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LIFE M3P

Material Match Making Platform for promoting the use of industrial waste in local networks

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1. Introduction

The Life M3P project dealt with circular economy and industrial symbiosis between different production chains in order to reduce industrial waste and decrease environmental impacts in the involved areas.

Through the Life M3P project, the partners have promoted an industrial symbiosis model based on an online platform that is not a simple market place, but which allows the match among technologies and waste, to go beyond the experiences of individual companies and develop examples of industrial symbiosis.

The starting point was description and characterization of over 400 industrial waste, thanks to the involvement of the companies that joined the online platform M3P (www.materialmatch.eu). The wastes registered on the online platform come from many different industrial sectors, each coming from different local areas. The analysis of these sectors was useful to set an overall view of the waste streams, sources and possible outcomes.

On the basis of needs and constraints coming from the industrial districts, the partners selected more than 100 wastes to be analysed more deeply. In particular, they have been evaluated for mechanical, chemical ecological, aesthetical characteristics and performance.
Among these materials, the partners identified again the most significant ones and matches wants/needs emerging from the M3P Platform, then the partners supported some matches by studying technical, environmental and economic feasibility in order to develop them as pilot cases and develop creative concepts for new applications.

This document aims to shows some results coming from the two research lines of the Life M3P project. The first one identified several matches between offered waste and requested materials, from which technological feasibility studies have been developed (pilot cases).

The second research line involved three of the most-know design schools based in Milan, one of the biggest European centre of design, in order to offer their students the opportunity to broaden their knowledge and apply their skills in this challenge addressing the nowadays fundamental concept of design for a circular economy. The different approaches highlighted the versatility and unpredictability of a design-driven investigation of industrial wastes as new unexpected raw materials.

2. Technical Matches

2.1. MICROSPHERES

The waste consists of microspheres of ion exchange resin for medical grade water purification. Ion exchange resin is a widely used material for filtration and others uses. It is also often used in the chemical field for the purification of solvents, to prepare particular reaction and synthesis environments. In this case the waste comes from filters that soften the water for use in the medical field, one of the most other degrees of water purity.

The difference is in the form of orange microspheres with a diameter between 0.3 mm and 1.2 mm. It is lighter than water and has a density that goes from 700 g/L to 740 g/L. The resin is composed of polystyrene cross-linked with divinyl benzene, the most used material for ion exchange. In this case the resin has been functionalized with anionic and cationic groups, giving an amphoteric behaviour to the resin, able to capture both positive and negative ions.

Fig. 01: Microspheres of ion exchange resin

Going to the match

The exhausted resin, once extracted from the filters, is taken to the incinerator. This process has a high cost for the company. Due to the nature and use of the resin, it is classified as non-hazardous special waste.

The partners carried out some specific tests (like as the analysis of halogenated solvents; the analysis of.

Analysis showed a high concentration of potassium, compatible with normal use of the resin, no Volatile Organic Compounds emissions, non-hazardous nature of the material and the absence of contaminants. The pH of the water in contact with the resin is slightly acidic with a value of 6.5.

On the basis of the analysis results, it is possible to reuse the ion exchange resin for filtration in industrial sectors that have less stringent limits than in the medical field, such as for the recovery of grey water or industrial wastewater.

2.2. FABRIC FOR FILTERING

This type of waste, coming from out of standard high precision technical fabric for filtering, is different in chemical composition and weaving parameters, generally:
- Polyester;
- Polyamide 6.6.

The fabrics are composed by monobave yarns. The scraps differ n size (from few to 30 meters) width (from 1,5 to 3 meters) and fabric mesh.
The areic mass of the various fabric changes from product to product.
The company guarantees a high regularity of the product, as a small defect can lead to inefficient filtration. For this reason even a single defect can lead to the waste of many meters of material.
The company produces about 8 tons of textile waste per year. Production is discontinuous, depending very much on customer demand. There is a predominance of polyester waste over 6.6 nylon waste.
The waste is delivered to an incinerator. This practice is and added cost for the company and it has a great environmental impact due to the emission of carbon dioxide in the atmosphere.

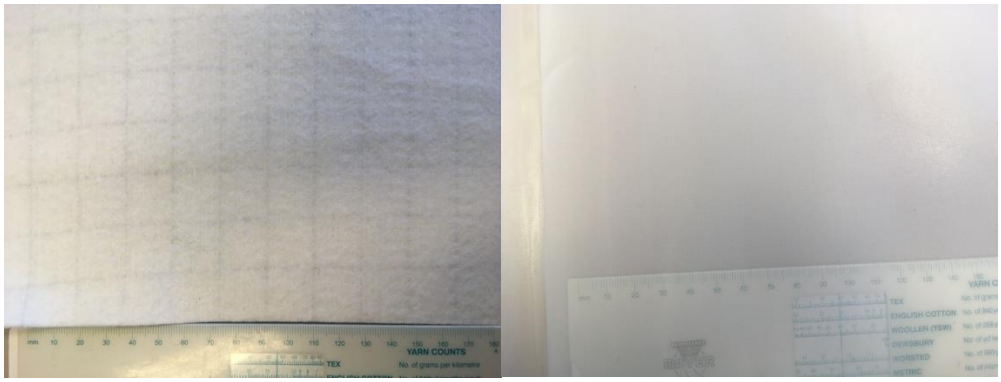

Fig. 02: High precision technical fabric for filtering.

Going to the match

A thermogravimetric analysis showed a possible recyclability by thermomechanical way.
Two possible matches have been raised from the waste analysis.

a) A company of thermoplastic laminates for furniture has shown interest in polyester waste. Tests were performed to impregnate the fabrics that produced prototypes. The company states that it is interested in a commercial agreement because the prototypes have good mechanical properties.
b) Thermomechanical recycling has been developed for polyamide waste. A spinning mill expressed interest in the material and conducted a differential calorimetric scanning test, which showed that the material can be integrated into their production, but needs pre-treatment before being processed in the spinning plant.

