DIGITAL TEXTILE PRINTING WITH PIGMENT DYES

DIGITAL TEXTILE PRINTING

By using only the exact amount of dye needeed to create the desired pattern on fabric, digital printing in most cases uses less water, dye and auxiliaries than screen printing.

A goal of a study by VTT, Environmental Performance of Future Digital Textile Printing made for Printscorpio print house, was to evaluate the environmental impacts of digital textile printing. In order to assess how digital printing was performing, similar fabric was printed with screen printing method. Reactive dyes were used in the study.

Excerpts from the conclusions of this study

- “When the life time and usability of printed textile product is assumed to be the same for both printing methods, digitally printed textile product has slightly smaller environmental impacts than screen printed textile product.”

- “When comparing products with each other it is essential to include quality and durability aspects in the assessment. Nowadays there are no significant differences in quality between the studied printing methods and thus these aspects were not included in the comparison.”

- “By prolonging the life time of a textile product, and thus avoiding a purchase of a new product, environmental impacts can be reduced remarkably.”

Kujanpää, Marjukka & Nors, Minna. (2014). Environmental performance of future digital textile printing.
https://www.researchgate.net/publication/267513023_Environmental_performance_of_future_digital_textile_printing

DIGITAL TEXTILE PRINTING

- “Screen printing is more dye, energy and water consuming whereas digital printing needs fabric pretreatment, which in turn requires raw materials and energy and causes environmental impacts”

- “When smaller printing batches are studied, digital printing causes less greenhouse gas emissions than screen printing. Digital printing is better for small batches also because of the flexibility of the system and fewer amounts of production waste.”

- “The water consumption at textile printing process (with gate-to-gate approach) is much higher for screen printing where the main reason is after washing. There are new-type of technological solutions to reduce water consumption in washing.”

- “Water Availability Footprint results show that the difference between digital printing and screen printing is very small due to very good availability of water at Finland (a competitive advantage). The significance of water consumption would increase, if the textile manufacturing would instead occur in an area of high water stress.”

- “There is still obvious need of primary data from different manufacturers in the life cycle of textile printing product e.g. more precise information about different materials; base material as well as printing inks and chemicals are needed”

- “Cotton production (cultivation, fabric production and refinement) causes most of the environmental impacts of digital and screen printed textiles.”

Kujanpää, Marjukka & Nors, Minna. (2014). Environmental performance of future digital textile printing.
https://www.researchgate.net/publication/267513023_Environmental_performance_of_future_digital_textile_printing

PIGMENT DYES

As found on the study by VTT and in many other studies, digital printing is ecological printing method compared to screen printing, but for the production to be sustainable, also other aspects, especially the base material and the printing inks used, need to be taken in concideration.

“Digital fabric printing has rapidly evolved over the last few decades creating new opportunities for designers, printers and consumers alike. One important component of this technology besides the machinery is the ink.”

Table 3: Digital Textiles Inkjet Printing Inks, Color Fiber-Interaction and Finishing Techniques

Colorant	Fiber Type	Color Fiber-Interaction	Coloristic Properties	Fixation	Reference
Pigment	All fibers	No interaction – complex surface polymer (binder) bonding mechanism	Good washing fastness Excellent light fastness, good rubbing fastness depending on binder content	Oven curing at 160-180^{0}C for 30-90 seconds	(King 2013, Schulz 2002)
Reactive dye	Cotton, silk and wool, linen	Covalent fiber bonding	Bright colors, excellent washing fastness, excellent rubbing fastness poor light fastness	Steaming for 90-120 ^{0}C for 8-30minute depending on steamer type, washing and drying	(Lewis 2011, Stempien et al. 2016, Yang and Naarani 2007, Soleimani-Gorgani, Najafi and Karami 2015)
Disperse dye	Polyester	Hydrophobic- solid state mechanism	Excellent light, washing and rubbing fastness, bright colors	Transfer press or “thermosoled” or oven cured depending on type of disperse ink	(Niaounakis 2015a, Noppakundilograt et al. 2010)
Acid dye	Nylon, silk, wool, leather	Electrostatic and hydrogen bonding with fiber	Bright colors, excellent light fastness, good washingand rubbing fastness	Steaming for 20-60minutes depending on steamer type at 20-120 ^{0}C depending on shade and fiber type, washing and drying (except leathers)	(Campbell 2008, Hawkins 2003),(Niaounakis 2015a)

Tawiah, B. Howard, E. K., Asinyo, B. K. (2016) The chemistry of inkjet inks for digital textile printing –review. International Journal of Management, Information Technology

PIGMENT DYES

“Nevertheless, these changes in production will only be complete with good quality environmentally friendly inks that print all substrate and can offer superior coloristic properties. Particularly water base pigmented inkjet inks are getting popularity due to their environmental friendly nature and weather stability of the pigments as colorants.”

