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Effect of Plasticizer on Polyblends of Acrylonitrile - Butadiene Rubber (NBR) and Polyvinyl Chloride (PVC)

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ABSTRACT

Polyblends of NBR/PVC were prepared in the various compositions. The NBR/PVC ratio was varied from 75:25 to 25:75 (w/w). The Dibutyl phthalate was used as liquid plasticizer and Zinc stearate was used as stabilizing agent. The effect of Dibutyl phthalate in polyblends of NBR/PVC was studied. Dibutyl phthalate was found to be efficient as plasticizer as evidenced by the Mooney viscosity, tensile and swelling behavior of the polyblends.

Keywords: NBR/PVC Polyblend, Plasticizer, Dibutyl phthalate, Zinc Stearate, Mooney viscosity, Tensile strength, swelling.

INTRODUCTION

Polyblend is a mixture of thoroughly mixed polymers present as a single entity of material, which are not linked covalently. Polyblends have greater importance as tailor-made properties can be obtained by taking the optimum ratios of component polymers and additives [1]. Two polymers are said to be compatible if mixing them, one obtains a single phase mixture. However, if two separate phase result, the two polymers are said to be incompatible with one another. Incompatible polymers, even on mastication, will not form a single homogenous phase. In many cases, mixture of polymers will consist of a discrete phase of one polymer dispersed in a continuous phase of the other polymer. In some cases, the two polymers will form interpenetrating network where neither of the two components form the discrete phase [2-10].

Compatibility refers to certain morphology, solution property or mechanical behavior of the polymeric system. Mixing of polymers involves thermodynamic consideration of the components and thermal mechanical and kinetic aspects associated with attainment of equilibrium [11]. Heterogeneity of polymeric system can be detected by a phase contrast light microscope. Matsuo, Nozaki and Jyo [12] showed that heterogeneity at 100^0A scale can be detected readily in blends of polyviny1 chloride (PVC) and acrylonitrile-butadiene rubber (NBR). The microscopy can offer a measure of heterogeneity upto 0.01 µ scales which is smaller than the Doman size of the most poly blends. Matsuo et al [12] found in the blend of PVC-NBR (60:40 by mole), the dynamic mechanical scanning gave one peak indicating compatibility. A thin section of the blend under a microscope showed heterogeneity clearly at 100^0A scale.

The acrylonitrile - butadiene rubber (NBR) is being used in large quantity because of its excellent resistance property. However, it shows poor ozone resistance. PVC, when blended with NBR, improves its resistance towards ozone, swelling in oils and solvents. Besides this, tear and abrasion resistances are also improved. PVC being reinforcing in nature, imparts higher tensile and modulus to NBR gum stocks [13-15].

Plasticizers are organic substances which are used to improve flexibility and processibility of the polymers [16]. In PVC, plasticizers are added to lower the polymer processing temperature below its degradation temperature, to facilitate easy processing, and to modify its service properties. Two types of plasticizers i.e. internal plasticizers and external plasticizers are used in PVC. Internal plasticizers are used for the modification in properties of the polymers and the degree of polymerization of the monomers by the addition of co-monomers during polymerization [17-19]. External plasticizers are added to PVC during compounding/ processing. Plasticizers are high boiling liquids or solids. If a more elastic polymer is added to a rigid polymer, plasticization of the rigid polymer takes place. Liquid plasticizers have drawbacks like volatility, extractability and tendency to migrate to other materials. Polymeric plasticizers are relatively immobile, have low volatility and do not cause blooming on finished product surface [20-23].

The review of literature showed [24-25] that there are the differences of opinion on the compatibility of NBR and PVC and on the interpenetrating network formation in vulcanized NBR / PVC blends. Fluxed blends of NBR and PVC, prepared at elevated temperature, showed higher ultimate properties compared to those obtained on a blend made from lattices of these polymers. Blends made from solutions of the two polymers may show conflicting results in terms of lower mechanical properties. It may be because of the intimate mixing leading to increased compatibility or formation of interpenetrating network or because of the increased interaction between the two components. NBR acts as a permanent plasticizer in PVC and the properties of PVC improves like chemical resistance, abrasion resistance and thermal ageing etc [26, 27].

