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### Reinforced paperboard tray, method for manufacturing a reinforced paperboard tray, and method for using a paperboard tray

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#### Abstract

A reinforced paperboard tray includes a coated paperboard in the form of a bottom wall, a side wall extending upwardly around the bottom wall, and a curved flange extending outwardly around the side wall. The coated paperboard includes a single-ply paperboard substrate having a first major side and a second major side, the first major side corresponding to an upper side of the bottom wall, and a barrier coating on the first major side of the single-ply paperboard substrate. A paperboard reinforcement is attached to the curved flange.

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## Background/Summary

**PRIORITY (1)** This application claims priority from U.S. Ser. No. 62/940,506 filed on Nov. 26, 2019, the entire contents of which are incorporated herein by reference.

### FIELD

(1) The present application relates to the field of trays suitable for food packaging, particularly trays suitable for overwrapping of moist food products into a case-ready package for shelf storage.

### BACKGROUND

(2) Various trays are known in the art for carrying moist food products, such as meat, poultry, seafood, and produce. It is desirable that such trays are water- and grease-resistant to effectively carry and store the food products.

(3) Such trays may be overwrapped with a transparent wrapping material in order to display the food products carried by the tray and placed on display in retail markets. Thus, it is desirable that such trays handle the overwrapping process without failing.

(4) Suitable trays include conventional trays formed from expanded polystyrene. However, there is a growing trend to limit the use of expanded polystyrene trays.

(5) Accordingly, those skilled in the art continue with research and development in the field of trays suitable for food packaging.

### SUMMARY

(6) In one embodiment, a reinforced paperboard tray includes a coated paperboard in the form of a

bottom wall, a side wall extending upwardly around the bottom wall, and a curved flange extending outwardly around the side wall. The coated paperboard includes a single-ply paperboard substrate having a first major side and a second major side. The first major side corresponds to an upper side of the bottom wall. A barrier coating is disposed on the first major side of the single-ply paperboard substrate. A paperboard reinforcement is attached to the curved flange.

(7) In another embodiment, a method for using a reinforced paperboard tray includes positioning a food product within a reinforced paperboard tray and wrapping a film over the product and the reinforced paperboard tray. The reinforced paperboard tray includes a coated paperboard in the form of a bottom wall, a side wall extending upwardly around the bottom wall, and a curved flange extending outwardly around the side wall. The coated paperboard includes a single-ply paperboard substrate having a first major side and a second major side, the first major side corresponding to an upper side of the bottom wall, and a barrier coating on the first major side of the single-ply paperboard substrate. A paperboard reinforcement is attached to the curved flange.

(8) Other embodiments of the disclosed reinforced paperboard tray and method for using a reinforced paperboard tray will become apparent from the following detailed description, the accompanying drawings, and the appended claims.

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## Description

### BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. 1 is a perspective view of an exemplary paperboard tray according to the present description.

(2) FIG. 2 is a bottom view of the paperboard tray of FIG. 1.

(3) FIG. 3 is a side sectional view of the paperboard tray of FIG. 2 along section A-A.

(4) FIG. 4 is a cross-section of the paperboard tray within circle B of FIG. 3.

(5) FIG. 5 is a bottom view of an exemplary paperboard tray of FIG. 1, including a paperboard reinforcement, according to one aspect of the present description.

(6) FIG. 6 is a side sectional view of the paperboard tray of FIG. 5 along section C-C.

(7) FIG. 7 is a cross-section of the paperboard tray within circle D of FIG. 6.

(8) FIG. 8 is a bottom view of an exemplary paperboard tray of FIG. 1, including a paperboard reinforcement, according to another aspect of the present description.

(9) FIG. 9 is a side sectional view of the paperboard tray of FIG. 5 along section C-C according to a first variation.

(10) FIG. 10 is a side sectional view of the paperboard tray of FIG. 5 along section C-C according to a second variation.

(11) FIG. 11 is a side sectional view of the paperboard tray of FIG. 5 along section C-C. according to a third variation.

(12) FIG. 12 is a bottom view of another exemplary paperboard tray of FIG. 1, including a paperboard reinforcement, according to another aspect of the present description.

(13) FIG. 13 is a side sectional view of the paperboard tray of FIG. 12 along section E-E.

(14) FIG. 14 is a bottom view of another exemplary paperboard tray of FIG. 1, including a paperboard reinforcement, according to another aspect of the present description.

(15) FIG. 15 is a side sectional view of the paperboard tray of FIG. 12 along section F-F.

(16) FIG. 16 is a bottom view of another exemplary paperboard tray of FIG. 1, including a paperboard reinforcement, according to another aspect of the present description.

(17) FIG. 17 is a bottom view of another exemplary paperboard tray of FIG. 1, including a paperboard reinforcement, according to yet another aspect of the present description.

(18) FIG. 18 is a side sectional view of the paperboard tray of FIG. 17 along section G-G.

(19) FIG. 19 is a bottom view of another exemplary paperboard tray of FIG. 1, including a

- paperboard reinforcement, according to yet another aspect of the present description.
- (20) FIG. 20 is a bottom view of another exemplary paperboard tray of FIG. 1, including a paperboard reinforcement, according to yet another aspect of the present description.
- (21) FIG. 21 is a side sectional view of the paperboard tray of FIG. 20 along section H-H.
- (22) FIG. 22 is a bottom view of another exemplary paperboard tray of FIG. 1, including a paperboard reinforcement, according to yet another aspect of the present description.
- (23) FIG. 23 is a bottom view of another exemplary paperboard tray of FIG. 1, including a paperboard reinforcement, according to yet another aspect of the present description.
- (24) FIG. 24 is a side sectional view of the paperboard tray of FIG. 23 along section I-I.
- (25) FIG. 25 is a cross-section of the paperboard tray within circle J of FIG. 24, according to one aspect.
- (26) FIG. 26 is a cross-section of the paperboard tray within circle J of FIG. 24, according to another aspect.
- (27) FIG. 27 is a bottom view of yet another exemplary paperboard tray of FIG. 1, including a paperboard reinforcement, according to yet another aspect of the present description.
- (28) FIG. 28 is a side sectional view of the paperboard tray of FIG. 27 along section K-K.
- (29) FIG. 29 is a bottom view of yet another exemplary paperboard tray of FIG. 1, including a paperboard reinforcement, according to yet another aspect of the present description.
- (30) FIG. 30 is a side sectional view of the paperboard tray of FIG. 29 along section L-L.
- (31) FIG. 31 is a bottom view of yet another paperboard tray, including one example of a spiral paperboard reinforcement.
- (32) FIG. 32 is a side sectional view of the paperboard tray of FIG. 31 along section M-M.
- (33) FIG. 33 is a side sectional view of yet another paperboard tray, including another example of a spiral paperboard reinforcement.
- (34) FIG. 34 is a side sectional view of yet another paperboard tray, including another example of a spiral paperboard reinforcement.
- (35) FIG. 35 is a side sectional view of yet another paperboard tray, including another example of a spiral paperboard reinforcement.
- (36) FIG. 36 is a side sectional view of yet another paperboard tray, including yet another example of a spiral paperboard reinforcement.
- (37) FIG. 37 is a side sectional view of yet another paperboard tray.
- (38) FIG. 38 is a side sectional view of yet another paperboard tray.

#### DETAILED DESCRIPTION

(39) By positioning a high stiffness barrier coating on a side of a single-ply paperboard substrate that corresponds to an inner side of a paperboard tray formed from the single-ply coated paperboard, the paperboard tray can be provided with water- and grease-resistance desirable for carrying moist food items, and the paperboard tray can be provided with sufficient rigidity to withstand conveying the paperboard tray through belts, holding the paperboard tray at a fixed point, and using the paperboard tray in an overwrapping process. In an aspect, the present description enables providing a coated paperboard and paperboard tray that are compostable. In another aspect, the present description enables providing a coated paperboard and paperboard tray that are recyclable. In yet another aspect, the present description enables providing a coated paperboard and paperboard tray that are printable or capable of being dyed.

