D2.4 Textile product obtained

Grant Agreement Nº	EASME/EMFF/2017/1.2.1.12/52/03/552.789390		**Project Acronym**	OCEANETS
Project Title	Technological approaches for circular economy solutions in terms of prevention, recover, re-use and recycle of fishing gears to obtain added-value products in the textile industry			
Funding scheme	Sustainable Blue Economy: marine litter			
Start date of project	01/01/2019		**Duration of project**	30 months
Project coordinator	AIMPLAS			
Due date of Deliverable:	Month M27	**Actual date of Deliverable:**	Month M27	
Participant responsible:	SINTEX, a.s.	**Work Package related**	WP 2	
Dissemination Level *(mark with an ´X´ in the column to the far right)*	CO	Confidential, only for partners of the Consortium (including the Commission´s Services)		
	PU	Public		**X**
	PP	Restricted to other programme participants (including the Commission Services)		
	RE	Restricted to a group specified by the Consortium (including the Commission Services)		

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Content

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Overview

Main role of SINTEX work was in the WP2. The goal was to evaluate input recycled yarns supplied by ECOALF, develop and optimize fabrics in 4 different structures containing recycled nylon yarns.

Two of these new fabrics were also transformed into the final garments – specifically T-shirts and leggins suitable mainly for sport and leisure time activities.

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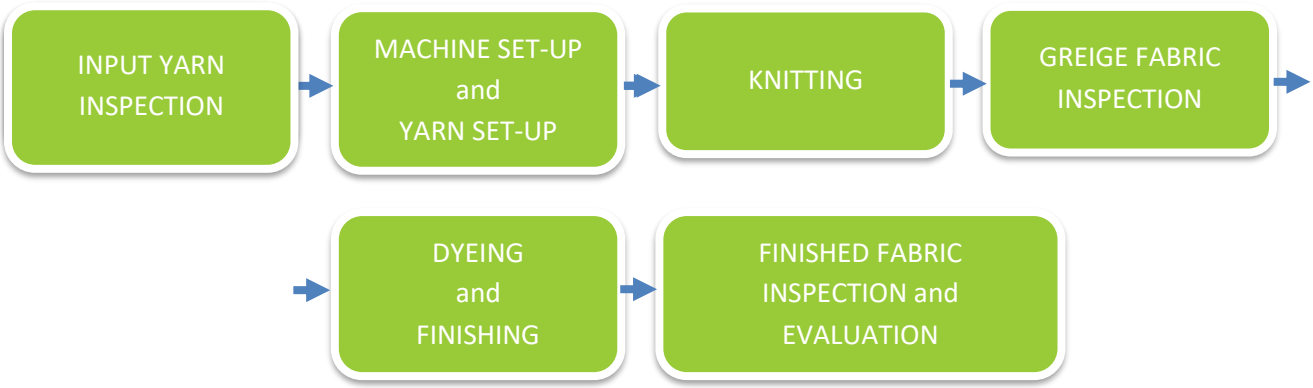
Description and objectives

Fabrics production process - SINTEX



Scheme of a production of knitted fabrics – SINTEX

Technological possibilities (machinery) - SINTEX

Production portfolio company SINTEX includes next technological possibilities:

- Single bed machines ……. production of fabrics like single jersey, pique, laid-in fabric
- Double bed machines ……. production of fabrics like interlock, double face, rib
- Flatbed machines ……. production of collars and cuffs

Regarding the machinery there are available types:

- Mayer&Cie with diameter 30", and gauge 18E, 20E, 22E, 24E and 28E
- Terrot with diameter 34" and gauge 18E
- Monarch with diameter 30" and gauge 28E
- ZENIT with diameter 30" and gauge 20E
- Shima Seiki (flatbed) with length 122 cm and gauge 12E
- Libra 130 (flatbed) with length 130 cm gauge 12E

