Optimization of soil-release finishing processes of the polyester fibers

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INTRODUCTION

Polyester fabrics are made from poly (ethylene terephthalate) (PET), currently accounting for more than 50% of all fibrous materials. Their properties include high uniformity, mechanical strength and resistance against chemicals and abrasion. However, PET fibers produce an accumulation of electrostatic charges that attract and retain dirt. This problem can be minimized by improving fiber hydrophilicity through the chemical functionalization of PET. The present study aimed to develop a polyester fibers with chemical optimized soil-release properties using a simple finishing strategy, applicable at industrial level.

MATERIALS AND METHODS

A 100% polyester fabric, taffeta, with surface mass of 100 g/m^2, was purchased from Lemar (Portugal). PEGs were purchased from Merck (Portugal), Adipret P-LF was used as a crosslinking agent and kindly offered by ADI Group (Portugal).

PET fabrics previously hydrolysed (NaOH 3.0M) and stored in conditioned atmosphere (20± 2ºC and 60% R.H.) during 24h, were impregnated with PEG (250 g/L; M_w 1000 to 2000), in the presence of a modified DMDHEU resin and catalyst (Adipret P-LF; 60 g/L and 120 g/L). Different drying protocols were tested as well as curing conditions. In the end, all samples were properly washed and dried.

The modified materials were characterized by contact angle, DSC, FTIR-ATR, DMA and SEM-EDS methods. The soil-release behavior was evaluated using the AATCC Test Method standard 130-2000.

RESULTS AND DISCUSSION

The best finishing results were obtained with the impregnation of an aqueous solution of PEG 2000 (250 g/L) with 60 g/L of chemical modified DMDHEU resin (wet pick up 90%) followed by drying at 20ºC during 24h and curing for 1.5 minutes at 180ºC.
The modification of the polyester was verified by the increase in the absorption peak at 1700 cm^{-1} in FTIR spectrum, which corresponds to the vibration of the carbonyl group in the tetrafunctional ring of the resin that bridges the PEG and PET (Figures 1 and 2)

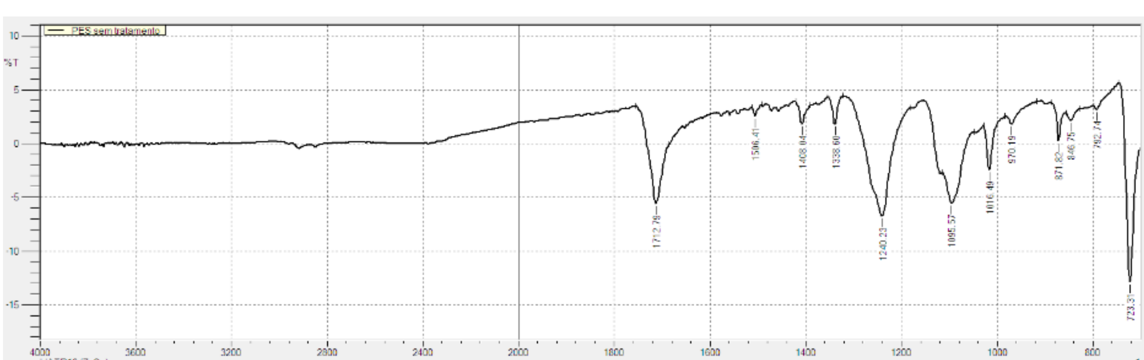


Figure 1- FTIR-ATR spectrum of untreated PET.

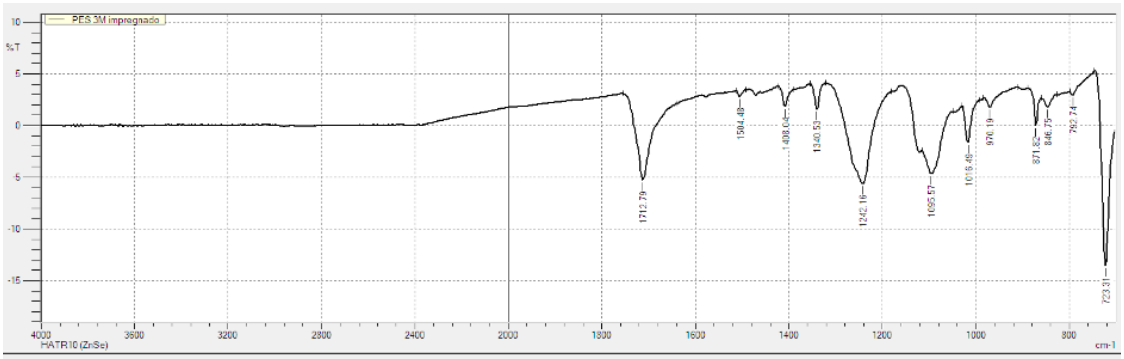


Figure 2- FTIR -ATR spectrum of treated PET hydrolyzed (NaOH 3M) PEG (250 g/L; M_w 2000), in the presence of a modified DMDHEU (60 g/L).