The present study deals with the effect of dibutyl phthalate (DBP) in the various compositions of NBR/PVC polyblends. Dibutyl phthalate was found to be efficient as a plasticizer as evidenced by Mooney viscosity, tensile strength and swelling index.

MATERIALS AND METHODS

Materials: Acrylonitrile – butadiene rubber (NBR) powder (Acrylonitrile = 35 %), Polyvinyl chloride (PVC) powder of K value of 65, Dibutyl phthalate was used as liquid plasticizer. Zinc stearate (ZnST) was used as stabilizing agent. Sulphur was used as vulcanizing agent. Zinc oxide and stearic acid were used as activating agents for the vulcanization of rubber. For the compatibilization of rubber, Dicumyl peroxide (DCP) and Phthalic anhydride (PAH) were used.

Preparation of Polyblends: Polyblends were prepared in a mixer equipped with rotors at 140 ^{0}C temperature. The formulations prepared are given in table 1. The rotor speed was kept at 50 rpm for all the formulations. PVC powder was premixed with DBP and Zinc Stearate in a dish for 5 min at room temperature (25 ^{0}C) as the mixer attained 140 ^{0}C temperature, the above mixer along with DCP and PAH were charged to the mixer. Nitrile rubber was added after 5 min. the mixing was continued for 300 min. Vulcanizing agent (Sulphur), ZnO and stearic acid were added to the mixer of Polyblend at 40 ^{0}C temperature for 10 min. the blends were cured at 180 ^{0}C temperature and 140 Newton cm^2 -1 pressure in a Collin hydraulic press. Polyblend was cooled to room temperature.

Table 1: NBR/PVC Polyblend Formulations

Materials	Polyblend-1(Parts)	Polyblend-2(Parts)	Polyblend-3 (Parts)
NBR	75	50	25
PVC	25	50	75
Dibutyl phthalate	50	50	50
Zinc Stearate	2.5	2.5	2.5
Zinc Oxide	2.5	2.5	2.5
Stearic Acid	1.25	1.25	1.25
Sulphur	3.0	3.0	3.0
Dicumyl peroxide	0.3	0.3	0.3
Phthalic Anhydride	3.0	3.0	3.0

Testing of Polyblend: Mooney Viscometer at 100^0C temperature was used to measure Mooney viscosities of the Polyblends-1, Polyblends-2 and Polyblends-3 before vulcanization. It is defined as the torque on instrument's rotating spindle within heated dies. The rubber compound must enclose and overflow the spindle in order for the measurement to be accurate.

Tensile properties were measured by Zwick Tensile Tester. Dumb-bell shaped five specimens of 2 mm thickness were cutted from the moulded sheets for each polyblends for the tensile strength measurement. Swelling percentage of the polyblends were determined using test specimens of 2mm x 5 mm x 30 mm dimensions. The specimens were immersed in cyclohexane at room temperature for 40 h. The specimens were dried with the help of tissue paper and weighed. Swelling index was calculated as the ratio of the swollen weight of test specimen to the initial weight of the test specimen.

RESULTS AND DISCUSSION

The Mooney viscosity was found to increase from 28 for Polyblend-1 to 60 for Polyblend-3 with the increase of PVC content in the polyblends. The tensile strength was found to increase from 4.1 MPa for Polyblend-1 to 10.2 MPa for Polyblend-3 with the increase of PVC content in the polyblends. The swelling index was found to decrease from 3.0 for Polyblend-1 to 1.7 for Polyblend-3 as the percentage of PVC increase from 25 % to 75 % in the Polyblend. NBR as well as PVC, both are soluble in cyclohexane. The moulded Polyblend swells only to a limited extent which confirms the presence of cross linking in the polyblends. The results obtained for all the three polyblends are shown in Table 2.