(40) FIG. 1 is a perspective view of a paperboard tray 20. FIG. 2 is a bottom view of the paperboard tray 20 of FIG. 1. FIG. 3 is a side sectional view of the paperboard tray of FIG. 2 along section A-A. FIG. 4 is a cross-section of the paperboard tray within circle B of FIG. 3.

(41) Although the paperboard tray 20 is illustrated as having a rectangular shape, the shape is not limited to rectangular and may include any shape, such as circular, square, polygon, or irregular. In a specific expression, the paperboard tray 20 may be rectangular. In an aspect, the length may be between 8 and 10 inches, the width may be between 6 and 7 inches, and the height may be between

0.75 and 2 inches. In a specific expression, the length, width, and height may be approximately 8.75 inches, 6.5 inches, and 1.25 inches, respectively. However, it will be understood that the present description is not limited to these specific dimensions and other dimensions and shapes are possible and would be desirable.

(42) As shown in FIGS. 1-3, the paperboard tray **20** includes a coated paperboard **2** (FIG. 4) in the form of a bottom wall **21**, a side wall **22** extending upwardly around the bottom wall **21**, and a flange **23** extending outwardly around the side wall **22**.

(43) As shown in FIG. 4, the coated paperboard **2** for the paperboard tray **20** includes a single-ply paperboard substrate **4** having a first major side **6** and a second major side **8** and a barrier coating **10** on the first major side **6** of the single-ply paperboard substrate **4**. The first major side **6** of the paperboard substrate **4** corresponds to an upper side of the bottom wall **21** of the paperboard tray **20**. The barrier coating **10** may be, for example, a single coating layer positioned directly on the first major side **6** of the single-ply paperboard substrate **4**. The barrier coating **10** may define a first outermost surface of the coated paperboard **2** and the second major side **8** of the single-ply paperboard substrate **4** may define a second outermost surface of the coated paperboard **2**. Alternatively, as shown, the coated paperboard **2** may further include a topcoat **12** on the second major side **8**, and the topcoat **12** may define the second outermost surface of the coated paperboard **2**. The topcoat **12**, may be printable, or capable of being dyed, such as to permit display of graphics and/or text on the paperboard tray **20**.

(44) In an aspect, the coated paperboard **2** for the paperboard tray **20** may have an average caliper thickness of 0.010 inch or greater. In another aspect, the coated paperboard **2** may have an average caliper thickness in the range of 0.010 inch to 0.035 inch. In yet another aspect, the coated paperboard **2** may have an average caliper thickness in the range of 0.016 inch to 0.026 inch.

(45) The single-ply paperboard substrate **4** for the paperboard tray **20** may include any cellulosic material that is capable of being coated with the barrier coating layer. The single-ply paperboard substrate **4** may be bleached or unbleached. Appropriate single-ply paperboard substrates **4** include corrugating medium, linerboard, solid bleached sulfate (SBS), folding boxboard (FBB), and coated unbleached kraft (CUK). In a specific expression, the single-ply paperboard substrate **4** may be solid bleached sulfate.

(46) In an aspect, the single-ply paperboard substrate **4** for the paperboard tray **20** may have an average caliper thickness of 0.010 inch or greater. In another aspect, the single-ply paperboard substrate **4** may have an average caliper thickness in the range of 0.010 inch to 0.035 inch. In yet another aspect, the single-ply paperboard substrate **4** may have an average caliper thickness in the range of 0.016 inch to 0.024 inch (16 point to 24 point). In yet another aspect, the single-ply paperboard substrate **4** may have an average caliper thickness in the range of 0.016 inch to 0.022 inch (16 point to 22 point). In yet another aspect, the single-ply paperboard substrate **4** may have an average caliper thickness in the range of 0.016 inch to 0.020 inch (16 point to 20 point). In a specific expression, the single-ply paperboard substrate **4** may have an average caliper thickness of 0.018 inch (18 point). A high caliper of the single-ply paperboard substrate **4** may function to increase rigidity of the coated paperboard **2** (FIG. 4) when formed into a paperboard tray to withstand conveying the paperboard tray through belts, holding the paperboard tray at a fixed point, and a process of overwrapping the paperboard tray.

(47) In an aspect, the single-ply paperboard substrate **4** for the paperboard tray **20** may have an uncoated basis weight of at least about 60 pounds per 3000 ft.<sup>2</sup>. In one expression the single-ply paperboard substrate **4** may have an uncoated basis weight ranging from about 60 pounds per 3000 ft.<sup>2</sup> to about 400 pounds per 3000 ft.<sup>2</sup>. In another expression the single-ply paperboard substrate **4** may have an uncoated basis weight ranging from about 120 pounds per 3000 ft.<sup>2</sup> to about 250 pounds per 3000 ft.<sup>2</sup>. In another expression the single-ply paperboard substrate **4** may have an uncoated basis weight ranging from about 150 pounds per 3000 ft.<sup>2</sup> to about 210 pounds per 3000 ft.<sup>2</sup>. In a specific expression the single-ply

paperboard substrate **4** may have an uncoated basis weight of about 185 pounds per 3000 ft.<sup>2</sup>.  
(48) In an aspect, the single-ply paperboard substrate **4** for the paperboard tray **20** may have an internal sizing agent incorporated therein. The internal sizing agent may be any chemical or chemicals added, before thermoforming, which exhibit hydrophobicity. The internal sizing agent may be added before the papermaking process, during the papermaking process, after the papermaking process, or combinations thereof. In an example, the internal sizing agent may be added after the papermaking process via a liquid additive system, such as a continuous metering system from CMS Industrial Technologies, LLC, Gainesville, Georgia, United States.

(49) The internal sizing for the paperboard tray **20** agent may include, for example, alkyl ketene dimer (AKD), dispersed rosin size (DRS), alkyl succinic anhydride (ASA), and combinations thereon. In a specific expression, the internal sizing agent may include 8 to 12 pounds of DRS per ton of paperboard and 1 pound of AKD per ton of paperboard.

(50) When the coated paperboard **2** (FIG. **4**) is formed into a paperboard tray **20**, the barrier coating **10** functions to separate a moist food product carried on the paperboard tray from the single-ply paperboard substrate **4**. Thus, the barrier coating **10** is a coating having water- and grease-resistance.

(51) The barrier coating **10** for the paperboard tray **20** may optionally be a high stiffness barrier coating having an elastic modulus of 1.5 GPa or greater. By positioning the high stiffness barrier coating **10** on the upper side of the bottom wall **21**, the paperboard tray **20** is provided with water- and grease-resistance desirable for carrying moist food items, and the paperboard tray **20** is provided with increased rigidity to withstand conveying the paperboard tray **20** through belts, holding the paperboard tray **20** at a fixed point, and using the paperboard tray **20** in an overwrapping process. In an aspect, the barrier coating **10** may have an elastic modulus of from 1.5 GPa to 6.0 GPa. In another aspect, the barrier coating **10** may have an elastic modulus of from 2.0 GPa to 5.0 GPa.

(52) In an aspect, the barrier coating **10** for the paperboard tray **20** may include polylactic acid (PLA). For example, the barrier coating **10** can be (or can include) one or more of the biopolymer coatings disclosed in Intl. Pat. App. No. PCT/US2016/062136 filed on Nov. 16, 2016, the entire contents of which are incorporated herein by reference. In another aspect, the barrier coating **10** includes polyethylene terephthalate (PET).

