



# Monochlorotriazinyl- $\beta$ -cyclodextrin grafting onto polyester fabrics and films

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## ABSTRACT

The monochlorotriazinyl- $\beta$ -cyclodextrin (MCT- $\beta$ -CD) grafting onto polyester fabrics and films was carried out in an alkaline medium (saponification conditions with  $\text{Na}_2\text{CO}_3$  respectively NaOH) at different temperatures (20 and 130 °C) and treatment durations (30 min, 1 h, 3 h, 5 h, 24 h) through a discontinuous procedure. The saponification and grafting were accomplished in two variants: individually and simultaneously respectively. It was noticed that the alkaline medium produces chemical and superficial modifications which make possible the MCT- $\beta$ -CD grafting onto the polyester supports. This was rendered evident through FTIR analysis and SEM electron microscopy. The degree of grafting depends on the saponification/grafting conditions (the concentration of alkaline agents, time, temperature, MCT- $\beta$ -CD concentration) and is reflected by the nitrogen content, hygroscopicity, air permeability, as well as by mechanical properties (tensile breaking strength, breaking elongation, breaking mechanical work and the specific mass work).

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## 1. Introduction

During the last years, many works were dedicated to the study of polyester (PES) behavior during the saponification operation (Asakuma, Nakagawa, Maeda, & Fukui, 2009; Kondratowicz & Ukielski, 2009; Mishra, Zope, & Goje, 2002; Ng, Zhang, Liu, & Yang, 2009; Partini & Pantani, 2007; Vigneswaran & Anbumani, 2007; Wada et al., 2007) carried out either only with alkaline agents, or with sodium hydroxide in the presence of an alcohol (methanol or ethanol) (Achwal, 1984a, 1984b; Nandy, Mishra, Thakker, & Bhattacharya, 1999). All these arrived at the conclusions that the alkaline medium results in the polyester de-polymerization, which in turn determines the amplification of antistatic properties, as well as of wetting and water retention. Aiming to improve the saponification effects, polymer grafting was carried out with chitosan (Matsukara, Kasai & Mizuta, 1995), in order to induce a "wash-fast antistatic effect" and/or germicidal effects: with poly-oxalkylene in various conditions, to improve the antistatic properties and to get a good dyeability with cationic dyes (Kim & Ko, 1986) with acrylic acid, which determines a modification of the electric conductivity (Hirotso & Nakajima, 1987). Other attempts were based on the utilization of  $\alpha$ -,  $\beta$ -,  $\gamma$ -cyclodextrin for the direct polyester grafting, but the results proved the impossibility of grafting with-

out the existence of certain very reactive groups which are to be attached to the cyclodextrin structure. The  $\beta$ -cyclodextrin ( $\beta$ -CD) grafting on polyester fabrics is only possible when one makes use of cyclodextrine derivatives which migrate inside the polymer structure, or chlorine-type non-metals (bonded to a triazinic cycle) that can participate in substitution nucleophilic reactions (Denter, Buschmann, & Schollmeyer, 1991; Denter, Schollmeyer, Szejtli, & Szente, 1996; Ruppert, Knittel, Buschmann, Wenz, & Schollmeyer, 1997). Another working version is indicated by Martel and Co. (Martel, Morcellet, Ruffin, Ducoroy, & Weltrowski, 2002), by means of the poly-carboxyl acids playing the role of reticulant agents.

This work is dedicated to the investigation of the possibility of monochlorotriazinyl- $\beta$ -cyclodextrin (MCT- $\beta$ -CD) grafting onto saponified polyester fabrics and films (either prior or simultaneous to grafting) through discontinuous depletion based procedures, at extreme temperatures: 20 °C and 130 °C, respectively. Basic mediums (NaOH and  $\text{Na}_2\text{CO}_3$ ) at different concentrations and durations were used for saponification. It was noticed that the degree of MCT- $\beta$ -CD grafting on polyester is much higher when the saponification and grafting occur in the same bath through discontinuous procedures, than through the pad-dry-cure technology (Abdel-Halim, Abdel-Mohdy, Al-Deyab, & El-Newehy, 2010).

The effects acquired through simultaneous saponification and grafting are: a high degree of grafting, shown off through a large amount of nitrogen, a higher hygroscopic sorption, and improved mechanical properties. The grafting diminishes the roughness produced by saponification and determines a decrease of air permeability.

