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Using Tensiometry to Establish Point of Optimal Interaction of PMMA/PVC in a Blend.

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ABSTRACT

Polymers have, in the last few decades, been replacing traditional materials such as metals, wood, ceramics, cement and glass in their applications. However, it is observed that most polymerics of commerce these days are not usually homopolymers but blends or alloys of two or more polymers. This is because it has been seen that blending often results in materials that synergistically incorporate desirable properties of the individual components. In this work, PVC and PMMA were blended by the liquid-liquid technique and the resultant films characterized by tensiometry. The results obtained show optimal interaction at 0.28 PVC base mole fraction for tensile strength and 0.07 PVC base mole fraction for elongation. This point indicates most facile blend composition as well as utility

KEYWORDS: *Polymer blend, PVC, PMMA, tensiometry and optimal interaction*.

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I. INTRODUCTION

The great interest in this work is that the ability to combine existing polymers into new compositions with commercializable properties offers the advantage of reduced research and development expenses compared to the development of new monomers and polymers to yield a particular property profile [1], for diverse applications requiring polymeric materials [2-4]. Moreover, property profile which may not be feasible with a single polymer can often be achieved through polymer blending. Most often property improvements are in such areas as impact strength, weather resistance, improved low temperature performance, flame retardancy, etc [5].From a scientific stand point an increasing battery of characterization techniques has also lead to deeper understanding of mechanism involved in the polymer mix, their fundamental interactions and how these interactions affect their final properties. These include X-ray scattering, scanning electron microscopy, infra-red spectroscopy etc [2,3,6].

II. MATERIALS AND METHOD

The following materials were used. PVC powder from LG Chemical Seetec Ltd, Chung-Nam Korea; PMMA from British Drug House Poole, England; tetrahydrofuran from Pharmacos Ltd, Southend-on sea, Essex, England and cyclohexane from Riedel-Dahacnag Seelze-Hannover, Germany.

Blend preparation:

PMMA ($20g/1000cm^3$), PVC ($20g/1000cm^3$) were separately made in cyclohexane and tetrahydrofuran respectively. $25cm^3$ each of the stock solution of PMMA was mixed with varying volumes of PVC solution. Each polymer solution mix was stirred vigorously and was poured quickly into the respective moulds. Also, $25.0cm^3$ of each homopolymer solution was taken into separate moulds. By this technique blend films were cast on the mould surface, after the evaporation of the solvents. The films were allowed to stand for further seven days at 25°Cto ensure complete evaporation and further vacuum dried. They were characterized for tensile strength and elongation at break using the Instron Universal Testing machine.

III. RESULTS AND DISCUSSION

The basis for the use of the present technique to establish point of optimal interaction is the adoption of the Neilson's additivity equation [7]:

$$\gamma_{theoretical} = \gamma_1(M_1) + \gamma_2(M_2)$$

where $\gamma_{theoretical}$ is the theoretical tensile strength or elongation , γ_1 and γ_2 are the observed tensile strength or elongation of the blend components. M_1 and M_2 are base mole fractions of the blends.Neilson maintains that deviation from additive value is a measure of degree of interaction. That means that at point of optimal or facile interaction between the component polymers of a blend, deviation from additivity would be highest.

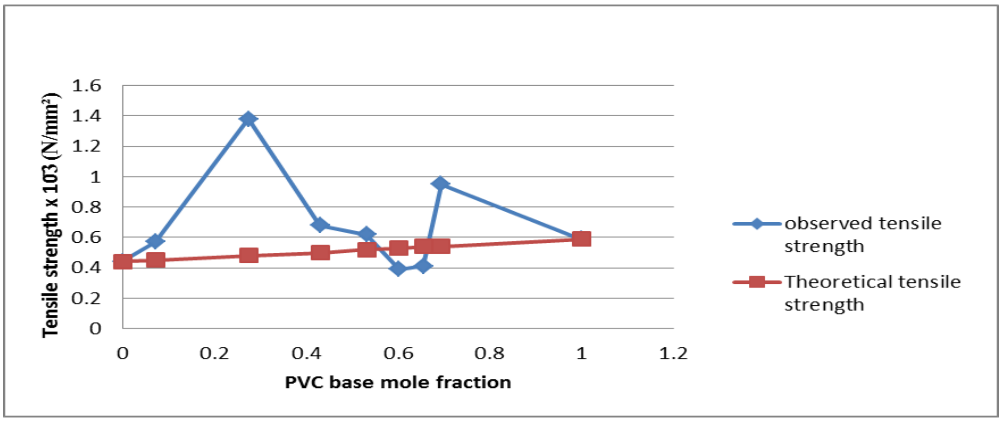

Fig.1: Effect of blending ratio on the tensile strength of PMMA/PVC pair.

