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(54) Title: STORAGE, TRANSPORTATION, AND/OR DISPENSE PACKAGING

(57) Abstract: The present disclosure relates to storage, transportation, and/or dispense packaging systems, and particularly container-based or liner-based storage, transportation, and/or dispensing systems, such as but not limited to bottle systems, drum systems, bag-in-bottle (BIB) systems, bag-in-drum systems, or the like for use in any suitable dispense application.



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STORAGE, TRANSPORTATION, AND/OR DISPENSE PACKAGING

Field of the Invention

[001] The present disclosure relates to storage, transportation, and/or dispense packaging systems, and particularly container-based or liner-based storage, transportation, and/or dispensing systems, such as but not limited to bottle systems, drum systems, bag-in-bottle (BIB) systems, bag-in-drum systems, or the like for use in any suitable dispense application.

Background of the Invention

[002] Numerous manufacturing processes require the use of ultrapure liquids, such as acids, solvents, bases, photoresists, slurries, detergents and cleaning formulations, dopants, inorganic, organic, metalorganic and TEOS, and biological solutions, DNA and RNA solvents and reagents, pharmaceuticals, hazardous waste, radioactive chemicals, and nanomaterials, including for example, fullerenes, inorganic nanoparticles, sol-gels, and other ceramics. Such applications require that the number and size of particles in the ultrapure liquids be minimized. In particular, because ultrapure liquids are used in many aspects of the microelectronic manufacturing process, semiconductor manufacturers have established strict particle concentration specifications for process chemicals and chemical-handling equipment. Such specifications are needed because, should the liquids used during the manufacturing process contain high levels of particles or bubbles, the particles or bubbles may be deposited on solid surfaces of the silicon. This can, in turn, lead to product failure and reduced quality and reliability.

[003] In addition to the manufacturing processes described above, several other industries or applications require a suitable container or packaging designed to fit their needs. Such industries or applications can include, but are not limited to, storage, transportation, and/or dispense of coatings, paints, polyurethanes, food, soft drinks, cooking oils, agrochemicals, industrial chemicals, cosmetic chemicals, petroleum and lubricants, adhesives (including, for example, UV curing adhesives, UV moisture curing silicones, UV curing acrylics, acrylics, silicones, urethanes, polyurethanes, moisture curing polyurethanes, epoxies, two-part epoxies, and 1-part epoxies), sealants, health and oral hygiene products, and toiletry products, etc.

[0004] Accordingly, there is a need in the art for storage, transportation, and/or dispensing of such contents with containers or packaging capable of providing adequate protection for the retained liquids. Furthermore, there is a need in the art for containers or packaging capable of use in a variety of applications.

Brief Summary of the Invention

[0005] The present disclosure in one embodiment relates to a packaging system that includes a cardboard overpack, and a liner blow-molded into the cardboard overpack. In some embodiments, the liner comprises PET. In some embodiments the liner comprises PEN. The cardboard overpack can be a rectangular prism. In other embodiments, the cardboard overpack is cylindrical. The liner is collapsible upon at least one of a vacuum applied to the interior thereof or a pressure applied to the space between the overpack and liner, in some embodiments.

[0006] The present disclosure also relates to a packaging system comprising a substantially rigid blow-molded overpack, and a blow-molded liner positioned within the overpack. The packaging system also includes at least two separate ports arranged on the substantially rigid overpack, the at least two separate ports providing separate access to within the overpack for dispensing contents of the liner and pressurizing at least one of the interior of the liner or the annular space between the overpack and liner. In some embodiments, the liner is collapsible upon application of pressure to the annular space between the overpack and liner via a first of the at least two separate ports and a second of the at least two ports is configured for dispense of the contents of the liner upon collapse of the liner. In other embodiments, a first of the at least two ports can permit access to the interior of the liner for application of pressure directly to the interior thereof and a second of the at least two ports is configured for dispense of the contents of the liner upon application of pressure via the first of the at least two ports. In yet other embodiments, a first of the at least two ports is configured for dispense of the contents of the liner via gravity dispense and a second of the at least two ports provides a vent between the interior of the liner and an exterior of the overpack.

[0007] The present disclosure also relates to a packaging system that includes a substantially rigid blow-molded overpack, and a blow-molded liner positioned within the overpack, wherein at least one of the overpack and liner comprises a material having a glass transition temperature above 50 °C. In one embodiment, the

overpack comprises a material having a glass transition temperature above 50 °C. In a further embodiment, the overpack consists of material having a glass transition temperature between 50 – 120 °C. In some embodiments, the liner comprises a material having a glass transition temperature above 50 °C.

Brief Description of the Drawings

[008] While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter that is regarded as forming the various embodiments of the present disclosure, it is believed that the disclosure will be better understood from the following description taken in conjunction with the accompanying Figures, in which:

[009] FIG. 1 is a cross-sectional view of a shipping and dispensing system according to one embodiment of the present disclosure.

[010] FIG. 2 is a cross-sectional view of a shipping and dispensing system including a packaging element according to one embodiment of the present disclosure.

[011] FIG. 3 shows a shipping and storage system for use with indirect pressure dispense according to one embodiment of the present disclosure.

[012] FIG. 4 shows statistics related to the indirect pressure dispense method shown in FIG. 3 provided in graphical form in accordance with one embodiment of the present disclosure.

Detailed Description

[013] The present disclosure relates to novel and advantageous storage, transportation, and/or dispense packaging systems, and particularly container-based or liner-based storage, transportation, and/or dispensing systems, such as but not limited to bottle systems, drum systems, bag-in-bottle (BIB) systems, bag-in-drum systems, or the like for use in any suitable dispense application. The various embodiments of storage, transportation, and/or dispense packaging systems may include improvements, alterations, modifications, enhancements, changes, additions, eliminations, or the like, as described herein, which may be applied to generally any type of known packaging system.

[014] An example packaging system is illustrated in Figure 1. Figure 1 illustrates one embodiment of a liner-based shipping and dispense system 100, which

may include the improvements, alterations, modifications, enhancements, changes, additions, eliminations, or the like of the present disclosure. In some embodiments, the shipping and dispense system 100 may include an overpack 102, a liner 104, and one or more connectors or connector assemblies, which may be, for example, a filling connector and/or a dispensing connector or connector assembly.

[015] The overpack 102 may include an overpack wall 106, an interior cavity 108, and a mouth 110. The overpack 102 may be comprised of any suitable material or combination of materials, for example but not limited to, one or more polymers, including plastics, nylons, EVOH, polyolefins, or other natural or synthetic polymers. In further embodiments, the overpack 102 may be manufactured using polyethylene terephthalate (PET), polyethylene naphthalate (PEN), poly(butylene 2,6-naphthalate) (PBN), polyethylene (PE), linear low-density polyethylene (LLDPE), low-density polyethylene (LDPE), medium-density polyethylene (MDPE), high-density polyethylene (HDPE), polypropylene (PP), and/or a fluoropolymer, such as but not limited to, polychlorotrifluoroethylene (PCTFE), polytetrafluoroethylene (PTFE), fluorinated ethylene propylene (FEP), and perfluoroalkoxy (PFA). The overpack 102 may be of any suitable shape or configuration, such as, but not limited to, a bottle, a can, a drum, etc.

[016] As described above, the shipping and dispense system 100 may include a liner 104, which may be disposed within the overpack 102. The liner 104 may include a liner wall 112, an interior cavity 114, and a mouth 116. The mouth 116 of the liner 104 may include a fitment portion 118. The fitment portion 118 may be made of a different material than the rest of the liner 104 and may be harder, more resilient, and/or less flexible than the rest of the liner. The fitment portion 118 may include threads that may couple with complementary threads on a connector or connector assembly. It is appreciated, however, that the fitment portion 118 may alternatively or additionally include any other means for coupling with a connector, such as but not limited to, snap-fit or friction-fit means, bayonet means, or any other suitable mechanism or combination of mechanisms for coupling, as will be appreciated by those skilled in the art. In some embodiments, a connector or connector assembly may couple to, or may also couple to, the mouth 110 of the overpack 102.

[017] In some embodiments, the liner 104 may be a collapsible liner that is substantially flexible, while in other embodiments the liner may be somewhat rigid

but still collapsible, e.g., a rigid collapsible liner. The liner 104 may be manufactured using any suitable material or combination of materials, such as but not limited to, any of the materials or combination of materials listed above with respect to the overpack 102. In some embodiments, the liner and/or overpack may be comprised of recyclable and/or biodegradable materials. The overpack 102 and liner 104 need not be manufactured from the same materials. In some embodiments, the material or materials selected and the thickness of that material or those materials may determine the rigidity of the liner 104. The liner 104 may have one or more layers and may have any desirable thickness. A liner 104 may have a thickness of, for example, from about 0.05 mm to about 3 mm, or any other suitable thickness.

