

## CHAPTER II

### LITERATURE REVIEW

#### 2.1 Melt Grafting of Maleic Anhydride onto Polypropylene

S.H.P. Bettini and J.A.M. Agnelli (1999) studied grafting of maleic anhydride onto polypropylene, four factors were varied: the maleic anhydride and peroxide concentrations, rotor speed, and reaction time. The effect of rotor speed and reaction time on the level of reacted maleic anhydride, obtained by infrared spectroscopy, and on the extent of degradation, by means of melt-flow index (MFI) measurements. The increase in rotor speed results in an increase in the percentage of reacted maleic anhydride and a reduction in MFI when the initial maleic anhydride concentration is high, and in a reduction in the percentage of reacted maleic anhydride and increase in MFI when the initial maleic anhydride concentration is low.

S.H.P. Bettini and J.A.M. Agnelli (2000) studied grafting of maleic anhydride onto polypropylene, in the presence of peroxides. Quantification of reacted maleic anhydride was tested by titration of acid groups and Fourier transform infrared spectroscopy (FTIR). It was found that each type of processing requires purification of the samples for removal of residual maleic anhydride. Spectroscopy was shown to be better for the quantification of reacted maleic anhydride, as long as the samples are submitted to thermal treatment at 130°C for at least 24 h.

Yongsok Seo *et al.* (2000) studied the crystallization kinetics of isotactic polypropylene (iPP) and maleic anhydride grafted polypropylene (MA-PP) and their blends, crystallized both nonisothermally and isothermally, were investigated by differential scanning calorimetry. It was found that the diffusional activation energy was smaller for MA-PP than for iPP. The number of heterogeneous nuclei for MA-PP was larger than that for iPP. The presence of MA-PP in iPP affects the crystallization of iPP by acting as a nucleating agent.

Dean Shi *et al.* (2001) studied chemical structures and molecular parameters of grafted materials of PP-g-MAH prepared by melt reactive extrusion by using electrospray ionization-mass spectrometer and gel permeation chromatography. It

was found that the initial radicals, due to homolytic scission of dicumyl peroxide could be combined with maleic anhydride (MAH) monomers as well as polypropylene (PP) molecular chains. The homopolymerization of MAH cannot occur and the MAH radicals undergo a dismutational reaction under the processing condition ( $180\pm 190^\circ\text{C}$ ).

Wulin Qiu *et al.* (2005) studied a novel method of preparation of maleic anhydride grafted polypropylene (MAPP). The preparation was performed by ball milling of polypropylene (PP) powder, maleic anhydride (MA), and peroxide initiator in balls-containing jars with a planetary ball mill for a certain time. Maleic anhydride grafted polyethylene (MAPE) was obtained via this technique. The novel technique has advantages of a solventless, lower process temperature and is energy efficient, low cost, and is simple. Furthermore, it is very easy to obtain purified products.

G.R. P. Henry *et al.* (2009) studied amorphous and low crystallinity polypropylenes were produced by reactive processing of commercial isotactic polypropylenes in the presence of peroxide. Characterization of the modified polypropylene microstructures using NMR spectroscopy revealed that crystallinity loss is correlated with the epimerization of numerous methylenes randomly along the polymer backbone, leading to decreasing isotacticities and average isotactic block lengths.

## 2.2 Melt Grafting of Maleic Anhydride onto Polyethylene

C. Rosales *et al.* (1998) studied grafting of various commercial polyethylenes, high-density polyethylenes (HDPEs), and linear low-density polyethylenes (LLDPEs) with diethyl maleate (DEM) was carried out in two co-rotating twin screw extruders with different screw configurations and extrusion conditions. It was found that when the initiator level was raised in the LLDPEs the grafting degree increased and the molecular weight distribution of the grafted LLDPE did not show appreciable differences when they were compared to the virgin resin.

G. Moad (1999) studied the synthesis of polyolefin graft copolymers by reactive extrusion or melt phase processing. These materials, which may serve as precursors to other polyolefin graft copolymers, include polyolefins with grafted maleic anhydride, fumarate and maleate esters, (meth) acrylate esters and (meth) acrylic acid. Methods include the transformation functional polyolefins into graft copolymers by opening of epoxide or anhydride, transesterification and related processes, and free radical induced coupling.

Bing Lu and T. C. Chung (2000) studied a new chemical route to prepare maleic anhydride (MAH) grafted polyethylene and polypropylene polymers with controlled molecular structure, that is, MAH grafted content and polymer molecular weight and composition distributions. The chemistry involves a free radical graft reaction of maleic anhydride with poly(ethylene-*co-p*-methylstyrene) and poly(propylene-*co-p*-methylstyrene) copolymers.

Yanhan Shen *et al.* (2007) studied grafting copolymerization of maleic anhydride (MAH) onto high density polyethylene (HDPE) carried out through solvothermal process. Infrared spectra (IR) revealed that MAH had been successful grafted onto the HDPE backbone. The influences of the reaction parameters on the grafting copolymerization, e.g., the concentration of the initiator, MAH and HDPE content, reaction time, reaction temperature, comonomer, and different solvents were also studied. MAH could be grafted onto HDPE in both good solvents and poor solvents, which was much different from the traditional solution grafting method.

Zhe Chen *et al.* (2008) studied rheological behavior, thermal properties, and molecular mobility of a series of maleic anhydride (MAH) grafted high-density polyethylenes. The viscosity of the samples in their melt state decreased with an increase in the graft yield, and this could be attributed to the higher molecular mobility for samples with a higher degree of grafting. Moreover, it was found that the grafted MAH group played a significant chemical inhibition role in formation when the graft yield was low.