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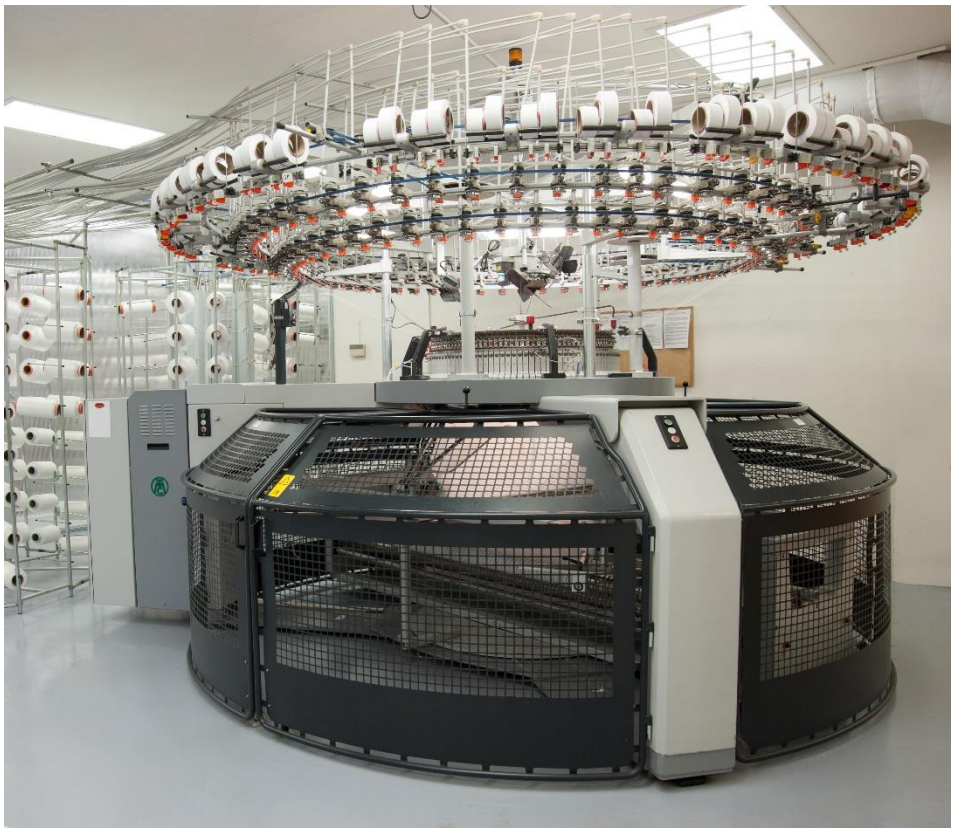

Photo of knitting machine Mayer&Cie

Final selected fabrics

There were next four final optimized fabrics selected as the output of the project:

CIRCULAR KNITTED FABRICS

- Elastic single jersey – heavy version – leggins (single bed machine) – code JC1152
- Elastic single jersey – light version - T-shirt (single bed machine) – code JC1153
- Elastic rib fabric – 270 gr/m^2 (double bed machine) – code FSC2246

WOVEN FABRIC

- Plain weave – 150 gr/m^2 (sampling weaving loom) – code CCI 0509 B

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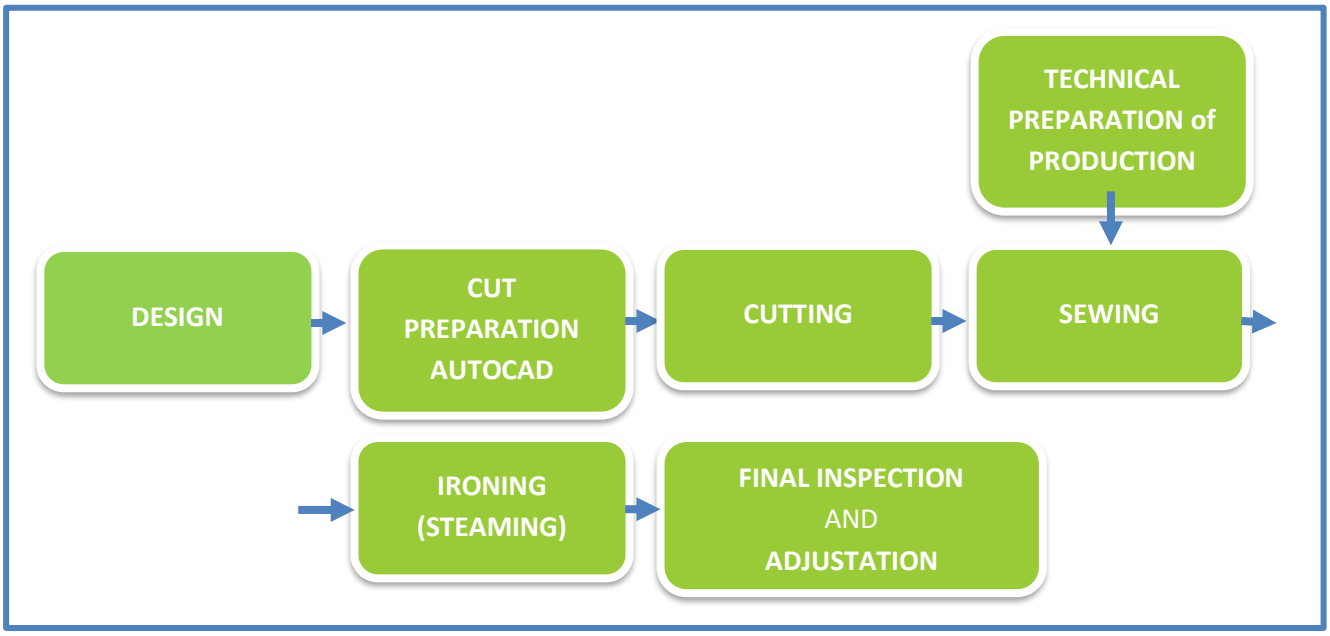
Clothing technology