Tkalec, M., Glogar, M. I., & Sutlovic, A. (2022). ECOLOGICAL SUSTAINABILITY OF DIGITAL TEXTILE PRINTING. Economic and Social Development: Book of Proceedings, 105-115. http://zbw.eu/econis-archiv/bitstream/11159/8727/1/1807045382_0.pdf#page=111

Pigment printed fabrics have high fastness to light and vibrant colours. Pigments can be printed on any fibres and blends and they are less expensive than for example reactive dyes. For printing, pigment is always mixed with printing paste. In printing paste, there can be also additional chemicals to for example soften the print result. However, the paste contains always at least solvent, binder and thickening agent. In the fixation process, the printed fabrics are treated with heat cure. The heat activates the binder to adhere the pigments onto the surface of the cloth. Therefore, any thickening agent remains on the printed cloth. This stiffens the printed areas, but also saves water, and makes sure no chemicals are released in waste waters in finishing washes.

Woodhead Publishing Series in Textiles: Number 126: Textiles and Fashion - Materials, Design and Technology
Edited by R Sinclair, 20.2.1 Pigment Printing

Pellonpää-Forss M (2018) Contemporary Colour Methods, Aalto ARTS Books, Helsinki

PIGMENT DYES IN DIGITAL PRINTING WITH EPSON-PRINTERS

“Digital textile printing uses pigment inks that are better for the environment than those used in traditional analog methods. The production of pigment inks does not require much water, and in addition, the digital printing method contains fewer steps than the traditional method and is easier to use. No printing plates are needed for digital printing, and there is no need to wash or store the fabrics to be printed separately during production. The amount of ink used is small, it is possible to start the production of even small batches quickly and there is not as much waste as when using traditional methods.”

“Epson’s digital Monna Lisa printers save water compared to the traditional analog method. The pigment inks used are also more environmentally friendly than before. Epson’s GENESTA pigment inks have ECOCERT’s GOTS approval.”

Epson´s press release

THE PRINT GROUND AND THE PRINT

Epson-printers print digitally with pigment inks making the printing process sustainable compared to many other printing methods. In this competion it is your task to decide how the print is used, and on what base material it is printed.

In the study Environmental Performance of Future Digital Textile Printing by VTT it was found that even the goal was to study the environmental impact of digital printing and compare the method to screen printing, the cotton used as a base fabric in both methods had the biggest environmental impact in the end result. The selection of print ground is crucial in the terms of sustainability, and it is one of the approaches you might take in this competion.

PRINT GROUNDS MADE FROM RECYCLED MATERIALS

In circular economy all products should be used as long as possible, after which the materials should be recycled. One approarch to base fabrics could be to use recycled or upcycled materials. The latter side of this lecture will concentrate on that topic, and other lectures in this project will take different aspects in concideration.

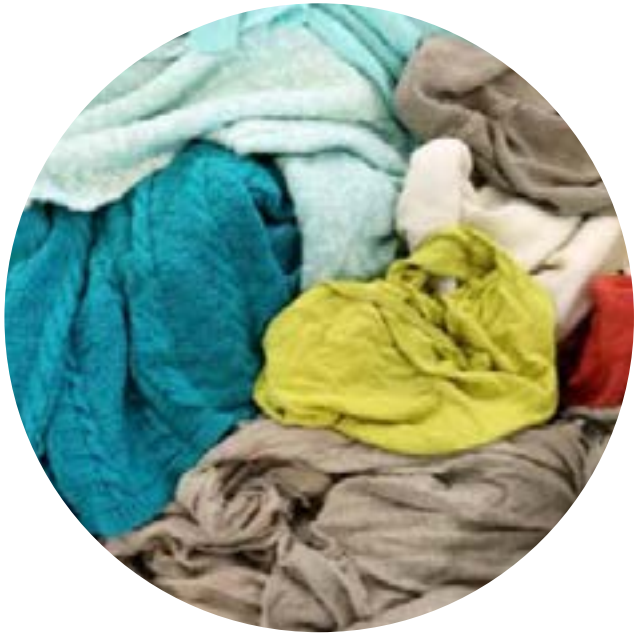
This lecture will mainly concenrate in two topics: recycled yarns which could be used to make print grounds by weaving or knitting, and upcycling used materials with printing. In addition, ready-made fabrics made from recycled materials could be naturally used.

