PLYMOUTH COLLEGE of ART

Making Futures

# The material experiences as DIY-Materials:

## Self production of wool filled starch based composite (NeWool).

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### Abstract

This paper presents the growing phenomena of self-produced materials, namely 'Do-It-Yourself (DIY) Materials', and illustrates the pattern of conditions and circumstances which led to the emergence of this approach to materials. The DIY Materials phenomena is derived from a broader concept defined as 'emerging materials experiences' and through their definition we think in new and meaningful interaction between users and these new materials qualities derived by a self-production process.
Through the presentation of a case study, NeWool, a bio composite made of starch and wool fibres, we outline a design practice based on direct experimentation, tinkering and envisioning for designer.

### Keywords

DIY Materials, Materials Experience, bio-based materials, natural fibers composites, self-production.

## Introduction

Through the following paper the recent interesting phenomena called 'DIY Materials' will be not only presented, but illustrated through a case study called NeWool.
The 'Do-It-Yourself Materials' phenomena is derived from a broader concept defined as 'emerging materials experiences' (Karana et al. 2015 - a). This kind of experiences are characterized mainly by the conscious or not conscious awareness people possess through the daily interaction with materials embedded in thousands of artifacts every day. We know and experience a large amount of materials precisely because they are embodied in our daily objects. Therefore, the knowledge that we have of many materials and their qualities derives from those relationships and interactions. The expression 'materials experience' is defined as the experiences that people have with, and through, the materials of a product: the wood of the furniture, the plastic of the kitchen utensil, the leather of the handbag, and so on. 'The expression acknowledges that while product (or user) experiences may originate from—or be moderated by—a wide variety of sources, one of the prominent sources is the physical reality of an artifact' (Karana et al. 2015 - b), that is the material.

Since our daily objects come mainly from industrial mass production, our materials experience, as users but also as designers, is affected and determined by industrial materials. With industrial materials we mean all the materials used in the manufacture of hard goods, that are durable machines, products and equipment produced for industry and consumers. They are industrially processed with a series of operations that transform industrial materials from a raw-material state into finished parts or products. Looking at the Gary Hustwit's brilliant documentary titled Objectified (2009) it is easy to realize how we are surrounded by designed objects, industrially produced with industrial materials, industrially processed. Although this industrial paradigm is established in our society and for sure it will not change in the near future, today we are observing the emergence of another approach to product design in general and to materials for design in particular. This new and alternative approach is bringing a new dimension to the relationship amongst designer, technologies, processes and materials.
The emergence is related with the creation of new materials that offers opportunities for achieving new and unconventional materials experiences.

Designers need to explore how new materials, or new phenomena related with materials and technologies, shape our daily experiences with products and they also are demonstrating the need to get in contact with materials, put their hands on them and get their hands dirty.

Materials libraries, in their conventional setup, that is an infinite collection of industrial materials samples, are no longer enough (Akin and Pedgley 2016). In fact, one of the emerging materials experiences that we found in the present context of design is related to the trend of designers who feel the necessity to compose, combine, develop, modify, tinker and self-produce their materials. 'DIY Materials' is the name we gave to this trend. 'Do-It-Yourself Materials' are materials created through individual or collective self-production practices, often by techniques and processes of the designer's own invention. The common characteristic of these materials is that they are very often low-tech materials and with a very crafty and imperfect appearance. They can be totally new materials, modified or further developed version of existing materials (Rognoli et al. 2015). In self-producing their materials, designers may be creatively inspired by processes and techniques that come from other disciplines, such as culinary science and arts, activating a trans-disciplinary cross-pollination that leads to original and poetic results. Plus, usually they are produced using local resources, promoting sustainability, reducing the costs and underlining the connection with a place, a community or the designer. We identified some external conditions that enable the emergence of this new materials experience defined as 'DIY Materials'.
For instance, one of these conditions is the revaluation of crafts or, better said, 'renaissance of craftsmanship' based on a strong integration between design, handmade and technologies processes (Sennett 2008; Bean and Rosner 2012; Bardzell et al. 2012; Bettiol and Micelli 2013). The renaissance of craftsmanship is related with the new dialogues across borders opened up by the collaborations between designers and craftspeople that often bridge language boundaries with the simplicity of visuals, colours and materials (Edelkoort 2012). As Paola Antonelli (2012) stated: 'the evolution in the role of technology has brought a cathartic return to the roots of making'.

