January 2024 - Politecnico di Torino

LIFE CYCLE ASSESSMENT RESULTS

COTTON JERSEY DYEING TECHNIQUES:

COMPARISON OF CONVENTIONAL AND FIBRE52™ DYEING PROCESSES

For full LCA, email support@fibre52.com

Study Overview

This study compares the environmental impacts generated for dyeing 1 kg of jersey (dark shade) through the conventional and *Fibre52* dyeing techniques.

- Inventory data for both the conventional and *Fibre52* processes are primary information collected in 2023 in a plant located in Bangladesh
- LCA model developed with SimaPro 9.5 software and Ecoinvent 3.9.1 database
- Potential environmental impacts were calculated with EF 3.1 method, in line with the most recent European guidelines for LCA

For all the analyzed environmental indicators, *Fibre52* dyeing technique results are responsible for **lower environmental impacts** in comparison to the conventional dyeing technique.

- Reduction of impacts **range from 4%** (indicator fossil resource use) **to 45%** (indicator marine eutrophication), **with an average decrease of 21%**
- As the **climate change indicator** is concerned, the conventional dyeing of 1 kg of cotton jersey results having an impact of 2.54 kg CO_2 eq., while with the *Fibre52* dyeing it decreases to 1.88 kg CO_2 eq. (**26% less**)

Impact Assessment of Jersey Dyeing

Potential impact of dyeing 1 kg of cotton jersey with the conventional and the Fibre52 techniques

Impact category	Unit	Jersey dyeing with conventional process	Jersey dyeing with *Fibre52* process
Acidification	mol H+ eq	1.34E-02	1.15E-02
Climate change	kg CO2 eq	2.54	1.88
Ecotoxicity, freshwater - inorganics	CTUe	2.27E+01	1.89E+01
Particulate matter	disease inc.	1.06E-07	9.16E-08
Eutrophication, marine	kg N eq	5.61E-03	3.08E-03
Eutrophication, freshwater	kg P eq	8.70E-04	5.99E-04
Eutrophication, terrestrial	mol N eq	2.36E-02	1.90E-02
Human toxicity, cancer	CTUh	1.41E-09	1.16E-09
Human toxicity, non-cancer	CTUh	4.85E-08	3.61E-08
Ionising radiation	kBq U-235 eq	4.58E-02	3.99E-02
Land use	Pt	8.27	6.62
Ozone depletion	kg CFC11 eq	6.49E-08	4.57E-08
Photochemical ozone formation	kg NMVOC eq	8.42E-03	6.46E-03
Resource use, fossils	MJ	3.50E+01	2.63E+01
Resource use, minerals and metals	kg Sb eq	2.73E-05	2.62E-05
Water use	m3 depriv.	8.47E-01	7.21E-01

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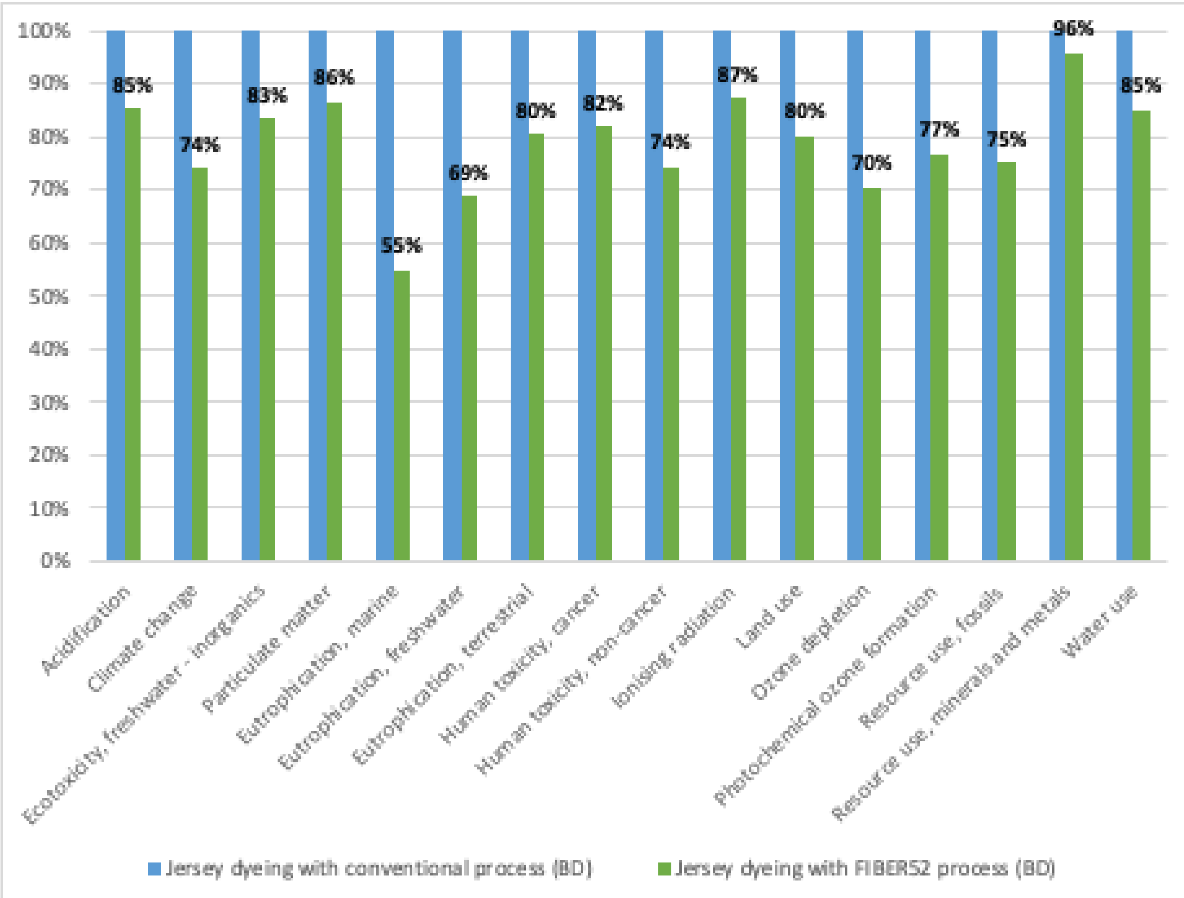
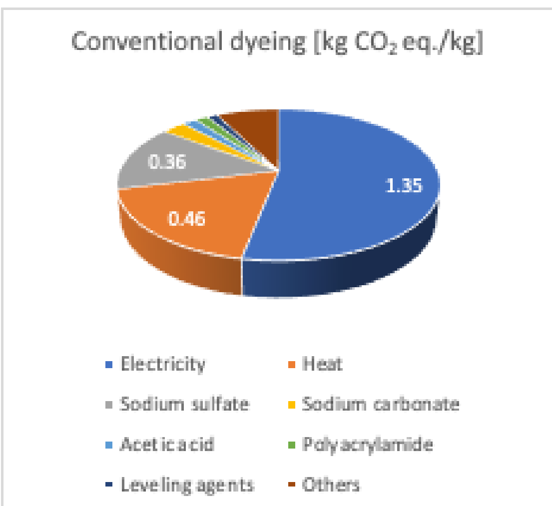


