

Mergerization or how a traditional process can reduce the environmental impacts of a shirt

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Wallonie



- **Mercerizing**

- **Tests in laboratory**
 - Dyeing
 - Use phase
 - Lifetime

- **LCA**



Mercerizing

■ Mercerizing ?

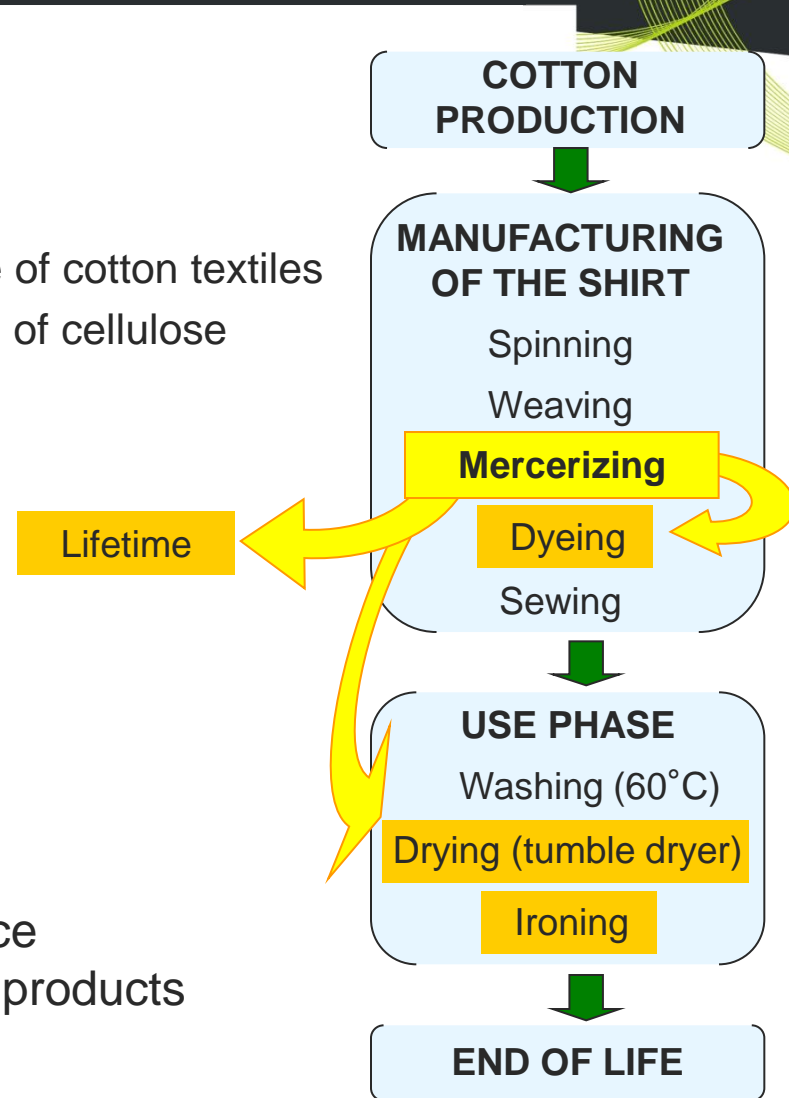
- Optional treatment during the manufacture of cotton textiles
- Changes the macromolecular organization of cellulose

➔ Mercerized fabrics :

- is dyed more easily
- dries faster
- creases less
- has a better quality

} Actions on
use phase
and lifetime

↓
2 effective levers to reduce
environmental impacts of textile products



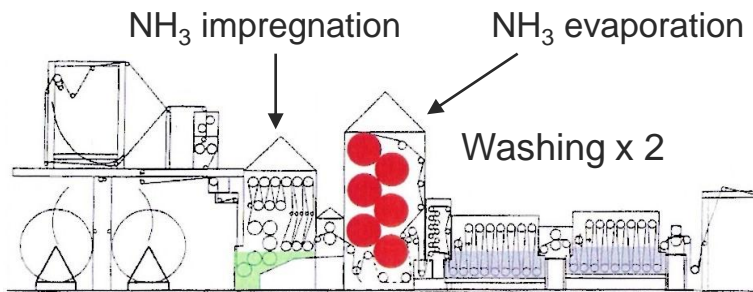
2 processes of mercerizing → with NaOH or with NH₃

■ Traditional process with soda (NaOH)