(53) In an aspect, the barrier coating **10** for the paperboard tray **20** may have an average thickness of 0.00025 inch or more. In another aspect, the barrier coating **10** may have an average thickness of 0.00025 to 0.005 inches. In yet another aspect, the barrier coating **10** may have an average thickness of 0.0005 to 0.003 inches. In yet another aspect, the barrier coating **10** may have an average thickness of 0.00075 to 0.002 inches. In yet another aspect, the barrier coating **10** may have an average thickness of 0.001 to 0.00175 inches. In yet another aspect, the barrier coating **10** may have an average thickness of 0.001 to 0.0015 inches. In yet another aspect, the barrier coating **10** may have an average thickness of 0.001 to 0.00125 inches.

(54) The barrier coating **10** for the paperboard tray **20** may be applied, for example, by extrusion coating onto the single-ply paperboard substrate.

(55) According to the present description, the flange **23** may include or may be a curved flange. The flange **23** may include or may be curved around the entire periphery of the paperboard tray **20** as shown in FIG. **3**, or the flange **23** may include or may be curved around less than the entire periphery of the paperboard tray **20**. In an example, the flange **23** may include or may be curved at one or both longitudinal sides of the paperboard tray **20** and the flange **23** may include or may be horizontal at one or both latitudinal sides of the paperboard tray **20**. In another example, the flange **23** may include or may be curved at one or both latitudinal sides of the paperboard tray **20** and the flange **23** may include or may be horizontal at one or both longitudinal sides of the paperboard tray **20**.

(56) Also, as shown in FIG. **3**, the flange **23** may be entirely curved with respect to a cross-section

thereof as shown in FIG. 3. Alternatively, the flange 23 may be partly curved with respect to a cross-section thereof, or the flange 23 may be mostly curved with respect to a cross-section thereof. In FIG. 3, the flange 23 is entirely curved with respect to a cross-section thereof around the entire periphery of the paperboard tray 20. In an alternatively, the flange 23 may be entirely curved with respect to a cross-section thereof around part of the periphery of the paperboard tray 20 while the flange 23 may be partly curved or mostly curved around another part of the periphery of the paperboard tray 20.

(57) The curvature of the flange 23 is beneficial for providing the paperboard tray 20 with sufficient characteristics to withstand conveying the paperboard tray 20 through belts, holding the paperboard tray 20 at a fixed point, and using the paperboard tray 20 in an overwrapping process.

(58) The paperboard tray 20 may be formed by any manufacturing method, such as by a thermoforming method.

(59) According to an aspect of the present description, a method for manufacturing the paperboard tray 20 includes forming a paperboard blank from a coated paperboard 2, in which the coated paperboard 2 (FIG. 4) includes the single-ply paperboard substrate 4 having the first major side 6 and the second major side 8 and the barrier coating 10 on the first major side of the single-ply paperboard substrate 4. The method further includes thermoforming the paperboard blank into the paperboard tray 20 having the bottom wall 21, the side wall 22 extending upwardly around the bottom wall 21, and the flange 23 including the curvature as described above.

(60) The paperboard blank may be formed from a roll of coated paperboard 2 (FIG. 4). For example, a roll of coated paperboard 2 may be fed to a forming press. The roll may be unwound at the forming press and directed to a cutting section of the forming press where the coated paperboard 2 is cut to the shape of the paperboard blank.

(61) The paperboard blank may then be transported to a thermoforming section of the same (or different) forming press. The thermoforming section may include a male die and a female die used for thermoforming the paperboard blank into a paperboard tray 20.

(62) At the thermoforming section, the paperboard blank is thermoformed with the male die and the female die using heat and pressure to form the paperboard tray 20. Thus, the paperboard blank may be heated, drawn into the temperature-controlled female die by the temperature-controlled male die, and then held against the surfaces of the male die and female die until cooled.

(63) According to the present description, the paperboard tray 20 may further include a paperboard reinforcement 30 attached to the flange 23. The paperboard reinforcement 30 reinforces the flange 23 to provide the flange 23 of the paperboard tray 20 with sufficient characteristics to withstand conveying the paperboard tray 20 through belts, holding the paperboard tray 20 at a fixed point, and using the paperboard tray 20 in an overwrapping process. Particularly, the paperboard reinforcement 30 increases strength of the flange to prevent buckling or kinking often due to stress while overwrapping or during distribution. The strength is increased by the combination of the additional paperboard and the additional coating of the integral paperboard flange.

(64) In an aspect, the coated paperboard 2 (FIG. 4) that is formed into the form of the bottom wall 21, the side wall 22, and the flange 23 of the paperboard tray 20 may further include the form of the paperboard reinforcement 30. Thus, the bottom wall 21, the side wall 22, the flange 23, and the paperboard reinforcement 30 may be formed from the same unitary piece of coated paperboard 2, such as shown in FIGS. 5 and 6. The coated paperboard 2 for the paperboard tray 20 may be formed, such as by thermoforming as described above, into the form of the bottom wall 21, the side wall 22, the flange 23, and a paperboard reinforcement 30 attached to the flange 23.

(65) In another aspect, the paperboard reinforcement 30 may be separate from the coated paperboard 2 that is formed into the form of the bottom wall 21, the side wall 22, and the flange 23 of the paperboard tray 20. Thus, the bottom wall 21, the side wall 22, and the flange 23 may be formed from the same unitary piece of coated paperboard 2, and the paperboard reinforcement 30 may be a separate piece of paperboard. In this case, the coated paperboard 2 for the paperboard



reinforcement **30** may have the same composition as the coated paperboard **2** for the paperboard tray **20** or may have a different composition as the coated paperboard **2** for the paperboard tray **20**. (66) Thus, in an aspect, the paperboard reinforcement **30** may be a coated paperboard **2** that is the same composition as or different composition from the coated paperboard **2** that forms the bottom wall **21**, the side wall **22**, and the flange **23** of the paperboard tray **20**.

(67) In an aspect, the coated paperboard **2** for the paperboard reinforcement **30** may include a single-ply paperboard substrate **4** having a first major side **6** and a second major side **8** and a barrier coating **10** on the first major side **6** of the single-ply paperboard substrate **4**. The barrier coating **10** may be, for example, a single coating layer positioned directly on the first major side **6** of the single-ply paperboard substrate **4**. The barrier coating **10** may define a first outermost surface of the coated paperboard **2** and the second major side **8** of the single-ply paperboard substrate **4** may define a second outermost surface of the coated paperboard **2**. Alternatively, as shown, the coated paperboard **2** may further include a topcoat **12** on the second major side **8**, and the topcoat **12** may define the second outermost surface of the coated paperboard **2**.

(68) In an aspect, the coated paperboard **2** for the paperboard reinforcement **30** may have an average caliper thickness of 0.010 inch or greater. In another aspect, the coated paperboard **2** may have an average caliper thickness in the range of 0.010 inch to 0.035 inch. In yet another aspect, the coated paperboard **2** may have an average caliper thickness in the range of 0.016 inch to 0.026 inch.

(69) The single-ply paperboard substrate **4** for the paperboard reinforcement **30** may include any cellulosic material that is capable of being coated with the barrier coating layer. The single-ply paperboard substrate **4** may be bleached or unbleached. Appropriate single-ply paperboard substrates **4** include corrugating medium, linerboard, solid bleached sulfate (SBS), folding boxboard (FBB), and coated unbleached kraft (CUK). In a specific expression, the single-ply paperboard substrate **4** may be solid bleached sulfate.

