WP T2 – INNOVATION ON TEXTILE WASTE MANAGEMENT

ACTIVITY A.T2.3 PILOT CASES

D.T2.3.3 PILOT CASES TECHNICAL REPORT

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Partner:
PP 7 INOTEX Ltd.
(Czech Republic)

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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.

CONTENT

1. Pilot case description – aim and scope

The Pilot case "Generation of waste from manufacturing of technical textiles"

In Czech textile industry, the highest share (about 2/3) of the value of economic indicators in 2016 had the manufacture of other textiles (CZ-NACE 13.9) - mainly manufacturing of non-woven and technical textiles. Technical textile manufacturing grew in recent years by an average of about 10% per year; today, technical textiles represent a significant majority (65%) of the outputs and revenues of textile production in Czech Republic. With respect to the long-term dominant position of the production of motor vehicles in Czech economy, there is also growth in the production of respective intermediates, including production of technical textiles used, inter alia, in automotive industry.

Whereas the recycling technologies for processing of textile waste such as the old clothing or home textiles are traditional and well available in Czech Republic (almost mechanical technologies as cutting and tearing), the processing and utilization of waste from technical textiles are often difficult or costly due to their technical nature (coatings, laminations, composites ...). This type of waste cannot be processed by these traditional mechanical technologies.

The three Czech companies producing the heavy coated textiles are looking for the processing and reuse opportunities for their waste. Two of them (Company 1 and Company 2) are producers of the technical textiles for abrasive, printing and bookbinding sector. The third company (Company 3) is the producer of bathmats. The generated waste consists of selvedges (edge strips), cuttings, pieces of yardage textiles with or without coatings, or yarns and fibers.

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

There are number of companies on the Czech market dealing with recycling of textile. Some of them are processing textile waste and selling it as a raw material for further use, some of them are using it as a raw material e.g. for production of cleaning rags and polishing discs, non-woven or technical textiles (geotextiles, upholsteries, insulations); one company produces the alternative fuel for a cement plant from waste paper, plastics, wood and textiles.

Mapping of these companies was done within this pilot study; the companies processing the textile waste were contacted with the demand on processing of pilot textile waste from our pilot companies. Unfortunatelly, in majority of the cases the answer wasn´t any or was negative; the overview is summarised in the text bellow.

The company **Arca Chrast, Nové Hrady** deals with processing of secondary textile raw materials, textile residues and textile waste from primary production such as weaving mills, cutting and laundries; these are processed using the tearing technology of the LAROCHE tearing line. The processed materials comprise cotton, wool, polyester, viscose, linen and acrylic. Resulting produts are schredded regenerated textile fibres. (1)

No answer to our demand.

According to it´s corporate website, the company **Czech Fibre, Raspenava** processes any textile waste that is not destroyed by rubbing, melting, or other non-textile materials such as hard plastics, metal, hazardous chemicals, etc. In the company, textile waste is sorted, the non-textile parts are removed and then the material is cutted and teared. The company processes the textile waste from spinning mills, weaving mills, finishing plants, production of nonwovens, production of sealing and insulating materials for cars, sorting of worn clothes; they can process not only classic fabrics, but also high-strength safety belts, cord fabrics or other similar high quality products. The resulting products are schredded regenerated textile fibres in staple form or as a mixture of individual fibers and yarn remnants. The regenerated fibers can be used in the production of coarse yarns, nonwovens and insulating materials as raw materials. In many cases, the company regenerate waste generated by its partners directly in their production or in the production of their customers. (2)

According to their answer to our offer, they already investigated processing of the similar type of textile waste but the conclusion was that they are not able to process it. As the final products from their production are the textile fibres, they need to cut and tear the textiles to get them; in case of coated textiles with tightly connected fibres due to the coating the fibres cannot be separated by tearing technology.

The company **EKOTEX Ltd. Ivančice** belongs to the leading manufacturers of regenerated fibre. They buy, sort and process the textile waste and produce the non-woven textiles for use as geotextiles, upholsteries, insulating and cleaning textile materials, transport and eleemosynary covers. As a raw material, they purchase the fibrous materials, mixed scraps and other secondary raw materials. Their technology comprises sorting of purchased textile waste followed by loosening of textile materials through tearing, cutting, through subsequent fiber creating and its netting (by the garnett machine) as well as through subsequent thread cutting (by a cutting machine). (3)

According to their answer to our offer, they actually buy and recycle only knitted textiles; therefore they were not interested in our pilot wastes.

The company **GALA a.s., Prostějov** manufactures sports and medical balls, hiking equipment, sewn accessories for the army and police, harnesses for garden and rescue equipment, scarves, bags and baby carriers, punching bags and other sewn products; the company is the only European manufacturer of top volleyball, handball and netball balls. (4)

In 2017, they were looking for the supplier of textile waste – primarily textile laminated by foam, fleece or duffel; but they didn´t answer to our offer.

Green way recycling s.r.o., Opava – the company purchases waste, by-products and residual products from textile production, which they recycle and process into material usable as a raw material for further industrial production. (5)

The company Green way recycling was the only one company which answered positively to our demand and assessed the samples of textile waste from this pilot case. The details are described in chapter 3.3.

The company **Klatex Ltd., Klatovy** recycles and processes pure textile waste to make nonwovens for the automotive industry, building and upholstery. Recycled fibers are prepared by loosening of the cutted material from textile waste. The nonwoven textiles are produced using the needling and thermal bonding technologies. (6)

Their answer to our offer was that, unfortunately, they are not eble to process our type of textile waste by their technology.

MITOP, akciová společnost, Mimoň is one of the leaders among the producers of non-woven textiles. The company produces technical textiles by needling and weaving technology. They products include the geotextiles, filter fabrics and filter elements, paper or special felts, polypropylene staple and technical textiles for automotive industry. (7)

No answer to our demand.

OSSY s.r.o., České Budějovice is focusing on the trade in textile goods and processing and recycling of textile, plastic, paper, glass and metal waste; they also offer a complete service in the collection, sorting and recycling of the waste. (8)

No answer to our demand.

Recycling J&F, s.r.o., Ústí nad Orlicí - Kerhartice offers processing of textile and plastic waste and the comprehensive services within waste management solutions. They are focusing on buying up and recycling of waste from the various productions - spinning, weaving, production of nonwovens or sealing and insulating materials from automobiles production. (9)

No answer to our demand.

RETEX a.s., Moravský Krumlov belongs to leaders on the Czech textile recycling market. They are focusing on the development and production of non-woven textiles by neede punching or Airlay technology, with optional treatment by number of operations as coating, velouring, shearing, cutting or formating. Their portfolio covers the products for automotive (interior decorative carpets, visible trunk carpets, interior and exterior insulation), building industry (needled punched geotextiles for traffic constructions, landfill constructions, remediation etc., thermally nd acoustically insulated boards based on the airlaid technologies), Aquadesk (special desks for green roofs), protective textiles (e.g. for house painters), mattress core etc. (10)

Our company INOTEX has the long-term cooperation relationships with RETEX company. Based on these relationships, the company assessed the samples of the waste from our pilot case. The details are described in chapter 3.1.

UO TEX, s.r.o., Kerhartice specializes in the production of geotextiles, blankets and pillows, and in the production of cleaning and nonwovens. (11)

According to their answer to our demand, they are not eble to process our type of textile waste by their technology.