2.3. IMPREGNATED FABRICS

This waste come from fabrics impregnated with thermoplastic resins for the footwear industry. This material is used to make toe-puffs, buttresses and uppers for all types of footwear. The thermoplasticity of the material allows an optimal processing to obtain the different shapes desired by customers.
The scraps come in different shapes, they can be long strips 5 cm wide resulting from the cutting of selvedges or cuttings of different planar shape due to the processing of the article. The base fabric can be of various chemical nature as well as the thermoplastic resin that impregnates it. This makes it difficult to recycle this waste.
The company claims to produce between 400 and 450 tonnes of waste per year. The production is continuous throughout the year, the nature of the waste depends on the market demands of the source product.
The material is a special non-hazardous waste due to the inert chemical nature of the material. Currently the waste is sent to landfill, with no way to recover it.
The technicians performed a thermogravimetric analysis of the waste. The results of the analysis showed a good thermal stability up to 250° C, in fact the decomposition of the material starts around 300° C.

Fig. 03: Scraps of fabrics impregnated with thermoplastic resins

Going to the match

On the basis of the analysis and the desk studies a potential technological solution of material recovery could be to shred the material into smaller fragments and use it as a filler inside a panel made with Air-Lay technology. The thermoplastic nature of the resin could be useful to bind the scrap to the other components of the panel. Further studies are under consideration by technicians.
This waste was used also by the young designers for develop creative concepts and prototypes. You can find the description in the next chapter,

2.4. LEATHER DUST

Leather dust is coming from the lapping process to regularise the thickness of the finished product, eliminate small defects and reduce larger ones. It also serves to give particular aesthetic effects to the leather.
The powder is made by very fine and volatile grains. It is greyish in colour and has the typical smell of freshly worked leather. It is collected by vacuum cleaners, compacted with proper machinery and collected in bags.
The company produces about 94 tons of leather powder waste per year.

Fig. 04: Leather dust

Going to the match

The waste is delivered to a waste manager who categorizes it as R13 (storage). The waste is found to be non-hazardous.
In order to identify the re-use of the material, that one has been subjected to the classical analysis of leather products:
- Analysis of aromatic amines derived from azo dyes;
- Analysis of total metals;
- Analysis of extractable metals;
- Concentration of Cr VI;
- Analysis of preservatives in leather;
- Concentration of formaldehyde.

The results of the analysis showed a high content of aluminium and chromium in the powder. The concentration of preservatives is in line with other leather products. There is no presence of harmful substances that could affect the recycling of the material.

The technicians tried to use the Air-Lay technology in order to agglomerate the powder and obtain a new semi-finished material similar to the leather. This process didn't give back satisfying results as the powder was too thin to be processed in this way. For this reason further studies could be useful in order to investigate other technical solutions.

2.5. ACETAL RESIN FLAKES

Acetal resin flakes (POM - polyoxymethylene) are coming from the processing of thermoplastic products. These products are manufactured by injection moulding.

Acetal resin is a thermoplastic material widely used for the production of different types of products. Thanks to its remarkable mechanical properties, it is used instead of metals for products such as door hinges or mechanical gears. It is also often used for the production of products for the electronic and electrotechnical sector.

The company says it produces 24 tonnes of acetal resin waste per year.

Fig. 05: Acetal resin flakes (POM)

Going to the match

The waste is collected by a specialised waste disposal company which declares it as R13 waste (storage).
In order to verify the thermomechanical recyclability of the polymer, a differential calorimetric scan analysis was carried out. Comparing the results with the data in the scientific literature of the virgin material, there wasn't difference and it was an excellent candidate for mechanical recycling.
The tangible result of the activities focused on this waste is a commercial agreement between the waste company and a supplier of regenerated polymers in order to reuse the material as a secondary raw material in other industrial sectors.

2.6. THERMO-HARDENING RESIN

Thermo-hardening resin processing is widely used to produce rigid components for electrical insulation. Its thermosetting property makes it a difficult material to recycle in traditional ways.

The material is made by a mixture of thermosetting resins, which, unlike thermoplastic materials, tends to become more rigid as the temperature increases, as the chemical components inside continue to create a cross-linked structure at high temperatures.
The waste is either flakes from the product finishing or defective finished products.
The company declares an annual production of 80 tonnes of waste of various kinds of thermosetting resin.

Fig. 06: Waste of thermo-hardening resin processing

Going to the match

The material is categorized as non-hazardous special waste. Waste disposal is very expensive for the company.
A company is interested in using thermosetting resin flakes as inert fillers in its products. The product must have a high degree of thermal insulation and must be non-flammable, so the resin is an excellent filler material for this purpose.

2.7. OFFCUTS OF WOVEN AND KNITTED FABRICS

Offcuts of woven and knitted fabrics are coming from the cutting of garments. This processing produces a lot of fabric waste and, although this material can be reduced by working on the arrangement of the pieces to be cut, the waste is physiological at this stage of production.
The material is presented as patches of various sizes, of various materials and of various colours. Waste is collected and sorted according to its chemical composition, which makes it easier to reuse. There are two main materials: polyester and polyamide 6. These types of fabrics and knits are widely used for sportswear.
The material is non-hazardous industrial waste. It is light but very bulky and disposal is very expensive for any company.