(70) In an aspect, the single-ply paperboard substrate **4** for the paperboard reinforcement **30** may have an average caliper thickness of 0.010 inch or greater. In another aspect, the single-ply paperboard substrate **4** may have an average caliper thickness in the range of 0.010 inch to 0.035 inch. In yet another aspect, the single-ply paperboard substrate **4** may have an average caliper thickness in the range of 0.016 inch to 0.024 inch (16 point to 24 point). In yet another aspect, the single-ply paperboard substrate **4** may have an average caliper thickness in the range of 0.016 inch to 0.022 inch (16 point to 22 point). In yet another aspect, the single-ply paperboard substrate **4** may have an average caliper thickness in the range of 0.016 inch to 0.020 inch (16 point to 20 point). In a specific expression, the single-ply paperboard substrate **4** may have an average caliper thickness of 0.018 inch (18 point). A high caliper of the single-ply paperboard substrate **4** for the paperboard reinforcement **30** may function to increase rigidity of the flange **23** of the paperboard tray to withstand conveying the paperboard tray **20** through belts, holding the paperboard tray **20** at a fixed point, and a process of overwrapping the paperboard tray.

(71) In an aspect, the single-ply paperboard substrate **4** for the paperboard reinforcement **30** may have an uncoated basis weight of at least about 60 pounds per 3000 ft.<sup>2</sup>. In one expression the single-ply paperboard substrate **4** may have an uncoated basis weight ranging from about 60 pounds per 3000 ft.<sup>2</sup> to about 400 pounds per 3000 ft.<sup>2</sup>. In another expression the single-ply paperboard substrate **4** may have an uncoated basis weight ranging from about 120 pounds per 3000 ft.<sup>2</sup> to about 250 pounds per 3000 ft.<sup>2</sup>. In another expression the single-ply paperboard substrate **4** may have an uncoated basis weight ranging from about 150 pounds per 3000 ft.<sup>2</sup> to about 210 pounds per 3000 ft.<sup>2</sup>. In a specific expression the single-ply paperboard substrate **4** may have an uncoated basis weight of about 185 pounds per 3000 ft.<sup>2</sup>.

(72) In an aspect, the single-ply paperboard substrate **4** for the paperboard reinforcement **30** may have an internal sizing agent incorporated therein. The internal sizing agent may be any chemical or chemicals added, before thermoforming, which exhibit hydrophobicity. The internal sizing agent

may be added before the papermaking process, during the papermaking process, after the papermaking process, or combinations thereof. In an example, the internal sizing agent may be added after the papermaking process via a liquid additive system, such as a continuous metering system from CMS Industrial Technologies, LLC, Gainesville, Georgia, United States.

(73) The internal sizing agent for the paperboard reinforcement **30** may include, for example, alkyl ketene dimer (AKD), dispersed rosin size (DRS), alkyl succinic anhydride (ASA), and combinations thereon. In a specific expression, the internal sizing agent may include 8 to 12 pounds of DRS per ton of paperboard and 1 pound of AKD per ton of paperboard.

(74) The barrier coating **10** for the paperboard reinforcement **30** may optionally be a high stiffness barrier coating having an elastic modulus of 1.5 GPa or greater. By positioning the high stiffness barrier coating **10** on the single-ply paperboard substrate **4** for the paperboard reinforcement **30**, the paperboard tray **20** may be provided with increased rigidity to withstand using the paperboard tray **20** in an overwrapping process. In an aspect, the barrier coating **10** may have an elastic modulus of from 1.5 GPa to 6.0 GPa. In another aspect, the barrier coating **10** may have an elastic modulus of from 2.0 GPa to 5.0 GPa.

(75) In an aspect, the barrier coating **10** for the paperboard reinforcement **30** may include polylactic acid (PLA). For example, the barrier coating **10** can be (or can include) one or more of the biopolymer coatings disclosed in Intl. Pat. App. No. PCT/US2016/062136 filed on Nov. 16, 2016, the entire contents of which are incorporated herein by reference. In another aspect, the barrier coating **10** includes polyethylene terephthalate (PET).

(76) In an aspect, the barrier coating **10** for the paperboard reinforcement **30** may have an average thickness of 0.00025 inch or more. In another aspect, the barrier coating **10** may have an average thickness of 0.00025 to 0.005 inches. In yet another aspect, the barrier coating **10** may have an average thickness of 0.0005 to 0.003 inches. In yet another aspect, the barrier coating **10** may have an average thickness of 0.00075 to 0.002 inches. In yet another aspect, the barrier coating **10** may have an average thickness of 0.001 to 0.00175 inches. In yet another aspect, the barrier coating **10** may have an average thickness of 0.001 to 0.0015 inches. In yet another aspect, the barrier coating **10** may have an average thickness of 0.001 to 0.00125 inches.

(77) The barrier coating **10** for the paperboard reinforcement **30** may be applied, for example, by extrusion coating onto the single-ply paperboard substrate **4** for the paperboard reinforcement **30**.

(78) In one or more aspects, the paperboard reinforcement **30** may be in the form of strips of paperboard to add an additional layer in locations requiring increased rigidity. The strips may be flat, curved, or spiral. The strips can be applied through gluing, adhesive or heat-activated coatings. Glue can further provide rigidity by tacking and providing an extra support. Application of the strips can occur either before, during or post thermoforming. Methods of production before thermoforming include, for example, gluing strips before die cutting and scoring. Additionally, strips can be fed into thermoforming tooling used for forming the overall shape of the paperboard tray and combined with flange through heat and pressure by heat-activating coatings. Finally, strips can be applied post thermoforming by, for example, gluing and attaching strips with or without pressure.

(79) In another one or more aspects, the paperboard tray may have stiffening members lateral to the flange (stiffeners) structures that can fold over during or post thermoforming. The stiffeners may come as a result of extensions from the flange(s). The stiffeners can either be folded or rolled to the original distance of an arced flange. Folds or rolls can be held in place by the following: lug to lock it in place, crimper, welder, or glue. Glue can further provide rigidity by tacking and providing an extra support while stiffeners are folded over. Folds can be created and reinforced during thermoforming by a pre-step of folding and placing in the thermoforming tooling wherein it is reinforced to the inside portion of the flange by applying heat and pressure. Another method to create the fold as well as the roll would occur post-thermoforming. During thermoforming the stiffeners can extend outside the tooling to form the tray. After thermoforming the trays can stay in

the tooling or be conveyed to a secondary step that folds or rolls the extensions to the underside of the flange(s). Folds/rolls can be held in place by an adhesive or glue as well as physical features such as slits that hold the stiffeners into place.

(80) According to an embodiment of the present description, the paperboard reinforcement includes an integral paperboard reinforcement attached to a bottom surface of the flange, wherein the integral paperboard reinforcement is formed from the same coated paperboard that forms the bottom wall, the side wall, and the flange. Examples of the integral paperboard reinforcement **31** are shown in FIGS. 5-22. The integral paperboard reinforcement increases strength of the flange to prevent buckling or kinking often due to stress while overwrapping or during distribution. Also, the integral paperboard reinforcement redirects cut edges from areas of high purge/moisture concentration near the top of the tray to area of low purge/moisture concentration nearer to the bottom of the tray.

