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(54) CONTROLLED FLOW POLYMER BLENDS AND PRODUCTS INCLUDING THE SAME

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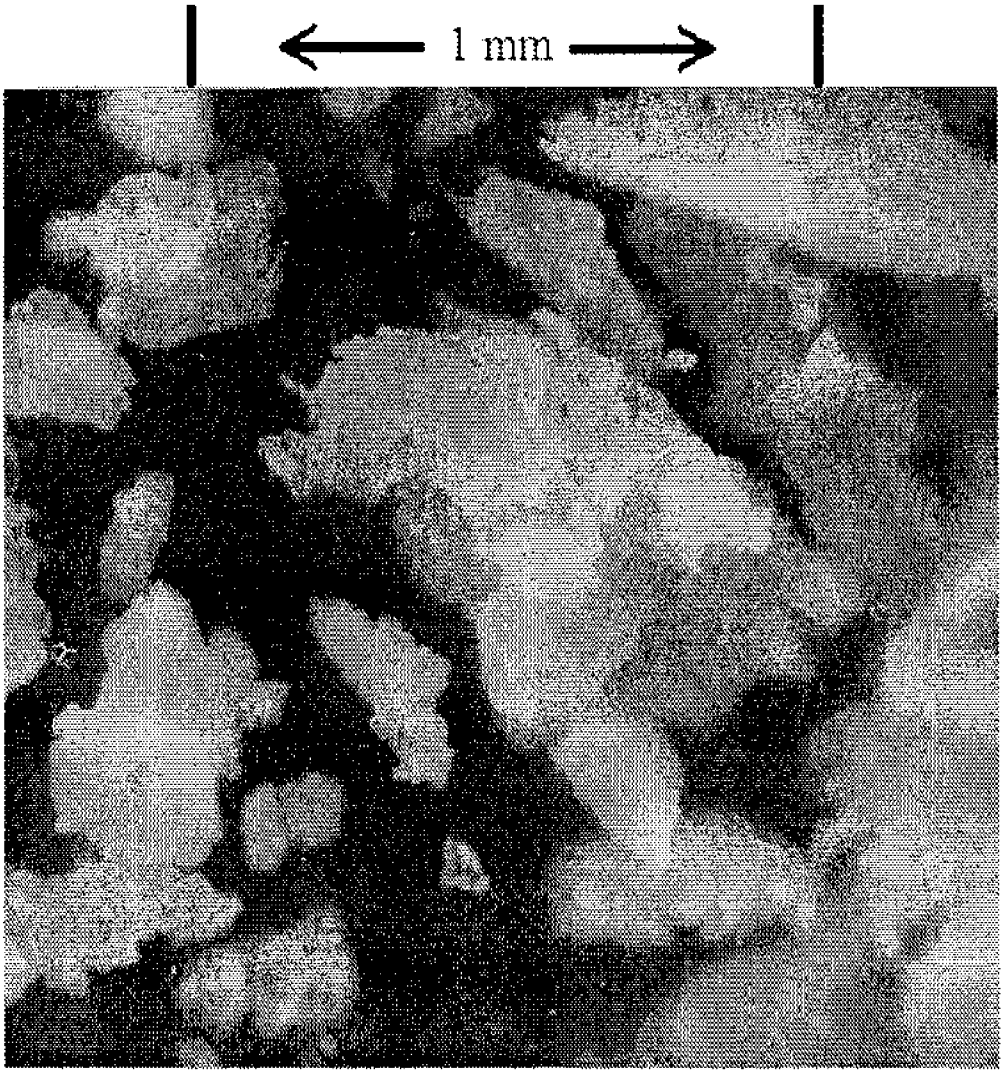
(57) **ABSTRACT**

The present invention is directed to polymer blends having controlled flow properties. The polymer blends can be useful in various applications including bonding systems and additive delivery systems, which can provide durable binding and/or delivery and/or affixing of additives. The polymer blends can include at least two different components, at least one being a polymer component having a higher molecular than the other of the components. When heated to an activating temperature, the resultant blend exhibits desirable flow or wet out properties without applied pressure. Despite the controlled flow properties, the blends do not exhibit blocking or fusing properties typically associated with high flow polymer materials.



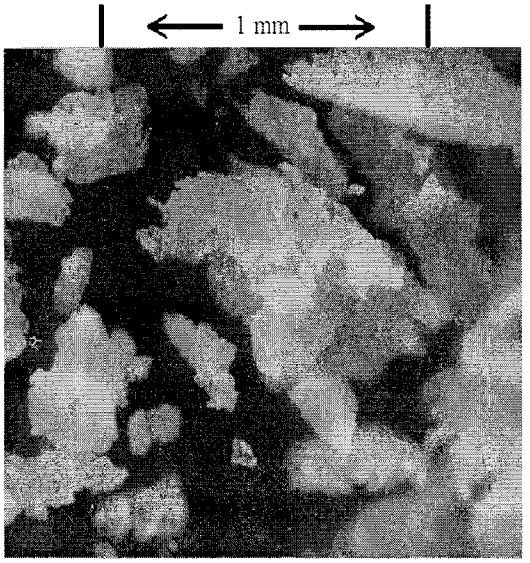


FIGURE 1

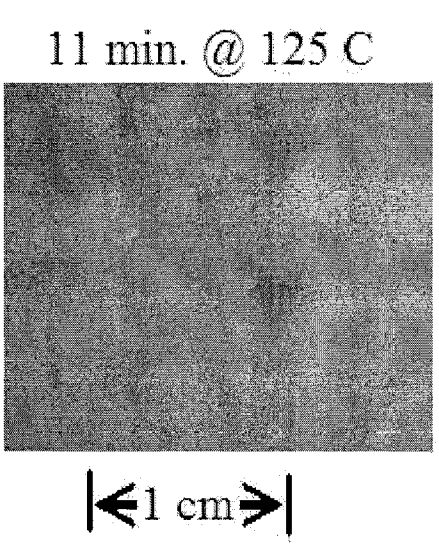


FIGURE 2A

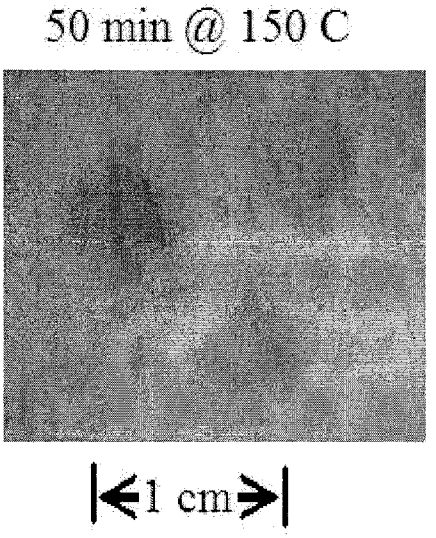


FIGURE 2B

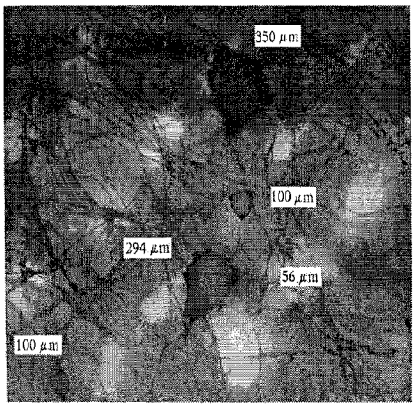


FIGURE 3A

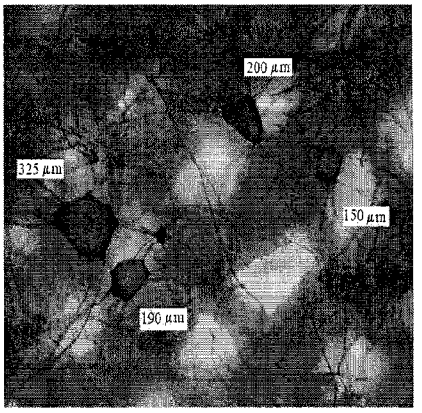
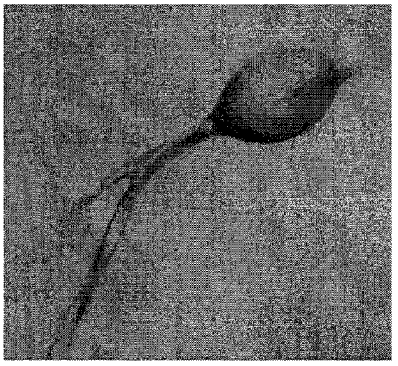


FIGURE 3B



70 µM droplet

FIGURE 4A

FIGURE 4B

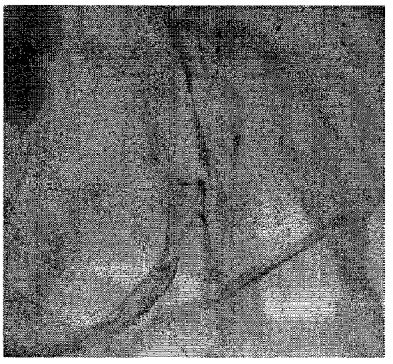


FIGURE 4C

CONTROLLED FLOW POLYMER BLENDS AND PRODUCTS INCLUDING THE SAME

FIELD OF THE INVENTION

[0001] The present invention relates to polymer blends and articles including the same. More particularly, the present invention relates to polymer blends having useful flow or wetting properties without undesirable blocking properties and to products including the same.

BACKGROUND OF THE INVENTION

[0002] Fibrous materials having various functionalities are useful in many different applications. Often, it can be useful to treat a fibrous material to impart or enhance a particular property thereof, such as flame retardance, UV resistance, and the like.

[0003] The functionality of a fibrous material can be modified by introducing a suitable additive into the fibrous structure. Many natural fibers exhibit polar functionality (such as hydroxyl functionality found in cotton fibers), due at least in part to the biological origins of such materials. Nonetheless, functional groups present in many natural fibrous materials can exhibit limited reactivity, and accordingly, additive formulations can simply sit in a bead and not wet out the substrate.

[0004] Natural (plant and animal) fibers can be blended with synthetic fibers to formulate functionalized fibrous materials. The differences in physical properties between synthetic and natural fibers, however, can result in phenomena like pilling, which can reduce the desirability and effectiveness of the blend. Other treatments for imparting functionality to natural fibrous materials may be limited to use with liquid vehicles. Yet, to penetrate a fibrous material sufficiently to provide adequate bonding, the fibrous materials are typically saturated with the liquid, which results in a large volume of solution to be handled, removed from the fabric, and disposed in compliance with environmental regulations.

[0005] It can be difficult to introduce functional additives into synthetic fibrous materials as well. For example, the crystallinity of certain substrates, such as polypropylene fibrous articles, can present a relatively hard, non-reactive surface to a would-be binder. Many polyester copolymers such as are used as binders in nonwoven fabrics also do not adhere well to polypropylene and/or do not meet needed temperature-flow profiles. Further, the effectiveness of an additive may depend on surface area presentation. For example, silver antimicrobial agents operate via release of silver ions. Yet such activity can be impeded if the antimicrobial agent is buried deep within a treated synthetic fiber or fabric. It can be difficult, however, to locate an active agent on or near the surface of a synthetic fiber, and this difficulty can be acerbated in applications dictating relatively minor amounts of the active agent.

[0006] In addition to the issue of effectively introducing an additive into a fibrous material, it can also be difficult to impart permanency to the treated product. Topical treatments can exhibit limited durability or can be readily reversed, particularly when the fibrous material is exposed to washing, cleaning solvents, and other environmental forces that the material itself may be able to withstand, but a coating may not. Even for solvent based additive systems, which can generally withstand numerous washings, there is a desire to move away from solvent based systems due to environmental concerns.

[0007] In addition, the additive carrier or binder should have adequate thermal flow to allow it to be applied under commercially feasible conditions and time frames, for example, at lower bonding temperatures and/or residence times. Many polymer systems with high molecular weights (which can be desirable for the requisite physical properties) may lack flowability sufficient to penetrate through a fibrous material. Accordingly, the use of high molecular weight polymer systems may require the application of pressure, such as by calendering. Further, high molecular weight polymer systems may require relatively high bonding temperatures and/or residence times, which can increase energy costs and bonding times associated with using the same.

