



CHAPTER II LITERATURE SURVEY

2.1 Miscibility of Polymer Blends having Acrylic-Acid

Miscibility can be studied by several techniques depending upon the interest and desired performance characteristics of the system. In this case, thermal and mechanical characteristics were studied and indicated that such blends of low density polyethylene (LDPE) and ethylene acrylic-acid (EAA) copolymer were immiscible at all proportions for acrylic acid contents. Immiscibility was attributed to the polarity of copolymer chains. However, compatible blends were formed if the acrylic acid content of the EAA copolymer was less than 5 mol%. In such blends perhaps ethylene units of both the polymers cocrystallize to a certain extent. The physical properties of the compatible blends were intermediate with the components' properties. (Agarwal P.K. and Horriion J., 1989)

Jo *et al.* (1990) investigated that 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 mole%. The miscibility has been assigned to the specific interaction between styrene oxide and acrylic acid segments and intermolecular repulsive force in SAA copolymer.

The unique properties of EAA copolymers that are toughness, good hot tack, good adhesion to polar substrates such as aluminum foil due to carboxyl groups allow them to be utilized as high-performance sealant layers in packaging applications. In this case, EAA/PB blends were extrusion-coated onto a foil-based substrate. The EAA/PB blends formed incompatible mixtures that demonstrated a good balance of hot-tack and aluminum adhesion while exhibiting peelable seal characteristics. The best balance of performance properties for face-to-face peelable sealant applications was EAA/PB (75/25). At 25 wt% PB in EAA, a viable peelable seal can be obtained for use in an easy-opening packaging. Potential applications are for snack food packaging, medical device packaging and lidding-stock applications. (Ridgeway A.L. and Mergenhagem L.K., 1993)

Poly(ethylene-co-acrylic acid) or PEA possesses high tensile strength and excellent adhesion to metals. Mohanty and coworkers (1995) used PEA as a one component of polymer blend between Epoxidized Natural Rubber (ENR) and PEA to improve the strength properties of ENR and also improve flexibility, impact resistance of PEA. ENR/PEA blends were partially miscible up to 50% by weight of PEA and complete miscible beyond this proportion. The miscibility was studied using DSC that exhibited a single second-order transition (T_g) for the 30:70 and 50:50 (ENR/PEA) blends. For the 70:30 (ENR/PEA) blend, the T_g 's shift toward an intermediate value but do not merge to form a single T_g , making the blend partially miscible. In order to confirm phase morphology, Scanning Electron Microscope (SEM) was used and gave similar results to Differential Scanning Calorimetry (DSC).

Next year, Mohanty *et al.* studied the mechanical properties of blends of PEA and 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 as increasing PEA content and exhibited a synergistic behavior that calculated via the additivity rule.

Blends of amorphous and crystalline polylactides (PDLA and PLLA) with poly(methyl methacrylate) (PMMA) and poly(methyl acrylate) (PMA) were studied by Eguiburu *et al.* (1998) via thermal behavior using differential scanning calorimetry (DSC). 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.

Glosh *et al.* (1998) studied the modification of the 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 calorimetry (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 polyethylene 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 its also imparted stiffening effect.

ESCOR[®]320 terpolymer is a novel polymer that has similar composition and structure as EAA copolymer. Thus in the theory, polymer blends between ESCOR[®]320 terpolymer and EAA copolymer might be miscible blends. Worakanya *et al.*, (2001) studied that such blends and indicated that only blends of ESCOR[®]320/EAA1 at 80 wt% EAA1, ESCOR[®]320/EAA2 at 90 and 95 wt% EAA2, ESCOR[®]320/EAA4 at 80 wt% EAA4, and ESCOR[®]320/EAA5 at 80wt% EAA5 showed single glass transition temperature resulting from dynamic mechanical properties, suggesting completely miscibility. The mechanical properties of these blends increased with increasing EAA content, but the gloss of most blends dropped upon blending, which indicated phase separation. ESCOR[®]320 with EAA2 at 60 wt% EAA content was considered the most suitable for used as the dampener material due to its high $\tan \delta$ and good mechanical properties.

2.2 Vibration Dampening

A material will be a good dampener for vibrations if it has very high $\tan \delta$ value from experiment or high loss factor value from theory.

In fact, poly(ethylene-co-acrylic acid) or PEA has already been tested as a component of a blend for used as a vibration dampener. PEA was used to laminate steel sheet and the laminate was expected to serve as a vibration dampener. The theoretical analysis of dampening efficiency was based on a model proposed by Ungar. The frequency analyzer was used to measure the loss factor of the laminates. The results showed that the loss factor of the laminate increased monotonically with increasing thickness of the viscoelastic layer. Ungar's theory predicted a higher loss factor than the experimental data. This might have resulted from interfacial adhesive bonding, a non uniform viscoelastic layer thickness, and the extrapolation of the rheological data from low to high frequencies. The loss factor of the laminate

increased with increasing temperature. Compared to the laminates using pure resin, the maximum dampening peak of the laminates become broader, and occurred at a temperature between the T_g 's of the individual components of the polymer blend. (Chen Y.S. and coworker., 1991)

Liao *et al.* (1992) was studied the vibration dampening properties of the polymer-laminated steel sheet in both of theoretically and experimentally. The laminate consisted of a polymer layer, which was sandwiched between steel sheets. Two polymers, a polyvinyl butyral and EAA copolymer were used as polymer layer. Storage modulus (G'), loss modulus (G''), and $\tan \delta$ of polymers at high frequency were studied using time-temperature superposition principal. 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 dampening application is using in the temperature range of 85°C - 90°C for PVB-based laminate and 55°C - 60°C for PEAA-based laminate.