(81) FIGS. 5-7 illustrate a first example of an integral paperboard reinforcement **31**. As shown, a rectangular paperboard tray **20** includes a coated paperboard **2** (FIG. 4) in the form of a bottom wall **21**, a side wall **22** extending upwardly around the bottom wall **21**, a curved flange **23** extending outwardly around the side wall **22**, and the integral paperboard reinforcement **31** at an end of the flange **23**. The coated paperboard **2** includes a single-ply paperboard substrate **4** and a barrier coating **10** on the side of the single-ply paperboard substrate **4** that corresponds to an upper side of the bottom wall **21** and optionally a topcoat **12** on the side of the single-ply paperboard substrate **4** that corresponds to a lower side of the bottom wall **21**. The integral paperboard reinforcement **31** is attached to the bottom surface of the curved flange **23**. By attaching the integral paperboard reinforcement **31** to the bottom surface of the curved flange **23**, the integral paperboard reinforcement **31** reinforces the flange **23** to provide the flange **23** of the paperboard tray **20** with improved characteristics to withstand conveying the paperboard tray **20** through belts, holding the paperboard tray **20** at a fixed point, and using the paperboard tray **20** in an overwrapping process. By reinforcing the flange **23** rather than the flange **23**, the side wall **22**, and the bottom wall **21**, less material is required for the paperboard tray **20** and better flexibility of the paperboard tray **20** is facilitated. In a specific example, as shown in FIG. 5, the integral paperboard reinforcement **31** that is attached to the bottom surface of the curved flange **23** ends at the top of the side wall **22**.

(82) In the example shown in FIGS. 5-7, integral paperboard reinforcement **31** is attached to the bottom surface of the flange **23** at both longitudinal ends of the rectangular paperboard tray **20**. In an alternative, the integral paperboard reinforcement **31** may be attached to the bottom surface of the flange **23** at both latitudinal ends of the rectangular paperboard tray **20**. In another alternative, the integral paperboard reinforcement **31** may be attached at the corners of the rectangular paperboard tray **20**. In yet another alternative, the integral paperboard reinforcement **31** may be attached to the bottom surface of the flange **23** at both longitudinal ends and both latitudinal ends of the rectangular paperboard tray **20**. In yet another alternative, the integral paperboard reinforcement **31** may be attached to the bottom surface of the flange **23** at either the longitudinal ends or both latitudinal ends of the rectangular paperboard tray **20** and the corners of the rectangular paperboard tray **20**. In yet another alternative, the integral paperboard reinforcement **31** may be attached to the bottom surface of the flange **23** at both longitudinal ends, both latitudinal ends, and the corners of the rectangular paperboard tray **20**. By way of example, FIG. 8 shows an exemplary paperboard tray **20** in which the integral paperboard reinforcement **31** is attached to the bottom surface of the flange **23** at the longitudinal ends of the rectangular paperboard tray **20** and the corners of the rectangular paperboard tray **20**. Thus, the integral paperboard reinforcements **31** can stop short of the corners such as shown in FIG. 5 or the integral paperboard reinforcements can extend to the corners of the paperboard tray **20** such as shown in FIG. 8. Stopping the integral paperboard reinforcements **31** short of the corners requires less material for the paperboard tray **20** and ensures better flexibility of the paperboard tray **20**. Stopping the integral paperboard

reinforcements **31** short of the corners requires less material for the paperboard tray **20** and ensures better flexibility of the paperboard tray **20**. Extending the integral paperboard reinforcements **31** to the corners of the paperboard tray **20** enhances strength of the flange **23** and also increases the overall strength of the paperboard tray **20**. The integral paperboard reinforcements **31** reduce the likelihood of buckling along the flange **23** and reduce the likelihood of bending at the corners and twisting of the paperboard tray **20** at the corners when pressure is applied along the latitudinal or longitudinal ends of the paperboard tray **20**. Thus, extending the integral paperboard reinforcements **31** to the corners of the paperboard tray **20** decreases the likelihood of buckling along the latitudinal or longitudinal ends and decreases the likelihood of bending in the corners which could torque the tray. Also, due to the integral nature of the integral paperboard reinforcement, the cut edges are redirected from areas of high purge/moisture concentration near the top of the tray to area of low purge/moisture concentration nearer to the bottom of the tray both at the straight edges of the latitudinal or longitudinal ends and at the corners of the paperboard tray. Other embodiments include that the paperboard tray **20** has a shape other than rectangular.

(83) In the illustrated example as shown in FIG. 6, the shape of the integral paperboard reinforcement **31** at the bottom surface of the flange **23** matches the shape of the flange **23**. Alternatively, the integral paperboard reinforcement **31** may have a different shape than the bottom surface of the flange **23** such there is an air gap between the integral paperboard reinforcement **31** and the bottom surface of the flange **23**. The air gap facilitates for de-nesting of multiple paperboard trays stacked upon each other in a nesting relationship. The air gap may be positioned at any point between the integral paperboard reinforcement **31** and the bottom surface of the flange **23**. FIGS. 9 to 11 shown three exemplary positions of an air gap between the integral paperboard reinforcement **31** and the bottom surface of the flange **23**. In FIG. 9, the air gap is positioned between the integral paperboard reinforcement **31** and the bottom surface of the flange **23** at an end portion of the flange **23**. In FIG. 10, the air gap is positioned between the integral paperboard reinforcement **31** and the bottom surface of the flange **23** at a middle portion of the flange **23**. In FIG. 11, the air gap is positioned between the integral paperboard reinforcement **31** and the bottom surface of the flange **23** at a beginning portion of the flange **23** near the side wall **22**. The purpose of the air gaps is to produce a section of the reinforced flange that aids in separating the paperboard trays when stacked on each other, which can be useful for de-nesting of the paperboard trays.

(84) FIGS. 12 to 15 illustrate a second example of an integral paperboard reinforcement **31**. As shown, a rectangular paperboard tray **20** includes a coated paperboard **2** (FIG. 4) in the form of a bottom wall **21**, a side wall **22** extending upwardly around the bottom wall **21**, a curved flange **23** extending outwardly around the side wall **22**, and the integral paperboard reinforcement **31** at an end of the flange **23**. The coated paperboard **2** includes a single-ply paperboard substrate **4** and a barrier coating **10** on the side of the single-ply paperboard substrate **4** that corresponds to an upper side of the bottom wall **21** and optionally a topcoat **12** on the side of the single-ply paperboard substrate **4** that corresponds to a lower side of the bottom wall **21**. The integral paperboard reinforcement **31** is attached to the bottom surface of the curved flange **23** and an outside surface of the side wall **22**. By attaching the integral paperboard reinforcement **31** to the bottom surface of the curved flange **23** and the outside surface of the side wall **22**, the integral paperboard reinforcement **31** reinforces the flange **23** and the side wall **22** to provide the flange **23** and the side wall **22** of the paperboard tray **20** with improved characteristics to withstand conveying the paperboard tray **20** through belts, holding the paperboard tray **20** at a fixed point, and using the paperboard tray **20** in an overwrapping process. By reinforcing the flange **23** and the side wall **22** rather than the flange **23**, the side wall **22**, and the bottom wall **21**, less material is required for the paperboard tray **20** and better flexibility of the paperboard tray **20** is facilitated. In a specific example, as shown in FIGS. 12 and 13 the integral paperboard reinforcement **31** that is attached to the bottom surface of the curved flange **23** and the outside surface of the side wall **22** ends at the middle of the side wall **22**. In another specific example, as shown in FIGS. 14 and 15, the integral paperboard reinforcement

**31** that is attached to the bottom surface of the curved flange **23** and the outside surface of the side wall **22** ends at the bottom of the side wall **22**.

