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# Applications of Polymer Blends

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***Abstract:***
*Polymer blending is becoming increasingly important in applications to improve properties, improve processing, or reduce costs. Achieving a consistent quality blend with the desired properties necessitates careful consideration of both the process and the product design. Aspects of polymer blending are highlighted that are critical for in-line mixing of resins and other ingredients in a single-screw extruder during film converting. The factors that lead to elongated blend morphologies in blown film are examined, as are key aspects of thermodynamics and morphology development of polymer blends. Dispersing inorganic fillers, nanocomposites, and polymer blend rheology are also discussed.*
***Keywords:***
*Polymer blends, Drug delivery, Dosage forms, Solid dispersions, Bioavailability enhancement*

## I. Introduction:

Polymers are widely used in pharmaceutical and healthcare product formulation. Controlling drug release, providing site-specific delivery of active pharmaceutical ingredients (APIs), and improving drug stability are some of the applications. Polymers are used in almost all major dosage forms, such as tablets, films, capsules, semi-solids, suspensions, gels, and transdermal patches, as well as specialised delivery systems such as long-acting injections and biodegradable implants.

There are currently a number of polymers available with unique properties that have been used in marketed drug and healthcare products. Because of this history of use, these polymers may be used in the development of new pharmaceutical products, as long as the amounts used are within the safety limits. Despite the fact that these polymers are widely available, there is a need for new and improved materials.While it is possible to synthesise new polymers to achieve desired functionalities, the extensive safety testing requirements for new materials are frequently a limiting barrier to their use in new drug products. Given the time and resources required to obtain regulatory approval for a new excipient, polymer blends present an appealing alternative method of addressing various formulation and drug delivery challenges.

### Polymer blend interactions:

Noncovalent polymer-polymer interactions can range from van der Waals forces in physical mixtures to stronger intermolecular interactions during processing such as hydrogen bonding, ionic interactions, and hydrophobic interactions. Depending on the state of the material being studied, a variety of experimental techniques are available for characterization of polymer blends. Methods widely used include molecular weight characterization, spectroscopy, thermal analysis, rheology, and mechanical testing in conjunction with long-term product stability evaluation. [1]

### Molecular level blends:

Molecular level blends are created by processing two polymers to a state in which they can interact at the molecular level. In general, processing methods involve using a common solvent or thermally co-processing the polymers in molten or above the glass transition temperature (Tg) states. The resulting mixture may have one or more detectable phases depending on their thermodynamic compatibility, polymer ratio, and temperature. Clear films, capsule shells, gels, and solutions are examples of systems containing blends in which polymers can be homogeneous at the molecular level. Polymer-polymer miscibility has been observed in all proportions for hypromellose (HPMC) and methylcellulose blend films, with mixing exhibiting ideal behaviour.Polymer miscibility is desirable in films and capsule shells because it produces clear, transparent films (if there are no insoluble or highly crystalline additives). Molecular scale interactions are also important in amorphous solid dispersions to ensure that the drug does not crystallise during the drug's shelf life. Polymer-polymer miscibility in solutions reduces the possibility of phase separation. [2]

