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LINER FOR AN OVERPACK ASSEMBLY

Abstract

An overpack assembly and a method of making an overpack assembly is disclosed. The overpack assembly includes a liner positioned within an overpack. In one embodiment, the method includes making a liner including providing a first sheet including a fitment positioned over a second sheet, the first sheet attached to the second sheet along an attachment seam at an entire perimeter edge. The first sheet is pulled apart from the second sheet at a center of the liner, forming a three-dimensional liner with triangular wings. A vertical seam is formed across each triangular wing, the vertical seam being perpendicular to the attachment seam, where a length of the vertical seam corresponds to the height of the liner when in use. The liner is positioned within the overpack.

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Background/Summary

RELATED APPLICATIONS [0001] This application is a divisional of U.S. patent application Ser. No. 17/962,250 filed Oct. 7, 2022, which is a divisional of U.S. patent application Ser. No. 16/696,748 filed Nov. 26, 2019 (now U.S. Pat. No. 11,498,738 issued Nov. 26, 2019), which claims priority to and the benefit of U.S. Provisional Application No. 62/785,020 filed Dec. 26, 2018, all of which are incorporated herein by reference in their entirety for all purposes.

TECHNICAL FIELD
[0002] This disclosure generally relates to liners for use with overpack assembly and methods of making such liners.
BACKGROUND
[0003] Overpack assemblies are used for storing, shipping, and dispensing materials. One type of storage and dispensing system includes an overpack assembly having a liner positioned within an overpack. The liner is filled with a material that may be stored, shipped, and then dispensed at a later time. Such overpack assemblies have been termed a bag in a bottle system.
[0004] Some liners used in bag-in-a bottle systems are formed as a two-dimensional bag. Two flat pieces or material sheets are secured together at the edges. A connector, in some applications known as a fitment, may be located along one of the liner edges. The fitment allows fluid access in and out of the two-dimensional liner bag. In typical applications, the two-dimensional liners are used for storing, shipping, and dispensing materials in a three-dimensional container such as a bottle or rectangular-shaped overpack. Positioning two-dimensional liners in three-dimensional containers can result in dispensability problems, volume optimization, and structural concerns due to wrinkles and creases in the liner. Further, cleanliness issues may exist due to problems with cleaning the liners.
SUMMARY
[0005] This disclosure generally relates to liners for use with overpack assembly and methods of making such liners.
[0006] In one embodiment, a method of making an overpack assembly includes making a liner by providing a first sheet including a fitment positioned over a second sheet, the first sheet attached to the second sheet along an attachment seam at an entire perimeter edge, and pulling the first sheet apart from the second sheet at a center of the liner, forming a three-dimensional liner with triangular wings. The first sheet and second sheet can be square-shaped. The liner is then positioned within an overpack. In one embodiment, the method includes folding the liner for positioning the liner in the overpack. In some embodiments, a vertical seam is formed across each triangular wing, the vertical seam being perpendicular to the attachment seam, where a length of the vertical seam corresponds to the height of the liner when in use. In some cases, each triangular wing can be flattened prior to forming the vertical seam. The vertical seam can be welded. In certain cases, each triangular wing can be truncated along the vertical seam to form truncated triangular wings, and each truncated triangular wing can be folded inward towards a central axis of the liner prior to positioning the liner within the overpack. The method can include positioning the fitment in an opening of the overpack. The overpack can include a neck having an opening and a retainer can be positioned about the fitment to secure the liner within the overpack. A connector