(85) In the examples shown in FIGS. **12** to **15**, the integral paperboard reinforcement **31** is attached to the bottom surface of the flange **23** and the outer surface of the side wall **22** at both longitudinal ends of the rectangular paperboard tray **20**. In an alternative, the integral paperboard reinforcement **31** may be attached to the bottom surface of the flange **23** and the outer surface of the side wall **22** at both latitudinal ends of the rectangular paperboard tray **20**. In another alternative, the integral paperboard reinforcement **31** may be attached at the corners of the rectangular paperboard tray **20**. In yet another alternative, the integral paperboard reinforcement **31** may be attached to the bottom surface of the flange **23** and the outer surface of the side wall **22** at both longitudinal ends and both latitudinal ends of the rectangular paperboard tray **20**. In yet another alternative, the integral paperboard reinforcement **31** may be attached to the bottom surface of the flange **23** and the outer surface of the side wall **22** at either the longitudinal ends or both latitudinal ends of the rectangular paperboard tray **20** and the corners of the rectangular paperboard tray **20**. In yet another alternative, the integral paperboard reinforcement **31** may be attached to the bottom surface of the flange **23** and the outer surface of the side wall **22** at both longitudinal ends, both latitudinal ends, and the corners of the rectangular paperboard tray **20**. In other alternatives, the integral paperboard reinforcement **31** may be attached to the bottom surface of the flange **23** and the outer surface of the side wall **22** at one or more of the longitudinal ends, the latitudinal ends, and the corners of the rectangular paperboard tray **20** and attached to only the bottom surface of the flange **23** at other of the longitudinal ends, the latitudinal ends, and the corners of the rectangular paperboard tray **20**. By way of example, FIG. **16** shows an exemplary paperboard tray **20** in which the integral paperboard reinforcement **31** is attached to the bottom surface of the flange **23** at the longitudinal ends of the rectangular paperboard tray **20** and the corners of the rectangular paperboard tray **20**. Thus, the integral paperboard reinforcements **31** can stop short of the corners such as shown in FIGS. **12** and **14** or the integral paperboard reinforcements can extend to the corners of the paperboard tray **20** such as shown in FIG. **16**. Stopping the integral paperboard reinforcements **31** short of the corners requires less material for the paperboard tray **20** and ensures better flexibility of the paperboard tray **20**. Extending the integral paperboard reinforcements **31** to the corners of the paperboard tray **20** enhances strength of the flange **23** and also increases the overall strength of the paperboard tray **20**. The integral paperboard reinforcements **31** reduce the likelihood of buckling along the flange **23** and reduce the likelihood of bending at the corners and twisting of the paperboard tray **20** at the corners when pressure is applied along the latitudinal or longitudinal ends of the paperboard tray **20**. Thus, extending the integral paperboard reinforcements **31** to the corners of the paperboard tray **20** decreases the likelihood of buckling along the latitudinal or longitudinal ends and decreases the likelihood of bending in the corners which could torque the tray. Also, due to the integral nature of the integral paperboard reinforcement, the cut edges are redirected from areas of high purge/moisture concentration near the top of the tray to area of low purge/moisture concentration nearer to the bottom of the tray both at the straight edges of the latitudinal or longitudinal ends and at the corners of the paperboard tray. Other embodiments include that the paperboard tray **20** has a shape other than rectangular.

(86) In the illustrated example as shown, the shape of the integral paperboard reinforcement **31** at the bottom surface of the flange **23** matches the shape of the flange **23**. Alternatively, the integral paperboard reinforcement **31** at the bottom surface of the flange **23** may have a different shape than the bottom surface of the flange **23** such there is an air gap between the integral paperboard reinforcement **31** and the bottom surface of the flange **23**. The air gap facilitates for de-nesting of multiple paperboard trays stacked upon each other in a nesting relationship. The air gap may be positioned at any point between the integral paperboard reinforcement **31** and the bottom surface of the flange **23**. In an example, the air gap may be positioned between the integral paperboard reinforcement **31** and the bottom surface of the flange **23** at an end portion of the flange **23**. In

another example, the air gap may be positioned between the integral paperboard reinforcement **31** and the bottom surface of the flange **23** at a middle portion of the flange **23**. In yet another, the air gap may be positioned between the integral paperboard reinforcement **31** and the bottom surface of the flange **23** at a beginning portion of the flange **23** near the side wall **22**. The purpose of the air gaps is to produce a section of the reinforced flange that aids in separating the paperboard trays when stacked on each other, which can be useful for de-nesting of the paperboard trays.

(87) FIGS. **17** and **18** illustrate a third example of an integral paperboard reinforcement **31**. As shown, a rectangular paperboard tray **20** includes a coated paperboard **2** (FIG. **4**) in the form of a bottom wall **21**, a side wall **22** extending upwardly around the bottom wall **21**, a curved flange **23** extending outwardly around the side wall **22**, and the integral paperboard reinforcement **31** at an end of the flange **23**. The coated paperboard **2** includes a single-ply paperboard substrate **4** and a barrier coating **10** on the side of the single-ply paperboard substrate **4** that corresponds to an upper side of the bottom wall **21** and optionally a topcoat **12** on the side of the single-ply paperboard substrate **4** that corresponds to a lower side of the bottom wall **21**. The integral paperboard reinforcement **31** is attached to the bottom surface of the curved flange **23**, an outside surface of the side wall **22**, and the bottom surface of the bottom wall **21**. By attaching the integral paperboard reinforcement **31** to the bottom surface of the curved flange **23**, the outside surface of the side wall **22**, and the bottom surface of the bottom wall **21**, the integral paperboard reinforcement **31** reinforces the flange **23**, the side wall **22**, and the bottom wall **21** to provide the paperboard tray **20** with improved characteristics to withstand conveying the paperboard tray **20** through belts, holding the paperboard tray **20** at a fixed point, and using the paperboard tray **20** in an overwrapping process. As shown, only a portion of the bottom wall **21** is reinforced, leaving a remaining portion of the bottom wall **21** not reinforced by the integral paperboard reinforcement **31**. By reinforcing the flange **23**, the side wall **22**, and a portion of the bottom wall **21** rather than the flange **23**, the side wall **22**, and the entire bottom wall **21**, less material is required for the paperboard tray **20** and better flexibility of the paperboard tray **20** is facilitated. In a specific example, as shown in FIGS. **17** and **18**, the integral paperboard reinforcement **31** that is attached to the bottom surface of the curved flange **23** and the outside surface of the side wall **22** ends before reaching a center of the bottom wall.

(88) In the example shown in FIGS. **17** and **18**, integral paperboard reinforcement **31** is attached to the bottom surface of the flange **23**, the outer surface of the side wall **22**, and a portion of the bottom wall **21** at both longitudinal ends of the rectangular paperboard tray **20**. In an alternative, the integral paperboard reinforcement **31** may be attached to the bottom surface of the flange **23**, the outer surface of the side wall **22**, and a portion of the bottom wall **21** at both latitudinal ends of the rectangular paperboard tray **20**. In another alternative, the integral paperboard reinforcement **31** may be attached at the corners of the rectangular paperboard tray **20**. In yet another alternative, the integral paperboard reinforcement **31** may be attached to the bottom surface of the flange **23**, the outer surface of the side wall **22**, and a portion of the bottom wall **21** at both longitudinal ends and both latitudinal ends of the rectangular paperboard tray **20**. In yet another alternative, the integral paperboard reinforcement **31** may be attached to the bottom surface of the flange **23**, the outer surface of the side wall **22**, and a portion of the bottom wall **21** at either the longitudinal ends or both latitudinal ends of the rectangular paperboard tray **20** and the corners of the rectangular paperboard tray **20**. In yet another alternative, the integral paperboard reinforcement **31** may be attached to the bottom surface of flange **23**, the outer surface of the side wall **22**, and a portion of the bottom wall **21** at both longitudinal ends, both latitudinal ends, and the corners of the rectangular paperboard tray **20**. In other alternatives, the integral paperboard reinforcement **31** may be attached to the bottom surface of flange **23**, the outer surface of the side wall **22**, and a portion of the bottom wall **21** at one or more of the longitudinal ends, the latitudinal ends, and the corners of the rectangular paperboard tray **20** and attached to only the bottom surface of the flange **23** or to the bottom surface of the flange **23** and the outer surface of the side wall **22** at other of the

