WP T2 – INNOVATION ON TEXTILE WASTE MANAGEMENT

ACTIVITY A.T2.3 PILOT CASES

D.T2.3.3 PILOT CASES TECHNICAL REPORT

Version 1

Partner:

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Innovatext - Multifelt Factory

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ENTeR – Expert Network on Textile Recycling

ENTeR works in five central European countries that are involved in the textile business, to promote innovative solutions for waste management that will result in a circular economy approach to making textiles.

The project will help to accelerate collaboration among the involved textile territories, promoting a joint offer of innovative services by the main local research centres and business associations (“virtual centre”), involving also public stakeholders in defining a strategic agenda and related action plan, in order to link and drive the circular economy consideration and strategic actions.

The approach of the proposal and the cooperation between the partners is oriented to the management and optimization of waste, in a Life Cycle Design (or Ecodesign) perspective.

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1. Pilot case description – aim and scope

The stakeholder of the pilot case is the Multifelt Factory, which is the only felt producing company in Hungary. The present - new - the owner is highly committed to environmentally friendly solutions, including waste management of quality guaranteeing a win-win position benefiting both the company and the environment.

"Felt" is a term that can be used to describe a variety of different textiles included felted woven wools, synthetics, and industrial felts. Traditionally, felt is a nonwoven textile composed of loose fibres which are matted together to form a coherent material. [1]There are two types of preparation, the needle felting and the wet felting. Multifelt Factory uses the wet felting technology only and produces 100% wool and wool-viscose mixture felts. The felts are manufactured from Merino wool that is typically sourced primarily from Hungary and Australia.

Currently, their waste is generated in the production of industrial and decorative materials, mainly in the form of cut off material edges. Most of them consist of only 100% wool, but the decorative materials contain viscose, and most of them painted. Their paintings meet the STANDARD 100 by OEKO-TEX requirements. The cut edges of the wool felt are too small to sell as felt for decoration and industrial use, so they are out of their business scope. The company needs to find another way to use these raw materials. These smaller parts contain the same good quality wool, so they are potential raw materials for another type of usage. It could be an extra profit if company could find new features of this form of wool. Wool is particularly well suited for felting and is superior to synthetic fibres. Characteristics include inherent durability and resilience as the crimp or bend in the fibres give it natural elasticity. Such flexibility makes it durable and the outer skin of the fiber acts as a protective film, providing abrasion resistance. Lanolin, the thin waxy coating on wool fibres, makes wool naturally resistant to water and soil. Wool readily accepts natural dyes as they can penetrate the core of the fiber and undergo a chemical reaction making the colour change permanent and intensely saturated. In addition, because wool retains moisture in every fiber, it resists flame without chemical treatment. Instead of burning when touched by flame, wool chars and self-extinguishes when removed. Due to these natural characteristics of wool, Wool Design Felt is high quality, sustainable comes in highly saturated colours and is perfect for demanding design applications. Today felt becomes very popular again. The Do It Yourself activities are very trendy and exercised by many people. Lot of them prepare handmade felts, but the machine-felted materials are also popular. Felt is a versatile textile; industrial, home decoration and fashion designers use it, too.

[1] Felts of the nonwoven class are considered to be the first textile goods produced, and many references may be found to felts and their uses in the histories of ancient civilizations. The nomadic tribes of north central Asia still produce felts for clothing and shelter, utilizing the primitive methods handed down from antiquity. Source. https://www.britannica.com/topic/textile/Braiding-or-plaiting#ref359481

2. Mapping of the market available technologies for waste pre-treatment in partner region

2.1. Textile waste and available technologies for textile waste treatment in Hungary

2.1.1. Textile waste and end-of-life clothing

In Hungary, *textile waste recycling technologies mostly comprise mechanical processing as tearing and cutting.* (Source: Dt.1.12.Regional report Hungary, p. 8). It is important to note that actually in Hungary half of textile products are used for technical purposes. The textile waste is usually used for manufacturing non-woven textiles for quilt, mattresses, geotextiles, upholstery textiles for furniture, paddings, fabrics for garments, interlining, filters, industrial wipers, mop cloths, quilts, technical textiles for insulation, braids, wicks, ropes, various fillings, insulations, parts for automotive industry, braids, wicks, healthcare textiles, home and household textiles, fashion items, car carpets, etc. The textile/cloth producers are partly traditional and partly high-tech textile producers (working for example for car industry).

End-of-life clothing

In many municipalities, citizens can dispose of their useless textiles (clothing, home textiles) into the collecting containers operated by charities (Hungarian RedCross, Malteser, etc.) or by waste and recycling companies. After sorting ('separation by hand (code E0206), textile is offered for further use by people in material need, sold in second-hand shops or used/sold for recycling. End-of-life clothing, which is mainly not sorted, is disposed with other municipal waste (energy generation, landfills).