Fig. 07: Offcuts of knitted fabrics

Going to the match

Composition of the material can be confirmed by FT-IT spectrometric analyses.
The fabric remnants, both polyester and polyamide, have been garnetted separately. The Garnett machine is a tool for fraying textile fibres, especially synthetic fibres. The machine consists of a series of toothed rollers that grip, tear and split the individual fibres of the mesh and fabric. A very light fibre web comes out of the machine and can be condensed and cut into bows. The flakes obtained by this process have been processed by the Air-Lay process with the addition of a two-component polymeric binder. The binder is a thermoplastic material that bonds the various flakes together. Two wadding has been obtained in the two different starting materials, the polyester one has an areic mass of about 125 g/m2, the polyamide one is a bit heavier with an areic mass of 160 g/m2. Analyses were carried out on the wadding to measure the parameters for thermophysiological comfort. The results show high resistance to evaporation and low thermal resistance.

2.8. MIXED FIBRES

Mixed fibres are coming from the knitting production of technical socks for sportwear and workwear.
The material is a series of various segments of yarn of different nature, such as wool, acrylic and polyamide. It was not possible to sort out the individual materials. The fibres also have different colours.
The estimated annual production of this difference is 10 tonnes.

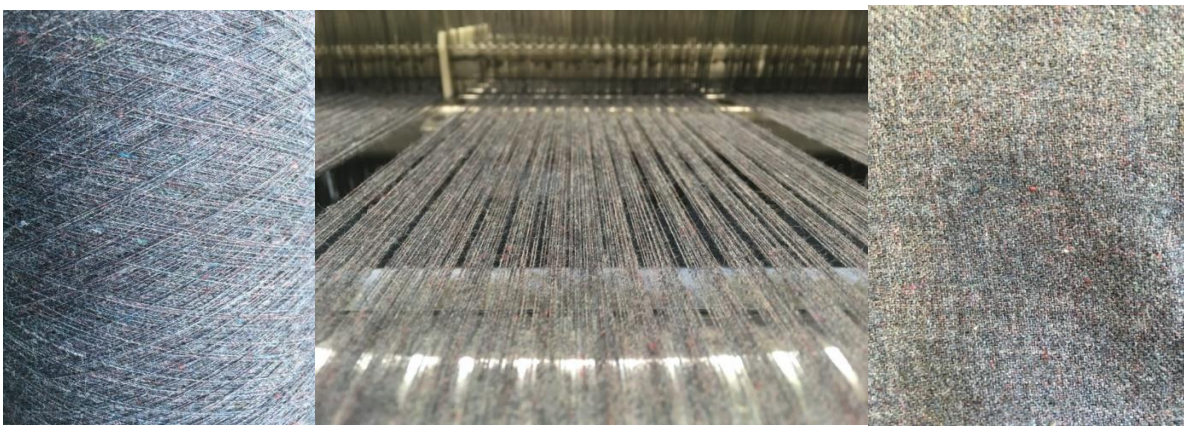

Fig. 08: Yarns and fabrics from mixed fibres

Going to the match

A grey yarn has been made from these mixed fibres. The following tests were carried out on the yarn
- Yarn count
- Composition
- Yarn twisting
- Yarn pull
- Yarn Irregularities

The composition consists of 35% acrylic fibre, 32.6% wool, 24.6% polyamide, 2.1% cotton and 0.7% polyester.
The yarn has a title of 33.5 tex, comparable to fine wool yarns. It is very irregular and not very resistant to traction.
Based on these results, a prototype fabric with a twill weave and a piquet knit was produced and seamless knitting technology. Tests of colour fastness under various conditions, abrasion resistance tests, pilling test, tensile and sliding tests of the yarns were carried out on them.
Both the knitted and the fabric have an excellent colour fastness, not degrading and not yielding the colour on other textile materials. They have an excellent resistance to abrasion but produce many pills, which does not degrade the material over time.
Some 100% recycled prototypes garments have been made by both the knitwear and the fabric.

2.9. ELASTANE FIBER

This waste comes from the processing of sock production waste. The socks are cut and fed into a Garnett machine that frays them. The Garnett machine is made up of a series of toothed rollers that tears the fibres from the knit and returns a web that can be condensed and cut into flakes. Below the machine an accumulation of elastane fibres is formed which is separated by gravity from the material being processed.
Elastane is an elastic material widely used in the textile industry to make fabrics more elastic. In this case elastane is presented in the form of white fibres of variable length not less than 5 cm.
It is estimated that production of this waste of around 5 quintals per year continues throughout the year.
Optical microscopy analysis was performed to identify elastane. The material turns out to be the elastomer of interest.

Fig. 09: Elastane fiber waste

Going to the match

A yarn was made by spinning elastane with recycled wool in the owed by the spinner. Chemical composition, title and tensile strength analyses were carried out on the product. The yarn has a composition of 90% wool and 10% elastane. It has the title of about 70 tex, compatible with that of other wool products. It has a low tensile strength.
A fabric has been made with the yarn, inserting in the warp of the wool silk yarn and in the weft the prototype of recycled yarn. Abrasion and tear resistance tests were carried out on the fabric. The fabric has low abrasion resistance and low tear resistance.

2.10. CELLULOSE ACETATE RUSH

Cellulose acetate rush is are coming from the processing of eyeglass frames.
Cellulose acetate is a plastic material widely used to make accessories. Thanks to its ability to incorporate both organic and inorganic colours and its workability, the material lends itself to the creation of various decorative patterns with a high aesthetic factor. The scrap is therefore composed of cellulose acetate, dyes and a concentration varying between 3% and 7% of diethyl phthalate (DEP) used as plasticizer.
The company produces about 530 tons of scrap metal per year. If you also count other waste in the form of slabs and sticks that can be reduced to scrap, the waste is more than 1300 tons per year.
The material is inert and non-hazardous, but has a high cost of management, both internal storage and disposal.
A thermogravimetric analysis has been performed on the scrap to evaluate whether there is degradation at a processing temperature of 180°C. The analysis shows that the material starts to lose mass around 200°C.
A test was carried out to purify cellulose acetate from its additives. The test consists of dissolving the cellulose acetate in acetone and then re-precipitating it in water, so that both the dyes and the plasticizer are dissolved in acetone solution. Analysis of the DEP contained in acetone, re-precipitated cellulose acetate and water showed that purification is not complete and that there is a large contamination of diethyl phthalate in the water. For this reason no further tests were carried out.