3. Results and conclusions

The Czech textile waste processing companies were contacted with demand on assessment and trials of processing and use of the textile waste from the pilot companies, as described in chapter 2, but only two companies (RETEX and Green way recycling) were interested. In addition to them also the project partner STFI provided some testing trials of the waste samples.

Thanks to the personal contacts initiated during the CZ national ENTeR conference organised by INOTEX in October 2019, the testing trials of the textile waste were still started in November 2019 by company IBCSD LAB s.r.o.

The details and results are described in the following chapters.

In all cases, the samples of textile waste from two pilot case companies Company 1 and Company 2 were sent to processors for assessment. Textile waste from third pilot company – Company 3 – were refused by all processing companies; any of them didn´t see any possibility for processing and use. Therefore, this type of pilot waste from Company 3 will not be further discussed in the following text.

3.1. Assessment of the textile waste samples by company RETEX a.s.

Two independent assessments of samples of the textile waste were provided by the Czech company RETEX a.s., Moravský Krumlov. In January and November 2019, the company obtained two sets of textile waste samples from the pilot companies Company 1 and Company 2

The first assessment was done in January 2019. The following samples were sent to RETEX:

	Sample name	
SAMPLE name:	**ENTeR_RET01**	
Date:	10 January 2019	
Source:	BA	
Material:	100% cotton fabric (blue) with starch coating	

	Sample name	
SAMPLE name:	**ENTeR_RET02**	
Date:	10 January 2019	
Source:	Company 1	
Material:	100% cotton fabric (brown) with coating	

	Sample name	
SAMPLE name:	**ENTeR_RET03**	
Date:	10 January 2019	
Source:	Company 2	
Material:	Polycotton with coating (abrasive base cloth)	

	Sample name	
SAMPLE name:	**ENTeR_RET04**	
Date:	10 January 2019	
Source:	Company 2	
Material:	Polycotton with coating (printmedia)	

	Sample name	
SAMPLE name:	**ENTeR_RET05**	
Date:	10 January 2019	
Source:	Company 2	
Material:	Viscose backed with paper	

	Sample name	
SAMPLE name:	**ENTeR_RET06**	
Date:	10 January 2019	
Source:	Company 2	
Material:	100% cotton with coating	

	Sample name	
SAMPLE name:	**ENTeR_RET07**	
Date:	10 January 2019	
Source:	Company 2	
Material:	100% PES with coating	

Assessment results:

According to the answer from RETEX, any of these waste is not suitable for processing by the company.

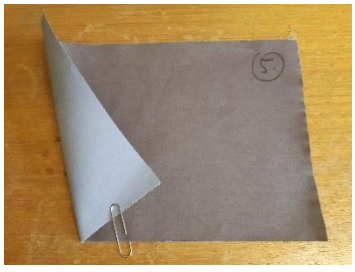
The second assessment was done in November 2019. The following samples were sent to RETEX:

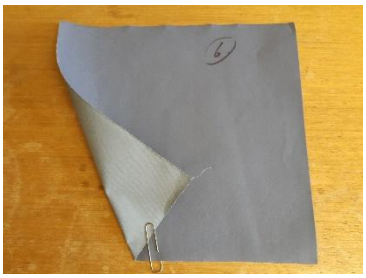
	Sample name	
SAMPLE name:	**ENTeR_IN01**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN02**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN03**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% PES	

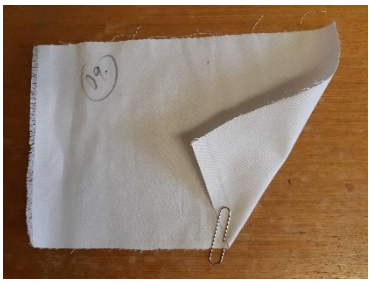
	Sample name	
SAMPLE name:	**ENTeR_IN04**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN05**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN06**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN07**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN08**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN09**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% PES	

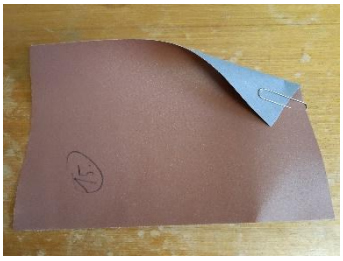
	Sample name	
SAMPLE name:	**ENTeR_IN010**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	ENTeR_IN011	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	ENTeR_IN012	
Date:	11 November 2019	
Source:	Company 1	
Material:	Cotton/PES	

	Sample name	
SAMPLE name:	ENTeR_IN013	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	ENTeR_IN014	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	ENTeR_IN015	
Date:	11 November 2019	
Source:	Company 1	
Material:	Cotton/PES	

	Sample name	
SAMPLE name:	**ENTeR_IN016**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN017**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN018**	
Date:	11 November 2019	
Source:	Company 1	
Material:	?	

	Sample name	
SAMPLE name:	**ENTeR_IN019**	
Date:	11 November 2019	
Source:	Company 1	
Material:	?	

	Sample name	
SAMPLE name:	**ENTeR_IN020**	
Date:	11 November 2019	
Source:	Company 2	
Material:	100% cotton (bookbinding cloth)	

	Sample name	
SAMPLE name:	ENTeR_IN021	
Date:	11 November 2019	
Source:	Company 2	
Material:	Viscose backed with paper	

Assessment results:

The answer of the **R&D** department: "Waste material of the ENTeR project will be registered, but at present it is not suitable for processing due to the capacity reasons and the nature of the material."

3.2. Testing trials in STFI

Based on the cooperation within the ENTeR project, the project partner STFI made a verification tests of processing of waste samples of coated textiles.

	Sample name	
SAMPLE name:	Comp1-01	
Date:	28 November 2017	
Source:	Company 1	
Material:	100% cotton fabric (blue) with starch coating	

	Sample name	
SAMPLE name:	Comp1-02	
Date:	November 2017	
Source:	Company 1	
Material:	100% cotton fabric (brown) with coating	

	Sample name	
SAMPLE name:	Comp2-01	
Date:	November 2017	
Source:	Company 2	
Material:	Polycotton with coating (abrasive base cloth)	

	Sample name	
SAMPLE name:	**Comp2-02**	
Date:	November 2017	
Source:	Company 2	
Material:	Polycotton with coating (printmedia)	

	Sample name	
SAMPLE name:	**Comp2-03**	
Date:	November 2017	
Source:	Company 2	
Material:	Viscose backed with paper	

	Sample name	
SAMPLE name:	**Comp2-04**	
Date:	November 2017	
Source:	Company 2	
Material:	100% cotton with coating	

	Sample name	
SAMPLE name:	**Comp2-05**	
Date:	November 2017	
Source:	Company 2	
Material:	100% PES with coating	

Assessment results:

For a classical mechanical treatment of the textiles with the tearing technology (carding machine) especially the coated samples are not suitable. Due to the applied coatings the textiles have lost the textile character of dry untreated fabrics and cannot be opened up into single fibers with the tearing technology.

As alternative methods, the waste samples can be treated with the cutting mill. The textile scraps can be applied as bedding material for e. g. riding arenas or as textile filler materials. Furthermore, a chemical recycling and decomposition can be a solution.

Also as filling material for the KEMAFIL®-Technology the scraps can be used. The STFI did testing trials and sent the samples of scrabs processed by KEMAFIL®-Technology to Inotex; how to use these ropes could be subject of a new project.