assembly can be coupled to the fitment to secure the liner within the overpack. The liner can be inflated and filled with a desired material.
[0007] In other embodiments, a method of making an overpack assembly having a three-dimensional liner includes making a liner by providing a two-dimensional liner including a first rectangular sheet with a fitment positioned over a second rectangular sheet, the first rectangular sheet attached to the second rectangular sheet along an attachment seam at a perimeter edge, and pulling the first rectangular sheet apart from the second rectangular sheet at a center of the two-dimensional liner, forming the three-dimensional liner with triangular wings. The liner is then positioned within an overpack.
[0008] In one embodiment, pulling the first rectangular sheet apart from the second rectangular sheet is done along a central axis generally orthogonal to the first rectangular sheet and the second rectangular sheet, causing the attachment seam to fold inward toward the central axis creating the triangular wings. The triangular wings can be flattened, and a side seam can be across each triangular wing, the side seam being spaced from and parallel to the central axis. In certain embodiments, the triangular wing can be truncated along each side seam. The side seams can be formed by forming a weld band. A welding device can be used to form the side seams. The first rectangular sheet and the second rectangular sheet can be defined to be square-shaped and, in some embodiments, can be formed form a fluoropolymer. The finished liner can be inserted into an overpack, inflated and filled with a desired material.
[0009] According to various other embodiments, an overpack assembly includes an overpack; and a liner positioned within the overpack. The overpack can be rectangular-shaped or cylindrical shaped. The liner can include a box-shaped liner body made of a fluoropolymer material having a top surface, a bottom surface, and four side surfaces; a liner seam extending substantially horizontally across the middle of each of the four side surfaces; a side seam extending vertically between each adjacent side surface; and a fitment extending from the top surface. In one embodiment, the liner seam and each side seam are a weld seam. In some embodiments, an interface between the top surface and each side surface is void of a seam, and/or an interface between the bottom surface and each side surface is void of a seam.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0010] The disclosure may be more completely understood in consideration of the following description of various illustrative embodiments in connection with the accompanying drawings
[0011] FIG. **1** is a perspective view of an overpack assembly in accordance with an embodiment of the disclosure.
[0012] FIG. **2** is a perspective view of a liner suitable for use in an overpack assembly in accordance with an embodiment of the disclosure.
[0013] FIG. **3** is a block diagram of a method of making a liner suitable for use in an overpack assembly in accordance with an embodiment of the disclosure.
[0014] FIG. **4** is a diagram illustrating one step of a method making a liner including a first sheet positioned over a second sheet in accordance with an embodiment of the disclosure.
[0015] FIG. **5** is a cross-sectional view of the liner shown in FIG. **4** taken along line **5**-**5**.
[0016] FIG. **6** is a diagram illustrating one step of a method of making a liner including forming a three-dimensional liner in accordance with an embodiment of the disclosure.
[0017] FIG. **7** is a top view of the liner shown in FIG. **6**.
[0018] FIG. **8** is a diagram illustrating one step of a method of making a liner in accordance with an embodiment of the disclosure.
[0019] FIG. **9** is a diagram illustrating one step of a method of making a liner including forming

vertical seams in accordance with an embodiment of the disclosure.
[0020] FIG. **10** is a diagram illustrating one step of a method of making a liner including truncating the triangular wings illustrated in FIG. **9** in accordance with an embodiment of the disclosure.
[0021] FIG. **11** is a top view of the liner of FIG. **9**.
[0022] FIG. **12** is a perspective view of a liner in an expanded state in accordance with an embodiment of the disclosure.
[0023] FIG. **13** is a diagram illustrating one step of a method of making a liner having a rectangular shape in accordance with an embodiment of the disclosure.
[0024] FIG. **14** is a cross-sectional view of the liner of FIG. **13** taken along line **14-14**.
[0025] FIG. **15** is a diagram illustrating one step of a method of making a liner including forming vertical seams in accordance with an embodiment of the disclosure.
[0026] FIG. **16** is a diagram illustrating one step of a method of making a liner including truncating the triangular wings of the liner shown in FIG. **15** in accordance with an embodiment of the disclosure.
[0027] FIG. **17** is a perspective view of a rectangular-shaped liner in an expanded state.
[0028] FIG. **18** is a diagram illustrating one step of a method of folding a liner for positioning within an overpack in accordance with an embodiment of the disclosure.
[0029] FIG. **19** is a diagram further illustrating one step of a method of folding a liner for positioning the liner in an overpack in accordance with an embodiment of the disclosure.
[0030] FIG. **20** is a diagram illustrating one step of a method of making an overpack assembly, including inserting a folded liner in an overpack.
[0031] FIG. **21** is a perspective view of an overpack assembly, including a liner positioned in an overpack, where the liner is in an expanded state within the overpack in accordance with an embodiment of the disclosure.
[0032] FIG. **22** is a diagram illustrating one example of an overpack assembly, including a liner positioned in an overpack, where the liner is in an expanded state within the overpack.
[0033] While the disclosure is amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit aspects of the disclosure to the particular illustrative embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the disclosure.
DETAILED DESCRIPTION
[0034] The following detailed description should be read with reference to the drawings in which similar elements in different drawings are numbered the same. The detailed description and the drawings, which are not necessarily to scale, depict illustrative embodiments and are not intended to limit the scope of the invention. The illustrative embodiments depicted are intended only as exemplary. Selected features of any illustrative embodiment may be incorporated into an additional embodiment unless clearly stated to the contrary.
[0035] As used in this specification and the appended claims, the singular forms “a”, “an”, and “the” include plural referents unless the content clearly dictates otherwise. As used in this specification and the appended claims, the term “or” is generally employed in its sense including “and/or” unless the content clearly dictates otherwise.
[0036] The term “about” generally refers to a range of numbers that is considered equivalent to the recited value (e.g., having the same function or result). In many instances, the term “about” may include numbers that are rounded to the nearest significant figure.
[0037] Numerical ranges expressed using endpoints include all numbers subsumed within that range (e.g. 1 to 5 includes 1, 1.5, 2, 2.75, 3, 3.80, 4 and 5).
[0038] Directional terminology, such as “top,” “bottom,” “front,” “back,” “leading,” “trailing,” etc., is used with reference to the orientation of the Figure(s) being described. Because components of embodiments of the present invention can be positioned in a number of different orientations, the