https://www.minerva.com/mp/1265446/minerva-core-range-recycled-polyester-soft-tulle-fabric-ivory

PRINT GROUNDS MADE FROM RECYCLED MATERIALS

Could the “recycled look” of the material - be it the special look of a yarn made from post-consumer textiles or a fabric that already has a print on it - be used as an inspiration in the design process?

What kind of print would best work with a material that already has a strong character of it´s own, that is already telling it´s own story?



Pigments can be printed on any textile materials, which can be concidered an advantage when printing on recycled materials.

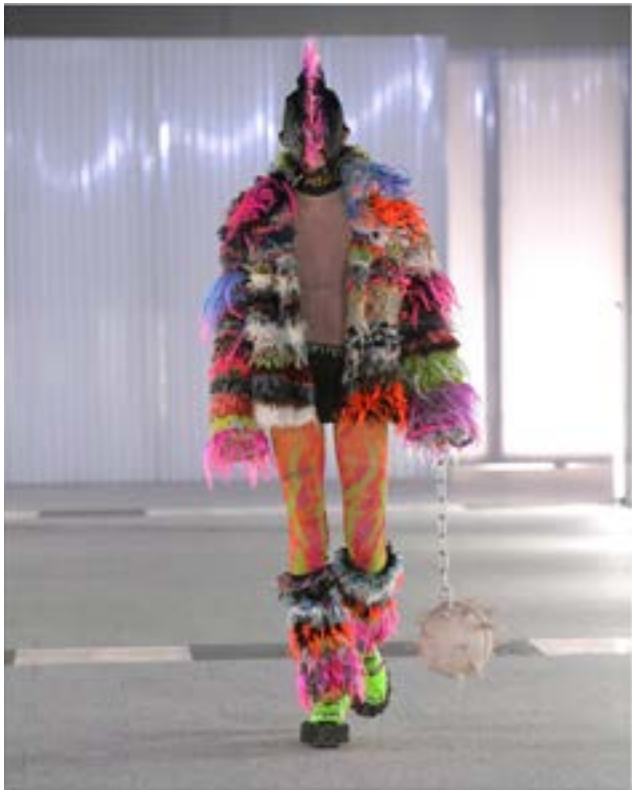
Images LSJH postconsumertextile.com

PRINT GROUNDS FROM RECYCLED MATERIALS - YARNS MADE OF MECHANICALLY RECYCLED TEXTILES

Mechanical recycling can be seen as dating back to weaving rugs from rags. Post-consumer textiles could be used as well as excess material from textile industry.

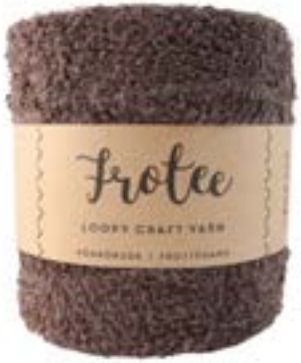
Leevi Ikäheimo used fabric edges from industrial weaving to weave a jacket, and these edges have also traditionally been recycled and used as wefts to weave carpets.

Finnish yarn supplier Lankava is selling some of these thicker weft materials made from both pre-consumer textiles and industrial waste.