[0008] Polymers have been developed for use in applications requiring relative good flow, such as hot melt adhesion and coating applications. Such polymers can have relatively high melt flow rates so as to impart desirable flow properties to the resultant product. Such polymers, however, typically have lower molecular weights, and thus can exhibit excessive molecular mobility and can be generally tacky or block at normal warehousing and handling conditions. Stated differently, products formed of polymers having relatively high melt flow rates can become "sticky" or "tacky" and thus tend to block, that is, to stick together, when subjected to conditions of elevated temperatures and increased humidity, such as associated with the commercial transportation and warehousing of products. Such polymers can also stick to and bind up on processing equipment, thereby decreasing manufacturing efficiencies.

[0009] Various techniques have been proposed to reduce the tendency of high flow polymers to block. Anti-tack agents are offered commercially to improve the block resistance of various polymers. Although useful, many anti-tack agents are only marginally effective, and further may be effective only with specific types of polymers.

BRIEF SUMMARY OF THE INVENTION

[0010] The present invention is directed to polymer blends exhibiting desirable flow properties without also exhibiting the blocking properties typically associated with high flow polymers. The polymer blends of the invention are capable of substantially wetting out a surface at a flow activating temperature without requiring the application of substantial pressure. Yet despite the melt flow properties of the blends, the polymer blend after applying and solidifying further exhibits blocking resistance properties, thereby facilitating manufacturing and downstream storage and transportation of products produced using the polymer blends.

[0011] The polymer blends of the invention include at least two, or more, components that differ from one another with regard to molecular weight. The polymer blend includes a first blend component including at least one polymer having a first molecular weight and a second blend component including at least one compound having a second molecular weight that is less than the first molecular weight of the at least one polymer of the first blend component. The molecular weight of the at least one polymer of the first blend component is sufficiently high to prevent the substantial wet out of the at least one polymer of the first blend component without the application of pressure at the activating temperature of the blend. The second molecular

weight of the at least one compound of the second component of the blend is sufficiently low so that the at least one compound of the second component of the blend exhibits a level of molecular mobility sufficient to limit its usefulness by itself for the production of an article such as a fiber or fabric. The at least one compound of the second component of the blend may, for example, exhibit such a high level of molecular mobility that when processed alone, its usefulness is limited because it may be susceptible to blocking, and/or because it may exhibit too much creep, and/or it may have inadequate melt strength or viscosity to be processed. Yet together the blend components can provide a combination of properties including sufficient flow for fiber formation and/or wet-out of a desired substrate without causing problems associated with blocking or creep.

[0012] The polymer blends of the invention can be useful in the production of products, such as binder fibers, that can be tailored to exhibit a range of various properties, such flow rates, activation temperatures, melt strengths, blocking temperatures, and the like, depending on the desired application of the product. The inventor has surprisingly found that polymer blends can be prepared of at least two components having high and low molecular weights, relative to one another, that can exhibit a melt strength that is higher than expected given the resulting viscosity of the blend. This is particularly surprising and useful in that it allows the production of articles, such as fibers, from materials that can have unusually low viscosity when remelted, as for instance when used as a binder fiber. The invention accordingly can provide a mechanism to fine tune polymer formulations for specific applications.

[0013] In exemplary embodiments of the invention, at least one of the components can include a substantially crystalline polymer, which can promote a sharp flow profile. In other exemplary embodiments of the invention, at least one of the components can include a functionalized polymer component, such as a maleic anhydride functionalized polyolefin, which can improve wetting and/or adhesive properties of the blend. In yet other embodiments of the invention, the polymer blend can include at least one additive.

[0014] One exemplary polymer blend of the invention capable of substantially wetting out a surface at a flow activating temperature without requiring the application of substantial pressure, the polymer blend further having blocking resistance properties, can include at least about 10 percent by weight, based on the total weight of the polymer blend, of a first blend component including at least one polymer having a first molecular weight and a glass transition temperature T_g, and at least about 10 percent by weight, based on the total weight of the polymer blend, of a second blend component including at least one substantially crystalline compound having a second molecular weight that is less than the first molecular weight of the at least one polymer of the first blend component and having a melting point that is greater than the T_g of the at least one polymer of the first blend component. In this embodiment of the invention, at least one of the first and second components can include a functionalized polymer, such as a functionalized polyolefin, including maleic anhydride modified polyolefins.

[0015] In other aspects, the present invention also provides a polymeric bonding system and bonding methods using the same. The polymeric bonding system of the invention can be in the form of an article, such as a fibrous material, film, foam, coating, a particulate material, and the like, formed of the polymer blend and combinations thereof.

[0016] Other aspects of the invention are directed to a polymeric delivery system and additive delivery methods using the same. The polymeric delivery system of the invention can include the polymer blend described herein in combination with an additive, and can also be provided in the form of an article, such as a fibrous material, film, foam, coating, a particulate material, and the like. The polymer delivery system can be applied to a substrate and treated (heated) to promote flow and form a coating. In this embodiment of the invention, the coating can be relatively low add on, can be substantially discontinuous (for example small islands) or substantially continuous, and/or can be applied in a pattern by various techniques. The coating may also be thin and/or flexible, which can aid durability.

[0017] The polymer bonding system and the polymeric delivery system of the invention and associated methods can be useful in the production of various articles, including fibrous webs, yarns, and the like and can secure additives to various substrates including natural fibers having limited polar functionality.

[0018] Another aspect is directed to composite articles that include a matrix material and the polymer blend of the invention. The matrix material can be selected from fibrous materials, such as synthetic and natural fibers, and cellulosic materials, such as wood fibers and particles. The composite articles can further include an additive. An exemplary embodiment of this aspect of the invention includes an article formed of cotton fibers having an additive, such as an antimicrobial additive, dispersed throughout via fibers formed of a mixture of the polymer blend of the invention and the antimicrobial additive.

[0019] Yet another aspect of the invention is directed to an activatable yarn. The activatable yarn includes a plurality of fibrous materials formed of a synthetic polymer having a first molecular weight and a functionalized additive for promoting adhesion of the synthetic polymer to another material and having a second molecular weight that is less than the first molecular weight of the synthetic polymer. Exemplary embodiments of this aspect of the invention include polyolefin and polyester yarns including a maleic anhydride modified polyolefin functionalized additive or an amine functionalized additive.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] Having thus described the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and in which:

[0021] FIG. **1** is a photomicrograph of particles of an exemplary polymer blend material in accordance with the present invention;

[0022] FIGS. **2**A and **2**B are photomicrographs illustrating penetration of a polymer blend in accordance with the present invention into a fibrous substrate;

[0023] FIGS. **3**A and **3**B are photomicrographs illustrating a fibrous substrate following application of an exemplary polymer blend in accordance with the present invention; and

[0024] FIGS. **4**A, **4**B and **4**C are photomicrographs illustrating droplet wicking of a polymer blend of the present invention along a fiber surface.

DETAILED DESCRIPTION OF THE INVENTION

[0025] The present invention now will be described more fully hereinafter in the following detailed description of the invention, in which some, but not all embodiments of the invention are described. Indeed, this invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. As used in the specification, and in the appended claims, the singular forms "a", "an", and "the" include plural referents unless the context clearly dictates otherwise.

[0026] The polymer blends of the present invention can have desirable yet contradictory properties. The polymer blends can exhibit wet out properties that can be useful in various applications, yet surprisingly the inventor has also found that the polymer blends of the invention can also exhibit desirable blocking resistance (or anti-blocking) and durability properties as well. The ability to formulate the polymer blends of the invention to provide contradictory properties without significantly diminishing the same is surprising in view of the tradeoffs typical in polymer blending. That is, as will be recognized by the skilled artisan, the properties of a polymer blend typically are not simply a linear mixture of those of the constituent polymers, but rather the blend properties that result are often inferior to that of a linear prediction. For example, modifying the melt viscosity of a polymer used in the production of hot melt adhesives by blending with another polymer to reduce tackiness can negatively impact the desired flow of the resultant product and render is useless for its intended application. Conversely, blending a high melt strength polymer with another polymer to improve flow properties can similarly result in a product that no longer useful for its intended purpose.

[0027] The polymer blends of the invention can substantially wet out a surface at a given activating temperature without requiring the application of substantial pressure. Stated differently, the polymer blends of the invention are readily flowable under activating temperature conditions without requiring the concurrent application of pressure to promote or facilitate polymer flow. Yet, despite the ready flow or wetting properties of the polymer blends of the invention, in contrast to conventional flowable polymers, the polymer blends of the invention do not exhibit substantial blocking problems.

[0028] Reference herein to substantially "wetting out" a surface to which the polymer blend is applied will be readily understood by the skilled artisan and can be assessed using known techniques. In exemplary embodiments of the invention, the polymer blend can substantially wet out a surface to which is has been applied without requiring the application of substantial pressure in about one hour or less, and can be applied in as low as a few minutes (for example, less than or about two minutes) at a selected activating temperature, although the period for wetting a substrate surface can fall outside of this range as well. As will be appreciated by the skilled artisan, the term "wet-out" of a substrate surface generally refers to contact angles of less than about 90 degrees, or less than about 135 degrees, etc., which can be evaluated, for example, using microscopy techniques. Sometimes colorants are used in coating or binders to enhance the contrast. The contact angle of an exemplary polymer blend of the invention is illustrated, for example, in the droplet of FIG. **3**.

[0029] The flow activating temperature can vary depending on various factors but typically is a temperature ranging from about 100° C. to about 150° C., including flow activating temperatures of about 125° C., although polymer blends exhibiting substantial wetting properties at activating temperatures outside of this range can also be useful in accordance with the present invention. As will be appreciated by the skilled artisan, the term "activating temperature" as used herein refers to the temperature at which the polymer blend will flow (for example, the temperature at which the polymer blend in the form of a coating, fabric or other article as discussed herein will flow) and does not refer to the temperature of an oven, dye bath, etc. through which the article may be passing.

[0030] In one exemplary embodiment of the invention, the polymer blend can exhibit a flow activating temperature of about 100° C. Such systems can be designed to exhibit very high flow when the substrate to which the blend is applied, for example, passes through a low temperature drying oven (i.e. enough heat to drive off water), such as used with cotton or other natural fibers, or is exposed to high temperature water or steam. The low activating temperature can minimize discoloration (yellowing) that can occur with cotton. The blends can flow substantially in high temperature water conditions, such as that exhibited by many conventional dye baths and/or at temperatures used in fabric drying processes. The onset of softening can be well above 55° C. (131° F.) so that the flow transition can be sharp to avoid tackiness or blocking, for example, under hot summer conditions normally encountered in warehousing and transportation. Thus, despite the 100° C. activating temperature, advantageously in this embodiment of the invention, the resultant polymer blend is not tacky and does not block above about 55° C. This system can have the highest flow relative to the two exemplary systems described as follows and can be suitable for powdered delivery (for example via foam, spray, slurry, and the like) to a substrate such as a cotton fabric in applications for which flow under fabric drying conditions and/or high temperature water conditions is advantageous or required.

[0031] In another exemplary embodiment of the invention, the polymer blend can exhibit a flow activating temperature of about 125° C. Such systems can be substantially inert at boiling water temperatures yet can flow well in an autoclave, for example. Such systems can be suited for powdered delivery to a substrate, such as a cotton fabric, in applications for which stability in hot water, such as in washing, is advantageous or required.

[0032] In yet another exemplary embodiment of the invention, the polymer blend can have an activating temperature of about 150° C. Such systems can have higher melt strengths and accordingly can be more readily melt spun to form a fibrous article, such as a component of a multicomponent fiber or filament (for example, a sheath component of a bicomponent sheath core fiber). The resultant higher viscosity exhibited by the polymer blends in accordance with this embodiment of the invention can result in longer penetration times at temperatures of less than 150° C. (for

example about 125° C.), but viscosity can decrease at increasing temperatures, including temperatures approaching 150° C., and/or using finer dispersions of the solid binder and/or more penetrating radiant energy for faster heat-up. Such systems can be suited for delivery via bicomponent fibers introduced into a substrate, for example, by blending the bicomponent fibers with other fibers (natural fibers such as cotton fibers and/or other synthetic fibers).

