CHAPTER I

INTRODUCTION

Nowadays, paints or coating are used for various purposes such as surface protection and decoration. Coatings can be seen everywhere, on the walls, refrigerator, cabinets and furniture. Clearly, the functional and decorative requirements of coating span a very broad spectrum. It is therefore not surprising that coating is developed continuously.

The surface coating can be classified in many ways. The type of binder is used to classify in this work. The polyurethane group is one of many polymeric materials that can be used as binders in coating application. The polyurethane group can be produced in various forms such as foam, elastomer and coatings. The major raw materials for polyurethane synthesis are isocyanate and compounds containing active hydrogen atoms, especially polyol, the high molecular weight alcohol. The applications of polyurethane group can be varied by reacting of polyol and polyisocyanate in different chemical structures, molecular weight and functionality of isocyanate and polyol.

Polyurethane coating can be classified into many types such as block isocyanate polyurethane, moisture cure polyurethane and two-package polyurethane etc. The two-package polyurethane will be focused in this work.

The two-package polyurethane coating is the most popular of urethane coatings, because of its low curing temperature and good film properties. [Wicks, Jr., Jones and Pappas, 1992] It consists of polyol and polyisocyanate packed in

separate cans and mix together before using. One of the packages contains the polyol, pigment, solvents, catalyst and additives. The other one contains the polyisocyanate and moisture free solvent.

Polyol, one of the two components, can be prepared by various methods. Polyester polyol, polyether polyol and acrylic polyol are three general types of polyols. Polyether polyol is not widely used in coating applications since the resulting coatings show high moisture vapor permeability and poor exterior durability. Polyester polyol and acrylic polyol are commonly used in surface coating application. Generally, polyester polyol permits higher solids and greater solvent resistance while acrylic polyol provides faster drying, lower cost and better exterior durability. [Wicks, Jr., Jones and Pappas, 1992]

Acrylic polyol focused in this work is made up of various acrylic monomers to be acrylic polyol copolymer. Examples of the acrylic monomers are methyl methacrylate, butyl acrylate and hydroxyethyl acrylate. The monomers are polymerized into polyol copolymer by solution polymerization method. Concerning the isocyanate, it is produced in many forms, such as biurets or isocyanurate in order to reduce toxicity and increase functionality for improving film properties. [Ulrich, 1996]

The NBDI, Norbornane Diisocyanate, a new type of isocyanate, recently supplied by Mitsui Chemical Inc is the new choice in polyurethane industry. The NBDI is a clycloaliphatic diisocyanate and is a suitable raw material for the production of light stability and weather resistance, because of a stiff norbornane structure. NBDI used in form of isocyanurate (tri-isocyanate) is studied in this work. Its physical film properties are going to be compared with IPDI isocyanurate, the other conventional hardener. The main reason that IPDI is selected for comparison with NBDI because of their similar chemical structures of

them. However, IPDI is different from NBDI with respect to the reactivity of isocyanurate group. The primary isocyanate group of IPDI reacts faster than the secondary isocyanate while the reactivity of two isocyanate group of NBDI is equal. [Ulrich, 1996]

The other important factor in properties of film is polyol. It is easier to improve the properties of film by changing the structures of polyols than modifying the hardener, the isocyanate. Most of manufacturers often produce the polyol which are suitable for the hardener that is economically available in this time. Consequently, the relationship of film properties between acrylic polyol and NBDI isocyanate, the new hardener, is very interesting to study in order to synthesize the suitable polyol for this hardener.

In the systhesis of the acrylic polyol, there are many ways to modify the structures of acrylic polyols. The most effective method that is generally used is to change the compositions of monomers and catalysts. There are two types of monomers classified in synthesis step, functional and non-functional monomers. The properties of acrylic polyol are mainly resulted from functional monomers. The functional monomer in this work making up of hydroxyl monomer and acid monomer is varied to study for its effects on the properties of the polyurethane film produced. Moreover, the molecular weight of acrylic polyol which is attributed to the quantity of catalyst is also an important factor.

In summary, the methods of synthesis acrylic polyol are studied by varing three factors: hydroxyl value (OHV), molecular weight (MW) in terms of the quantity of catalyst, and acid value (AV). After that, the synthesized polyols are mixed with two hardeners, NBDI and IPDI isocyanurate. Finally, the polyurethane film properties that are produced from three factors above with two different hardeners are examined.

1. The objectives of the present study.

1.1 To study the synthesis method for acrylic polyol.

1.2 To study the three factors, hydroxyl value (OHV), molecular weight (MW) in terms of the quantity of catalyst and acid value (AV) that are related to the film properties.

1.3 To study the film properties of NBDI isocyanurate compared with IPDI isocyanurate, the conventional hardener.

2. The scope of the present study.

2.1 Synthesis of the acrylic polyol.

The acrylic polyols at different formulas are synthesized. Three factors are chosen to be examined in this work. Each of them is varied at two levels: low (-1) and high (+1) level, i.e. OHV(-1) = 60, OHV(+1) = 80, Catalyst(-1) = 0.31 % of monomer (MW = 110,000-140,000), Catalyst(+1) = 0.61 % of monomer (MW = 60,000-80,000) and AV(-1) = 2.0-2.2, AV (+1) = 3.4-3.6. The variations of three factors at two levels result in eight acrylic polyols.

2.2 Test the film properties.

The eight acrylic polyols reacting with two hardeners, NBDI and IPDI isocyanurate, produce sixteen samples. All of them are tested in film properties, pencil hardness, bending, dupont impact, acid-base resistance, drying time, gel time, weatherablity, tensile strength and dynamic mechanical analysis (DMA).