

European Good Practices in New materials and new applications

**Hospital service textiles – new tools
employing, bio- and smart,
aiming at dematerialization and circular
economy**

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“New materials and new applications ”
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COMPANY PROFILE

inoTEX®

INNOVATION FROM THE SOURCE

**69 years experience in innovation
for textile wet processing**

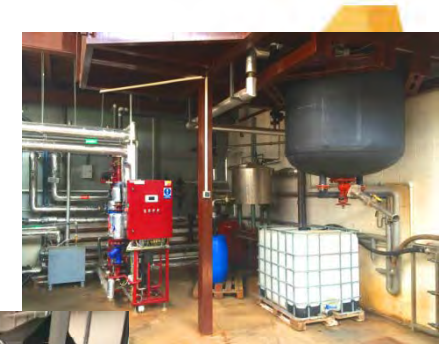
**R&D – Technology Transfer –
Special small-lot productions – Services**

Key strategy:

**Implementation of tailored R&D into the
practice by use of own start-up productions**

- **textile chemistry and biotechnology, colouristic**
- **special machinery equipment and devices**
- **textile testing and analytical lab**
- **eco-services and consultancy**

WE OPERATE IN THE HEART OF EUROPE



HOSPITAL SERVICE & ELDERLY PEOPLE LIFE STANDARD IMPROVING TEXTILES



One of steady growing market segments
rising volumes under the continuous pressure of costs
(often under the public tender vendor selection)

- **Functionality** = protection + comfort
 - **Durability** = compensation of higher added value
step towards resource sustainability (dematerialization)
 - **Customised solutions** = interdisciplinary approach

PROGRESS IN MEDICAL CARE x TEXTILE INNOVATION x MAINTENANCE SERVICES

Preconditions for extensional growth on the market

THREE INOTEX CONTRIBUTIONS USING THE NEW APPROACHES TO GET THE INNOVATIVE EFFICIENT PROBLEM SOLVING



- A) **Bio-modification of PES textiles** – durable comfort and functionality
- B) **Durable functional textiles for daily hospital use** – dematerialization supported by maintenance services
- C) **Smart flexible electronic** – wound dressing sensor

Results of interdisciplinary project activities

Efficiency – knowledge based solution – envi sustainability

New complex model – higher comfort and PPE efficiency costs covered by less cost per 1 cycle of use

STEP TOWARDS THE CIRCULAR ECONOMY (ETP TC SIRA vision)

A) BIO-MODIFICATION OF PES TEXTILES

Selective enzymatic treatment – an emerging tool of PES hospital and clean room garment functionalization

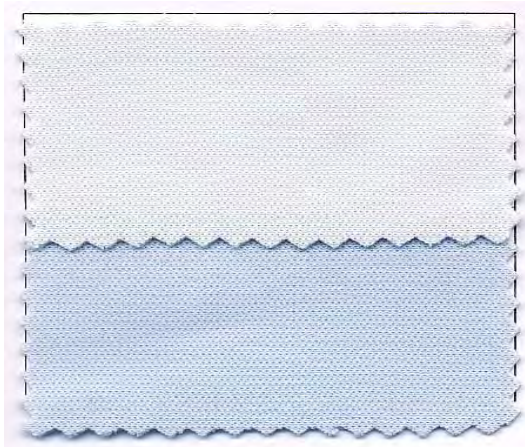
TEXAZYM PES

The unique functionalization of PES fibre substrate to improve required durable protective properties and comfort of widely used PES type of synthetic fibre

The supposed PET polymer structure modification mechanism:



C.I.Reactive Blue 19



Confirmation of durability
- enzymatic PET structure modification
presence of - OH groups by Reactive dyeing (0,5% dye)

