ABSTRACT

Novel thermoplastic vulcanizates (TPVs) based on polypropylene (PP) and new generation ethylene octene copolymer (EOC) have been prepared by dynamic vulcanization process, which involves simultaneous melt mixing and crosslinking of a rubber with a thermoplastic material. The effect of dynamic vulcanization and influence of various types of peroxides were studied in details. Three structurally different peroxides, namely dicumyl peroxide (DCP), tert-butyl cumyl peroxide (TBCP) and di(tert-butylperoxyisopropyl)benzene (DTBPIB) were taken for investigation. Addition of peroxide in PP/EOC blend involves two major competing reactions: crosslinking in EOC and degradation of PP by β chain-scission. This is the main reason which limits the applicability of peroxide cured TPVs. An alternative approach to overcome the above mentioned drawback could be to introduce a compound that not only improves the efficiency of peroxide during crosslinking, but also decreases the extent of degradation. Generally, coagents are multifunctional vinyl monomers which are highly reactive towards free radical either by addition reaction and/or by hydrogen abstraction. Accordingly, incorporation of a coagent increases the crosslinking efficiency in the EOC phase and decreases the extent of degradation in the PP phase. The effects of three structurally different coagents namely, triallyl cyanurate (TAC), trimethylol propane triacrylate (TMPTA) and N, N'-m-phenylene dimaleimide (MPDM) on the performance properties of the PP/EOC thermoplastic vulcanizates (TPVs) were studied in detail. Furthermore, special attention on the influence of 1,2-polybutadiene (1,2-PB) as a special coagent have been studied, because of its non-polar, polyolefinic and structurally similarity to the base blend compounds. It is also necessary to explore the processing conditions or parameters which minimize the extent of degradation and thus may improve the ultimate performance properties of the TPVs. Three different mixing sequences were employed. They are as follows: (a) preblending method – melt mixing of PP and EOC followed by dynamic vulcanization (b) phase mixing method – curative master batch of EOC added in molten PP (c) split addition method – preblending procedure followed by addition of half part of PP (dilution of dynamic vulcanizate). Special emphases on the melt rheological properties have been evaluated at the processing temperature (180°C) in a Rubber Process Analyzer (RPA 2000). A variety of rheological observations such as analogy with Payne effect, modulus recovery and shear rate sensitivity were studied by carrying out frequency and strain amplitude sweeps to understand the reinforcement mechanism of TPVs. Finally, the comparison of peroxide cured PP/EOC TPVs with PP/ethylene propylene diene rubber (EPDM) TPVs was studied in detail. It was found that, the origin of the improved performance properties of EOC based uncrosslinked and dynamically crosslinked blends are due to the combined effect of the unique molecular architecture and better interfacial interaction with PP. Therefore, peroxide crosslinked PP/EOC TPVs may be a potential alternative to the conventional PP/EPDM TPVs.

Key words: Polypropylene, Ethylene octene copolymer, Ethylene propylene diene rubber, Thermoplastic vulcanizate, Peroxide, Coagent.