

CHAPTER 3

LITERATURE REVIEW

Yoshida, Morck, Kringstad, and Hatakeyama (1987) studied the mechanical properties of polyurethane from a kraft lignin-polyether triol-polymeric MDI system. Polyurethane with various NCO/OH ratios and kraft lignin contents were synthesized by polymerization of kraft lignin, a propylene-oxide-based polyether triol and polymeric MDI in tetrahydrofuran solution. Films were made by solvent casting and tested with respect to swelling behavior and tensile properties. The result shown that when an optimum quantity to kraft lignin was used, the resulting polyurethanes show improved mechanical properties compared to the polyurethanes synthesized with the polyether triol as the only polyol component. This effect can be found at all NCO/OH ratios studied, but is comparatively small at higher NCO/OH ratios. At high kraft lignin contents, the obtained polyurethanes were hard and brittle regardless of the NCO/OH used.

Wales and Sagar (1991) studied the effect of structure on susceptibility of polyurethane to biodegradation. The relationship between chemical structure of simple film-forming polyurethanes and the effect of microbial structure of film-forming polyurethanes and the effect of microbial attack on tensile properties is investigated. Polyurethanes with different "hard block" and "soft block" component and different diisocyanate were synthesised. The polymers synthesised then were placed on the plates inoculated with spore suspension of microorganisms. Tensile strength of polymer after incubation were determine and the degree of polymer degradation was also monitored by weight loss determinations.

The result of this work demonstrated an inverse relationship between the susceptibility of the urethane group to hydrolysis and the length of the linear carbon chain between the urethane moieties. Polyether-based polyurethanes are more resistant to microbiological attack than their polyester-based counterparts.

Filip (1992) studied activity of microbial in soil and water on the degradation of synthetic polymers. Characteristic of the soil microflora was given, and some examples of the microbial degradation of synthetic polymers, i.e., polyvinylchloride, polyurethane, polyethylene, was demonstrated.

This work found that two fungal species indigenous to soil and surface water, i.e., Aspergillus niger and Cladosporium herbarum were effective in the deterioration of polyether based polyurethane. The decomposition of some synthetic polymers such as polyurethanes was accelerated in environments well supported with easily utilizable nutrients.

Huang et al. (1992) studied the effect of structure and morphology on the degradation of polymers. Some of results on the structure and morphology effect on the degradation of synthetic polymers containing one or more hydrolyzable linkage (amide, ester, and urethane) were reported. All polymer investigated had molecular weights in area of 40,000. Enrichment of culture media with nitrogen was set up as a parallel experiment in hope for discovering the effects of nitrogen incorporated into a polymer backbone. A lack of added nitrogen was expected to force an organism to disassemble urethane linkages in order to satisfy its nitrogen nutrient requirements.

The result of this work were noted that both polyurethanes derived from aliphatic diisocyanate and aromatic diisocyanate were degraded. Aromatic polymers degraded at slower rates than aliphatic polymers. In the absence of added nitrogen degradation was reduced.

Kawai (1992) summarized the biodegradability studied on polyethers and described the degradation of copoly(ether/ether)s and copoly(ether/ester)s by polyether-utilizing bacteria and lipase. PEG having an average molecular weight (M_n) between 400-6,000 was assimilated by several different species. PEG-PPG block copolymers were assimilated by PEG and/or PPG-utilizing bacteria. The result of this work were conclude that polyether known to provide the elasticity to the hard segments can be used for synthesizing biodegradable copolymers.

Hatakeyama et al. (1995) studied properties of polyurethane sheets and foams having plant components in their network. Polyethylene glycol (PEG) was mixed with one of the following; molasses, lignin, woodmeal, or coffee grounds. The mixture obtained was reacted with diphenylmethane diisocyanate (MDI) at room temperature, and precured PUs were prepared. The precured PUs were heat-pressed and PU sheets were obtained. In order to make PU foam, the above mixture was reacted with MDI after the addition of plasticizer, surfactant, catalyst (di-*n*-butyltin dilaurate), and droplets of water under vigorous stirring.

The results of this work were conclude that saccharide and lignin residues act as hard segments in PUs. It was found that the PUs obtained were biodegradable in soil. The rate of biodegradation of the PUs derived from molasses and coffee grounds was between that of cryptomeria (*Cryptomeria japonica*) and beech (*Fagus sieboldi*).

Coppola and Conn (US. Pat. No. 4,087,389) studied preparation a semi-rigid polyurethane for use in packaging fragile or shock-sensitive objects. The foam composition was prepared from polyether polyol and polymeric isocyanate with high level of water and an organic foaming agent. The reaction mixture had a low NCO/OH index from about 30 to 60. The silicone-based surfactant is preferably employed in a proportion from about 1.8-3.0 part per 100 parts by weight of total polyol.

Jackson et al. (US. Pat. No. 5,187,204) studied preparation the rigid polyurethane foams free of chlorinated fluorocarbon blowing agents. The foams used in the present invention comprised the reaction product of a C₂-C₄ alkylene oxide adduct of propylene glycol or ethylene diamine or mixtures thereof , an isocyanate in which all the isocyanate groups are aromatically bound , a catalyst or mixture of catalysts , water , a surfactant , a chain extender and optionally pigments, a flame retardant, fillers, or other additives. A preferred chain extender when used was glycerin. In the instant invention it has been found that certain water blown rigid polyurethane foams can be produced which exhibit energy absorbing characteristics comparable to the CFC blown rigid polyurethane foams.

Hanna et al. (US. Pat. No. 5,227,408) provided a method of preparing polyurethane packaging foam which reduces liquid dispensing temperatures as well as maximum reaction exotherms in carbon dioxide blown polyurethane packaging foam. According to the present invention, the objects are achieved by adding less than about one percent by weight of a nucleating agent to the polymeric isocyanate and/or adding less than about one percent by weight of a nucleating agent to the polyoxyalkylated polyol. Preferably, methyl formate is added to the polymeric isocyanate and methanol is added to the polyol resin. Incorporation of a nucleating agent into the isocyanate and polyol resin components results in a carbon dioxide blown polyurethane packaging foam preferably having a density of 0.2 lb./ft.³ to 2.0 lb./ft.³ and the cushioning properties of the control are identical to the cushioning properties of the present invention.