The SEM structural analysis of the modified and original PET is present in Figure 3. It can be observed that the PEG chains are deposited on the surface of PET fibers.

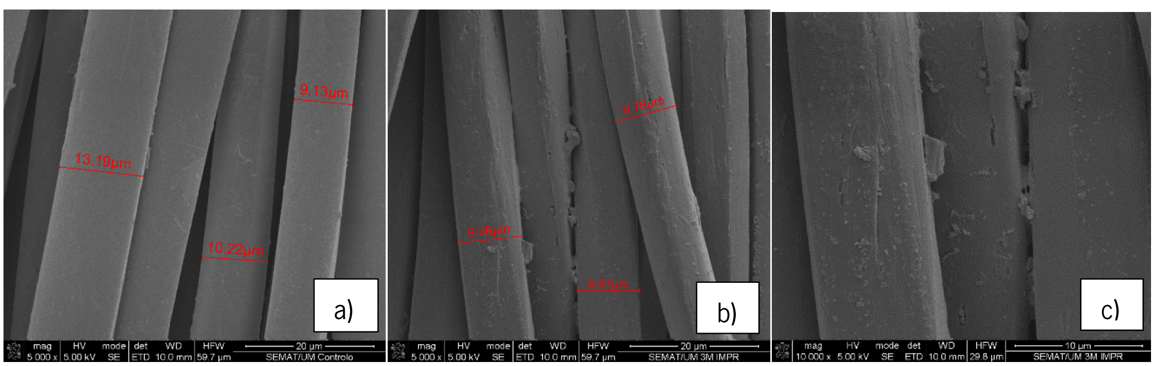
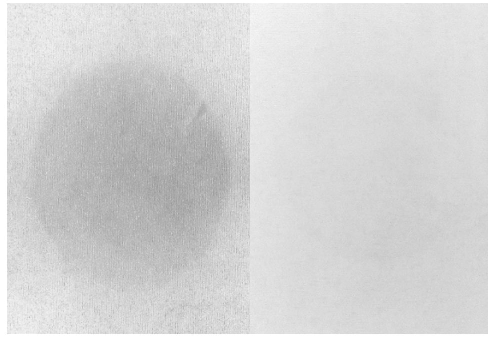


Figure 3. SEM analysis of a) Original PET, b) Hydrolyzed PET with PEG (250 g/L, M_w 2000) and resin (60 g/L) (5000x) and c) Hydrolyzed PET with PEG (250 g/L, M_w 2000) and resin (60 g/L) 10000 x).

In previous work, we were define that the best PET saponification conditions were obtained using a solution of sodium hydroxide (3M) at 55 °C for 30 minutes[1]. The hydrolyzed samples have an average contact angle of 30.98° and acceptable mechanical performance when compared to the untreated polymer. However, the finishing with PEG 2000 and resin, allows a marked decrease of the contact angle, reaching an average value of 2.85º (Figure 4). Furthermore, the soil-release behavior of modified PET was increased, presenting 4-5 grade for stain release (Figure 5).

a b

Figure 4. Static contact angles of water drop on a) Sample of original polyester; b) Hydrolyzed PET with PEG (250 g/L, M_w 2000) and resin (60 g/L) by pad-dry-cure process.



a b

Figure 5. Soil-release properties: a) Untreated PET; b) Treated PET with PEG 250 g/L, M_w 2000) and resin (60 g/L) by pad-dry-cure process.

CONCLUSIONS

A simple hydrolyzed PET finishing process using PEG with an average molecular weight of 2000 and a resin often used in textiles allows for a significant improvement in the hydrophilicity and soil release properties of fabric.

REFERENCES

1. Miranda, T., Santos, J., & Soares, G. M. B., 2017. Materials Science and Engineering, v. 254, (3), p. 1-6.

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