Fig.No.1: Scrabs of coated textile fabics processed by KEMAFIL®-Technology

3.3. Testing trials by company Green way recycling s.r.o.

Company Green way recycling s.r.o. was interested in testing trials of the pilot textiel waste samples. In the past they already had an experience with processing of coated PES fabric. According to their opinion, this type of waste could be processed by their tearing technology (using theich machinery with modified tearing knives). The samples of the pilot waste were sent ot the company for preliminary assessment. The cooperation was than discussed also during the face-to-face meeting in April 1019; as agreed during the meeting, larger volumes of samples were sent to Green way recycling in the second round, togehter with samples from the German pilot case (this cooperation is summarised in chapter 3.5.).

	Sample name	
SAMPLE name:	**ENTeR_GW01**	
Date:	09 April 2019	
Source:	Company 1	
Material:	100% cotton fabric (blue) with starch coating	

	Sample name	
SAMPLE name:	**ENTeR_GW02**	
Date:	09 April 2019	
Source:	Company 1	
Material:	100% cotton fabric (brown) with coating	

	Sample name	
SAMPLE name:	**ENTeR_GW03**	
Date:	09 April 2019	
Source:	Company 2	
Material:	Polycotton with coating (abrasive base cloth)	

	Sample name	
SAMPLE name:	**ENTeR_GW04**	
Date:	09 April 2019	
Source:	Company 2	
Material:	Polycotton with coating (printmedia)	

	Sample name	
SAMPLE name:	**ENTeR_GW05**	
Date:	10 January 2019	
Source:	Company 2	
Material:	Viscose backed with paper	

	Sample name	
SAMPLE name:	**ENTeR_GW06**	
Date:	09 April 2019	
Source:	Company 2	
Material:	100% cotton with coating	

	Sample name	
SAMPLE name:	**ENTeR_GW07**	
Date:	09 April 2019	
Source:	Company 2	
Material:	100% PES with coating	

	Sample name	
SAMPLE name:	**ENTeR_GW08**	
Date:	09 April 2019	
Source:	Company 1	
Material:	100% cotton, yarn remnants removed from the bobbins	

	Sample name	
SAMPLE name:	**ENTeR_GW09**	
Date:	09 April 2019	
Source:	Company 1	
Material:	100% cotton, desized yarns	

	Sample name	
SAMPLE name:	**ENTeR_GW10**	
Date:	09 April 2019	
Source:	Company 1	
Material:	100% cotton, trimmed edges from weaving mill	

	Sample name	
SAMPLE name:	**ENTeR_GW11**	
Date:	27 May 2019	
Source:	Company 1	
Material:	100% cotton (gray) with starch coating	

	Sample name	
SAMPLE name:	**ENTeR_GW12**	
Date:	27 May 2019	
Source:	Company 1	
Material:	100% cotton (blue) with coating	

	Sample name	
SAMPLE name:	ENTeR_GW13	
Date:	27 May 2019	
Source:	Company 1	
Material:	Polycotton with coating (base abrasive-emery cloths)	

	Sample name	
SAMPLE name:	ENTeR_GW14	
Date:	27 May 2019	
Source:	Company 1	
Material:	100% cotton with coating (base abrasive-emery cloths)	

	Sample name	
SAMPLE name:	ENTeR_GW15	
Date:	27 May 2019	
Source:	Company 2	
Material:	Viscose backed with paper	

	Sample name	
SAMPLE name:	ENTeR_GW16	
Date:	27 May 2019	
Source:	Company 2	
Material:	100% cotton with coating	

	Sample name	
SAMPLE name:	ENTeR_GW17	
Date:	27 May 2019	
Source:	Company 2	
Material:	100% cotton (buckram)	

	Sample name	
SAMPLE name:	**ENTeR_GW18**	
Date:	27 May 2019	
Source:	Company 2	
Material:	Paper reinforced with synthetic fibers, water-based latex coating	

Assessment results:

Samples:

- ENTeR_GW08 (100% cotton, yarn remnants removed from the bobbins),
- ENTeR_GW09 (100% cotton, desized yarns),
- ENTeR_GW10 (100% cotton, trimmed edges from weaving mill)

Textile waste from Company 1, volume approx. 1 tonne / weeak for each of them.

The company Green way recycling was interested in buying, offer price CZK 2 / kg, transport by Green way recycling. This offer was was discussed with the waste producer; actually, they already have a lot of demands from waste processors located near to the company for better price that offered by Green way recycling. From this reason, Company 1 was not interested in this offer.

Samples:

- ENTeR_GW11 (100% cotton (gray) with starch coating),
- ENTeR_GW12 (100% cotton (blue) with coating),
- ENTeR_GW13 (Polycotton with coating (base abrasive-emery cloths)
- ENTeR_GW17 (100% cotton (buckram)

Processing of the samples was tested using the special tearing machine HAMSTER (modifications of the tearing machinery developed by Green way recycling) with special tearing knives. It was not possible to rip up these materials with hard coating, the pieces of textiles were picked up at the knives. Another testing trial was provided by the company cooperating with Green way recycling using the tearing machine TRUSZCHLER; but not even by this technology testing was not succesful. The materials were again picked-up at the on the rollers, sliding on them and plugging the machine technology.

The only technology, which – on opinion of the Green way recycling company - might be suitable for processing of these materials, seems to be textile mill where the fiber is milled and destroyed to small parts and is used in building and automotive industry.

Samples:

- ENTeR_GW15 (Viscose backed with paper),
- ENTeR_GW18 (Paper reinforced with synthetic fibers, water-based latex coating)

These samples are materials with higher content of the paper and synthetic water-based latex coating. For these samples, company does not know potential processing and use.

The other textile samples were not suitable for testing trials, according to the experienxe of company Green way recycling.

3.4. Testing trials by company IBCSD LAB s.r.o., Plzeň

The contacts between the companies INOTEX and IBCSD LAB were initiated thanks to the personal contact launched during the Czech national ENTeR conference organized by INOTEX in October 2019.

The company focuses on industrial upcycling of various types of waste from different materials under the own developed strategy INDUSTRY 5.0. **(12)**

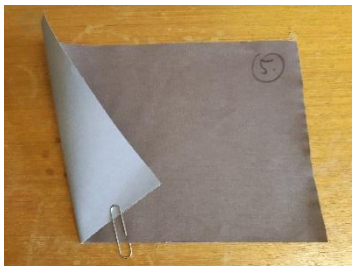
The company assessed the samples of textiles with coatings from companies Company 1 and Company 2.

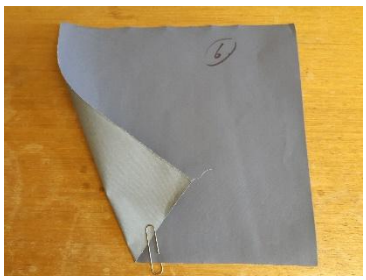
	Sample name	
SAMPLE name:	ENTeR_IN01	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	ENTeR_IN02	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	ENTeR_IN03	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% PES	

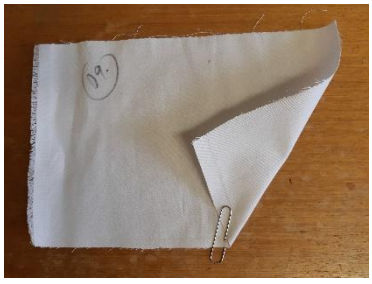
	Sample name	
SAMPLE name:	ENTeR_IN04	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN05**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN06**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

