

CHAPTER III

LITERATURE REVIEWS

Crevecoeur, J. J., Nelisse, L., Van der san, M. C. M. and Lemstra, P. J. [1996] studies the impact strength of blends consisting of polystyrene (PS) and ethylene-propylene-diene rubber (EPDM) could be increased by adding a poly(styrene/ethylene-propylene) (SEP) compatibilizer and an organic peroxide during reaction extrusion. The increased impact strength could be related to an enhanced adhesion between the dispersed EPDM phase and the PS matrix, as a consequence of radical grafting or co-crosslink reactions between the rubbery part (EP) of the compatibilizer and the dispersed EPDM rubber. The morphology of the blend proved to be dependent upon the type and amount of peroxide used, as well as on the residence time (feeding position) of the peroxide in the extruder. The dependence of the mechanical properties of the blend on the type and concentration of peroxide used, is discussed in relation to the distribution of the peroxide between the PS and the EPDM phases.

Jing Sheng and Jing hu [1996] studies synthesis graft copolymer of styrene (St) onto random ethylene-propylene diene monomer (EPDM) with benzoyl peroxide (BPO) and 2,2-azo-bis-isobutyronitrile (AIBN) as the initiator in solvent. Results showed that BPO was superior to AIBN. The influence factors, such as reaction St and BPO, on the extent of graft were discussed. The existence of grafted copolymer was verified by infrared spectra, NMR, and thin-layer chromatography. The grafted copolymer was characterized by thermally simulated current.

Fischert, M. and Hellmann, G. P. [1996] studies High-impact-modified polystyrene (HIPS) is made by thermal or radical polymerization of styrene containing dissolved polybutadiene (PB). The reaction leads, intermediately, to blends of yet ungrafted PB, of the homopolymer PS, and of graft copolymers PBgS varying in the number of PS grafts per PB chain. The polymerization induces a phase separation and a phase inversion which results in the well-known "salami"

morphology of HIPS. To elucidate the mechanism producing this morphology, the polymerization of styrene in PB/styrene mixtures was studied kinetically and morphologically, in toluene solution and in the bulk. Besides the conventional techniques of polymerization kinetics, electron microscopy was employed to examine the PS/PB/PBgS blends that are formed during the polymerization. The electron micrographs reflect sensitively the composition of these blends, the architecture of the PBgS graft copolymers and the miscibility of PBgS with PS and PB. The blends were isolated from the polymerizing system by two methods, i.e. (i) evaporation of styrene and (ii) dissolution and film casting. Method i preserves the in-situ morphology of the polymerizing system, while method ii leads to a thermodynamically controlled morphology. Pair wise comparison of these two types of morphology reveals that HIPS owes its salami structures to the fact that PBgS chains with two grafts or more can solubilize the homopolymer PS while PBgS chains with only one graft cannot.

Jing Sheng, Jing hu, Xu-Bn Yuan, Yun-Ping Han, Feng-Kui Li and Dong-Cai Bian [1998] studies the pressed films of blends of polystyrene (PS) with ethylene-propylene diene monomer rubber (EPDM) or grafted copolymer of styrene (St) onto EPDM (EPDM-g-St) rubber were examined by small-angle X-ray scattering (SAXS), and scanning electron microscope (SEM). Small-angle X-ray scattering from the relation of phase was analyzed using Porod's Law and led to value of interface layer on blends. The thickness of interface layer (σ_b) had maximum value at 50/50 (PS-EPDM-g-St) on blends. The radius of gyration of dispersed phase (domain) and correlation distances a_c in blends of PE-EPDM-g-St were calculated using the data of SAXS. The morphology and structure of blends were investigated by SEM.

Thai Hoang, Jong-Gu Park, Gu-Ni Kim, Sang-Teak Oh, Chang-Sik Ha and Won-Jei Cho [1999] studies the styrene-EPDM-vinylacetate (SEV) graft polymer, which linked respectively the styrene (St) unit and vinylacetate the (VAc) unit to the ethylenepropylene-diene terpolymer (EPDM) backbone was synthesized by two-step graft polymerizations: First the graft polymerization of VAc onto EPDM was carried out, and then St was added successively in the prepolymerized solution and further polymerized for a given period to obtain SEV. The effects of concentration of EPDM and an initiator, mole ratio of VAc to St, polymerization time, temperature, and

solvent were examined on the graft polymerizations. The synthesized graft polymers (SEVs) that have different contents of St or VAc were identified by Fourier transform IR spectrum. The highest graft ratio has been obtained by 10 wt % of EPDM, 1.0 mole ratio of VAc to St, and 1.0 wt % of BPO in toluene for 48 h at 70°C. The glass transition temperature of SEV is lower than that of poly(vinyl acetate) (PVAc) and polystyrene (PS). The thermal stability of SEV is higher than that of PVAc, PS, and the acrylonitrile-butadiene-styrene (ABS) resin. The tensile strength of SEV was improved as compared with that of EPDM. The light resistance and weather ability of SEV were better than those of ABS.