The Hungarian textile industry – in comparison with other industries and the national economy as a whole - generates only a small amount of waste. According to the Hungarian Waste Information System (OKIR), between 2010 and 2017 there was not any textile company among the 100 largest Hungarian waste producers.

Figure 1 Textile waste, kg, Hungary, 2010-2017

Table 1 C13 Manufacture of textiles, waste, 2010-2017, kg

Year	Dangerous waste, kg	Non-dangerous waste. kg	Total. kg	Dangerous waste in the % of total waste
2010	213524	4171077	4384601	5,12%
2011	329880	4965965	5295845	6,64%
2012	335380	5447718	5783098	6,16%
2013	336067	5205580	5541647	6,46%
2014	138533	4693940	4832473	2,95%
2015	133738	5384556	5518294	2,48%
2016	127151	6497503	6624654	1,96%
2017	113770	5029121	5142891	2,26%

Source: http://web.okir.hu/sse/?group=EHIR, downloaded 07/11/2019

The amount of textile waste reached its peak in 2016, it was already 6 624 tons, in front of 4 384 tons in 2010. In 2017 the quantity of textile waste decreased by 23% from 2016 to 5 143 tons.

We have also to add, that the volume of hazardous waste is insignificant compared to the total amount of waste generated in the production of textiles. The total amount of textile waste in 2017 accounted for 0.04% of the total waste generated in Hungary (14 052 887 tons) (EHIR).

Table 2 Non-dangerous textile industry (0402) waste according to waste type and region, 2017

Waste denomination	Region	Quantity, kg
Not dangerous waste		

Non-dangerous primary waste		
wastes from processed textile fibres	Budapest	35318
wastes from composite materials (impregnated textile, elastomer, plastomer)	Budapest	460
wastes from processed textile fibres	Pest	12760
wastes from composite materials (impregnated textile, elastomer, plastomer)	Central Transdanubia	404177
wastes from unprocessed textile fibres	Central Transdanubia	62880
wastes from processed textile fibres	Central Transdanubia	3750916
wastes from processed textile fibres	Western Transdanubia	947533
wastes from composite materials (impregnated textile, elastomer, plastomer)	Western Transdanubia	196170
wastes from processed textile fibres	South Transdanubia	116691
wastes from composite materials (impregnated textile, elastomer, plastomer)	South Transdanubia	543615
wastes not otherwise specified	South Transdanubia	2180
sludges from on-site effluent treatment other than those mentioned in 04 02 19	South Transdanubia	85400
wastes from processed textile fibres	Northern Hungary	97
wastes from unprocessed textile fibres	Northern Great Plain	15
wastes from processed textile fibres	Northern Great Plain	169544
wastes from composite materials (impregnated textile, elastomer, plastomer)	Northern Great Plain	591316
wastes from composite materials (impregnated textile, elastomer, plastomer)	Southern Great Plain	10969
Subtotal		6930341
Not dangerous, secondary produced waste		
wastes from composite materials (impregnated textile, elastomer, plastomer)	Central Transdanubia	2820
wastes from processed textile fibres	Western Transdanubia	22060
Subtotal		24880
Total, primary and secondary waste		6955221

While the major quantity of wastes from processed textile fibres is generated in Central Transdanubia, most of the wastes from composite materials (impregnated textile, elastomer, plastomer) comes from South Transdanubia and Northern Great Plain. The quantity of sludges from on-site effluent treatment contained and not hazardous substances (EWC 04 02 19) is significant in South Transdanubia).

Table 3 Dangerous textile industry (0402) waste, waste according to waste type and region, 2017

Waste denomination	Region	Quantity, kg
Dangerous primary produced waste		
sludges from on-site effluent treatment containing dangerous substances	Budapest	6034
sludges from on-site effluent treatment containing dangerous substances	Pest	1120
sludges from on-site effluent treatment containing dangerous substances	Central Transdanubia	1050
sludges from on-site effluent treatment containing dangerous substances	Western Transdanubia	1128
sludges from on-site effluent treatment containing dangerous substances	South Transdanubia	493
sludges from on-site effluent treatment containing dangerous substances	Northern Hungary	1130
sludges from on-site effluent treatment containing dangerous substances	Northern Great Plain	269611
sludges from on-site effluent treatment containing dangerous substances	Southern Great Plain	1612
Subtotal		282178
Dangerous secondary produced waste		
sludges from on-site effluent treatment containing dangerous substances	Pest	33640
Subtotal		33640
Total		315818

Source: http://web.okir.hu/sse/?group=EHIR, downloaded 07/11/2019

In 2017 the total sum of non-dangerous and dangerous wastes produced in the textile industry was 7 271 tons. It includes already not only the primary textile wastes but also other, concomitant wastes (composite materials). Taking into the view the different wastes in the textile industry according to types, already 4,5 % of the waste – 315,8 tons - was considered as dangerous.