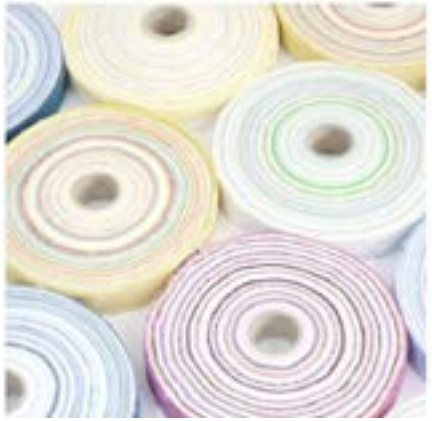
Design Leevi Ikäheimo, Photo James Cochrane

LANKAVA FROTEE LOOPY CRAFT YARN



Frotee Loopy craft yarn is a thick bouclé type yarn. Frotee is especially suitable for crocheting and weaving interior textiles, such as rugs. You can also knit Frotee into chunky knits, including blankets. Frotee is made from recycled cotton, which is sorted by colors and then mixed again to create the unique shades we have available. This clever process ensures that there is no need to dye the yarn during the manufacturing process, which of course saves energy and water.

LANKAVA AINO RAG RUG YARN COLOR MIX



Give new life for discarded sheets as woven, crocheted or knitted items! Lankava Aino Rag Rug Yarn is ecologically sustainable yarn made in Finland from recycled sheets and other textile waste. All stages of the production, from the collection of the waste to the sewing of the yarn, take place in Finland. Aino rag yarn consist of a variety of different patterned and solid-colored sheets that are cut and sewn together and then wound into a ready-to-use disc.

Please note: this unique rag rug yarn is made from recycled material. Because of this, the availability of colors and patterns vary and the photos of Aino are representative.

Recycled yarns by Lankava

PRINT GROUNDS FROM RECYCLED MATERIALS - YARNS MADE OF MECHANICALLY RECYCLED TEXTILES

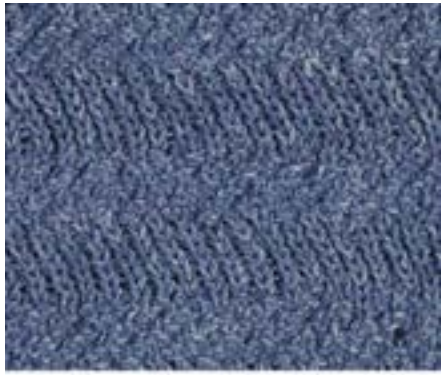
“LSJH is a municipal waste management company in charge of collecting, sorting and processing Finnish household post-consumer textiles into quality raw-materials for different industries.”

postconsumertextile.com

PRINT GROUNDS FROM RECYCLED MATERIALS - YARNS MADE OF MECHANICALLY RECYCLED TEXTILES

Also Pinori, an italian yarn supplier, produces several types of yarns made from mechanically recycled fabrics.