Figure 1. Comparison of environmental performances for dyeing 1 kg of jersey with the conventional and Fibre52 techniques

As can be observed, the *Fibre52* technique results having better environmental performances for all the analyzed impact categories. The improvement ranges from 4% (resource use, minerals and metals) to 45% (eutrophication, marine), with an overall average of 21%.

In terms of impact on climate change, dyeing 1 kg of jersey using the conventional technique results in a carbon footprint of 2.54 kg CO_2 eq., while for the *Fibre52* technique results of 1.88 kg CO2 eq. The pie chart in Figure 4 shows the processes responsible of the main contributions to the total impact on climate change. In addition, charts in Figures A1 and A2 of Annex 1 graphically illustrate the impact of input/output flows of the dyeing processes: the size of red arrows is proportional to the impact on climate change. It emerges that energy (electricity + heat) plays a key role, contributing to 71% of the carbon footprint in the conventional technique (equal to 1.81 kg CO_2 eq./kg) and 65 % in the *Fibre52* technique (equal to 1.22 kg CO_2 eq./kg). The decrease in energy consumption obtained with *Fibre52* technique (due to lower process temperatures and to a minor number of passages) is the main responsible of the better carbon footprint of *Fibre52* technique in comparison to the conventional technique. All together the chemicals accounts for 0.6 kg CO_2 eq./kg in both the processes (representing the 24% in the conventional process and the 33% in the *Fibre52* process). However, most part of this impact is due to the sodium sulfate, which is used in the same quantity in both the techniques and contributes to an impact of 0.36 kg CO_2 eq./kg. All the other chemicals have an impact lower (or equal, in the case of the bio-products used during the *Fibre52* scouring and bleaching phase) than 5%.



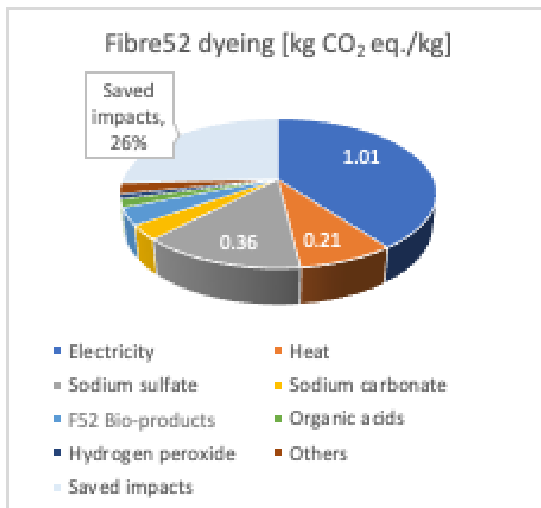


Figure 2. Impact on climate change (expressed in kg CO_2 eq) for dyeing 1 kg of jersey with the conventional process (graph on the left) and with the Fibre52 process (graph on the right).