Assumption:
NaOH is 70%
recycled

■ Alternative process with liquid ammonia (NH₃)



■ Different influence:
○ on the fabrics
➡ on the life cycle

- Industrial data
- Recycling of NH₃ (more than 99%)

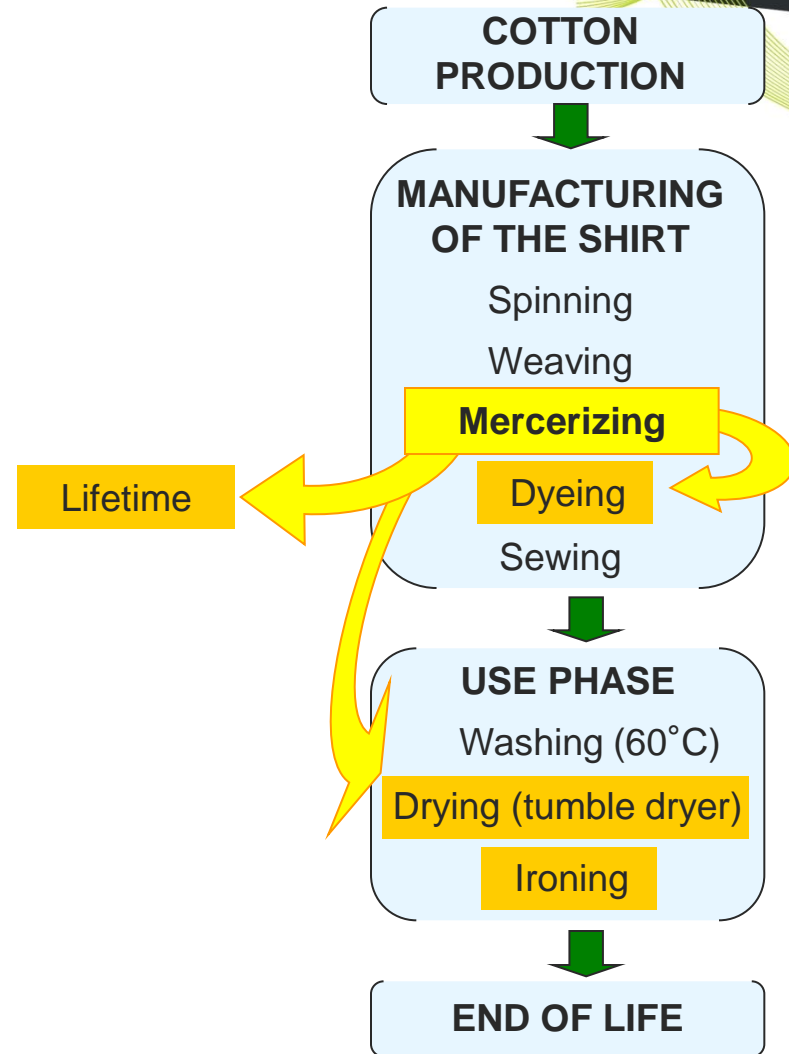
Objective of the study



- ➔ **Comparative LCA** between 3 shirts:
- ➔ a untreated shirt
 - ➔ a NH_3 mercerized shirt
 - ➔ a NaOH mercerized shirt



- ➔ **Tests in laboratory** on the 3 fabrics to evaluate differences on:
- ➔ Dyeing step
 - ➔ Use phase
 - ➔ Lifetime



Tests in laboratory

Dyeing

- **Principle:**

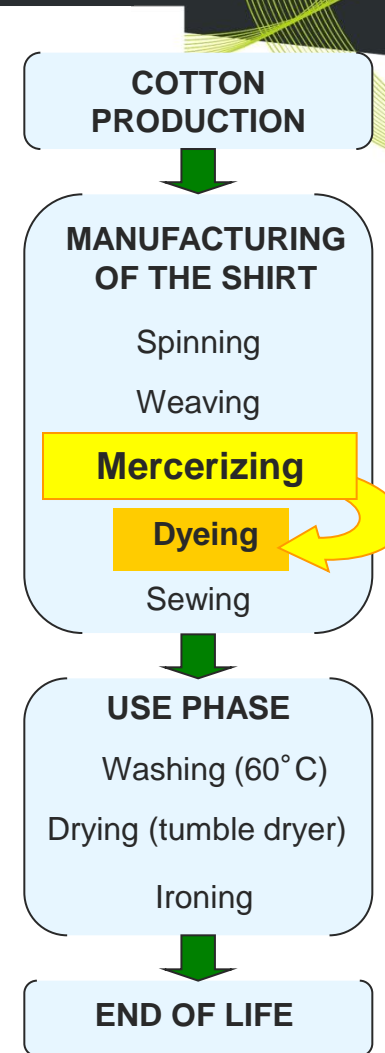
- Application of the same dyeing processes on the 3 fabrics
- Study of the color obtained