Another important factor enabling the DIY Materials as phenomena is the new wave of DIY called by scholars as 'Third waves of DIY' and defined by Fox (2014) as: 'DIY that draws upon the read/write functionality of the Internet, and digitally-driven design/manufacture, to enable ordinary people to invent, design, make, and/or sell goods that they think of themselves'. Furthermore, the democratization of fabrication technologies (Tanenbaum et al. 2013) combined with the rising desire of individuals to personalize their products offers the opportunity to experiment with advanced, distributed and shared production processes, enabling self-production of materials and products both supported by the Internet and the open source philosophy (Bianchini and Maffei 2013). As a result of these conditions industrial design becomes 'industrious design' (Bianchini 2014): willing to directly self-produce, craft, tinker, modify, hack and control and with all the tools to do it.
The term 'self-production', which refers to a way of controlling production processes through experimentation and tinkering, contrast dramatically with the idea of creating a material in a 'lab' which is something of our full interest. Not only by the fact that the designer is in control of the material since the beginning of the process, but because in the same lab, the material is processed into a product. The diffusion of labs of low cost and accessible fabrication tools and open and shared knowledge about production processes, recipes of materials and instructions for building production machines are the new events that are allowing the self production practices to spread.

After having speculated on why designers are stimulated to become self-producers of materials, we present a state of art on this topic and a small number of DIY material cases and analyze them to reveal their commonalities and differences. We will focus on one particular case, the DIY Material developed by Giada Lagorio with the support of Valentina Rognoli and Marta Rink at the School of Design, Politecnico di Milano called NeWool (Lagorio 2014). This leads us to the vocabulary necessary to understand and discuss DIY material design practices and to inspire future design research and practice agendas.

## State of the art

To define DIY Materials as an emerging materials experiences, several different cases were collected. With different approaches coming from a broad scope of initiatives it was possible to start building a framework to study deeper this phenomena, that without any doubt is growing rapidly. This collection of cases study is illustrated in the article: DIY Materials by Rognoli, Bianchini, Maffei and Karana (2015).

Our research on DIY Materials continuously search for patterns and paths that can enrich the panorama. Some scholars and designers have previously highlighted the emergence of the trend to self-produced materials.
One of the most interesting research in this domain is illustrated in Material Alchemy by Jenny Lee (2015). The book is developed with the aim to redefine materiality in the twenty-first century. Novel concepts of material forecasting as ways to understand the impact of materials in lifestyle of people appear in the text accompanied with the idea that the boundaries of design are been pushed by enabling all senses to interact with consumers. To this end the term 'alchemy' reveals as a new possibility to be addressed in the context of materials for design by the fact that the designer is able to develop a project with a mix of precise methods of experimentation and a drop of imagination.

Another contribution we believe added significant contents to the Do-It-Yourself-Materials context is a series of recipes collected by Miriam Ribul in the text Material Activism[i] (Ribul 2014). Through the text and collection of cases study is not only possible to see and understand how to create things with common tools and ingredients, but the author seems to invite people to rebel against the consolidated (industrial) material system.

More connected with the idea of sharing and open source is the example called Open Materials, a research group founded by Catarina Mota aimed to open investigation and experimentation with DIY production methods and uses of materials. Through the platform[ii] it is possible to browse a continuously growing catalogue of DIY practices and techniques to create things with different materials (above all, smart materials).

The last example deals with the use of the kitchen as an auto-production facility that gives autonomy to designers for their own projects. By understanding the physical boundaries that manufacturing processes and transformation of materials have, with specific methodologies to follow and basic understanding of the states of matter and some laws of physics, it is possible for a designer to develop a project. In the project and text called Cooking Materials by Laurence Humier[iii] (2012), the designer converts of into a chef to be able to transform materials as the ingredients of a recipe with tools in the kitchen.
Material education in the School of Design demonstrated a growing interest in this new and emerging phenomena. In fact we acknowledged some examples of academic projects around the world.  Here we present a few.

The Basis of Processes - Experimenting with Food to Re-Shape the Industry Language (Ayala 2015) decodes the manufacturing techniques of the industry and search for analogue cooking procedures to teach designers how to cut, extrude, mold and finish with food and simple kitchen tools. By doing so, designers will gain autonomy to experiment without the need of complex industrial facilities to develop a project.
C-NOTE. Strategie di design per il recupero degli scarti della produzione industriale del cioccolato, un nuovo materiale ed un prodotto provocatorio (Badalotti 2014) identifies in cocoa beans shells, which represents one of the largest waste product in chocolate industry, a promising and profitable resource to produce a bio composite with interesting technical and sensorial properties.