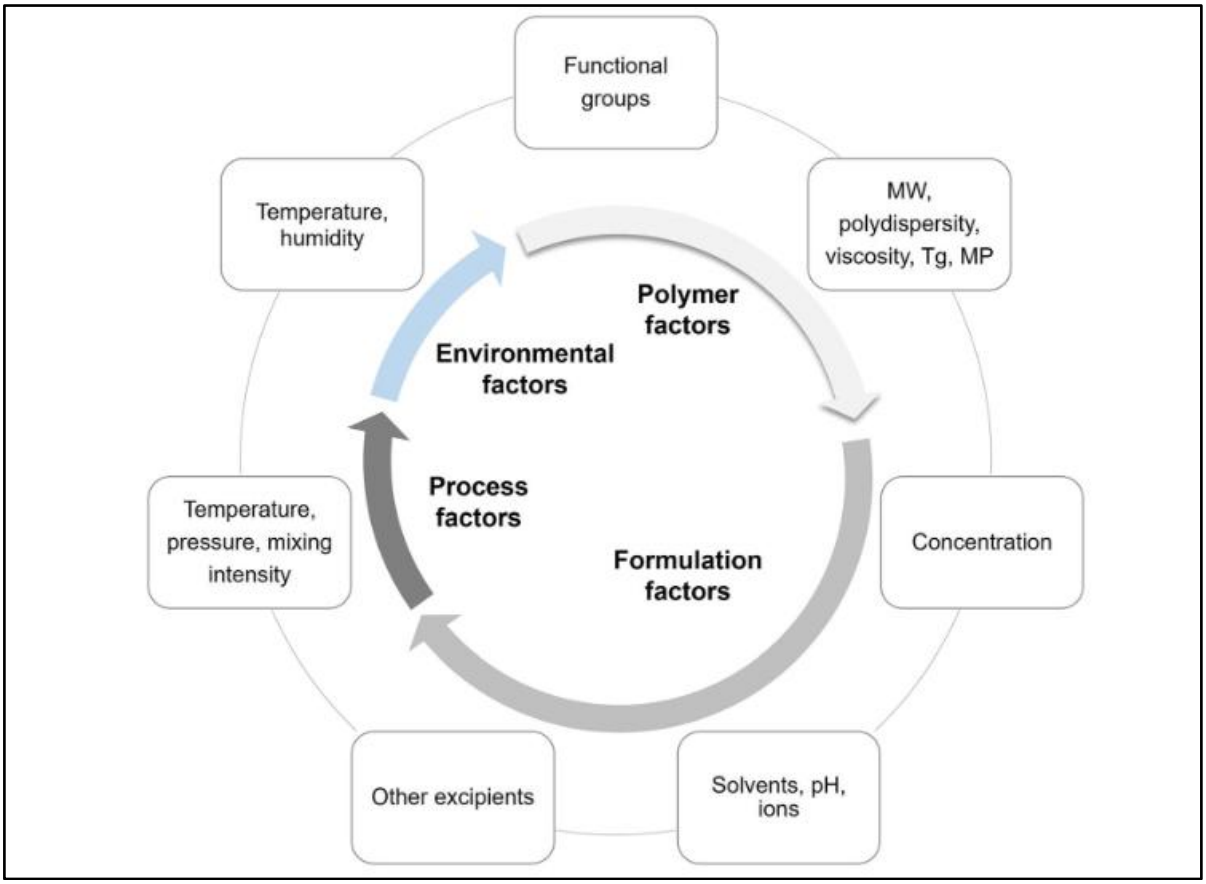


**Figure 1: Factors influencing polymer-polymer interactions**

Over the last few decades, a number of technological and commercial advances in engineering polymer blends have been realised. Various combinations of pre-existing polymers have been used to create new commercial polymers. Polyester and polycarbonate (polybutylene terephthalate/polycarbonate; polyarylate/polycarbonate; cyclohexane dimenthanol-based polyesters/polycarbonate and polyethylene terephthalate/polycarbonate) have been two of the most important areas. The development of polymeric materials for future auto panels has resulted in a large number of potential candidates, almost entirely based on engineering polymer blends [3].

The ethylene carbon monoxide alternating copolymers, first introduced by Shell, are the most recent addition to the engineering polymer field. The commercial polymer is highly crystalline and is thought to contain a trace of propylene to lower the crystalline melting point and allow for a wider range of processability. Several areas involving extensive research efforts are currently being investigated that are relevant to future polymer blends: These areas include, but are not limited to, molecular composites, liquid crystalline polymer blends, electrically conductive polymer blends, biodegradable polymer blends, and theoretical studies involving polymer phase behaviour prediction. Another intriguing area is the prediction of polymer miscibility using computational models.

