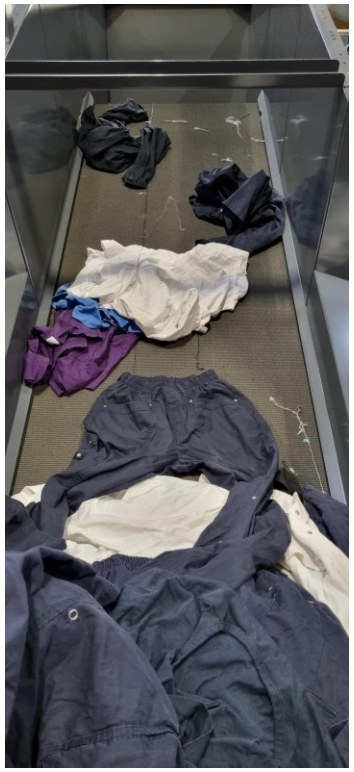
# Recycling – Status, Challenges and Design

1. Sorting of textiles for recycling
2. Processing – Fibre to fibre
3. Processing – Dissolution
4. Market development – global data
5. Message from the market
6. Decision making basic information
7. Recycling, Recycling and Recycling
8. Design for recycling

# Sorting of textiles for recycling

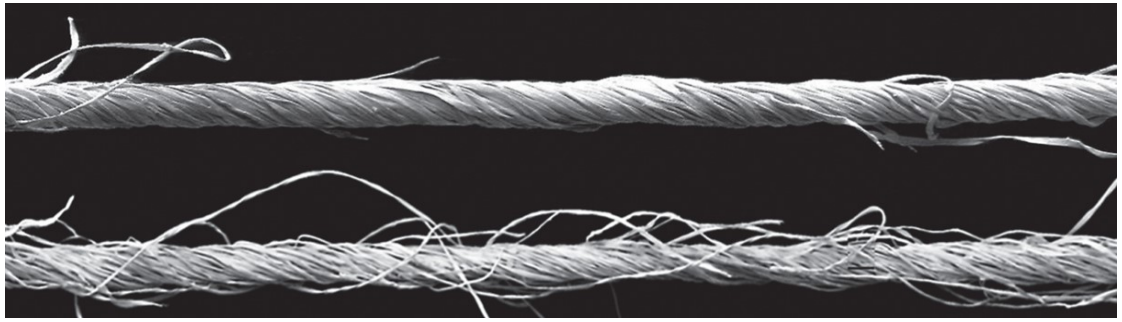
1. Sorting – NewRetex as example
   - 4 sensor types (e.g. NIR, AI, VIS, )
   - Accuracy app. 95%
   - 4 robots
   - Sorting in 30 fractions (colour/type)
   - 50 Tons/week capacity
   - Data recordings
   - Traceability to fibre/yarns

