An Alternative Future of Spatial Materiality

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“Everything starts as material and ends as material.”

(Peter Zumthor, Architect)
In our practice the choice of materials is mostly driven by practical reasons, aesthetics and a given budget, and it is often applied rather at the end of the process – rarely is it the driver of any design process. What often gets forgotten is that materials can carry an immaterial layer of connotations. This means that materials are not perceived neutrally but are instead always loaded with certain meanings and values we attribute to them which in return can evoke different emotions in us. In my thesis project I explore the effect of an alternative design process that uses materials as the point of departure.

Through experimental explorations I have produced my own materials and investigated possibilities to use them in a spatial context. I created different scenarios to speculate about the potential these materials could have. Could they become applicable materials for interior and furniture design as well as for being a carrier of meaning?

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Introduction
on the generic materiality of space
The shells of the spaces we inhabit are most likely not very different from one another regarding their materiality. Commonly, the range of materials used is not that broad: concrete, brick, plasterboard, wallpaper, plaster, laminate, vinyl, tiles, wood in the best case. Looking from a materials’ perspective we all inhabit similar spaces. But how does that affect us as inhabitants and our relationship to those spaces?

What happens if we change the materiality of a space? Can materials change our relationship to spaces? Do they influence how we use space and how we behave in it?

New materials offer new opportunities in regards to shape, aesthetics, properties and meanings. Once aware of the power of materials, we can use these features to create characteristic spaces - spaces that are expressive and communicate with their inhabitants or users. We might also find new ways to tailor spaces so that they are especially and exclusively created for the individual human being and his/her needs. Since we are all different and have different needs, one could argue that a generic materiality for all the spaces we inhabit might not be applicable for all individuals. Materials have a diversity of capacities; they can to support the function of a space but also change the way spaces relate to or communicates with us; they can even evoke certain emotions in us. For me this means that material use is a powerful tool to shape not only a space itself but also the way we as humans relate to that space.

Rather than creating neutral, non-communicative spaces that are supposed to suit everyone but instead communicate with no-one really, I believe that it is our strength as interior architects to create spaces with distinctive characters that create a strong connection to certain individuals. Spaces that can relate to us on an emotional level.

In this thesis I will explain my own approach towards material use in the context of furniture design and interior architecture. I will start by explaining the theory of Material Driven Design and how I want to bring this method used in Industrial Design into my own practice as an Interior Architect. I will illustrate my approach towards this method through the examples of two previous projects before I go into explaining the design process of my thesis project.

With accounting the current state of my material developments and the search for spatial applications, I will describe 3 different scenarios of how the materials could be applied using my own private space as a case study and starting point of the development. Eventually I will describe and reflect on the setup of the Spring Exhibition where I tried to show other potential material applications.
Material Driven Design
in Interior Architecture
Parts of my research take place in the field of Industrial Design particularly in exploring a method that is referred to as Material Driven Design (short MDD). This quite new approach towards Industrial Design is based on the aim to create a certain user experience with materials as the point of departure. In *Materials Experience: fundamentals of materials and design* Elvin Karana and Paul Hekkert explain that materials inherit either universal meanings or learned meanings. Universal meanings are generally embodied meanings such as wood being perceived as warm and therefore inviting and cosy, whereas steel as a hard and cold material seems to be rather tough and distant. These universal meanings are said to have a ‘sensorimotor’ nature, which means that they are persistent and not sensitive to cultural or individual differences.

Learned meanings, on the other hand, can differ a lot depending on social, cultural and individual context and can also change over time. Materials that are frequently used in a specific context become associated with particular meanings that are dominant in that context. Therefore we can easily assume that those connotations are incorporated characteristics of the materials. But we may not forget that these meanings or characteristics are based on the experience of the individual and are always subjective even if possibly coherent in a certain cultural circle or group.

The fact that learned meanings can also change over time is due to new and developing technologies that can create new uses and contexts for materials. Plastics for example are no longer that one “horror material that denies death” (as in the understanding of Japanese Culture) but instead new kinds of plastics like bioplastics are being developed and slowly changing our perception and attributed meaning of that material.