directional terminology is used for purposes of illustration and is in no way limiting.
[0039] An overpack assembly and method of making an overpack assembly is disclosed. The overpack assembly includes a liner positioned within an overpack. In one embodiment, the overpack assembly includes a liner that is a three-dimensional liner formed from a simple two-dimensional liner, without the need for complex side weld seams or attachments. The liner can be filled with a material for storage, shipping, and/or dispensing at a later time. The liner is operably positioned within a more rigid outer container termed an overpack.
[0040] FIG. **1** illustrates one embodiment of an overpack assembly generally at **100**. The overpack assembly **100** can be used as part of a “bag in a bottle” (BIB) or “bag in a can” (BIC) system. In the illustrative embodiment, the overpack assembly **100** includes a liner **101** positioned within an overpack **102** (i.e., a container). The overpack **102** has a shape suitable for its intended use. In one illustrative embodiment, the overpack **102** has a rectangular shape. In another embodiment, the overpack **102** has different shape such as a round or cylindrical shape.
[0041] Liner **101** is a three-dimensional liner formed from a two-dimensional liner. The liner **101** is suitable for being filled with a material for storage, shipping, and/or dispensing at a later time. Liner **101** includes a liner body **104**. A fitment **106** extends from the liner body **104**. A retainer (not shown) aids in retaining the fitment within an opening in overpack **102**. In one embodiment, the fitment **106** cooperates with a connector assembly **108** for use in transferring material in and out of the liner body **104** positioned with the overpack **102**. One example of fitment suitable for use with liner **101** is available under the registered trademark NOWPAK® from Entegris of Billerica, Massachusetts.
[0042] In one embodiment, connector assembly **108** includes a cap **110**, dispensing tube **112** and fill tube **114**. One suitable cap for use with connector assembly **110** is available under the tradename SmartCap from Entegris of Billerica, Massachusetts.
[0043] Embodiments of an overpack assembly **100** including liner **101** and methods of making an overpack assembly **100** including liner **101** an overpack **102** are described in detail further in this specification.
[0044] FIG. **2** is a perspective view further illustrating one embodiment of liner **101** suitable for use with overpack assembly **100**. Liner **101** is a three-dimensional liner formed from a two-dimensional liner. Liner **101** includes liner body **104**, illustrated in an expanded shape. In one embodiment, liner **101** has a box shape. When positioned within a container such as an overpack, liner **101** is expanded and will generally take on the interior shape of the container. Typical overpack containers have an interior shape that is a geometrical shape, such cylindrical or box shaped sidewalls, and may also have a shaped bottom such as a flat or rounded bottom.
[0045] In the illustrated embodiment of FIG. **2**, liner body **104** includes four sides **124**-liner side **132**, liner side **134**, liner side **136** and liner side **138**. Liner perimeter seam **126** extends across all four sides **124**-including liner side **132**, liner side **134**, liner side **136** (on backside indicated by dashed arrow) and liner side **138** (on back side indicated by dashed arrow) along a common seam line indicated at **140**. In the illustrated embodiment, liner side **132** includes top panel **142** and bottom panel **143**; liner side **134** includes top panel **144** and bottom panel **145**. Liner perimeter seam **126** secures top panel **142** to bottom panel **143**, and secures top panel **144** to bottom panel **145** along seam line **140**.
[0046] Each adjacent side **124** is secured to each other via a vertical side seam **128**. In liner body **104**, vertical side seams **128** extend from top **120** to bottom **122**. In one embodiment, side seam **150** secures liner side **138** to liner side **132**; side seam **152** secures liner side **132** to liner side **134**; side seam **154** secures liner side **134** to liner side **136**; and side seam **156** secures liner side **136** to liner side **138**. The length of vertical side seams **128** corresponds to the height of liner **100** when the liner **100** is in an expanded state (i.e., when in use and filled with a desired material).
[0047] A seamless transition exists between the top **120** and the four sides **124**. In a similar manner, a seamless transition exists between the bottom **122** and the four sides **124**. In other embodiments,