Fig. 10: Cellulose acetate rush

Going to the match

With the help of Air-Lay technology 3 prototypes of panels were produced:
- Run 1 composed of 50% cellulose acetate, 45% textile fibres and 5% binder;
- Run 2 composed of 80% cellulose acetate, 15% textile fibres and 5% binder;
- Run 4 composed of 90% cellulose acetate and 10% binder.

Sound absorption and thermal insulation tests have been carried out on these semi-finished products. Run 2 has a strong sound absorption capacity compared to the other prototypes. On the other hand, the best thermal insulation is Run 1, which has a higher textile component.
These semi-finished products have attracted the attention of a company that produces laminates for furniture. The prototypes could be used as inert material inside their products.

2.11. VULCANIZED RUBBER DUST

The waste comes from the carding of the rubber, which abrades the surface of some parts of the product to increase adhesion with other components.
The waste is composed of vulcanized rubber grains that are larger than 2 mm. It is mainly black, but there is also the presence of other colors such as orange and light blue. The grains are composed of a mixture of various rubbers such as SBR, NBR and EVA. The mixture is additive with silica to increase the durability of the material.
The company produces about 30 tons of rubber powder waste per year. Production is continuous throughout the year.
The waste is classified as special non-hazardous waste, it is disposed of through a specialized operator who classifies it as R13 (storage).
A thermogravimetric analysis has been carried out on the rubber powder in order to understand at what temperature the waste decomposes. The material has a good thermal stability up to 250° C, over 300°C it starts to decompose.

Fig. 11: Vulcanized rubber dust.

Going to the match

With the support of Air-Lay technology, two panels have been developed. They have different thickness but the same composition: 90% rubber powder 10% binder.
The two panels, Run5 and Run6, are 2 cm and 4 mm thick respectively. Run5 has a mass per unit area of about 3.0 kg/m2 while Run6 has 0.67 kg/m2.
Both panels have been tested for sound absorption, impact attenuation and thermal resistance. Run6 is very thin, so it insulates very little thermally and it has low sound attenuation and low impact attenuation. Run5 has good sound attenuation, good thermal insulation and good impact attenuation, which would make it a good candidate as a building material.

3. Creative concepts

Considering workshop equipment of the involved design schools, partners of Life M3P consortium will select, classify and characterize industrial wastes for the development of design concepts which are:

- SOLID, resulting from production processes such as production by-products (scraps/off-cuts, residues, dusts], production rejects [unsaleable goods, non reusable goods) and consumables (packaging, components, backings, etc.)
- EASILY MANIPULATED, enabling young designers to explore intrinsic material characteristics and experiment new transformation processes
- NON TOSSIC, such as chemical components, contaminated materials
- EASILY TRASPORTABLE, in order to make some waste samples available to the young designers

Among over 150 design concepts, the most interesting were chosen for further developments. Following the selection made by the partners that shows how a waste material could become an interior design object, a furniture, panel for insulation, etc.

3.1. MICROSPHERES

Fig. 12: Microspheres of ion exchange resin

Design concept/creative prototype

The concept is called Sandman, like the legendary creature from the world of dreams. It is a special type of lamp made with ionic resin, an hourglass filled with spheres illuminated from below. With the passing of time the lower part of the hourglass fills up and makes the light emitted change colour from yellow to orange to dark red. The main function of this product is to reconcile the sleep of the user, through a mix of colours and sounds that refer to the ionic movement. A little light in the basis of the object illuminates the falling sand made by the ionic resins, giving the light itself a warm and comfortable red/orange colour. Moreover, the sound of the falling resins helps to sleep, spreading a highly relaxing sound through the room. Once a cycle is complete, you can turn the main body on the other side to make it start again.
The concept was created by the design students of the Politecnico di Milano.

Fig. 13: Concept: Sandman

3.2. RUBBER OFFCUTS

Fig. 14: Rubber offcuts

Design concept/creative prototype

The concept is called Parasite and it is a storage accessory without the need of further processing and with strong communication opportunities. The concept is based on the history of the brand and the outdoor lifestyle that the company inspires. The opportunities of the concept:

- Re-use the waste for a new product without further processing of the material
- Possibilities of several rubber colour combination
- Possibilities to customize and associate the textile part with the Company catalogue of material and colours
- Emphasize the rubber, Company's iconic material

Considering the spirit of the company and the one of its customers, the concept focuses on outdoor and dynamic situations like hiking, camping, urban mobility, etc.
The concept was created by the design students of the IED Milano – Istituto Europeo di Design.

Fig. 15: Concept: Parasite

3.3. FELT SELVEDGE

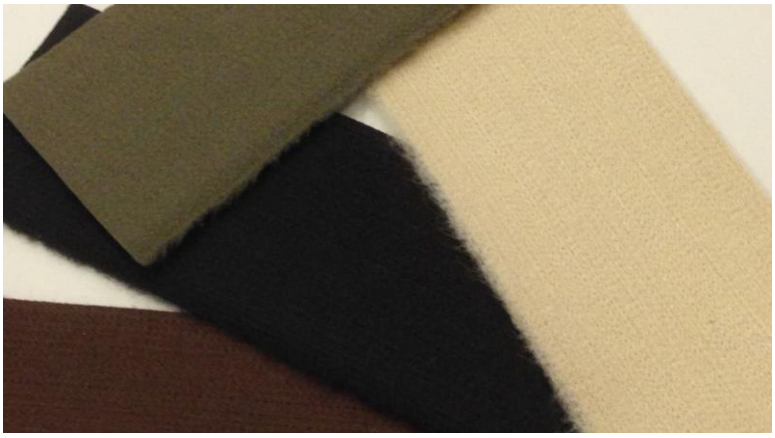

Fig. 16: Felt selvedge

Design concept/creative prototype

The material is designed for the cleaning and hygiene sector. The material waste takes the form of long strips of compact felt in various colours and thicknesses and it is made by polyester.