The final garment production process starts with creating a design with all necessary details and ends with finished garments and their inspection and adjusting. The whole process with all his steps is shown on the Scheme below.

Scheme – Clothing technology



Final selected garments

There were next two final optimized garment types:

- Ladies leggins EASY – made from the fabric code JC1152 in blue and black colour
- Ladies T-shirt MARIKA – made from the fabric code JC1153 in blue and black colour

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Experimental design

Next steps were arranged by SINTEX in the frame of WP2 for optimized fabrics and garments:

- Yarn testing - new developed yarn – dope dyed with traceability; checking of mechanical-physical properties and testing of workability in knitting production
- Development and pilot production of 4 new types of knitted fabrics – 2x single jersey with elastan, 1x rib fabric with elastan, 1x woven fabric
- Fabric dyeing and finishing
- Fabric testing and evaluation – comparison with benchmark samples
- Development of laboratory dyeing technology for black colour and fabric re-dyeing and finishing
- Testing and evaluation of finished fabrics
- Comparison fabrics properties with requirements of standard OECOTEX Standard 100 (ecological and hygienic harmlessness, colourfastness in different conditions, etc.)
- Production of garment samples – ladies T-shirt and leggings from the optimized fabrics JC1152 and JC1153 and their evaluation including the wearing tests and evaluation of the tracker workability
- Preparation of technical datasheets for optimized fabrics and garments including recommendations for maintenance
- Spread final garment samples to the project partners

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Main results

Yarns

Yarn evaluation – all yarns have very good workability and suitable physical-mechanical properties – see details in below table:

	Testing method	Recycled PAD filament 167 dtex f 72x1
Yarn count (dtex)	EN ISO 2060	201,60
Variation coefficient (%)		0,79
Number of individual filaments (pc)		72
Force (cN)	EN ISO 2062	473
Max/min (cN)		521/431
Variation coefficient (%)		5,00
Tensile strenght (cN.dtex^{-1})		2,35
Elongation (%)		30,9
Max/min (%)		35,7/24,7
Variation coefficient (%)		9,41
Shrinkage in water 90 °C (%)	ČSN 80 2530	- 12,98
Preparation content (%)	ČSN 80 0523	1,18

Fabrics

Fabrics were produced in blue colour (dope-dyed yarns) and part of the elastic single jerseys were also produced in black colour. Finally, there were produced more than 300 metres of optimized fabrics. Planned was production of 50 metres.

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All fabrics meet the set-up requirements. Final parameters are in the tables below:

Final fabrics parametres – table I	**Testing method**	**JC 1152 blue**	**JC 1153 blue**
Contain of material		90% PAD/10% Lycra	94% PAD/6% Lycra
Type		Single jersey elastic	Single jersey elastic
Square weight ($g.m^{-2}$)	EN 12127	282	248
Width (cm)	EN 1773	158	168
Dimensional change 1. washing 40 °C (%)	EN ISO 6330	-1,7/-2,7	-1,6/-1,4
Fabric propensity to surface fuzzing and to pilling	EN ISO 12945-2	5/5/5/5/5/4-5 5/4-5/4-5/4-5/4/4	5/5/5/5/5/5 5/4-5/4-5/4-5/4/4
Abrasion resistance by the Martindale method	EN ISO 12947-2	> 70 000	> 70 000
Colour fastness to rubbing – dry/wet	EN ISO 105-X12	4-5/4-5	4-5/4-5
Colour fastness to perspiration – acidic, alkaline	EN ISO 105-E04	4-5/4-5	4-5/4-5
Colour fastness to domestic and commercial laundering	EN ISO 105-C06	4-5	4-5
Colour fastness to water	EN ISO 105-E01	4	4
pH aqueous extract	EN ISO 3071	7,4	7,4