Colourfastness properties modif.PES

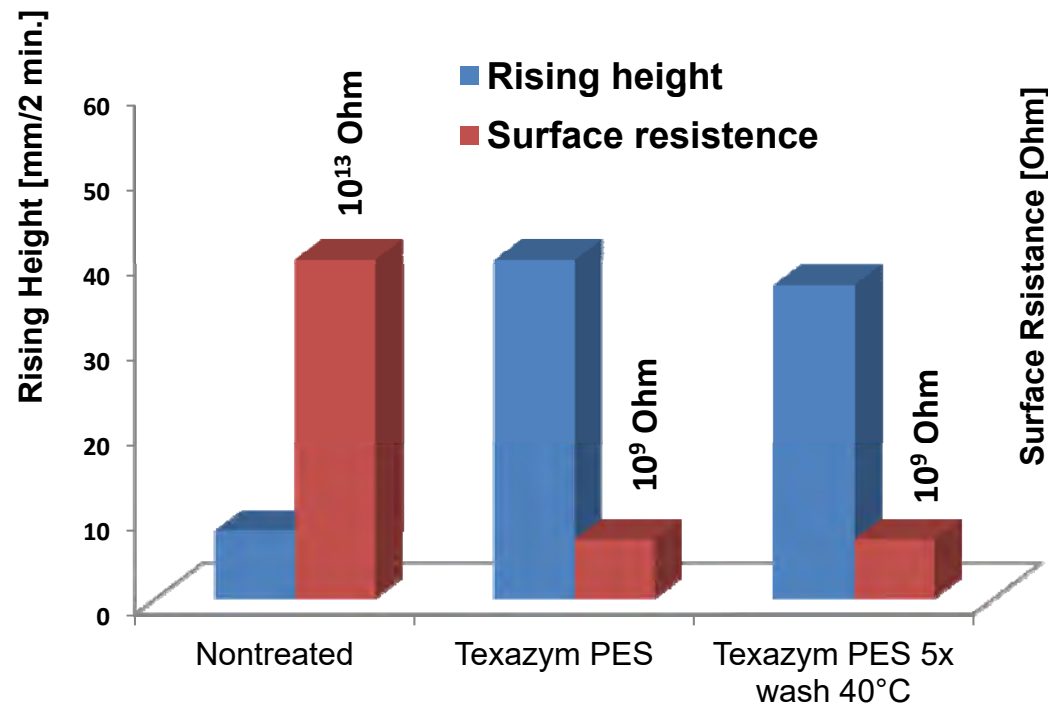
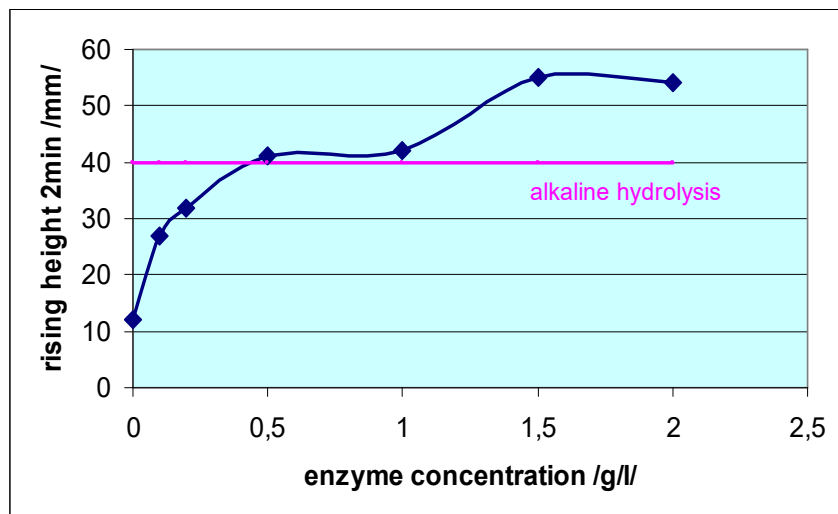
| | |
|-------------------|--------------------|
| water | : 4D / 4-5 / 4-5 |
| washing 40°C | : 4-5D / 4-5 / 4-5 |
| alk. perspiration | : 2-3D / 4-5 / 4-5 |
| wet rubbing | : 4-5 |
| dry rubbing | : 4-5 |

ENZYMATIC MODIFICATION OF PET

Substrate: 100% PES, TWILL 160 g/m²

Treatment: enzymatic: 0-2 g/l TEXAZYM PES, pH=4,5-5,5, 40°C, 35 min., washing JIG (Jet, winch)