Also, there are always new materials that are being developed which have no history and no context yet. This gives us as designers the task - which can be seen as a unique opportunity for designers to be able to influence the meaning of materials and therefore the objects, furniture or spaces that they are embodied in. Also, we can use materials as a powerful tool to influence the relationship we want to create between a user and an object - or between a human and a space.

And this is where I am trying to bridge between Industrial Design and Interior Architecture because I believe that both fields follow the same goal: to create a (long lasting) relationship between a user or inhabitant and an object or a space. Whilst of course other factors such as form, colour or function play a role in the creation of that relationship, I believe that with materials as a starting point we will discover new possibilities to create new designs as well as meanings.

When I create the design of a space the most important questions to me are: What kind of emotions is that space supposed to evoke? What sort of relationship is it supposed to create and to whom? And how do I achieve that? Taking all the above mentioned factors into account, I believe that materials influence all of these factors. The one same room can have many different characters depending on what materials are used. Also, with materials as a starting point, we can think in a variety of shapes because different materials allow different ways of form-giving.
The connection between materials and emotions is similar in concerns of being a rather subjective phenomenon. In the same chapter of *Materials Experience*, Elvin Karana and Paul Hekkert describe how materials evoke certain emotions. An appraisal model is mentioned that explains the cause of an emotion as an evaluation of a situation which causes a certain reaction in our brains and bodies. It can be illustrated like this:

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STIMULUS → COGNITIVE APPRAISAL → PHYSIOLOGICAL RESPONSE → EMOTION
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“Surprise is described as one of the most interesting and strongest emotions that can be provoked. A material can be surprising for instance when it meets our expectations that are built upon a visual inspection but then turns out to have different features than expected. It can be surprisingly light or soft or flexible whereas its look suggests the opposite. When being surprised we tend to find the situation, object or material at hand fascinating - this creates a positive reaction in our body and brain. We may even want to engage more with it or we will at least keep the material in our memory. Therefore, a strong user-experience is created which in return leads to a stronger user-object relationship. However, it can be challenging and difficult to evoke a desired emotion since emotions, as mentioned before, are always subjective and depend on the users’ experience, background and knowledge.

“Surprise can be obtained from performance as well as from suddenness.”

*(Geoffrey Pyke)*

"It's not what you look at that matters, it's what you see (in it)."

*(Henry David Thoreau)*

According to that appraisal model it is not a situation itself that evokes an emotion but rather our interpretation of it. If we translate that into design, it would be that not an object or space is causing an emotion but rather our perception of it. This can be influenced by many factors, of course, but materials can be seen as one of the strongest ones. As an example: a fork is still a fork whether made from stainless steel or plastic. They both fulfil their purpose and yet do we evaluate them differently: whereas the stainless steel fork will be interpreted as being of higher quality and more valuable we evaluate the plastic fork as being cheaper, more brittle and probably even less hygienic. In a spatial context this is of course a bit more complex since there is not only one but usually several materials that are being taken into account. However, the universal meaning inherited by some materials makes it easier to predict what emotions people would have when they experience a space. Wood for instance is often used when the atmosphere is supposed to be cozy and warm which makes people feel comfortable and calm whereas metals or concrete radiate more distance and coolness. It gets more interesting though when materials are being used that are not well known or carry less inherited meaning so the evoked emotions are less predictable.
In the paper *Material Driven Design (MDD): A Method to Design for Material Experiences* by Alvein Karana, Bahareh Barati, Velantina Rognoli and Anouk Zeeuw van der Laan the authors describe three different methods for designers to approach MDD:

Method 1 is working with a well-known material but bringing it into a new context and therefore evoking new meanings and experiences. Here, the outcome should be a fully developed sample.

Method 2 is described as working with a rather unknown yet existing material that has not been experienced in many ways so it hardly inherits any settled meanings. That gives the designer the possibility to shape those meanings and define possible applications. The outcome should be a fully developed sample here as well.

Method 3 is defined as a material proposal with properties that still have to be further developed. It is the designer’s task to find meaningful applications that will lead to the evocation of new user experiences and meanings. Since those do not exist as a novel material, their development partly depends on the users’ feedback. The outcome here may be semi-developed or exploratory samples.