With these polyester ribbons 3 very interesting concepts were created by the students of the Nuova Accademia delle Belle Arti in Milan (NABA).

A. Felt wall Panels

They are made by modular interlocking felt components that allow to create panels in different sizes Each panel is sticker and these modules give it life to an interesting and particular texture. They are decorative sound-absorbing panel, made by cutting the selvedges into geometric segments that are inserted into each other, thus creating a modular product that can be customized according to the customer's needs. They could be used in several locations as restaurants, shops, offices and private houses. The felt has some intrinsic characteristics that make it perfect for the panels application. In fact, it is a non-tear material, waterproof and insulator. Starting from production offcuts and scraps is possible to create these decorative panels and exploiting all the felt characteristics. Another prototype

Fig. 17: Concept: Felt Wall

B. Braided Pouf

The pieces of felt have been braided creating an orderly and linear motif. The felt pouf is pleseant to touch, soft and inspires a feeling of comfort. The scrap pieces have fixed dimensions, therefore the students have been able to create regular weave and a simple and clear shape. It is thought for an hand-craft production because the braided is done manually

Fig. 18: Concept: Braided Pouf

C. Felt Slipper

The challenge of this concept was to exploit the small strip od felt to make a slipper. To be able to realize it, several strips have been sewn together and then cut. In order to not add materials and to make the slippers only with this kind of industrial waste (felt), a tongue has been left to one end while cuts have been made at the opposite side; in this way, the closure is made by felt as well. Several layers of felt have been glued on order to make the sole stiffer and prevent people from tripping. The value of the Felt Slipper is that is entirely made by recycled felt, it doesn't produce many scraps and waste during the use. The slippers can be made for any size and as the felt is available in different colours they can be customized.

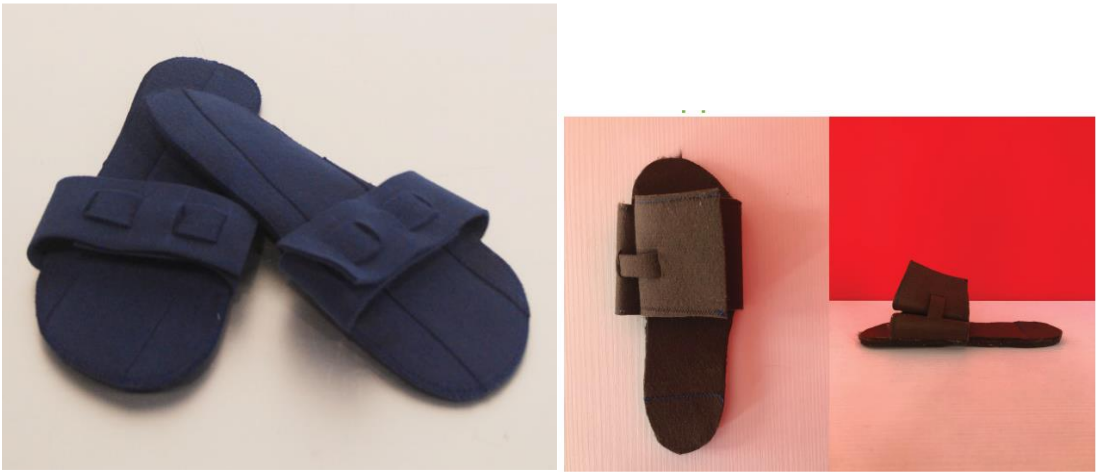

Fig. 19: Concept: Felt Slipper

3.4. MESH OFFCUTS

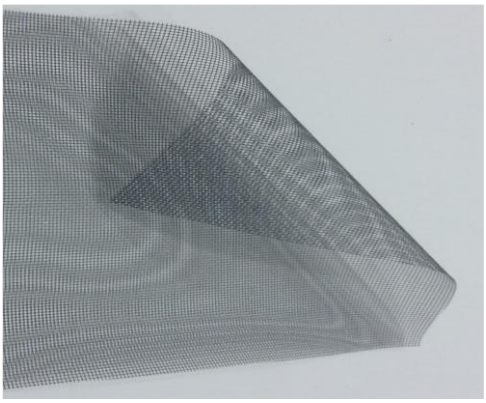

Fig. 20: Mesh offcuts

Design concept/creative prototype

The concept is called “Swing in the air” and it is a hammock designed and by re-using mesh offcuts in Polyester and in PVC coated fiberglass coming from the production of the mosquitos nets. The design concept and the prototype has been developed by the students of NABA Milano – Nuova Accademia di Belle Arti.

The product has been made on the basis of the weaving thechnique. The most agreable and easy solution was to create a seriens of squares. Bending inwards the two vrtical sides of the strip obtained from thr PVC mesh offcuts roll and then overlapping the two faces, the youg designers solved the problem of the roughness of the sides.

The obtained hammock colud be transformed in different ways in order to have different functionalities.The hammock is easy to remove and also to disassemble.The strings that are used to hang it on the trees can be removed and reassembled. The hammock can become a tablecloth or even an object holder for your desk. Furthermore, by putting in a metal pipe among the strips, the hammock can become a rigid and resistant curtain ideal for those desire a diffused light during the day.