seams could exist between the top **120** and four sides **124**, and between the bottom **122** and the four sides **124**.

[0048] In one embodiment, the liner perimeter seam **126** and side seam **128** are welded seams. As a result of this seam configuration, perimeter seam **126** across liner side **132** is folded upward from seam line **140**, indicated by arrow **160**, and perimeter seam **126** across liner side **134** is folded downward, indicated by arrow **162**. In other embodiment, perimeter seam **126** may be folded in different directions or fold in the same direction across the four sides **124**. In other embodiments, excess material from perimeter seam **126** may be removed.

[0049] Typical storage materials include gas or liquid storage materials. In one embodiment, the liner is used as part of an overpack assembly to store a liquid reagent for semiconductor manufacturing. In another embodiment, the liner **101** is used to store materials used in the health care or medical industry. The liner **101** may or may not be a re-useable liner.

[0050] The liner body **104** is made of a flexible film material. In various embodiments, the flexible film material is a polymeric material. Suitable polymeric materials include polyethylene, polytetrafluoroethylene, polypropylene, polyurethane, polyvinylidene chloride, polyvinylchloride, polyacetal, polystyrene, polyacrylonitrile, and polybutylene. In one embodiment, the liner body **104** is made of a polytetrafluoroethylene (PTFE). In other embodiments, the liner body **104** can be made of a combination of materials or a number of material layers. The material layers may be different materials. The fitment, retainer and overpack (See FIG. **1**) are made of a generally rigid polymeric material. In one embodiment, the fitment is made of injection molded natural virgin PFA, the retainer is made of injection molded natural virgin HDPE, and the overpack is made of injection molded LDPE. In other embodiment, the fitment, retainer and overpack are made of other materials.

[0051] Any suitable thickness of liner body **104** is contemplated by the present disclosure. For example, the liner body **104** can have an overall thickness of about 80 microns to 280 microns. The liner body **104** can have a greater thickness (e.g., 200 microns) or a relatively smaller thickness (e.g., 100 microns), based on the type of material, amount of material, and overpack used for the storage, transportation and dispensing of the material.

[0052] FIG. **3** is a flow diagram at **200** illustrating one embodiment of a method of making an overpack assembly including a liner. The liner can be similar to the liner **101** previously described herein. At **202**, a liner is formed including positioning a first sheet over a second sheet. The first sheet is attached to the second sheet along an attachment seam at an entire perimeter edge. In one embodiment, the first sheet includes a fitment. At **204**, the first sheet is pulled apart from the second sheet at a center of the liner, forming a three-dimensional liner with triangular wings. At **206**, a vertical seam is formed across each triangular wing. In one embodiment, the vertical seam is perpendicular to the attachment seam. A length of the vertical seam corresponds to the height of the liner when in use (i.e., when the liner is in an expanded state). At **208**, the liner is positioned within an overpack.

[0053] FIGS. **4**-**12** illustrate in detail one embodiment of a method of making a liner suitable for use with an overpack assembly, including making a three-dimensional liner from a two-dimensional liner. The liner is similar to liner **101** previously described in this specification. In FIG. **4**, a first sheet **210** is positioned over a second sheet **212** (See FIG. **5**). In this embodiment, first sheet **210** and second sheet **212** have a square shape. First sheet **210** includes a fitment **214**. In one embodiment, the fitment **214** is centrally located on first sheet **210**. First sheet **210** is attached to the second sheet **212** along an attachment seam at an entire perimeter edge, indicated as liner perimeter seam **216**. In one embodiment, liner perimeter seam **216** is a welded seam, and is formed by welding the first sheet **210** to the second sheet **212**.