[0033] The polymer blends can be applied to any suitable substrate, as discussed in more detail below. Suitable substrates can have substantially smooth surfaces or can include a plurality of voids or interstices (such as can be present along the surface of a fibrous substrate) into which the polymer blend can flow and substantially fill.

[0034] As used herein, the term "blocking" refers to the "stickiness" or "tackiness" polymer products can exhibit when exposed, either in the raw material state or after activation and resolidification, to elevated temperatures and/or other environmental conditions (such as humidity) during processing, storage, and/or transportation. Blocking can be particularly problematic in the storage and/or transportation of products formed of readily flowable polymers that are subjected to extremes in ambient temperature, humidity and other conditions that can result in undesired adhesion of the products to one another, or to other objects.

[0035] In contrast to many conventional flowable polymers, the polymer blends of the invention exhibit block resistant (or anti-blocking) properties, without requiring the addition of substantial amounts of anti-blocking agents. The polymer blends of the invention accordingly are not susceptible to developing a tacky or sticky feel when cooled from elevated temperatures such as those used in polymer processing or when packages or rolls are exposed to expected extremes of temperature, humidity and other environmental conditions to which a polymer product can be exposed during transportation and storage.

[0036] As will be appreciated by the skilled artisan, blocking can be evaluated using procedures known in the art. For example, pellets or powder can be layered several deep in an aluminum pan, which is then placed in a convection oven at a specified time for a specified temperature. The skilled artisan will appreciate what various test conditions, for example time, temperature, humidity, and the like, to employ in analyzing blocking properties, based on anticipated field use conditions that will be experienced. The pellets are then removed from the oven and cooled. If the pellets adhere to one another at all, they are judged to fail by "blocking." Weight may be applied and blocking may appear only at the bottom of a container. Long storage times and potential humidity effects may also increase actual blocking behavior.

[0037] The uniform polymer blends of the invention can include at least two, or more, different components, wherein at least two of the components include one or more polymers or other compounds that differ from one another with respect to the molecular weights of the same. The polymer blends can include at least a first blend component that includes at least one, or more, polymers having a first molecular weight and at least a second blend component that includes at least one, or more, compounds (which may or may not be polymeric in nature) having a second molecular weight that is less than the first molecular weight of the at least one polymer of the first blend component. The respective blend components can also be referred to as the higher molecular weight polymer component and the lower molecular weight component. In exemplary embodiments of the invention, the higher molecular weight blend component can include at lease one or more polymers having a molecular weight that is at least about three times, and up to about five times, or more, higher than the molecular weight of at least one or more compounds of the lower molecular weight blend component.

[0038] Although not wishing to be bound by any theory or explanation of the invention, it is currently believed that the blends take advantage of the fact that melt strength and melt viscosity follow different functions of polymer molecular weight distribution. The inventors have found combinations of high and low molecular materials that can exhibit high melt strength or elasticity as compared to the viscosity or resistance to flow also exhibited by the blend. The resultant blends can flow well yet can also be strong and can be spun into fibers.

[0039] The molecular weight of the one or more of the polymers of the higher molecular weight blend component can be selected to prevent the one or more polymers and/or the first blend component from substantially wetting out a surface without the application of substantial pressure under the same temperature conditions (flow activating temperature) under which the polymer blend will substantially wet out a surface, as discussed above. The higher molecular weight polymer(s) can have a molecular weight ranging from greater than about 6000 to about 50,000, and higher, number average molecular weight, for example, from about 18,000 to about 30,000 number average molecular weight, although polymers having a molecular weight outside of these ranges can also be useful in the present invention so long as the higher molecular weight polymer exhibits the wet out properties as discussed herein. The higher molecular weight polymer component can be useful in imparting desired melt strength to the polymer blends of the invention.

[0040] In various embodiments of the invention, the polymer(s) of the higher molecular weight blend component is selected to have a molecular weight that is sufficiently high to impart sufficient melt strength to the blend to permit processing the polymer blend, for example, to permit melt spinning, and quenching, the polymer blend to form a desired product such as a fiber or fibrous structure, including a component of a multicomponent fiber. As will be appreciated by the skilled artisan, melt strength is commonly measured by die-swell when a polymer is exuded from a capillary. The practical manifestation is that molten streams in a spin cabinet can be pulled without breaking, elongating to form individual fibers.

[0041] The molecular weight of the one or more compounds of the lower molecular weight component can be selected to be sufficiently low so that the one or more compounds and/or the second blend component exhibits a level of molecular mobility sufficiently high so as to limit its usefulness for the production of an article such as a fiber or fabric when processed alone and without combination with another component. The one or more compounds and/or the second blend component may, for example, exhibit too much molecular mobility so that its usefulness alone is limited because it may be susceptible to blocking, and/or because it may exhibit too much creep, and/or it may have inadequate melt strength to be processed. In various exemplary embodiments of the invention, the one or more compounds of the lower molecular weight blend component can

have a number average molecular weight of about 6000 or less, for example greater than 0 to about 6000 number average molecular weight, for example greater than about 500 to about 6000 number average molecular weight. Generally, the one or more compounds of the lower molecular weight blend component cannot be spun onto a package without blocking, using normal commercial fiber spinning operations.

[0042] As will also be appreciated by the skilled artisan, creep or cold flow of a polymer blend can be evaluated using an accelerated test as follows. Pellets are loaded into a capillary rheometer such is used for melt flow testing, and a specified weight is applied (e.g. the standard 2.16 kg). The temperature is then ramped up in gradual steps until the weighted piston begins to compress the pellets. The temperature at which this happens is noted. Cold flow can also be checked at ambient temperatures periodically, for example, for 30 days, 60 days, etc.

[0043] In addition to the relative molecular weights of the components of the blends of the invention, the blend components, and one or more of the constituent polymers and/or compounds thereof, can also differ with regard to melt flow rate (MFR), also as determined using conventional test standards, such as ASTM method D 1238B. In exemplary embodiments of the invention, the higher molecular weight polymer component, and/or one or more of its constituent polymer(s), can have a melt flow rate that is less than the melt flow rate of the lower molecular weight component, and/or one or more of its constituent compound(s). Stated differently, the lower molecular weight component (and/or one or more of its constituent polymers) of the polymer blend can have a relatively high MFR as compared to the MFR of the higher molecular weight polymer component (and/or one or more of its constituent compounds).

[0044] As non-limiting examples, in exemplary embodiments of the invention, the lower molecular weight component (and/or one or more of its constituent compounds) can have a melt flow rate that is at least about five times, and at least about ten times, or more, higher than the melt flow rate of the higher molecular weight polymer component (and/or one or more of its constituent polymers). In other embodiments of the invention, the higher molecular weight polymer component (and/or one or more of its constituent polymers) can have a melt flow rate of about 1 decigrams per minute at a temperature of about 125° C. as determined in accordance with ASTM method D 1238B, or less, and the lower molecular weight component (and/or one or more of its constituent compounds) can have a melt flow rate of about 100 decigrams per minute at a temperature of about 125° C. as determined in accordance with ASTM method D 1238B, or more, although the invention is not so limited and polymers having melt flow rates outside of these ranges can be useful in accordance with the present invention.

[0045] The components, and/or one or more of the constituent polymers and/or compounds thereof, of the blends of the invention can also differ from one another with regard to melting point, as determined using conventional test standards, such as differential scanning calorimetry (DSC). In exemplary embodiments of the invention, the higher molecular weight polymer component (and/or one or more of its constituent polymers) can have a melting point that is higher than the melting point of the lower molecular weight component (and/or one or more of its constituent compounds). Stated differently, the lower molecular weight component (and/or one or more of its constituent compounds) of the polymer blend can have a relatively low melting point as compared to the melting point of the higher molecular weight polymer component (and/or one or more of its constituent polymers). In exemplary embodiments of the invention, the higher molecular weight polymer component (and/or one or more of its constituent polymers) can have a melting point of at least about 10° C., for example, at least about 20° C., and for example at least about 50° C., or more, higher than the melting point of the lower molecular weight component (and/or one or more of its constituent compounds).

[0046] The melting point of the uniform polymer blend itself can also vary, depending on various factors. In exemplary embodiments of the invention, the melting point of the polymer blend can be within about 20° C. of the targeted blend application temperature (i.e., the activating temperature). The inventor has surprisingly found that the polymer blends exhibit the desired flow properties described herein despite the presence of the higher molecular weight component, which typically does not flow until exposed to an "activating" temperature of at least about 50° C. or more above its melting point. Suitable polymer components useful for providing a polymer blend with a melt temperature as described herein can include substantially crystalline polymers, as discussed in more detail below.

[0047] The molecular weight ranges of the blend components can vary depending on a particular application or use of the blend and can be readily determined by the skilled artisan. Various embodiments of the invention can include blends of similar portions of two materials with fairly extreme differences in flow (due to crystallinity and/or molecular weight) yet are compatible and provide synergistic properties in the blend. Such synergies can be exhibited by sufficient melt strength/viscosity for fiber formation and/or by a flow/tack sharp profile effect as discussed herein.

[0048] The polymer components of the polymer blends of the invention can include any of the types of polymers suitable for the formation of a particular article, i.e., can be any of the types of polymer resins known in the art capable of being formed into article such as fibrous materials (including without limitation fibers, filaments, yarns, nonwoven articles, and the like, as discussed herein), films (permeable and impermeable), foams, sheets, coatings, particulate materials, and the like, as well as combinations thereof. Examples of polymers useful in the practice of the present invention include without limitation polyolefins, including polypropylene, polyethylene, polybutene, and polymethyl pentene; polyamides, including nylon 6 and nylon 6,6; polyesters, including polyethylene terephthalate (PET), polyethylene naphthalate (PEN), polytrimethylene terephthalate (PTT), poly(1,4-cyclohexylene dimethylene terephthalate) (PCT), glycol-modified polyethylene terephthalate (PETG), and aliphatic polyesters such as polylactic acid (PLA); acrylics; thermoplastic elastomers; polyacrylonitrile; acetals; fluoropolymers; epoxies; phenoxies; vinyl alcohol polymers; polyesterimides; polyhydroxyl alkanoates (PHA); polysulfone; polyetheretherketone; cellulose acetate and rayons; polyurethanes; hot melt adhesives; and the like, as well as co- and ter-polymers and ionomers of these and other suitable polymers, and combinations thereof. Polyolefins can be particularly advantageous in various embodiments of the invention, although the invention is not limited

to use of polyolefins. Bio-based polymers which can be biodegradable made from PLA and PHA can also be useful in various embodiments.

[0049] Hot melt adhesives can also be useful in various embodiments of the invention. Hot melt adhesives are typically thermoplastic polymers that are solid at room temperature and liquid at elevated temperatures, for example, solid at temperatures below 180° F. and low viscosity fluids above 180° F. Hot melt adhesives set to a bond on cooling. Hot melt adhesives can include without limitation paraffins, waxes, polyolefins, polyvinyl acetate polyamides, ethylene vinyl acetate (EVA) copolymers, styrene-isoprene-styrene (SIS) copolymers; styrene-butadiene-styrene (SBS) copolymers; ethylene ethyl acrylate copolymers (EEA); polyurethane reactive (PUR), and the like, and combinations thereof.

[0050] Thermoplastic elastomers as known in the art can also be useful in various embodiments of the invention. Exemplary elastomers include without limitation polyurethane elastomeric materials; polyamide elastomeric materials; polyester elastomers; polyetherester elastomeric; polyetheramide elastomeric materials; polyolefin elastomers; elastomeric styrene block copolmyers, including diblock and triblock copolymers based on polystyrene (S) and unsaturated or fully hydrogenated rubber blocks, which can consist of butadiene (B), isoprene (I), or the hydrogenated version, ethylene-butylene (EB); and the like and combinations thereof.

[0051] Functionalized polymers can also be useful as one or more of the components of the blends of the invention. The functionality can be selected to provide a desired thermodynamic attractive force between the polymer blend and the target substrate to which the blend is applied, such as a natural fiber. This in turn can improve wet out of the polymer blend.