Free and hydrolysed formaldehyde ($mg.kg^{-1}$)	EN ISO 14184-1	No detect	No detect
Colour fastness to light	Q-SUN XE1S	6	6
UPF	EN 1758-1 + A1	1000	1000

Final fabrics parametres – table II	**Testing method**	**FSC 2246 blue**	**CCI 0509 B blue**
Contain of material		94% PAD/6% Lycra	100% PAD
Type		Double jersey elastic	Woven fabric – plain weave
Square weight ($g.m^{-2}$)	EN 12127	271	148
Width (cm)	EN 1773	169	
Dimensional change 1. washing 40 °C (%)	EN ISO 6330	-1,3/-2,4	-1,8/-0,7
Fabric propensity to surface fuzzing and to pilling	EN ISO 12945-2	5/5/5/5/5/5 5/5/5/5/5/5	5/5/5/5/5/5 5/5/5/5/5/5
Abrasion resistance by the Martindale method	EN ISO 12947-2	> 100 000	> 120 000
Colour fastness to rubbing – dry/wet	EN ISO 105-X12	4-5/4-5	4-5/4-5
Colour fastness to perspiration – acidic, alkaline	EN ISO 105-E04	4-5/4-5	4-5/4-5

Colour fastness to domestic and commercial laundering	EN ISO 105-C06	4-5	4
Colour fastness to water	EN ISO 105-E01	4-5	4
pH aqueous extract	EN ISO 3071	7,2	6,4
Free and hydrolysed formaldehyde ($mg.kg^{-1}$)	EN ISO 14184-1	No detect	No detect

Final fabrics parametres – table III	**Testing method**	**JC 1152 black**	**JC 1153 black**
Contain of material		90% PAD/10% Lycra	94% PAD/6% Lycra
Type		Single jersey elastic	Single jersey elastic
Square weight ($g.m^{-2}$)	EN 12127	312	221
Width (cm)	EN 1773	147	159
Dimensional change 1. washing 40 °C (%)	EN ISO 6330	-1,3/-2,2	-6,0/-1,2
Fabric propensity to surface fuzzing and to pilling	EN ISO 12945-2	5/5/5/5/4-5/4-5 5/4-5/4-5/4-5/4-5	5/5/5/5/5/5 5/4-5/4-5/4-5/5/5
Abrasion resistance by the Martindale method	EN ISO 12947-2	> 70 000	> 70 000
Colour fastness to rubbing – dry/wet	EN ISO 105-X12	4-5/4-5	4-5/4-5

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Colour fastness to perspiration – acidic, alkaline	EN ISO 105-E04	4-5/4-5	4-5/4-5
Colour fastness to domestic and commercial laundering	EN ISO 105-C06	4-5	4-5
Colour fastness to water	EN ISO 105-E01	4	4
pH aqueous extract	EN ISO 3071	7,4	7,1
Free and hydrolysed formaldehyde ($mg.kg^{-1}$)	EN ISO 14184-1	No detect	No detect
Colour fastness to light	Q-SUN XE1S	6	6
UPF	EN 1758-1 + A1	1000	1000

Conclusions

Main goal of the WP2 was reached. There were evaluated input recycled yarns supplied by ECOALF, developed, optimized and evaluated fabrics in 4 different structures containing recycled nylon yarns. There were also developed and produced two types of final garments – T-shirt and leggins including wearing tests.

For all products were prepared technical datasheets including maintenance recommendations.

There is necessary to highlight next moments and experience from the WP2:

- good yarn workability during knitting and sewing process
- almost excelent fabric properties .... mainly Martindale pilling and abrasion, UPF properties and colourfastnesses, low shrinkage after washing, etc.
- good garment performance during wearing tests
- working of the yarn tracker even after re-dyeing fabrics to black colour
- the weaker point is uneven yarn colour (blue) - and it is necessary solve it in the future development to keep product with "lower water consumption"

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