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Waste tire rubber in polymer blends: A review on the evolution, properties and future

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ABSTRACT

This review addresses the progress in waste tire recycling with a particular attention to incorporation of waste tire rubber (WTR) into polymeric matrices. Methods of waste tire downsizing, importance of WTR characterization and current practice of WTR modification has been emphasized. Detailed discussion on influence of WTR size, loading, modification, compatibilization and crosslinking on the rheological, mechanical and thermal properties of rubber, thermoplastic and thermoplastic elastomer blends utilizing WTR

Abbreviations: 3R, reduce, reuse, recycle; AAm, acrylamide; BR, butadiene rubber; CB, carbon black; DCP, dicumyl peroxide; EB, elongation at break; EPDM, ethylene propylene diene monomer rubber; EPR, ethylene propylene rubber; EPRS, extended producer responsibility scheme; EU, European Union; EVA, ethylene vinyl acetate copolymer; FTIR, Fourier transform infrared spectroscopy; GTR, ground tire rubber; HDPE, high density polyethylene; HVA-2, N,N-1,3 phenylene bismaleimide; IPN, interpenetrating network; LDPE, low density polyethylene; LLDPE, linear low density polyethylene; MA, maleic anhydride; MAgGTR, MA grafted GTR; MAgPE, MA grafted polyethylene; MAgPP, MA grafted polypropylene; MAgSEBS, MA grafted styrene ethylene butylene styrene copolymer; MFA, multifunctional acrylates; NBR, acrylonitrile butadiene rubber; NR, natural rubber; PE, polyethylene; PFM, polyfunctional monomer; POE, ethylene octylene copolymer; PP, polypropylene; PVC, polyvinyl chloride; PVI, *N-cyclohexyl thiophthalimide*; RTR, reclaimed tire rubber; SBR, styrene butadiene rubber; SBS, styrene butylene styrene copolymer; SEBS, styrene ethylene butylene styrene copolymer; T_g, glass transition temperature; TM, tensile modulus; TMPTA, trimethylol propane triacrylate; TOR, trans-polyoctylene rubber; TPE, thermoplastic elastomer; TPGDA, tripropylene glycol diacrylate; TPV, thermoplastic vulcanizate; TS, tensile strength; US, United States; UV, ultraviolet; WTR, waste tire rubber; XPE, crosslinked PE.

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Reclaimed tire rubber
GTR polymer blends
Compatibilization

has been reported. By far, thermoplastic elastomer blends; though still in its infancy; has shown the most promising properties balance which is capable of commercialization. Rubber/WTR blends also show ease of processing and acceptable properties. Thermoplastic/WTR blends suffers in term of toughness and elongation at break. However, the waste thermoplastic/WTR is a viable solution to address polymeric waste problem. Review also highlights the lack of studies concentrating on dynamic mechanical, aging, thermal and swelling properties of WTR polymeric blends.

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