[018] The liner 104 may be configured to comprise any desirable shape that is appealing to the user, and/or assists in the collapse of the liner. The liner 104, in some embodiments, may be dimensioned and shaped to substantially conform to the interior of the overpack 102. As such, the liner 102 may have a relatively simplistic design with a generally smooth outer surface, or the liner may have a relatively complicated design including, for example but not limited to, indentations and/or protrusions. In some embodiments, the liner wall 112 may include a generally textured surface in order to minimize leaching and/or adhesion. For example, in some embodiments, the surface may include a plurality of bumps, scales, or projections, which may each have any appropriate size, for example, but not limited to, from about 0.5 – 100 μm . Texturizing features may be spaced any suitable distance from one another. In some embodiments, the texturizing may comprise a framework, such as a lattice or scaffold, for example. Examples of some suitable texturizing features are described in greater detail in U.S. Provisional Patent Appln. No. 61/334,005, titled, “Fluid Processing Components with Textured Surface for Decreased Adhesion and Related Methods,” filed May 12, 2010, which is hereby incorporated by reference herein in its entirety. The liner 104 may have a relatively thin liner wall 112, as compared to the thickness of the overpack wall 106. In some embodiments, the liner 102 may be flexible such that the liner wall 112 may be readily collapsed, such as by vacuum through the mouth 116 or by pressure between the liner wall 112 and overpack wall 106, referred to herein as the annular space therebetween.

[019] The liner 104, in a further embodiment, may have a shape, when inflated or filled, that is different from, but complimentary with, the shape of the overpack 102 such that it may be disposed therein. In some embodiments, the liner

104 may be removably attached to the interior of the overpack wall 102. The liner 104 may provide a barrier, such as a gas barrier, against drive gas migration from the annular space between the liner wall 112 and the overpack wall 106. Accordingly, the liner 104 may generally ensure and/or maintain the purity of the contents within the liner.

[020] In some embodiments, particularly where sterility of the contents of the liner must be substantially maintained, the liner 102 may be comprised of a material that may help ensure or maintain a sterile environment for the contents disposed in the liner. For example, in some embodiments the liner may be comprised of TK8 manufactured by ATMI of Danbury, Connecticut, or any other suitable material. As noted above, in some embodiments, the liner 104 may comprise multiple layers. The multiple layers may comprise one or more different polymers or other suitable materials. In some embodiments, the thickness, ply, and/or the composition of the liner and/or the layers of the liner may allow for the secure and substantially uncontaminated shipment of the contents of the liner-based system of the present disclosure by limiting or eliminating typical weaknesses or problems associated with traditional liners or packages, such as, for example weld tears, pin holes, gas entrainment, and/or any other means of contamination. Similarly, or in addition, the liner 104 may also contribute to the secure and substantially uncontaminated shipment of the contents of the shipping and dispense system 100 of the present disclosure by configuring the liner to substantially conform to the shape of the overpack when the liner is filled, thereby reducing the amount of movement of the contents during shipping.

[021] The liner and/or overpack may include one or more coatings and/or films that may help provide leak detection. For example, the liner and/or overpack may be coated or may comprise aluminized nylon that may have altered electrical conductivity when it comes into contact with a leaked chemical. The change in electrical conductivity can be measured to determine whether there has been a leak. A measuring instrument, or meter for measuring electrical conductivity, may be located at any suitable position on the liner-based assembly or may be an external instrument configured for electrically coupling with the aluminized nylon. In one example embodiment, a meter may be incorporated into a cap and/or connector. It will be understood that any other suitable composition may be used as a leak detection

coating or film, and the present disclosure is not limited to solely compositions of aluminized nylon.

[022] The overpack 102 and liner 104 may each be manufactured using any suitable manufacturing process, such as but not limited to, injection blow molding, injection stretch blow molding, extrusion, etc., and may each be manufactured as a single component or may be a combination of multiple components. In some embodiments, the overpack 102 and liner 104 may be blow molded in a nested fashion, also referred to herein as co-blow molded. Examples of liner-based systems and methods utilizing co-blow molding techniques have been described in greater detail in U.S. Prov. Appl. No. 61/506,807, titled "Nested Blow Molded Liner and Overpack and Methods of Making Same," filed July 12, 2011, and International Patent Appl. No. PCT/US11/55560, of the same name filed October 10, 2011, which is hereby incorporated herein by reference in its entirety. In still other embodiments, the liner may be blow molded into an overpack. For example, an existing overpack that has been manufactured by any suitable method may be used as the mold for a liner that may be blow-molded into the overpack.

[023] Additional or alternative examples of the type of packaging systems that may include the improvements, alterations, modifications, enhancements, changes, additions, eliminations, or the like, as described herein, are disclosed in more detail in: International PCT Appl. No. PCT/US11/55558, titled, "Substantially Rigid Collapsible Liner, Container and/or Liner for Replacing Glass Bottles, and Enhanced Flexible Liners," filed October 10, 2011; International PCT Appl. No. PCT/US11/55560, titled, "Nested Blow Molded Liner and Overpack and Methods of Making Same," filed October 10, 2011; International PCT Appl. No. PCT/US11/64141, titled "Generally Cylindrically-Shaped Liner for Use in Pressure Dispense Systems and Methods of Manufacturing the Same," filed December 9, 2011; U.S. Prov. Appl. No. 61/468,832, titled "Liner-Based Dispenser," filed March 29, 2011; U.S. Prov. Appl. No. 61/525,540, titled "Liner-Based Dispensing Systems," filed August 19, 2011; U.S. Pat. Appl. No. 11/915,996, titled "Fluid Storage and Dispensing Systems and Processes," filed June 5, 2006; International PCT Appl. No. PCT/US10/51786, titled "Material Storage and Dispensing System and Method With Degassing Assembly," filed October 7, 2010, International PCT Appl. No. PCT/US10/41629, U.S. Pat. No. 7,335,721, U.S. Pat. Appl. No. 11/912,629, U.S. Pat. Appl. No. 12/302,287, and International PCT Appl. No. PCT/US08/85264, each of which is hereby incorporated by reference herein

in its entirety., each of which is hereby incorporated by reference herein in its entirety. In addition to the improvements, alterations, modifications, enhancements, changes, additions, eliminations, or the like, as described herein, the overpack 102 and liner 104 for use with the shipping and dispense system 100 of the present disclosure may include any of the embodiments, features, and/or enhancements disclosed in any of the above noted applications, including, but not limited to, flexible, rigid collapsible, 2-dimensional, 3-dimensional, welded, molded, gusseted, and/or non-gusseted liners, and/or liners that contain folds and/or liners that comprise methods for limiting or eliminating choke-off and liners sold under the brand name NOWpak® by ATMI, Inc. for example.

[024] The packaging systems of the present disclosure may be used for any suitable sized amount of contents, such as but not limited to storage of one or more milliliters (including single-dose applications) up to about 2000 L or more of liquid, or from one or more milligrams (including single-dose applications) up to one or more tons of solid material. As discussed above, example uses of such packaging systems may include, but are not limited to, the storage, transportation, and/or dispense of acids, solvents, bases, photoresists, slurries, detergents and cleaning formulations, dopants, inorganic, organic, metalorganic and TEOS, and biological solutions, DNA and RNA solvents and reagents, pharmaceuticals, hazardous waste, radioactive chemicals, and nanomaterials (including for example, fullerenes, inorganic nanoparticles, sol-gels, and other ceramics), coatings, paints, polyurethanes, food, beverages, soft drinks, cooking oils, agrochemicals, industrial chemicals, cosmetic chemicals, petroleum and lubricants, adhesives (including but not limited to UV curing adhesives, UV moisture curing silicones, UV curing acrylics, acrylics, silicones, urethanes, polyurethanes, moisture curing polyurethanes, epoxies, two-part epoxies, and 1-part epoxies), sealants, health and oral hygiene products, and toiletry products, etc. However, those skilled in the art will recognize the benefits of such packaging systems, and therefore will recognize the suitability of the liners to various industries and for the transportation and dispense of various products. The contents may be stored, transported, and/or dispensed in any suitable form, including liquid form, gas form, solid or powder form, including flowable powder form.

[025] As generally indicated above, the packaging systems may include components made out of any suitable materials, such as the materials described in U.S. Prov. Appl. No. 61/499,524, titled "Substantially Rigid Collapsible Liner,

Container and/or Liner for Replacing Glass Bottles, and Flexible Gusseted or Non-Gusseted Liners,” filed June 21, 2011 and International PCT Appl. No. PCT/US11/55558, titled, “Substantially Rigid Collapsible Liner, Container and/or Liner for Replacing Glass Bottles, and Enhanced Flexible Liners,” filed October 10, 2011, each of which were previously incorporated by reference herein. For example, in some embodiments, one or more of the packaging system components, such as a container, bottle, overpack, or liner, may be manufactured using one or more polymers, in one or more layers of the same or different polymers, including plastics, nylons, EVOH, polyolefins, polyethylene terephthalate (PET), polyethylene naphthalate (PEN), poly(butylene 2,6-naphthalate) (PBN), polyethylene (PE), linear low-density polyethylene (LLDPE), low-density polyethylene (LDPE), medium-density polyethylene (MDPE), high-density polyethylene (HDPE), polypropylene (PP), or other natural or synthetic polymers. In some embodiments, the material or materials selected and the thickness of that material or those materials may determine the rigidity of the packaging system or one or more components thereof. In still other embodiments, one or more of the packaging system components may be manufactured using a fluoropolymer, such as but not limited to, polychlorotrifluoroethylene (PCTFE), polytetrafluoroethylene (PTFE), fluorinated ethylene propylene (FEP), and perfluoroalkoxy (PFA). In yet other embodiments, the packaging system may include a contact surface (e.g., surface contacting the contents stored therein) that is acid resistant or substantially acid resistant or that has better performance in low temperatures. For example, using a fluoropolymer wall or fluoropolymer coating may provide acid resistance, and using a polyolefin wall or polyolefin coating may provide better performance in low temperatures. With such features, a packaging system with increased chemical compatibility can be provided. It is recognized, however, that the various embodiments of packaging systems or one or more components thereof described herein may be manufactured from any suitable combination of materials disclosed herein.

