

CHAPTER II

LITERATURE SURVEY

2.1 Miscibility of Polymer Blends Having Acrylic Acid

Jo *et al.* (1990) investigated that the miscibility of blends of poly(ethylene oxide) and poly(styrene-co-acrylic acid) (SAA) as a function of the comonomer content of the polymer by using thermal analysis technique. This blend became miscible when having an acrylic acid content higher than 7 mol%. The miscibility has been assigned to the specific interaction between ethylene oxide and acrylic acid segments and intermolecular repulsive force in SAA copolymer.

Mohanty *et al.* (1995) studied the miscibility of blends of epoxidized natural rubber (ENR) and poly(ethylene-co-acrylic acid) (PEA) (6 wt % of acrylic acid). These blends are partially miscible up to 50% by weight of PEA and completely miscible beyond this proportion, confirming by DSC study, which exhibited a single second order transition (T_g). The miscibility was assigned to the esterification reaction between $-OH$ groups formed *in situ* during melt blending of ENR and $-COOH$ groups of PEA, confirmed by UV and IR spectroscopic studies. The existence of a single phase of the blends beyond 50 wt % of PEA was shown by SEM studied.

Mohanty and coworkers (1996) studied the mechanical and dynamic mechanical properties of blends of poly(ethylene-co-acrylic acid) (PEA) and epoxidized natural rubber (ENR). The miscibility of the blends was studied by using a computer simulation method and experimentally confirmed by dynamic mechanical analysis. The dynamic mechanical properties of the blends exhibited single glass transition temperature (T_g) values, thus confirming the law of miscibility. The mechanical properties of tensile strength, elongation at break and shore-A hardness, gradually increased with

increasing PEA content and exhibited a synergism behavior that calculated via the additivity rule.

Mcevoy *et al.* (1996) studied the impact strength of annealed interfaces between high-density polyethylene (HDPE), low-density polyethylene (LDPE), and polypropylene (PP) and some ethylene-co-acrylic acid (EAA) copolymer using Notched Izod test. EAA-PP interfaces using EAA with 3 to 20 wt % acrylic acid (AA), were equal to or greater than those of the homopolymer used. However, the impact strengths of EAA-HDPE and EAA-LDPE interfaces were all lower than those of pure HDPE or LDPE.

Eguiburu *et al.* (1998) studied the miscibility of blends of amorphous and crystalline polylactides with poly(methyl methacrylate) and poly(methyl acrylate) via thermal behavior using differential scanning calorimeter (DSC) and the results were compared with those obtained by dynamic mechanical analysis (DMTA). It was proposed that only one T_g was found in PDLA/PMA and PDLA/PMMA blends, indicating a high degree of miscibility over entire composition range.

In the same year, Glosh *et al.* studied the modification of low density polyethylene (LDPE) by graft copolymerization with acrylic acid (AA) and ethyl acrylate (EA) using dicumyl peroxide (DCP) as the initiator by differential scanning calorimeter (DSC). DSC was used to study the measurements of the heat of reaction and the kinetics and energetic of the overall reaction during graft copolymerization. Mechanical properties of PE on acrylic grafting such as elastic modulus, yield stress and tensile strength of the blends were found to slowly increasing trend, even though the elongation at break decreased gradually when the percentage of grafting value increased and it also imparted stiffening effect.

2. Miscibility and Other Properties of Other Polymer Blends

Ameduri *et al.* (1988) studied miscibility behavior of ternary blends poly(caprolactone)/poly(vinyl chloride)/chlorinated poly(vinyl chloride). The addition of PCL to a PVC/CPVC mixture allowed the observation of a single transition temperature (T_g) at PCL contents larger than 40% at high PVC/CPVC ratios and at PCL contents larger than about 26% at lower PVC/CPVC ratios.

The miscibility behavior of various poly(styrene-co-methacrylonitrile) (SMAN)/polymethacrylate blends was studied in 1994 by Chen *et al.* using differential scanning calorimeter (DSC). SMAN is immiscible with poly(ethyl methacrylate) (PEMA), poly(*n*-propyl methacrylate) (PnPMA) and poly(isopropyl methacrylate) (PiPMA) over certain copolymer composition ranges, but is immiscible with poly(*n*-butyl methacrylate) (PnBMA) and poly(isobutyl methacrylate) (PiBMA). The width of the miscibility window decreased with increasing size of the pendant ester group of the polymethacrylate, and is wider than that of the corresponding poly(styrene-co-acrylonitrile) blend system.