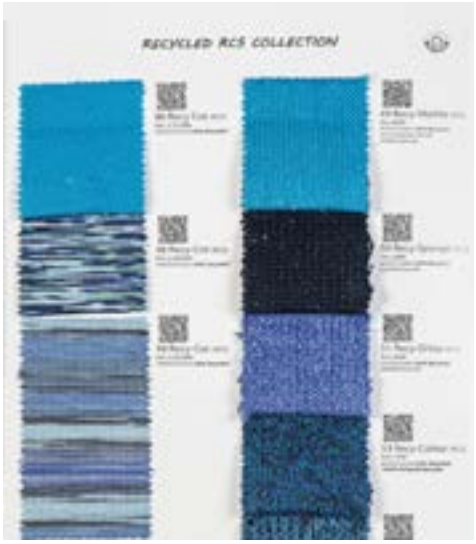
https://www.pinori.it/en/

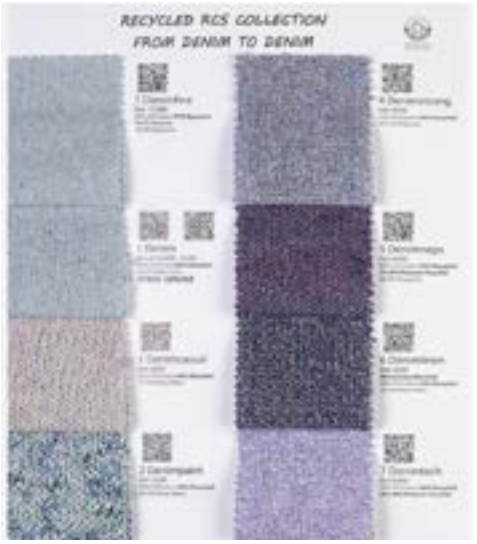


DENIMPAINT Nm 3100

Composition: 80%CO/Recycled Cotton 15%CO/Cotton 5%OF/Other Fibers
Knitting Suggestion: 1 end flat machine g.5
Dyeing process: Space-dyed – minimum 30 Kg with surcharges until 80 Kg
Colour fastness: washing 3/4 light 3 dry 4
For especially brilliant and intense colours, colour fastness may vary.
Warnings: This yarn is made with recycled fibres, due to this matter, final composition and colour could be little bit different for each colour and lot.

PINORI *filati*





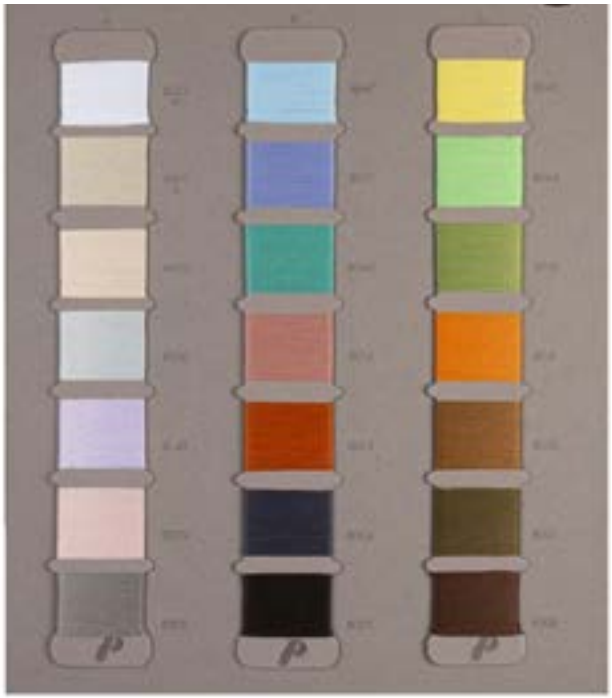
Ecological Textiles is a smaller supplier of similar yarns.

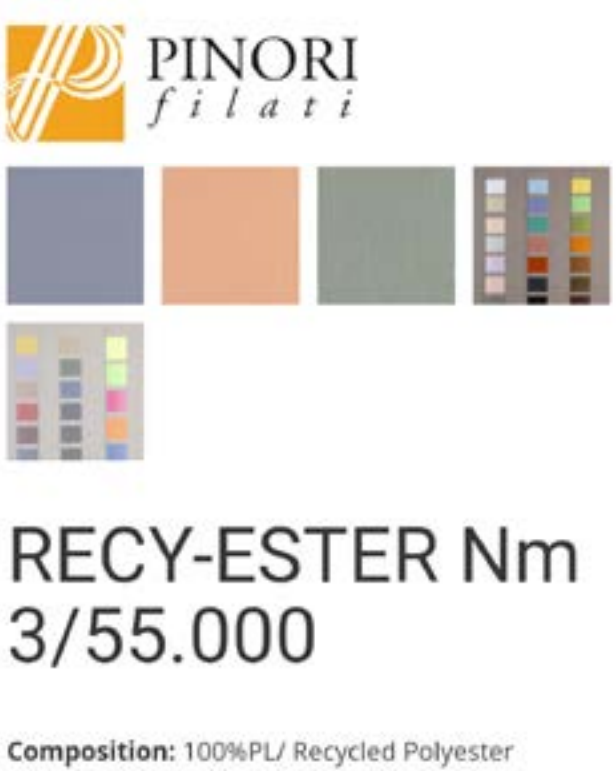
https://www.ecologicaltextiles.com/contents/en-uk/d11445_RECYCLED-COTTON-YARNS.html

PRINT GROUNDS FROM RECYCLED MATERIALS - YARNS MADE FROM THERMALLY RECYCLED PLASTICS

“This is the best method of polyester recycling in which the waste PET bottles are initialy cuts in to small pieces the washed and melted to spin through the spinneret to get desired polyester filaments, which further converted into fabric and garments.”

