AN OVERVIEW OF INTEGRATED CHEMICAL PROCESS USED FOR CONVERTING VALUABLE TEXTILE WASTE

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Introduction

Nowadays, consumption generates large amounts of waste. Every year there are 150 million tonnes of textile waste. Textile waste has two disposal streams: landfilling or incineration. However, these solutions have a negative impact as they lead to a waste of valuable resources and environmental pollution [1, 2].

Textile waste is generally composed of cotton and cellulose fibres, which are renewable and biodegradable polymers that can be recovered and recycled and put to a variety of uses.

The main goal of this study is to present chemical methods described in the literature as an alternative for converting textile waste into value-added compounds (e.g. lactic acid and sorbitol, respectively).

Materials and Methods

In order to obtain glucose, the following pre-treatment methods were used:

- for uncoloured cotton waste - pre-treatment with NaOH,
- for coloured cotton waste - pre-treatment with H_2O_2 and CH_3COOH to decolourise the waste, followed by pre-treatment with NaOH,
- for cotton waste mixed with PET - pre-treatment with NaOH and C_2H_5OH.

In Figure 1 chemical procedures for obtained lactic acid and sorbitol from cotton textile waste are presented.

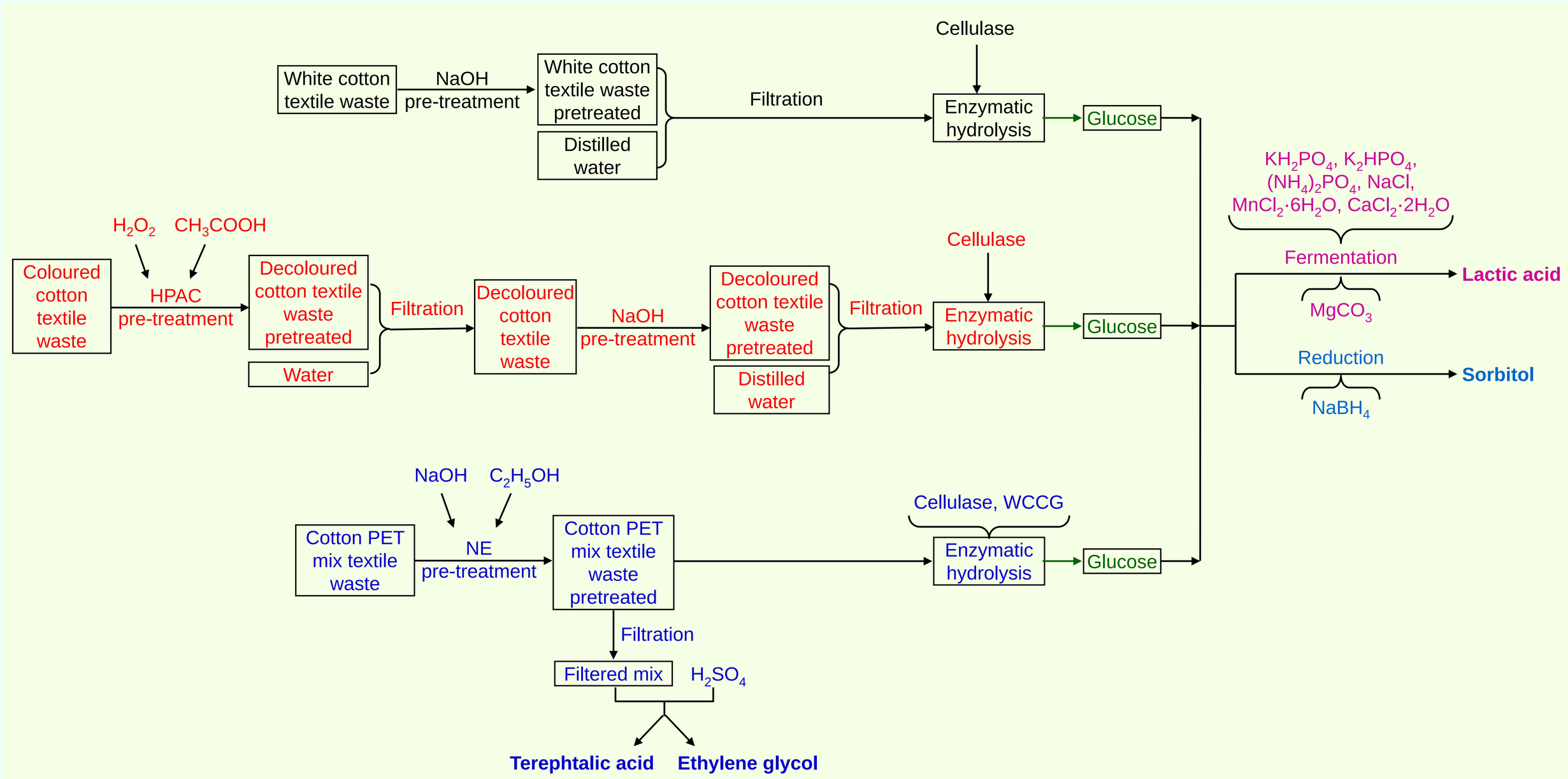

Figure 1. Chemical procedures for obtained-value added products from cotton textile waste

Results and Conclusions

Currently different chemical methods have been developed to convert textile waste from cotton processing into valuable products. For this purpose, a biorefining process is required, sorting them into (i) coloured cotton, (ii) uncoloured cotton and (iii) cotton mixed with PET.

The theoretical maximum yields of valuable compounds obtained were:
- lactic acid 83.6%
- sorbitol 70%

As presented in the Materials and Methods section, Table 1 summarizes the maximum glucose yields as reported in the literature [1]:

Table 1 Yield of glucose obtained when is applied different pre-treatment conditions:

Type of textile waste	Pre-treatment condition	Maximum glucose yield %
White and coloured cotton textile waste	NaOH	85.30
Cotton/Pet mix waste	NaOH and C_2H_5OH	74.21

Various chemical processes can be obtained from the sorting of these wastes, such as lactic acid, sorbitol, terephthalic acid and ethylene glycol. This process can thus be an important step towards a more efficient management of textile waste, based on the principle of a circular economy that relies the converting and recycling this waste into value-added products. In conclusion, after the sorting and valorisation processes, the two useful constituents are obtained which can have different practical applications.

Following the application of the previously mentioned chemical methods, it can be concluded that the yield of enzymatic hydrolysis (obtaining glucose) is higher in the case of textile waste based on undyed cotton.

References

[1] Cho, E.J., Lee, Y.G., Song, Y., Kim, H.Y., Nguyen, D.T. and Bae, H.J., 2023. Converting textile waste into value-added chemicals: An integrated bio-refinery process. Environmental Science and Ecotechnology, 15, p.100238.

[2] Vera, R.E., Zambrano, F., Suarez, A., Pifano, A., Marquez, R., Farrell, M., Ankeny, M., Jameel, H. and Gonzalez, R., 2022. Transforming textile wastes into biobased building blocks via enzymatic hydrolysis: A review of key challenges and opportunities. Cleaner and Circular Bioeconomy, p.100026.