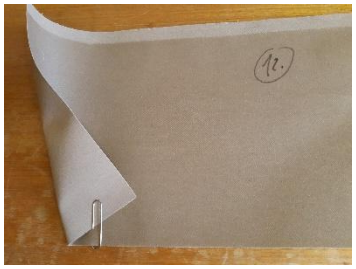
	Sample name	
SAMPLE name:	**ENTeR_IN07**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN08**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN09**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% PES	

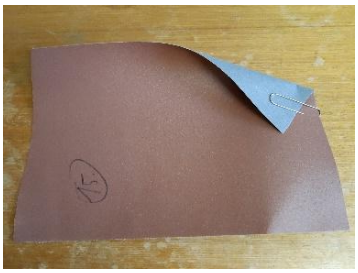
	Sample name	
SAMPLE name:	**ENTeR_IN010**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN011**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN012**	
Date:	11 November 2019	
Source:	Company 1	
Material:	Cotton/PES	

	Sample name	
SAMPLE name:	**ENTeR_IN013**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN014**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

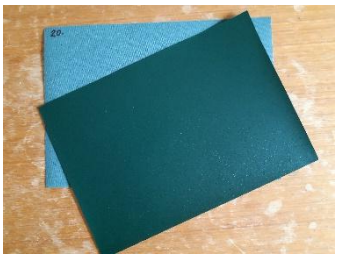
	Sample name	
SAMPLE name:	**ENTeR_IN015**	
Date:	11 November 2019	
Source:	Company 1	
Material:	Cotton/PES	

	Sample name	
SAMPLE name:	**ENTeR_IN016**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN017**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN018**	
Date:	11 November 2019	
Source:	Company 1	
Material:	? (identified by FT IR as cotton/PES)	

	Sample name	
SAMPLE name:	**ENTeR_IN019**	
Date:	11 November 2019	
Source:	Company 1	
Material:	?	

	Sample name	
SAMPLE name:	**ENTeR_IN020**	
Date:	11 November 2019	
Source:	Company 2	
Material:	100% cotton (bookbinding cloth)	

	Sample name	
SAMPLE name:	**ENTeR_IN021**	
Date:	11 November 2019	
Source:	Company 2	
Material:	Viscose backed with paper	

Assessment results:

a) sample ENTeR_IN020 – buckram

The most interesting seemed to be sample ENTeR_IN020 in form of sheets; the company proposed it's processing by the "ORIGAMI" method. They had an idea to use it as a design pacaking material. But discussing this proposal with producer of the waste (Company 2), the following serious obstacle was identified.

Coated fabric ENTeR_IN020 is a buckram for manufacturing of ID documents. At the producer (Company 2), this product belongs to category "security". Regarding the opportunity to use it for manufacturing of packaging materials, the management of Company 2 decided not to grant permission to use this residual fabric as a raw material, nor in the case the material would be devaluated (Fig.No.2)

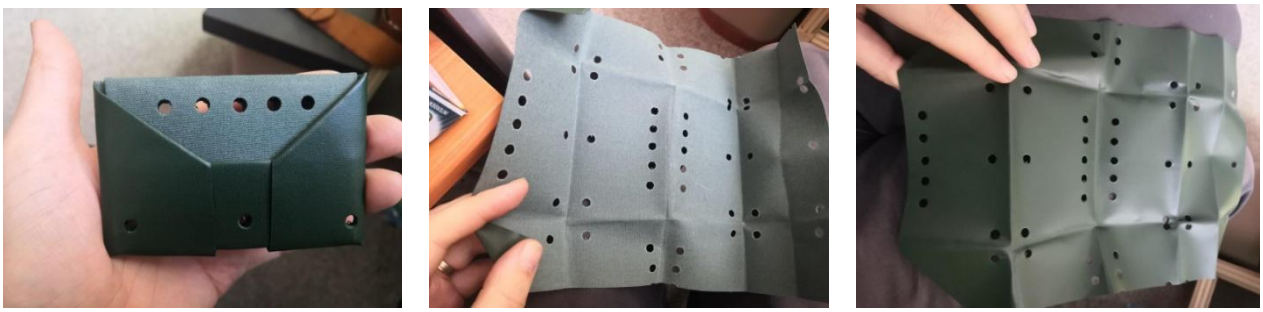
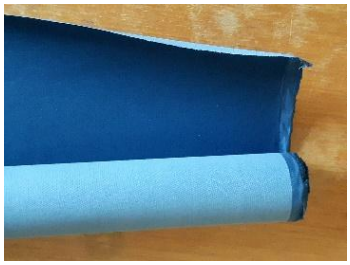
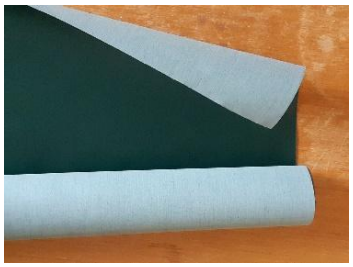


Fig.No.2: Proposed devaluating of the textile material

After this decision of the management, INOTEX organized samples of other coated fabrics residues produced by Company 2 which are very similar (material composition, coating, some of them may have lower basis weight), but don´t belong to category "security".

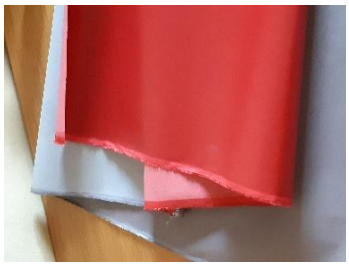
	Sample name	
SAMPLE name:	**ENTeR_IN022**	
Date:	16 December 2019	
Source:	Company 2	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN023**	
Date:	16 December 2019	
Source:	Company 2	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN024**	
Date:	16 December 2019	
Source:	Company 2	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN025**	
Date:	16 December 2019	
Source:	Company 2	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN026**	
Date:	16 December 2019	
Source:	Company 2	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN027**	
Date:	16 December 2019	
Source:	Company 2	
Material:	100% cotton	

Verification testing of these samples is still ongoing during the creative workshops organized by company IBCSD LAB.

b) samples ENTeR_INO01 – ENTeR_INO17

Company did some verification tests of textile residues in form of fabric pieces and tested some selected materials both as parts of the packaging and within the creative activities and teaching. The creative ideas how to use this materials – see the Fig.No.3:.

Fig.No.3: Proposed use of the textile residues

3.5. The cooperation with STFI on German pilot case

3.5.1. Samples of various textiles

Within the ENTeR project, INOTEX and STFI agreed to cooperate in solving their pilot cases. INOTEX sent the samples of textile waste from company Textilausrüstung PFAND GmbH to company Green way recycling, s.r.o., Opava, for assessment.

