned. Not only the origin and after-life phase of materials play a role here, but also the design process. For example, the frequent usage of fans (drying too slow lead to mould (Fig. 232)) and a high water consumption were seen as deficits and are points that need improvement in future projects.

Furthermore, mica powder (shimmer effect) should be replaced. The definition of biopolymer includes its completely organic origin (Fuad-Luke, 2002). Mica is chemically inorganic matter, therefore most of the here produced bio plastic must not be named biopolymers.

Fig. 232: Mould

The project focused on the different expressions of bio plastic to challenge sustainability in textiles. To connect the audience, sustainability and an interior dimension visual and tactile senses were addressed through colour, texture/pattern and light. The combination of these intrigued the audience to touch and question the material’s origin.

First the surfaces were presented as pure material samples but this left too many open ends. The context of interior design was set out through draping and illumination.
This provoked ideas for possible material manipulations, applications and opened up a discussion about potential limitations.

One limitation or challenge for textile designers working with bio plastic is scale. It was already mentioned in the introduction and motive for this project. At this point the sizes were increased from lab scale to other varying dimensions. This emerged from the idea to produce something in a relatable and easily approachable size. For further up-scaling a combination of the modules or an additional construction in another material could be options (Fig. 233, 234).

Used tools like the laser cutter and the portability played important roles in the decision process as well. Besides, the chosen material groups emphasised the experimental aspect of the design research based project.

A surprise factor were the used plant dyes. The first projects of this design program dealt with plant dyes on conventional cellulosic materials (fibres, yarns). During the research project the focus shifted to a more basic research - designing a material out of raw ingredients. Exploring this material's design properties and using them to define a new formal language provided the possibility for an infinite number of experiments within the field of textile design. Everything from colour to thickness, from size to texture, from pattern to translucency could be determined freely. It seemed difficult to narrow the topic down. Finally, the series of experiments was started with combining the before explored plant dyes in basic bio plastic recipes. More and more colours were added and a colour chart of possible colorants was established (Fig. 235).
Fig. 234: Option for scaling up and combining the elements of DYNAMIC STRIPE
Fig. 235: Colour chart with material samples for this project
At this point the aim was to create a palette of almost artificially bright colours - without any trace of brown. Food waste like beetroot peel showed great results in colour intensity and fulfilled the initial idea of only using non eatable ingredients. But soon it was discovered that the colorants that were filtered from boiled peels did not have the same durability as plant powders that were mixed and left in the material like turmeric or indigo. It was decided to discard beetroot as red and replace it with madder powder to generate a stronger and more lasting colour expression for this project. This possibility of change in colour (Fig. 236, 237), which evolves during approximately three months, could be used for following tests. It would underpin the natural transformation of the material with time.

Above all, the material's physical state was changed through its surrounding (moisture, heat). These material transitions could be the startingpoint for a new series of explorations. Finally, the question about the bio plastic's nature, its behavioural pattern or expression, and significance for the field of interior textiles had to be answered. Undoubtedly, the overall results did not support the expectations of clearly contrary expressions of the methods. The five developed ones were based on the different design properties of the material and therefore enhanced them. Furthermore, it was possible to add smart material properties like colour change or light transmission to the speculative future material. For the designer bio plastic was a material with great potential since it could be turned into endless shapes. However, it still held its own behaviour and elements of surprise considering the unpredictable plant ingredients. This indicated that even strictly geometrically planned designs would always have a biomorph and alive undertone – the bio plastic's nature seemed to be a dynamically changing one.

Experiments about reshaping objects showed that the bio plastic also changed its form with time which is an important factor for designing design methods for the field of textiles. Sharp parts broke through flexible foils if properties were combined in one design (Fig. 238, 239).

Fig. 236: Day 1  Fig. 237: Day 120

Fig. 238: Breaking wire  Fig. 239: Solid + flexible
9. References

Articles

Books

Websites
BUET, V. (n.d.) [online] Available at: https://violainebuet.com/
BUILDINGGREEN (n.d.) [online] Available at: https://www.buildinggreen.com/blog/we-spend-90-
our-time-indoors-says-who/
GOTS (n.d.) [online] Available at: http://www.global-standard.org/
LOHMANN, J. (n.d.) [online] Julialohmann.co.uk. Available at: http://www.julialohmann.co.uk/
SCHMEER, J. (n.d.) [online] Available at: http://johannaschmeer.com/

Other

Photos and Illustrations
Fig. 1 - 7, 9, 10, 220, 222 - 225, 233, 234: Berg, J. (2018)
Fig. 11 - 219, 221, 226 - 232, 235-239: Nitsche, T. (2018)
10. Appendix

ABOUT SOLVING
AND DISSOLVING

A MATERIAL INVESTIGATION
ABOUT SOLVING AND DISSOLVING

A MATERIAL INVESTIGATION

Tanja Marie Nitsche
The Swedish School of Textiles, University of Boras

Copyright © Tanja Marie Nitsche

Images © Tanja Marie Nitsche

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy or any information storage and retrieval system, without permission in writing from the copyright owner.

