

Estimating Biodegradation Of Cotton Fabric By Soil Burial

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ABSTRACT

Today we can see a greater awareness of sustainability and environmental protection, however, there are many environmental impacts that are not measured and therefore taking measures to minimize them is not easy. In this article we intend to evaluate the biodegradability of a cotton fabric through the generation of one of the greenhouse gases, CO₂. For this, the cotton fabric is buried in an artificial ecosystem and accelerated aging is carried out. The results show that the biodegradability of cotton fabric is around 70-80% of the biodegradability of cellulose.

1. INTRODUCTION

The textile industry is today one of the largest industrial polluters and is responsible for 10% of global carbon emissions. [1] Sustainable industrial production shows to have effect on greenhouse effect, but with growing fashion industry and increased consumer demands sustainable and ecological textile production, it will not be enough [2].

Only 12% of all virgin textile fibers are currently recycled [1]. The lack of recycling of textiles results in millions of tons of textiles entering landfills around the world [2]. The non-biodegradability of plastics has caused extensive environmental problems associated with their disposal [3]. This in turn lead to that microplastics are able to enter into the wastewater and to aquatic systems [4].

In view of the afore mentioned, the new European Directive ((EU) 2018/851) amending Directive 2008/98/EC on waste is of particular importance. The new Directive obliges Member States to begin separate collection of textile waste by 1 January 2025, and to set targets for the preparation for re-use and recycling of textile waste. [5].

It is, therefore, clear need to strengthen focus on circulatory economy and on life cycle assessment of textile products [2]. Moreover, the biodegradability is often used as a standard measurement for the environmental friendliness of textile products [6].

In this paper authors aim to determine the a cotton fabric biodegradability in comparison to a standard cellulose.

5. REFERENCES

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2. MATERIALS AND METHODS

In this study, a glass container with a hermetic closure with a capacity of 2.5 L is used, which will contain perlite and universal cultivation soil, distilled water and 1,6 g of 100 % cotton fabric to be evaluated. A microcrystalline cellulose was taken as a reference, and a pot with soil without fibers was used as a target. Each of the samples is placed in an individual container. Biodegradability assessment is performed with potassium hydroxide (KOH) solution, barium chloride (BaCl₂) solution, hydrochloric acid (HCl) solution and phenolphthalein as indicator. All solutions were prepared with distilled water.

This test was conducted according to the methodology described by Miniyasami et al [7] and Modelli et al [8]. On top of the ecosystem, a glass with 40 mL of KOH were placed to catch CO₂. Every 3-4 days the glass is replaced by new KOH, and the glass which has entrapped CO₂ is valorised with BaCl₂ and HCl. This valorisation has been studied for 50 days.

3. RESULTS AND DISCUSSION

The biodegradation is calculated according to the following equation: $\% \text{ Biodegradability} = \frac{\text{mg CO}_2 \text{ produced}}{\text{mg CO}_2 \text{ theoretical}}$

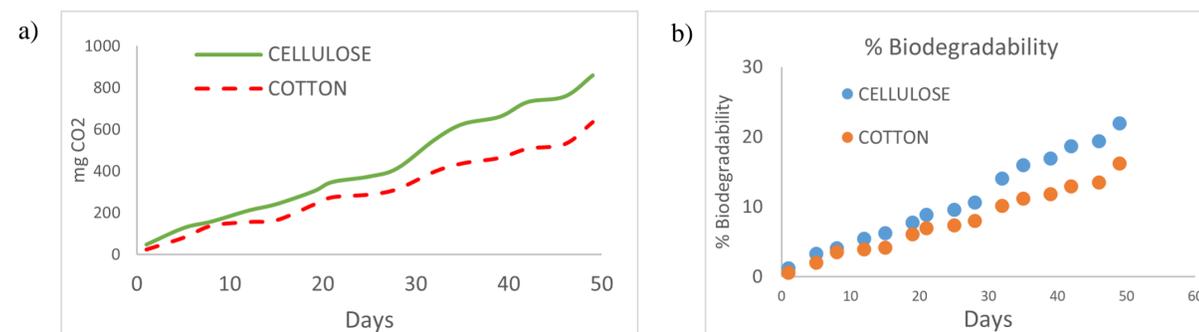


Figure 1. Degradation behaviour of buried cotton fabric. a) mg CO₂; b) biodegradability

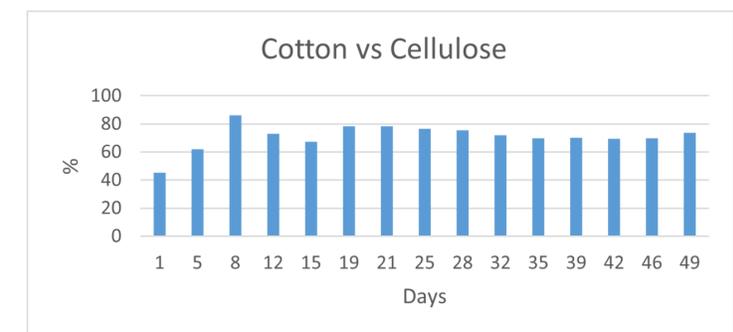


Figure 2. Comparative degradation of cotton fabric against cellulose.

4. CONCLUSION

In this paper we showed there is a similar behaviour on the degradation of cotton in comparison to cellulose when the material is buried. Cellulose degradation is faster than the one for cotton fabric from both points of view: mg CO₂ generated and the biodegradability according to the theoretical CO₂ capable to be generated from the specimen tested.

The biodegradability of cotton is at least 20 % slower than the cellulose, although it must be considered the speed of degradation is faster for cellulose on the first week of test. This can be due to the presence of other substances apart from pure cellulose on the cotton fabric such as wax or lignin, substances which are interfering on the biodegradability of the fabric. However, the influence of the structural parameters of the textile should not be underestimated.