[0052] The polymers can be functionalized as known in the art to impart a desired property thereto, such as a functional group to improve wet out and/or adhesion properties of the polymer component and/or the resultant polymer blend. Exemplary functionally modified polymers useful in various embodiments of the invention can include, for example, various functionalized polyolefins, such as but not limited to olefins modified by reaction with at least one at least one unsaturated anhydride, unsaturated acid or unsaturated ester. As non-limiting example, functionalized polyolefins useful in the invention can include an olefin modified by reaction with at least one unsaturated anhydride, unsaturated acid or unsaturated ester selected from the group consisting of maleic anhydride, citraconic anhydride, itaconic anhydride, glutaconic anhydride, 2,3-dimethylmaleic anhydride, maleic acid, fumaric acid, citraconic acid, itaconic acid, mesaconic acid, glutaconic acid, acrylic acid, methacrylic acid, crotonic acid, 2-pentenoic acid, 2-methyl-2-pentenoic acid, dimethyl malcate, diethyl maleatc, di-n-propyl malcate, diisopropyl maleate, dimethyl fumarate, diethyl fumarate, di-n-propyl fumarate, di-isopropyl maleate, dimethyl itaconate, methyl acrylate, ethyl acrylate, methyl methacrylate, ethyl methacrylate, methyl crotonate, and ethyl crotonate. Polymer blends including one or more maleic anhydride modified olefins, including without limitation maleic anhydride modified polypropylene and maleic anhydride polyethylene, can be particularly useful in various applications. As will be appreciate by the skilled artisan, some of these functionalities can also be created by oxidizing an olefin, and other exemplary polymers include polymers functionalized by oxidizing the polymer, for example, by oxidizing a polyolefin.

[0053] Non-limiting examples of functionalized polymers useful in the present invention include maleated polyethylene commercially available from Dow Chemical and maleated waxes such as the Epolene waxes commercially available from Eastman Chemical Company. Also useful are polymeric or non-polymeric compounds having one or more carboxyl, hydroxyl, and/or amine functional groups. In this embodiment, the lower molecular weight component can include one or more substantially crystalline or semicrystalline functionalized compounds, which can also be lower molecular weight compounds that have a melting point that is higher than the T_g of at least one polymer of the higher molecular weight component of the blend. Although not wishing to be bound by any theory or explanation of the invention, it is currently believed that the increased functionality imparted to the blends by incorporating such functionalized polymers can increase wet-out and improve adhesion to cellulosics, cotton, and other natural fibers, as well as synthetic fibers spun from acrylic, nylon, and other polar polymers.

[0054] At least one or more of the components of the polymer blends of the invention can include a substantially crystalline or semicrystalline polymer. Various embodiments of the invention can include, for example, at least one or more substantially crystalline low molecular weight polymer component(s). The term "substantially crystalline or semicrystalline" is understood in the polymer art and as used herein refers to a material's inherent ability to crystallize when referring to material type, or alternatively its current state of crystallinity when referring to a particular product or object, as determined using conventional techniques as known in the art. Methods for determining the degree of crystallinity of a polymer are known in the art and include, for example, DSC, density gradient tubes, and x-ray diffraction techniques. Generally as used herein, the term crystalline or semicrystalline refers to materials having a melt peak on DSC with at least about 5 J/g of material, or more, for example, at least about 10 J/g material or more. As non-limiting examples, polyesters cay exhibit a melt peak on DSC of about 30 to about 50 J/g and olefins can exhibit a melt peak on DSC of up to about 100 J/g.

[0055] The addition of a substantially crystalline polymer component, including a low molecular weight substantially crystalline polymer component, can promote the flow of the polymer blend at low temperatures without blocking or fusing. The addition of one or more substantially crystalline low molecular weight polymers can, for example, result in a blend having a melting point within about 20° C. of the targeted blend application temperature (i.e., the activating temperature, which can be, for example, about 125° C. or less).

[0056] In exemplary embodiments of the invention, the low molecular weight component includes a substantially crystalline polymeric or non-polymeric component (also referred to herein as a substantially crystalline plasticizer). In this embodiment of the invention, the substantially crystalline low molecular weight component can have a melt point (T_m) that is higher than the glass transition temperature T_g of the higher molecular weight polymer component of the blend. Again, although not wishing to be bound by any explanation of the invention, it is currently believed that the

use of such materials in the blend can result in sharp flow profiles. The polymer blend of this embodiment of the invention can be in any of the various forms discussed herein, including fibers, nonwoven fabrics, coatings, and the like. An exemplary blend in accordance with this embodiment of the invention can include phenoxy having a T_g as the high molecular weight component and a substantially crystalline component (plasticizer) having a T_m that is higher than the T_g of the phenoxy component, and the like, including combinations thereof.

[0057] Each of the components can be present in the polymer blend of the invention in an amount sufficient to impart the desired wetting and blocking resistance properties thereto. In exemplary embodiments of the invention, the blend can include at least about 10 percent by weight of one, or both, of the higher molecular weight and the lower molecular weight components. For example, the polymer blends of the invention can include at least about 20 percent by weight, at least about 30 percent by weight, at least about 40 percent by weight, and at least about 45 percent by weight, based on the total weight of the polymer blend, of one or both of the higher and lower molecular weight components.

[0058] The skilled artisan will realize that the respective first and second components of the polymer blends of the invention can include at least one, or a blend or more than one, component thereof. For example, the first component of the polymer blend can include at least about 10 weight percent of one polymer or can include at least about 10 weight percent of a blend of two or more polymers, in accordance with the present invention (in which case, the first blend component can include less than 10 weight percent of a particular polymer of the polymer blend). Similarly, the second component of the polymer blend can include at least about 10 weight percent of one compound or can include at least about 10 weight percent of a blend of two or more such compounds (in which case, the second blend component can include less than 10 weight percent of a particular compound or component thereof). As used herein, the term "compound" in reference to the second blend component can include polymeric and non-polymeric compounds.

[0059] In embodiments including a blend of polymers as the first blend component, one or more of the polymers can meet one or more of the criteria of molecular weight, T_g, etc., as discussed herein. Similarly, in embodiments including a blend of compounds as the second blend component, one or more of the compounds can meet one or more of the criteria of molecular weight, T_m, etc., as discussed herein.

[0060] In other embodiments of the invention, the polymer blend can further include at least one additive, as discussed herein, in about a 1:1:1 ratio high molecular weight polymer component:low molecular weight component:additive, although as discussed herein additives when present can be present in amounts outside of this range.

[0061] The polymer components, and additives when present, can be present in amounts outside of these ranges as well. Surprisingly, however, the inventors have found that relatively high amounts (at least about 10 percent by weight, and more, up to 50 percent) of the low molecular weight component (which can have a melt flow rate in the thousands) can be included in the polymer blends of the invention without substantially decreasing the blocking resistance of the polymer blend and also without significantly decreasing the processability of the polymer blend. Similarly, the inventors have surprisingly found that the polymer blends can include relatively high amounts (at least about 10 percent by weight, and more) of the high molecular weight polymer component without significantly reducing the flow or wetting properties of the blend as described herein.

[0062] The polymer components can blended with one another using conventional mixing techniques. In exemplary embodiments, the polymer components can be dry blended with one another prior to melting the polymers in subsequent extrusion or other polymer processing steps. In other exemplary embodiments, separate polymer melts can be combined with one another, for example, as polymer melts pass through an extruder.

[0063] The polymer blends of the invention can further include at least one, or more, additives mixed or blended therewith. Such embodiments of the invention can be useful, for example, as additive delivery systems, as discussed in more detail herein. Exemplary additives useful in the present invention can include without limitation antimicrobials, biocides, flame retardants, toxic absorbers, conductive agents, abrasives, antioxidants, UV stabilizers, optically active compounds, tracers, plating catalysts, particulates, reinforcing agents, fillers, pigments, talc, glass fibers, clays, silicas, mineral silicates, mica, odor absorbers, nano-particles, chemical deactivators such as activated carbon, antistats, markers, counterfeit tracers, fluorescents, fungicides, mildewcides, phosphorescents, reflectants, "smart fabric" components, polytetrafluoroethylene (PTFE), repellants, ointments, and the like, and combinations thereof. The invention allows the ready application of a wide ranging amounts of additives and can be particularly useful in the application of very low amounts of additives. The invention can be useful for applying a very small amount of additive substantially uniformly to a substrate with durability. The resultant layer can in many instances be just a few microns thick as well so that the particle size of the additive can be very small. This can be useful in many applications in which the additive particles might otherwise be buried below the skin of a synthetic fiber.

[0064] For example, silver and/or copper based antimicrobials can be introduced into a suitable substrate in accordance with the present invention. Such antimicrobials can be particulate in nature to promote controlled release of the active agent yet typically must also be near the surface of a substrate (such as a fiber) to function. Typically, a relatively low amount of the antimicrobial agent can be effective. The present invention can allow the introduction of relatively small quantities of such antimicrobial agents into a suitable substrate, such as a surface of a fiber, for use in numerous applications, including without limitation health care products such as hospital sheets, gowns, draperies, and mattresses to help control secondary infections; and sports or athletic wear to help reduce odors from bacteria and mildew. More uniform distributions can be achieved by dispersion using such a vehicle when the additive level is low, such as but not limited to the 0.01 to 0.1% range.

[0065] Odor absorbing agents such as activated carbon can also be effectively introduced into a suitable substrate in accordance with the present invention. Similar to silver and copper antimicrobial agents, particulate odor absorbing agents can be more effective when held at the surface of the substrate (such as a fiber surface). The present invention can allow the introduction of effective amounts of odor absorb-

ing agents into a suitable substrate, such as a fiber surface, to help in protecting freshness in sportswear, among other applications.

[0066] Similarly, nano-particles and other additives useful, for example, in the deactivation of chemical agents can also be introduced into a suitable substrate in accordance with the present invention. The resultant products can be useful in military, industrial, and homeland security applications.

[0067] Flame retardant agents are another non-limiting example of the types of active agents that can be introduced to a suitable substrate in accordance with the present invention. For example, particles that expand when heated to flame temperatures could be used to bolster intumescent flame retardant systems and could be affixed to fabrics in accordance with the present invention. The flame retardant particles can also be a part of multicomponent flame retardant systems such as discussed in copending and commonly assigned U.S. application Ser. No. 11/369,252, filed Mar. 7, 2006, the entire disclosure of which is hereby incorporated by reference. Non-limiting examples of flame retardant additives suitable for use in accordance with the present invention include, for example, melamine cyanurate, boric acid and boron containing salts, halogens, antimony compounds, ammonium polyphosphate, melamine polyphosphate, phosphorous compounds, hydrates such as aluminum trihydrate, expanded graphite, char-inducing catalysts, and the like and combinations thereof.

[0068] As yet another non-limiting example, taggant or tracer additives can be adhered to a suitable substrate in accordance with the present invention. Such taggant or tracers for fabric, paper and other products can be useful, for example, to audit the source of fabrics, to help control counterfeiting, and the like. In other non-limiting examples, many optical markers such as fluorescent or phosphorescent agents typically function at relatively high concentrations. Using the present invention, such agents can be made visible at lower concentrations by the increased efficiencies of concentrating the agents into localized regions of a suitable substrate where they are delivered by a polymer blend of the invention.

[0069] The present invention is not limited to these applications. The formulated systems of the invention can have the additional benefit of having inherently low color. This mask surface imperfections of a substrate to which the polymer blend is applied, such as that on a natural fiber, which in turn can reduce dullness and create a "wetter," silkier look.

[0070] These and other additive(s) can be incorporated into the polymer blends of the present invention using conventional techniques. The additive(s) can independently blended with one or more of the polymer components and/or can be added to the polymer blend. In exemplary embodiments, the additive(s) can be dry blended with one or more of the polymer components of, and/or with the polymer blend itself, prior to melting the polymer components and/or the resultant polymer blend in subsequent extrusion or other polymer processing steps. The additive(s) can also be added to melts of the polymer components and/or of the polymer blend, for example, as the polymer component and/or polymer blend melt(s) pass through an extruder. A masterbatch of one or more polymer components and/or the polymer blend of the invention and the additive(s) can also be prepared and added to the polymer components and/or polymer blend in dry or melt form. The additive(s) can be used in the invention in various forms, including powder, liquid and melt forms, as appropriate for a given application.