Turukmane, Ranjit & Daberao, Amarjeet & Gulhane, Sujit. (2018). Recycling of PET Clothes and Bottles.
https://www.researchgate.net/publication/325170774_Recycling_of_PET_Clothes_and_Bottles





https://www.pinori.it/en/

PRINT GROUNDS FROM RECYCLED MATERIALS - YARNS MADE FROM CHEMICALLY RECYCLED CELLULOSE

Chemical recycling of cellulose-based materials such as paper or used textiles into new cellulose yarn is one of the most promising recycling methods today.

Lyocell can be made partly from recycled cellulose. This type of lyocell is called Refibra™

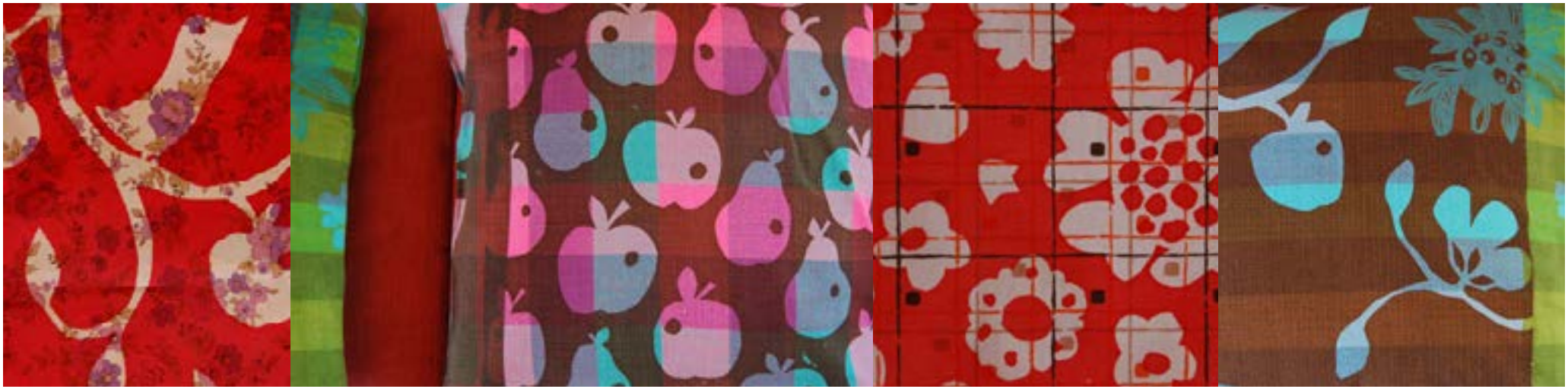
https://www.tencel.com/refibra

“Ioncell® is a technology that turns used textiles, pulp or even old newspapers into new textile fibers sustainably and without harmful chemicals. The process converts cellulose into fibers which in turn can be made into long-lasting fabrics.”

https://ioncell.fi/

UPCYCLING WITH PRINT

Upcycling with print is a different take on the idea discussed in this lecture - it can open up interesting possibilities for the interaction of the print and the ground.