	Sample name	
SAMPLE name:	**ENTeR_GW19**	
Date:	27 May 2019	
Source:	Textilausrüstung Pfand GmbH, Germany	
Material:	Artificial leather	

	Sample name	
SAMPLE name:	**ENTeR_GW20**	
Date:	27 May 2019	
Source:	Textilausrüstung Pfand GmbH, Germany	
Material:	Coloured scrabs – various composition	

	Sample name	
SAMPLE name:	ENTeR_GW21	
Date:	27 May 2019	
Source:	Textilausrüstung Pfand GmbH, Germany	
Material:	Dust from final treatment	

	Sample name	
SAMPLE name:	ENTeR_GW22	
Date:	27 May 2019	
Source:	Textilausrüstung Pfand GmbH, Germany	
Material:	Embroidery ground fabric PVA	

	Sample name	
SAMPLE name:	ENTeR_GW23	
Date:	27 May 2019	
Source:	Textilausrüstung Pfand GmbH, Germany	
Material:	Hometextiles PES	

	Sample name	
SAMPLE name:	ENTeR_GW24	
Date:	27 May 2019	
Source:	Textilausrüstung Pfand GmbH, Germany	
Material:	Selvedges	

	Sample name	
SAMPLE name:	ENTeR_GW25	
Date:	27 May 2019	
Source:	Textilausrüstung Pfand GmbH, Germany	
Material:	Warp-knitted fabric PES	

	Sample name	
SAMPLE name:	**ENTeR_GW26**	
Date:	27 May 2019	
Source:	Textilausrüstung Pfand GmbH, Germany	
Material:	Woven PPS selvedges, finished (unknown)	

	Sample name	
SAMPLE name:	**ENTeR_GW27**	
Date:	27 May 2019	
Source:	Textilausrüstung Pfand GmbH, Germany	
Material:	Yarn residues	

Assessment results:

According to results, most of the samples cannot be processed by available mechanical methods as tearing at the TRÜTZSCHLER tearing machine or at the HAMSTER machine (special device constructed by Green way recycling for their own purposes) with specially modified ripping knive: ENTeR_GW23 (material cannot be processed by tearing; when testing, there were a residual non-teared parts), ENTeR_GW24, ENTeR_GW25, ENTeR_GW26 (not suitable for processing by any available technology; when propcessed, the material is broken to the dust).

According tot he opinion of company Green way recycling, some oft he samples might be suitable for any processing: ENTeR_GW20, ENTeR_GW27 - might be processed by tearing (common tearing technologies – TRÜTZSCHLER, LAROCHE) and used as a raw material for manufacturing of e.g. geotextiles, fillings, sound insulation, buildings.

According to the opinion of the company, the only processing technology which might be suitable for the textile materials which cannot be processed by tearing, is a milling (textile mill – Schredder technology), where the textile fibers are milled and broken into small particles. The resulting material could be used in building and automotive industry.

The sample ENTeR_GW21 (textile dust from finishing processes) is not suitable for any use. According to information from company Green way recycling, in Finland, they have a project on processing and use of the textile dust; the resulting material can be used for manufacturing of soundproofing and thermo-insulating boards. But in Central Europe, there is not such a type of production.

3.5.2. PES edge stripes

In November 2019, INOTEX helped STFI to look for use of the polyestere edge stripes produced by company PFAND. INOTEX offered this waste to two companies: Green way recycling, s.r.o., Opava and C.C.T. International s.r.o., Liberec. Together with STFI, INOTEX organized sending of the samples from company PFAND.

The results are described in the following text.

This samples are the 100% PES edge stripes, approx. 5 cm width, white colour, without any chemical final treatment, only with slight termofixation. The produced amount is 2,5 – 3 tonnes / each moth; the production of PES fabrics takes place nearly every second day.

The scabs are pressed into bales, one has a weight of around 200 kgs.

Fig.No.4: PES egde strips from PFAND

Fig.No.5: Bales with PES egde strips

	Sample name	
SAMPLE name:	**ENTeR_PF01**	
Date:	20 November 2019	
Source:	Textilausrüstung Pfand GmbH, Germany	
Material:	100% PES knitted fabric (edges) - white, without any chemical treatment, only slight termofixation	

Assessment results:

a) Green way recycling, s.r.o., Opava

Company Green way recycling was interested in this type of textiles. It mihgt be used for manufacturing of the litter for the horse arenas (they just finished development of the new

product for this purpose) and part of this PES could be teared and used for automotive (as they cooperate with 3 automotive companies close to Green way recycling.)

So, samples were sent to Green way recycling fort the preliminary assessment. The verification tests are still needed to assess the real behaviour of the textiles on industrial machinery; testing is still ongoing.

b) C.C.T. International s.r.o., Liberec

Company C.C.T.International is producer of its original product HIPOSAFE. HIPOSAFE are additional geitextiles and textile mixtures for sand surfaces designed for all types of horse riding arenas. The material for this product has to be white or light colour, with high ability to absorb moisture (water). From ths point of view, the ideal material is PES fabric. (From this reason, the coated textiles wouldn´be suitable for this purpose, because they repels water rather than abrosbing; therefore, the textile waste of coated textiles is unusable for this purpose).

INOTEX contacted this company an offered the PES scrabs from PFAND. According to the answer from them, they need at first to provide the pilot tests on real industrial machinery to know the real behaviour of the material.

Because the trials are ongoing in company Green way recycling, the testing by C.C.T.International was not launched yet.

3.6. The cooperation with INNOVATEX on Hungarian pilot case

Based on the cooperation within the ENTeR project, INOTEX offered the project partner INNOVATEXT to ask the Czech company Green way recycling s.r.o., Opava if they would be interested in the hungarian pilot waste – the woolen felt from hungarian company Multifelt Factory Kft..

This waste is the mixture of the cuttings of woolen felt from 100% wool and from blend wool/viscose (80:20). The producing company is able to separate the cuttings from poor wool and from the blend, as well as to collect separatelly different colours. Company produces 300 kgs/year of the cuttings from 100% wool and approx. 1 tonne/year of the felten waste from the blend wool/viscose.

The samples of the felt cuttings were sent to the company Green way recyclin, s.r.o., for the preliminary assessment.

	Sample name	
SAMPLE name:	**ENTeR_HU01**	
Date:	29 November 2019	
Source:	Multifelt Factory Kft., Hungary	
Material:	100% wool; blend wool (80%) / viscose (20%)	

Assessment results:

Generally, the company would be interested in this material for processing by one of its customers. But the problem is, that the volumes available from the Multifelt Factory (300 kg/y and 1000 kg/y) are very low,; from this reason this is not interesting for them for any cooperation project – also taking into account the long distance from Hungary to Czech processing company. (They would need at least 1 tonne / month).

This conclusion demonstrates that however in some oft he partner regions would be possible to process and use the textile waste, the feasibility depends also on many other factors as e.g. volume of waste, ferquency oft he waste production, transport distance etc.

3.7. FT IR analysis of waste

Within this pilot case, the textile wastes were represented by textiles from various materials (100% cotton, 100% PES, 100% viscose, blends cotton/PES), without any coating or with warious coatings (starch, acrylates). For the processing, the processing company needs to know the composition.

There are the various methods of textile materials identification. The most common of them are:

1. Dissolution tests that utilize different solubilities of different types of textile fibers in organic solvents, lye or acids, either cold or hot. This procedure has been widely used, but it is lengthy for samples with a completely unknown composition and unpleasant for the laboratory staff due to the nature of the chemicals used.
2. Inspection of characteristic shape of fibers under light microscope - the method requires a worker with a knowledge of preparing the preparations for microscopy and skilled in the field of textile fibers.
3. Use of the Fourier Transform Infrared Spectrometer (FT IR) equipped with ATR adapter (ATR: Attenuated total reflection) - it is a modern, fast method, which enables quick identification of single-component textile materials in particular. However, in some cases it is necessary to combine this method with light microscopy (e.g. a blend of cotton and viscose or flax) or with dissolution tests (e.g. in case of multi-component materials).

INOTEX did the verification tests of the identification of textile materials in textile wastes samples by the FT IR method. The aim of these tests was to confirm that also in case of the heavy coated textiles, it is posible to identify the materials of the textile substrate.

21 samples of waste textiles were delivered for evaluation. For quick identification of used textile materials, the FT IR method was chosen. The samples were measured from the front and back side. In some cases, the preparation of the single yarn and at least a partial mechanical cleaning of the applied coating has proved to be suitable.