➡ Best color strength with NaOH mercerized fabric

➡ Less dye is necessary for this fabric

- Only 3.5% of dye

{ 8.5% of dye for the untreated fabric
7% of dye for the NH₃ mercerized fabric

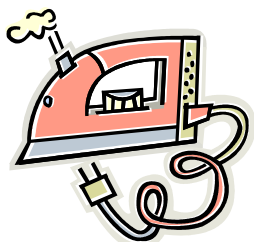


Life cycle of a shirt

- Measurements are realized to quantify the differences between the 3 fabrics concerning the drying and the ironing

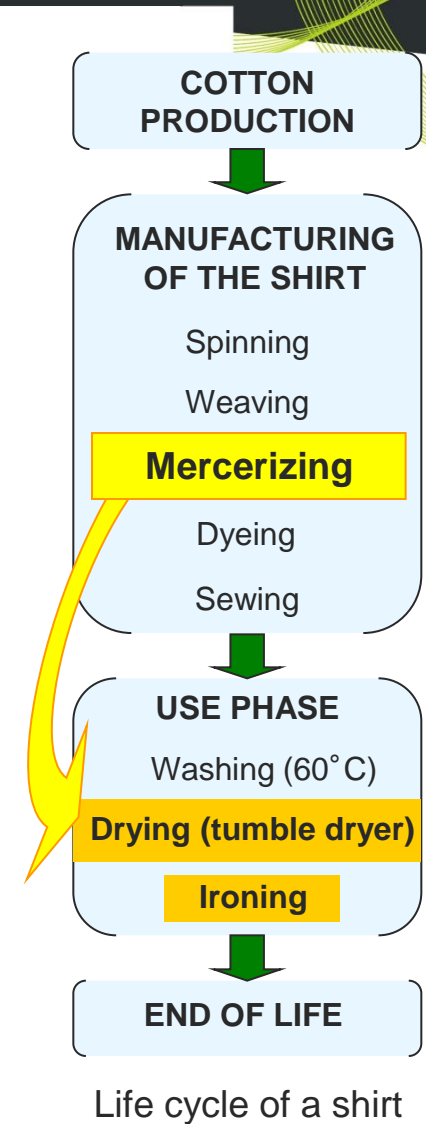
➔ Drying

- Measure of the residual moisture on the 3 fabrics after washing
- Slight decrease in the amount of moisture with mercerized fabrics (5%)
- Reduction of time in the tumble dryer