To get an understanding for any material at hand, a technical and experiential characterisation is recommended in MDD. Technical means to tinker around with the material and try to find out what its mechanical properties are, how it can be machined differently and what resistances or weaknesses it has. Encountering an experiential characterisation rather means to understand the material on a user-based level in concerns of how it is being received by people. Four different levels of experiential qualities are described: sensorial (what the material feels like), interpretive (what the material is associated with), affective (which emotions the material evokes) and performative (what action the material causes). Both characterisations are supposed to help the designer to find a meaningful application and reasonable context considering all technical and emotional qualities.

In the following design phase, those findings are being translated into either a developed product (method 1 & 2) or a proposal (method 3). Method 1 and 2 will mainly allow a manipulation of the material’s sensorial qualities by e.g. using different shapes, recipes, finishing or manufacturing processes. The design part for method 3 will be more complex since probably not all properties have been revealed. This can result in a continuous tinkering phase, where several samples are created which are supposed to demonstrate the envisioned performance or application for the material. It might me a conceptual prototype that can be tested in the envisioned context.

Even though the method of MDD is solely described for an industrial design process, I could see parallels and interesting possibilities for an application of that method in an interior architecture practice. Since we are usually dependent on the industry and what materials it offers for us, the idea of inventing my own materials or explore existing ones in new contexts struck me. I could see great opportunities for my own practice and way of designing by developing an alternative design process that uses materials as a starting point.
Material Explorations
Previous and Current Investigations
I always found it interesting to explore materials in different ways. In previous works I have been investigating materials and material use from two different angles: one is to use an existing material and challenge it and its properties by bringing it in a new context or using it in a different context. The other one is to explore ways of creating my own material and then find suitable applications for it. Back then I have been unaware of the fact that both approaches are according to Material Driven Design, and that I had developed two projects that explore the aforementioned Method 1 and Method 3 of MDD.

As an example for Method 1 we can look at my project Concrete Contradictions from the first year of the master's program. The starting point was a collaboration with Vinnova, the Swedish governmental agency for research funding. Because of the refurbishing of their office, they gave some of their old furniture to us Konstfack students to turn them into something new. The furniture was mainly built from chipboard and I started with steaming it in order to dissolve the glue in it and thereby get the pure wood chips.

Afterwards I was looking for a new binder and started some trials with different materials like glass, gips, concrete, plaster and cement. The different binders showed various properties but whilst gips or plaster seemed to be too weak and concrete too predictable and also heavy, I decided to continue on the development with cement. During the experimentation to find the right recipe I also started a research on the potentials of the combination of the two materials and came across the fact that this material, called wood cement, has been used as a construction material in Germany during World War II when resources were low and real concrete was not broadly affordable. It sunk into obscurity after the recovery and growth of the economy. It is not use in architecture nowadays but can be found in the field of nature conservation where it is sometimes used to build bird houses that will eventually (after a period of approximately 10 years) disintegrate itself into the soil without doing any harm to nature.

I am intrigued by the contradictions the material carries aesthetically as well as metaphorically. It is a combination of a cold, mineral material with which we associate connotations like cold, heavy, constructive and a warm, natural material that is generally being perceived as being cosy, warm and inviting. Its look is cold and warm at the same time, its touch is rough yet soft.

The challenge with this material is to use it in a new context which is why I decided to build a piece of furniture from it, particularly a chair, and challenge its performance by the restriction not to use any further additives or reinforcement. That would result in its ability to disintegrate itself but during my experimentation and research I also found out that it is possible to fire the material (with around 600°C) which burns off the wood and only leaves cement (which doesn't burn off) and wood ash which again contains a lot of calcium that would make the cement even stronger. So the cement could be used over and over again recycling new batches of wood shavings.
To illustrate my encounter of Method 3 - to create new materials and find suitable applications for them - I will sum up the project. After where I investigated the possibilities of using coffee grounds as a raw material to build objects or furniture.