longitudinal ends, the latitudinal ends, and the corners of the rectangular paperboard tray **20**. By way of example, FIG. **19** shows an exemplary paperboard tray **20** in which the integral paperboard reinforcement **31** is attached to the bottom surface of the flange **23** at the longitudinal ends of the rectangular paperboard tray **20** and the corners of the rectangular paperboard tray **20**. Thus, the integral paperboard reinforcements **31** can stop short of the corners such as shown in FIG. **17** or the integral paperboard reinforcements can extend to the corners of the paperboard tray **20** such as shown in FIG. **19**. Stopping the integral paperboard reinforcements **31** short of the corners requires less material for the paperboard tray **20** and ensures better flexibility of the paperboard tray **20**. Extending the integral paperboard reinforcements **31** to the corners of the paperboard tray **20** enhances strength of the flange **23** and also increases the overall strength of the paperboard tray **20**. The integral paperboard reinforcements **31** reduce the likelihood of buckling along the flange **23** and reduce the likelihood of bending at the corners and twisting of the paperboard tray **20** at the corners when pressure is applied along the latitudinal or longitudinal ends of the paperboard tray **20**. Thus, extending the integral paperboard reinforcements **31** to the corners of the paperboard tray **20** decreases the likelihood of buckling along the latitudinal or longitudinal ends and decreases the likelihood of bending in the corners which could torque the tray. Also, due to the integral nature of the integral paperboard reinforcement, the cut edges are redirected from areas of high purge/moisture concentration near the top of the tray to area of low purge/moisture concentration nearer to the bottom of the tray both at the straight edges of the latitudinal or longitudinal ends and at the corners of the paperboard tray. Other embodiments include that the paperboard tray **20** has a shape other than rectangular.

(89) In the illustrated example as shown, the shape of the integral paperboard reinforcement **31** at the bottom surface of the flange **23** matches the shape of the flange **23**. Alternatively, the integral paperboard reinforcement **31** at the bottom surface of the flange **23** may have a different shape than the bottom surface of the flange **23** such there is an air gap between the integral paperboard reinforcement **31** and the bottom surface of the flange **23**. The air gap facilitates for de-nesting of multiple paperboard trays stacked upon each other in a nesting relationship. The air gap may be positioned at any point between the integral paperboard reinforcement **31** and the bottom surface of the flange **23**. In an example, the air gap may be positioned between the integral paperboard reinforcement **31** and the bottom surface of the flange **23** at an end portion of the flange **23**. In another example, the air gap may be positioned between the integral paperboard reinforcement **31** and the bottom surface of the flange **23** at a middle portion of the flange **23**. In yet another, the air gap may be positioned between the integral paperboard reinforcement **31** and the bottom surface of the flange **23** at a beginning portion of the flange **23** near the side wall **22**. The purpose of the air gaps is to produce a section of the reinforced flange that aids in separating the paperboard trays when stacked on each other, which can be useful for de-nesting of the paperboard trays.

(90) FIGS. **20** and **21** illustrate a fourth example of an integral paperboard reinforcement **31**. As shown, a rectangular paperboard tray **20** includes a coated paperboard **2** (FIG. **4**) in the form of a bottom wall **21**, a side wall **22** extending upwardly around the bottom wall **21**, a curved flange **23** extending outwardly around the side wall **22**, and the integral paperboard reinforcement **31** at an end of the flange **23**. The coated paperboard **2** includes a single-ply paperboard substrate **4** and a barrier coating **10** on the side of the single-ply paperboard substrate **4** that corresponds to an upper side of the bottom wall **21** and optionally a topcoat **12** on the side of the single-ply paperboard substrate **4** that corresponds to a lower side of the bottom wall **21**. The integral paperboard reinforcement **31** is attached to the bottom surface of the curved flange **23**, an outside surface of the side wall **22**, and the bottom surface of the bottom wall **21**, in which the integral paperboard reinforcements **31** at opposing side of the of the paperboard tray **20** meet or overlap at the center. By attaching the integral paperboard reinforcement **31** to the bottom surface of the curved flange **23**, the outside surface of the side wall **22**, and the across the entire bottom surface of the bottom wall **21**, the integral paperboard reinforcement **31** reinforces the flange **23**, the side wall **22**, and the

entire bottom wall **21** to provide the paperboard tray **20** with improved characteristics to withstand conveying the paperboard tray **20** through belts, holding the paperboard tray **20** at a fixed point, and using the paperboard tray **20** in an overwrapping process.

(91) In the example shown in FIGS. **20** and **21**, integral paperboard reinforcement **31** is attached to the bottom surface of the flange **23**, the outer surface of the side wall **22**, and across the entire bottom wall **21** at both longitudinal ends of the rectangular paperboard tray **20**. In an alternative, the integral paperboard reinforcement **31** may be attached to the bottom surface of the flange **23**, the outer surface of the side wall **22**, and across the entire bottom wall **21** at both latitudinal ends of the rectangular paperboard tray **20**. In another alternative, the integral paperboard reinforcement **31** may be attached at the corners of the rectangular paperboard tray **20**. In yet another alternative, the integral paperboard reinforcement **31** may be attached to the bottom surface of the flange **23**, the outer surface of the side wall **22**, and the entire bottom wall **21** at both longitudinal ends and both latitudinal ends of the rectangular paperboard tray **20**. In yet another alternative, the integral paperboard reinforcement **31** may be attached to the bottom surface of the flange **23**, the outer surface of the side wall **22**, and across the entire bottom wall **21** at either the longitudinal ends or both latitudinal ends of the rectangular paperboard tray **20** and the corners of the rectangular paperboard tray **20**. In yet another alternative, the integral paperboard reinforcement **31** may be attached to the bottom surface of flange **23**, the outer surface of the side wall **22**, and across the entire bottom wall **21** at both longitudinal ends, both latitudinal ends, and the corners of the rectangular paperboard tray **20**. In other alternatives, the integral paperboard reinforcement **31** may be attached to the bottom surface of flange **23**, the outer surface of the side wall **22**, and across the entire bottom wall **21** at one or more of the longitudinal ends, the latitudinal ends, and the corners of the rectangular paperboard tray **20** and attached to only the bottom surface of the flange **23** or to the bottom surface of the flange **23** and the outer surface of the side wall **22** at other of the longitudinal ends, the latitudinal ends, and the corners of the rectangular paperboard tray **20**. By way of example, FIG. **22** shows an exemplary paperboard tray **20** in which the integral paperboard reinforcement **31** is attached to the bottom surface of the flange **23** at the longitudinal ends of the rectangular paperboard tray **20** and the corners of the rectangular paperboard tray **20**. Thus, the integral paperboard reinforcements **31** can stop short of the corners such as shown in FIG. **20** or the integral paperboard reinforcements can extend to the corners of the paperboard tray **20** such as shown in FIG. **22**. Stopping the integral paperboard reinforcements **31** short of the corners requires less material for the paperboard tray **20** and ensures better flexibility of the paperboard tray **20**. Extending the integral paperboard reinforcements **31** to the corners of the paperboard tray **20** enhances strength of the flange **23** and also increases the overall strength of the paperboard tray **20**. The integral paperboard reinforcements **31** reduce the likelihood of buckling along the flange **23** and reduce the likelihood of bending at the corners and twisting of the paperboard tray **20** at the corners when pressure is applied along the latitudinal or longitudinal ends of the paperboard tray **20**. Thus, extending the integral paperboard reinforcements **31** to the corners of the paperboard tray **20** decreases the likelihood of buckling along the latitudinal or longitudinal ends and decreases the likelihood of bending in the corners which could torque the tray. Also, due to the integral nature of the integral paperboard reinforcement, the cut edges are redirected from areas of high purge/moisture concentration near the top of the tray to area of low purge/moisture concentration nearer to the bottom of the tray both at the straight edges of the latitudinal or longitudinal ends and at the corners of the paperboard tray. Other embodiments include that the paperboard tray **20** has a shape other than rectangular.