It is evident in Fig.1 that the result of tensile strength study of PMMA/PVC blend indicates highest interaction at 0.28PVC base mole fraction and moderate interaction at 0.69PVC base mole fraction while at other base mole fractions (0.07, 0.43, 0.53, 0.60 and 0.66) the interactions seem very minimal. So it can be said that it is good to blend at 0.28 and 0.69PVC base mole fractions. From the result it is observed that between 0.28 and 0.69 base mole fractions, it would not be advisable to blend at these compositions as deviations at these points are not prominent.

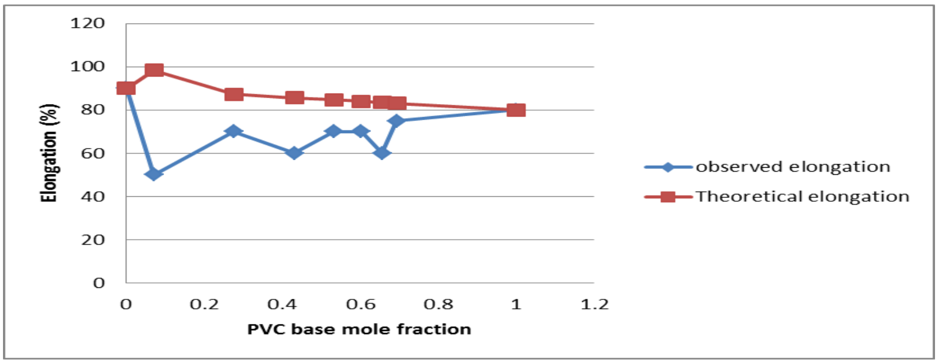

Fig.2: Effect of blending ratio on the elongation of PMMA/PVC pair.

The consideration of PMMA/PVC blend for elongation at break, Fig.2 depicts highest deviation at 0.07 and 0.66PVC base mole fractions and moderate deviations at other base mole fractions. This is in line with what should be expected as elongation should not be high at 0.28 and 0.69PVC base mole fractions since elongation is often inverse of tensile strength. The interaction may be as a result of electrostatic bonding between PVC and carbonyl present in PMMA.

IV. CONCLUSION

From this work PMMA/PVC gave best interactions at 0.28 and 0.69PVC base mole fractions for a product of optimal tensile strength and o.07 and 0.66 if elongation is of paramount consideration. This approach is definitely better than blindly mixing polymer pairs to form a blend.

REFERENCES

[1] Robeson, L. M., Polymer Blend: A Comprehensive Review, Hanser Gardner Publication, Inc, Ohio, U. S. A, (2007), pp. 1-20
[2] Bever, M., Polymer Blends: Encyclopedia of Materials Science and Engineering, Pergamon Press, Oxford, New York, Vol.5, (1988), pp. 3654-3657.
[3] Bloor, D., Brook, R. J., Flemings, M. C. and Mahajan, S.,Polymer Blends: The Encyclopedia of Advanced Materials, Elsevier Science Ltd., Kidlington, England, . (1994), pp.2043-2047
[4] Utracki, I. A., Polymer blends Handbook, Kluwer Academic Publisher, Netherland, Vol.1, (2003), pp.95-97
[5] Rosato, D. V., Di Mattia, D. P. and Rosato, V. D., Designing with Plastics and composites: A Handbook , Van Nostrand-Reinhold, new York, (1991), pp.72-166
[6] Billmeyer, F. W., Textbook of Polymer Science, 3rd ed., John Wiley and Sons , New York, (2003), pp. 151-232, 345-347
[7] Neilson, L. E., Mechanical Properties of Polymers, Reinhold, New York, (1963).