Schierholz, J.U. and Hellmann, G.P. [2002] studied rubber-modified polystyrene (PS) owes its impact resistance to a morphology of salami domains: in the PS matrix, polybutadiene (PB) domains are dispersed that, in turn, are strongly filled with PS subdomains. This unique structure is created in situ as styrene is polymerized in PB/styrene solutions. The salami domains are built up by graft copolymer chains PB-g-PS. It was suggested previously that these domains assume their characteristic architecture because strongly grafted chains stabilize them on the outside while weakly grafted chains provide their internal substructure. This model is extended in this paper that deals with the polymerization of methylmethacrylate (MMA) in EP/MMA solutions of a poly(ethylene-co-propylene) copolymer (EP). Intermediate and final products were characterized by ¹H-NMR spectroscopy, transmission electron microscopy, two-dimensional chromatography and statistical calculations, with a focus on the pivotal stage of phase inversion during the polymerization where the salami domains are born.

Xiongwei Qu, Shurui Shang, Guodong Liu, Liucheng Zhang [2002] studied Acrylonitrile-EPDM-styrene (AES) graft copolymers were synthesized by solution graft polymerization of styrene (St) and acrylonitrile (AN) onto EPDM in an n-hexane/benzene solvent with benzoyl peroxide (BPO) as an initiator. The structure changes were studied by an FTIR spectrophotometer. The grafting parameters were calculated gravimetrically. The influence of the polymerization conditions, such as the reaction time, concentration of the initiator, EPDM content, and weight ratio of St/AN, on the structure of the products was investigated. It was found that a proper initiator concentration and EPDM content will give a high grafting ratio of the AES

resin. The thermal property of the copolymer was studied using programmed thermogravimetric analysis (TGA). The results showed that the copolymer has a better heat-resistant property than that of ABS especially for the initial decomposition temperature (T_{in}) and the maximum weight loss rate temperature (T_{max}). Also, the mechanism of the graft reaction was discussed.

Qiu ,G. X., Zhang ,P., Pan ,J. X., Xie ,Y. and Zhao ,S. G. [2003] studies a remarkable breakthrough in technology for the polyolefin industry in recent years is the introduction of single-site metallocene catalysts, by which a completely new elastomer type, metallocene polymerized polyethylene (mPE) elastomers, could be developed. In this work mPE elastomer was used to replace the conventional elastomers, ethylenepropylene-diene-rubber (EPDM) and styrene-ethylene-butylene-styrene triblock copolymer (SEBS) in the toughening modification of polypropylene (PP). The influence of processing conditions and PP/elastomer ratio on the mechanical properties of PP/mPE blends were investigated. The mechanical properties of PP toughened with different elastomers were compared. The mPE in the PP/elastomer blends showed a superior low-temperature behavior and strain recovery performance in comparison to the conventional elastomers used for toughening PP. The morphology of the PP/mPE blend at blend ratio of 60/40 was analyzed by scanning electron microscopy, and the PP fibrils throughout mPE phase was observed.

Guo ,T. Y., Tang ,G. L., Hao ,G. J., Song ,M. D. and Zhang ,B. H. [2003] studies core-shell structured particles, which comprise the rubbery core and glassy layers, were prepared by emulsifier-free emulsion polymerization of paly(n-butyl acrylate/methyl methacrylate)/polystyrene [P(n-BA/MMA)PS]. The particle diameter was about 0.22 μ m, and the rubbery core was uncrosslinked and lightly crosslinked, respectively. The smaller core-shellstructured particle-toughened PS blends were investigated in detail The dynamic mechanical behavior and observation by scanning electron microscopy of the modified blend system with core-shell structured particles indicated good compatibility between PS and the particles, which is the necessary qualification for an effective toughening modifier. Notched-impact strength and related mechanical properties were measured for further evaluation of the toughening efficiency. The notched impact strength of the toughened PS blends with un-

crosslinked particles reached almost sixfold higher than that of the untoughened PS when 15 phr of the core-shell structured particles was added. For the crosslinked particles the toughening effect for PS was not obvious. The toughening mechanism for these smaller particles also is discussed in this article.