It started off with a research on food waste in Sweden, as I wanted to find a waste material that I could work with. According to the statistics, 1.211.000 tonnes of food waste have been produced in Sweden in 2012. 65% of that amount is unavoidable food waste such as peels, shells, bones or coffee grounds. These numbers and the observation of my surroundings led me to the decision to work with coffee grounds. I collected them from the cafeteria at Konstfack which produces 15-20 kg of coffee grounds everyday.

In searching for a practical binder I teamed up with Marcin Pogorcelski from the Industrial Design department and together, we explored the material and several processes to work with the material. Apart from 3D-printing, vacuum forming, steaming and compression moulding, we found out that rotation moulding was one of the best manufacturing processes for the material.

We also discovered that the material had some interesting properties such as being heat resistant, slightly sound absorbent and machinable; it can be cut, sanded, drilled screwed into. However, it is not water resistant and would therefore dissolve in water, but it can be treated with repellent lacquer.

Images 03-13: testing different processes (left to right & top to bottom): rotation moulding & result; vacuum forming & result; 3D-printing & result; steaming; hand forming; testing heat resistance; compression moulding; testing drilling & screwing.
In search of an application for the material we felt that we should make the weakness of dissolvability become its strength. That was when we started to take into account that coffee grounds can be used as a fertiliser for plants. So our final outcome was a plant pot in which any plant could be directly put into soil. It then would disintegrate itself and thereby give nutrients to the plant.

To me, the material was also interesting in relationship to its aesthetical qualities and at the time I felt the urge to explore it even further.
For my thesis project I decided to continue the material experimentation with coffee grounds and try to make it applicable for a spatial use. First and foremost that meant that I had to find ways of making the material stronger so to look for some reinforcement. Further, I realised that I have to invent a new production process that would allow me to scale up and at the same time produce sturdy samples. In the previous project phase I have tested different reinforcement materials like paper, fabric, natural fibre strings, nylon strings, metal wire, fabric and wood shavings. But since our final products were biodegradable plant pots and the material was strong enough for that use, no reinforcement was needed. The evaluation of the various reinforcements I had tested made clear that - besides paper - wood shavings have so far been the only potential material that works well in combination with bioplastic and also with coffee grounds. The combination of wood shavings and coffee grounds would also build the bridge between the two earlier projects.

Further, it changed the aesthetics quite a lot and the material shifted from being a dark, smooth, rather pure and fine grained material with a quite elegant aesthetic to a more rough, natural and earthy appearance. To me, the material has a different character now, the spotted surface makes it appear more natural and less sophisticated. It feels less distant and instead more warm and welcoming which I appreciated.
Another trial to make the material stronger was to change the binder and use algae instead of potato starch.

Whilst the mix of algae and coffee grounds did not work at all, the combination of coffee grounds, wood shavings and algae turned out to work slightly better. That led to my assumption that the wood shavings would work a better. Out of curiosity, I did a sample with algae and wood shavings solely. The result was very surprising; after a drying phase of 3 days I got an extremely light yet quite stable board. After a couple of more trials to find good proportions, I eventually managed to create an even bigger sample board that turned out to be pretty strong whilst still being very light.

I see a great potential in this material not only because of its lightweight and ecology reasons but also because of another factor that could be quite important in the manufacturing process: the binder (algae-based bioplastic) is and stays liquid during the whole process until it starts to compound with the wood shavings when it cools down and thereby cures. That means that unlike the starch based coffee grounds material, this material could be poured in any shape in any mould.

