materials

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Supplementary material

Artificial Weathering Mechanisms of Uncoated Structural Polyethylene Terephthalate Fabrics with Focus on Tensile Strength Degradation

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Table S1. Absorption peaks of polyethylene-terephthalate (PET).

Absorption Peak (cm^{-1})	Characteristic
3540	Stretching vibration of O-H in hydroxyl end group (hydrolysis product)
3480	O-H of carboxylic acid
3290	Stretching vibration of O-H of the carboxyl end (hydrolysis product)
3256	Carboxyl end group
2953	Asymmetric stretching vibration of C-H of methylene (-CH_2- in ethylene glycol) and stretching aliphatic vibration in the amorphous region
2864	Symmetric stretching vibration of C-H of methylene (-CH_2- in ethylene glycol) and stretching aliphatic vibration in the crystalline region
2650	-C-H of aldehyde
2258	Extent of crystallization (hydrolysis)
1760	C=O of aldehyde
1720	C=O of ester
1711	C=O of carboxylic acid, and carbonyl stretching as a signature of chain scission
1688	C=O of COOH
1576	Stretching vibration of C=O carbonyl group of carboxyl acid
1454	Bending (scissoring) vibration of C-H of the methylene (-CH_2- in ethylene glicol), bending of –CH_2- in the ethylene glycol in amorphous area, gauche conformer of ethylene glycol
1376	Wagging vibration of C-H of the methylene (-CH_2- in ethylene glycol), wagging vibration of –CH_2- in the ethylene glycol segment in the amorphous region, gauche conformer of ethylene glycol
1343	Wagging vibration of C-H of the methylene (-CH_2- in ethylene glycol), wagging vibration of –CH_2- in the ethylene glycol segment in the crystalline region, trans conformer of ethylene glycol
1233	C-O of carboxylic acid (by product of photodegradation in both Norrish type I and II), stretching vibration of C-O of carboxylic acid
1090	Symmetric stretching vibration of C-O of ethylene glycol (O-CH_2), and gauche form in the amorphous region
1018	In plane ring deformation (C–H) in the amorphous phase
972	Asymmetric stretching vibration of C-O of ethylene glycol (O-CH_2), and trans form in the crystalline region
898	Rocking vibration of C-H of the methylene (-CH_2-) in the ethylene glycol) in the amorphous region, gauche form of ethylene glycol
837	Rocking vibration of C-H of the methylene (-CH_2-) in the ethylene glycol) in the crystalline region, trans form of ethylene glycol
718	Out of plane bending vibration of ring (C-H), in-plane bending vibration of benzene ring
498	Stretching vibration of C-C between ring and ester group
1343/1376	Crystallinity index
100 × (973/1018)	Degree of crystallinity

Table S2. Direct and multi-step pathway equations for the tensile strength deterioration of PET type II under artificial exposure M4, t: time of exposure (hour) and Ts: tensile strength.

Warp Direction	
$t \rightarrow Ts$	$Ts = -6\times10^{-8}t^3 + 1.7\times10^{-4}t^2 - 0.17t + 62.57$
$t \rightarrow M_n$	$M_n = -6.26\times10^{-6}t^3 + 0.024t^2 - 19.13t + 26802.46$
$M_n \rightarrow Ts$	$Ts = 0.01\ M_n - 142.05$
$t \rightarrow M_n \rightarrow Ts$	$Ts = -4.72\times10^{-8}t^3 + 1.42\times10^{-4}t^2 - 0.14t + 60.04$
$t \rightarrow$ Chain scission	$Cs = 1.9\times10^{-10}t^3 - 6.3\times10^{-7}t^2 + 8.1\times10^{-4}t + 0.06$
Chain scission $\rightarrow Ts$	$Ts = -137.57Cs + 65.24$
$t \rightarrow$ Chain scission $\rightarrow Ts$	$Ts = -2.66\times10^{-8}t^3 + 8.7\times10^{-5}t^2 - 0.11t + 57.38$
$t \rightarrow C=O$ of COOH	$CO = -5.4\times10^{-12}t^3 - 2.46\times10^{-8}t^2 + 7.5\times10^{-5}t + 1.48$
$C=O$ of COOH $\rightarrow Ts$	$Ts = -2355.57CO^2 + 6132.08CO - 3863.9$
$t \rightarrow C=O$ of COOH $\rightarrow Ts$	$Ts = 4.87\times10^{-13}t^4 + 1.3\times10^{-8}t^3 + 7.6\times10^{-6}t^2 - 0.06t + 49.64$
Weft direction	
$t \rightarrow Ts$	$Ts = 2\times10^{-9}t^3 + 2\times10^{-5}t^2 - 0.05t + 31.873$
$t \rightarrow M_n$	$M_n = -2.6\times10^{-6}t^3 + 0.01t^2 - 14.82t + 25217.39$
$M_n \rightarrow Ts$	$Ts = 0.003M_n - 55.12$
$t \rightarrow M_n \rightarrow Ts$	$Ts = -8.86\times10^{-9}t^3 + 3.28\times10^{-5}t^2 - 0.050t + 30.64$
$t \rightarrow$ Chain scission	$Cs = -1.11\times10^{-10}t^3 + 8.5\times10^{-8}t^2 + 5.13\times10^{-4}t + 0.09$
Chain scission $\rightarrow Ts$	$Ts = -52.49Cs + 33.1$
$t \rightarrow$ Chain scission $\rightarrow Ts$	$Ts = 5.85\times10^{-9}t^3 - 4.47\times10^{-6}t^2 - 0.03t + 28.46$
$t \rightarrow C=O$ of COOH	$CO = -7.23\times10^{-12}t^3 + 2.18\times10^{-8}t^2 - 2.16\times10^{-6}t + 0.52$
$C=O$ of COOH $\rightarrow Ts$	$Ts = -5790.49CO^2 + 5089.8CO - 1059.81$
$t \rightarrow C=O$ of COOH $\rightarrow Ts$	$Ts = -2.9\times10^{-12}t^4 + 7.26\times10^{-9}t^3 - 2.03\times10^{-5}t^2 + 0.002t + 21.42$
$t \rightarrow$ Crystallinity	$cry = -1.4\times10^{-8}t^2 - 6.9\times10^{-6}t + 1$
Crystallinity $\rightarrow Ts$	$Ts = 17426.75cry^2 - 33555.01cry + 16152.3$
$t \rightarrow$ Crystallinity $\rightarrow Ts$	$Ts = 3.35\times10^{-12}t^4 + 4.18\times10^{-9}t^3 - 1.77\times10^{-5}t^2 - 0.01t + 24.38$