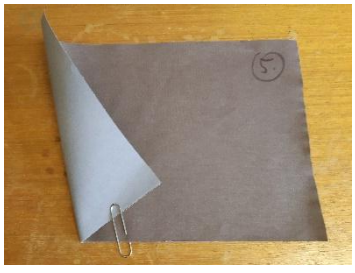
The measurement was performed on the device FT IR Avatar 330 from company Nicolet. Identification was performed by comparing the measured spectrum with spectra stored in a commercial library of the instrument and with standards measured directly in the laboratory.

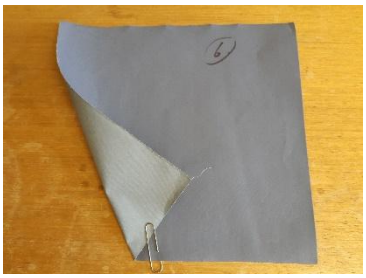
	Sample name	
SAMPLE name:	ENTeR_IN01	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	ENTeR_IN02	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	ENTeR_IN03	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% PES	

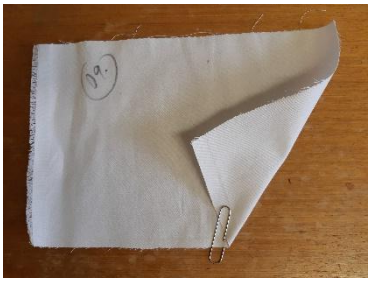
	Sample name	
SAMPLE name:	ENTeR_IN04	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	ENTeR_IN05	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN06**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN07**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN08**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN09**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% PES	

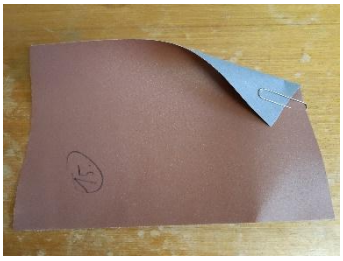
	Sample name	
SAMPLE name:	**ENTeR_IN010**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	ENTeR_IN011	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	ENTeR_IN012	
Date:	11 November 2019	
Source:	Company 1	
Material:	Cotton/PES	

	Sample name	
SAMPLE name:	ENTeR_IN013	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	ENTeR_IN014	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	ENTeR_IN015	
Date:	11 November 2019	
Source:	Company 1	
Material:	Cotton/PES	

	Sample name	
SAMPLE name:	**ENTeR_IN016**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN017**	
Date:	11 November 2019	
Source:	Company 1	
Material:	100% cotton	

	Sample name	
SAMPLE name:	**ENTeR_IN018**	
Date:	11 November 2019	
Source:	Company 1	
Material:	? (identified by FT IR as cotton/PES)	

	Sample name	
SAMPLE name:	**ENTeR_IN019**	
Date:	11 November 2019	
Source:	Company 1	
Material:	?	

	Sample name	
SAMPLE name:	**ENTeR_IN020**	
Date:	11 November 2019	
Source:	Company 2	
Material:	100% cotton (bookbinding cloth)	

	Sample name	
SAMPLE name:	ENTeR_IN021	
Date:	11 November 2019	
Source:	Company 2	
Material:	Viscose backed with paper	

Assessment results:

Based on this measurements, samples made of cellulose fiber (cotton, flax viscose) were selected. By checking these materials under a light microscope, 13 samples were identified as cotton and one sample as viscose. The combination of FT IR and light microscopy was used to determine the material composition of three blended samples as a cotton / PES blend. Idntification of 100% PES was identified only by FT IR.

It was possible to identify the material composition of most of the fabric samples. One sample could not be identified due to the very heavy coating. In summary, the set of samples contained 13 cotton samples, 3 polyester samples, 1 viscose sample, 3 samples made of cotton / polyester blend and one sample could not be identified.