[026] In some embodiments, one or more colors and/or absorbant materials may be added to the materials of the packaging system or one or more components thereof, such as a container, bottle, overpack, or liner, during or after the manufacturing process to help protect the contents of the packaging system from the external environment, to decorate the packaging system, or to use as an indicator or identifier of the contents within the packaging system or otherwise to differentiate

multiple packaging systems, etc. Colors may be added using, for example, dyes, pigments, nanoparticles, or any other suitable mechanism. Absorbant materials may include materials that absorb ultraviolet light, infrared light, and/or radio frequency signals, etc.

[027] In some embodiments, a low temperature packaging system may be provided by using a material with a low glass transition temperature for manufacturing the packaging system or one or more components thereof, such as a container, bottle, overpack, or liner. In one embodiment, for example, an overpack made of PEN (or other suitable material, as described above) may be used with, or co-blown with, an interior liner made of a material with a low glass transition temperature. For example, a low glass transition temperature may be below about 20 °C, for example. Such packaging system can provide a storage, transportation, and/or dispense packaging system specifically designed for low temperatures. Other embodiments may include a metal overpack and a soft polyolefin liner or other low temperature durable materials, for example, but not limited to linear low density polyethylene or low density polyethylene.

[028] Similarly, in some embodiments materials with a high glass transition temperature may be used at low temperatures without flexing. For example, a high glass transition temperature may be a temperature from about 50 to about 120 °C. Example materials include, but are not limited to: PEN with a glass transition temperature of 120 °C; PET with a glass transition temperature of 70 °C; and PBT with a glass transition temperature of 66 °C. For such materials, fatigue failure generally does not occur at low temperatures because these materials tend not to flex like other materials such as polyethylene that has a glass transition temperature of -125 °C.

[029] As generally indicated above, the packaging systems or one or more components thereof may be manufactured using any suitable manufacturing process, such as extrusion blow molding, injection blow molding, injection stretch blow molding, etc. A manufacturing process utilizing injection blow molding or injection stretch blow molding can allow for packaging systems with more accurate shapes than other manufacturing processes. In some embodiments, the packaging systems or one or more components thereof may be manufactured using co-extrusion or co-extrusion blow molding.

[030] Each of the embodiments of the present disclosure may be configured for dispensing the contents therein, in any suitably form, by pressure dispense (direct or indirect), pump dispense, pressure-assisted pump dispense, or gravity dispense. In embodiments using pressure dispense, pressurization may be performed using any fluid or gas, ranging from just above atmospheric pressure to any suitable higher pressure. Although not required in each embodiment, to aid in dispense, any of the packaging systems of the present disclosure may include an embodiment that has, or permits the use of, a dip tube. In other embodiments, the packaging systems of the present disclosure may not include a dip tube or may include, or permit the use of, a dip tube that extends only a partial distance into the container, sometimes referred to as a “stubby probe.” The diptube may be made of any suitable material, such as any of the materials previously described herein, and may be configured in any suitable shape and length. With any type of dispense, the packaging systems of the present disclosure may be configured to dispense at any orientation, including inverted dispensing orientations.

[031] Accordingly, each of the embodiments of the present disclosure may be adapted for use with any suitable connector or connection mechanism for dispensing. For example, in some embodiments, the packaging systems of the present disclosure may include, or permit use of, a misconnect prevention closure as well as a misconnect prevention connector. The misconnect prevention closure and misconnect prevention connector, in some embodiments, may be configured such that they are compatible with the NOWPak® dispense system, such as that disclosed in U.S. Pat. Appl. No. 11/915,996, titled “Fluid Storage and Dispensing Systems and Processes,” which was filed June 5, 2006, which was previously incorporated herein. A sample of the misconnect prevention connector may be that of ATMI of Danbury, Connecticut, or those disclosed in U.S. Pat. Appl. No. 60/813,083, filed on June 13, 2006; U.S. Pat. Appl. No. 60/829,623 filed on October 16, 2006; and U.S. Pat. Appl. No. 60/887,194 filed on January 30, 2007, each of which is hereby incorporated by reference herein in its entirety. In other embodiments, the packaging systems of the present disclosure may include, or permit use of connectors or connection mechanisms traditionally used for glass bottle storage, transportation, and/or dispense systems. In some embodiments, the connectors or connection mechanisms may be made of any suitable material, which in some cases may depend on its use, and the connectors or connection mechanisms may be sterile, aseptic, etc. In still further embodiments, the

connectors or connection mechanisms may be configured for applications that involve recirculation of the contents of the packaging systems. Other exemplary connectors that may be used in conjunction with embodiments of the present disclosure include those described in U.S. Pat. Nos. 6,015,068 and US 5,875,921, which are hereby incorporated herein in their entirety.

[032] The packaging systems described herein may be configured as any suitable shape, including but not limited to square, rectangular, triangular or pyramidal, cylindrical, or any other suitable polygon or other shape. Differently shaped packaging can improve packing density during storage and/or transportation, and may reduce overall transportation costs. Additionally, differently shaped packaging can be used to differentiate packaging systems from one another, such as to provide an indicator of the contents provided within the packaging systems or to identify for which application or applications the contents are to be used, etc. In still further embodiments, the packaging systems described herein may be configured as any suitable shape in order to “retrofit” the packaging system with existing dispense systems.

[033] Additionally, some embodiments of the packaging systems may include a base or chime component or portion. The chime portion may be an integrated or separate portion or component of the packaging system, and may be removable or detachable in some embodiments. In regard to chimes that are separate components, the chime may be attached by any suitable means, including snap-fit, bayonet-fit, friction-fit, adhesive, rivets, screws, etc. Some example chime embodiments are described and/or illustrated in U.S. Prov. Appl. No. 61/499,254, titled “Substantially Rigid Collapsible Liner, Container and/or Liner for Replacing Glass Bottles, and Flexible Gusseted or Non-Gusseted Liners,” filed June 21, 2011; International PCT Appl. No. PCT/US11/55558, titled, “Substantially Rigid Collapsible Liner, Container and/or Liner for Replacing Glass Bottles, and Enhanced Flexible Liners,” filed October 10, 2011; U.S. Prov. Appl. No. 61/506,807, titled “Nested Blow Molded Liner and Overpack and Methods of Making Same,” filed July 12, 2011; and International PCT Appl. No. PCT/US11/55560, titled, “Nested Blow Molded Liner and Overpack and Methods of Making Same,” filed October 10, 2011, which were previously incorporated herein. The chime may be any suitable size and shape, and may be made from any suitable material, such as the materials described herein. In some embodiments, the chime may be configured to enhance or add ability to the

packaging system for stacking, shipping, strength (e.g., structurally), weight, safety, etc. For example, a chime may include one or more interlocking or mating features or structures that is configured to interlock or mate with a complementary feature of an adjacent container, either vertically or horizontally, for example. As described for example in U.S. Prov. Appl. No. 61/499,254, titled "Substantially Rigid Collapsible Liner, Container and/or Liner for Replacing Glass Bottles, and Flexible Gusseted or Non-Gusseted Liners," filed June 21, 2011; International PCT Appl. No. PCT/US11/55558, titled, "Substantially Rigid Collapsible Liner, Container and/or Liner for Replacing Glass Bottles, and Enhanced Flexible Liners," filed October 10, 2011 and U.S. Prov. Appl. No. 61/506,807, titled "Nested Blow Molded Liner and Overpack and Methods of Making Same," filed July 12, 2011; and International PCT Appl. No. PCT/US11/55560, titled, "Nested Blow Molded Liner and Overpack and Methods of Making Same," filed October 10, 2011, which were previously incorporated herein, a packaging system or one or more components thereof may include a generally rounded or substantially rounded bottom. A rounded bottom can help increase dispensability of the contents therein, particularly in pump dispense applications. A chime may be used to provide support for such packaging systems.

[034] In some embodiments, the packaging systems described herein may include symbols and/or writing that is molded into the packaging systems or one or more components thereof. Such symbols and/or writing may include, but is not limited to names, logos, instructions, warnings, etc. Such molding may be done during or after the manufacturing process of the packaging systems or one or more components thereof. In one embodiment, such molding may be readily accomplished during the fabrication process by, for example, embossing the mold for the packaging systems or one or more components thereof. The molded symbols and/or writing may be used, for example, to differentiate products.

