Chapter 5

Conclusions

The study of crosslinking of polyurethane binders has shown that polymers are swollen in toluene. A higher content of MDI caused network formation, from the results, it is abvious that a variety of binders differing widely in the mechanical properties could be obtained by using different proportions of soft and hard segments. In general, the mechanical properties like tensile strength, modulus and stiffness decrease while the elongation increases on increasing the polyols and HTPB content. This is mainly caused by the soft segments, that in addition to causing irregularity in the chain packing in HTPB may act as an internal plasticizer. Crosslinking affected either the trimerization of MDI or multifunctionality of MDI and HTPB prepolymer. Polymers having functionality higher than 2 are capable of participation in crosslinking . Indeed, HTPB and polyols undergo curing with di-or tri-isocyanates to form polyurethane network as seen by the swelling properties data (not soluble).

1. Series 1

The polyurethane based on polyols standard binder has highest tensile strength and elongation. In other hand, the adhesive tests were poor when compared to HTPB-based in the same composition. In case of crosslink density, the polyols-based are higher too. Whereas the polyols:MDI ratio of 3:1 and 7:1 are equivalent in modulus of elasticity to HTPB-based.

2. Series 2

In figures 28,29 and 30 show the HTPB-based is poor in tensile and elongation properties but highest in peel strength, indicated that, it is better in adhesive properties of binder with aluminum alloys when prepared to polyols-based. Thus, researcher was mixed HTPB and polyols to form series 3 and 4.

3. Series 3

The polyurethane binder can not be formed at polyols:MDI ratio of 2:1:1 because the main composition is polyols that its very high in hydroxyl value therefore, the tensile stress, strain and shear strain are between series 1 and 2. While, the modulus of elasticity, stiffness and shear stress are highest. At polyols:HTPB:MDI ratio of 5:1:1 and 6:1:1 it was found that, the tensile strength is similar to polyols-based at a ratio 8:1 used by the Weapon Systems Development Center of RTAF but elongation of the former was less than the RTAF case. Also at the ratio of 6:1:1, use as the tensile strength, elongation, and peel strength, were satisfactory for the binder of composite propellant.

In case of peel strength, the stress were lower than series 2 but equivalent to series 1 while other, the strain are between series 1 and 2. At polyols:HTPB:MDI ratio of 8:1:1 to 3:1:1 of series 3, the shear strength that the main function of the binder were higher than minimum of RTAF case,(0.414 N/mm^2) when according to MIL-R-48233 (MU)

4. Series 4

The mechanical strength, however, were lower than the other sery, except series 2. A plot of the stiffness versus crosslink density for various series was shown in figure 33. It is clearly seen that the experiments of the polyurethane binders deviate significantly from the linear calculated plot, meaning thereby that the stiffness is vary to crosslink density and not valid at high crosslink density. Although it may be argued that the relationship could be valid at another series. It has absenced in series 5, researcher has stoped the experiment because the binders were poor in mechanical strength of all ratios. In case of peel and shear strength, the series 4 was highest but in this experiment. At polyols:HTPB:MDI ratio of 6:2:1 to 2:2:1 were satisfactory when compared to MIL-R-48233 (MU).