Zhang *et al.* (1994) investigated miscibility and phase behavior of poly(D,L-lactide)/poly(*p*-vinylphenol) blends using differential scanning calorimetry and Fourier transform infrared spectroscopy. Phase separation was observed in blends over a wide composition range and the blend samples exhibited two glass transitions temperatures (T_g).

Eisenbach *et al.* (1994) studied dynamic mechanical properties and spectroscopic of ionomer blends based on carboxylated or sulfonated flexible polystyrene and rigid poly(diacetylenes) with functional side groups. The results showed that miscibility of this unusually incompatible polymer pair can be achieved through ion-ion interactions between blend components.

Cimmino *et al.* (1995) investigated the tensile stress-strain behavior of high density polyethylene/hydrogenated oligo(cyclopentadiene) blends at 20, 80, and 100°C. The nominal stress-strain curves performed at 20°C indicated an increase of the modulus and a conspicuous decrease of the ultimate properties when increasing HOCP content in the blend. At 80, and 100°C, the nominal stress-strain curves showed a strong decrease of the modulus (compared to the value at 20°C). The behaviors at 80, and 100°C related to several factors: the higher mobility of HDPE molecules at these temperatures compared to that at 20°C.

Zheng *et al.* (1996) studied miscibility and phase separation in crystalline polymer blends of phenolphthalein poly(ether ether sulfone) and poly(ethylene oxide) on the basis of thermal analysis results. DSC studied showed that the PES-C/PEO blends possessed a single, composition dependent glass transition temperature, and thus that this blends were miscible in the amorphous state at all compositions at lower temperature. At higher temperature, blends underwent phase separation and the system found to display a lower critical solution temperature behavior. The thermal properties, such as temperature of crystallization and melting, the enthalpy of crystallization and fusion, depending on blend composition when phase separation occurred.

Xiaomin *et al.* (1997) studied morphology, mechanical properties and interfacial behavior of polyamide (PA) 1010/polypropylene (PP) blends, compatibilized with PP grafted with glycidyl methacrylate (PP-g-GMA). It was found that the size of the PP domains, tensile and impact strength of ternary blends, and adhesion fracture energy between two layers of PA1010 and PP were all significantly dependent on the PP-g-GMA contents in the PP layer. The improvements in properties have been attributed to chemical and physical interaction occurring between PA1010 and PP-g-GMA.

In the same year, Cardoso and coworkers studied morphology, thermal and dynamic mechanical behavior of HDPE/rosin blends. All blends showed phase separation. Both thermal and dynamic mechanical tests showed no shift of the HDPE glass transition temperature while the HDPE α_c transition appeared. The presence of an additional transition was also noticed as the second component was increased in blends; which was rosin component. Mcevoy *et al.* studied the impact strength and fracture surfaces of interfaces between polyethylene and polypropylene and some ethylene-containing copolymers. They suggested that additional of acid content or alcohol groups, the impact strength was increased.

Morphology and rheological property of HDPE/LCP blends compatibilized by a novel PE-g-LCP copolymer was investigated by Minkova *et al.* (1999). A PE-g-LCP consisting of polyethylene (PE) backbones and liquid crystalline polymer (LCP) branches was synthesized via reactive blending of an acrylic acid functionalized PE with a semiflexible LCP. COP was added as the compatibilizing activity of PE/SBH. The rheological behavior of the samples showed that COP leads to a slight increase of interfacial adhesion in the melt and the effect was more pronounced when lower molecular mass PE grade was used as the blend matrix. Melt-spinning test showed that deformation of the SBH droplets into highly oriented fibrils can be obtained for the blends of lower molar mass PE, compatibilized with small amounts of novel PE-g-SBH copolymer.

3. Damping Properties of Polymer Blends

The vibration damping properties of the polymer laminated steel sheet was investigated theoretically and experimentally by Liao *et al.* in 1992. They studied storage modulus, G' and loss tangent of the polymers at high frequency were studied using time-temperature superposition principal. Two

polymers, polyvinyl butyral (PVB) and copolymer of ethylene and acrylic acid (PEAA), were used. The results indicated that the transition temperature of the polymer-laminated steel sheet was 15°C - 30°C higher than the corresponding glass transition temperature of the laminated polymers. The damping application is using in the temperature range of 85°C - 90°C and 55°C - 60°C for PVB-based laminated and PEAA-based laminated respectively.