With several tests I found a reliable recipe that would create a sturdy, hard board with good resistance to pressure and deflexion.
Material & Application
My Private Space as a Case Study
In order to find out if a change of materiality in my surroundings would affect my relationship to the respective space and possibly even my behaviour in it, I decided to use my private space as a case study. Since the sleeping area of my room is quite bare and somewhat not really comfortable, I chose to use this area for my experiment. I covered the surrounding walls of my bed with recycled foam boards and shaped them in a way so that they would build smaller and bigger "waves" (image xx). The walls that were cold, hard concrete before now became soft and warm which indeed changed something for me. It became a cozy corner that I could use to sit in and read; I could now snuggle onto the wall and retract myself into the corner. When I looked up to the ceiling, the foam was coming out of the wall and softly folding over my head. I felt sheltered and secure. That made me realize that apparently I had certain spatial needs that were possibly not fed by the current setup of my space. Even though the folded foam wall was only a subtle interference it led me to a recollection of my own childhood memories, resembling the times when I had built my own shelters.
I go into my bedroom. I close the door. Silence. Oh I wish! But it isn't silent at all, the walls are way too thin, the insulation way too weak. I can still hear the noise of the outside world and wish it wasn't there. I wish I would have peace and quiet for just one short moment. I need to release, need to retreat, find and listen to my inner voice. But the noises around are so distracting. So I procrastinate from finding inner peace and instead I go to my laptop and log in to Facebook. More noise. Voiceless yet dominant. I can't think straight and it makes me feel dizzy so I shut it down after I have scrolled down a couple of meters. I lay down on my bed. All that noise from outside my room! I pick up my phone and open Instagram. Less noise but still a persistent hum. That was it - this is too much. I can't think! I grab my duvet, pull it over my head and bury myself in it. Darkness - finally. Silence - at least almost.

From time to time I just want to have a break from the outside world - from everything and everyone. The high-speed of the world sometimes overwhelms me and so I start looking for a place to wind down, shelter, a retreat.

For more than 8 years now I have been living in shared flats in different cities, different countries. But they all still have one thing in common: they are shared. You share your home and so you share your life, your privacy, your safe haven. Not that I don't like it. I love and enjoy it which is why I always chose to live like that. There are just these moments when you wish you could escape. Be on your own, with only the noise of your breath and thoughts. In those moments I always wish I had something even more intimate than my room. Some place to hide and have a break from life. Like a little den - my own hideaway.

When I was a kid I used to build my own little dens, small shelters to hide from the world, my parents or any other intruders. There were no limits, no rules, no obligations. I would build them wherever I wanted to - under the table, in my bed, in my closet, my mom's wardrobe, the attic, behind the sofa or in a tree in our garden. And I would use whatever material I would find - blankets, pillows, hangers, clothes, brooms, plants, lamps, branches, strings, mud and so on. The variety of materials seemed to be as big as the universe.

My attempt is also to go back to that free mindset and open my imagination for the material world that I lived in when I was a child and nothing seemed to be impossible.
As a reaction to the bedroom experiment and the returned childhood memories, I decided to develop that idea of a changed surrounding in my bedroom and to design a space that would enhance the feeling of being sheltered: my own cave that would make me feel safe, secure and secluded.

As a first step I modelled different versions of a cave-like structure in 3D and did a CAD-drawing of it installed in my bedroom. To see if the proportions would work, I decided to build a model of one version in scale 1:10. I used the laser cutter to get the grid of the cave and then used the vacuum machine to create a mould for being able to cast the mass in different materials.

I was planning on having a model of the cave made from coffee grounds solely but due to different reasons, the cave moulded and decomposed itself after a couple of days. Since the mould was made from plastic, the material did not get enough air during the drying process. It may also have been too thick and too less pressure used during the process (since I didn’t have an inside shape of the cave I used a big balloon to press the material against the plastic mould). I could still use the grid and the mould to figure out the scale and the relation between the construction and the inside.
Whilst the size of the cave looked appropriate in the drawing, I figured when playing around with the model that a different scale would possibly benefit my idea of the cave. It could become a more independent space instead of a furniture-size subspace.

I imagined the inside of the cave as an organically shaped space that uses its structure not only as the constructive part but also as a functional feature. By using different depths, thicknesses and shapes of the construction it could become e.g. seating, shelving, storage and that way cater different spatial needs.

But when I was reflecting on it, it became quite clear that this would mean that the cave would suddenly become just another multi-functional room instead of a retreat which I was initially aiming for.
The reflection upon the cave led me to design an even bigger spatial structure that would not only cover the sleeping area but change the whole room and turn it into a whole new space. It became an amorphic creature that swallows up all function in the room and leaves an organically, somewhat oddly shaped space. It has a cavernous character because of its specific shape, the curves and cavities, its height, and eventually also the material I was imagining it to have.