Similarly, in Characterisation of waste coffee grounds as a design material: A case study of material driven design (Zeeuw van der Laan 2013) waste coffee ground is used to produce a both a material and a product whose experience would be meaningful to the users.
Recently, in the School of Design of Politecnico di Milano, Italy, we ran a specific course focused on DIY Materials.

The students worked for five weeks developing their own materials through direct experimentation and tinkering. They had the possibility to understand that materials innovation can emerge from the practice of tinkering—experimenting, testing, probing, and making incremental improvements to new and existing materials and processes (figure 1).

We observed that through this kind of perpetual tinkering the students started to establish an emotional bonding with the materials they self-produced (Rognoli et al. 2016).

**Figure 1. DIY Materials Course at Politecnico di Milano**

Similarly, at TU Delft, The Netherlands, some courses were organized by Elvin Karana in which materials were also self-produced through the Material Driven Design method (Karana et al. 2015 - c).
In conclusion, other two universities are active on the notion and development of DIY-Materials. We are referring firstly to Central Saint Martin in London which has been offering a Master course named Material Futures[iv] for three years exploring the intersection of craft, science and technology and aiming to look beyond existing boundaries to anticipate future needs, desires, and challenges.
The second one is the School of Materials at the Royal College of Art[v] which promotes a research supported by a shared ethos of experimentation and innovation in design, studio practice and technology.

## Case Study

In order to clarify in depth what we have coined as Do-It-Yourself Materials, a case study is presented. Developed as a Master´s Thesis project at Politecnico di Milano The DIY-M project called NeWool by Giada Lagorio (Lagorio 2014) will illustrate step by step how a material is self-produced by a designer and envision a further application. This material is included in Transmaterial (Brownell 2017), a collection of novel materials that are redefining our physical environment.

New wool is a self-produced bio composite made of wool waste, potato starch and other basic ingredients. Through experimentation, mainly by cooking them all in different combinations using the kitchen as a laboratory, a stable material was created.
The basic ingredients of the NeWool recipe are as follows: wool, glycerol, vinegar, water and potato starch. Those ingredients are easily available on the market and many of them are consider a basic commodity. The presented production process of the material is by fact very simple. Therefore, everyone could Do It Yourself their own NeWool material in their own kitchen using simple tools to self-produce it by following the presented steps. As a matter of fact, the recipe that was used to start the experimentation phase was found online. The added value of the project was mainly given by tinkering with the material, playing with the ingredients, mixing them in different combinations and quantity and observe the results. While that type of approach seems very natural and simple, strangely no part of the original recipe suggested such approach. One can say that is part of the design thinking process of a designer unlocking that type of performance or specific behavior with a material in hand.
The process started with sampling inside a matrix a mix of glycerol with potato starch and having another sample of glycerol alone (figure 2). Next, a series of pigmentation processes by cooking wool with natural pigments took place as seen in figure 3. Once the wool is dried and a particular color is chosen, the fibers of wool are cut, organized and arranged in different quantities. That will further affect the appearance of the material samples, enabling customization (figure 4).

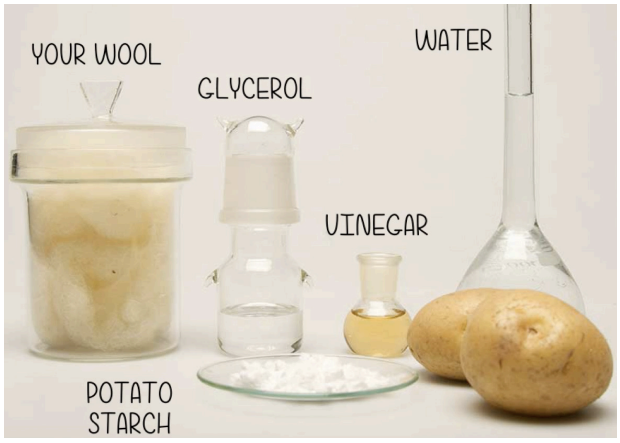


**Figure 2. All ingredients needed to develop the material**


**Figure 3. Cooking wool with different pigments**

The second phase of experimentation ends with a series of iterations and creation of samples made adding and subtracting wool fibers to the mix of glycerol and starch and cooking them in a conventional oven. By analyzing the different samples, the first classification of possible material directions for further development started to arise (figure 5).