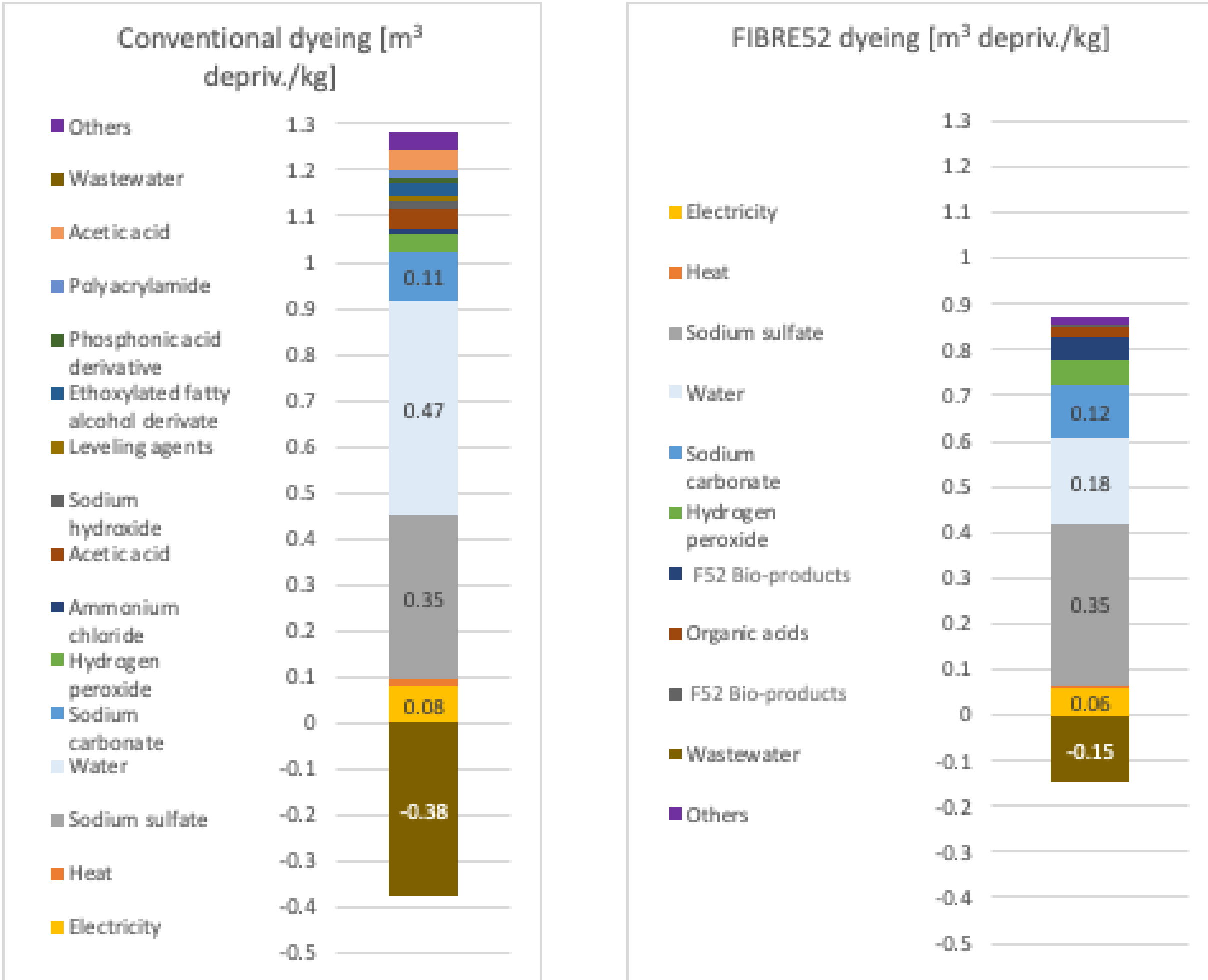


Figure 3. Impact on water use (expressed in m^3 deprivation) for dyeing 1 kg of jersey with the conventional process (graph on the left) and with the Fibre52 process (graph on the right).

The potential impact on freshwater eutrophication for dyeing 1 kg of jersey with the conventional technique results of 0.87 g P eq., whereas it is 0.60 g P eq. for the *Fibre52* technique, representing a 31% reduction. In this case, the higher quantity of water to be treated for dyeing with the conventional technique, has a non-negligible influence on the impact results. Therefore, the contribution of wastewater treatment in *Fibre52* process (equal to 0.12 g P eq, 20% of the total impact) is less than half of the wastewater impact in the conventional process (equal to 0.30 g P eq, 35% of the total impact). It should be noticed that these values are estimations based on an average wastewater treatment generated from an ordinary transforming activity. Therefore, to approximate the wastewater treatment it has been necessary to use a dataset from Ecoinvent 3.9.1 database (slightly adapted to better represent Bangladeshi electricity mix and water) since specific data on dyeing wastewater treatment in Bangladesh are unavailable.

In both the technologies, the sodium sulfate is responsible for a high share of impact on the freshwater eutrophication indicator (0.19 g P eq, 22%-32% of the total impact).

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