[0071] Other aspects of the invention include polymeric bonding systems and polymeric additive delivery systems that include the polymer blends of the invention as a component thereof, as well as methods of using the same. In these and other aspects of the invention, the polymer blends can be provided in any form useful for a particular end application, including without limitation, in the form of a fibrous material, film (including co-extruded films, permeable films, impermeable films), foam, sheet, coating, a particulate material, and the like, and combinations thereof.

[0072] The polymer blends of the invention can be particularly useful as additive delivery systems to impart additive functionality to a substrate, including cotton and other natural fibers. The polymer blends can be suited for uniformly dispersing and binding particulate additives to a substrate, durably anchoring the additive to the substrate, for example via a thin flexible coating, to optimize placement and maximize performance. As noted herein, the polymer compositions of the invention can have sharp flow profiles with improved flow at lower temperatures for bonding. Yet the polymer blends are not tacky or prone to block at normal extremes of temperature exposure during transporting and warehousing. The polymer blends can be used to deliver discontinuous deposits (for example small islands) or a substantially continuous yet breathable network that coats and bridges the surface layer of the substrate (such as the surface of fibers) in a construction. In addition, the polymer blend additive systems can exhibit the permanence of a thermoplastic but can be applied to a substrate at very low levels with good penetration and dispersion.

[0073] As used herein, the term "fibrous material" includes fibrous articles such as but not limited to staple fibers, continuous filaments, yarns, tows, fiber bundles, bulked continuous filament (BCF), staple fiber spun yarns, twisted yarns (i.e., 2 or more yarns twisted together), wrapped yarns, sewing thread, meltblown fibers, spunbonded filaments, nowoven fabrics, woven fabrics, knit fabrics, and the like, as well as combinations thereof. In general, staple, multifilament, and spunbond fibers in accordance with the present invention can have an equivalent diameter of about 0.5 to about 100 denier. Meltblown filaments can have a diameter of about 1 to about 5 microns. The fibers can also be monofilaments, which can have a fineness ranging from about 20 to about 5,000 denier.

[0074] For ease of discussion, the term "fiber" as used herein can refer both to fibers of finite length, such as conventional staple fiber, as well as substantially continuous fibrous structures, such as continuous filaments, unless otherwise indicated. The term fiber as used herein can also include crimped, uncrimped, and textured fibers and filaments, including bulked continuous filaments (BCF) and filament tows as well. The fibers of the invention can be hollow or non-hollow fibers, and further can have a substantially round or circular cross-section or non-circular cross-section (for example, "shaped fibers" or fibers with shaped cross-sections, such as but not limited to oval fibers, rectangular fibers, multi-lobed or lobal fibers, delta cross-sections, and the like).

[0075] When the polymer blends of the invention are in the form of a fiber, the fibers can be monocomponent fibers or multicomponent fibers, in which at least one, or more,

components thereof includes the polymer blend of the invention. At least one or more components can be dissolvable. The multicomponent fibers can have a variety of fiber configurations as known in the art so long as the fiber components are arranged so as to form distinct cross-sectional segments along at least a portion of the length of the fiber. The multicomponent fibers can include substantially non-occluded segments, such as those present in pie/wedge fibers, side-by-side fibers, segmented round fibers, segmented oval fibers, segmented rectangular fibers, segmented multilobal fibers, and the like. The present invention is not limited to non-occluded fiber constructions, and accordingly other fiber configurations are included within the scope of the present invention, including those in which at least a portion of a one fiber segment is partially or fully occluded by an adjacent segment, such as found in islands in the sea fiber constructions, sheath core fibers, and the like. The multicomponent fibers of the invention further can be splittable, i.e., capable of separating into microfilaments upon appropriate chemical and/or mechanical action. Alternatively, the multicomponent fibers of the invention can be substantially nondissociable.

[0076] Nonwoven fabrics useful as the fibrous materials of the invention can be made according to any of the known commercial processes for making nonwoven fabrics, including processes that use mechanical, electrical, pneumatic, or hydrodynamic means for forming or assembling fibers into a web, for example carding, wetlaying, air laying, spunbonding, meltblowing, and the like. The webs can be bonded using techniques as known in the art, such as but not limited to mechanical bonding, such as hydroentanglement and needle punching, adhesive bonding, thermal bonding, and the like, to form a coherent and useful fabric structure. An example of thermal bonding is through-air bonding, although other thermal bonding techniques, such as calendering, microwave or other RF treatments can be used. Other textile structures such as but not limited to woven and knit fabrics and tufted carpets and yarns prepared for use in forming such woven and knit fabrics and tufted carpets are similarly included within the scope of the present invention. Nonwoven-containing articles similarly include but are not limited to hygiene, safety masks, filter media, footwear components and furniture backing. In tufted carpets, the coatings of the invention can be useful in applying antimicrobials and other consumer pleasing functionalities, as well as improving tip definition and wear properties.

[0077] As used herein, the term "particulate materials" can include a plurality of particles formed of the polymer blends of the invention. Exemplary embodiments of the invention include polymer blends in the form of finely reduced powders having average diameter of less than about one millimeter (mm), and finely divided powder having an average diameter of less than about 200 microns, for example from about 20 to about 200 microns, although the present invention is not so limited and particulate material having an average diameter outside of these ranges can also be useful in the present invention.

[0078] The polymeric additive delivery systems of the invention can further include one or more additives as a component thereof, as described herein. The additives can be substantially uniformly mixed with the polymer blend so that the additive is substantially uniformly distributed throughout the delivery system (for example, substantially uniformly distributed throughout a staple fiber formed of an admixture of the polymer blend and one or more additives). Alternatively, the additive can be substantially non-uniformly distributed in the additive delivery system. As a non-limiting example of this embodiment of the polymeric delivery systems of the invention, the additive can be present along a surface of a fiber formed of the polymer blend, which can result from "blooming" of the additive to the article surface under suitable conditions.

[0079] In this aspect of the invention, additives can be delivered within a matrix, such as a fibrous system, even if the polymer blend is not present in sufficient quantity to significantly bond the matrix fibers together. In this manner, the present invention can provide a mechanism for introducing an additive into a matrix material by activating the blend and allowing the polymer blend spread out and coat the matrix materials. The relatively low flow temperature of the polymer blends of the invention may provide the additional advantage of allowing the use of temperature-sensitive additives that might not survive incorporation into higher melt temperature synthetic fibers.

[0080] The polymeric bonding systems and polymeric additive delivery systems in accordance with these aspects of the invention can be useful in the production of various products, including without limitation, fibrous articles, laminates, composites, and the like, as well as combinations thereof. The articles of the invention including the polymer blend as a component thereof can be generally described as including a matrix material and the polymer blend, per se or in the form of a polymeric bonding system, polymeric additive delivery system, or the like, as described herein.

[0081] As used herein, the term "matrix material" refers generally to the material to which the polymer blend is applied or blended with to achieve bonding, additive delivery or other functional aspects of the present invention. In various exemplary embodiments of this aspect of the invention, articles including the polymer blends of the invention can be referred to generally as "composite articles" to indicate that the articles include a combination of two or more materials, including the polymer blend of the invention and another material (i.e., the matrix material as defined herein), that differ in form or composition. The constituent components of the composite articles of the invention may, but are not required to, retain their identities, be physically identified and exhibit an interface between one another.

[0082] Non-limiting examples of the types of matrix materials that may be useful in the production of the articles of the invention include fibrous materials (including synthetic fibers and natural fibers, such as plant fibers and animal fibers), cellulosic materials, laminates, composites, polymeric resins, foams, and the like, as well as combinations thereof. The matrix materials can have different functions, including support, reinforcement, filler, binder, and the like, as well as combinations of these functions.

[0083] Exemplary fibrous materials useful as matrix materials of the composite articles of the invention include any of the types of fibrous materials described herein. As an example, the polymer blend (for example in the form of staple fibers or particulate material, optionally in combination with an additive) can be applied to and/or intermixed with a plurality of staple fibers formed of a different polymer composition to form a nonwoven web. The staple fibers can include synthetic and/or man-made fibers, natural fibers, and/or blends of the same. Exemplary synthetic fibers include without limitation acrylic fibers, polyolefin fibers,

polyester fibers, polyamide fibers, and the like, as well as blends thereof with one another and/or with natural fibers. Exemplary natural fibers include without limitation cotton fibers, wool fibers, and the like, as well as blends thereof with one another and/or with synthetic fibers. Fibrous materials can be utilized separately, further incorporated into multilayer constructions such as laminates or composites, or be used as coating substrates within the scope of the invention.

[0084] In this embodiment of this aspect of the invention, the resultant web can be subjected to activation temperature conditions sufficient to promote substantially wetting of the staple fibers or particulate material formed of the polymer blend of the invention within the web sufficient to bond the staple fibers to form a substantially coherent structure and/or to distribute an additive within the fabric structure. The present invention can provide an advantageous mechanism for delivery of an additive, such as an antimicrobial agent, to a fibrous structure, such as a web including a plurality of cotton fibers.

[0085] As a non-limiting example, a fiber containing the polymer blend of the invention in which are imbedded antimicrobial particles (such as silver or copper compounds) is blended with cotton fibers, for example, during a carding process. The resultant mixture can be heat treated under conditions sufficient to activate the polymer to wet out and coat the cotton fibers and thus deliver the antimicrobial agent within the cotton article to provide a cotton article with antimicrobial properties. The high flow of the polymer blend can allow the use of a relatively small amount of synthetic fiber to treat a larger volume of cotton. The relatively low activation temperature of the polymer blends can further advantageously minimize discoloration that can occur when heat treating cotton fibers at relatively high temperatures.

[0086] The polymeric bonding systems and/or polymeric additive delivery systems of the invention can also be useful in the production of other fibrous articles, including products requiring relatively deep penetration of an adhesive into the article, such as may be the case for many tuft-locks on carpet, scatter rugs, automotive flooring, and the like. The polymeric bonding systems and/or polymeric additive delivery systems of the invention can also be useful in various hot melt applications, such as anti-slip coatings on carpets and other flooring materials, which can benefit from improved flow and sharper flow profiles (and thus faster operation in industrial application) as compared to traditional hot melt adhesives. In still other applications, the polymeric bonding systems and/or polymeric additive delivery systems can be useful as coatings for yarns and other fibrous materials to reduce hairiness, pilling, minimize yarn pullout, increase strength, and to improve abrasion resistance.

[0087] The polymeric bonding systems and/or polymeric additive delivery systems of the invention can also be useful in the production of other fibrous articles such as chenille yarns, felt, other wrapped yarns, and the like. In these types of products, the adhesive delivery system must bond fibers many fiber diameters removed from where the binder is applied, and accordingly flow characteristics can be increasingly important for the performance of the end product. The present invention can provide such bonding and further can improve carpet yarn timp definition and wear aesthetics. For example, in the manufacture of chenille yarn, typically twisted pairs of a core yarn hold in place bundles of "effect" yarn at an angle substantially perpendicular to the core yarn. A binder applied via the core yarn advantageously has enough flow to penetrate to a depth of dozens of fiber diameters, yet stop short of wicking out the length of the effect yarn and so causing it to stiffen. In one embodiment of the invention, the polymer blends of the invention can be incorporated as a part of one or more core yarns. The polymer blend may be incorporated into the core yarn using any suitable techniques, such as blending fiber formed of the polymer blend with the core yarn, coating the core yarn with the polymer blend, and/or incorporating the polymer blend as a component in a multicomponent core fiber.

[0088] As another non-limiting example, the matrix materials can include any of the types of cellulosic materials known in the art, such as but not limited to wood particles, wood fibers, fluff pulp (such as can be used in disposable absorbent articles such as diapers), cellulose acetate fibers, cotton, flax, and the like and mixtures thereof, and can be useful in the production of paper products, including wipes. In this embodiment of this aspect of the invention, the polymer blend (for example in the form of staple fibers or particulate material, optionally in combination with an additive) can be applied to and/or intermixed with a plurality of wood fibers or particles and the resultant mixture can be subjected to activation temperature conditions sufficient to promote substantially wetting of the staple fibers or particulates formed of the polymer blend of the invention within the article sufficient to bond the wood fibers or wood particles to form a substantially coherent structure and/or to distribute an additive within the coherent structure. In exemplary embodiments, the length scale of bonding may be limited to that area around neighboring fibers and the flow requirement may be low. The present invention can be helpful in such application to control the bonding temperature to a desired processing target, and insure good wet-out and bonding. The present invention can also be useful for incorporating and/or delivering various additives, including additives capable of improving insect resistance and/or mildew resistance.