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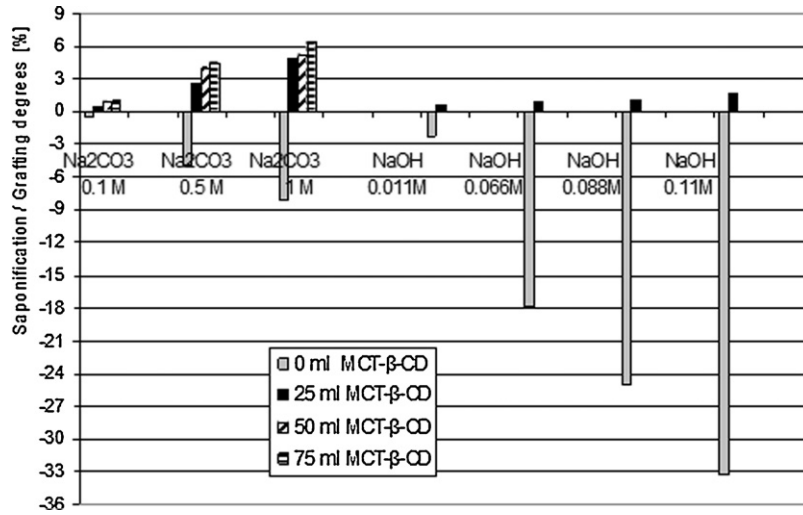


Fig. 1. Influence of the saponification formula (through alkaline agent type and concentration) on grafting with 25–75 ml MCT-β-CD at 130 °C for 1 h, onto a PES fabric.

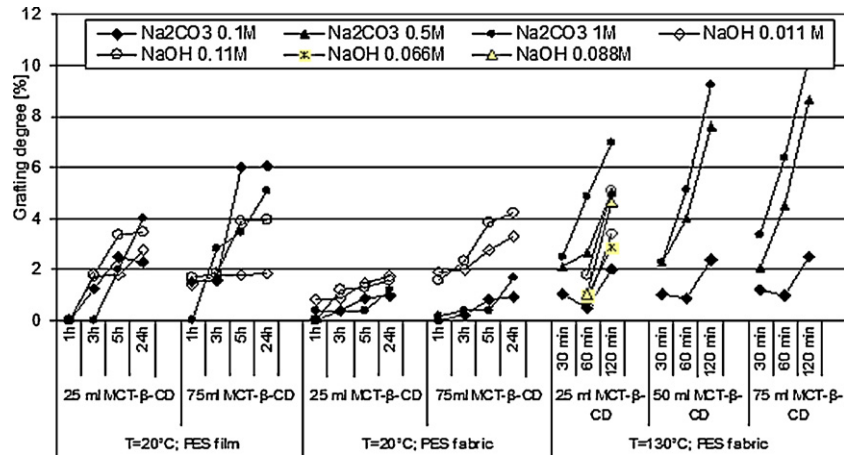


Fig. 2. Influence of processing conditions on the degree of grafting.

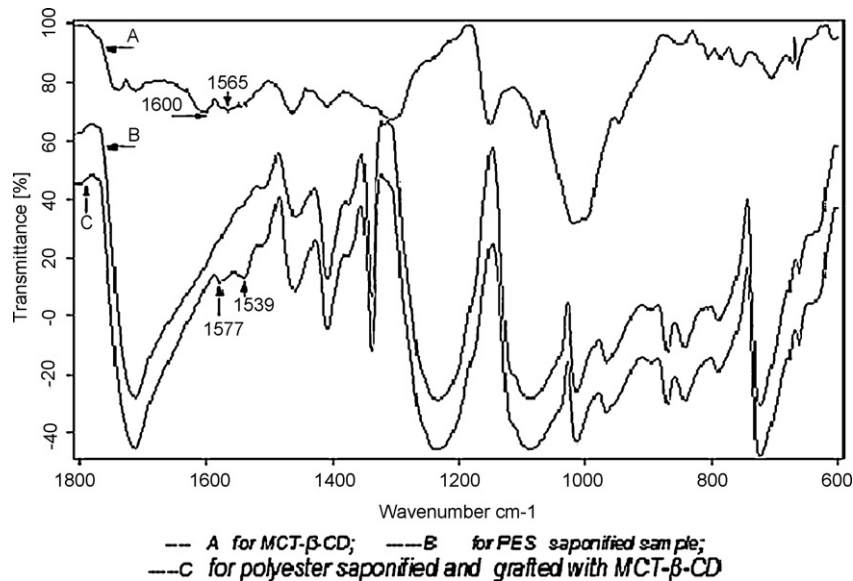


Fig. 3. FTIR-ATR spectra.

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