

Converting textile waste: a sustainable approach through pretreatment and hydrolysis for obtaining building blocks

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Abstract:

In the past decade, the interest towards the textile sector has been significantly increasing due to the phenomenon of fast fashion, and the reevaluation of its waste as valuable commercial resources [1]. Bibliographic analysis reveals that the issue of textile waste is of interest not only in traditional production countries such as India and Bangladesh, but also in countries subject to new international policies [2].

Recent publications focus on the possibility of reducing and valorizing textile waste, with particular attention to the conversion process to obtain glucose. More specifically, the textile pretreatment phase emerges as a critical and costly phase, with its effectiveness influencing up to 40 % of the yield of hydrolytic treatment [3]. These conditions pose the additional challenge of requiring tailored study for textile materials, unlike subsequent steps where valorization techniques common to other waste materials can be applied [4].

This study compares various techniques for pretreating textile waste to provide a detailed overview of the most promising methodologies for one of the costliest and crucial steps in textile waste conversion to obtain glucose. In our study we adopted an experimental design approach to identify the most efficient and sustainable pretreatment conditions for textiles made of cotton and PET, two major and key components of the fast fashion supply chain. Variables considered include mechanical pretreatments, chemical treatments with organic and inorganic bases, as well as the regulation of treatment temperature and duration. The resulting pretreated materials were evaluated using analytical techniques such as HPLC and SEM spectroscopy to identify the pretreatment technique with the most promising and the lowest environmental impact.

Keywords: Textile waste valorization, pretreatment, hydrolysis, fast fashion wastes.

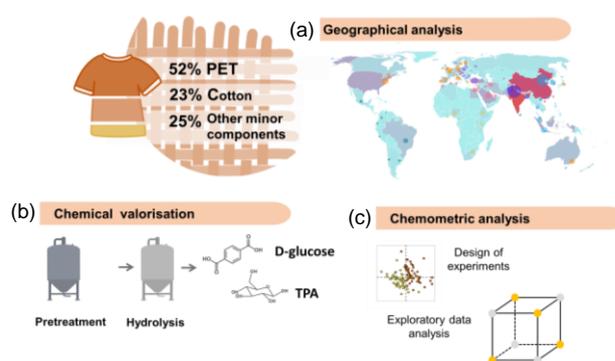


Figure 1: The main topics discussed in the work divided in sections: (a) the World map obtained by counting and visualizing with color the number of articles searched in the Scopus database with the keyword "textile waste" from each nation for the year 2023; (b) the process of chemical valorization of fibers to emphasize the significance of the pretreatment and hydrolysis steps in achieving the initial building blocks of commercial interest; (c) chemometric approaches used to design experiments and to conduct evaluations according to both experimental data and literature sources.

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