**Objectives:**

1. The goal of blending polymers from a functionality standpoint is to improve, customize, or maximize material performance.
2. To study of application of polymers in drugs
3. To analysis of Pharmaceutical applications of polymer blends.

## II. Review Of Literature:

polymers (Bucknall, 2000; Horak et al., 2005). (Bucknall, 2000; Horak et al., 2005). Poly(-caprolactone) (PCL) is a soft, biocompatible, and biodegradable semicrystalline polyester with a rubbery amorphous phase at room temperature and a melting temperature range of 55-70°C (Pitt, 1990;). As a result, PLA/PCL blends should retain favourable biocompatibility and biodegradability while exhibiting increased impact strength over neat PLA. The primary goal of preparing PLA/PCL blends, in which PLA is a major component, is to significantly increase PLA toughness while reducing stiffness to a minimum. [4-6]

Kumar and Singh accomplished this through starch modification via photoinduced cross linking. Casting was used to create composite films from aqueous dispersions of starch and microcrystalline cellulose with glycerol as a plasticizer and irradiated under ultraviolet (UV) light with sodium benzoate as a photo-sensitizer. When compared to control samples, the Young's modulus of composites reinforced with 5, 10, and 15% wt% and irradiated for 30 minutes improved by 72.41%, 42.5%, and 32%, respectively. [7]
Kohli et al. investigated the effect of deformation history on the morphology and properties of LCPs blended with polycarbonate resin. The addition of an immiscible LCP phase improved the host thermoplastic polymer's melt processability. Furthermore, using a suitable deformation history, the LCP phase can be elongated and oriented so that microfibrillar morphology is preserved in the solid state. This has significant implications for the development of self-reinforcing polymer blends that can compete with traditional inorganic fibre reinforced polymers. Shear flows are generally ineffective in developing these morphologies, but flows with an extensional region, such as the converging flow at the entrance to a capillary or die, can produce an elongated LCP phase. [8]

Bousmina et al used linear viscoelasticrheology, optical microscopy, and inverse gas chromatography (IGC) techniques to examine phase segregation in a poly (styrene-co-acrylonitrile)/poly (methyl methacrylate) (SAN/PMMA) blend with a lower critical solution temperature (LCST). At low temperatures, the blends behaved like homogeneous polymer melts, but near phase segregation, a shoulder in the storage modulus and the linear relaxation modulus, G (t), was observed. [9]

## III. Research Methodology:

Books, educational and development journals, government papers, and print and online reference resources were just a few of the secondary sources we used to learn about the composition, use, and consequences of polymer blend application. We did research. Polymer blends are being used in new pharmaceutical processing techniques.

## IV. Result And Discussion:

From a functional standpoint, the goal of polymer blending is to improve, customise, or maximise material performance.

**Table 1 Pharmaceutical applications of polymer blends**

| **Dosage forms** | **Applications** |
|---|---|
| Tablets | Modulation of drug release profiles |
| Hard and soft capsules | Capsules shell formation, enteric protection |
| Film coatings | Plasticization, modulation of mechanical properties, adhesion, vapor permeability and drug release rates |
| Oral films | Plasticization, modulation of mechanical properties. Preventing setting of dispersed phases; modulating tear resistance |
| Liquids, emulsions, and suspensions | Rheological adjustment, suspension stabilization |
| Gels | Rheological modification, modulation of diffusion, swelling, dissolution/erosion and drug release rates |
| Topical semi-solids and transdermal patches | Rheological/mechanical properties modification, modulation of bioadhesion and drug release rates |
| Long-acting injectables, implants, ophthalmic inserts | Modulation of degradation, drug release rate and mechanical properties |
| Solid dispersions | Drug solubilization, dissolution enhancement, stabilization of solid state forms, crystallization inhibition, modulation of super-saturation and precipitation inhibition |

Table 1 shows how polymer blends are used in pharmaceutical dosage forms. Depending on the type of delivery system, different mechanisms of drug release from polymer-based dosage forms are possible. [10]
There are a number of cases where polymer blends provide unique functionality Table 2.