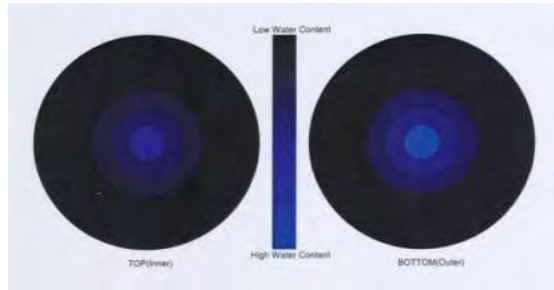
Alkaline: 20 g/l NaOH (s), 98°C, 45 min., washing



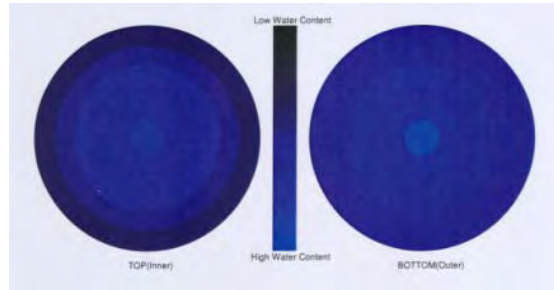
| process | Weight lost (%) | | | |
|-------------|-----------------|-----------|-----------------|----------------------|
| | 86 g/sgm | 122 g/sgm | 113 g/sgm Micro | 160 g/sgm Trevira CS |
| alkaline | 5,56 | 10,35 | 10,23 | 14,8 |
| Texazym PES | 0,56 | 1,02 | 0,8 | < 1,0 |

ENZYMATIC MODIFICATION OF PES

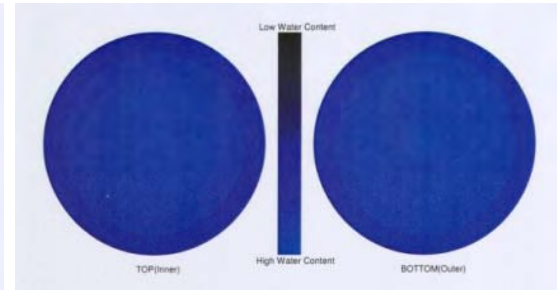
3D moisture spread in the modified PES fabric (MMT-SDL)



Blank: PES THERMOFIX

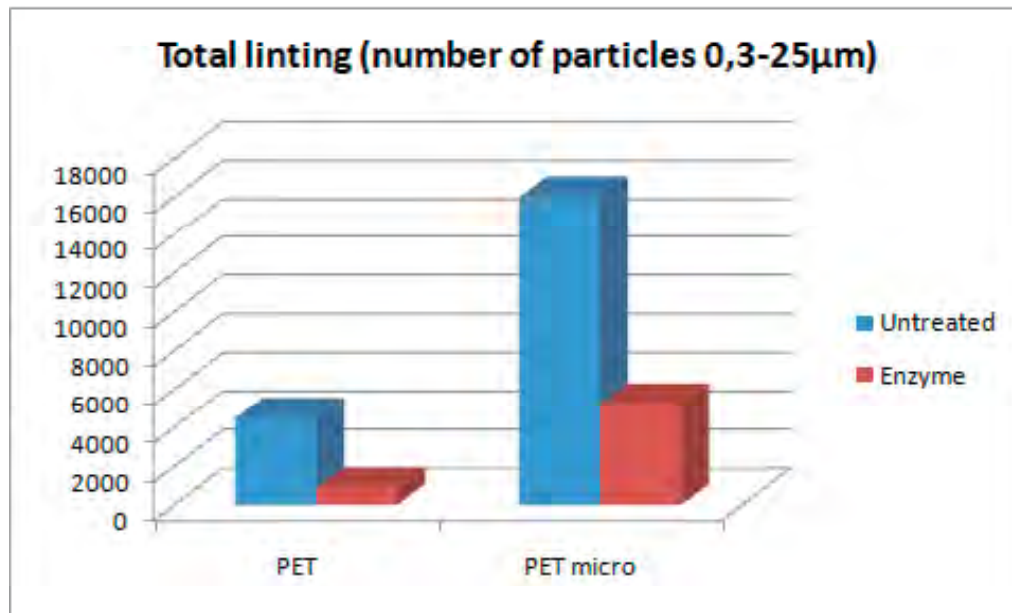


TEXAZYM PES



Alkaline hydrolysis

Linting measurement



ISO 9073-10 Clean Room Class 5 (EN ISO 14644-1)

RESULTS:

- Improvement of PET hydrophilicity and antistatic properties
- Contrary to harsh alkali de-weighting no loss of weight (< 1% against 20%)
- Durable polymer functionalization (-OH, -COOH) step towards functionality, CR, physiological comfort
- selectivity of enzyme – blends can be functionalized
- no lost of weight – no change of construction
- step towards dematerialization, long service life

B) DURABLE TEXTILES FOR DAILY USE AND LAUNDRY



Health care service functional textiles incl. re-activation by laundry services

Large volumes of textiles and garments – part of daily life of hospitals and other health care facilities exposed by massive dirt and contamination

Microbial contamination can significantly negatively influence the whole medical treatment (risk of nosocomial infections)

Co/PES blends offer an excellent resistance against mech-phys damages
durability of functional effects often fail more quickly

- **Harmonisation of durability and functionality** – part of maintenance services – revitalization of AMB by industrial laundry
- **Improvement of physiology comfort** (sufficient as such) can be realised by enzymatic hydrophilization
(antistat = soil release treatment)

DURABLE TEXTILES FOR DAILY USE AND LAUNDRY

Comparizon of service life 100% Co vers. **Co/PES 50/50** 145 g/m² (bed linen)
190 g/m² (staff clothing)

AMB treatment AEGIS MAEDICAL (modified) on enzyme premodified fabric (pad application)
laundry procedure: **chemothermo disinfection 60°C**

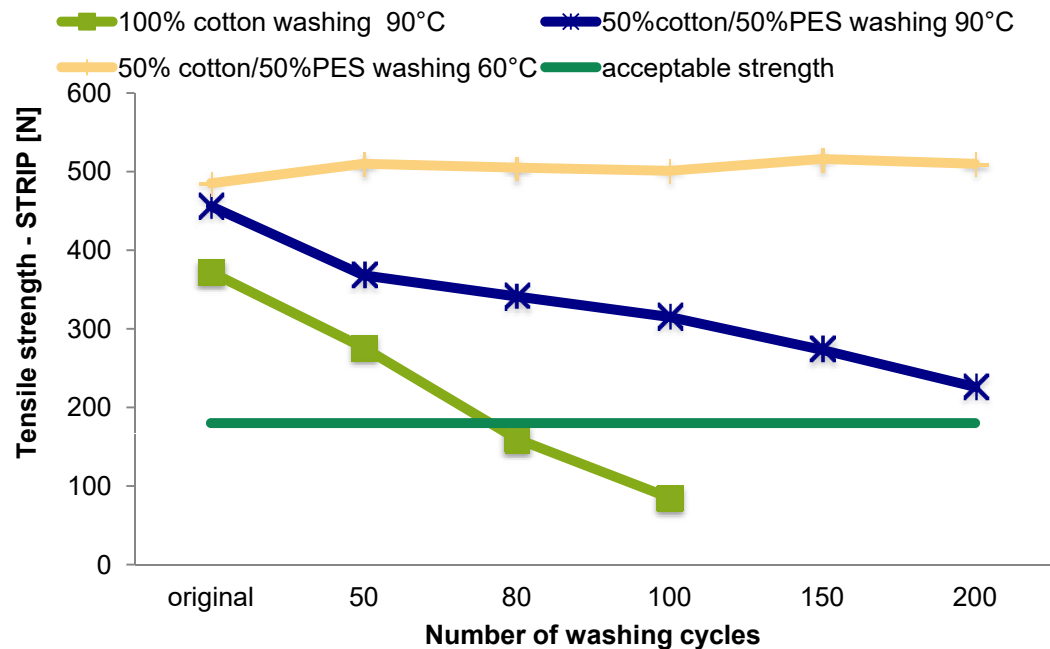
reactivation in hospital laundry – washextractor (4% w.o.f. 1:10, 30 min. 40°C)

tensile properties determination: EN-ISO13934-1, part 1

antimicrobial properties: AATCC 147-2004, ISO 20743:2007



Durability of fabric



RESULTS:

- Blends Co/PES durability more than 2,5x of 100% Co 240 against 80 cycles (nurse garment prototypes after 400 cycles in use)
- After 50 wash cycles (CHT 60°C) AMB „reactivation“ – laundry
- Confirmed in by intensive clinical use (ChUni Prague General Hospital) and hospital laundry (Regional Claudians hospital M.Boleslav)
- **New tender criteria proposed „cost per 1 cycle of use“**