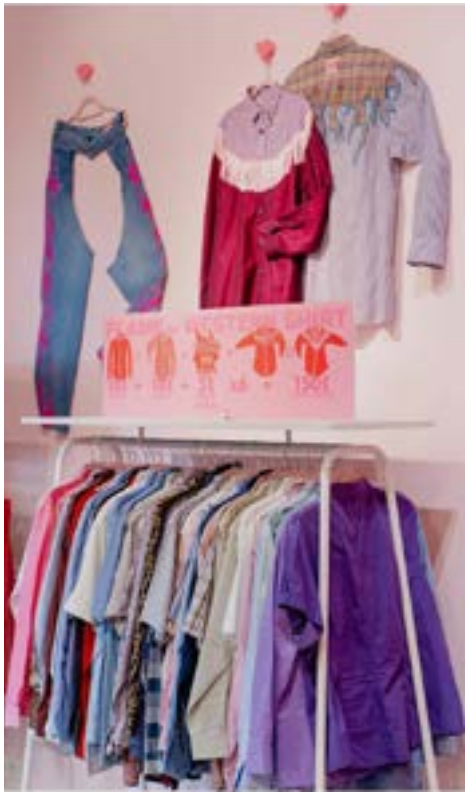
Maija Fagerlund and Maria Härkäpää

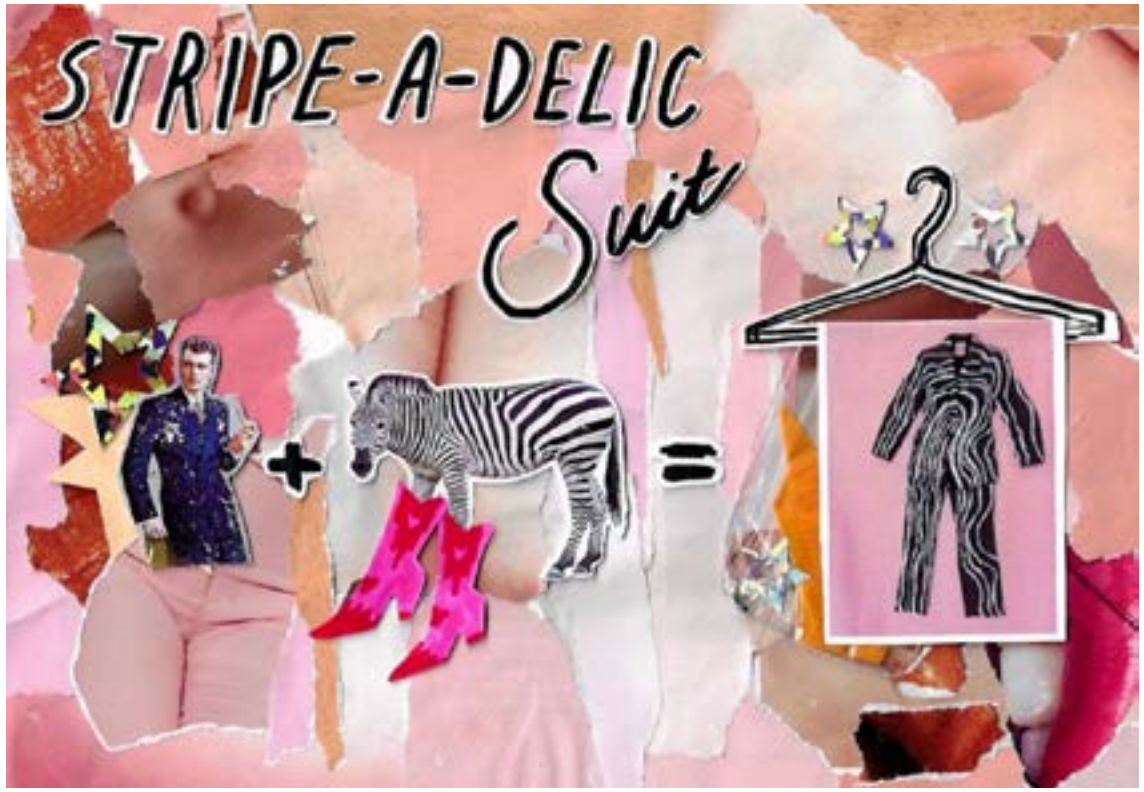
THE BASE FABRIC AND THE PRINT - UPCYCLING

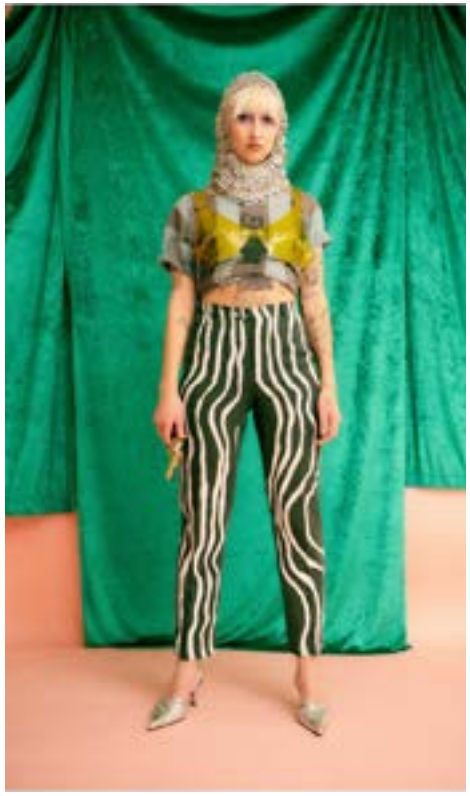
Hurrapangpang, a swedish brand describes their approach:

“HURRA PANGPANG was established in sweden late summer 2021 by Hanna Linnea Ryd & Izabella Simmons. It’s rooted in our mutual love for second hand clothing and the leftover stock that never reaches the consumers. We target the value and memory charged in these items and by re-design we turn them into something that it before was not. These materials are the core of our philosophy and practice.

