

CHAPTER II

LITERATURE REVIEW

Ludwig and Urban (1996) determine isocyanate concentration quantitatively in crosslinked polyurethane's coatings. The influence of relative humidity on the rate of isocyanate functionality depletion at the film-air and film-substrate interfaces of a urethane coating was examined using attenuated total reflectance (ATR) FTIR. The effect of relative humidities (RH) ranging from 0 to 80% on crosslinking reactions was examined. The results indicate that reactions of isocyanate groups with OH functionalities are inversely proportional to the RH. The results are discussed in terms of the reactions which occur between water and isocyanate, as well as the plasticization effects of water and solvent molecules. These studies indicate that the presence of competing reactions within the system may result in various degrees of crosslinking.

Van der Ven, Van Houwelingen, and Lamping (1992) characterize cross-linked polyurethane films. The chemical composition and the physical properties of two component polyurethane coatings are influenced by the curing conditions, viz. relative humidity and temperature. Apart from the formation of urethane, carbon dioxide can be released by hydrolysis of the isocyanate groups, leading to the formation of urea groups. Chemical analytical methods have been developed to characterize cross-linked polyurethane coatings based on hydroxy-functional acrylic resins and trifunctional isocyanates. Spectroscopic and wet chemical methods as well as carbon dioxide measurements were applied. Quantitative

data were obtained on the contents of isocyanate, hydroxyl and amino groups and on urethane and urea crosslinks. The influence of the curing temperature, relative humidity, and type of hydroxyl groups on the network structure has been investigated. The relative humidity influences the composition of the coating cured at ambient temperature. During curing at elevated temperatures, the relative humidity hardly affects the chemical structure of the film. However, during storage after baking, urea groups are formed.

Nakamichi, T and Ishidoya, M. (1988) discussed about cure behaviour and film properties of two-component acrylic urethane coatings. The influences of cure temperature, content of carboxylic acid and dibutyl tin dilaurate (DBTDL) on the reaction of a biuret of hexamethylene diisocyanate with acrylic polyol in the film state are reported. The catalytic effect of carboxylic acid was clearly observed in this study. Since the isocyanate groups do not react completely under ordinary cure conditions, the film properties were influenced by the extent of reaction of isocyanate groups. Tensile properties and weathering properties of these systems are reported as the functions of the extent reaction.

Yang and Lee (1987) studied the effects of different polyol-terminated urethane prepolymers on the properties of their corresponding crosslinked films. Polyglycols (PG) and toluene diisocyanate (TDI) were reacted at various molar ratios to produce isocyanate-terminated polyurethanes and were then reacted with glycerine to produce hydroxyl-terminated urethane prepolymers of different molecular weights. Pretreated copper wires were coated and baked to give polyurethane coated magnet wires. The mechanical properties of the polyurethane crosslinked films, the change of functional groups during the

crosslinking reaction, and the properties of magnet wires coated with polyurethane varnishes are discussed.

Kamath and Sargent, Jr.(1987) developed t-amyl peroxides a new class of commercial organic peroxides. They are very efficient initiators and yield radicals which are poor hydrogen abstractors. As a result, acrylic resins can be readily synthesized with low molecular weight and narrow molecular weight distribution. This enables one to obtain acceptable spray viscosity at high (>75%) solids content, which complies with the decreasing VOC requirements of the coating industries. Polymerizing typical acrylic monomer combinations for coating applications, the performance of film with t-amyl peroxide over conventional t-butyl peroxides and azonitrile initiators. Performance criteria included resin molecular weight, molecular weight distribution, solids content, solution viscosity, resin color, residual monomer levels, as well as final film properties, such as initial gloss and gloss retention as a function of QUV exposure time.

Smms and Spinelli (1987) studied the group transfer polymerization, a new polymerization process that enables one to control the structure of polymer molecules. These resins, because of their unusual design, offer advantages over conventional resins in the applications, appearances of the coatings as well as final film properties. Some of these advantages are higher solids, better pigment dispersion, improvements in hardness, flexibility, and control of the rheology application of coatings.

Hill and Kozlowski (1987) determined the crosslink density of high solids MF-cured coatings. Dynamic mechanical analysis (DMA) and solvent induced swelling were used to determine the crosslink density (XLD) of cured films. Films were prepared from polyester of acrylic polyols crosslinked with etherified melamine formaldehyde (MF) resins. Cure conditions were found for which co-condensation of the polyol with the MF resin was avoided. Under these conditions, excellent agreement was found between experimental XLD values and XLD values calculated from structure using rubber elasticity theory and swelling theory. New insights, concerning network formation in high solids films, became apparent. For example, it was found that all of the methoxy-methyl groups in MF resins can react during cure.

Buter (1987) developed the new types of high solid acrylic resins with low molecular weight and narrow molecular weight distribution. The resins were tested in automotive topcoats in combination with hexamethocymethylmelamine as a crosslinker and titanium dioxide as the pigment. The curing cycle was 30 min at 130°C. The solid contents were at least 70% by weight at spraying viscosity. All the coating properties, including mechanical properties, Weather-Ometer test, Kesternich test, xylene and water resistance, and durability tests in Arizona and Florida, were on the same level or better level than the reference (conventional thermosetting acrylic coatings).

R.A. Gray (1985) prepared acrylic oligomers for high solids coatings by using hydroxy-functional mercaptan chain transfer agents. Acrylic oligomers intended for application in high solids acrylic coating formulations were prepared by free radical solution polymerization using hydroxy-functional mercaptans that are commercially available or could easily be made from commercially available

substances are emphasized. Properties of the oligomers were investigated. These properties included molecular weight, polydispersity, solution viscosity, and residual odor. Properties of cured coatings, resulting from high solids formulations of the oligomers and methylated melamine resins, were also investigated.

Varadarajan (1983) reviewed dielectric and dynamic mechanical relaxation techniques for the characterization of organic coatings. In a dynamic mechanical experiment, the viscoelasticity of coatings are characterized by the application of a cyclic stress and measuring their response. A review of the successful application of dynamic mechanical methods in characterizing the glass transition temperature, adhesion, aging, kinetics of cure, and crack resistance is also presented.

Roller (1982) reviewed the glass transition temperature of polymer. The glass transition temperature is normally reported at a single temperature. The fact that the reported value is dependent on heating rate and frequency. It also can be instrument and operator dependence too. Over many years the usage dynamic mechanical techniques to evaluate polymers and coatings, it has been observed that there is a great deal of information derivable from the shape of the glass transition region. For example, the T_g could show the effect of polymer preparation, cure mechanism, component compatibility, and cure on the glass transition region. The relationship between the dynamic mechanical properties and polymer performance is also discussed.

Roller and Gilham (1978) described the historical development of dynamic mechanic testing in coating field. Examples are given of the application of a fully

automated torsion pendulum to the investigation of many effects such as cure optimization, monitoring of phase separation, effect of different crosslinking agents and plasticization.



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