**Table 2 Polymer blends in tablet technology platforms and excipients**

| **Polymers** | **Advantages(s)** | **Commercial Product** |
|---|---|---|
| Polyethylene oxide, hypromellose | Gastric retention and controlled drug release facilitating upper Gl tract delivery by controlled swelling and erosion | Actform Technology |
| Xanthan gum, locust bean gum | Sustained release from synergistic polymer interaction | TIMERx Technology |
| Microcrystalline cellulose guar gum | Improved sensory characteristics of chewable tables | Avicel CE 15 |

With the exception of the previously discussed co-processed CE 15 excipient, most direct compression and wet granulated based powder mixtures would be classified as particulate level blends. [11]

## V. Conclusion:

Blendingpolymers is an effective method for overcoming the limitations of individual polymers. Because there are so many existing polymers with established safety profiles and a history of use in pharmaceutical and biomedical products, there are numerous polymer blend combinations that could address many of the formulation challenges encountered in the development of new drug products. Characterization and understanding of the nature of polymer-polymer interactions in these systems are critical to the rational selection and use of these polymer blends. This allows for the development of novel polymer blends that can be manufactured consistently and address unmet needs in polymer-based drug delivery.

## Reference:


[1]. Mi FL, Shyu SS, Lin YM, Wu YB, Peng CK, Tsai YH (2003) Chitin/PLGA blend microspheres as a biodegradable drug delivery system: a new delivery system for protein. Biomaterials 24:5023–5036.

[2]. Nyamweya N, Hoag SW (2000) Assessment of polymer-polymer interactions in blends of HPMC and film forming polymers by modulated temperature differential scanning calorimetry. Pharm Res 17:625–631. https://doi.org/10. 1023/A:1007585403781

[3]. L. A. Utracki, ''Polymer Blends Handbook,'' Kluwer Academic Publishers, Dordrecht, 2002

[4]. Bucknall, C. B. (2000). Deformation mechanisms in rubber-toughened polymers, in The Polymer Blends, V. 2: Performance, eds. Bucknall, C. B., and Paul, D. R. (New York: John Wiley & Sons, 83–136.

[5]. Horak, Z., Fortelny, I., Kolarik, J., Hlavata, D., and Sikora, A. (2005). Polymer blends, in The Encyclopedia of Polymer Science and Technology, ed. Kroschwitz, J. (New York, NY: John Wiley & Sons), 1–59. doi: 10.1002/0471440264.pst276

[6]. Pitt, C. G. (1990). Poly- ε-caprolactone and its copolymers, in The Biodegradable Polymers as Drug Delivery Systems, eds. Langer, R., and Chasin, M. (New York, NY: Marcel Dekker, 71–120.

[7]. Kumar, A.P.; Singh, R.P. Biocomposites of cellulose reinforced starch: Improvement of properties by photo-induced crosslinking. Bioresource Technol. 2008, 99, 8803-8809

[8]. A. Kohli, N. Chung and R. A. Weiss, ''The Effect of Deformation History on the Morphology and Propertiesof Blends of Polycarbonate and a Thermotropic LiquidCrystalline Polymer,'' Polymer Engineering and Science,Vol. 29, 1989, pp. 573-580.doi:10.1002/pen.760290902

[9]. M. Bousmina, A. Lavoie and B. Riedl, ''Phase Segrega-tion in SAN/PMMA Blends Probed by Rheology, Mi-croscopy, and Inverse Gas Chromatography Tech-niques,'' Macromolecules, Vol. 35, No. 16, 2002, pp.6274-6283. doi:10.1021/ma020053w

[10]. Gusler G, Berner B, Chau M, Padua A (2004) Optimal polymer mixtures for gastric retentive tablets, US Patent 6,723,340B2, 2004

[11]. Li CL, Martini LG, Ford JL, Roberts M (2005) The use of hypromellose in oral drug delivery. J Pharm Pharmacol 57:533–546. https://doi.org/10.1211/ 0022357055957