International Research Journal of Environment Sciences ISSN 2319–1414
Vol. **3(3),** 11-13, March **(2014)** *Int. Res. J. Environment Sci.*

Influence of Poly (Vinylpyrrolidone) on Binary Blend Films Made from Poly (Vinyl Alcohol)/Chitosan

Masti S.P.[1] and Chougale R.B.[2]
[1]Department of Chemistry, Karnatak Science College, Dharwad - 580 001, INDIA
[2]Department of Materials Science, Mangalore University, Mangalgangotri - 574 199, INDIA

Available online at: www.isca.in, www.isca.me
Received 22nd January 2014, revised 12th February 2014, accepted 14th March 2014

Abstract

Ternary polymer blend films of poly (vinyl pyrrolidone) (PVP) doped poly (vinyl alcohol) *(PVA)*/chitosan (CS) *blend films were prepared by solvent casting method. In this study, films containing different concentration (wt %) of PVP and equal quantity of CS/PVA (50/50) were characterized. With increase in the concentration (wt%) of PVP into the equal quantity of CS/PVA, blend shows slight increase in tensile strength and significant increase in elongation at break and decrease in young's modulus.*

Keywords: Poly (vinyl pyrrolidone), poly (vinyl alcohol), Chitosan, mechanical properties.

Introduction

Polymer blends are the physical mixtures of two or more homopolymer, copolymers, which interact with secondary forces such as hydrogen bonding with no covalent bonding. Polymer blends are prepared by many methods and among them solution blending is very simple and rapid. Blending of two or more polymers has become an increasingly important technique, since already existing polymers can be used in blending as a result costly development of new monomer or polymerization of monomer can be avoided. The final properties of the blends mainly depend on the properties of the constituent polymers and also on the phase morphology developed during blending..

Chitosan is second most abundant natural polysaccharides next to cellulose and is well known for its biocompatibility and biodegradable properties[1]. Chitosan has high modulus of elasticity owing to high glass transition temperature and crystallinity[2, 3]. Since PVP contains hydroxyl and amine groups, it is potentially miscible with PVA/PVP blend matrix due to the formation of hydrogen bonds[4].

Poly (vinyl alcohol) (PVA) is semicrystalline, water soluble, non toxic, better film and fiber forming, biocompatible, excellent chemical resistance, good mechanical properties and biodegradable synthetic polymer which is widely used in the biomedical field[1, 2]. The crystalline state of the polymer is most stable state of a polymer.

Poly (vinyl pyrrolidone) (PVP) is an amorphous vinyl polymer which has wide applications in biomedical field because of its properties including adhesion, excellent physiological compatibility, low toxicity and reasonable solubility in water and most organic solvents[3]. When these polymers are mixed, the interaction among chitosan, poly (vinyl alcohol) and poly (vinyl pyrrolidone) are expected to take place through hydrogen bonding.

Material and Methods

Poly (vinyl alcohol) (PVA), molecular weight, 1, 40,000 and poly (vinyl pyrrolidone) (PVP) average weight, 40,000 and chitosan (CS) were procured from, Himedia, Mumbai, and were used as received. Acetic acid was procured from, spectrochem, Mumbai, and was used as received. Doubly distilled water was used throughout the experiment.

Preparation of blend films: Chitosan solutions were prepared by dissolving the required amount of chitosan in 2% acetic acid solution and PVA solutions were prepared by dissolving the known quantity of PVA in distilled water at ambient temperature with constant stirring overnight. PVP solutions were made by dissolving required amount of PVP in bidistilled water. The required quantity of PVP solutions in different concentrations (0.0, 5, 10, 15, 20 and 25 wt %) was added to the equal quantity binary polymer blend solution. The mixture was stirred till the solution becomes homogenous and subsequently highly viscous bubble free solution poured onto cleaned and dried petri dishes to form blend films. The thickness of the blend film was controlled by pouring a definite quantity of blend solution at every time and solvent was evaporated at room temperature and to ensure complete removal of trace amount of solvent present in the blend films petri dishes were kept in hot air oven at 45°C for 72 hours. After drying, all films were peeled off from petri dishes and kept in vacuum desiccators after measuring the thickness randomly at five different places before use.