[035] In some cases, liner-based packaging systems may include various features to reduce, prevent, and/or hide distortions in the packaging that may occur during pressure dispense, for example. Anti-dimpling features may include surface features on the liner and/or overpack. In some embodiments, a chime and/or sleeve may be included in the packaging system that may be positioned over the overpack and thereby disguise any distortions in the overpack. These and other anti-dimpling features may be included in liner-based systems of the present disclosure and are discussed in greater detail in International Patent Appln. No. PCT/US2011/055558,

titled “Substantially Rigid Collapsible Liner, Container and/or Liner for Replacing Glass Bottles, and Flexible Gusseted or Non-Gusseted Liners” filed, October 10, 2011; International PCT Appl. No. PCT/US11/55558, titled, “Substantially Rigid Collapsible Liner, Container and/or Liner for Replacing Glass Bottles, and Enhanced Flexible Liners,” filed October 10, 2011; U.S. Provisional Patent Appln. No. 61/605,011, titled “Liner-Based Shipping and Dispensing Systems,” filed February 29, 2012; and each of which are incorporated herein in their entirety.

[036] Similarly, in some embodiments, the packaging systems or one or more components thereof may be provided with different textures or finishes. As with color and molded symbols and/or writing, the different textures or finishes may be used to differentiate products, to provide an indicator of the contents provided within the packaging systems, or to identify for which application or applications the contents are to be used, etc. In one embodiment, the texture or finish may be designed to be a substantially non-slip texture or finish or the like, and including or adding such a texture or finish to the packaging systems or one or more components thereof may help improve graspability or handling of the packaging system, and thereby reduce or minimize the risk of dropping of the packaging system. The texture or finish may be readily accomplished during the fabrication process by, for example, providing a mold for the packaging systems or one or more components thereof with the appropriate surface features. In other embodiments, the molded packaging may be coated with the texture or finish. In some embodiments, the texture or finish may be provided on substantially the entire packaging system or substantially the entirety of one or more components thereof. However, in other embodiments, the texture or finish may be provided on only a portion of the packaging system or a portion of one or more components thereof.

[037] In some embodiments, the interior walls of the packaging systems or one or more components thereof may be provided with certain surface features, textures, or finishes. In embodiments wherein the packaging system comprises an overpack and liner, or multiple liners, etc., the interior surface features, textures, or finishes of the overpack, or one or more of the liners, may reduce adhesion between the overpack and liner, or between two liners. Such interior surface features, textures, or finishes can also lead to enhanced dispensability, minimized adhesion of certain materials to the surface of the overpack or liner(s), etc. by controlling, for example, the surface hydrophobicity or hydrophilicity.

[038] Similarly, in some embodiments, the exterior and/or interior walls of the packaging systems or one or more components thereof may have any suitable coating provided thereon. The coating may increase material compatibility, decrease permeability, increase strength, increase pinhole resistance, increase stability, provide anti-static capabilities or otherwise reduce static, etc. Such coatings can include coatings of polymers or plastic, metal, glass, adhesives, etc. and may be applied during the manufacturing process by, for example coating a preform used in blow-molding, or may be applied post manufacturing, such as by spraying, dipping, filling, etc.

[039] In still further embodiments, the packaging system or one or more components thereof may comprise metal or may be provided with a metal layer or metal coating, for example, but not limited to AL (aluminum), steel, coated steels, stainless steels, Ni (nickel), Cu (copper), Mo (molybdenum), W (tungsten), chromium-copper bi-layer, titanium-copper bi-layer, or any other suitable metal material or combination of materials. In some embodiments, metal and metal coated components may be overcoated with a protective dielectric, for example, SiO₂ from TEOS (tetraethylorthosilicate), or SiCl₄ (silicon tetrachloride), MO (metal organics), TiO₂ from TiCl₄ (titanium tetrachloride), or other suitable metal oxide material, or any other suitable metal, or some combination thereof. Metal coated packaging systems may be advantageous for storing and shipping substances, including ultra-pure substances, because a metal coating may be substantially impermeable to gases, thus reducing oxidation and/or hydrolysis of the contents and maintaining the purity of the substance contained in the packaging. Because of the impermeability of the metal coating, a packaging of this embodiment may be substantially free of pinholes or weld tears and may be very robust and have a consistent fill volume.

[040] In still another embodiment, the packaging systems of the present disclosure may be provided with a metal overpack or the overpack may comprise metal, for example, but not limited to aluminum, nickel, stainless steel, thin-walled steel, or any other suitable metal material or combination of materials. In some embodiments, these metal overpacks may be coated on the internal surface with inert films to reduce interaction of the contents with the metal walls. The films may be inert metals, metal oxides, metal nitrides or metal carbides chosen specifically to reduce the chemical interactions and degradation of the contents inside the metal overpack. In another embodiment, a metal overpack may have an internal surface

coated with glass, plastic, SiO₂, or any other suitable material or combination of materials. Because of the rigidity of the metal, a packaging of this embodiment may be substantially free of pinholes or weld tears and may be very robust and have a consistent fill volume.

[041] In one specific embodiment, a packaging system may include a plastic liner provided with a coating of metal. For example, a liner may be formed of a polymer such as PP, PE, PET, PEN, HDPE or any other suitable polymer, or combination of polymers as described above. The outside of the liner may be metalized with, such as but not limited to aluminum. It will be recognized that any suitable metal may be used to metalize the outside of a polymer liner according to this embodiment. The liner may be metalized by any suitable method, such as, for example, plating, electro-plating, spraying, etc. Metalizing the outside of the liner may substantially decrease or eliminate the effects of gas permeability. Because of the impermeability provided by the metal coating, a liner of this embodiment may be substantially free of pinholes or weld tears and may be very robust and have a consistent fill volume.

[042] In some embodiments, the packaging system may include one or more handles. The one or more handles can be of any shape or size, and may be located at any suitable position of the packaging system. Types of handles can include, but are not limited to, handles that are located at the top and/or sides; are ergonomic; are removable or detachable; are molded into the packaging system or are provided after fabrication of the packaging system (such as by, for example, snap fit, adhesive, riveting, screwed on, bayonet-fit, etc.); etc. Different handles and/or handling options can be provided and may depend on, for example but not limited to, the anticipated contents of the packaging system, the application for the packaging system, the size and shape of the packaging system, the anticipated dispensing system for the packaging system, etc.

[043] In some embodiments, the packaging systems may include two or more layers, such as an overpack and a liner, multiple overpacks, or multiple liners. In further embodiments, a packaging system may include at least three layers, which may help ensure enhanced containment of the contents therein, increase structural strength, and/or decrease permeability, etc. Any of the layers may be made from the same or different materials, such as but not limited to, the materials previously discussed herein. The liner and/or overpack may comprise laminates of two or more

layers or the package may comprise multiple liners and/or multiple overpacks that may be disposed within each other, for example.

[044] In order to assist in making the packaging systems described herein more sustainable, the packaging systems or one or more components thereof, including any overpack, liner(s), handles, chimes (support members), connectors, etc., may be manufactured from biodegradable materials or biodegradable polymers, including but not limited to: polyhydroxyalkanoates (PHAs), like poly-3-hydroxybutyrate (PHB), polyhydroxyvalerate (PHV), and polyhydroxyhexanoate (PHH); polylactic acid (PLA); polybutylene succinate (PBS); polycaprolactone (PCL); polyanhydrides; polyvinyl alcohol; starch derivatives; cellulose esters, like cellulose acetate and nitrocellulose and their derivatives (celluloid); etc.

[045] In some embodiments, the packaging system or one or more components thereof may be manufactured from materials that can be recycled or recovered, and in some embodiments, used in another process by the same or a different end user, thereby allowing such end user(s) to lessen their impact on the environment or lower their overall emissions. For example, in one embodiment, the packaging system or one or more components thereof may be manufactured from materials that may be incinerated, such that the heat generated therefrom may be captured and incorporated or used in another process by the same or different end user. In general the packaging system or one or more components thereof may be manufactured from materials that can be recycled, or that may be converted into raw materials that may be used again.

[046] In some embodiments, structural features may be designed into the packaging system that add strength and integrity to the packaging system or one or more components thereof. For example, the base (or chime in some embodiments), top, and sides of the packaging may all be areas that experience increased shake and external forces during filling, transportation, installation, and use (e.g., dispensing). Accordingly, in one embodiment, added thickness or structural edifices (e.g., bridge tressel design) may be added to support stressed regions of the packaging, which can add strength and integrity to the package. Furthermore, any connection region in the packaging may also experience increased stress during use. Accordingly, any of these such regions may include structural features that add strength through, for example, increased thickness and/or specifically tailored designs. In further embodiments, the use of triangular shapes could be used to add increased strength to any of the above

described structures; however, other designs or mechanical support features may be used.

[047] In some embodiments, the packaging system or one or more components thereof, including any overpack or liner(s), may include reinforcement features, such as but not limited to, a mesh, fiber(s), epoxy, or resin, etc. that may be integrated or added to the packaging system or one or more components thereof, or portions thereof, in order to add reinforcement or strength. Such reinforcement may assist in high pressure dispense applications, or in applications for dispensing high viscosity contents or corrosive contents.