In our studio and showroom in central Gothenburg we collect unwanted materials from second hand sorting facilities and private clients. We have developed a design method where we link these items together to generate a new wearable hybrid.



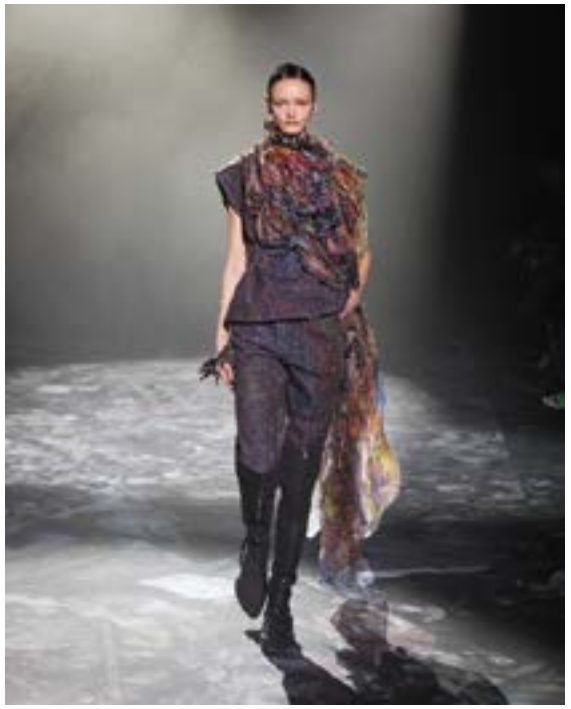


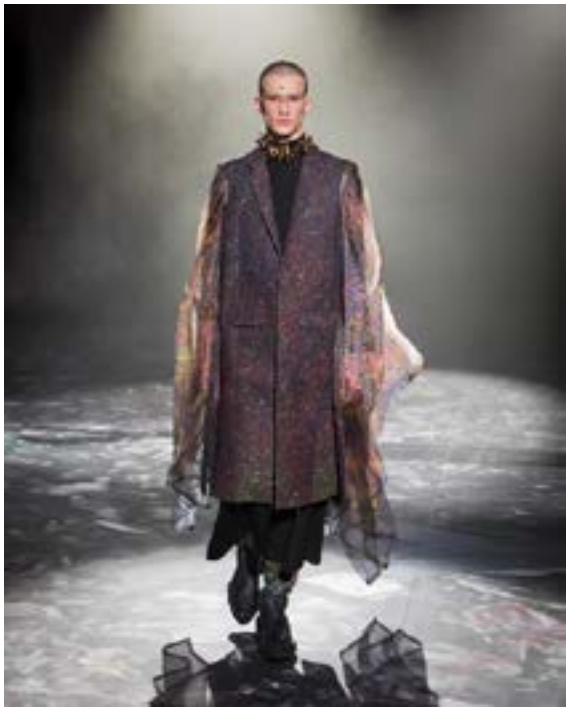


https://www.hurrapangpang.com

COLLABORATION BETWEEN EPSON AND YUIMA NAKAZATO

“YUIMA NAKAZATO’s collection was presented at Paris Haute Couture Fashion Week Spring - Summer 2023, on January 25. Epson used its digital textile printing technology and Dry Fiber Technology to support the production of the designs in the collection, which featured upcycled fashions made using used garments.
Epson is working with YUIMA NAKAZATO to evolve the value chain in the fashion industry by providing technology, processes, and schemes that enable the lower environmental impact production of high-quality custom clothing.”





https://corporate.epson/en/business/innovation/open-innovation/activity/yuima-nakazato/paris-fashion-week/paris2023-spring-summer.html