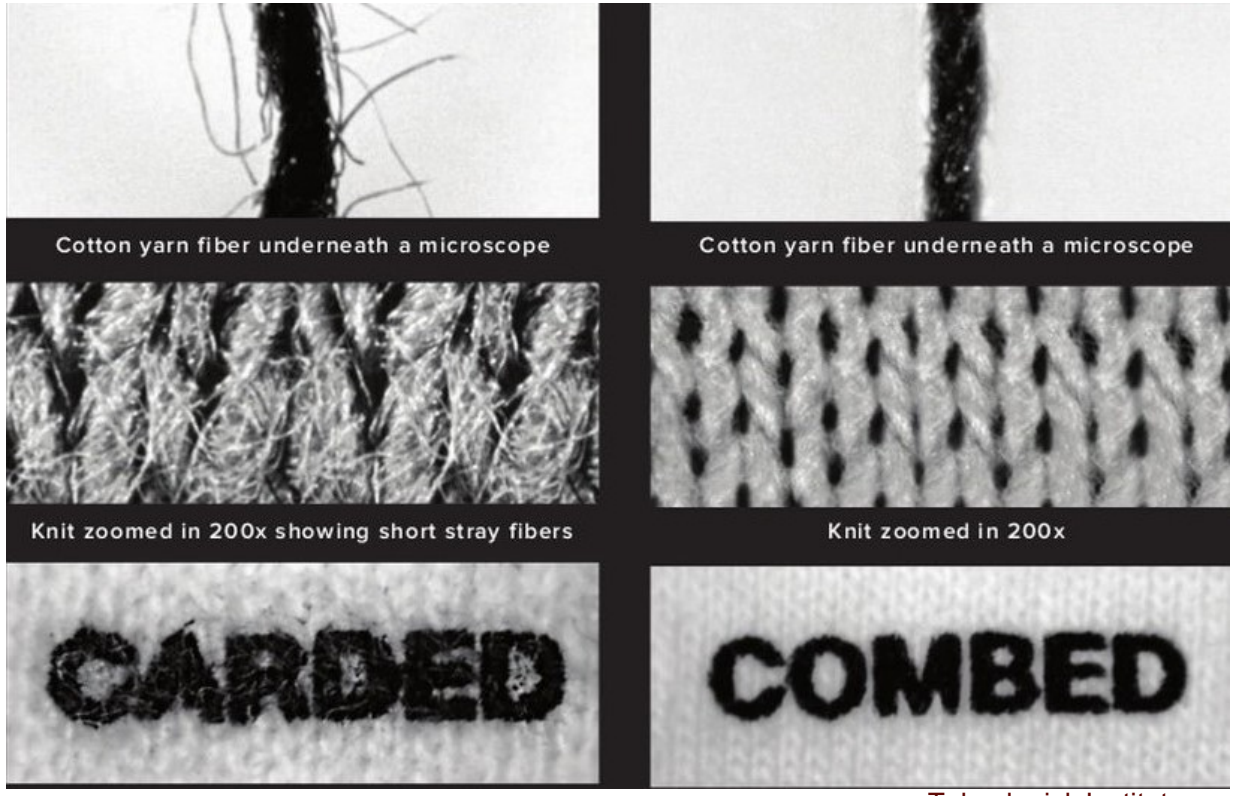



# Processing – Fibre to fibre

Optimal properties:

- Long fibres
- Crinkled, twisted, wavy
- Uneven fibre surface structure





# Processing – Fibre to fibre

Shredding → Opening → Carding

- Reduced fibre length
- General breakdown of polymeric chains
- Increased fragility and crispness
- Increased tendency to fibrillation

(virgin cotton 3-6 cm) → Increasing yarn twist

Cotton polymeric chains
app. 3.000 monomers

# Processing – Fibre to fibre

- Limited percentage of recycled fibres
- Pilling
- Dustformation
- Weight loss

Advantage:

Method with least use of chemistry and resources!

- *Legislative product liability – REACH etc. ???*

# Processing – Dissolution

Fibre → Dissolution (Chemicals, Solvents) → Polymerization into new fibre (Chemicals)

- Dissolution of cellulotic fibres
  - Regenerated fibres
- Dissolution of man made fibres
  - Stripping of PES-fibres
  - PET-bottles

➢ Lots of new and exciting fibres in the market, especially regenerated cellulosic fibres

# Processing – Dissolution

## Challenges:

- Fibremixtures
  - Improvements has been made
  - Difficulties with impurements
  - Difficulties with fibre contamination
- General
  - Dyes & chemical residues
  - Quality level

- ➢ continued restraint on processing post consumer polyester fibres
- ➢ Continued R&D projects to develop new and improve excisting methods

Advantage:

Fibre length is not an issue

Only man made fibres possible

# Market development

- DTI – OEKO-TEX Institute

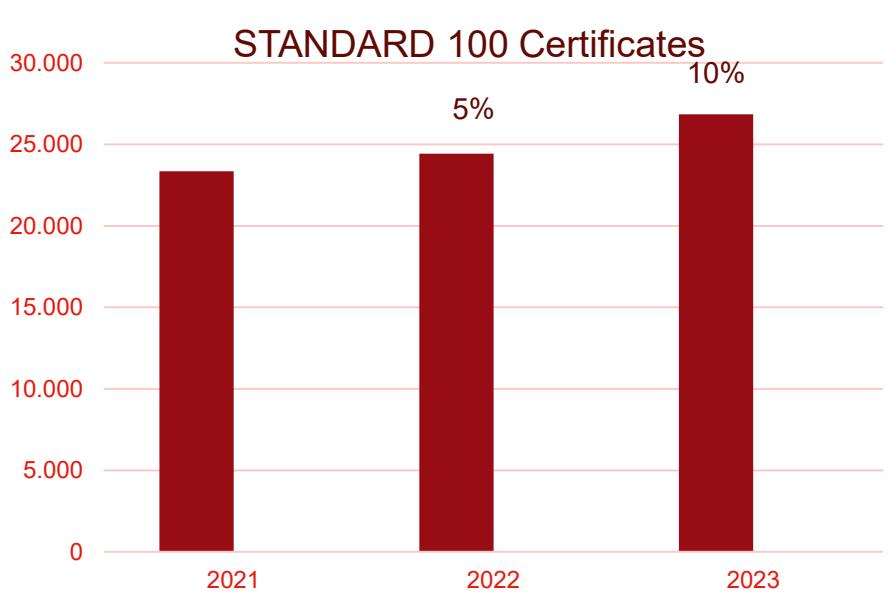
- Global customers

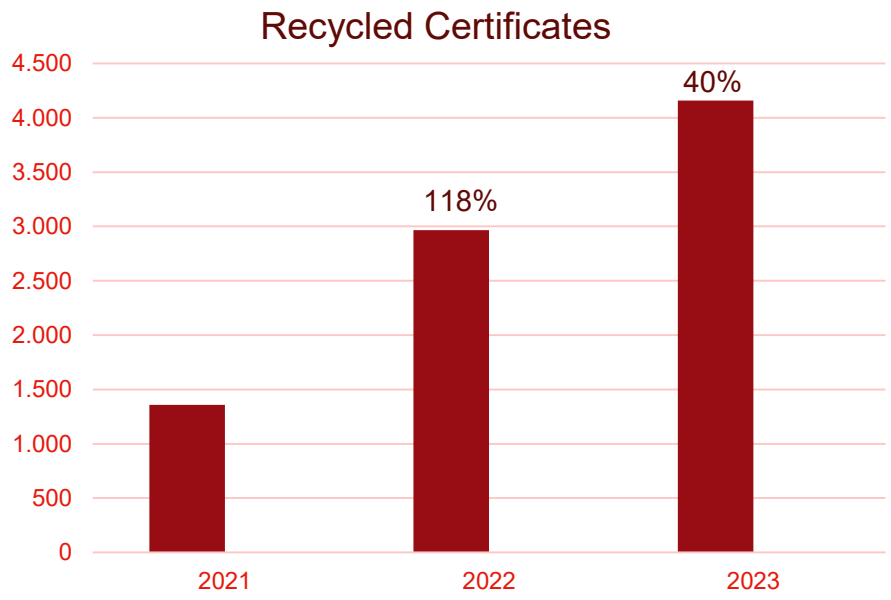
- Reason for certification
  - Demand from customers
  - Demand through legislation
  - Objective of responsible and environmentally responsible production

→ Generally costumers who, compared to the global market, act with more responsibility!

STANDARD 100 certificates have included recycled material since many years, but since 2021 separate certificates has become obligatory