[048] In some embodiments, the packaging system may include level sensing features or sensors. Such level sensing features or sensors may use visual, electronic, ultrasonic, or other suitable mechanisms for identifying, indicating, or determining the level of the contents stored in the packaging system. For example, in one embodiment, the packaging system or a portion thereof may be made from a substantially translucent or transparent material that may be used to view the level of the contents stored therein.

[049] The packaging systems of the present disclosure may include one or more ports, which may be used for the processes of filling and dispensing, and may include, for example: a liquid/gas inlet port to allow a liquid or gas to enter the packaging system; a vent outlet; a liquid/gas outlet; and/or a dispense port to permit the contents of the liner to be accessed. In some embodiments a single port may be used for venting/pressurization and dispense, while in other embodiments one or more ports may be dedicated to dispense while one or more additional ports may be dedicated to venting the liner (e.g., pump or gravity dispense), pressurizing the contents (e.g., direct pressure dispense), or pressurizing the annular space (e.g., indirect pressure dispense). The ports may be provided at any suitable location or locations, and need not all be relatively near one another. In one embodiment, the ports may be provided generally at or near the top of the packaging. In other embodiments the port may be provided generally at the side or bottom of the liner. In a further embodiment, the packaging systems may include a septum which may be positioned in or adjacent a connector (such as those described above) and may seal the packaging thereby securely containing any substance therein. In some embodiments any or all of the ports and/or septum may be sterilized or aseptic. The septum and the

port can be sterilized by any suitable method, for example, by heat, gamma radiation, and/or ethylene oxide treatment.

[050] As described in U.S. Prov. Appl. No. 61/499,254, titled “Substantially Rigid Collapsible Liner, Container and/or Liner for Replacing Glass Bottles, and Flexible Gusseted or Non-Gusseted Liners,” filed June 21, 2011, any of the packaging systems of the present disclosure or one or more components thereof may be shaped or otherwise configured, for example but not limited to, with folding patterns that may include one or more “hard folds” and/or one or more “pre-folds” or “secondary folds” in the rigid collapsible liner, so as to allow them to substantially uniformly collapse in a desirable manner. The overpack may or may also have one or more “hard folds” and/or one or more “pre-folds” or “secondary folds” to allow for a more controlled collapse during dispense. In other embodiments, the packaging systems of the present disclosure or one or more components thereof may include other shaped structures or features, such as honeycomb structures or features in the walls that can be used to control the collapsing pattern of the packaging system or one or more components thereof. In one embodiment, such structures (e.g., folds, honeycombs, etc.) may be used to control collapse of the packaging system or one or more components thereof, such that it collapses radially, without substantially collapsing vertically.

[051] In some embodiments, the packaging systems may be configured to provide ports or channels, such as air flow ports or channels, into the annular space between two layers of the packaging systems, such as between an overpack and a liner or between two liners. The annular space could then be pressurized or vacuumed to provide a minor pressure blanket or vacuum blanket and sealed, and may be done after filling and prior to transportation to the end user. Such pressure or vacuum blanket in the annular space could provide several purposes. One is to provide double containment or extra protection for the contents of the packaging system. Another purpose is to provide an indicator to the end user as to whether the packaging system had been breached or otherwise has failed or been opened.

[052] The packaging system in some embodiments may also include a level sensor or indicator of any suitable type. For example, in one embodiment, a mechanical level indicator could include a substantially transparent or translucent tube operably or integrally connected with a liner-based assembly of the present disclosure and may more particularly be operably or integrally connected in fluid communication with the interior of the liner. The tube may thus be presented with the

same or substantially same interior air pressure as the interior of the liner, and accordingly, in a substantially non-horizontal position, the vertical height of the contents in the liner will be presented at the same or similar vertical height in the indicator tube. Since the indicator tube is transparent or translucent, the vertical height of the contents in the indicator tube may be observable externally, and thus the corresponding remaining amount left in the liner – being at substantially the same temperature and pressure – can also be identified. An example of a type of level indicator that may be used with the present disclosure is included with some versions of the FluoroPure Pressure Vacuum Vessel sold by Entegris, though other suitable types of level indicators are also within the spirit and scope of the present disclosure.

[053] In some embodiments of packaging systems, an expanding or expandable foam material, or other expandable material may be filled or injected into the annular space between two layers of the packaging systems, such as between an overpack and a liner or between two liners. During dispense of the contents of the packaging system, a fluid, such as but not limited to a gas, may be introduced into the annular space, such as through air flow ports or channels described above, causing the expandable material in the annular space to expand. The expanding material in the annular space applies a pressure to the inner liner, collapsing the inner liner and expelling the contents thereof. The expandable foam material or other expandable material may be, but is not limited to, such materials as the expanding foam insulation material sold under the brand name Great Stuff™ by The Dow Chemical Company.

[054] In some embodiments, the packaging system may comprise a single wall overpack or liner. In even further embodiments, the single wall may comprise PEN. In another embodiment, the packaging system may comprise a liner that is made of a flexible glass type or a flexible glass/plastic hybrid. Such flexible glass liner may reduce or eliminate the permeation of oxygen and water into the contents stored therein. A flexible glass liner may also add the ability of withstanding chemicals or chemistries not compatible with other materials, such as PEN or other plastics.

[055] The packaging system, in other embodiments, may be a bag-in-box system, including a liner, made according to any of the embodiments described herein, provided within a box, such as but not limited to, a cardboard box or overpack. Such embodiments may provide a low cost packaging system. In yet further embodiments, the liner may be blow-molded directly inside of the cardboard box or

overpack, which may reduce cost and/or increase simplicity of the packaging. The liner preform may be heated before it is inserted and blow-molded into the cardboard box or overpack. The cardboard box or overpack may take any desirable shape, for example, but not limited to rectangular, cylindrical, spherical, etc.

[056] In one embodiment of the present disclosure shown in Figure 2, a storage and dispense system 200 may include an additional optional packaging element 220, in which the liner and overpack 202 may be positioned. The packaging element 220 may be used to store, transport, and/or carry the liner and overpack 202, in some cases relatively easily. The packaging element 220 may generally be a box configured from a corrugated material, such as but not limited to cardboard. However, in other embodiments, the packaging element 220 may be comprised of any suitable material or combination of materials including paper, wood, metal, glass, or plastic, for example. The packaging element 220 may include one or more reinforcing elements 230 that may provide support and/or stability for the liner and overpack 202 disposed therein. A reinforcing element 230 may be positioned at any appropriate or desired height in the packaging element 220. For example, as may be seen in Figure 2, one reinforcing element 230 may be provided near the top of the body of the overpack and liner 202. However, in other embodiments, one or more reinforcing elements may be positioned at other areas of the overpack, for example at the bottom of the overpack, or the middle of the overpack. In still another embodiment, the reinforcing element may generally fill substantially all of, or some portion of the space not taken up by the liner and overpack. The reinforcing element(s) 230 may be comprised of any suitable material or combination of materials, such as but not limited to the materials listed above for the packaging element. In some embodiments, the reinforcing element(s) 230 may be comprised of the same material as the remainder of the packaging element 220, although use of the same materials is not necessary. The packaging element 220 may also have one or more handles or handle slots/openings 440 that may make the packaging element 220 relatively easy to move and/or carry. The packaging element 220 may be any desired shape, and in some cases may be a generally rectangular box, as shown. A plurality of systems, such as those shown in Figure 2, may be easily and conveniently packed for storage and/or shipping due to the rectangular box shape of the packaging element. Additionally, the packaging element may further protect the liner and overpack disposed therein from exposure, such as exposure to potentially harmful UV rays.

[057] In some embodiments including a packaging element 220, the liner and overpack system may not include a handle or chime because the storage unit 220 may provide handle slots/openings and the support otherwise provided by the chime. Accordingly, a cost associated with the liner and overpack related to the handle and/or chime may be reduced or eliminated in such embodiments. Nonetheless, in other embodiments, the liner and overpack may still include a handle and/or chime in embodiments including a packaging element.

[058] In some embodiments, the packaging system can include features permitting integrated mixing. Such integrated mixing may be useful, for example, when storing and dispensing two phase or emulsive products or contents. Mixing may be provided, for example, via a magnetically coupled stirring rod or stirring plate; however, other stirring mechanisms can be used, such as but not limited to a Tesla turbine, in order to circulate or mix the contents. In some embodiments, the packaging system or one or more components thereof may need to be modified to provide a more wear resistant, or a substantially wear resistant, location for the mixing device. Such wear resistant area may include, but is not limited to, a dimple or a thickened area in the wall of the packaging system or one or more components thereof. In still other embodiments, the packaging system could be configured to mate or be used with a shaker or roller in order to mix the contents stored therein.