About Solving and Dissolving is an independent publication and has not been authorised, sponsored, or otherwise approved by any company.
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreword</td>
<td>5</td>
</tr>
<tr>
<td>Introduction</td>
<td>6</td>
</tr>
<tr>
<td>Methodology</td>
<td>8</td>
</tr>
<tr>
<td>Plant dyes in bio plastic</td>
<td>9</td>
</tr>
<tr>
<td>References</td>
<td>104</td>
</tr>
</tbody>
</table>
Foreword

During the first plastic revolution in the 1970s society thought it could get rid of outdated products by flushing them (Morton, 2013). Today the general public starts to understand how destructive the consequences of overconsumption and non-sustainable behaviour will be in close future. Humanity and therefore designers have to consider the afterlife of an object before it is produced because if it is brought to existence – what will happen with it once time and daily usage “broke” it? Flushing unwanted items transport them to the oceans where synthetic materials and toxic chemicals will not just disappear. Sustainability was variously defined by researchers from different backgrounds. For this project it referred to the usage of as non-environmentally-polluting ways of designing as possible, this built the ethical fundament for all experiments. Plant dyes were chosen because they were non-toxic, plant materials like agar (seaweed powder) and potato starch were the main ingredients for the produced material because they were renewable and biodegradable. Leftover material was buried in soil and recycled through “cooking” it again that way little waste is produced. This ethical aspect of the project was based on the philosophical thought construct of “away is not away” (Morton, 2013) and was executed in every step of the design process. Creating intriguing and appealing designs to reconnect the audience to the material by sensing it through touch and look played an important role in this material based research. This was a similar approach as Rouillon (n.d.) discusses in her work Daily haptics. The pottery artist transformed the everyday life product cup into an exciting object that offers a tactile experience for the consumer in addition to its conventional function. Addressing the human craving to explore, sense and touch its surrounding helped to make the audience wonder about the textile’s origin. One wanted to touch it, see if the structure breaks if it was bent and how it felt on the skin. This way, a connection between the audience and the design was established. This material exploration project worked towards the aim to increase haptic aspects of surfaces to attract the audience’s interest and create a more exciting human habitat. Likewise the definition of the term tactility was visualised through differences in heights and possible changes in textures within the designs.
Introduction

Designers like Oxman (2010) observed how nature developed its objects and claimed that the ideal way of designing would be to grow objects seamlessly like nature does. Digital design methods based on geometric calculations helped to take a step closer to this ideal method, however they were not sufficient when it came to designing ideal material-object combinations yet. Shapes that were informed by their functionality and behaviour of the material were the objectives.

If form followed matter- what design possibilities for matter would designers have? This archive of bio plastics showed the material’s various natures and material behaviours to trigger a new generation of textile designs. The used material processing methods for this book included a range from low tech moulding to computerized techniques like laser cutting and were planned to be taken further into a fully digitally manufacturing technique like 3d printing.

The materials in this book were categorized by their processing steps and the order of decisions that supported them (Methodology). All developed materials were based on two initial recipes that were adapted throughout the process of this artistic design research. Firstly the material’s flexibility or solidity and it’s grade of translucency were elected. Then the suitable ingredients were mixed together in room temperature. Next, the solution was heated slowly during constant stirring until it turned transparent and bubbles appeared. Now the material could be poured flat on a background foil or manipulated to generate a texture. The dried material could be further modified, the pattern was added. Ingredients, textures and patterns could be combined in infinite variations to generate materials with new visual and tactile expressions which later on inform their own three-dimensional shape. The recipes for this material library are variations of the following bases:

Recipe 1
100 ml Water
10 g Potato Starch
7,5 g Vinegar
10 g Glycerol

Recipe 2
100 ml Water
3 g Agar
6 g Glycerol
Methodology | A chronological order of decisions
Plant dyes in bio plastic
flexible
100% translucent
plain texture
plain pattern
Beetroot, agar agar, cut, layered

Red cabbage, agar agar, rolled, layered

Beetroot, agar agar, piped, rolled

Turmeric, agar agar, creased
Red cabbage, agar agar, cut, layered
flexible
50% translucent: mica
plain texture
plain pattern
flexible
50% translucent: paper
plain texture
plain pattern
Onion, agar agar, small paper flakes

Onion, agar agar, big paper flakes

Beetroot, agar agar, big pink paper flakes

Beetroot, agar agar, small paper flakes
flexible
100% translucent
+ other material
Copper wire flat, onion, agar agar