[0054] FIG. **5** is a diagram illustrating one embodiment of a cross-sectional view taken along **5**-**5** of FIG. **4**. First sheet **210** is pulled apart from second sheet **212** at a center of the liner, indicated by central arrows **218**, **220**. First sheet **210** is pulled relative to second sheet **212**. As such, both sheets

210 and **212** may be pulled apart in opposite directions by pulling first sheet at a central location in a first direction, indicated by arrow **218**, and at the same time pulling second sheet **212** at a central location in an opposite direction, indicated by arrow **220**. Alternatively, one sheet can be held steady (e.g., sheet **212**) and the other sheet can be pulled at a center of the liner (e.g., sheet **210**).

[0055] FIG. **6** is a diagram illustrating one embodiment of making a liner after first sheet **210** is pulled apart from second sheet **212**. By pulling first sheet **210** apart from second sheet **212** along central axis **222**, a three-dimensional liner **230** is formed with triangular wings **232**. In the illustrative embodiment, the triangular wings **232** include triangular wing **234**, triangular wing **236**, triangular wing **238**, and triangular wing **240**. FIG. **7** is a diagram illustrating one embodiment of a top view of the liner of FIG. **6**. Each triangular wing **234**, **236**, **238**, and **240** extends outward from central axis **222**. Pairs of triangular wings are flattened against each other to form a flattened liner **230**. Triangular wing **234** is flattened against triangular wing **240**, indicated by directional arrow **242**. Triangular wing **236** is flattened against triangular wing **240**, indicated by directional arrow **244**. FIG. **8** is a diagram illustrating one embodiment of liner **230** in a flattened position. Triangular wing **234** is flattened against triangular wing **240**. Triangular wing **236** is flattened against triangular wing **238**.

[0056] FIG. **9** is a diagram illustrating one embodiment of making a liner including forming vertical seams in the liner. A vertical seam is formed across each triangular wing. The length of the vertical seam corresponds to the final height of the liner when it is in an expanded state. In one illustrative embodiment, vertical seam **250** is formed on triangular wing **234** and vertical seam **252** is formed on triangular wing **236**. In one embodiment, vertical seam **250** and vertical seam **252** are substantially perpendicular to perimeter seam **216**. In other embodiments, vertical seam **250** and vertical seam **252** are not substantially perpendicular to perimeter seam **216**. In a similar manner, vertical seams are also formed on triangular wing **238** and triangular wing **240**. In one or more embodiments, the vertical seams are formed using a seam welding process.

[0057] FIG. **10** is a diagram illustrating one embodiment of making a liner including truncating the triangular wings illustrated in FIG. **9**. Reference is also made to FIG. **11** which is a top view of the liner of FIG. **10** when each of the triangular wings are extending from a central axis. Each triangular wing is truncated along its vertical seam. Triangular wing **234** is truncated along vertical seam **250**; triangular wing **236** is truncated along vertical seam **252**; triangular wing **238** is truncated along vertical seam **254**; and triangular wing **240** is truncated along vertical seam **256**. Liner **230** is now complete and ready for use.

[0058] FIG. **12** is a diagram illustrating one embodiment of a completed liner in an expanded state, as it would appear within an overpack. As liner **230** is filled with a material or air (illustrated by fill arrow **260**), the liner **230** sides expand outward from central axis **222** (illustrated by expansion arrows **262**, **264**, **266**, **268**). In an expanded state, the liner **230** is generally box shaped and has a generally square-shaped top and a generally square-shaped bottom. When positioned within an overpack, it is recognized that the liner will take on the internal shape of the overpack.

[0059] The completed liner **230** is similar to the liner **101** previously described in detail herein. Liner **230** includes liner body **274** having a liner top **280**, a liner bottom **282**, and four sides **284**. A liner perimeter seam **216** extends substantially horizontally across the four sides **284**. A side seam **252**, **254**, **256**, **258** extends vertically between each corresponding adjacent side **290**, **292**, **294**, **296**. Fitment **214** extends from top **280**. A seamless transition exists between the top **280** and the four sides **284**. In a similar manner, a seamless transition exists between the bottom **282** and the four sides **284**. With this configuration, completed liner **230** is a three-dimensional liner that is formed from a two-dimensional liner allowing for easy assembly and use.

