Enzymatic modification of poly(ethylene terephthalate) by cutinase

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1. Introduction

Poly(ethylene terephthalate) (PET) fibers are widely used in the textile industry including outdoor, sports, and in numerous technical applications.

Apart from the excellent physicochemical properties of PET, an important disadvantage is the hydrophobic character that weakens the physiological properties of fabrics and causes difficulties in finishing. Conventionally, the hydrophilicity of PET fibers is improved by sodium hydroxide treatment. To reduce the environmental impact and to obtain improved fiber properties, plasma or enzyme treatment have been carried out. The use of enzymes is an environmentally friendly alternative due to high specificity and efficiency, which work under mild conditions. Enzymes have frequently been used in other textile processes for several years, particularly in the field of natural fibers.

In this paper, we tried the cutinase treatment of PET, which is supposed to modify the surface properties of fiber.

2. Experimental

2.1 Materials

Cutinase originated from EST1 (JM003) which species are Sphingobiumchungbukense, Foron Red E-2BL (C.I. Disperse Red 60, E-type), Foron Blue S-2RN (C.I. Disperse Blue 183, S-type), 10mM Tris-HCL buffer (pH 8), Triton X-100, Sodium Phosphate Buffer, 0.1M, pH 8, Sodium Phosphate Buffer, 1/6M, pH 7, Sodium Phosphate Buffer, pH 5, Sodium carbonate, Scanning Electron Microscopy (JSM-6380LV), Tensile Strength autograph AG-X 5 KN (Shimadzu Corporation, Kyoto Janpan)

2.2 Cutinase treatment

The PET fabrics were cut into pieces of 6× 7 cm and treated in 250 ml Erlenmeyer flasks with the 30 ml enzyme solutions which were prepared by 25 ml cutinase stock solution and 5 ml of 1/6M Sodium

phosphate solution to adjust pH to 8.0. After the treatment, fabrics were washed with Triton X-100 (5g/L) and subsequently with Na_2CO_3 (2g/L) for 30 min at 50 °C to remove the adsorbed protein, and then rinsed with distilled water completely.

2.3 Dyeing and Measurements

After enzymatic treatment, samples were dyed with 3% owf Foron Red E-2BL (C.I. Disperse Red 60, E-type) and Foron Blue S-2RN (C.I. Disperse Blue 183, S-type).

The dyeing was performed at 130 °C (Foron Blue S-2RN) and at 120 °C (Foron Red E-2BL) for 5, 10, 15, 20, 30, 60 min at pH 5 respectively.

Weight loss was calculated from the dry weight of PET fabric before and after cutinase treatment.

Tensile strength was obtained by Ravelled Strip Method.

AATCC 79-1992 drop test method was used for the measurement of hydrophilicity.

3. Results and Discussion

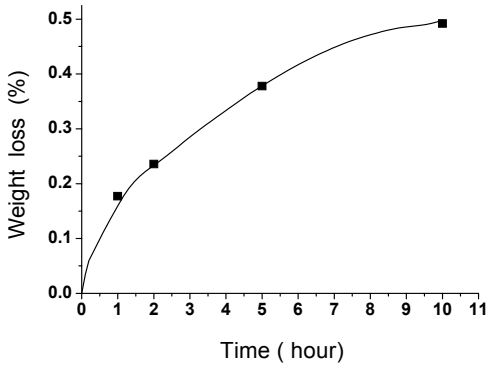

Fig. 1. Weight loss of PET treated with cutinase at 60 °C, pH 8.

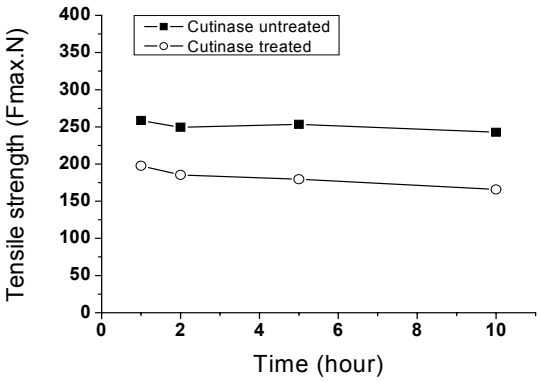

Fig. 2. Tensile strength of PET treated with cutinase at 60 °C, pH 8.

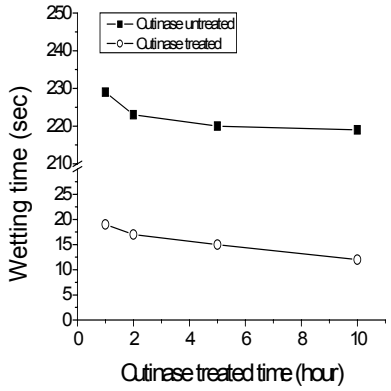

Fig. 3. Hydrophilicity of PET treated with cutinase at 60 °C, pH 8.

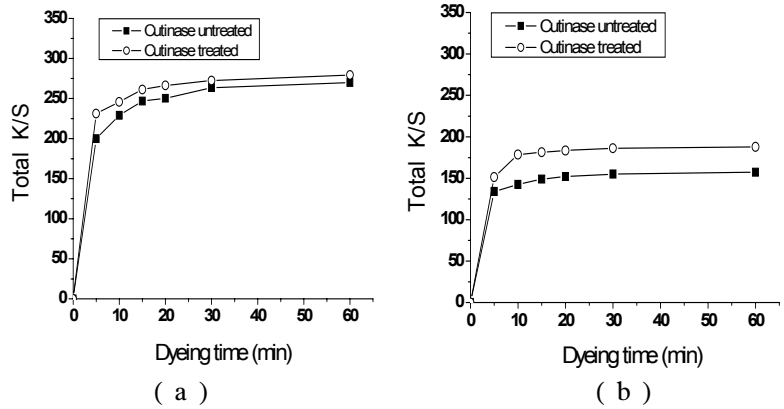

Fig. 4. Rate of dyeing of PET with Foron Blue S-2RN (a) at 130 °C and Foron Red E-2BL (b) at 120 °C.