Recycled cotton cloth, fully coated, geometric pattern, agar agar

Copper wire twisted, onion, agar agar

Onion, agar agar, nut shells, shiny side
Nut shells, spikey side, onion, agar agar
Ink, beetroot, agar agar
Salt, beetroot, agar agar
Thread, onion, agar agar
Copper wire circle, red cabbage, agar agar

Fibre optics, onion, agar agar

Side glowing fibre optics, onion, agar agar

Tufted hemp, fully coated, onion, agar agar
Flax ribbon, fully coated, onion, agar agar

Synthetic net, fully coated, onion, agar agar

Paper, fully coated, onion, agar agar

Printed tracing paper, fully coated, beetroot, agar agar
Tabby cotton cloth, fully coated, onion, agar agar

Panama cotton cloth, fully coated, onion, agar agar

Digitally printed panama cotton cloth, fully coated, twisted, onion, agar agar

Cotton velvet, partly coated, red cabbage, agar agar, mica
Cotton velvet, partly coated, molded on plastic board, red cabbage, agar agar

Paper, partly coated, onion, agar agar

Tabby cotton cloth, partly coated, onion, agar agar
Threads, dipped, onion, agar agar

Threads, fully coated, onion, agar agar

Dried onion bio plastic dots in fresh red cabbage bio plastic, agar agar

Panama cotton cloth, partly coated, onion, agar agar
flexible
100% translucent
piped texture
plain pattern
Beetroot, agar agar, piped in lines, layered as grid

Beetroot, agar agar, piped in circles, layered
flexible
100% translucent
moulded texture
plain pattern
Transparent, agar agar, moulded in holes, thin

Indigo, agar agar, mica, moulded on spikes, thick

Turmeric, agar agar, moulded on spikes, thin

Onion, agar agar, moulded on spikes, thick
Turmeric, agar agar, moulded on spikes, thin

Red cabbage, agar agar, moulded on bubblewrap, thick

Beetroot, agar agar, moulded on pleats, thick

Beetroot, agar agar, moulded on spikes, thin
Indigo, agar agar, moulded on emerging grid, thin
Onion, agar agar, moulded in plaster imprint, hand

Onion, agar agar, moulded in clay imprint, bubbles

Onion, agar agar, moulded in clay imprint, lines
Onion, agar agar, moulded in clay imprint, hand

Turmeric, agar agar, moulded on spikes, thin

Red cabbage, agar agar, moulded on spikes, thin

Red cabbage, agar agar, moulded on spikes, thick
Indigo, agar agar, moulded in plaster imprint (textile)

Indigo, agar agar, moulded in plaster imprint (net)

Indigo, agar agar, moulded in lacquer coated net

Indigo, agar agar, moulded in clay imprint, bubbles
Indigo, agar agar, moulded in clay imprint (net)
Indigo, agar agar, moulded in acryl imprint (bubblewrap)
Indigo, agar agar, moulded in plaster imprint, lines
Indigo, agar agar, moulded in concrete (coated) imprint, knit
Turmeric, agar agar, moulded in holes

Onion, agar agar, moulded in clay imprint, big bubbles

Indigo, agar agar, moulded on spikes

Beetroot, agar agar, moulded on laser etched acrylic board, waves
Transparent, agar agar, moulded on laser etched acrylic board, waves

Red cabbage, agar agar, moulded on spikes, thick

Beetroot, agar agar, moulded on spikes, thin

Transparent, agar agar, moulded on spikes, thin
flexible
100% translucent
moulded texture from object
plain pattern
Beetroot, agar agar, poured, moulded through metal grid on top
Beetroot, agar agar, poured, moulded through cups on top

Onion, agar agar, poured, moulded through leaves on top

Beetroot, agar agar, poured, moulded through plastic strips on top
Beetroot, agar agar, poured, moulded through glass beads on top
flexible
100% translucent
moulded texture in object
plain pattern
flexible
50% translucent: mica moulded texture plain pattern
Indigo, agar agar, mica, moulded on glue gun circles
Indigo, agar agar, mica, moulded in holes
Indigo, agar agar, mica, moulded on concrete imprint
Indigo, agar agar, mica, moulded on acrylic surface
Beetroot, agar agar, mica, moulded on bubblewrap, thin

Indigo, agar agar, mica, moulded on bubblewrap, thin

Turmeric, agar agar, moulded on nubs
Turmeric, agar agar, mica moulded on plastic net

Indigo, agar agar, mica, moulded on cut acrylic board

Transparent, agar agar, mica, moulded on plastic net

Indigo, agar agar, mica, poured on different base foils
flexible
50% translucent: paper moulded texture plain pattern
Onion, agar agar, low amount of recycled paper, moulded on spikes