**Figure 4. Cutting and arranging wool fibers**

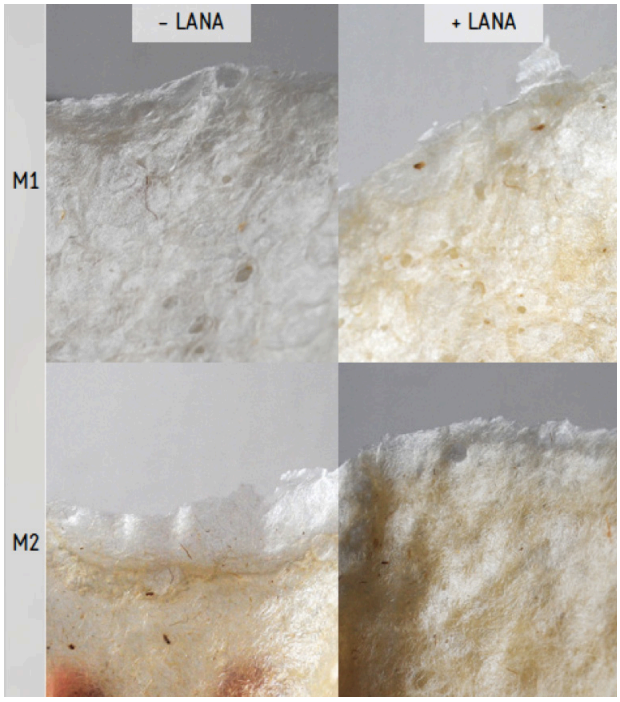


**Figure 5. First material samples**

The third iteration phase begins with dying selected samples with natural pigments once again. This time natural pigments coming from spices were used. Figure 6 show the sample dyed with cinnamon. Figure 7 illustrates the results obtained by using turmeric, cardamom, karkadè and black beans. During the same iteration phase we tried to mix the spices in different quantities in order to obtain shades of different colors. Once this phase was over and a second selection of samples were defined, the New wool collection was born (figure 8). A self-produced, low-tech and easily replicable materials.

**Figure 6. Material dyed with cinnamon**

**Figure 7. samples dyed with turmeric, cardamom, karkadè and black beans**

As designers it was merely impossible to stop there: soon another experimentation phase was developed. We started the experimentation on how to process the material to obtain different shapes. In addition, all the tools needed for that phase were developed as DIY tooling. At the end of the process, two simple shapes were created with the material (figure 9) and a complete new path of experimentation by trial and error of possible shapes became visible.

**Figure 8. The Material Collection**

**Figure 9. Do-It-Yourself Tooling and shapes obtained**

Furthermore, the research suggests to focus on the sensorial qualities and experiential patterns of the materials developed in order to obtain different and meaningful materials experiences. For that reason, a full course on the matter was created and is taking place on a regular basis at the Politecnico di Milano.

## Conclusions

Through the article we tried to describe the recent interesting phenomena called 'DIY Materials' and we illustrated it through a case study called NeWool.
The described panorama reveals how several changes in the material for design arena are taking place. It is also visible how designers are embarked in a research for alternatives that is different from the consolidated and rigid material selection processes of the industry.
By making their own materials designers can create meaningful emerging materials experiences and generate innovation to their projects from a material point of view.
The self-production direction presents tremendous advantages by gaining full control of the process of tuning the materials from a sensorial-expressive and material identity approaches respectively; the advantages of DIY materials direction are evident also from the sustainability point of view, since they are derived from material gathering that take place in re-use and re-cycle processes.

Further developments of this research will be pointing to enrich the definition of 'Do It Yourself Materials' and the capitalization of it in the educational field of product design.

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## Bibliography

Akin, F., Pedgley, O., (2016) Sample libraries to expedite materials experience for design: A survey of global provision, Materials and Design, Volume 90, Pages 1207–1217.

Antonelli, P. (2012). States of Design 11: Handmade Design. Domus n. 956. Retrieved from: http://test.qrt.edidomus.net:4503/content/domusweb/en/design/2012/03/26/states-of-design-11-handmade-design.html on March 2015.

Ayala C. (2015). The Basis of Processes – Experimenting with Food to Re-Shape the Industry Language. In: Proceeding of Cumulus Conference, The Virtuous Circle: Design Culture and Experimentation organized by Politecnico di Milano in Milan, Italy on June 3 – 7, McGraw-Hill Education Italy.

Badalotti M. (2014). C-NOTE. Design strategies for the recovery of scraps of industrial production of chocolate, a new material and a provocative product.(Unpublished master's thesis supervised by Venanzio Arquilla and Carlo Santulli). School of Design, Politecnico di Milano, Milan, Italy

Bardzell, S., Rosner D. K., Bardzell J. (2012). Crafting quality in design: integrity, creativity, and public sensibility. In Proceedings of the Designing Interactive Systems Conference (DIS '12). ACM, New York, NY, USA, pp.11-20.