DURABLE TEXTILES FOR DAILY USE AND LAUNDRY

Next development:

DURABLE FR TREATMENT OF LIGHT WEIGHT 100% Co AND Co/PES 50/50 TEXTILES

(PPE EN ISO 15025, EN ISO 14116: 3/25x60, BED LINEN: EN ISO 12952)

TEXAFLAM DFR (Inotex) system

- Unique halogen, antimony, VOC, formaldehyde-free system
- Minimum loss of strength (tear strength) = light weight fabrics
- No yellowing, no significant change of soft handle, breathability
- WAH PERMANENT FR (at least 25x60°C and more)

Multifunctional properties:

- FR + antistat (suitable for textiles with antistat fibre content)
- FR + WR/OR(single bath application with FC₆)
- OBA compatible (for full white)

Processing: impregnation – dry – cure – washing
PADDING / STENTER x JIG, JET



High wearing comfort – breathable – moisture transport – soft handle

C) SMART FLEXIBLE ELECTRONIC

Autonomous sensor for detection of the saturation of wound dressing by moisture

Advanced wound dressing – one of fast expanding segment of medical textiles
Ageing of population – higher demand for accelerated treatment of complicated lengthy ulcerations (pressure ulcers, diabetic foot etc.)

Appropriate level of moisture = exudate flow key to the effective wound healing

- Modern concept
- „(bio) active“ wound contact layer
 - „drainage“ absorbing exudate
 - bandage (top fixing) + moisture sensor



moisture sensor



fixing bandage

drainage (exudate sorption)

(bio)active contact layer

wound

Monitoring of wound dressing humidity

Flexible printed autonomous sensor based on simple electrochemical cell

- exudate = electrolyte low voltage generated
- electrochromic sensor changes its colour



Dry

Wet

- no wires - no mobility tie down
- no risk of disconnecting
- light weight

less risk of severe pain and wound devastation by redressment

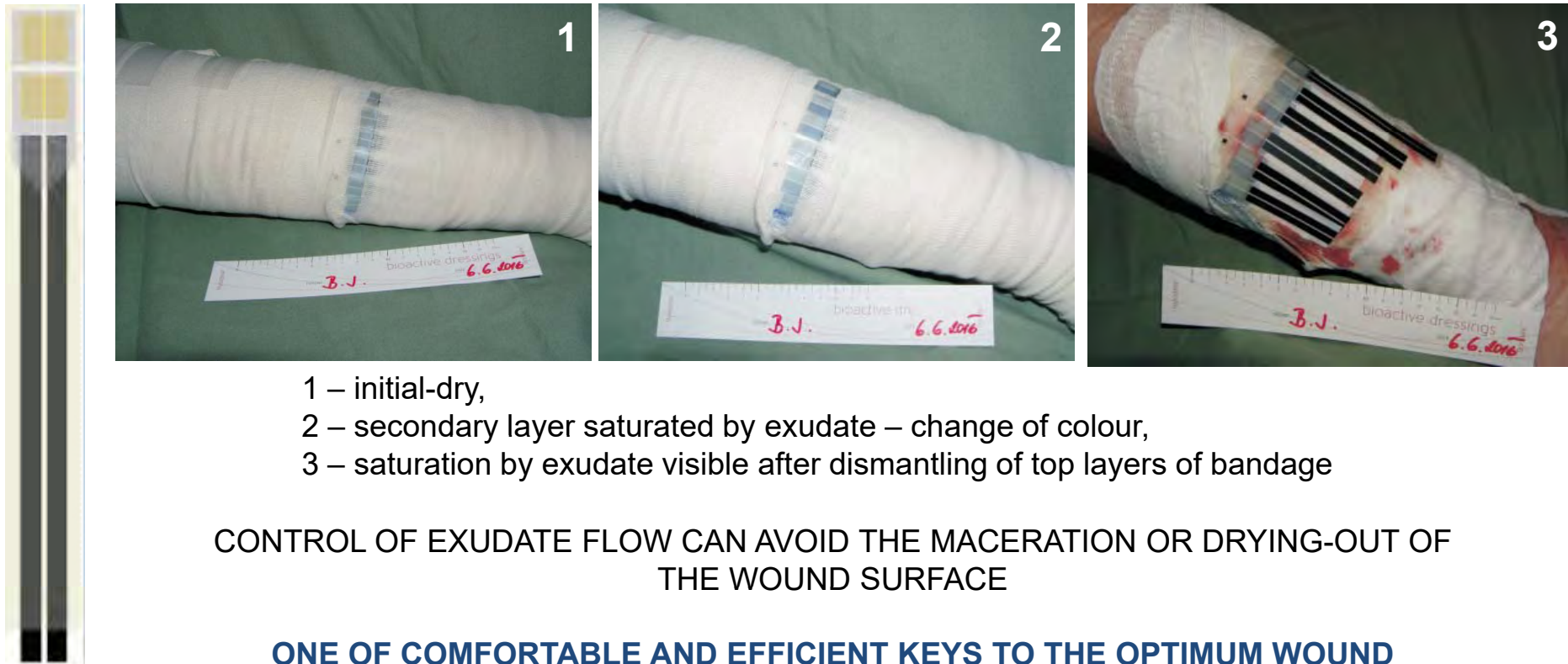
Prolongation of primary active layer exchange