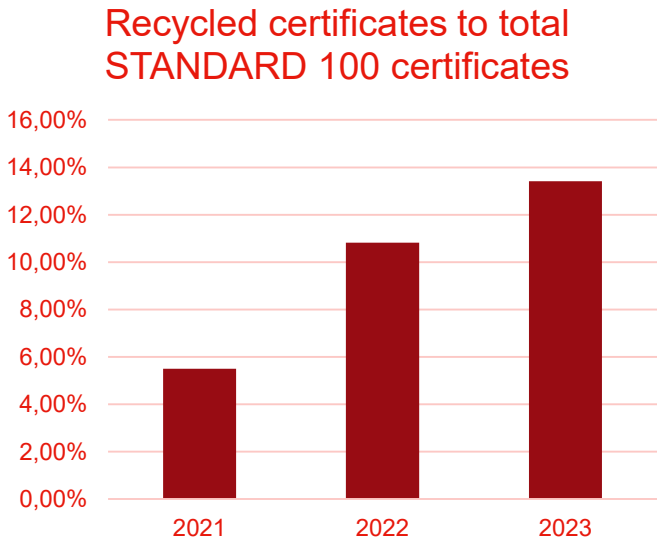
# Market development

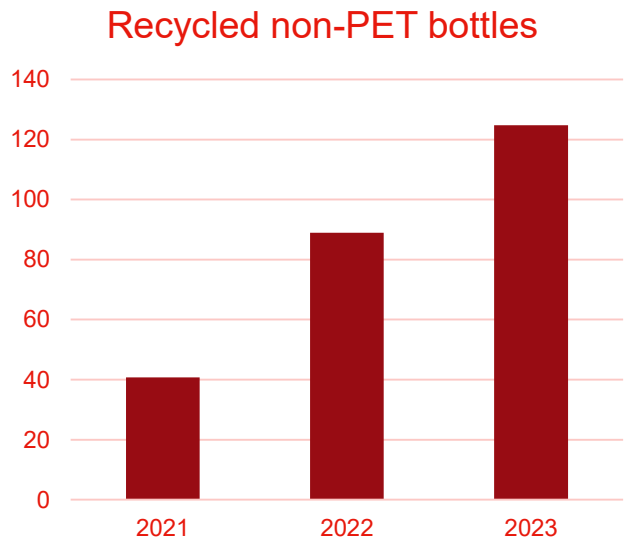


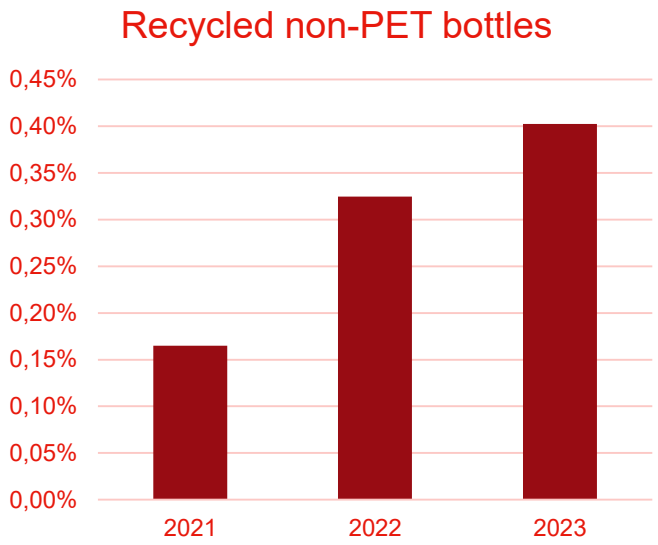



# Market development

Of all recycled certificates app. 97% are from PET bottles



# Message from the market

- Currently; - No demand for post consumer non-PET bottles recycled material

Down cycling!

Confusion in the market

- What is the right solution?
- Conflicting statements from projects
- Implementation of necessary test programs and control

- Challenges in relation to quality level
- Unsatisfying quality level for sewing thread
- General durability is reduced

# Decision making basic information

Projects - focused on specific result

Properties of methods and developed fibres are exaggerated, incomplete and insufficient documented

Testing programs are often limited, inkonsequent and unfocused

- Incomplete information

# Decision making basic information

What is needed?

Centralized information on possibilities and limitations of methods

Fibre-2-fibre:

- Optimal shredding/opening processes
- Maximal expected average staple fibre length
- Maximal content [%] of shredded fibres
- Optimal compositions and spinning methods

- *Legislative product liability – REACH etc. ???*

Dissolution & fibre production:

- What are the limitations
- which fibre mixtures continue to pose challenges
- Optimal removal of problematic dyes and chemicals – limitations
- Content of hazardous residues
- Challenges in fibre production

# Decision making basic information

What is needed?

Same quality level as virgin fibres!

# Decision making basic information

Testing programs which enables actual comparison

- Relevant tests depend on the field of application

Relevant tests:

(not complete)

- Strength
- Elongation and elasticity
- Abrasion resistance - Martindale
- Pilling tendency
- Light fastness
- Dust formation (Fibre-2-fibre)
- Dimensional stability
- Fastness levels

Durability

Test programme after X washing cycles

- Pilling tendency
- Dust formation (Fibre-2-fibre)
- Weight loss (Fibre-2-fibre)
- Dimensional stability

*Compared to virgin fibres*

# Recycling, Recycling and Recycling

Recycling and recycling of recycled fibres, - and again…

Higher twist necessary:
- Harder yarns
- Colder yarns

Fibre-2-fibre recycling

- Mixture with virgin fibres
- Mixture with recycled polymerized fibres

Shredding
Opening
Carding →

- Continously reduced fibre length and quality
- Poorer properties

*Still; Legislative product liability – REACH etc.*

Primary solution:

Fibre → Dissolution → Polymerization into new fibre

# Design for recycling

- Evaluate needed primary properties of your final product
- Which fibre material would best encapsulate your need
- Use single fibre material if possible
- Minimize the use of fibre mixtures
- Design areas of increased abrasion for longer durability
- Use recycled material according to your main material type
- Choose accessories accordingly and be aware how they can be either reused or removed easily

CO → CO/reg. cellulosic
PES → rPES
PA → rPA
CV → CV/CO/reg. cellulosic

# Thank you for your attention!