Mechanical Properties: The tensile properties of the prepared ternary polymer blend films were measured in accordance with

ASTM D-882 standards at room temperature in air using LLOYD LRX plus Universal Testing Machine (UTM) (LLOYD-5kN, London, UK). For the measurement, film strips measuring 100×25 mm in dimension and free from air bubbles or any other physical imperfection was held in between two grips positioned at a distance of 5 cm. During the measurement film was pulled by the upper grip at a rate of 50 mm/min at a distance of 5 cm before returning to the initial point. The force and elongation was measured when films break. The tensile properties such as tensile strength, modulus of elasticity and elongation at break were calculated using NEXYGEN Plus software.

Results and Discussion

Mechanical properties: The tensile strength, percent elongation and modulus of elasticity could be used to describe how the mechanical properties are related to their chemical structure. The tensile strength indicates the maximum tensile stress that the film can sustain. Modulus of elasticity is a measure of the stiffness of the material. Percent elongation is the maximum change in length of a test specimen before breaking.

Table-1
Mechanical properties of PVP/PVA/CS

Blend ratios PVA/CS/PVP (wt %)	Tensile Strength (MPa)	Young's Modulus (MPa)	Elongation at break (%)
50/50/0.0	12.881	136.639	27.489
47.5/47.5/5	17.190	95.727	48.679
45/45/10	17.768	77.352	59.082
42.5/42.5/15	21.380	60.394	61.603
40/40/20	19.038	14.416	70.495
37.5/37.5/25	14.481	29.828	83.290

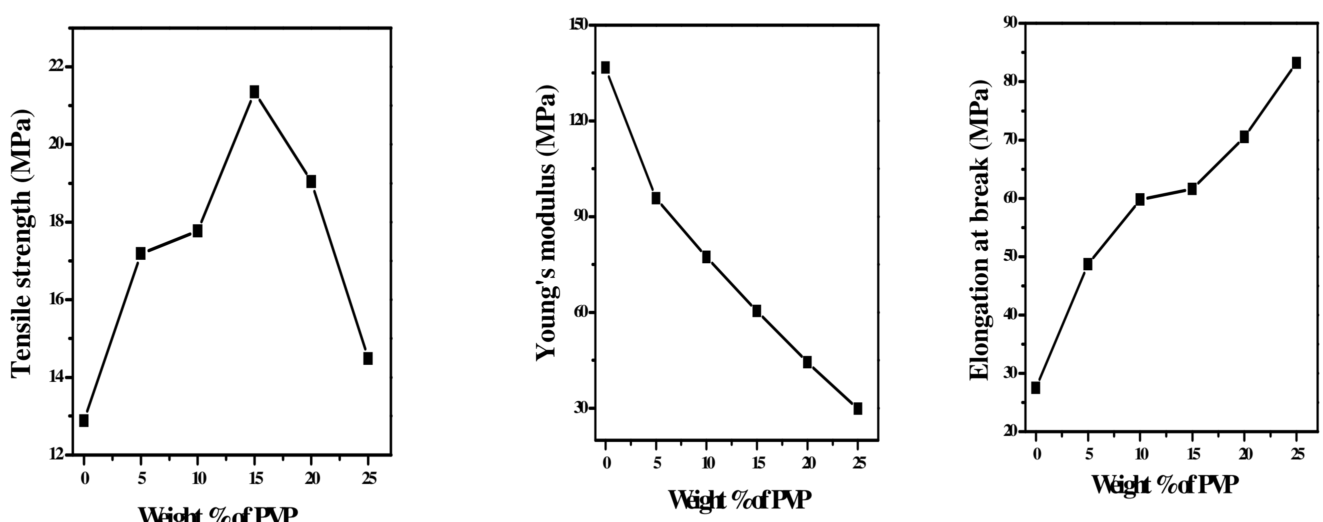
The mechanical properties investigated of poly (vinyl pyrrolidone) (PVP)/poly (vinyl alcohol)/chitosan blend films are tabulated in Table 1 and presented graphically in figure 1 and 2. The addition of different weight percent of poly(vinyl pyrrolidone) (PVP) to the equal quantity of blend shows increase in tensile strength, decrease in young's modulus and significant increase in the elongation at break in comparison with equal quantity of pure blend (50/50). Because adding poly (vinyl pyrrolidone) (PVP) to the equal weight percent of chitosan (CS)/poly (vinyl alcohol) (PVA) blend, interaction among the poly (vinyl pyrrolidone) (PVP)/ chitosan (CS)/poly (vinyl alcohol) (PVA) occurs.