Botros, S. H. and Moustafa ,A.F.[2003] studies Acrylonitrile-co-styrene-co-methylmethacrylate (AN-S-MMA) terpolymer was prepared by bulk and emulsifier-free emulsion polymerization techniques. The bulk and emulsion "terpolymers were characterized by means of Fourier transform infrared spectroscopy, ^{13}C - nuclear magnetic resonance (NMR) spectroscopy, gel permeation chromatography, thermal gravimetric analysis, and elemental analysis. The kinetics of the terpolymerization were studied. The terpolymers were then incorporated into butadiene-acrylonitrile rubber (NBR)/ethylene propylene diene monomer rubber (EPDM) blends and into chloroprene rubber (CR)/EPDM blend. The terpolymers were then tested for potential as compatibilizers by using scanning electron microscopy and differential scanning calorimetry. The terpolymers improved the compatibility of CR/EPDM and NBR/EPDM blends. The physicomechanical properties of CR/EPDM and NBR/EPDM blend vulcanizates revealed that the incorporation of terpolymers was advantageous, since they resulted in blend vulcanizates with higher 100% moduli and with more thermally stable mechanical properties than the individual rubbers.

Siddaramaiah, S. Roopa, Guruprasad ,K. H. [2003] studies The sorption and diffusion of halogenated hydrocarbon penetrants through different ethylene-propylene-diene terpolymer (EPDM) blends, such as EPDM/natural rubber, EPDM/bromobutyl rubber, and EPDM/styrene butadiene rubber (50/50 w/w), were studied. The diffusion coefficient of halogenated penetrants fell in the range $1.5\text{-}14.52 \times 10^{-7} \text{ cm}^2/\text{s}$ in the temperature range of 25-60 °C. Transport data were affected by the nature of the interacting solvent molecule rather than its size and also by the structural variations of the EPDM blends. 1,2-Dichloro ethane showed a lower mass uptake compared to other penetrants. The temperature dependence of the transport coefficient was used to estimate the activation parameters, such as the activation energy of diffusion (E_D) and the activation energy of permeation (E_p) from Arrhenius plots. The activation parameters for E_D of aliphatic chlorinated organic penetrants was in the range 7.27-15.58 kJ/mol. These values fell in the expected range for rubbery

polymers, well above their glass-transition temperature. Also, the thermodynamic parameters, such as enthalpy and entropy, were calculated and fell in the range 2-15 kJ/mol and 3-54 J/mol/K, respectively. Both first- and second-order transport kinetics models were used to investigate the transport kinetics, and first-order kinetics were followed.

Mei Hua Zhou, Won-Jei Cho [2003] studies four oil absorbents based on styrene-butadiene (SBR)-pure SBR (PS), 4-tert-butylstyrene-SBR (PBS), EPDM-SBR network (PES), and 4-tert-butylstyrene-EPDM-SBR (PBES)-were produced from crosslinking polymerization of uncured styrene-butadiene rubber (SBR), 4-tert-butylstyrene (tBS), and ethylene-propylene-diene terpolymer (EPDM). The reaction took place in toluene using benzoyl peroxide (BPO) as an initiator. Uncured SBR was used as both a prepolymer and a crosslink agent in this work, and the crosslinked polymer was identified by IR spectroscopy. The oil absorbency of the crosslinked polymer was evaluated with ASTM: method F726-81. The order of maximum oil absorbency was PBES > PBS > PES > PS. The maximum values of oil absorbency of PBES and PBS were 74.0 and 69.5 g/g, respectively. Gel fractions and swelling kinetic constants, however, had opposite sequences. The swelling kinetic constant of PS evaluated by an experimental equation was $49.97 \times 10^{-2} \text{ h}^{-1}$. The gel strength parameter, S , the relaxation exponent, n , and the fractal dimension, d_f of the crosslinked polymer at the pseudo-critical gel state were determined from oscillatory shear measurements by a dynamic rheometer. The morphologies and light resistance properties of the crosslinked polymers were observed, respectively, with a scanning electron microscope (SEM) and a color difference meter.