

To Study Curing Behavior of Polyurethane Using Different Hardener

Vijay Parashar

Abstract— This paper describes the curing behaviour of Polyurethane (PU) using different hardener and has wide applications in Paint-shops of automotive industries. Both aliphatic and aromatic hardener were used for the study and components were painted with PU Paints mixed with both types of hardeners and components were kept for the stability study for 4 months. Very thin layer of the component surface was transferred on Silicon Carbide (SiC) paper. The transferred sample was scanned by FTIR using Diffused Reflectance Accessory (DRS). Aromatic & Aliphatic isocyanate standard data was created using liquid samples with liquid samples of hardener. FTIR Analysis shows that difference observed near 1600 cm^{-1} in aliphatic and aromatic isocyanate hardener peaks. The ABS component painted with paint containing Aromatic isocyanate found yellowing from its original white color, while Aliphatic isocyanate based painted component found perfectly white. The colour difference of yellowing $\Delta_{a,b}^*$ exhibits a systematic tendency to higher values with increasing irradiation time due to photodegradation of polyurethane

Index Terms— Polyurethane; Isocyanate; Yellowing; Photodegradation.

I. INTRODUCTION

Conventional two-component polyurethane systems (2C-PU) are successfully used in various applications. Typical examples are OEM topcoats and clear coats, automotive repair coatings (fillers, clearcoats and topcoats), industrial paints, furniture lacquers, plastic coatings etc. Polyurethanes tend to be the most diverse as well as the most use specific. In other words there are many products that are designed for a specific end use. We have fast setting products, slow setting products, clear materials, opaque materials, semi flexible urethanes, filled urethanes, and urethanes that are self foaming, both rigid and flexible. Polyurethanes [1] result from the reaction of a polyalcohol and an organic diisocyanate. They can be used as surface coatings, to make furniture and footwear and in foam form, for packaging. Polyurethane coating resins and varnishes offer advantages over alkyd resin systems in speed of drying, hardness of the film and resistance to wear. But selection of wrong hardener during painting with PU based paint results into yellowing of polyurethane as a result of UV radiation. In the presence of UV radiation, the synthesized aromatic polyurethane undergoes photodegradation with gradual change of its colour. The photochemical degradation of the

polyurethane is associated with the scission of the urethane group and photo-oxidation of the central CH_2 group between the aromatic rings. Overall, $\Delta E_{a,b}^*$ colour change correlates well with photo degradation[2] of polyurethane by relative increase of the concentration of carbonyl group. The photo-oxidation and yellowing have also been evaluated for coatings [3] modified with different additives and/or their synergistic mixtures.

II. EXPERIMENTAL

FT-IR spectroscopy was used to study the chemical changes caused by UV irradiation. Two different samples of PU based paint were prepared with addition of Aliphatic and aromatic hardener simultaneously in paint in the same ratio. ABS components were painted using both the samples. Both the painted components were kept under observation for UV irradiation. Component painted with synthesized aromatic polyurethane started yellowing (Fig.1) with duration of time. FTIR analysis of both the aliphatic and aromatic hardener was done for standard as a reference for further study. Further Very thin layer of the components painted surface was transferred on Silicon Carbide (SiC) paper. The transferred sample was scanned by FTIR using Diffused Reflectance Accessory (DRS).

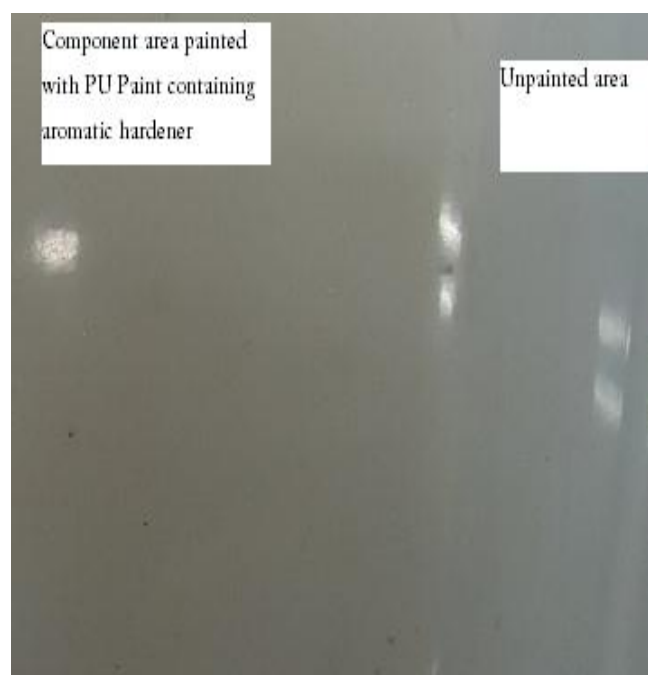


Fig. 1 Yellowing of Polyurethane surface containing aromatic hardener

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Vijay Parashar, USBAS, Guru Gobind Singh Indraprastha University, Delhi, India, Tel: +91-9662058464