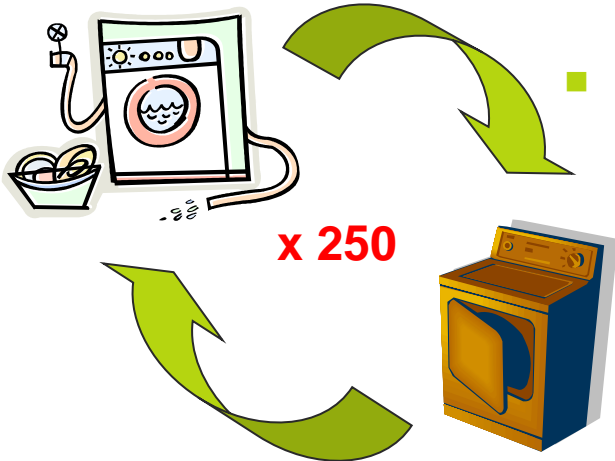


➔ Ironing

- Time reduction of **40%**



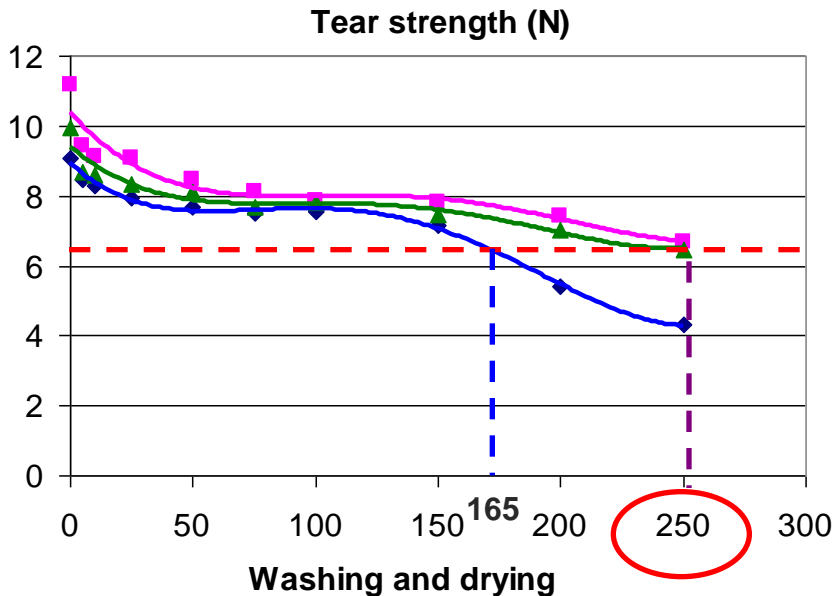
Tests in laboratory Lifetime



Evaluation of the degradation of shirts during washing :

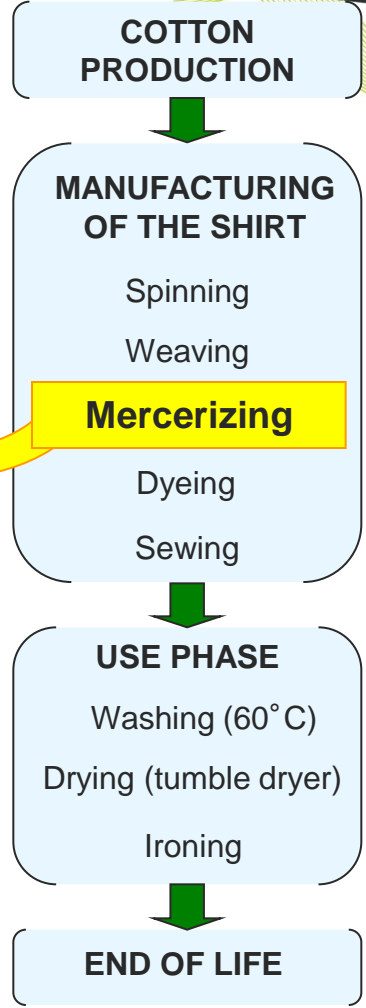
- Fabrics are washed and dried in tumble dryer during 250 cycles

Evolution of tear strength



Mercerizing increases the lifetime by 50%

Lifetime



Life cycle of a shirt

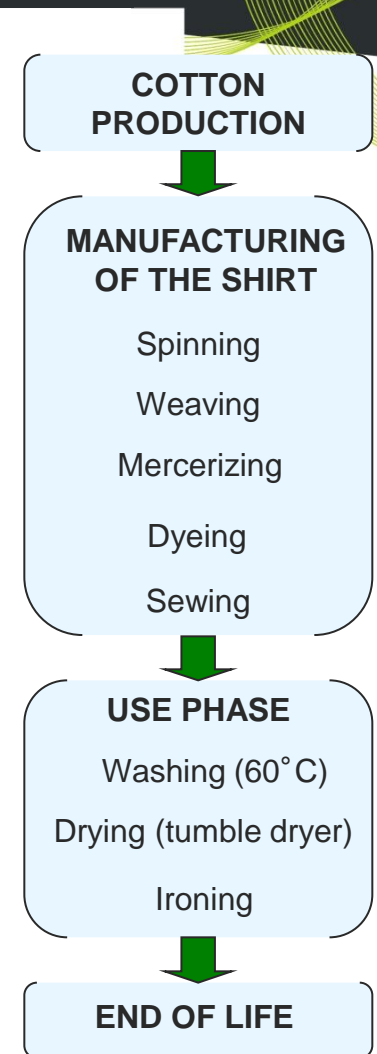
- **Functional unit:**
 - “use and wash a shirt during one day”

- **Assumptions:**
 - the shirts weights 200g
 - shirts are washed after each use
 - drying in tumble dryer

- **Calculation of the impacts:**
 - ReCiPe method (midpoint)