I could either choose to use the coffee grounds with wood shavings solely or to create a material mix from all the materials I have been working with. A homogeneous materiality (image 49) would possibly enhance the cavernous character but if I want to tailor the space for its inhabitant then I would use different materials to support the inhabitant’s needs in certain areas (image 50). In the sleeping area, a soft material like the recycled foam is much more desirable than the hard wood cement or coffee grounds whereas in the working area a hard materiality could be reasonable. In any way it would become a space with a distinct, odd character.

I was aiming to create an odd space that would make its inhabitant almost feel like entering a different reality. This idea made me think of Niki de Saint Phalle’s Tarot Garden where, amongst other creations, she has built a cave-like space that is covered in splinters of mirrors. The shape of the space as well as, of the complete furniture is rather strange and, together with the use of uncommon materials, creates that sort of odd reality I was imagining for my space.

“The inhabited space transcends geometric space.”
(Gaston Bachelard - The poetics of Space)
Because I also wanted to test the limits of my material or rather find out if I would be able to clad the Spatial Structure with them, I decided to build a section of the space I had drawn in scale 1:1 instead of making a model of it. Therefore I had to figure out a simple yet sturdy construction and eventually decided to use a wooden construction made from roof battens. That resulted in a cheap, rough and not-too-heavy framework that I could assemble into any shape.

I chose an area in which I wanted to test how it would feel being surrounded by the material when sitting or even lying in it. Thus, I also created a big sheet of the coffee-grounds-material. Due to the new process I had found the combination of compression and heat finally allowed me to fabricate bigger sheets since the connection of smaller portions is not an issue in this process (description follows on pp. 52-53).
Material & Reality
Following the Materials’ Lead
After reflecting on the work I had done so far and the context I wanted to put it in, I realised that forcing the material into becoming this big, cave-like space was probably not the right approach. I also got some valuable feedback during the presentations:

“Listen to what your material can do - follow its lead.”

That sentence was very important for me because it brought me back to my initial idea of bringing Material Driven Design in to my own practice as an interior architect.

So how could I use the materials that I had created in a spatial context whilst following their guidance? The process I had figured out using a certain recipe, pressing the material in the veneer press and letting it rest on a subconstruction was the only reliable way of fabricating the material so I decided to stick to that process and to start producing a big range of sheets. The application I would figure out later on.

At that point I also started naming the materials and came up with the following: grainsheets are made from coffee grounds, wood shavings and potato starch; grainblocks are wood shavings in cement; grainboards are composed of wood shavings and algae.

Image 54: Collection of materials for the mid-term review, showing grainsheets, grainblocks and grainboards
Since I had tried compression moulding in a very low-tech and small scale version before, I knew that it was an efficient way to process the material. I have also tested to work with paper as a substitutional material to slow down the drying process and influence the deformation. So as a next step of testing the possibilities to manufacture the material, I produced a larger portion of the material, spread it out on a paper sheet and put it into the veneer press with the paper covering also the upper surface.

This test eventually led to this reliably working process:

I multiply the base recipe by seven and cook the material until I get a sticky, gluey dough which I then apply on a sheet of recycled paper. I can cook 4-6 portions in a row before I put them into the veneer press where I leave them with around 30-40°C and 400 bar pressure for approximately 3 hours.

When I take them out of the press, the material is still a bit warm and flexible but at the same time more stable and robust than before the compression.

I let the sheets dry on different subconstructions or moulds depending on what kind of shape I am aiming for. As stated before, this will guide the material in a certain direction but it will still deform in its own will.

For the form giving part of the process, I have been using different subconstructions in order to get a variety of curves and bendings. I used chicken wire that I shaped for creating more tight curves and a bent wooden subconstruction for a more flat curve. Since one application that I had in mind from the beginning was furniture, I also tried to shape seats for stools or chairs. I used a chair on which I let a sheet rest whilst another chair on top is pressing the material to get the right curves on both sides. The material can only rest in between the chairs for 1 day because eventually it needs air to dry properly. That's when the uncontrolled deformation sets in and creates a more organic shape.