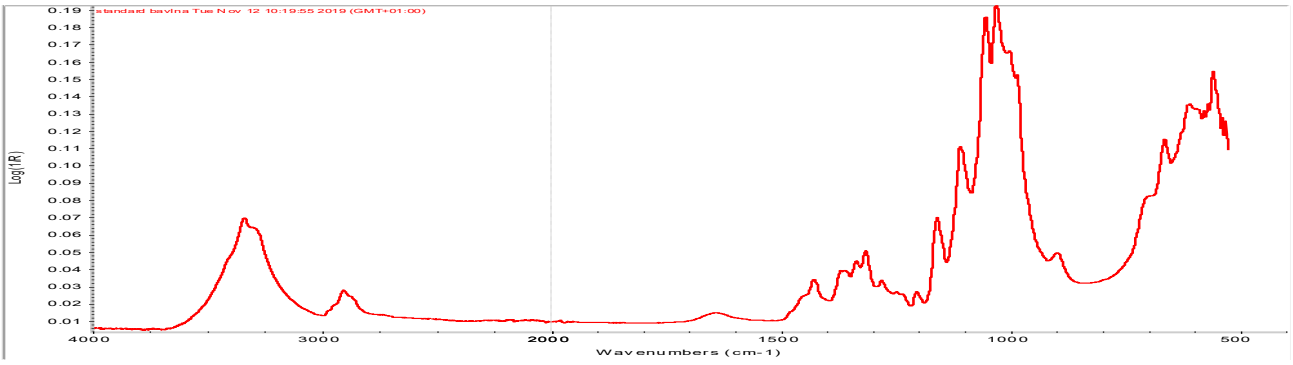


Fig.No.6: Standard spectrum – cotton

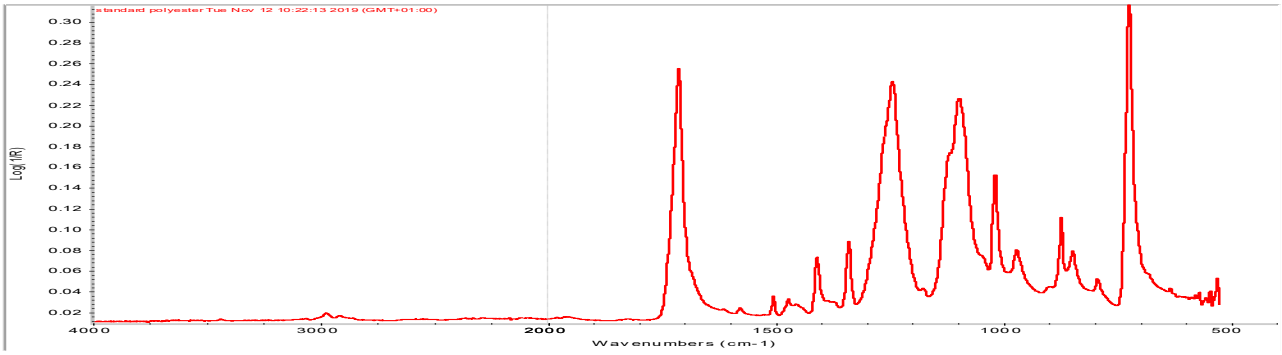


Fig.No.7: Standard spectrum – polyester

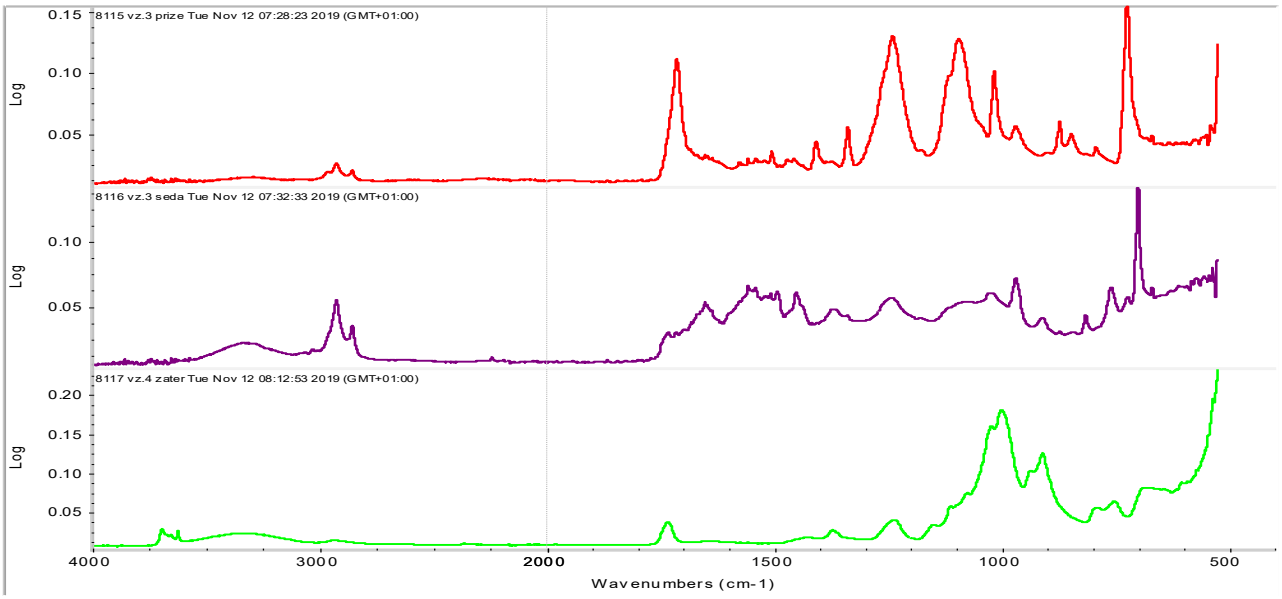


Fig.No. 8: Sample ENTeR_INO3 – polyester (identified from yarn, compliance with standard 95,9 %)

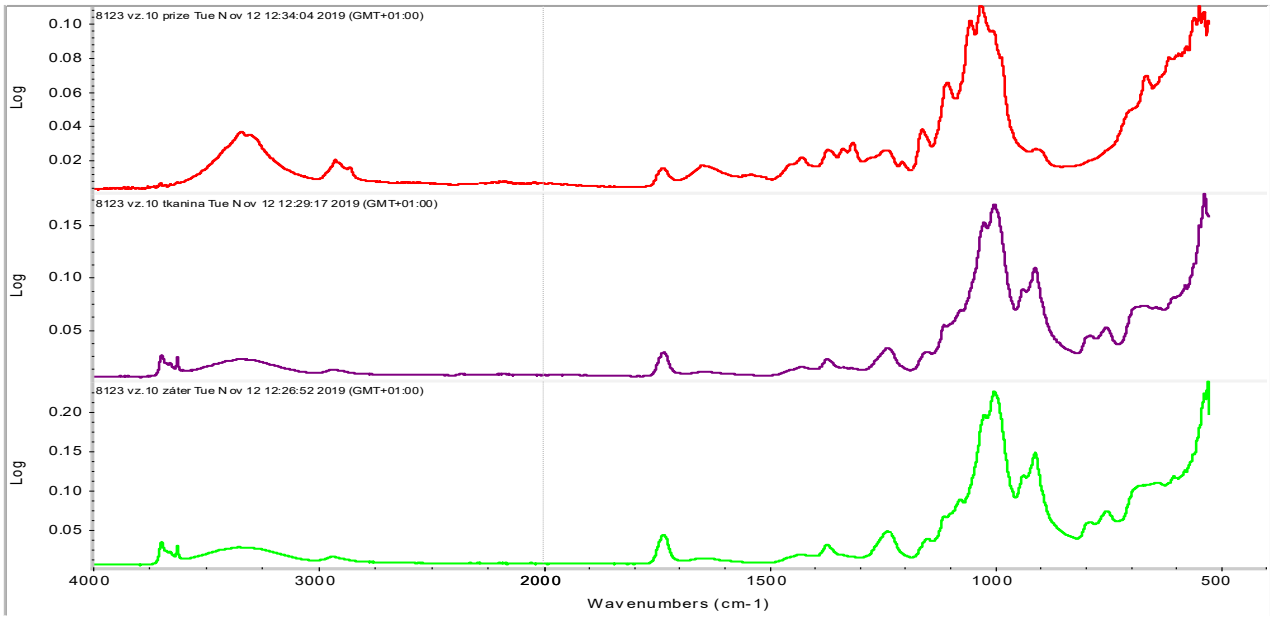


Fig.No.9: Sample ENTeR_INO10 – cotton (identified from yarn, compliance with standard 93,5 %)

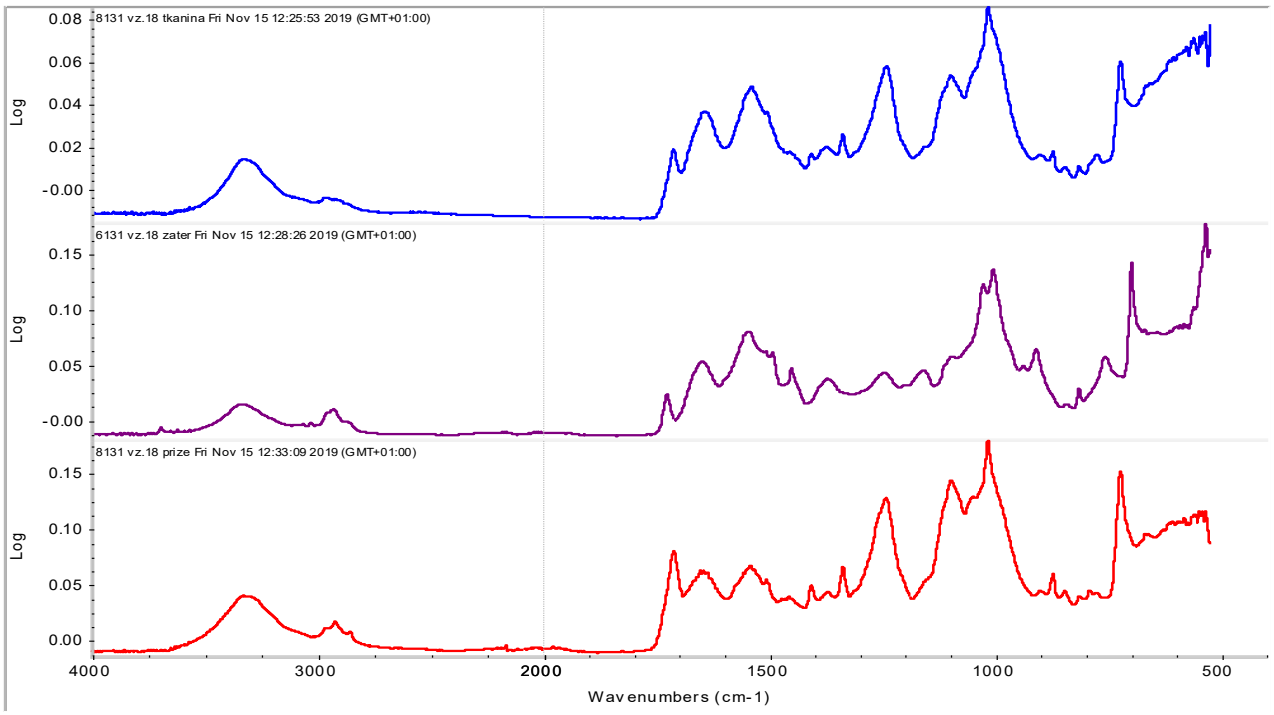


Fig.No.10: Sample ENTeR_INO18 – cotton/PES (identified from yarn, compliance with standard 90,4 %)

