

Chapter 1



Introduction

The polyurethane elastomer network, derived from polyols and diisocyanates, include this polymer which contains a significant number of urethane groups. An understanding of the relationship between prepolymer properties and the mechanical behaviour of the crosslinking is crucial important to the development of binders technology. Network characteristics such as crosslink density (V_e), molecular weight between crosslinks (M_c), are calculated from a small number of polymer characteristics like component, functionality, and OH/NCO ratio.

The polyurethane binders can be formed by a variety of methods, although the most widely used production method is the reaction of di-or polyfunctional hydroxyl compounds, e.g., hydroxyl-terminated polybutadiene with di-or polyfunctional diisocyanates, e.g., 4,4'-diphenyl methane diisocyanate. The general simple structure of a polyurethane derived a dihydroxy compound, HOROH, and a diisocyanate, OCNR'NCO, can be represented by the following general formula:



(1)

There can be introduced, in a controlled manner, specific chemical structures displaying chain stiffness or flexibility, an ability to orient or crystallize and interchain attraction or chemical crosslinking, all of paramount importance in determining the mechanical and swelling properties. However, if crosslinks are introduced via combination of linear and tri- or multifunctional polyols and isocyanates, the effect is different. The soft segments lead to increased the flexibility of the matrix in all the cases. Whereas, the hard segment tendency toward glassy state.

Aliphatic polyols are used as flexible segments in commercial elastomeric polyurethanes. These have glass transition temperature below room temperature and are low melting-point solids or liquids. They are amorphous, and the molecular weight range used is from about 600 to 3000. Optimum molecular weight depends upon the particular composition required. Higher molecular weight gives materials with better tensile properties but with an increasing tendency to cold-harden, and this is a phenomenon which is due to slow crystallization of the flexible blocks during storage. Therefore the main consequences of an increase in the molecular weight of the flexible blocks for a given overall molar ratio of polyol block to isocyanate plus chain extender are a fall in modulus and an increase in the elongation at break. The undesirable tendency of some polyol to crystallize and produce cold hardening in polyurethane elastomer can be avoided by the use of copolyol which possess structural irregularity. A second aliphatic glycol is introduced into the polyol component and their give elastomer which do not cold-harden but whose properties are not usually quite as good as those from polyethylene adipate. A compromise is therefore necessary between the level of physical properties required and the acceptable degree of cold hardening. This ability of the flexible polyol segments to crystallize upon extension of the elastomer is a desirable feature since the strength of the material is thereby increased. The influence polyol backbones has upon the properties of polyurethane cast elastomers, which gives data obtained with 4,4'-diphenylmethane diisocyanate-based materials.

Hard segments are essentially low molecular weight polyurethanes of polyureas and their properties determine the interchain interactions in the elastomers to a large extent and so determine the network structure in these materials. Preferred diisocyanates are those having large molecular structural bulk resulting in interchain steric hindrance, and these have the highest levels of modulus and tensile strength. The diisocyanate residues in the polymer apparently influence the ability of the polymer chains to align themselves and affect

the development of interchain structure by hydrogen bonding. Low temperature properties of polyurethane elastomer are, however, only moderately affected by the diisocyanate used.

All polyurethanes are based on the exothermic reaction. Additionally several other chemical reactions of isocyanates are used to modify or extend the range of isocyanate-based elastic materials. The chemically efficient polymer reaction may be catalyzed, allowing extremely fast cycle times and quantity production but in this case about 0.001 % by weight of dibutyl tin dilaurate.



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