No matter which forming process I use, the sheets need to dry for around 3 days before they can be treated further.
After the drying process I sand off the paper from one side of the sheets. In some parts, especially in bendings, the paper eats itself quite deep into the material which makes it nearly impossible to remove it completely. Even though unintentionally, I started to work with the paper as an additional feature and found it to be interesting in concerns of the aesthetics of the material. It creates a different pattern and sometimes a camouflage-like appearance. I also like the idea of the material showing a part of its manufacturing process.

I fabricated 34 grainsheets using the same base recipe but still experimenting with some variations in thickness and amount and type of wood shavings. Also, I tested how big I could go in size and created one sheet that has the dimensions 125 x 70 cm. Even though it is almost equally sturdy as the smaller sheets it shows some uncertainty and is also way harder to handle which is why I decided to go for the round sheets that are all about the same size (ø = 35-40cm).

What I had to figure out then was how to connect the sheets with one another in order to assemble them as a spatial configuration. At first, I tested to glue them together with wooden dovels. I thought it would be good to use the same materiality and to make the connections almost invisible as they would not be prominent from the wood shavings.

Even though this joint worked quite well I was not satisfied. It would require a lot of drying time and during that time the joints would be quite fragile. So I tested another connection by using brass bolts which did not only work even better but also added a certain quality. It gave the otherwise very natural and un-sophisticated looking compilation a well-engineered character which in my eyes has been missing. A further argument for that connection was the fact that I could use tie-wire anchors for hanging the assembled grainsheets from the ceiling.
Apart from creating a spatial arrangement, I also wanted to show the material’s potential to be applicable for furniture design. Therefore I tried to shape some of the sheets as seats for stools. Eventually I built 3 stools using different wooden subconstructions. The first prototype, a three-legged stool, required a full surface that it could rest on since the sheet I had made was quite thin and fragile. For the second and third prototype I made the sheets thicker and therefore more stable. One sheet turned out to have the perfect shape for a seat just with very irregular curves. So I wanted to try to build a subconstruction that would follow those lines perfectly and would be tailored especially for that one seat.

The other four-legged stool was a more random sheet so I made its subconstruction rather simple and not a perfect fit. To get the right angles that I wanted the legs to have, I built a cross with chamfered ends in which I could glue the legs in.

To fix the seat on the respective subconstruction, I this time went for the joints with wooden dovels because I wanted to have a smooth and even surface with no alien elements in it. It was also easier to fabricate since the grainsheets would be connected to timber instead of one another.
Following the Materials' Lead

Material & Reality

Image 76 prototype 1 for a 3-legged grainsheet stool

Material & Reality

Image 77 prototype 2 and 3 for a 4-legged grainsheet stool

Following the Materials' Lead
To show a possible application for the grainboards, I decided to create a flooring from them. Therefore I built a mould for 5 equally sized boards that I then filled with the same amount of wood shavings. I calculated that I would need 9 times the volume of the base recipe to fill every section of the mould. After mixing the ingredients (Agar Agar, water and Glycerol) the mixture needs to be stirred whilst cooking until it gets a cloudy and slightly thick liquid. It can then be poured into the prepared mould with the wood shavings. To make sure, all parts of the wood shavings are equally covered, I stir up the whole mass and then spread it evenly in the mould. The material cools and hardens surprisingly fast (approximately 1 hour) but let it rest in the mould for a bit longer before I release it from the mould. Eventually though, the material needs to be aired to dry, otherwise it risks to crack or become mouldy. It can take up to 2 weeks until the sheets are completely dry and hardened. When I put them into the exhibition they have been drying for 6 days so they were practically not ready yet but at least firm enough to use them as floor panels.
Since I had explored wood concrete in a previous project, it seemed to be an interesting material and I decided to continue exploring it and its properties. I wanted to find out how far I can push the limits of its properties in concerns of weight and material thickness as well as working with its aesthetics. Therefore I have been playing with different proportions, shapes, sizes and pigments. I also tested different ways of machining it like e.g. cutting, sanding, drilling, milling.