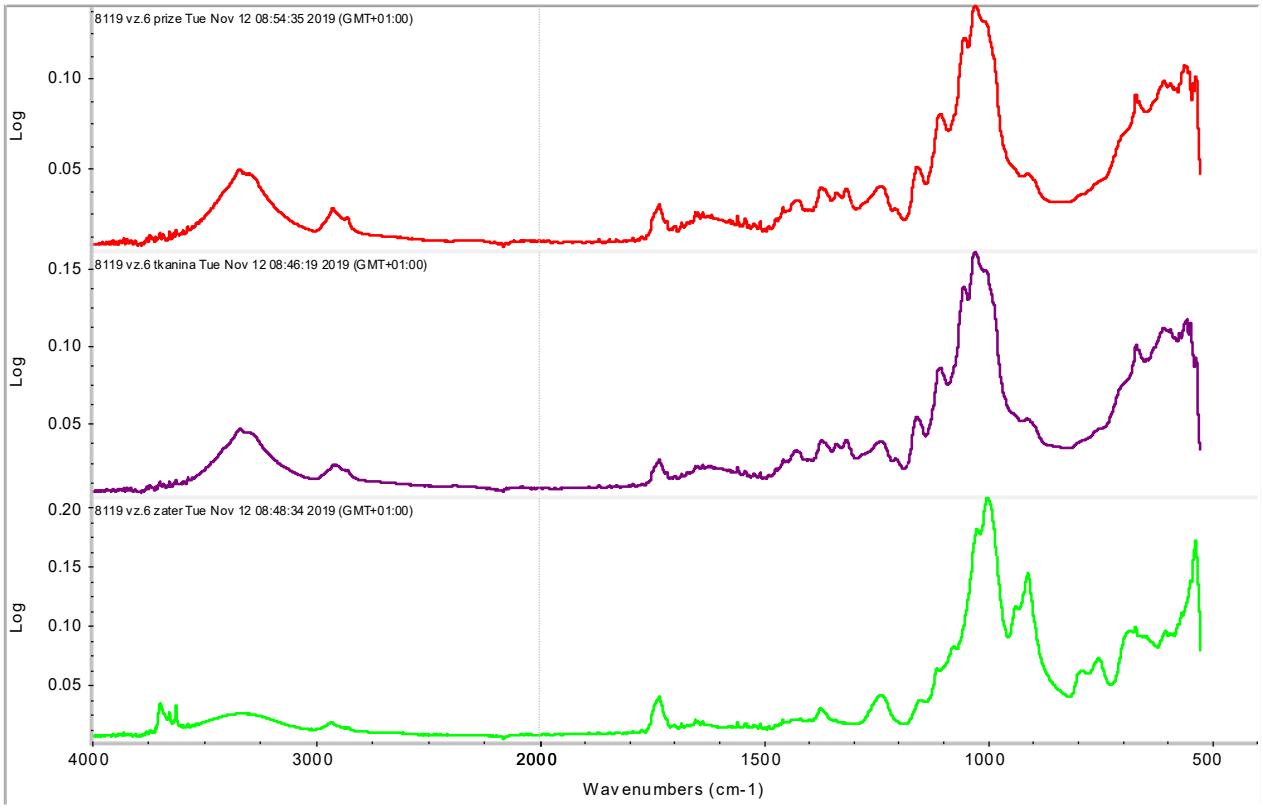


Fig.No.11: Sample ENTeR_INO6 – cotton (identified from fabric, compliance with standard 88,8 %)

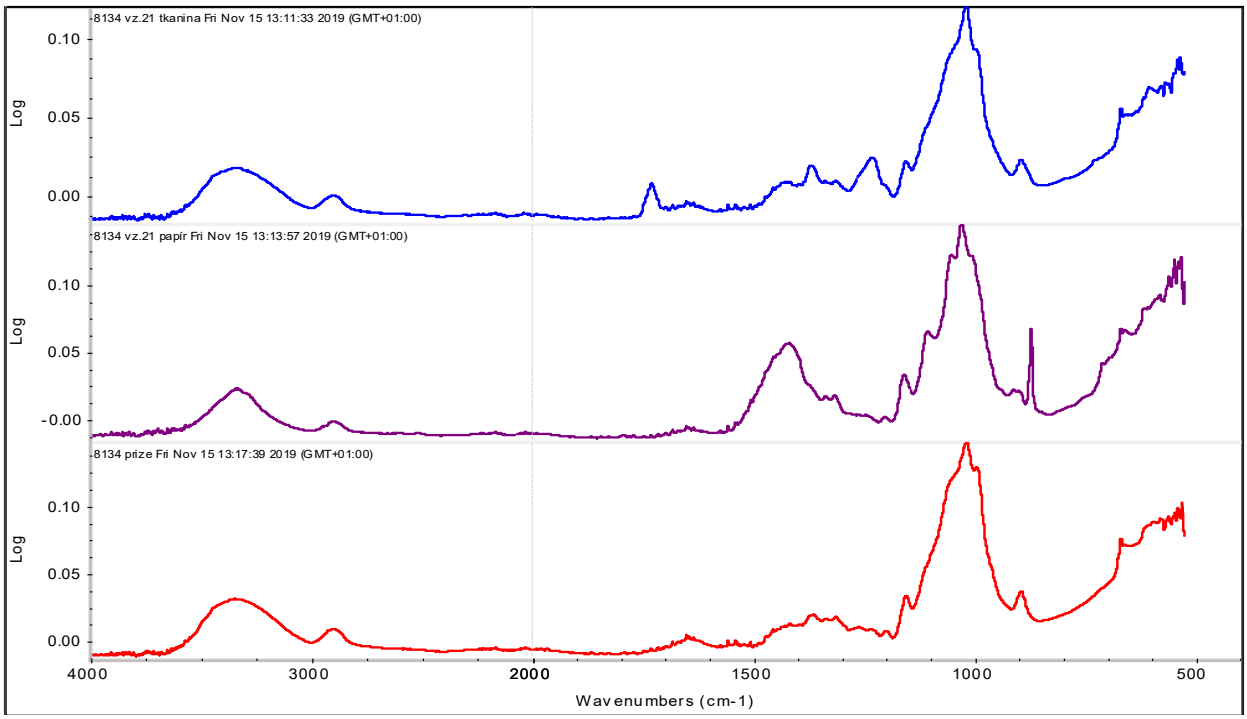


Fig.No.12: Sample ENTeR_INO21 – viscose (identified from yarn, compliance with standard 90,25 %)

4. Bibliography

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(4) http://www.gala.cz
(5) http://www.greenwayrecycling.cz
(6) http://www.klatex.cz
(7) http://www.mitop.cz
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(11) https://www.uotex.cz
(12) https://www.ibcsd.biz