AN OVERVIEW OF CIRCULAR ECONOMY APPROACH FOR TEXTILE WASTE: PROCESS SUSTAINABILITY IN ETHANOL PRODUCTION

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Introduction

The textile industry is one of the most polluting industries, and the environmental impact is significant, in terms of the water component: consumption and toxic compounds (dyes and metals resulting from the dyeing process).

From literature data is known that in the world are generated 92 million tonnes (MT) of textile waste in each year, of which 6 MT is generated in the European Union, 17 MT in the USA and 20 MT in China.

The environmental impact must be reduced by introducing less polluting manufacturing technologies, which must be pursued in order to reduce waste produced in the textile industry.

In order to implement the context of the circular economy, there is a need for closer cooperation between manufacturers, as well as sorting and recycling of the companies involved.

The aim of this paper is to present economically and environmentally feasible methods for recovering ethanol from textile waste.

Materials and Methods

The experimental methods presented in this paper are that using the following dissolving agents used to solubilize cellulose from textile waste:
- N-methylmorpholine-N-oxide - NMMO - Figure A
- Na_2CO_3 sol. - Figure B
- H_3PO_4 conc. - Figure C
- NaOH/urea mix. - Figure D

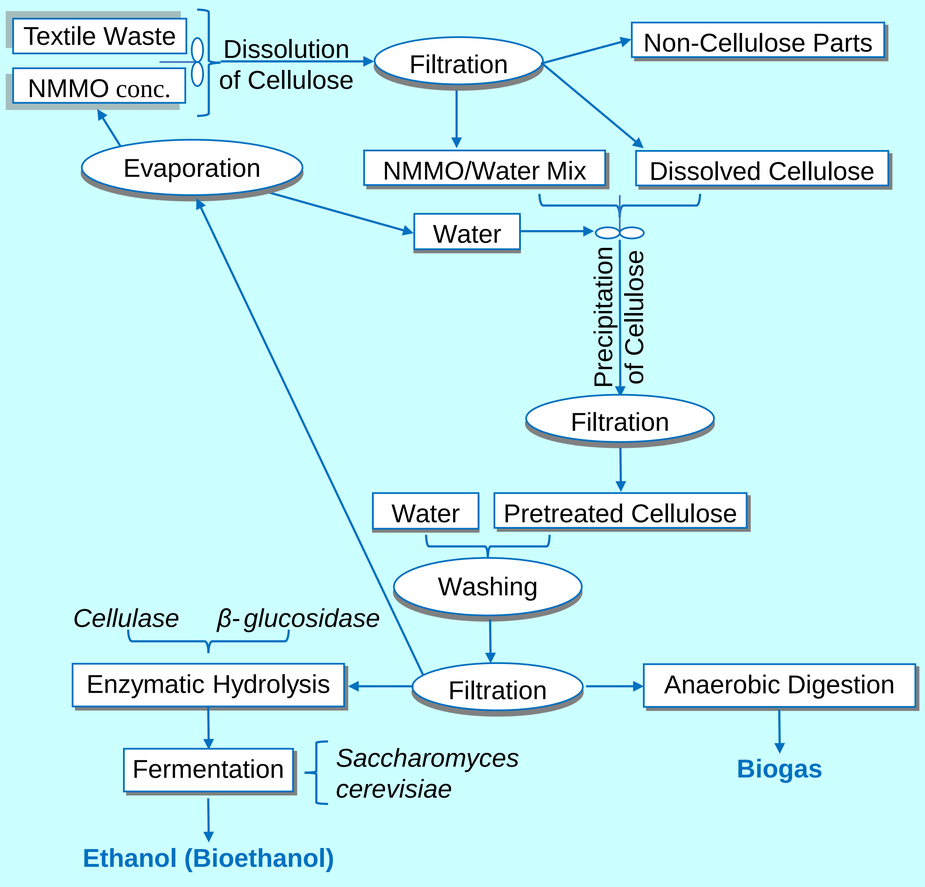

Figure A. Experimental method using NMMO to solubilize cellulose from textile waste, where the textile waste represent blends of polyester/cotton and polyester/viscose

Figure B. Experimental method using Na_2CO_3 (sol.) to solubilize cellulose from textile waste, where the textile waste represent blend of polyester/cotton