III. RESULTS AND DISCUSSION

The standard spectra of aliphatic isocyanate and aromatic isocyanate shows that difference observed near 1600 cm^{-1} as shown by arrow in Fig.2 . Also, thin layer spectra of painted components shows the peak difference near 1600 cm^{-1} as shown in Fig.3. Our results are in agreement with the quinone (yellow colour) formation as the chromophoric reaction product of polyurethane degradation. These results are used to discuss the photodegradation process in terms of chemical and physical changes due to UV-irradiation in protective polymeric systems[4].

IV. CONCLUSION

The yellowing is due to the use of aromatic isocyanate in place of aliphatic isocyanate. Yellowing of polyurethane is caused by a side reaction to a quinone urethane. Since this side reaction is dependent upon oxygen and ultraviolet light, keeping the component covered with minimal exposure to air will slow the yellowing. The obtained results show that the performance of the two-component polyurethane coatings depends on the selectivity[5] of the employed hardener.

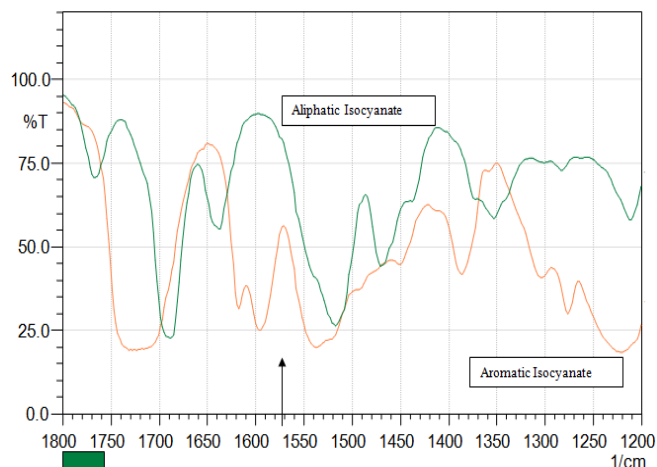


Fig.2 Aliphatic Isocyanate v/s Aromatic Isocyanate Standard Data

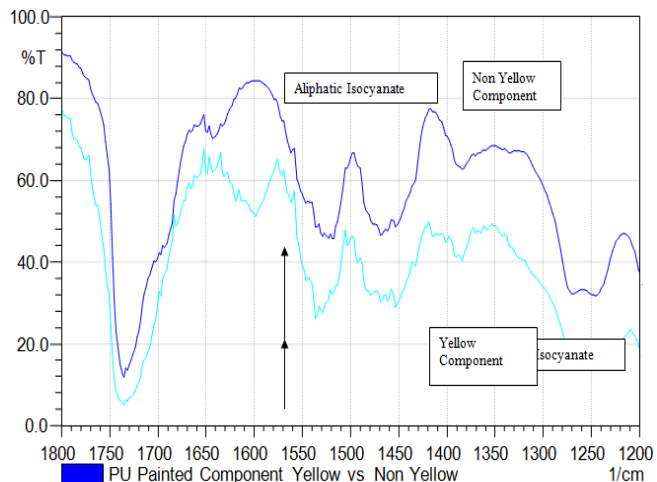


Fig. 3 PU Painted ABS components (Yellow v/s Non Yellow)

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Vijay Parashar is working as a research fellow in School of Basic and Applied sciences at Guru Gobind Singh Indraprastha University, Delhi. He did his post graduation in Chemistry from Guru Jambheshwar University, Hissar in 2003 and joined Phd under the supervision of Prof.A.K.Narula in 2005. His main area of research is curing and thermal properties of polymeric material in presence of Nanosilica particles. Prof. A.K.Narula is Dean of University School of Basic and applied sciences in Guru Gobind Singh Indraprastha University, Delhi.