[0060] It is recognized that the liner in accordance with this disclosure can vary in shape based in using different design parameters, and still be within the scope of this specification. FIGS. **13-17** are diagrams illustrating one embodiment of a method of making a liner having a box shape with a rectangular-shaped top and bottom. The liner is similar to the liner assemblies previously described

herein.
[0061] FIG. **13** illustrates one embodiment of making a three-dimensional rectangular liner from a two-dimensional liner generally at **300**. A first sheet **310** is positioned over a second sheet **312** (See also FIG. **14**). In this embodiment, first sheet **310** and second sheet **312** have a rectangular shape. First sheet **310** includes a fitment **314**. In one embodiment, the fitment **314** is centrally located on first sheet **310**. First sheet **310** is attached to the second sheet **312** along an attachment seam at an entire perimeter edge, indicated as liner perimeter seam **316**. In one embodiment, liner perimeter seam **316** is a welded seam, and is formed by welding the first sheet **310** to the second sheet **312**.
[0062] FIG. **14** is a diagram illustrating one embodiment of a cross-sectional view taken along **14-14** of FIG. **13**. To form a three-dimensional liner from a two-dimensional liner, first sheet **310** is pulled apart from second sheet **312** at a center of the liner, indicated by central arrows **318**, **320**. First sheet **310** is pulled relative to second sheet **312**. As such, both sheets **310** and **312** may be pulled apart in opposite directions by pulling first sheet at a central location in a first direction, indicated by arrow **318**, and at the same time pulling second sheet **312** at a central location in an opposite direction, indicated by arrow **320**. Alternatively, one sheet can be held steady (e.g., sheet **312**) and the other sheet can be pulled at a center of the liner (e.g., sheet **310**).
[0063] FIG. **15** is a diagram illustrating one embodiment of making a liner after first sheet **310** is pulled apart from second sheet **312**. By pulling first sheet **310** apart from second sheet **312** along central axis **322**, a three-dimensional liner **330** is formed with wings **332**. In the illustrative embodiment, the wings **332** include wing **334**, wing **336**, wing **338** (indicated by dashed arrow and hidden from view), and wing **340** (indicated by dashed arrow and hidden from view). Each wing **334**, **336**, **338**, and **340** extends outward from central axis **322**. Pairs of wings are flattened against each other to form a flattened liner **330**. Wing **334** is flattened against wing **340**. Wing **336** is flattened against wing **340**.
[0064] Vertical seams are formed in the liner. A vertical seam is formed across each wing. The length of the vertical seam corresponds to the final height of the liner when it is in an expanded state. In one illustrative embodiment, vertical seam **350** is formed on wing **334** and vertical seam **352** is formed on wing **336**. In one embodiment, vertical seam **350** and vertical seam **352** are substantially perpendicular to perimeter seam **316**. In other embodiments, vertical seam **350** and vertical seam **352** are not substantially perpendicular to perimeter seam **316**. In a similar manner, vertical seams are also formed on wing **338** and wing **340**. In one or more embodiments, the vertical seams are formed using a seam welding process.
[0065] FIG. **16** is a diagram illustrating one embodiment of making a liner including truncating the wings illustrated in FIG. **15**. Each wing is truncated along its vertical seam. Wing **334** is truncated along vertical seam **350**; Wing **336** is truncated along vertical seam **352**; Wing **338** is truncated along vertical seam **354**; and Wing **340** is truncated along vertical seam **356**. Liner **330** is now complete and ready for use.
[0066] FIG. **17** is a diagram illustrating one embodiment of a completed liner in an expanded state, as it would be when positioned for use within an overpack. As liner **330** is filled with a material or air (illustrated by fill arrow **360**), the liner **330** sides expand outward from central axis **322** (illustrated by expansion arrows **362**, **364**, **366**, **368**). In an expanded state, the liner **330** is generally box shaped and has a generally rectangular-shaped top and a generally rectangular-shaped bottom.
[0067] The completed liner **330** is similar to the liners **101** and **230** previously described in detail herein. Liner **330** includes liner body **374** having a liner top **380**, a liner bottom **382**, and four sides **384**. A liner perimeter seam **316** extends substantially horizontally across the four sides **384**. A side seam **352**, **354**, **356**, **358** extends vertically between each corresponding adjacent side **390**, **392**, **394**, **396**. Fitment **314** extends from top **380**. A seamless transition exists between the top **380** and the four sides **384**. In a similar manner, a seamless transition exists between the bottom **382** and the four sides **384**. With this configuration, completed liner **330** is a three-dimensional liner that is