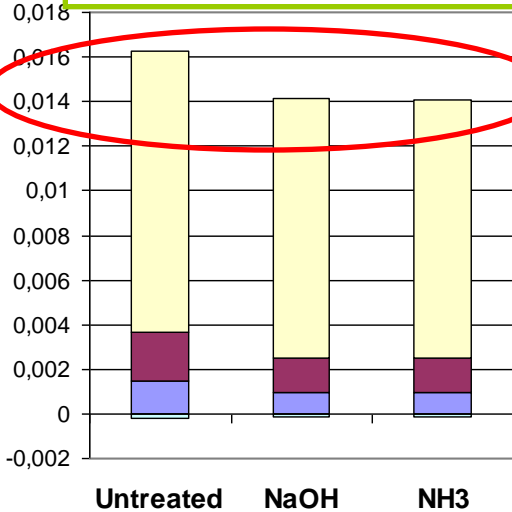
- **Software :**
 - GaBi (PE International AG)

- **Data sources :**
 - GaBi software, ELCD and EcolInvent databases in general
 - **Experimentation**, publications and industrial data for more specific processes

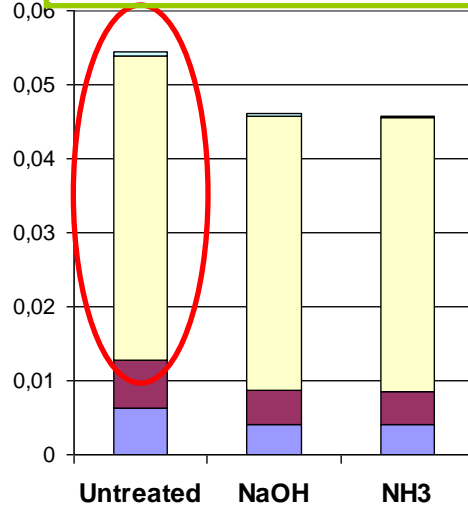


System boundary

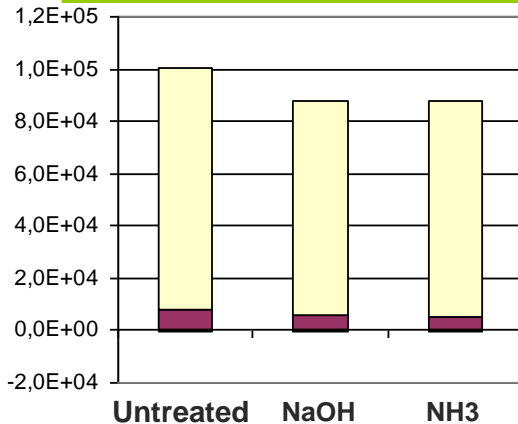
Fossil depletion [kg oil Equiv.]



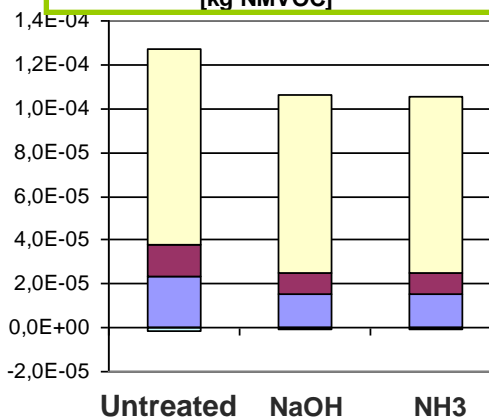
Climate change [kg CO2-Equiv.]



Ionising radiation [kg U235 Equiv]