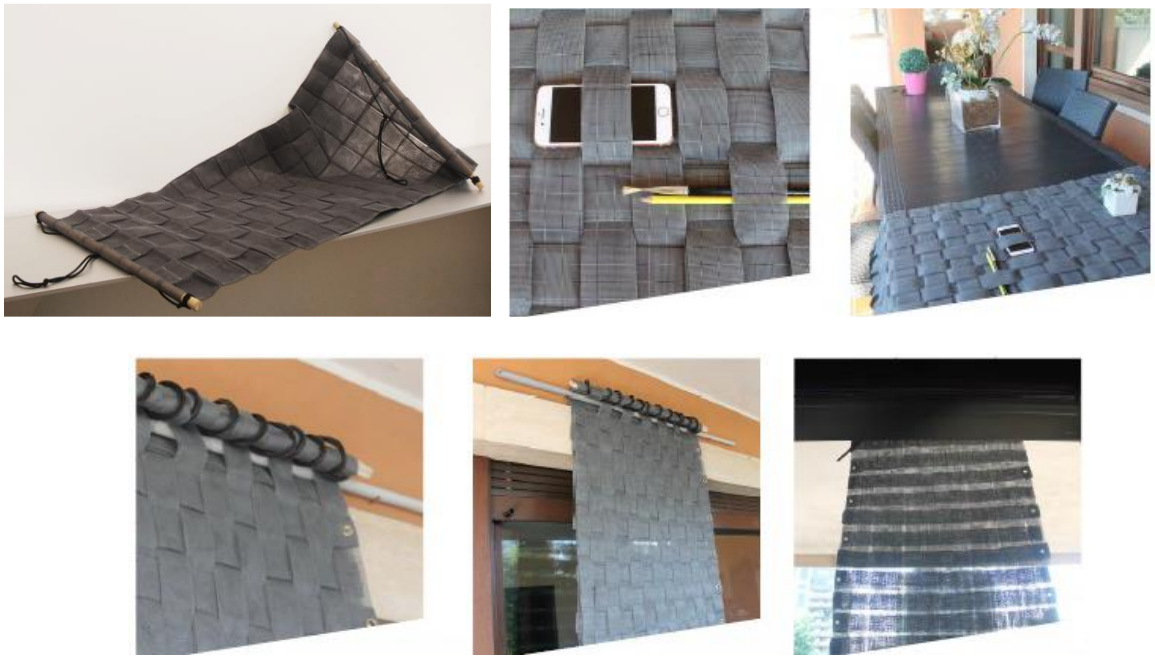

Fig. 21: Concept: Swing in the air

3.5. IMPREGNATED FABRIC OFFCUTS

Fig. 22: Impregnated fabric offcuts

Design concept/creative prototype

The name of the prototype is “Shoes in Shoes” and it is designed and developed by the students of the IED Milano - Istituto Europeo di Design. The prototype is a shoe stretcher made by using scraps. The product was created with a non-toxic resin. The interesting idea behind this concept is that the waste from a product of the footwear industry has been used as second raw material for a product of the same sector.

The purpose on the basis of the design concept is to support the company in terms of extending its product range by giving added value.

Fig. 23: Concept: Shoes in Shoes

3.6. ANIMAL SKIN

Fig. 24: Animal skin

Design concept/creative prototype

A. Materic Lamp

"Materic Lamp" has been designed and developed by the students of NABA Milano – Nuova Accademia di Belle Arti. It is made by scraps of the real animal skin coming from the fur sector and re-used for a design object. These wastes are small size offcuts, beige colour, thin and light. The lamp may be placed in an indoor location and hung from a ceiling. It can be made in different sizes, depending on the available space. It is a very bright object because the thin thickness of the skin lets the light penetrate and illuminate the location in which it is placed.

Fig. 25: Concept: Materic Lamp

B. Phone Light

"Phone Light" has been designed and developed by the students of NABA Milano – Nuova Accademia di Belle Arti. It is made by scraps of the real animal skin coming from the fur sector and re-used for a design object.

These objects are light diffusers and the energy source is the mobile phone itself that it is place under the object in order to create a sophisticate atmosphere. The various diffusers were made by creating, at first, the shape with Ciba, an easy material to be modelled. Then by means of thermoforming, a hot plastic moulding technique starting from a transparent plastic plate, under pressure or under vacuum, were made the casts of the various forms. Subsequently, these forms were covered with industrial waste of leather using Vinavil glue mixed with water, imitating the decoupage technique. Once the glue has dried, the skin become transparent and solidifies, creating a compact but at the same time light layer. The shapes are various: some are parallelepipeds with various facets that take inspiration from mountains, other are rounded with a smooth surface similar to a river stone. A simple object with mainly aesthetic function, which favours an easily transportable light such as the mobile phone.

Fig. 26: Concept: Phone Light

3.7. SAWDUST

Fig. 27: Sawdust

Design concept/creative prototype

A. Bulding blocks

The design concept is the Bulding blocks for children and it is developed by the students of IED Milano - Istituto Europeo di Design.

The small pieces of wood have different textures, colours and patterns. These characteristics can be used in order to realize creative solutions by using transparent resin. Binding the small pieces of wood together in several shapes by using moulds can create building blocks for children. These blocks are interesting as there is an interplay of lights passing through it. You can also add tints to these resins in order to give them exclusive translucent effects.

Fig. 28: Building Blocks

B. Vallo

The design concept is called “Vallo” and it has been designed and developed by the students of the Politecnico di Milano.

The concept comes from an experimental research aimed to show the intrinsic sawdust sensations,modifying its structure. From the beginning,the concept was designed to suggest a product related to a primitive world, unrefined and raw, like the consistence of the material itself. Stuents explored different combinations between sawdust and filling matrials in order to create a more consistent and compct one. The final product is a tile with a clssic shape,but the roughness of the ough is highlighted by the irregular surface. The sawdust is a thermal and acoustic insulator, which in combination whit a plaster mixture allow the creation of a coating. Thanks to its natural origin, and the quality of the plaster, being a completely recyclablematerial., in fact the product could be recovered after its disposal. Vallo can be destroyed and re-kneated just adding water.