Conclusion

The mechanical properties of ternary polymer blend films containing different weight % of PVP were studied. From the table 1 and figure 1 and 2 it is clear that tensile strength increases, young's modulus decreases and elongation at break increases significantly. This is because hydrogen bonding interaction occurs between the poly (vinyl pyrrolidone) (PVP), poly (vinyl alcohol) (PVA) and chitosan (CS). These blends films are very suitable as natural materials for food packaging and also for controlled release of various pharmaceutical drugs.

Acknowledgment

The authors Masti S.P. (Co-PI) and Chougale R.B. (PI) sincerely thank the university grants commission (UGC), New Delhi, India, for financially supporting this research (F.No.34-397/2008 (SR)/30 Feb., 2008).



(a) (b) (c)

Figure-1
Effect of PVP on (a) Tensile Strength (b) Young's Modulus (c) Elongation at Break

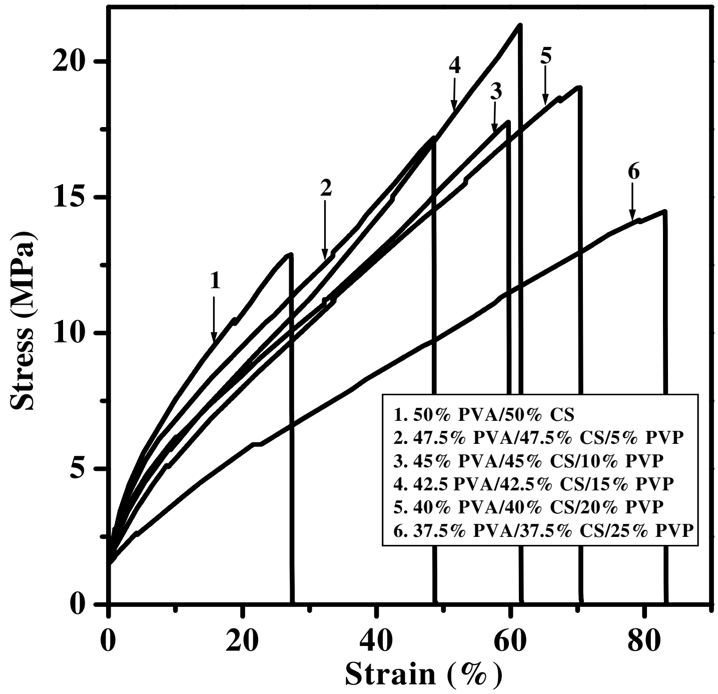


Figure-2
Stress-Strain plot containing different fractions of PVP

References

1. Geng X.Y., Kwon O.H. and Jang J., Electrospinning of Chitosan Dissolved in Concentrated Acetic Acid Solution, *Biomaterials*, **26(27)**, 5427-5432 **(2005)**

2. Chen C., Dong L. and Cheung M.K., Preparation and Characterization of Biodegradable poly(L-actide)/ Chitosan Blends, *Eur Polym J*, **41**, 958 **(2005)**

3. Yusong W.U., Seo T., Maeda S., Dong Y., Sasaki T., Irie S. and Sakurai K., Spectroscopic Studies of the Conformational Properties of Naphthoyl Chitosan in Dilute Solutions, *J Polym Sci Part B: Polym Phys,* **42(14),** 2747-2758 **(2004)**

4. Qin C.Q., Du Y.M., Xiao L., Li Z. and Gao X.H., Enzymic Preparation of Water-Soluble Chitosan and their Antitumor Activity, *Int. J. Biol. Macromol.*, **31**, 111-117 **(2002)**

5. Lee J.S., Choi K.H., Ghim H.D., Kim S.S., Chun D.H., Kim H.Y. and Lyoo W.S., Role of Molecular Weight of Atactic Poly(vinyl alcohol) (PVA) in the Structure and Properties of PVA Nanofabric Prepared by Electrospinning, *J Appl Polym Sci*, **93(4)**, 1638-1646 **(2004)**

6. Park J.S., Park J.W. and Ruckenstein E., Thermal and Dynamic Mechanical Analysis of PVA/MC Blend Hydrogels, *Polymer*, **42(9),** 4271-4280 **(2001)**

7. Li D. and Xia Y., Electrospinning of Nanofibers: Reinventing the Wheel?, *Advanced Materials*, **16(14),** 1151-1170 **(2004)**