[059] In further embodiments, the packaging system could be modified to deliver the contents to a mixing system for use in process. Alternatively, two or more packaging systems could be configured to be connected to one another, or their dispense ports or lines may be connected to one another, so that the contents thereof may be mixed upon dispense. In yet other embodiments, a single packaging system may include a plurality of liners (optionally within a single overpack) and may be configured to mix the contents of two or more of the plurality of liners upon dispense. Such embodiments may be used, for example, with reactive materials dispensing, which may require isolation of components prior to dispense and may require flow control to deliver the right ratio of isolated components. In one embodiment, orifices may be added to the liner and/or overpack and/or connector to control the flow mix ratio. The orifices may be of any configuration, for example, but not limited to concentric, eccentric, circular or oval, for example. There may be one or any other number of orifices. The orifices may determine the flow resistances of different materials, thereby controlling the flow mix ratio.

[060] One example would be systems that polymerize or cross-link on dispense like epoxies, casting compounds such as dental fillers or molds, cleaning agents requiring an oxidizer as a bleach that does not have long term stability when mixed in the full preparation, etc. Generally any scenario where short-lived material would desirably be generated as needed upon mixing could be used with such an embodiment of the present disclosure. In some embodiments, a mixing head or connector may be provided. The mixing head may control the ratio of materials as they are dispensed/mixed. In some embodiments, the mixing head may be able to be cleaned, purged, and/or sterilized. A simplistic embodiment of a mixing head may include orifice plates or constrained volume dip tubes so that the ratio of materials is controlled. However, more complicated mixing heads are suitable for the embodiments of the present disclosure. In other embodiments, a pump, including a portable pump, may be used with, or connected with one embodiment of a packaging system disclosed herein, so as to permit the end user to combine a material or ingredient with the contents of the packaging system upon dispense, or to add a material or ingredient to the packaging system prior to dispense. In still further embodiments, co-blow molded or nested preforms and liners, such as those described in U.S. Prov. Appl. No. 61/506,807, titled "Nested Blow Molded Liner and Overpack and Methods of Making Same," filed July 12, 2011, which was previously incorporated herein, may be used to manufacture a packaging system having greater than two layers. Two or more separate materials may be filled into the spaces between the layers. The packaging system may be configured to mix the separate materials upon dispense.

[061] In other embodiments, the packaging systems of the present disclosure may include baffles, baffling features, or other discontinuities in the interior surface(s) thereof to retard settling of the suspended solids contained therein during storage and/or transportation.

[062] In some embodiments, the packaging system may be designed to pressure dispense the contents thereof with a pressure of down to about 7 psi. In one embodiment, this may be done using an overpack and a liner of appropriate thickness (or thinness) provided therein, such that the thickness of the liner is selected so that the liner collapses at pressures down to about 7 psi, thereby dispensing the contents stored in the liner.

[063] The use of indirect pressure dispense may be advantageous over other dispense methods in some cases. For example, the use of pumps to dispense the contents of a liner can disadvantageously cause bubbling and stress on the material and the system, which may be undesirable because the purity of the contents of the liner may be crucial. Further, in some cases, a higher rate of dispense may be achieved by pressure dispense as opposed to pump dispense. Direct pressure dispense methods, however, can cause gas to be introduced directly to the contents of the liner and can reduce the purity of the contents of the liner. The use of indirect pressure dispense may help avoid or eliminate these problems.

[064] In some embodiments, the dispense connector features may allow for dispense using existing dispense systems, such as existing indirect pressure dispense systems. Generally, such indirect pressure dispense connector features may include a pressurizing gas inlet that generally permits a gas pressure in-line to be inserted through or coupled with the dispense connector and be in fluid communication with the annular space between the liner and the overpack. In such a system, a pressurizing fluid, gas, or other suitable substance may be introduced into the annular space, causing the liner to collapse away from the overpack wall, thereby pushing the contents of the liner out through a liquid outlet. In one embodiment, for example, to dispense liquid stored in the liner, the annular space between the liner and the overpack may be pressurized, as is further described in International Patent Application No. PCT/US2011/055558, filed October 10, 2011 entitled, "Substantially Rigid Collapsible Liner, Container and/or Liner for Replacing Glass Bottles, and Enhanced Flexible Liners," which was previously incorporated herein in its entirety.

[065] As stated above, embodiments of liners of the present disclosure, in some cases, may be dispensed at pressures less than about 100 psi, or more preferably at pressures less than about 50 psi, and still more preferably at pressures less than about 20 psi. In some cases, the contents of the liners of some embodiments, however, may be dispensed at significantly lower pressures, as may be desirable, depending on the intended use or application involved.

[066] In additional embodiments, a dispense assembly, including the connector, may also include control components to control the incoming gas and outgoing liquid. For example, a controller can be operably coupled to control components to control the dispense of the liquid from the liner. One or more transducers may also be included in some embodiments to sense the inlet and/or outlet

pressure. In this regard, such control components may be utilized to detect when the liner is near empty. Means for controlling such dispense of fluid from the liner and determining when a liner nears empty are described for example in U.S. Patent Number 7,172,096, entitled "Liquid Dispensing System," issued February 6, 2007 and PCT Application Number PCT/US07/70911, entitled "Liquid Dispensing Systems Encompassing Gas Removal," with an international filing date of June 11, 2007, each of which is hereby incorporated herein by reference in its entirety, and International Patent Application No. PCT/US2011/055558, previously incorporated by reference in its entirety.

[067] In an additional or alternative embodiment, shown in Figure 3, an empty detect mechanism may include a liner and overpack system 302 that may be operably connected to an indirect pressure dispensing assembly 304. The dispense assembly 304 may include a pressure transducer or sensor 306, a pressure solenoid or other control valve 308, and a vent solenoid or other control valve 310. A microcontroller may be used to control the pressure solenoid 308 and/or the vent solenoid 310. The outlet liquid pressure may be read and measured by the pressure transducer 306. If the pressure is too low, i.e. lower than a set value, the pressure solenoid 308 may be turned on for a period of time (P_{on}), thereby causing more pressurizing gas or other substance to be introduced into the annular space between the overpack and liner and raising the outlet liquid pressure. If the pressure is too high, i.e. higher than a predetermined value, the vent solenoid 310 may be turned on for a period of time (P_{vent}), somewhat relieving the pressure in the annular space between the overpack and liner, and thus the outlet liquid pressure. As may be seen in Figure 4, as the contents of the liner near empty, the liquid pressure drops 410. The drop in liquid pressure triggers the pressure solenoid to turn on for a longer period of time. The increase in the time that the pressure solenoid is turned on (P_{on}) rises rapidly as the liner nears empty 412. Accordingly, the amount of time that the pressure valve is on (P_{on}) may be used to determine when the endpoint of the dispense has been reached.

[068] Alternatively or additionally, the frequency of the on/off switching of the inlet pressure solenoid may be monitored. As indicated above, as the liner approaches empty, the inlet pressure will need to increase in order to maintain the constant liquid outlet pressure. The inlet pressure solenoid may thus switch on/off at a higher frequency as the liner nears empty to permit the required amount of

pressurized gas into the annular space between the liner and the container. This frequency of the on/off switching can be a useful empty detect indicator. Empty detect mechanisms such as those disclosed herein, may help save time and energy, and consequently money.

[069] After dispense is completed or substantially completed and the liner is empty or substantially empty, the end-user may dispose of the liner-based system, and/or recycle or reuse some or all of the liner-based system, including some or all of the closure/connector assembly. In order to assist in making the dispensers described herein more sustainable, the dispensers or one or more components thereof, including any overpack, liner(s), handles, etc., may be manufactured from biodegradable materials or biodegradable polymers, including but not limited to: polyhydroxyalkanoates (PHAs), like poly-3-hydroxybutyrate (PHB), polyhydroxyvalerate (PHV), and polyhydroxyhexanoate (PHH); polylactic acid (PLA); polybutylene succinate (PBS); polycaprolactone (PCL); polyanhydrides; polyvinyl alcohol; starch derivatives; cellulose esters, like cellulose acetate and nitrocellulose and their derivatives (celluloid); etc. Similarly, in some embodiments, and if suitable for the industry application, the dispensers or one or more components thereof may be manufactured from materials that can be recycled or recovered, and in some embodiments, used in another process by the same or a different end user, thereby allowing such end user(s) to lessen their impact on the environment or lower their overall emissions. For example, in one embodiment, the dispensers or one or more components thereof may be manufactured from materials that may be incinerated, such that the heat generated therefrom may be captured and incorporated or used in another process by the same or different end user. In general the dispensers or one or more components thereof may be manufactured from materials that can be recycled, or that may be converted into raw materials that may be used again.

[070] Traditional metering systems can be expensive and utilizing pumps that can cause spikes in pressure and add complexity. In some embodiments, the packaging systems of the present disclosure may permit for pressure dispensing of the contents therein into a metering system, such as a fluid metering system, and can eliminate the need for utilizing pumps or complex components or circuitry for handling spikes in pressure caused by the pump. Accordingly, the overall cost and complexity of a metering system can be reduced.

[071] In further embodiments, flow metering technology may be integrated into the dispense connector for a direct measurement of material being delivered from the packaging system to a downstream process. A direct measurement of the material being delivered could provide the end user with data which may help ensure process repeatability or reproducibility. In one embodiment, the integrated flow meter may provide an analog or digital readout of the material flow. The flow meter, or other component of the system, can take the characteristics of the material (including but not limited to viscosity and concentration) and other flow parameters into consideration to provide an accurate flow measurement. Additionally, or alternatively, the integrated flow meter can be configured to work with, and accurately measure, a specific material stored and dispensed from the packaging system. In one embodiment, the inlet pressure can be cycled, or adjusted, to maintain a substantially constant outlet pressure or flow rate.

