

SUMMARY

Multiphase polymeric systems have received wide attention during this decade, especially since the appearance of new polymeric types has diminished considerably. In order to maintain pace with the requirements of fast developing modern technology, the need for cost effective materials for specific applications has generated wide interest in developing new polymer applications mainly in the field of impact resistant plastics and thermoplastic elastomers.

Introduction of moderate concentration of rubbery phase into the matrix of a glassy polymer imparts impact strength to the latter without major loss in other mechanical properties. Best results are expected when there is optimum compatibility between the rubbery and glassy polymer.

- Polyvinyl chloride (PVC) is a versatile polymer known for its many remarkable properties such as high chemical resistance, good rigidity and reasonably high tensile strength. But it suffers from low impact strength low thermal stability and poor processibility. To overcome these drawbacks various property modifiers have been used with certain degrees of success. Modified rubbers - of which epoxidised natural rubber is an important example - form a separate group. However, there are only a few reports on the use of epoxidised polybutadiene (EPBR) for this purpose, in which mostly low molecular weight polybutadiene rubber (PBR) after epoxidation has been used. Compared to natural rubber, PBR with cis-1,4

structure has a lower glass transition temperature (T_g). It was expected that Epoxidized Polybutadiene (EPBR) would be a potential plasticiser in terms of lowering of T_g of PVC. The reported literature mainly deals with solution blends of epoxidised low molecular weight PBR with PVC. High molecular weight analogues are expected to provide better physical properties.

High molecular weight PBR used in the present study has little or no miscibility with PVC and leads to highly heterogeneous blends. Epoxidation of PBR introduces some degree of polarity. Conditions have been optimised to prepare EPBR with desired level of epoxidation (5 - 25 mole %) by using performic acid in situ. Further derivatization of EPBR has also been carried out to yield polymers with chlorohydrin functionality. Qualitative and quantitative information regarding the epoxidation level has been obtained by elemental analysis, IR and NMR spectroscopy (^1H , ^{13}C). Degree of polarity has been studied by contact angle measurements using a liquid probe. TG analysis showed no change in the thermal stability of the modified samples. Dilute solution viscosity was found to decrease with increasing epoxy content.

In this study the potentiality of epoxidised polybutadiene (EPBR) and chlorohydrin derivatives of PBR as property modifiers especially impact strength modifiers to rigid PVC has been investigated.

Binary blends of PBR with PVC and modified PBR with PVC have

been prepared by melt mixing and extruded by a Brabander Plasticorder and extrusiograph. The extruded material was obtained in the form of cylindrical strands, and the strands were cut into regular small cylindrical pellets by a pelletizer. Subsequently, the pellets were molded into sheet form by compression molding technique. The specimens for various testings were cut and machined and conditioned according to ASTM standard. All the samples have been characterised by Physico-chemical, rheo-morphological and thermal methods using Brabender Plasticorder, Izod Impact Tester, Instron Universal Testing Machine, SEM, Rockwell Hardness Tester, TGA, DSC, Rheometric Dynamic Spectrometer, X-ray Diffractometer, Heat Deflection Tester, and Contact Angle-meter. Thermal stability has also been tested by monitoring the evolution of HCl during heating using pH meter.

Torque measurement during melt mixing showed that modified PBR samples do have some interaction with PVC unlike PVC/PBR systems. This observation is supported by SEM studies. In the case of PVC/PBR blends, except for the plasticization effect and some improvement in thermal stability, addition of PBR does not lead to any improvement in properties of PVC. All the binary blends of modified PBR with PVC show higher impact strength in comparison with that of PVC but to some extent, at the expense of tensile properties. No significant change in hardness and heat distortion temperature has been observed. TGA and HCl evolution technique show significant improvement in the thermal stability of the modified PVC/PBR blends when compared to PVC/PBR system and PVC.

The improvement in thermal stability may be attributed to the removal of HCl by reaction with the rubbery phase thereby preventing autocatalysis of the degradation process.

SEM studies on the impact fractured surfaces reveal the state of dispersion of the rubbery phase in PVC which has a direct bearing on the mechanical as well as thermal properties of the blends. The fracture appears to be ductile rather than brittle fracture shown by neat PVC.

The results show significant dependence of ultimate properties of the blends on the level of epoxidation and on the ratio of the rubbery phase to PVC. The study reveals that epoxidized high molecular weight polybutadiene (25 mol %) can be effectively used as property modifier leading to significant gain in impact strength and thermal stability, without much loss in other useful properties of PVC. Chlorohydrin derivative of PBR can also be used to increase impact strength of PVC but it does not contribute to thermal stability of PVC.