Onion, agar agar, high amount of recycled paper, moulded on spikes
flexible
100% translucent
hairy texture
+ moulded texture
plain pattern
Turmeric, agar agar, viscose fibres, moulded on spikes
flexible
50% translucent: mica
bubbly texture
plain pattern
Indigo, agar agar, low amount of mica, soap, thick

Indigo, agar agar, high amount of mica, soap, metal wire

Indigo, agar agar, low amount of mica, soap, thin

Indigo, agar agar, high amount of mica, soap, metal wire
flexible
100% translucent
hairy texture
plain pattern
Onion, agar agar, flax fibres, coated/ glossy side
Tuermic, agar agar, hemp fibres, coated/ glossy side
flexible
50% translucent: mica
hairy texture
plain pattern
Indigo, agar agar, viscose fibres, mica
flexible
100% translucent
plain texture
geometric pattern
Onion, agar agar, cut circles

Onion, agar agar, cut squares with distance

Onion, agar agar, cut squares as grid
Red cabbage, agar agar, cut points

Beetroot, agar agar, cut stripes

Onion, agar agar, engraved knit pattern

Onion, agar agar, engraved circle pattern
Onion, agar agar, engraved square pattern
flexible
50% translucent: paper
plain texture
geometric pattern
Red Cabbage, agar agar, recycled paper, engraved triangle pattern

Onion, agar agar, recycled paper, cut and assembled triangle pattern

Red Cabbage, agar agar, recycled paper, engraved grid pattern
flexible
100% translucent
hairy texture
geometric pattern
Onion, agar agar, viscose fibres in rectangular shape

Turmeric, agar agar, viscose fibres, cut semicircle pattern

Beetroot, agar agar, viscose fibres, cut stripes
flexible
100% translucent
plain texture
pleated pattern
Beetroot, agar agar, creased foil

Turmeric, agar agar, creased foil, heat pressed

Charcoal, agar agar, pleated foil, heat pressed

Onion, agar agar, pleated foil, heat pressed
flexible
100% translucent
plain texture
pleated pattern
+ geometric pattern
Red cabbage, agar agar, cut, pleated and heat pressed
solid
100% translucent
plain texture
plain pattern
Beetroot, starch, thickly poured
Turmeric, starch, matt side

Turmeric, starch, shiny side

Red cabbage, starch, shiny side
Transparent, starch, matt side
solid
50% translucent: mica
plain texture
plain pattern
Turmeric, starch, blue mica, shiny side

Turmeric, starch, mica, matt side
solid
50% translucent: paper
plain texture
plain pattern
Indigo, starch, recycled paper
Turmeric, starch, recycled paper
solid
100% translucent
+ other material
Beetroot, starch, parallel threads

Turmeric, starch, seeds

Turmeric, starch, recycled paper, seeds, matt side

Turmeric, starch, recycled paper, seeds, shiny side
Beetroot, starch, sponge

Onion, starch, bast

Turmeric, starch, magenta thermochromic ink, cold

Turmeric, starch, magenta thermochromic ink, heated
Beetroot, starch, wire
solid
100% translucent
piped texture
plain pattern
Turmeric, starch, piped in circles

Transparent, starch, piped as grid

Turmeric, starch, piped as grid
solid
100% translucent
moulded texture
plain pattern
Onion, starch, moulded on spikes
solid
100% translucent
hairy texture
plain pattern
Turmeric, starch, flax fibres, matt side

Turmeric, starch, indigo blue needle-felted viscose

Turmeric, starch, flax fibres, shiny side
solid
100% translucent
hairy texture
+ moulded texture
plain pattern
Avocado, starch, viscose fibres, moulded on spheres
solid
100% translucent
plain texture
generic pattern
solid
100% translucent
hairy texture
geometric pattern
Indigo, starch, viscose fibres, cut stripes
solid
50% translucent: paper
plain texture
geometric pattern
Turmeric, starch, recycled paper, etched grid pattern

Onion, starch, recycled paper, cut and assembled triangles

Onion, starch, recycled paper, etched grid pattern, cut and assembled triangles
solid
50% translucent: paper
plain texture
organic pattern
Indigo, starch, recycled paper, etched geometric pattern
solid
100% translucent
plain texture
pleated pattern
Onion, starch, pleated foil, heat pressed
References


Further reading


Baltimore: Maryland Institute college of art

BUET, V. (n.d.) [online] Available at: https://violainebuet.com/
GOTS (n.d.) [online] Available at: http://www.global-standard.org/
LOHMANN, J. (n.d.) [online] Available at: http://www.julialohmann.co.uk/
NITSCHE (n.d.) [online] Available at: http://tmn-design.jimdo.com
SCHMEER, J. (n.d.) [online] Available at: http://johannaschmeer.com/