Simple monitoring of drainage layer saturation – by variable seceration

Low cost – single use – disposable sensor

FULLY AUTONOMOUS (WIRE-LESS) MONITORING OF THE WOUND DRESSING HUMIDITY

Fixed in between the secondary „drainage“ layer it allow to identify saturation of the bandage that needs to be changed



- 1 – initial-dry,
- 2 – secondary layer saturated by exudate – change of colour,
- 3 – saturation by exudate visible after dismantling of top layers of bandage

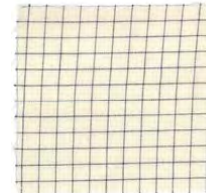
CONTROL OF EXUDATE FLOW CAN AVOID THE MACERATION OR DRYING-OUT OF THE WOUND SURFACE

ONE OF COMFORTABLE AND EFFICIENT KEYS TO THE OPTIMUM WOUND HEALING PROCESS

WHAT ELSE ?

SMART – FLEXIBLE ELECTRONIC FOR HEALTH CARE / ELDERLY PEOPLE

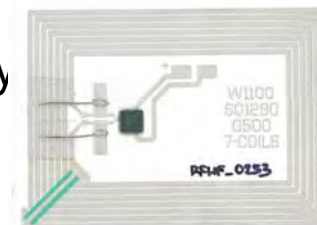
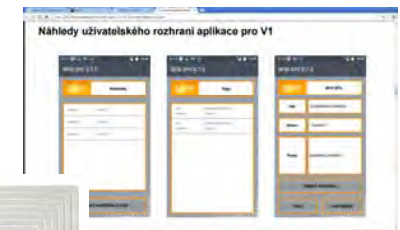
- application of organic electroconductive polymers (PEDOT, PPY) on textile substrates – yarn/fabrics
 - flexible e-textiles
 - antistatic, e-conductive, heating



- pressure responding sensors (e-polymer/3D textiles)



- sensors / tags as a building blocks for complex ICT monitoring of PPE within the producer - user – maintenance service systems
 - PPE/bed linen leasing - shared economy
 - towards dematerialization as part of circular economy



WHAT ELSE ?

(MULTI) FUNCTIONAL HEALTH CARE SERVICE TEXTILES (CO, CO/PES – 50/50)



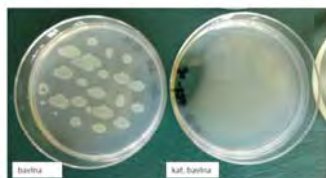
- **functional reactive dyeing with inherent antiodour / cleaning effect**
singlet oxigen based, long lasting, durable 60°C + CHTD

Clothing
Face masks
Bedlinen



- **functional FR + AMB system (AgNPs)**

durable FR + AMB with minimized leakage of AgNPs
durability in repeated hospital CHTD laundry
(peracetic acid, 60°C)



Protective clothing
Bedlinen
Full- white goods



ACKNOWLEDGEMENT



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IN CLOSE COLLABORATION WITH:



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RESET

Interreg Europe



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TEXTILES

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Thank you!