The different shapes I had tried for casting the grainblocks resulted in the decision to build a coffee table from the material using the thick columns as legs and a thin, round board as the table top with a diameter of 60 cm. I casted a table top as well as one round leg from white cement and wood shavings and another two legs additionally using red respectively blue pigments.

I sanded its top as well as the edges but decided to leave the downside of the top untreated. That way, the edge shows a nice contrast between the smooth, treated surface and the raw material and adds a feeling of naturalness.

For the exhibition, I also casted two small stands - one for postcards and another one for the label text.
Following the Materials' Lead

Material & Reality

Material & Reality

Following the Materials' Lead

Image 92 grainblock table

Image 93 detail of grainblock table top
Conclusion

Discussion, Reflection & Relevance
To conclude, I’d like to reflect on the question why I, as an interior architect, should deal with the issue of materiality or even approach the field of material innovation. I often hear but also ask myself that question. For me, the answer is actually quite obvious: we are the ones who know what demands we put on materials and what material qualities we are after. Further, it is our responsibility to use materials that are beneficial for humans’ mind and health as well as for our environment.

I have always been very sensitive when it comes to materials. To me, the design of any object or space depends on its materiality. It influences how I perceive it, whether I like it or not. I have a strong aversion to materials like plastic and am mainly attracted by natural materials like wood or stone. But if I am limited to the few real natural materials that are commonly used, I find myself strongly limited. Instead, I want to open up my imagination and try to broaden the spectrum of possible materiality. If I can create my own materials or contribute to the invention of such, I can only benefit from that.

Of course, environmental reasons also play a role in my investigation. I have deliberately limited myself to natural materials and ingredients that are neither harmful for the environment nor for our health. The reuse or up-cycling of waste materials was an obvious consequence.

During the exhibition I observed visitors and their reaction but also talked to them about their impressions and emotions caused by my materials and installation. Overall there was a frequent association to a natural product and material which I found very satisfying. Comments included were: “It reminds me of truffles – it looks delicious.” “What is this material? Is it something like cork? I almost feel like being in a tree”, as well as “I’ve never seen a material like this! I can’t tell what it is but it creates such a natural feeling.” “It looks like it is made from natural materials.” “I’ve never seen a material like this! I can’t tell what it is but it creates such a natural feeling.”

No one was able to identify the material and when I told them the ingredients they were all surprised and got curious about how I came up with the idea of using those ingredients and how the manufacturing process would look like. However, the overall response from people encountering my exhibition was really positive and the fact that the material caused so much surprise and fascination gave me good feedback.

Since I have only partly succeeded to make the material strong enough and applicable for the construction of furniture, this will be something I can imagine to continue exploring and developing in the future.

In conclusion I believe that we as architects and designers are equipped and have the opportunity to contribute to material innovations. Why should we leave the development of materials to the industry alone, as it makes us dependent on their products? Our involvement in what spaces and emotions, what relationships and environments we create could start with the design or innovation of new materials. We as architects and designers, but also our customers, the people who inhabit the spaces we create, would benefit.
Appendix
References & Literature


3 Niki de Saint Phalle, Tarot *Garden*

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To produce one grainsheet I use the following recipe and process:

**base recipe**
100 g water
40 g potato starch
30 g used coffee grounds
3 g salt
1 tsp Glycerol
16 g wood shavings (can differ, depending on the type of shavings)

I multiply the base recipe with 7 and then first solve the potato starch together with the salt in the correlative amount of water before I add Glycerol and eventually the coffee grounds. Then I put the mixture on a stove and heat it up at full heat. It is necessary to thoroughly stir during the whole process. After a while the fluid will start to thicken and go lumpy. You have to stir even faster in order to get an even, not claggy mass. I take the pot from the stove and continue stirring which now rather turns into kneading. I continue kneading until the mass gets really gluey and sticky and then add the wood shavings. In other trials I have tested to put in the wood shavings before and process all of the mass together but they soak up a lot of water so it is better to knead them in at last.
“Everything starts as material and ends as material.”
(Peter Zumthor, Architect)