Fig. 29: Concept: Vallo

3.8. RUBBER SEAL OFFCUTS

Fig. 30: Rubber seal offcuts

Design concept/creative prototype

A. Wall Stool

The creative prototype is a Wall Stool and it is designed by the students of NABA Milano – Nuova Accademia di Belle Arti.

The stool is based on the tension that exists within the rubber. Using the elasticity within the rubber offcuts, you can create an easy stool held together without glue or screws. The main structure could be made in several materials (e.g. plywood, hardwood, polycarbonate, etc.), however the simplest construction would consist of 18 mm Birchwood ply. Notches are placed strategically in the structure. Two offcuts are placed in each notch so that when the knot is tied, they cannot come out. You use knots as the length of the offcuts in unsure and weaving would require a larger length.

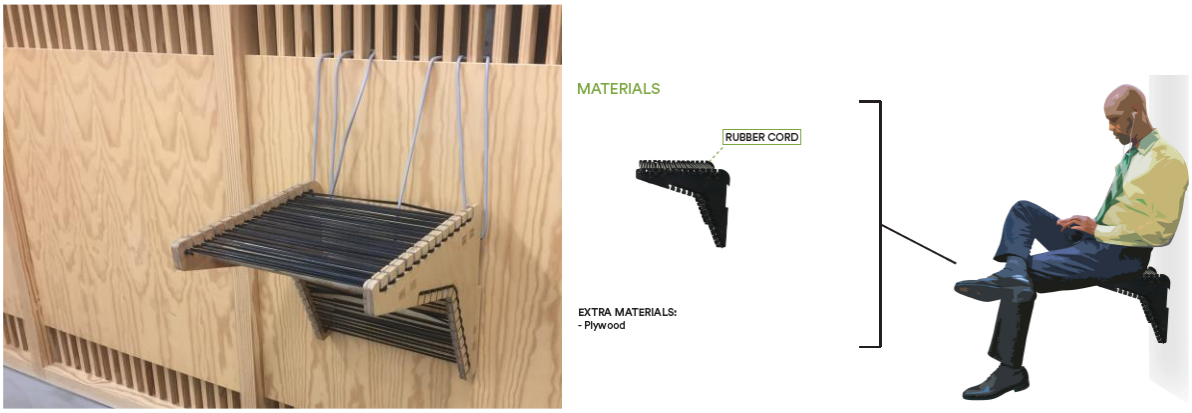

Fig. 31: Concept: Wall Stool

B. Handles

The creative prototypes are Handles (made by EPDM rubber) and they are designed by the students of IED Milano – Istituto Europeo di Design. The strategy behind the creative concept has been to use the "law of proximity". It means the students started to design the concept by keeping in mind the Company core business and by using the proximity approach, they have been outlined some cross files matching with the Company value.
In this case, the company provider of the waste produce windows and doors. The waste are the rubber offcuts coming from the profiles of the windows and doors.
Through an easy and low cost production process, the Company itself can produce handles for its doors and windows by re-using the rubber offcuts profiles, creating a corrispondence between the previous portfolio of the EPDM waste generating company.
This could be a service available for the customers, a brand extension product and,of course, a recycling process.

Fig. 32: Concept: Handles

3.9. KRAFT BAGS

Fig. 33: Kraft bags

Design concept/creative prototype

The design concept is called “TECO” and it has been developed by the students of the Politecnico di Milano. TECO is concept with the aim to create an external structure made up by waste or refused kraft bags.

The craft bag is a type of paper bag produced using the chemical pulp process. Thanks to its high tear and strai resistance, the optimal process for the manufacture of a product whit this matrial id by sewing. This allow to create new forms and unique forms to decorate and furhish interior and exterior spaces.