[0089] As yet another non-limiting example, the invention can include an additive delivery system including a water soluble additive, such as but not limited to a water soluble flame retardant. The polymer additive system of this embodiment of the invention can further include a polymer blend of the invention, which can be in any suitable form, for example, as a plurality of fine particles. The additive delivery system in accordance with this embodiment of the invention can be useful in emulsion type coatings, such as acrylic coatings. As a non-limiting example, the additive delivery system can be a waterborne coating system including include a water soluble additive, such as a water soluble flame retardant, encapsulated in a plurality of emulsified particles formed of the polymer blend of the invention. In various embodiments including a water soluble flame retardant additive, the additive delivery system may not see melt conditions until exposed to flame conditions (as contrasted to the manufacturing process), and the additive can thus be dispersed when an article on which the coating is applied is exposed to flame conditions and burns. Otherwise, the additive may still be "locked up" in the particles embedded in the coating. The invention can also be useful as a part of a A-B type dual layer coating (base and top coating) or A-B film system, in which A includes at least one flame retardant component and B includes another flame retardant component.

[0090] The blend of the invention can be present in the composite articles in varying amounts, depending upon various factors, such as the application of the resultant product, desired degree of bonding, aesthetics, and the like and can be readily determined by the skilled artisan. Generally, the polymer blend in the form of fibers, particulates, etc. can be present in the composite article in an amount ranging from about 1 to about 25 percent by weight, although the polymer blend can be present in amounts outside of this range as well.

[0091] In these and other embodiments of this aspect of the invention, the blend in the form of staple fibers, particulate material, and the like, can be applied to and/or mixed with a desired matrix material, and the resultant mixture can be subjected to a suitable activation temperature to activate wet out of the binder fibers and/or particulate materials. Although the polymer bonding system of the invention has been described herein with reference to staple fibers and particulate materials, the present invention is not so limited, and as indicated herein, the polymer bonding systems can also be in other forms such as a coating (for example one or more extrusion coated layers) applied to an article to bonded, as a film, sheet material, and the like.

[0092] Yet another aspect, the present invention includes activatable yarns. In this aspect of the invention, yarns formed of a suitable polymer, typically with limited reactivity such as many polyolefins and polyesters, can include a functionalized additive, typically having a lower molecular weight that the polymer of the yarn. The polymer and functionalized additive of the activatable yarns can each be present in the yarn in amounts of at least about 10 percent by weight, at least about 20 percent by weight, at least about 30 percent by weight, at least about 40 percent by weight, and up to at least about 50 percent by weight, and higher, based on the total weight of the yarn. The yarn can further include other additives such as those discussed herein in amounts also as discussed herein.

[0093] The functionalized additive can act as an "activating agent" to promote adhesion of the yarn and can be selected based at least in part upon the nature of an adhesive to be used with the yarn. The functionalized additive can be incorporated into the polyolefin or polyester yarn using any suitable technique, such as blending fiber formed of the functionalized additive with the yarn, coating the yarn with the functionalized additive, and/or incorporating the functionalized additive as a component in a multicomponent fiber. The functionalized additive can be incorporated into other synthetic polymers, such polyamides and modified celluloses.

[0094] A non-limiting example of an activatable yarn in accordance with this aspect of the invention includes a polyolefin or a polyester yarn having a maleic anhydride modified polyolefin incorporated therein. Activation of the maleic anhydride modified polyolefin can promote bonding of the polyolefin and/or polyester yarn using a nylon-based adhesive. Another non-limiting example of an activatable yarn in accordance with this aspect of the invention includes a polyolefin or polyester yarn having an amine functionalized additive, such as stearamide, incorporated therein as the functionalizing additive. Activation of the stearamide can promote bonding of the yarn using an acid functional binder.

[0095] The present invention will be further illustrated by the following non-limiting examples.

COMPARATIVE EXAMPLE

[0096] Several samples of ethylene methacrylate (EMAC) adhesive polymers having different molecular weights are evaluated to try to develop improved flow for better wet-out. The materials are tacky and block badly, even at molecular weights that still are not low enough to flow at a significantly reduced temperature.

COMPARATIVE EXAMPLE

[0097] A maleated polypropylene wax such as that commercially available from Eastman Chemical as Epolene E-43 is blended in amount of 5 to 10% into a polyethylene or polypropylene resin. This material can be spun, the maleic acid functionality can provide adhesive properties, and the blend can provide a binder for applications requiring little flow. The bulk and rheological properties of the blend, however, remain that of the dominant polymer.

COMPARATIVE EXAMPLE

[0098] A high molecular weight maleated polyethylene such as that commercially available from Eastman Chemical as Epolene G-2608 is blended in approximately equal amounts with a common polyethylene resin. This material retains the strength and flow characteristics of its constituents, i.e., they fall within the range of what can normally be found with differing grades of polyethylene. With these blends, the formulator achieves intermediate levels of acid functionality sufficient for bonding other polar fibers while reducing cost. Nonetheless, high temperatures (>180° C.) and/or pressures (calendering) are still required for bonding to take place.

EXAMPLE 1 (INVENTION)

[0099] 45% of a high molecular weight maleated polyethylene (such as that commercially available from Eastman Chemical as Epolene G-2608) is blended with 55% of a common paraffin (such as that commercially available as IGI 1230). The resulting blend exhibits sufficient melt strength for fiber spinning and further bonds (without pressure) to acrylic at 120° C., which is a 60° C. drop from the temperature required of G-2608 alone. The mixture does not exhibit blocking on the package even when held at temperatures above the melting point of the paraffin.

EXAMPLE 2 (INVENTION)

[0100] 50% of a maleated polypropylene wax (such as Eastman's Epolene C-18) is blended with 50% of a common paraffin (IGI 1230). This material is coated onto acrylic yarn and incorporated into chenille yarn. The blend bonds in boiling water baths typical of dying processes, yet does not exhibit blocking problems upon shipping. Improved wear resistance of the chenille is achieved at normal use temperatures in such applications as automotive upholstery. This example exemplifies a "100° C. flow system" as discussed herein and is illustrated in FIGS. **1**, **3**A-B and **4**A-C. In this example, the paraffin component alone exhibits blocking and no functionality for wet-out. The Epolene wax exhibits too high a melting point to flow at the desired temperatures. The blend can be useful as a coating onto a yarn and as a

core of a chenille yarn. The blend can penetrate readily into an effect yarn (such as an acrylic or cotton effect yarn) at about 100° C. (a temperature sufficient to drive off water) and can bind it in place for improved wear resistance. When an additive is blended in the polymer blend, the blend can be reduced to a powder. The powder can be sprinkled onto cotton and made to flow at about 100° C., creating an extremely thin coating over the cotton and binding the additive to the cotton.

EXAMPLE 3 (INVENTION)

[0101] A low molecular weight maleated polyethylene or polypropylene wax, such as those commercially available from Eastman Chemical under the trade name Epolene, is blended with a high molecular weight polyethylene or modified polypropylene to gives results similar to that exhibited by the blend of Example 2. The blend exhibits high flow yet good fiber-forming properties at remarkably low temperatures, and at the same time good integrity in uncontrolled storage conditions. This example exemplifies a "150° C. flow system" as discussed herein and is illustrated in FIGS. **2**A and **2**B. In this example, the polyethylene alone exhibits poor flow at this temperature and no functionality. The Epolene wax has too low a viscosity/melt strength to be spun into fibers. The blend may be useful spun as the sheath of a bicomponent filaments yarn and the yarn can be used as the core of a chenille yarn, When heated in an autoclave, the bonder can readily penetrate into the effect yarn and hold it in place for improved wear resistance.

EXAMPLE 4 (INVENTION)

[0102] A binder/additive delivery system of the invention can be provided for delivery of a hard-coat to a sheet product, such as polyester glazing. Suitable additives useful in this application include without limitation rigid flake products, such as glass flake, mica, and the like, and mixtures thereof. Mica flake can be more economically feasible than glass and further its functionality can contribute to good wet-out. In this example, a 1:1:1 mixture of paraffin, maleated polypropylene (PP) wax, and mica flake is prepared and applied to a sheet product, for example by sprinkling, spraying, foaming or other suitable techniques. A mild heat-treatment (steam or hot air gun) allows the blend to uniformly cover the surface of the product, wet out for optical clarity, and present the hard mica flake for wear and abrasion resistance. Abraded surfaces can be repaired/reflowed by additional heat-treatment, with or without the addition of more of the mixture. To improve adhesion, the glazing can have polar functionality to react with the acid in the wax. This can be accomplished, for example in the case of polyester glazing, by incorporating a tie layer of a bonding material such as a phenoxy resin, or by including an additive in the polyester itself, again such as phenoxy.

EXAMPLE 5 (INVENTION)

[0103] Phenoxy polymer (MW about 20,000) is an amorphous polymer used as a binder in composite automotive structures such as headliners. The Tg is about 90° C. and is important to preventing creep at elevated temperatures of an automotive interior. The high molecular weight limits its ability to flow and wet out a fibrous mat. The lack of crystallinity makes it difficult to spin into a fiber form, since it does not strain-harden.

[0104] When blended with pentaerythritol tetrabenzoate (PETB, sold as Uniplex 552 by Unitex Chemical Co.), non-polymeric MW=552, Tm=104° C. at 10-25%, the phenoxy blend flows much more readily when molded in a headliner, giving superior wet-out. PETB is an example of a substantially crystalline plasticizer, which in the invention as discussed herein has a Tm that is greater than the Tg of the phenoxy. The improved flowability also allows spinning into a fiber form, either as a filament yarn or as a non-woven, in part because the melt now increases in modulus more when oriented (much like solution spinning). Normally one would expect that such a plasticizer reduces Tg, which it does by as much as 25° C. However, because the PETB has a crystalline melt point higher than the Tg of the phenoxy, the mixture in fact shows a cold-flow point higher than the Tg of the unmodified phenoxy. Thus it continues to be useful as a binder in elevated temperature environments, does not creep excessively or become tacky as might be predicted by the Tg.

[0105] Example 1 of the invention above is similar to Example 5 in principle. The high molecular weight maleated polyethylene is a desirable binder, yet will not flow well at temperatures cotton will survive without discoloring. Adding (crystalline) paraffin improves flow without making the blend tacky.

EXAMPLE 6 (INVENTION)

[0106] Polypropylene is spun into synthetic fibers using a low level of polar functional additive, which comes to the surface. The polar functional additive can be, for example, an ionomer, PVOH, or the like. The maleic acid functional binders then wet the polypropylene fiber spontaneously, where previously polypropylene fiber is difficult to adhere to.

[0107] Various exemplary polymer blends of the invention are prepared and applied to a fibrous substrate to evaluate the flow properties thereof. FIGS. **1**-**4** are photomicrographs illustrating various behavior characteristics of exemplary polymer blends of the invention.

[0108] FIG. **1** is a photomicrograph of particles formed of an exemplary polymer blend of the invention, which blend can have an activating temperature of about 100° C. (a"100° C. Flow" system). The photomicrograph illustrates that the polymer blend material can be friable and treated to form a characteristic grain size under suitable conditions. The material of FIG. **1**, for example, includes particles of about 50 microns (2 mils) and larger particles show sharp features and internal cracking with this same length scale. This indicates that the polymer blend materials of the invention, such as the illustrated 100° C. flow material, can be reduced to a substantially stable powder, including 50 um powder, using suitable treatments as known in the art.