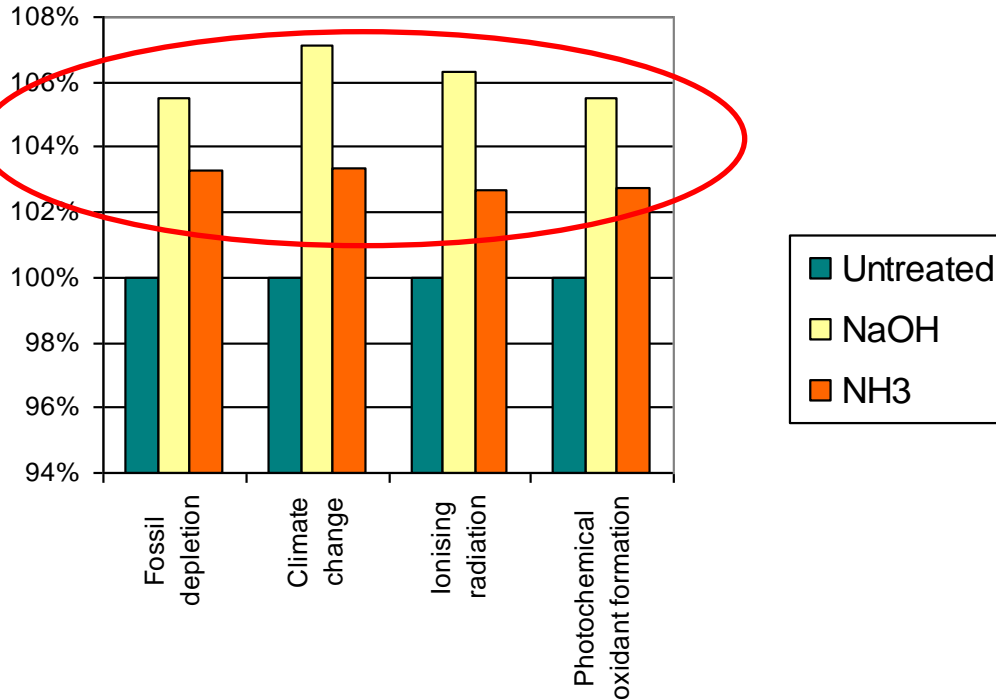
Photochemical oxidant formation [kg NMVOC]



■ Cotton production ■ Shirt production
■ Use phase ■ End-of-life

- **Mercerized fabrics are less impacting**
 → mainly due to lifetime (evaluate with tear strength)
- **Use phase is the most polluting step**
- **Drying: 40-57% of the impact of the use phase**
 → hypothesis: “systematic use of a tumble dryer”

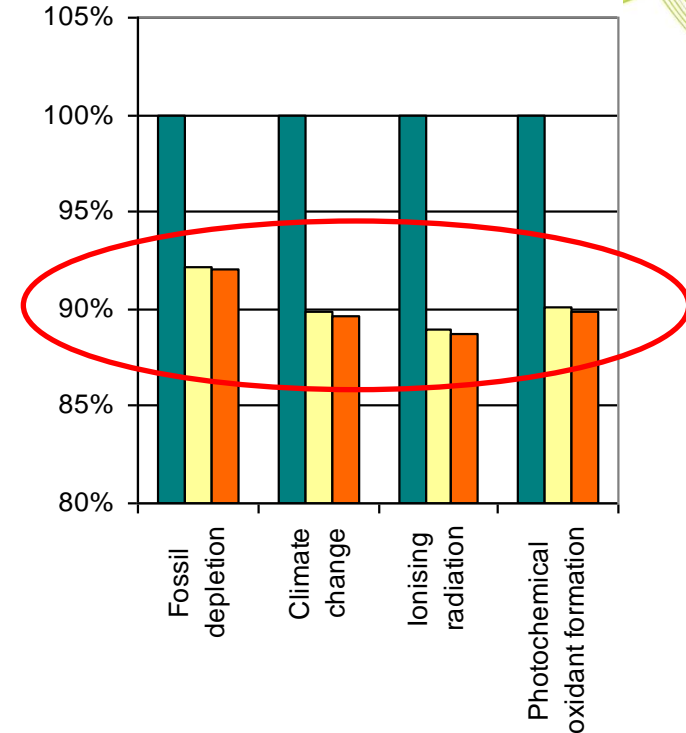
Shirt production



- Production of mercerized shirts is more polluting due to the additional step

→ **NaOH mercerizing is more impacting**

Use phase



- **Use phase of mercerized shirts are less impacting**

→ shirts dry faster and crease less (ironing time is shorter)

- Study of the degradation of the shirts during washing
→ to **quantify the lifetime improvement** with mercerised shirts.

- **Mercerizing:**
 - ➡ significant increase environmental impacts during the production phase
 - ➡ but **net environmental benefits on the all life cycle of a shirt**

- **Future works :**
 - Evaluation of the lifetime **with additional parameter** (in addition to the tear strength)
→ ex: tensile strength, abrasion resistance

 - Scenarios including **real use of shirts, air drying and systematic ironing**
→ evaluation of the new lifetime

 - **Soda is recycling (70%)** for NaOH mercerizing
→ in practice it is not systematic → sensitivity analysis

Thank you for your attention.



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