NOTE

Weatherability of SAN–Copolyester TPE Graft Polyblends

Perhaps the earliest publication on polymer durability was a paper by Hoffman in 1860 on the deterioration of guttapercha cables.[1] In the intervening years, thousands of papers related to polymer degradation or weatherability have appeared.

The durability of styrene/acrylonitrile (SAN)–rubber graft polyblends in outdoor environments has received considerable attention. Articles by Gesner[2,3] reporting the weatherability of ABS plastics show that ABS resins lose toughness and yellow outdoors through polybutadiene degradation. Improved weatherability has been reported by substituting weatherable rubbers for polybutadiene in ABS resins. Acrylic and EPDM rubbers are more weatherable than polybutadiene and give more weatherable SAN graft polyblends.[4]

We would like to report the synthesis of SAN–copolyester thermoplastic elastomer (TPE) graft polyblends and the effect of outdoor environment and UV irradiation on their physical properties. The copolyester TPE has a hard segment consisting of a poly(alkylene terephthalate) and a soft segment of a polyalkylene ether.

The SAN–copolyester TPE graft polyblends were prepared by solution polymerization in chlorobenzene, 25% solids, with 1% benzoyl peroxide at 72°C. The graft polyblend was isolated by coagulation in methanol. The graft polyblend contained 25% copolyester TPE and had a styrene/acrylonitrile ratio of 2. Graft efficiency, determined by solvent extraction, showed that 20–30% of the SAN was grafted onto the copolyester TPE.

The graft polyblend molded into tough, rigid films and bars with an impact of 7.9 coupled with a 4900 psi ultimate tensile strength and a 247,000 flex modulus (Table I).

The weatherability of SAN–copolyester TPE graft polyblends containing 80% styrene/acrylonitrile with a styrene/acrylonitrile ratio of 2 was determined by exposing 10–20 mil thick films outdoors and in a UV chamber according to ASTM Method D1501. The data in Table II show that a SAN–copolyester TPE graft polyblend loses its toughness both outdoors and in the UV chamber in a short time as indicated by a loss of 74–84% of its ultimate tensile strength and > 80% of its percent elongation after 16 weeks exposure.

The poor weathering of the SAN–copolyester TPE graft polyblend is due to the copolyester TPE moiety as indicated by its weathering (Table II). The copolyester TPE loses 94% of its ultimate tensile strength and 99% of its percent elongation after 16 weeks exposure outdoors and in the UV chamber. This is probably due to the small amount of poly(alkylene ether) present in the copolyester TPE.[5,6]

The weatherability of SAN–copolyester TPE graft polyblends may be improved by incorporation of a sterically hindered amine/sterically hindered phenol/phosphite stabilizing system (Table II). After 16 weeks, films of the graft polyblend retain 100% of their ultimate tensile strength both outdoors and in a UV chamber. Percent elongation retention is not as good. After 32 weeks exposure, 81–99% of the ultimate tensile strength remains.

In summary, SAN–copolyester TPE graft polyblends may be made by solution polymerization initiated by peroxide. The graft polyblends mold into tough rigid films

Table I Physical Properties of SAN–Copolyester TPE[a] Graft Polyblend

Izod impact	7.9
Ultimate tensile strength (psi)	4900
% Elongation	20
Flex modulus	247,000
Flex strength	8400
Heat distortion (°C)	65°

[a] The copolyester TPE is Hytrel made by DuPont.

* To whom correspondence should be addressed at 3608 Russett Lane, Northbrook, IL 60062.

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Table II Weatherability of Copolyester TPE and SAN–Copolyester TPE Graft Polyblends[a]

	SAN–Copolyester TPE		Copolyester TPE		Stabilized[c] SAN–Copolyester TPE	
Time (weeks)	Ultimate Tensile Strength	Elongation	Ultimate Tensile Strength	Elongation	Ultimate Tensile Strength	Elongation
			Outdoors[b]			
2	100	83	91	100	—	—
4	57	< 20	64	89	—	—
8	58	< 20	14	5	100	75
16	16	< 20	6	< 0.7	100	75
32	—	—	—	—	81	< 25
			UV Chamber[d]			
2	100	25	89	100	—	—
4	86	< 20	66	93	—	—
8	55	< 20	20	2	100	70
16	26	< 20	6	< 0.7	100	55
32	—	—	—	—	89	35

[a] Percent retention of physical properties.
[b] At R.C. Ingersoll Research Center.
[c] Stabilized with 1% sterically hindered amine, 0.15% sterically hindered phenol, and 1.7% phosphite.
[d] Dry samples 3 in. from a UV fluorescent bulb, Westinghouse 20T12, according to ASTM Method D1501.

and bars. The resins lose toughness outdoors and in the UV chamber as evidenced by dramatic decreases in short periods of time in ultimate tensile strength and percent elongation. The copolyester TPE moiety is responsible for the poor weathering. The weatherability of SAN–copolyester TPE graft polyblends may be improved somewhat by incorporation of stabilizers.

References

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JOHN C. FALK*
JAMES VAN FLEET

R. C. Ingersoll Research Center,
Borg-Warner Corporation,
Des Plaines, Illinois

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