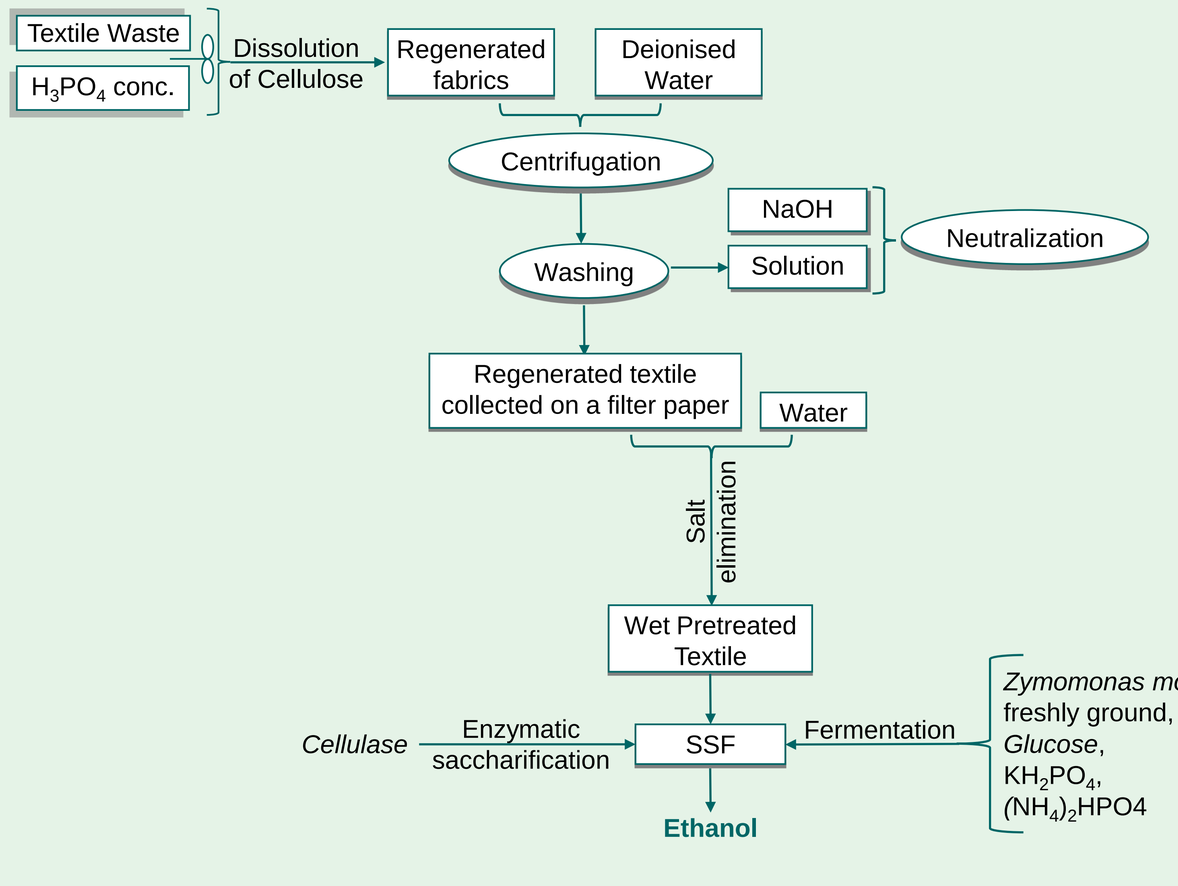

Figure C. Experimental method using H_3PO_4 (conc.) to solubilize cellulose from textile waste, where the textile waste represent 100% cotton linters and blend of polyester/cotton