2.1.1. Waste pre-treatment technologies in case of wool waste

Textile waste of wool comes from stocking factories, webbings, spinnings, textile laboratories. The first phase of work, which is fundamental for a correct diversification of production processes, is the subdivision of the raw material according to its type. After being split, the selected wool textile waste is packaged by the hydraulic press and then become so-called secondary raw material. The secondary raw material is stored in bales warehouse to be ready for sale. The quality of secondary raw material depends on the applied processes, which must comply with regulations and the protection of the recovered product. The wool obtained for reuse of production waste must be referred to as "recycled wool". [2]

[2] The fibre obtained from an operation of shearing the hair of the animal, usually occurring in spring, is called "virgin wool". However, the wool got after the slaughter of the animal is called "tanning wool."

A new, innovative approach

Without a doubt, we can tackle with new, interesting approaches, like Cook2Design. 'In the framework of the Cook2Design project… the raw materials used by designers have been investigated through cooking experiments. The result of the research was the production of NeWool, four materials based on potato starch and wool waste cooked together, which were presented in six colour declinations. The output of the process is a 100% recycled organic material, which could be the starting point for future research as the first prototype.'[3]

A holistic approach to raw materials

A holistic approach to raw materials is used by the Material Experience Lab. Research methods and technical tools are available to the designer, they work with the experts in social sciences, raw material developers and engineers to achieve radical change in the object culture. 'The expression 'Material Experience' describes the holistic approach to raw materials, which emphasizes the role of materials both technically and experientially. By exploring this, we can understand how physical, biological, social, and cultural conditions determine the human attitude and motivate designers for innovative material use.'[4]

2.1.2. Mapping of textile waste treatment in Hungary

Table 4 Non-dangerous waste

Waste type/name	Waste treatment	Quantity, kg
wastes from processed textile fibres	Incineration on land	4730
wastes from finishing other than those mentioned in 04 02 14	Incineration on land	832
wastes from composite materials (impregnated textile, elastomer, plastomer)	Incineration on land	248
wastes not otherwise specified	Incineration on land	7328
wastes from unprocessed textile fibres	Specially engineered landfill (e.g. placement into lined discrete cells which are capped and isolated from one another and the environment, etc.)	69340
wastes from composite materials (impregnated textile, elastomer, plastomer)	Specially engineered landfill (e.g. placement into lined discrete cells which are capped and isolated from one another and the environment, etc.)	1544774

[3] http://materialsexperiencelab.com/cook2design (2018.11.12)
[4] https://www.materialstoday.com/lab-profile-elvin-karana-materials-experience-lab/ (2018.11.12)

sludges from on-site effluent treatment other than those mentioned in 04 02 19	Specially engineered landfill (e.g. placement into lined discrete cells which are capped and isolated from one another and the environment, etc.)	85400
wastes from processed textile fibres	Specially engineered landfill (e.g. placement into lined discrete cells which are capped and isolated from one another and the environment, etc.)	1601400
wastes not otherwise specified	Specially engineered landfill (e.g. placement into lined discrete cells which are capped and isolated from one another and the environment, etc.)	6
wastes from processed textile fibres	Crushing (shredding, breaking, comminution, grinding)	295008
wastes from composite materials (impregnated textile, elastomer, plastomer)	Crushing (shredding, breaking, comminution, grinding)	45670
wastes from composite materials (impregnated textile, elastomer, plastomer)	Compacting, baling, agglomeration (like aggregating, regranulation)	137740
wastes from composite materials (impregnated textile, elastomer, plastomer)	Separation based on the material characteristics (classification)	88720
wastes from processed textile fibres	Separation based on the material characteristics (classification)	4230
wastes from composite materials (impregnated textile, elastomer, plastomer)	Other	5180
wastes from processed textile fibres	Other	170720
wastes from processed textile fibres	Mechanical - biological pretreatment	4480
wastes from processed textile fibres	Use principally as a fuel or other means to generate energy	2897320
wastes from composite materials (impregnated textile, elastomer, plastomer)	Use principally as a fuel or other means to generate energy	83220
wastes from unprocessed textile fibres	Recycling/reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes)	8360

wastes from composite materials (impregnated textile, elastomer, plastomer)	Recycling/reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes)	2820
wastes from processed textile fibres	Recycling/reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes)	96014
wastes from processed textile fibres	Recycling/reclamation of other inorganic materials	19035

