CHAPTER I

INTRODUCTION

1.1 General

Polyurethanes were discovered by Otto Bayer and his co-worker of I.G. Farbenindustric at Leverkusen, Germany in 1937. Since their discovery in the 1930s the polyurethanes have fascinated engineers and scientists by their unique combination of unusual properties and ability to be processed, shaped and formed by almost all known manufacturing techniques. The majority of polyurethanes under standard conditions exist in the elastic state. Polyurethane elastomers feature the best physical properties of all elastomer. They exhibit high moduli, remarkable marring and abrasion resistances, excellent resilience, and are capable of bearing greater loads than other rubbers.[1]

Polyurethanes are usually produced by the reaction of a polyfunctional isocyanate with a polyol or other reactant containing two or more reactive groups with isocyanate, most often hydroxyls. Since the functionality of the polyol or the isocyanate can be adjusted, a wide variety of branched or crosslinked polymers can be formed. It is well-known that controlled physical and mechanical properties of polyurethanes can be made according to particular chemical formulation of starting polymeric materials (or called precursors) used. Apart from polyisocyanates and polyols, the basic materials for polyurethane production, a wide variety of auxiliary chemicals may be added in order to control and modify both the polyurethane reaction itself and the properties of the final polymer. These additives include catalysts, crosslinking

agents, chain extending agents, blowing agents, surfactants, coloring materials, fillers, smoke suppressants and flame retardants.[2]

Crosslinking agents are the necessary components for preparation of polyurethane. The main function of a crosslinking agents are both to extend the polymeric chain and to cure the polymer. A crosslinked polymer represents a spacial network composed of rings of varying size. When a mixture of two monomers, liquid polymers, or a monomer and a polymer which not react with each other, are allowed to crosslink independently, interpenetrating polymer networks (IPNs) are formed. The IPNs are combination of two or more polymers that form interpenetrating rings without any chemical bonds between them. Among the most interesting IPNs are those using a polyurethane as one of their components.

To date, interpenetrating polymer networks of polyurethane elastomers have been developed with acrylics, epoxides, polyesters, neoprene, butadiene-styrene rubber, and siloxane polymers. The polymer are selected so as to minimize reactions between them. Usually the prepolymer technique is employed for this purpose, mixing the isocyanate-terminated prepolymer with the monomer (such as an unsaturated one), an extending agent, and catalysts, whereupon the simultaneous, independent polyreaction is made to proceed in both systems.

IPNs have also been obtain by mixing aqueous of polyurethanes and of other polymer, pouring and film and then crosslinking. It has been found that and IPNs system can be formulated such that its physical properties are remarkably superior to those of its individual components.

In this study, The polyurethane (PU) elastomer and polyurethane/polystyrene (PU/PS) elastomer was prepared by one-shot process using hand-casting procedure at various equivalent weight ratios of MDI, polyol, crosslinking agent, and amount of styrene monomer.

Their mechanical properties such as, tensile strength and elongation at break and physical properties such as glass transition temperature (T_g) at various formulations of the elastomer were determined.[3-4]

1.2 Objectives

1.2.1 To synthesize two crosslinking agents namely, BDPD and TAPE, suitable for preparation of crosslinked polyurethane elastomer.

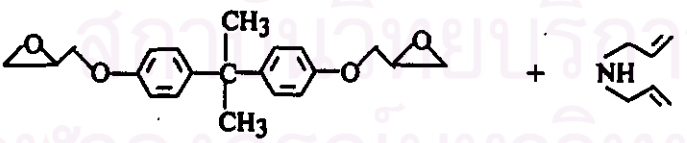
1.2.2 To prepare the PU and PU/PS elastomer by using the synthesized crosslinking agents. The mechanical and thermal properties of the crosslinked polyurethane were investigated.

1.3 Scope of the Research

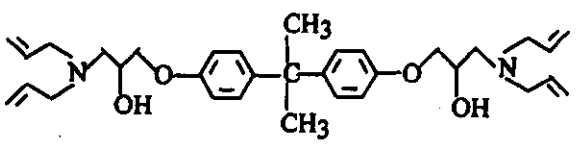
1.3.1 Synthesis of crosslinking agents .[5-6]

Two crosslinking agents, BDPD and TAPE, were synthesized using the following reactants.

a) Preparation of Bis-(3-N,N'-diallylamino-2-propanol) diphenylolpropane (BDPD, 3).

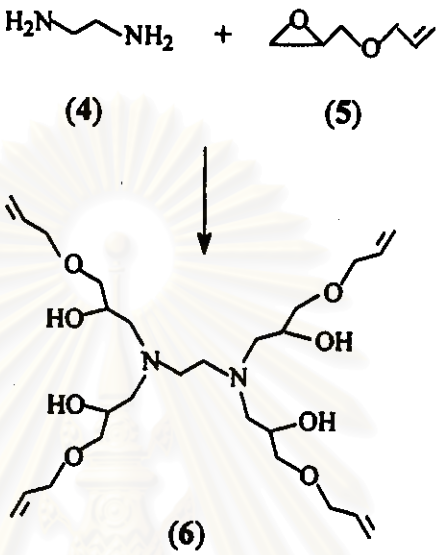


(1) (2)



(3)
BDPD

b) Preparation of N,N,N',N'-tetrakis-(3-allyloxy-2-propanol) ethylenediamine (TAPE, 6).



(4) (5)

(6)
TAPE

1.3.2 The Characterization of BDPD and TAPE using ^1H MNR spectroscopy and compare the data with those in the literature.

1.3.3 Determination of the suitable condition for the preparation of PU and PU/PS elastomer by one-shot process using hand-casting procedure by variation of the following parameters :

a) The equivalent weight ratio of isocyanate:polyol:crosslinking agent and amount of styrene monomer.

b) The optimum amount of initiator.

1.3.4 Investigation of the mechanical properties of the elastomers such as tensile strength, percentage elongation at break, hardness, and compression set.

1.3.5 Investigation of the thermal properties of the elastomers such as differential scanning calorimetry (DSC), thermogravimetry analysis (TGA), and dynamic mechanical analysis (DMA).

1.3.6 Summarizing the results.