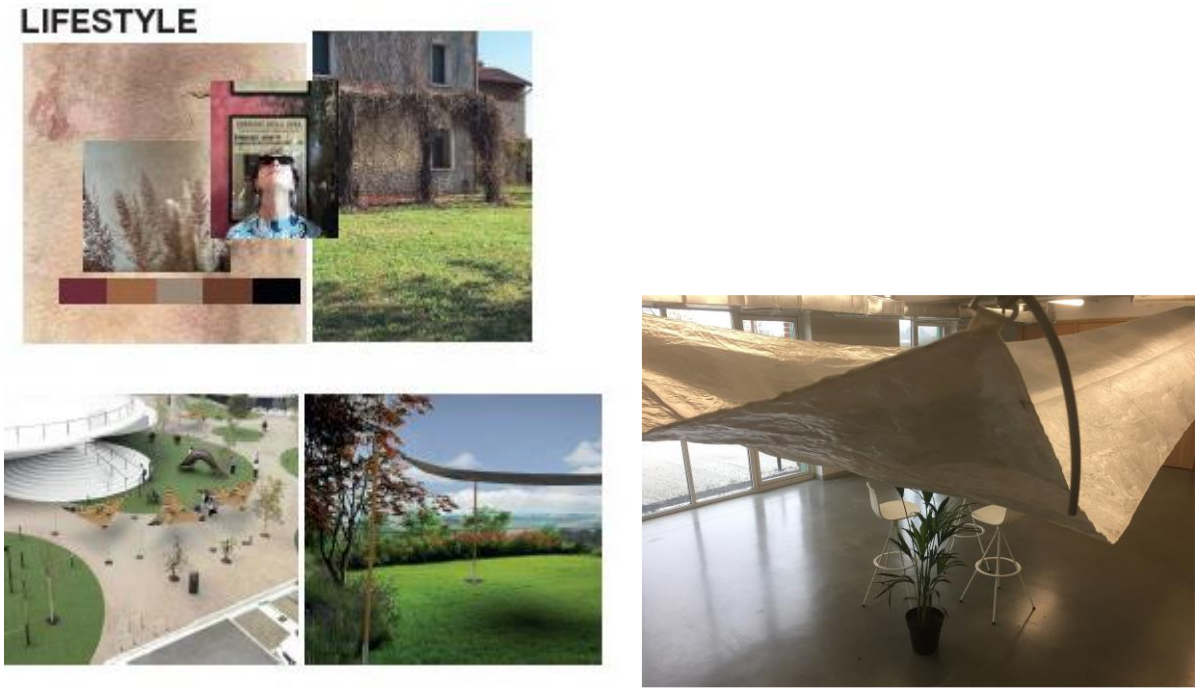

Fig. 34: Concept: Teco

3.10. USED JUTE BAGS

Fig. 35: Used jute bags

Design concept/creative prototype

Thank to this kind of waste, the students of NABA Milano – Nuova Accademia di Belle Arti designed and realized several concepts of objecs for daily use.
The characteristic of the jute bag that inspired the young designers is its aesthetic roughness and simplicity.The characteristic feature there are logos and writing of the coffee manufacturers so they can use for their commercials.
Below, some concepts:

A. Modern Traditional Lamp Shade

The coffee jute bag was cut as medium size rectangular and then special hard varnish was put by brushing. The cut jute bag was pasted on the plastic sheet and thenthat one converted to a cylinder. The jute was covered by fabric in order to protect theds and give more modernity. It is te standard size lampe shade so it can put on any lmps.

Fig. 36: Concept: Modern Traditional Lamp Shade

B. Chandelier Shade

The coffe jute bag was cut as a circuler and it was sunk to special hard varnish and then it was put in a mould. The muld shape s a cylinder so when the jute become dry, it got the shape of the mould. Little hole was cut on the top for lamp and cable.

The chandelier shade was inspired by rustic aestetic so the appreance is raw, naturale and organic. Te jute bag was cut on the part of the logos to give more characteristic.

Fig. 37: Concept: Chandelier Shade

C. Coasters

The coffe jute bag was cut in small sized rectangular and then special hard varnish was put by brushing. Jute sheet was put on wood. Wood bottom coaster is super ergonomic because it was inspired by disability person to handling better. Circle coaster is coaster is for coffee mug. It is strong and washable because special hard varnish prootect threads and texture of the jute.

Fig. 38: Concept: Coasters

D. Table mat

The coffee jute bag was cut as medium sized rectangular and then special hard varnish was put by brushing. It is strong and washable because special hard varnish prootect threads and texture of the jute.

Fig. 39: Concept: Table Mat

E. Pot cover

Coffe jute bag was cut as a big circle and there are 16 little holes for rubber robe on the pot cover which are metals. Rubber robes go trough holes and then linked together.

Fig. 40: Concept: Pot Cover

F. Vase

The coffee bag was cut as big sized square and then it was sunk to special hard varnish. The form of the jute has organic form that is curvy form. Couple threads was taken symmetrical by hand to give more space and depth so there are little square spaces on the vase.

Fig. 41: Concept: Vase

Design concept/creative prototype

Thanks to this kind of waste, the students of IED Milano (Istituto Europeo di Design) designed a “Lazy corner for cafeteria lounge”. It means they have been created a functional seating space with eco-friendly materials coming fro the same context of coffee production.
The concept is a seating/couch set. It includes four different types of soft seats, which are mainly made in a similar way of the “bean bags”. Here, the bags that are discarded as waste, the left over coffee bean bags are directly used for filling up with filler materials like foam. Few of the forms that imitate a box or a chair with back rest, needs a pattern to be created before it could be stitched into a seat or a cushion filled with foam pellets. To create a bit of play with different materials, a lining of other fabric materials could be stitched on to the surfaces for more comfort and looks.

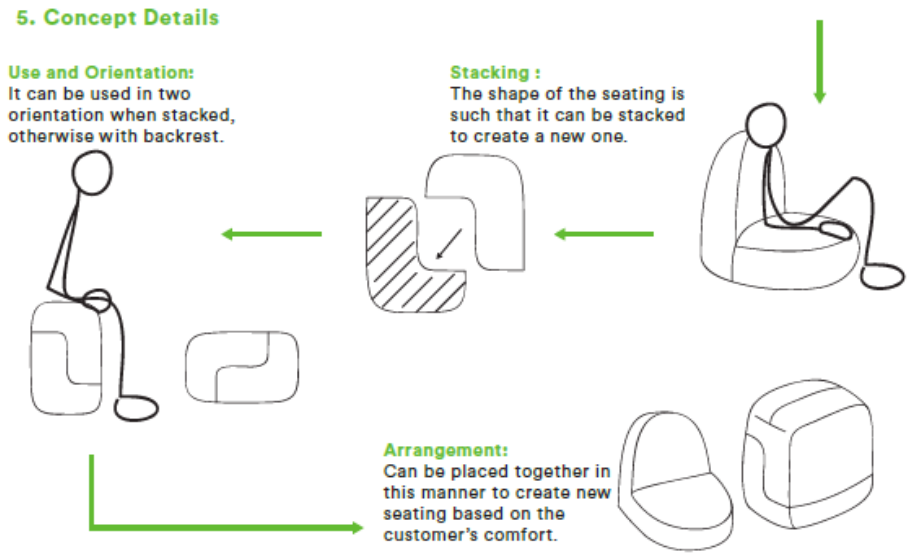

Fig. 42: Concept: Lazy corner for cafeteria lounge