[0109] FIGS. **2**A and **2**B are photomicrographs illustrating the ability of exemplary high flow temperature blends of the invention to suitably penetrate a fibrous substrate, for example, the strong thermodynamic drive for the polymer blend (binder) of the invention to penetrate a cotton fabric. In particular, FIGS. **2**A and **2**B are micrographs of a "150° C. Flow" system applied to a cotton substrate. FIG. **2**A is a photomicrograph of the back of a cotton fabric to which a polymer blend having an activating temperature of about 150° C. is applied after 11 minutes at 125° C., and FIG. **2**B is a photomicrograph of a cotton fabric to which a polymer blend having an activating temperature of about 150° C. is

applied after 50 minutes at 150° C. In this example, even an unreduced (3 mm) pellet of a polymer blend having an activating temperature of about 150° C. can flow into a cotton fabric. The photomicrographs demonstrate that after just 11 minutes at 125° C., the pellets have become droplets and wet through to the back of the fabric. With higher heat and longer exposure, the droplets can be absorbed completely. In contrast, the polymer blend system of FIG. **1** (the "100° C. Flow" system) would be expected to look like the micrograph of FIG. **2**B substantially as soon as it was brought to temperature. A finer dispersion of powder would be expected to provide thin, uniform coverage.

[0110] FIGS. **3**A and **3**B are photomicrographs illustrating the loading of roughly ground pellets formed of an exemplary polymer blend of the invention having an activating temperature of about 100° C. on a cotton fabric. The inserted text gives dimensions of the largest droplets. Good contact angles are observed yet large droplets approximating the original size range of the polymer blend particles as applied to the substrate remain. Far less mass was found under the microscope, however, than was added, a phenomenon clarified in FIGS. **4**A-C, discussed below.

[0111] FIGS. **4**A, **4**B and **4**C are higher resolution photomicrographs of the polymer blend of the invention of FIGS. **3**A and B as applied to a cotton substrate and demonstrate polymer droplet wicking (rather than elongating) down a fiber surface to form thin flexible coating layers. Following fiber saturation in a given area of the fabric, wicking ceases and the droplets seen in FIGS. **3**A and B remain at a stable size. However, if the fabric is compressed and unsaturated fibers come in contact with the droplets (or saturated fibers) during heat exposure, the flow will continue until the droplet reservoir is depleted.

[0112] The photomicrographs generally illustrate various behaviors of exemplary polymer blends in accordance with the present invention that make such systems useful vehicles for additive delivery. As non-limiting examples, pellets of the polymer blends can be reduced down to at least 50 micron particle size, with smaller additive particles suspended in them. The polymer blends can be dispersed onto the surface of a fabric by simple slurry or foaming methods. Once heated to activation temperature, the polymer blends can melt and flow along the fabric surfaces and through the fabric interstices, thereby forming thin layers on the surface of the fibers, and carrying the additive particles with them. These particles can thereafter be thinly encapsulated and well adhered to the natural fiber matrix.

[0113] Many modifications and other embodiments of the invention will come to mind to one skilled in the art to which this invention pertains having the benefit of the teachings presented in the foregoing descriptions. Therefore, it is to be understood that the invention is not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being defined in the claims.

That which is claimed is:

1. A polymer blend capable of substantially wetting out a surface at a flow activating temperature without requiring the application of substantial pressure, said polymer blend further having blocking resistance properties, said polymer blend comprising: at least about 10 percent by weight, based on the total weight of the polymer blend, of a first blend component comprising at least one polymer having a first molecular weight; and at least about 10 percent by weight, based on the total weight of the polymer blend, of a second blend component comprising at least one compound having a second molecular weight that is less than the first molecular weight of the at least one polymer of the first blend component, wherein the first molecular weight of the at least one polymer of said first blend component is sufficiently high to prevent the substantial wet out without the application of substantial pressure of the at least one polymer of the first blend component at said activating temperature, and wherein the second molecular weight of the at least one compound of said second blend component is sufficiently low so that the at least one compound of the second blend component exhibits sufficiently high molecular mobility to substantially prevent processing of the at least one compound of the second blend component alone.

2. The polymer blend of claim **1**, wherein said blend comprises at least about 20 percent by weight of the first blend component.

3. The polymer blend of claim **2**, wherein said blend comprises at least about 30 percent by weight of the first blend component.

4. The polymer blend of claim **1**, wherein said blend comprises at least about 20 percent by weight of the second blend component.

5. The polymer blend of claim **4**, wherein said blend comprises at least about 30 percent by weight of the second blend component.

6. The polymer blend of claim **1**, wherein the polymer blend substantially wets out a surface without requiring the application of substantial pressure in about one hour or less at said activating temperature.

7. The polymer blend of claim **6**, wherein the polymer blend substantially wets out a surface without requiring the application of substantial pressure in about two minutes or less at said activating temperature.

8. The polymer blend of claim **6**, wherein said activating temperature comprises a temperature of about 150° C. or less.

9. The polymer blend of claim **8**, wherein said activating temperature is comprises a temperature ranging from about 100° C. to about 150° C.

10. The polymer blend of claim **8**, wherein said activating temperature is comprises a temperature of about 100° C.

11. The polymer blend of claim **8**, wherein said activating temperature is comprises a temperature of about 125° C.

12. The polymer blend of claim **6**, wherein said activating temperature is comprises a temperature of about 150° C. or higher.

13. The polymer blend of claim **1**, wherein the first blend component comprises at least one polymer having a molecular weight at least about three times higher than the molecular weight of the at least one compound of the second blend component.

14. The polymer blend of claim **13**, wherein the first blend component comprises at least one polymer having a molecular weight at least about five times higher than the molecular weight of the at least one compound of the second blend component.

15. The polymer blend of claim **1**, wherein the second component comprises at least one compound having a number average molecular weight of about 6000 or less.

16. The polymer blend of claim **1**, wherein the first blend component comprises at least one polymer having a first melt flow rate and the second blend component comprises at least one compound having a second melt flow rate that is greater than the melt flow rate of the at least one polymer of the first blend component.

17. The polymer blend of claim **16**, wherein the second blend component comprises at least one compound having a melt flow rate of at least about five times greater than the melt flow rate of the at least one polymer of the first blend component.

18. The polymer blend of claim **17**, wherein the second blend component comprises at least one compound having a melt flow rate of at least about ten times greater than the melt flow rate of the at least one polymer of the first blend component.

19. The polymer blend of claim **18**, wherein the first blend component comprises at least one polymer having a melt flow rate of about 1 or less and the second blend component comprises at least one compound having a melt flow rate of about 100 or more.

20. The polymer blend of claim **1**, wherein said polymer blend comprises at least one polymer selected from the group consisting of polyolefins, polyesters, acrylics, polyamides, elastomeric polymers, polyacrylonitrile, acetals, fluoropolymers, epoxies, phenoxies, vinyl alcohol polymers, polyesterimides, polyhydroxyl alkanoates (PHA), polysulfone, polyetheretherketone, cellulose acetate, rayons, biopolymers, polyurethanes, hot melt adhesives, and copolymers, terpolymers and ionomers thereof, and combinations thereof.

21. The polymer blend of claim **20**, wherein said polymer blend comprises at least one elastomeric polymer.

22. The polymer blend of claim **1**, wherein the second blend component comprises a substantially crystalline or semicrystalline polymer.

23. The polymer blend of claim **22**, wherein the first blend component comprises at least one polymer having a glass transition temperature (T_g) and wherein the substantially crystalline or semicrystalline polymer has a melting point that is greater than the T_g of the at least one polymer of the first blend component.

24. The polymer blend of claim **20**, wherein at least one of the first and second blend components comprises a functionalized polymer.

25. The polymer blend of claim **1**, wherein at least one of the first and second blend components comprises a polyolefin.

26. The polymer blend of claim **25**, wherein both of the first and the second blend components comprise a polyolefin.

27. The polymer blend of claim **25**, wherein the polyolefin is selected from the group consisting of polypropylene, polyethylene, polybutylene, and copolymers, terpolymers, and combinations thereof.

28. The polymer blend of claim **25**, wherein the polyolefin is functionalized.

29. The polymer blend of claim **25**, wherein the polyolefin is elastomeric.

30. The polymer blend of claim **28**, wherein the polyolefin is functionalized by reaction with at least one unsaturated anhydride, unsaturated acid or unsaturated ester.

31. The polymer blend of claim **30**, wherein the polyolefin is modified by reaction with at least one unsaturated anhydride, unsaturated acid or unsaturated ester selected from the group consisting of maleic anhydride, citraconic anhydride, itaconic anhydride, glutaconic anhydride, 2,3-dimethylmaleic anhydride, maleic acid, fumaric acid, citraconic acid, itaconic acid, mesaconic acid, glutaconic acid, acrylic acid, methacrylic acid, crotonic acid, 2-pentenoic acid, 2-methyl-2-pentenoic acid, dimethyl malcate, diethyl maleatc, di-n-propyl malcate, diisopropyl maleate, dimethyl fumarate, diethyl fumarate, di-n-propyl fumarate, di-isopropyl maleate, dimethyl itaconate, methyl acrylate, ethyl acrylate, methyl methacrylate, ethyl methacrylate, methyl crotonate, and ethyl crotonate.

32. The polymer blend of claim **31**, wherein the polyolefin comprises a maleic anhydride modified polyolefin.

33. The polymer blend of claim **27**, wherein said polymer is functionalized by oxidation.

34. The polymer blend of claim **1**, further comprising at least one additive.

35. The polymer blend of claim **34**, wherein said at least one additive comprises an additive selected from the group consisting of antimicrobials, biocides, flame retardants, toxic absorbers, conductive agents, abrasives, antioxidants, UV stabilizers, optically active compounds, tracers, plating catalysts, fungicides, mildewcides, phosphorescents, reflectants, smart fabric components, polytetrafluoroethylene (PTFE), repellants, particulates, reinforcing agents, fillers, pigments, talc, glass fibers, clays, silicas, mineral silicates, mica, odor absorbers, nano-particles, chemical deactivators, antistats, markers, counterfeit tracers, fluorescents, ointments, and combinations thereof.

36. The polymer blend of claim **26**, wherein at least one of said first or second components comprises a maleic anhydride modified polyolefin, said second component comprises a substantially crystalline polyolefin, and said blend has a melting point within 20° C. of the flow activation temperature of the blend.

37. A polymer blend capable of substantially wetting out a surface at a flow activating temperature without requiring the application of substantial pressure, said polymer blend further having blocking resistance properties, said polymer blend comprising at least one polymer having a first molecular weight and a glass transition temperature T_g, and a substantially crystalline compound having a second molecular weight that is less than the first molecular weight of the at least one polymer and having a melting point that is greater than the T_g of the at least one polymer.

38. The polymer blend of claim **37**, wherein said blend comprises a functionalized polyolefin.

39. The polymer blend of claim **38**, wherein the functionalized polyolefin comprises a maleic anhydride modified polyolefin.

40. The polymer blend of claim **37**, wherein said blend comprises an elastomeric polyolefin.

41. A polymer blend capable of substantially wetting out a surface at a flow activating temperature without requiring the application of substantial pressure, said polymer blend further having blocking resistance properties, said polymer blend comprising a phenoxy having a first molecular weight and a glass transition temperature T_g; and a substantially crystalline plasticizer having a second molecular weight that is less than the first molecular weight of the phenoxy and having a melting point that is greater than the T_g of the phenoxy.

42. An article comprising the polymer blend of claim **41**, wherein said article is selected from the group consisting of fibers, nonwoven fabrics, permeable films, impermeable films, foams, and coatings.

43. A polymeric bonding system, comprising:

an article comprising a polymer blend capable of substantially wetting out a surface at a flow activating temperature without requiring the application of substantial pressure, said polymer blend further having blocking resistance properties, said polymer blend comprising at least about 10 percent by weight, based on the total weight of the polymer blend, of a first blend component comprising at least one polymer having a first molecular weight and at least about 10 percent by weight, based on the total weight of the polymer blend, of a second blend component comprising at least one compound having a second molecular weight that is less than the first molecular weight of the at least one polymer of the first blend component, wherein the first molecular weight of the at least one polymer of said first blend component is sufficiently high to prevent the substantial wet out without the application of substantial pressure of the at least one polymer of the first blend component at said activating temperature, and wherein the second molecular weight of the at least one compound of said second blend component is sufficiently low so that the at least one compound of the second blend component exhibits sufficiently high molecular mobility to substantially prevent processing the at least one compound of the second blend component alone.

44. The polymeric bonding system of claim **43**, wherein the polymeric bonding system is in the form of an article selected from the group consisting of fibrous materials, films, foams, coatings, particulate materials, and combinations thereof.