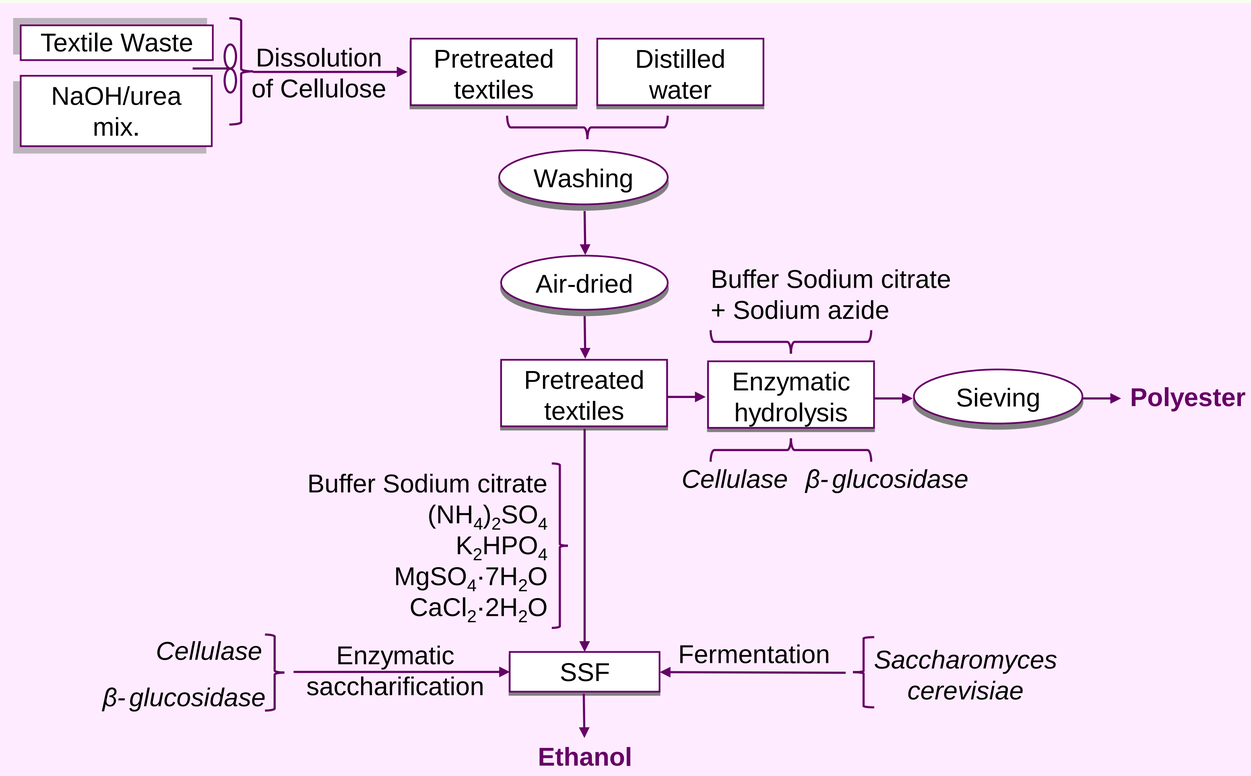

Figure D. Experimental method using NaOH/urea (mix.) to solubilize cellulose from textile waste, where the textile waste represent blend of polyester/cotton

Results and Conclusions

For the implementation ecological extraction of cellulose, firstly the selective collection system for textile waste, it is necessary. Here in, the main advantages of using the green agent for valorisation textile waste in order to extracting cellulose and converting it into ethanol and/or biogas are:

1. Separation of cellulosic and non-cellulosic fibres, thus the resulting non-cellulosic polymers are easier to process than the basic waste.
2. Dissolved cellulose hydrolyses easily into sugars.
3. It is possible to recover the extracting and reuse the extracting, in a new hydrolysis process.
4. Cellulose dissolution takes place at ambient temperature and subsequent in ethanol.
5. The process is environmentally friendly, because for obtained by-products chemical agents are not involved.
6. Since the rapid extraction of cellulose is produced, the production costs for processing the waste and obtained the cellulose are reduced.
7. This process is feasible and can be integrated into existing ethanol and/or biogas plants.

As presented in the Materials and Methods section, Table 1 summarizes the maximum theoretical ethanol yields as reported in the literature [1-5].

Table 1. Theoretical yield of ethanol obtained when is applied different chemical agents on waste textile

Chemical agent	Maximum theoretical yield of ethanol %
NMMO	95
Na_2CO_3 sol.	70
H_3PO_4 conc.	92
NaOH/urea mix.	70

To conclude, this paper briefly outlines methods for treating and recovering textile waste into valuable compounds. Thus, feasible methods (chemical and environmentally friendly) for the converting textile waste are presented. From the research carried out, it was found that the most appropriate method is the environmentally friendly one, because minimizes the negative impact of additional generation of new toxic waste.

References

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