[072] In still further embodiments, the packaging system may be provided with other sensors and/or RFID tags, which may be used to track the packaging, as well as to measure usage, pressure, temperature, excessive shaking, disposition, or any other useful data. The RFID tags may be active and/or passive. For example, strain gauges may be used to monitor pressure changes of the packaging. The strain gauges may be applied or bonded to any suitable component of the packaging system. In some embodiments, the strain gauges may be applied to an outer overpack or liner. The strain gauges may be used to determine pressure build-up in an aging product, but may also be useful for a generally simple measurement of the contents stored in the packaging. For example, the strain gauge may be used to alert an end user when to change out a packaging or may be used as a control mechanism, such as in applications where the packaging is used as a reactor or disposal system. In embodiments where the sensitivity of the strain gauge is high enough, it may be able to provide a control signal for dispense amount and flow rate.

[073] Although the various embodiments of the present disclosure have been described with reference to preferred embodiments, persons skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the present disclosure.

Claims

We claim:

1. A packaging system comprising:

a cardboard overpack; and

a liner blow-molded into the cardboard overpack.
2. The packaging system of claim 1, wherein the liner comprises PET.
3. The packaging system of claim 1, wherein the liner comprises PEN.
4. The packaging system of claim 1, wherein the cardboard overpack is a rectangular prism.
5. The packaging system of claim 1, wherein the cardboard overpack is cylindrical.
6. The packaging system of claim 1, wherein the liner is collapsible upon at least one of a vacuum applied to the interior thereof or a pressure applied to the space between the overpack and liner.
7. A packaging system comprising:

a substantially rigid blow-molded overpack;

a blow-molded liner positioned within the overpack; and

at least two separate ports arranged on the substantially rigid overpack, the at least two separate ports providing separate access to within the overpack for dispensing contents of the liner and pressurizing at least one of the interior of the liner or the annular space between the overpack and liner.
8. The packaging system of claim 1, wherein the liner is collapsible upon application of pressure to the annular space between the overpack and liner via

a first of the at least two separate ports and a second of the at least two ports is configured for dispense of the contents of the liner upon collapse of the liner.

9. The packaging system of claim 1, wherein a first of the at least two ports permits access to the interior of the liner for application of pressure directly to the interior thereof and a second of the at least two ports is configured for dispense of the contents of the liner upon application of pressure via the first of the at least two ports.

10. The packaging system of claim 1, wherein a first of the at least two ports is configured for dispense of the contents of the liner via gravity dispense and a second of the at least two ports provides a vent between the interior of the liner and an exterior of the overpack.

11. A packaging system comprising:

a substantially rigid blow-molded overpack; and

a blow-molded liner positioned within the overpack;

wherein at least one of the overpack and liner comprises a material having a glass transition temperature above 50 °C.

12. The packaging system of claim 11, wherein the overpack comprises a material having a glass transition temperature above 50 °C.

13. The packaging system of claim 11, wherein the overpack consists of material having a glass transition temperature between 50 – 120 °C.

14. The packaging system of claim 11, wherein the liner comprises a material having a glass transition temperature above 50 °C.