Table 5 Dangerous waste

Waste type/name	Waste treatment	Quantity, kg
wastes from finishing containing organic solvents	Incineration on land	117
sludges from on-site effluent treatment containing dangerous substances	Incineration on land	16182
sludges from on-site effluent treatment containing dangerous substances	Separation based on the formal characteristics (classification)	338
sludges from on-site effluent treatment containing dangerous substances	Other	60
sludges from on-site effluent treatment containing dangerous substances	Phase separation (like emulsion breaking)	44220
sludges from on-site effluent treatment containing dangerous substances	Recycling/reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes)	252658

Source: http://web.okir.hu/sse/?group=EHIR, downloaded 07/11/2019

For the textile waste, the most important treatment is the " Specially engineered landfill (e.g. placement into lined discrete cells which are capped and isolated from one another and the environment, etc.)" The processed textile fibres waste is used principally as a „ fuel or other means to generate energy".

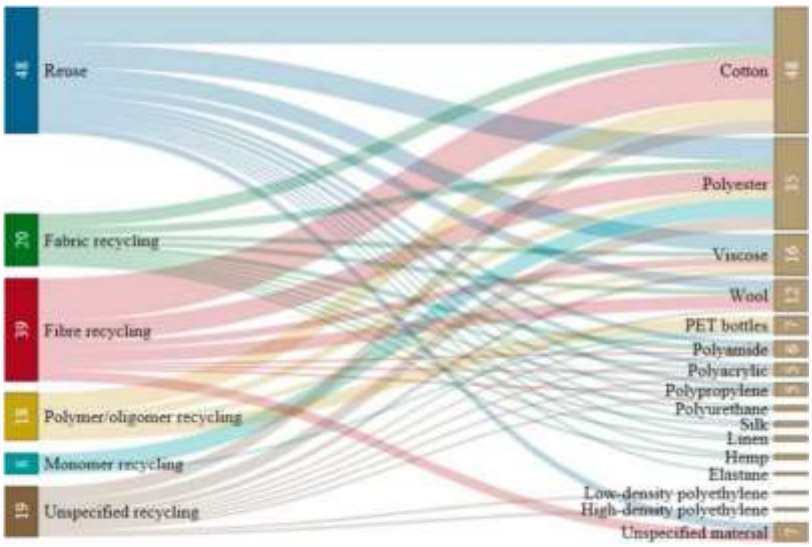
3. Results and conclusions

3.1. Identification of gaps: need to deal more with the reuse and recycling of wool

3.1.1. Gaps in wool/felt waste use

Due to wool's appearance in the textile industry, the question of its waste management is also a concern. As wool derives from the natural shearing of the sheep's fur, one of our oldest renewable fibre raw materials, its traditional processing is known in the textile industry. However, as concerns, the textile industry, the preponderance of deal with cotton and polyester is observed. Forty-one studies were reviewed by G. Sandine and Greg M. Peters (2018) and according to their finding 85% deal with recycling and 41% with reuse (27% cover both reuse and recycling). Fibre recycling is the most studied recycling type (57%), followed by polymer/oligomer recycling (37%), monomer recycling (29%), and fabric recycling (14%)…. Cotton is the most studied material (covered in 76% of the studies) for both studies of reuse and recycling, followed by polyester (63%), also counting bottle-to-fibre recycling, viscose (25%) and wool (20%). (Gustav Sandin & Greg M. Peters (2018), table 1.).

Figure 2 Place of wool in re-use and/or (fabric and fibre) recycling, according to peer-reviewed studies published in academic journals



Source: https://ars.els-cdn.com/content/image/1-s2.0-S0959652618305985-gr2_lrg.jpg

3.2. Gaps in the Hungarian textile recycling

Hungarian companies are looking for solutions to recycle their textile waste as much as possible. Unfortunately, textile waste from households and communal waste is not collected separately; it is handled and transferred as a communal waste – without separation and selection. The issue of the textile waste management system and textile recycling is very urgent question for the economy and for the society because there is global need to solve and handle this question. Textile waste recycling technologies are available in Hungary but in a small range, especially mechanical processing as tearing and cutting is used (see Temaforg and

TESA); the obtained textile material is usually used for manufacturing of non-woven textiles or for production of cleaning materials, various fillings, upholster materials, insulations, geotextiles. This solution is mostly available only for textile waste without any heavy chemical treatment (coating, laminating). The Hungarian companies seem to be interested in technology development related to textile & clothing sector and also in the optimization processes increasing competitiveness. (See: D.T1.1.2 Regional Report, p.21).

The answers of companies within the framework of ENteR survey[5] led by Innovatext and PBN show impediments like the shortage of capital and shortage of knowledge on textile waste management, sorting, recycling technology, the high processing costs and the lack of market acceptance for recycled products and the lack of regional waste management system of most of the companies.

[5] 70 companies were invited to fill the ENTeR questionnare, feedback was provided by 26 companies.

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