Bean J., Rosner D. (2012). Old hat: craft versus design? Interaction, vol. 19, n.1. ACM, New York, NY, USA, pp. 86-88.

Bettiol, M., Micelli S. (2013). The Hidden Side of Design: The Relevance of Artisanship. Design Issues. Volume 30, Number 1 Winter 2014, pp. 7-18.

Bianchini, M. (2014). Industrious design. The role of design in the evolution of (micro)production models enabled by the hybridization of individuals and organizations.

Unpublished PhD. Thesis, supervised by Stefano Maffei. School of Design, Politecnico di Milano.

Bianchini, M., Maffei S. (2013). Microproduction Everywhere. Defining the boundaries of the emerging new Distributed Microproduction socio-technical paradigm. Published by Nesta. Retrieved from www.nesta.org.uk/event/social-frontiers on December 2014.

Brownell, B. (2017). Transmaterial Next: A Catalog of Materials That Will Redefine Our Future Physical Environment. New York: Princeton Architectural Press. ( expected release 2017).

Edelkoort, L. (2012). Handmade, when design & craft meet. Retrieved from: http://www.trendtablet.com/10019-when-design-craft-meet on March 2016.

Fox S. (2014). Third Wave Do-It-Yourself (DIY): Potential for prosumption, innovation, and entrepreneurship by local populations in regions without industrial manufacturing infrastructure. Technology in Society, n. 39, pp.18-30.

Humier L. (2012). Cooking Material. Could Molecular Gastronomy Help Discover New Matter? E-Book of Exhibition on Triennale Design Museum, Milano.

Hustwitt G. (2009). Objectified. Documentary. www.hustwit.com/category/objectified/

Karana E., Pedgley O., Rognoli, V., and Korsunsky, A. (2015). Emerging material experiences. Special Issue on Emerging Materials Experience, Materials & Design, vol. 86, pp. 692–702; DOI 10.1016/j.matdes.2015.07.020 - (a)

Karana, E., Pedgley, O., and Rognoli, V. (2015). On materials experience. Design Issues, 31(3). – (b)

Karana, E., Barati, B., Rognoli, V., Van der Laan, A. Z. (2015 b), Material Driven Design (MDD): a method to design for material experiences, International Journal of Design, 9(2), pp. 35-54. – (c)

Lagorio, G. (2014). Cook to design. The mix of food chemistry and design of materials (Unpublished master's thesis supervised by Valentina Rognoli and Marta Rink). School of Design, Politecnico di Milano, Milan, Italy.

Lee J. (2014). Material Alchemy. Redefining Materiality Within the 21st Century. Bis Publisher, Amsterdam.

Ribul, M. (2013). Receipts for materials activism. Retriver from: https://issuu.com/miriamribul/docs/miriam_ribul_recipes_for_material_activism/ch1j

Rognoli, V., Ayala, C., Parisi, S. (2016). In The emotional value of Do-it-yourself materials. In: Proceeding of 10° Design and Emotion Conference, Amsterdam NL. (Under revision)

Rognoli, V., Bianchini, M., Maffei, S., & Karana, E. (2015). DIY Materials. Virtual Special Issue on Emerging Materials Experience. Materials and Design, vol. 86, pp. 692–702; DOI 10.1016/j.matdes.2015.07.020

Sennett, R. (2008). The Craftsman. New Haven: Yale University Press

Tanenbaum, J. G., Williams, A. M., Desjardins, A., Tanenbaum, K. (2013). Democratizing Technology: Pleasure, Utility and Expressiveness in DIY and Maker Practice. Proceedings of CHI 2013, April 27–May 2, 2013, Paris, France.

Zeeuw van der Laan, A. (2013). Characterisation of waste coffee grounds as a design material: A case study of material driven design (Unpublished master's thesis supervised by Elvin Karana and Valentina Rognoli). Delft University of Technology, Delft, the Netherlands.

i https://issuu.com/miriamribul/docs/miriam_ribul_recipes_for_material_a http://www.miriamribul.com/#!recipes-for-material-activism/ch1j

ii http://openmaterials.org/

iii http://www.triennale.org/it/education/cooking-material-ebook

iv http://www.materialfutures.com/ http://mamaterialfutures.tumblr.com/

v http://www.rca.ac.uk/schools/school-of-material/