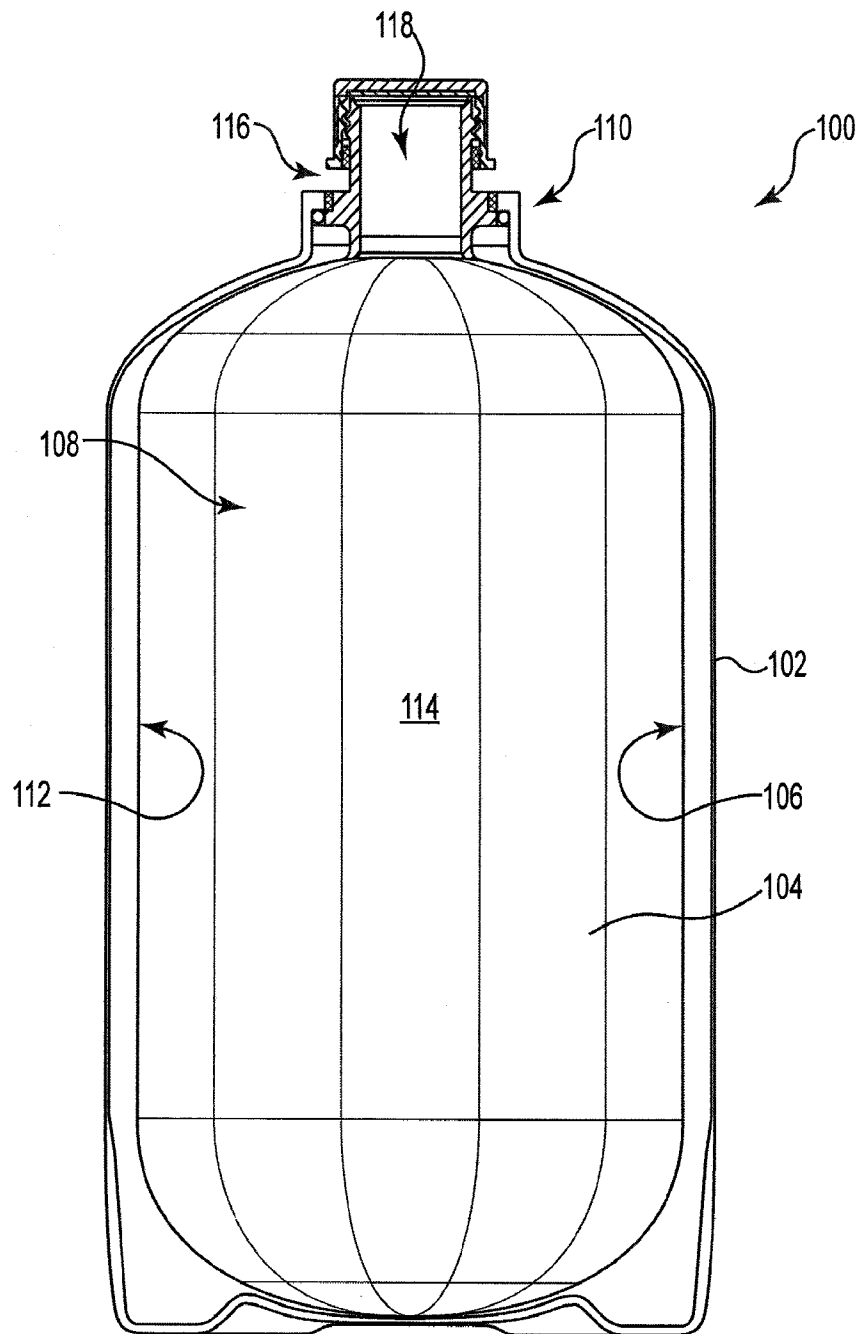


Fig. 1

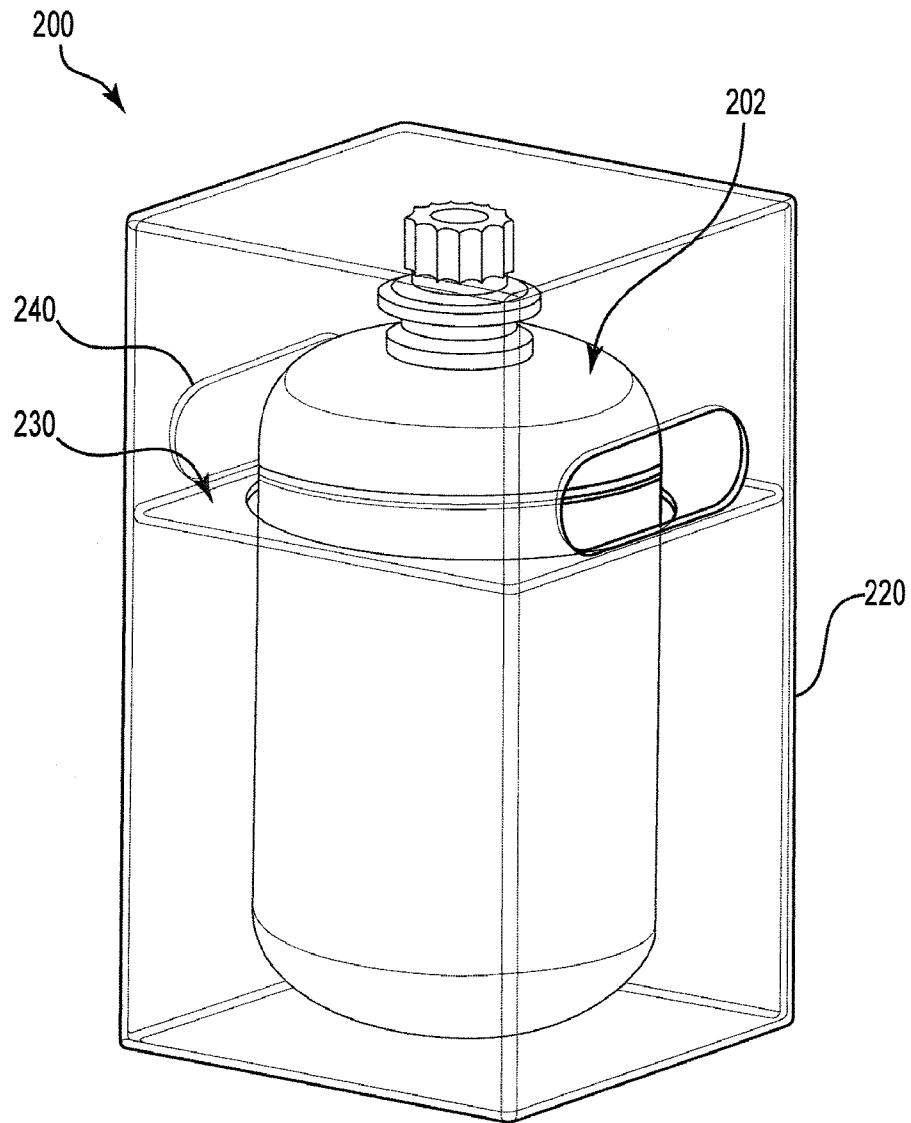


Fig. 2

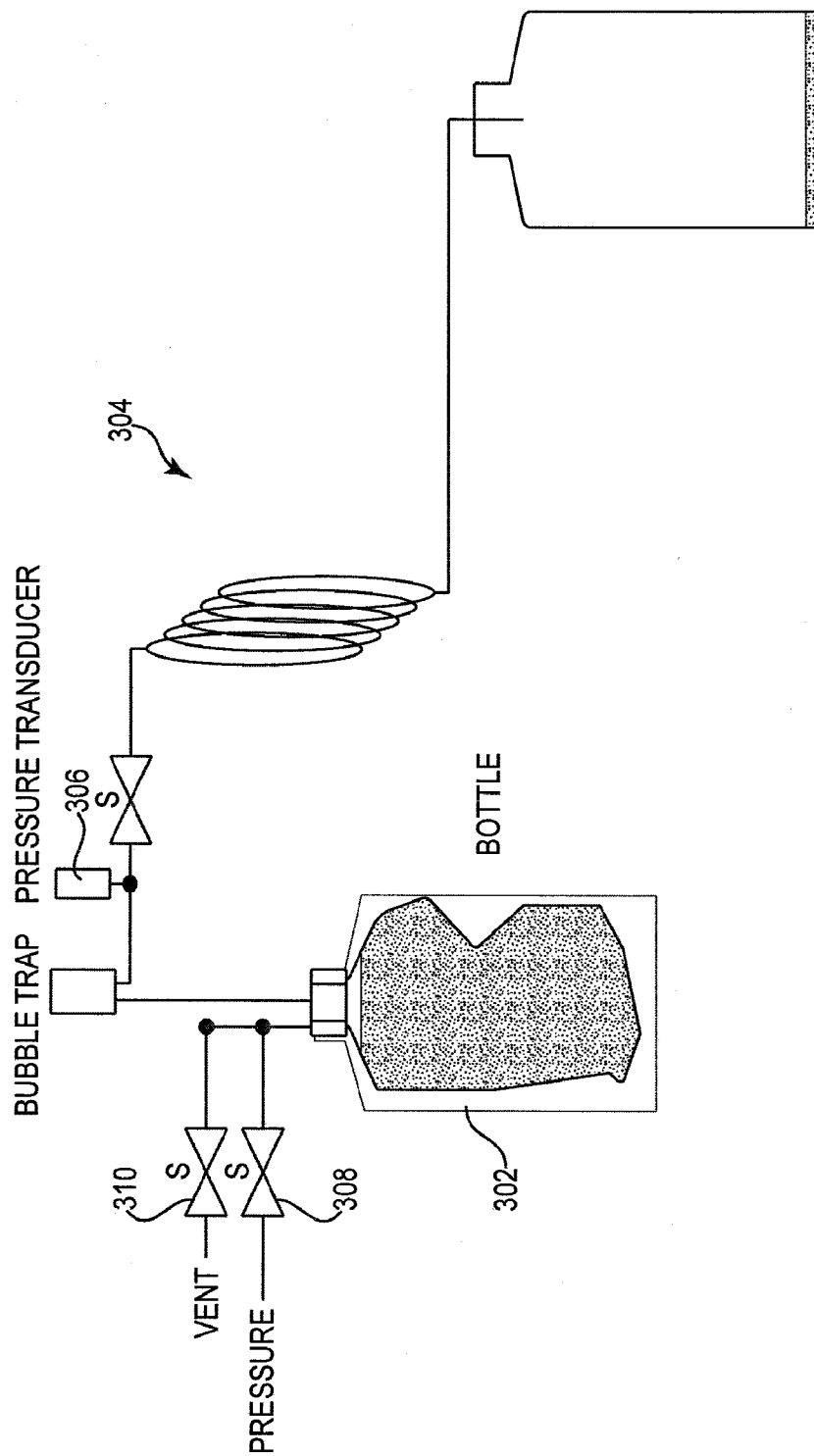


Fig. 3

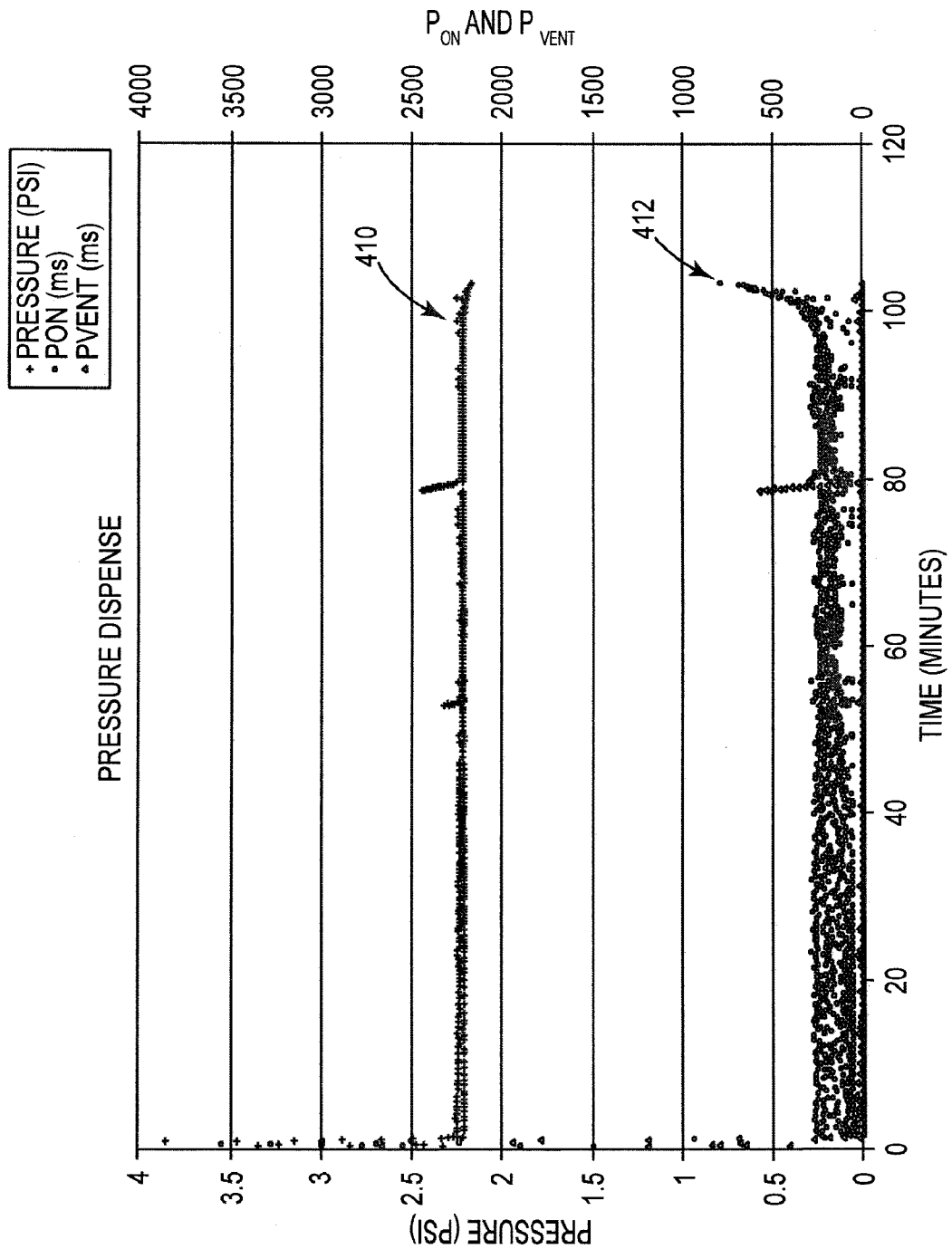


Fig. 4