formed from a two-dimensional liner allowing for easy assembly and use.
[0068] In use, the liner may be inserted into the overpack when the liner is in a collapsed state through a neck of the overpack. Once the liner has been positioned inside the overpack, the liner may be expanded to an expanded state. In some embodiments, the liner may be inflated with a clean gas, for example, N**2**, or clean dry air, prior to filling the liner with the desired material. In other embodiments, the liner may be expanded with a chemical or the chemical or material to be filled. After the liner has been filled with the desired material, the closure and/or connector assembly for the overpack may be detachably secured to the fitment of the liner. The system may be then shipped to a desired location or stored until shipped. Upon arrival at a desired location, the contents of the liner may be dispensed.
[0069] Liners of the present disclosure are relatively easier to insert into an overpack than traditional liners as a result of the advantageous method of folding the liner prior to insertion as disclosed herein. FIGS. **18**-**22** illustrate one embodiment of a process of folding a liner in accordance with the present disclosure, and inserting the liner into a container such as an overpack. It is understood that the terms bottom, top, upward, downward, outward, inward etc. are not intended to limit the present disclosure, but are used to describe a particular embodiment.
[0070] FIG. **18** is a diagram illustrating one embodiment of a method of making an overpack assembly, including folding a liner for positioning the liner in an overpack. The liner can be similar to liner **230** previously described in this specification. Each of the truncated wings are individually folded inward towards the center of liner **230**. In one illustrative embodiment, wing **234** is folded inward towards central axis **222**. In a similar manner, wing **236** is also shown folded inward towards central axis **222**. In reference also to FIG. **19**, this method is continued until all of the wings **234**, **236**, **238**, and **240** are folded inward towards central axis **222**.
[0071] Next, as illustrated in FIG. **20**, liner **230** is at least partially folded and inserted into an opening in overpack **400**. In this embodiment, the overpack **400** is a cylindrically shaped container. Overpack **400** includes a neck **402** having an opening **404**. The liner **230** is inserted into the overpack **400** through opening **404**. In reference also to FIG. **21**, a retainer **410** is positioned about fitment **214**. Retainer **410** is configured to secure the liner **230** in overpack **400** by retaining the fitment **214** within the neck **402**. Liner **230** is now positioned securely within overpack **400**.
[0072] FIG. **22** is a diagram illustrating one embodiment of an overpack assembly **500** including liner **230** positioned within overpack **400** in an expanded state. Once the liner **230** has been securely positioned inside overpack **400**, the liner may be expanded to an expanded state. Once expanded, the liner **230** takes on the interior shape of the overpack. As such, when inflated a rectangular-shaped liner will take on a rectangular shape when positioned within a rectangular-shaped overpack. That same liner will take on a cylindrical shape when positioned within an overpack having an interior with a cylindrical shape overpack.
[0073] In some embodiments, the liner may be inflated with a clean gas, for example, N**2**, or clean dry air, prior to filling the liner with the desired material. In other embodiments, the liner may be expanded with a chemical or the chemical or material to be filled. After the liner has been filled with the desired material, the closure and/or connector assembly for the overpack may be detachably secured to the fitment of the liner. The system may be then shipped to a desired location or stored until shipped. Upon arrival at a desired location, the contents of the liner may be stored or dispensed.
[0074] Having thus described several illustrative embodiments of the present disclosure, those of skill in the art will readily appreciate that yet other embodiments may be made and used within the scope of the claims hereto attached. Numerous advantages of the disclosure covered by this document have been set forth in the foregoing description. It will be understood, however, that this disclosure is, in many respects, only illustrative. Changes may be made in the details, particularly in matters of shape, size, and arrangement of parts without exceeding the scope of the disclosure.

The disclosure's scope is, of course, defined in the language in which the appended claims are expressed.

Claims

1. An overpack assembly comprising: an overpack; and a liner positioned within the overpack, the liner comprising: a box shaped liner body made of a fluoropolymer material having a top surface, a bottom surface, and four side surfaces; a liner seam extending substantially horizontally across the middle of each of the four side surfaces; a side seam extending vertically between each adjacent side surface; and a fitment extending from the top surface.
2. The liner of claim 1, where the liner seam and each side seam are a weld seam.
3. The liner of claim 1, where an interface between the top surface and each side surface is void of a seam.
4. The liner of claim 1, where an interface between the bottom surface and each side surface is void of a seam.
5. The liner of claim 1, where the overpack is rectangular-shaped.
6. The liner of claim 1, where the overpack is cylindrical shaped.