45. A polymeric bonding system, comprising:

an article comprising a polymer blend capable of substantially wetting out a surface at a flow activating temperature without requiring the application of substantial pressure, said polymer blend further having blocking resistance properties, said polymer blend comprising at least one polymer having a first molecular weight and a glass transition temperature T_g, and at least one substantially crystalline compound having a second molecular weight that is less than the first molecular weight of the at least one polymer and having a melting point that is greater than the T_g of the at least one polymer.

46. A polymeric delivery system, comprising:

a polymer blend capable of substantially wetting out a surface at a flow activating temperature without requiring the application of substantial pressure, said polymer blend further having blocking resistance properties, said polymer blend comprising at least about 10 percent by weight, based on the total weight of the polymer blend, of a first blend component comprising at least one polymer having a first molecular weight and at least about 10 percent by weight, based on the total weight of the polymer blend, of a second blend component comprising at least one compound having a second molecular weight that is less than the first molecular weight of the at least one polymer of the first blend component, wherein the first molecular weight of the at least one polymer of said first blend component is sufficiently high to prevent the substantial wet out without the application of substantial pressure of the at least one polymer of the first blend component at said activating temperature, and wherein the second molecular weight of the at least one compound of said second blend component is sufficiently low so that the at least one compound of said second blend component exhibits sufficiently high molecular mobility to substantially prevent processing the at least one compound of said second blend component alone; and

at least one additive.

47. The polymeric delivery system of claim **46**, wherein the polymeric delivery system is in the form of an article selected from the group consisting of fibrous materials, films, foams, coatings, particulate materials, and combinations thereof.

48. The polymeric delivery system of claim **47**, wherein the polymeric delivery system comprises a fibrous material.

49. The polymeric delivery system of claim **48**, wherein the fibrous material is selected from the group consisting of continuous filaments, staple fibers, yarns, tows, meltblown fibers, and spunbonded filaments.

50. The polymeric delivery system of claim **47**, wherein the polymeric delivery system comprises a particulate material.

51. The polymeric delivery system of claim **50**, wherein the particulate material comprises a powder having an average diameter of less than about 1 millimeter (mm).

52. The polymeric delivery system of claim **50**, wherein the particulate materials comprises a powder having an average diameter of less than about 200 microns.

53. The polymeric delivery system of claim **46**, wherein the at least one additive comprises an additive selected from the group consisting of antimicrobials, biocides, flame retardants, toxic absorbers, conductive agents, abrasives, antioxidants, UV stabilizers, optically active compounds, tracers, plating catalysts, fungicides, mildewcides, phosphorescents, reflectants, smart fabric components, polytetrafluoroethylene (PTFE), repellants, particulates, reinforcing agents, fillers, pigments, talc, glass fibers, clays, silicas, mineral silicates, mica, odor absorbers, nano-particles, chemical deactivators, antistats, markers, counterfeit tracers, fluorescents, ointments, and combinations thereof.

54. A polymeric delivery system, comprising:

a polymer blend capable of substantially wetting out a surface at a flow activating temperature without requiring the application of substantial pressure, said polymer blend further having blocking resistance properties, said polymer blend comprising at least one polymer having a first molecular weight and a glass transition temperature T_g, and at least one substantially crystalline compound having a second molecular weight that is less than the first molecular weight of the at least one polymer and having a melting point that is greater than the T_g of the at least one polymer; and

at least one additive.

55. A composite article comprising:

a matrix material; and

a polymer blend capable of substantially wetting out a surface of the matrix material at a flow activating temperature without requiring the application of substantial pressure, said polymer blend further having blocking resistance properties, said polymer blend

comprising at least about 10 percent by weight, based on the total weight of the polymer blend, of a first blend component comprising at least one polymer having a first molecular weight and at least about 10 percent by weight, based on the total weight of the polymer blend, of a second blend component comprising at least one compound having a second molecular weight that is less than the first molecular weight of the at least one polymer of the first blend component, wherein the first molecular weight of the at least one polymer of said first blend component is sufficiently high to prevent the substantial wet out without the application of substantial pressure of the at least one polymer of the first blend component at said activating temperature, and wherein the second molecular weight of the at least one compound of said second blend component is sufficiently low so that the at least one compound of the second blend component exhibits sufficiently high molecular mobility to substantially prevent processing the at least one compound of the second blend component alone.

56. The composite article of claim **55**, wherein the matrix material is selected from the group consisting of fibrous materials, cellulosic materials, and combinations thereof.

57. The composite article of claim **56**, wherein the matrix material comprises a fibrous material selected from the group consisting of synthetic fibrous materials, natural fibrous materials, and combinations thereof.

58. The composite article of claim **57**, wherein the natural fibrous material comprises cotton fibers.

59. The composite article of claim **58**, further comprising an antimicrobial agent.

60. The composite article of claim **56**, wherein the matrix material comprises a cellulosic material selected from the group consisting of cellulosic fibrous materials, cellulosic particles, and combinations thereof

61. The composite article of claim **55**, wherein the polymer blend is in the form of an article selected from the group consisting of fibrous materials, films, foams, coatings, particulate materials, and combinations thereof.

62. The composite article of claim **55**, wherein the polymer blend further comprises an additive.

63. A composite article comprising:

a matrix material; and

a polymer blend capable of substantially wetting out a surface at a flow activating temperature without requiring the application of substantial pressure, said polymer blend further having blocking resistance properties, said polymer blend comprising at least one polymer having a first molecular weight and a glass transition temperature T_g, and at least one substantially crystalline compound having a second molecular weight that is less than the first molecular weight of the at least one polymer and having a melting point that is greater than the T_g of the at least one polymer.

64. A chenille yarn comprising at least one core yarn and at least one effect yarn, wherein said core yarn comprises a polymer blend capable of substantially wetting out a surface at a flow activating temperature without requiring the application of substantial pressure, said polymer blend further having blocking resistance properties, said polymer blend comprising a first blend component comprising at least one polymer having a first molecular weight and a second blend component comprising at least one compound having a second molecular weight that is less than the first molecular weight of the at least one polymer of the first blend component, wherein the first molecular weight of the at least one polymer of said first blend component is sufficiently high to prevent the substantial wet out without the application of substantial pressure of the at least one polymer of the first blend component at said activating temperature, and wherein the second molecular weight of said at least one compound of the second blend component is sufficiently low so that the at least one compound of the second blend component exhibits sufficiently high molecular mobility to substantially prevent processing the at least one compound of the second blend component alone, wherein said effect yarn is bound by said polymer blend of said core yarn.

65. The chenille yarn of claim **64**, wherein said polymer blend is present in the form of one or more fibers blended with said core yarn.

66. The chenille yarn of claim **64**, wherein said core yarn comprises a coating formed of said polymer blend.

67. The chenille yarn of claim **64**, wherein said core yarn comprises a multicomponent fiber comprising at least one component formed of said polymer blend.

68. A polymer additive system comprising a water soluble additive and a plurality of particles formed of a polymer blend capable of substantially wetting out a surface at a flow activating temperature without requiring the application of substantial pressure, said polymer blend further having blocking resistance properties, said polymer blend comprising a first blend component comprising at least one polymer having a first molecular weight and a second blend component comprising at least one compound having a second molecular weight that is less than the first molecular weight of the at least one polymer of the first blend component, wherein the first molecular weight of the at least one polymer of said first blend component is sufficiently high to prevent the substantial wet out without the application of substantial pressure of the at least one polymer of the first blend component at said activating temperature, and wherein the second molecular weight of the at least one compound of said second blend component is sufficiently low so that the at least one compound of the second blend component exhibits sufficiently high molecular mobility to substantially prevent processing the at least one compound of the second blend component alone.

69. The polymer additive system of claim **68**, wherein said water soluble additive comprises a flame retardant additive.

70. A waterborne coating system comprising a water soluble additive encapsulated in a plurality of emulsified particles comprising a polymer blend, wherein said polymer blend comprises a first blend component comprising at least one polymer having a first molecular weight and a second blend component comprising at least one compound having a second molecular weight that is less than the first molecular weight of the at least one polymer of the first blend component, wherein the first molecular weight of the at least one polymer of said first blend component is sufficiently high to prevent the substantial wet out without the application of substantial pressure of the at least one polymer of the first blend component at said activating temperature, and wherein the second molecular weight of the at least one compound of said second blend component is sufficiently low so that the at least one compound of the second blend component exhibits sufficiently high molecular mobility to

substantially prevent processing the at least one compound of the second blend component alone.

71. A method of bonding an article, comprising activating a polymer blend applied to an article to be bonded at a flow activating temperature sufficient to substantially wet out a surface of the article to be bonded with the polymer blend at said activating temperature without the application of substantial pressure, wherein said polymer blend has blocking resistance properties and comprises at least about 10 percent by weight, based on the total weight of the polymer blend, of a first blend component comprising at least one polymer having a first molecular weight and at least about 10 percent by weight, based on the total weight of the polymer blend, of a second blend component comprising at least one compound having a second molecular weight that is less than the first molecular weight of the at least one polymer of the first blend component, wherein the first molecular weight of the at least one polymer of said first blend component is sufficiently high to prevent the substantial wet out without the application of substantial pressure of the at least one polymer of the first blend component at said activating temperature, and wherein the second molecular weight of the at least one compound of said second blend component is sufficiently low so that the at least one compound of the second blend component exhibits sufficiently high molecular mobility to substantially prevent processing the at least one compound of the second blend component alone.

72. A method of bonding an article, comprising activating a polymer blend applied to an article to be bonded at a flow activating temperature sufficient to substantially wet out a surface of the article to be bonded with the polymer blend at said activating temperature without the application of substantial pressure, wherein said polymer blend comprises at least one polymer having a first molecular weight and a glass transition temperature T_g, and at least one substantially crystalline compound having a second molecular weight that is less than the first molecular weight of the at least one polymer and having a melting point that is greater than the T_g of the at least one polymer.

73. A method of delivering an additive to an article, comprising activating a polymer blend comprising an additive to be delivered at a flow activating temperature sufficient to substantially wet out a surface of an article to which the additive is to be delivered at said activating temperature without requiring the application of substantial pressure to effectively deliver the additive to the article, wherein said polymer blend has blocking resistance properties and comprises at least about 10 percent by weight, based on the total weight of the polymer blend, of a first blend component comprising at least one polymer having a first molecular weight and at least about 10 percent by weight, based on the total weight of the polymer blend, of a second blend component comprising at least one compound having a second molecular weight that is less than the first molecular weight of the at least one polymer of the first blend component, wherein the first molecular weight of the at least one polymer of said first blend component is sufficiently high to prevent the substantial wet out without the application of substantial pressure of the at least one polymer of the first blend component at said activating temperature, and wherein the second molecular weight of the at least one compound of said second blend component is sufficiently low so that the at least one compound of the second blend component exhibits sufficiently high molecular mobility to substantially prevent processing of the at least one compound of the second blend component alone.

74. A method of delivering an additive to an article, comprising activating a polymer blend comprising an additive to be delivered at a flow activating temperature sufficient to substantially wet out a surface of an article to which the additive is to be delivered at said activating temperature without requiring the application of substantial pressure to effectively deliver the additive to the article, wherein said polymer blend comprises at least one polymer having a first molecular weight and a glass transition temperature T_g, and at least one substantially crystalline compound having a second molecular weight that is less than the first molecular weight of the at least one polymer and having a melting point that is greater than the T_g of the at least one polymer.

75. An activatable yarn comprising a plurality of fibrous material, said fibrous material comprising a synthetic polymer having a first molecular weight and a functionalized additive for promoting adhesion of the synthetic polymer to another material and having a second molecular weight that is less than the first molecular weight of the synthetic polymer.

76. The activatable yarn of claim **75**, wherein said synthetic polymer comprising a polymer selected from the group consisting of polyolefins, polyesters, polyamides, and combinations thereof.

77. The activatable yarn of claim **76**, wherein said functionalized additive comprises a maleic anhydride modified polyolefin.

78. The activatable yarn of claim **76**, wherein said functionalized additive comprises an amine functionalized additive.

79. The activatable yarn of claim **46**, wherein said fibrous material comprises at least one polymer having a first molecular weight and a glass transition temperature T_g, and a substantially crystalline compound having a second molecular weight that is less than the first molecular weight of the at least one polymer and having a melting point that is greater than the T_g of the at least one polymer.

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