New perspectives for textile waste: recycling material by mechanical/chemical pre-treatment and enzymatic hydrolysis processes

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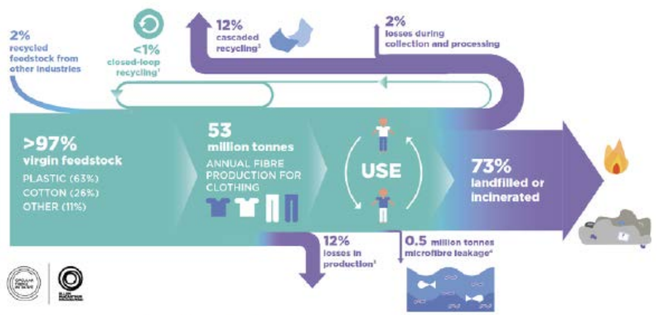
BACKGROUND

Fashion industry relies on a linear business model from the economic point of view. Large amounts of **non-renewable sources** are exploited to produce clothes: because of a short turnover, they quickly become **textile waste**.



1 Recycling of clothing into the same or similar quality applications
2 Recycling of clothing into other, lower-value applications such as insulation material, wiping cloths, or mattress stuffing
3 Includes factory offcuts and overstock liquidation
4 Plastic microfibres shed through the washing of all textiles released into the ocean

https://archive.ellenmacarthurfoundation.org/explore/fashion-and-the-circular-economy

ISSUE

Today, less than **15%** of clothes are collected for **recycling** and less than **1%** of the fibres is recycled into new ones. The most common way of recycling textile is the **mechanical** one. Only natural fibres can be mechanically recycled, in this case the quality decreases and costs increase simultaneously.

NOVEL APPROACH

BIOTECHNOLOGICAL APPROACH

Treatment of industrial textile waste by **enzymatic hydrolysis** in association with **mechanical/ chemical pre-treatments** to reduce the fibers to the constituent units. The **Glucose** obtained from cotton can be reused in industrial sectors like the textile itself, supporting industrial synergy and symbiosis and circularity principles.

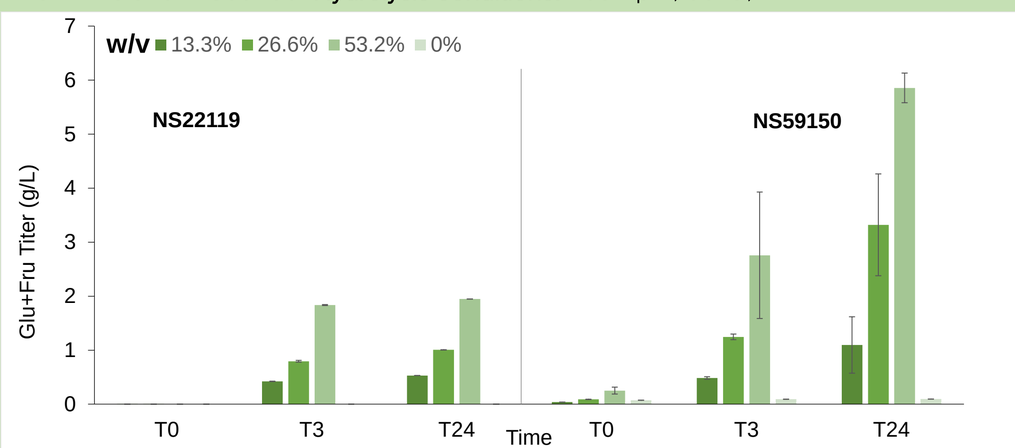
GOAL FOR THE 1° YEAR OF THE PROJECT: BASELINE STUDIES

MECHANICAL PRE-TREATMENT TESTS: these tests allowed to improve the step of **pre-consumer textile waste chopped into fibres**

OUTCOMES: Industrialization of an on site mechanical pre-treatment unit.

MECHANICAL PRE-TREATMENT + ENZIMATIC HYDROLYSIS

Pre-consumer textile waste treated at 121°C for 20 min and digested with two different Novozymes enzymatic cocktails NS22119 and NS59150. **Hydrolysis conditions:** 105 rpm, 50°C, 24 h.



OUTCOMES: THE REACTION PROCEEDS SLOWLY AND RELEASING LITTLE QUANTITIES OF SUGARS

NEXT STEPS?

Work in Progress

1: FURTHER OPTIMISATION OF THE ENZYMATIC HYDROLYSIS PROTOCOL AND TESTS ON RELEASED SUGARS

2: IMPLEMENTING THE MECHANICAL TREATMENT WITH GREEN CHEMICAL TREATMENTS (exploiting deep eutectic solvents, DES) BEFORE THE ENZYMATIC HYDROLYSIS