Table 2: Properties of NBR/PVC Polyblends

NBR/PVC Polyblend	Mooney Viscosity	Tensile Strength (MPa)	Swelling Index
Polyblend-1 (75/25)	28	4.1	3.0
Polyblend-2 (50/50)	32	6.9	2.1
Polyblend-3 (25/75)	60	10.2	1.7

CONCLUSIONS

NBR/PVC polyblends are very attractive because these have the good mechanical properties. The use of Dibutyl phthalate plasticizer affects positively on the properties of the polyblends.

REFERENCES

[1] S.C. Patrikios, T. Krasia, *Polymer*, **2002,** 43, 2917.
[2] J.Hwang H. Moon, J. Seo, S.Y. Park, T. Aoyawa, H. Sabase, *Polymer*, **2001,** 42, 3023.
[3] L. Yu, *J. Polym. Sci. Part (A); Poly Chem.*, **2001,** 39, 2557.
[4] J. Sanetra, D. Bogdal, M.WArzala, A. Boron, *Chem. Mater*, **2002,** 14, 89.
[5] S.R. Turner, D.M. Pai, *Macromolecules*, 12, 1.
[6] H.F. Mark, N.M. Bikales, C.G.Overger, Encyclopedia of Polymer Science and Engineering, Wiley Interscience, New York, **1985,** Vol. I, pp.461.
[7] B.C. Ho, W.K. Chim, Y.D. Lee, *J. Appl. Polym. Sci*, **1991,** 42, 99.
[8] L.J. Kotyk, P.A. Berger, E.E. Remson, *Macromolecules*, **1990,** 23, 5167.
[9] T. Asakura, N. Nakayama, M. Demura, A. Asamo, *Macromolecules*, **1992,** 25 , 4876.
[10] K. Dutta, M. Mukherjee, A.S. Brar, *J. Polym. Sci. Part (A) Polym. Chem;* **1992,** 15,551.
[11] P.K. Singh, A.S. Brar, *J. Appl. Polym. Sci;* **2006,** 100, 2667.
[12] M. Matsuo, C. Nozaki, Y. Jyo, *Poly. Engg.Sci*, **1969,** 9(3), 197.
[13] A.S. Brar, D.R. Pardhan, S. Hooda, *J. Appl. Polym. Sci*, **2005,** 96, 1865.
[14] S. Hooda, A.S. Brar, *J. Appl. PolymSci*, **2003,** 88, 3232.
[15] J.S. Roman, B. Vanquez, M. Valero, G.M. Guzman, *Macromolecules*, **1991,** 24, 16089.
[16] P.Y. Jia, C.Y. Bo, L.Q. Zhang, L.H. Hu, M. Zhang, Y.H. Zhou, *J. Industrial Engg. Chemistry*, **2015,** 28, 217-224.
[17] D.J.T. Hill, L. Dong, J.H. O' Donnell, *J. Polym. Sci. Part A Polymer Chemistry*, **1993,** 31, 295.
[18] M.F. Garcia, J.L. Fuente, E.L. Madruga, *Polym. Bull*, **2000,** 45, 397.
[19] T.Y. Katircioglu, O. Guven, *J. Appl. Polym. Sci*, **2001,** 82, 1936.
[20] S. Nakamura, T. Otake, K. Matsuzaki , *J. Appl. Polym. Sci;* **1972,** 16, 1817.
[21] T. Kelen, F.J. Tudos, *Macromo . Sci. Chem*, **1975,** A9, 1.
[22] S.H. Harris, R.D. Gilbert, *J. Polym. Sci, Chem. ED*. **1982,** 20, 1653.
[23] H.A. Schneider, H.N. Neto, *Polym. Bull*, **1983,** 9, 457.
[24] N. Denial, A.K. Srivastava, *Eur. Poly*, **2001,** 97, 2313.
[25] N. Denial, A.K. Srivastava, *J. Polym. Res*, **2000,** 7, 3161.
[26] I.R. Dewi, I.N. Indrajati, I. Setyorini, MajalahKulit, Karet, Dan Plastik, **2016,** 32(1), 51-58.
[27] Z. Liu, X. Zhu, L.Wu, Y. Li, *Polymer*, **2001,** 42, 737-746.

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