(92) In the illustrated example as shown, the shape of the integral paperboard reinforcement **31** at the bottom surface of the flange **23** matches the shape of the flange **23**. Alternatively, the integral paperboard reinforcement **31** at the bottom surface of the flange **23** may have a different shape than the bottom surface of the flange **23** such there is an air gap between the integral paperboard reinforcement **31** and the bottom surface of the flange **23**. The air gap facilitates for de-nesting of



multiple paperboard trays stacked upon each other in a nesting relationship. The air gap may be positioned at any point between the integral paperboard reinforcement **31** and the bottom surface of the flange **23**. In an example, the air gap may be positioned between the integral paperboard reinforcement **31** and the bottom surface of the flange **23** at an end portion of the flange **23**. In another example, the air gap may be positioned between the integral paperboard reinforcement **31** and the bottom surface of the flange **23** at a middle portion of the flange **23**. In yet another, the air gap may be positioned between the integral paperboard reinforcement **31** and the bottom surface of the flange **23** at a beginning portion of the flange **23** near the side wall **22**. The purpose of the air gaps is to produce a section of the reinforced flange that aids in separating the paperboard trays when stacked on each other, which can be useful for de-nesting of the paperboard trays.

(93) According to an embodiment of the present description, the paperboard reinforcement includes separate paperboard reinforcement attached to a bottom surface of the flange, wherein the separate paperboard reinforcement is formed from a separate piece of paperboard than the coated paperboard that forms the bottom wall, the side wall, and the flange. Examples of the separate paperboard reinforcement **32** are shown in FIGS. **23-30**. The separate paperboard reinforcement increases strength of the flange to prevent buckling or kinking often due to stress while overwrapping or during distribution.

(94) FIGS. **23-26** illustrate a first example of a separate paperboard reinforcement **32**. As shown, a rectangular paperboard tray **20** includes a coated paperboard **2** (FIG. **4**) in the form of a bottom wall **21**, a side wall **22** extending upwardly around the bottom wall **21**, and a curved flange **23** extending outwardly around the side wall **22**. The coated paperboard **2** includes a single-ply paperboard substrate **4** and a barrier coating **10** on the side of the single-ply paperboard substrate **4** that corresponds to an upper side of the bottom wall **21** and optionally a topcoat **12** on the side of the single-ply paperboard substrate **4** that corresponds to a lower side of the bottom wall **21**.

(95) The separate paperboard reinforcement **32** is formed from a separate piece of paperboard than the coated paperboard **2** that forms the bottom wall, the side wall, and the flange. The coated paperboard **2** for the separate paperboard reinforcement **32** includes a single-ply paperboard substrate **4'** and a barrier coating **10'** on one side of the single-ply paperboard substrate **4'** and optionally a topcoat **12'** on the other side of the single-ply paperboard substrate **4'**. As shown in FIG. **14**, the barrier coating **10'** may correspond to bottom surface of the separate paperboard reinforcement **32** opposite to the side of the separate paperboard reinforcement **32** contacting the flange **23**. Alternatively, as shown in FIG. **15**, the barrier coating **10'** may correspond to upper surface of the separate paperboard reinforcement **32** on the side of the separate paperboard reinforcement **32** contacting the flange **23**.

(96) The separate paperboard reinforcement **32** is attached to the bottom surface of the curved flange **23**. By attaching the separate paperboard reinforcement **32** to the bottom surface of the curved flange **23**, the separate paperboard reinforcement **32** reinforces the flange **23** to provide the flange **23** of the paperboard tray **20** with improved characteristics to withstand conveying the paperboard tray **20** through belts, holding the paperboard tray **20** at a fixed point, and using the paperboard tray **20** in an overwrapping process. By reinforcing the flange **23** rather than the flange **23**, the side wall **22**, and the bottom wall **21**, less material is required for the paperboard tray **20** and better flexibility of the paperboard tray **20** is facilitated.

(97) In the example shown in FIGS. **23-26** separate paperboard reinforcement **32** is attached to the bottom surface of the flange **23** at both longitudinal ends of the rectangular paperboard tray **20**. In an alternative, the separate paperboard reinforcement **32** may be attached to the bottom surface of the flange **23** at both latitudinal ends of the rectangular paperboard tray **20**. In another alternative, the separate paperboard reinforcement **32** may be attached at the corners of the rectangular paperboard tray **20**. In yet another alternative, the separate paperboard reinforcement **32** may be attached to the bottom surface of the flange **23** at both longitudinal ends and both latitudinal ends of the rectangular paperboard tray **20**. In yet another alternative, the separate paperboard

reinforcement **32** may be attached to the bottom surface of the flange **23** at either the longitudinal ends or both latitudinal ends of the rectangular paperboard tray **20** and the corners of the rectangular paperboard tray **20**. In yet another alternative, the separate paperboard reinforcement **32** may be attached to the bottom surface of the flange **23** at both longitudinal ends, both latitudinal ends, and the corners of the rectangular paperboard tray **20**. Thus, the separate paperboard reinforcements **32** can stop short of the corners such as shown in FIG. **23** or the separate paperboard reinforcements **32** can extend to the corners of the paperboard tray **20**. Stopping the separate paperboard reinforcements **32** short of the corners requires less material for the paperboard tray **20** and ensures better flexibility of the paperboard tray **20**. Extending the separate paperboard reinforcements **32** to the corners of the paperboard tray **20** enhances strength of the flange **23** and also increases the overall strength of the paperboard tray **20**. The separate paperboard reinforcements **32** reduce the likelihood of buckling along the flange **23** and reduce the likelihood of bending at the corners and twisting of the paperboard tray **20** at the corners when pressure is applied along the latitudinal or longitudinal ends of the paperboard tray **20**. Thus, extending the separate paperboard reinforcements **32** to the corners of the paperboard tray **20** decreases the likelihood of buckling along the latitudinal or longitudinal ends and decreases the likelihood of bending in the corners which could torque the tray. Other embodiments include that the paperboard tray **20** has a shape other than rectangular.

(98) In the illustrated example as shown, the shape of the separate paperboard reinforcement **32** at the bottom surface of the flange **23** matches the shape of the flange **23**. Alternatively, the separate paperboard reinforcement **32** at the bottom surface of the flange **23** may have a different shape than the bottom surface of the flange **23** such there is an air gap between the separate paperboard reinforcement **32** and the bottom surface of the flange **23**. The air gap facilitates for de-nesting of multiple paperboard trays stacked upon each other in a nesting relationship. The air gap may be positioned at any point between the separate paperboard reinforcement **32** and the bottom surface of the flange **23**. In an example, the air gap may be positioned between the separate paperboard reinforcement **32** and the bottom surface of the flange **23** at an end portion of the flange **23**. In another example, the air gap may be positioned between the separate paperboard reinforcement **32** and the bottom surface of the flange **23** at a middle portion of the flange **23**. In yet another, the air gap may be positioned between the separate paperboard reinforcement **32** and the bottom surface of the flange **23** at a beginning portion of the flange **23** near the side wall **22**. The purpose of the air gaps is to produce a section of the reinforced flange that aids in separating the paperboard trays when stacked on each other, which can be useful for de-nesting of the paperboard trays.

(99) FIGS. **27** and **28** illustrate a second example of a separate paperboard reinforcement **32**. As shown, a rectangular paperboard tray **20** includes a coated paperboard **2** (FIG. **4**) in the form of a bottom wall **21**, a side wall **22** extending upwardly around the bottom wall **21**, and a curved flange **23** extending outwardly around the side wall **22**. The coated paperboard **2** includes a single-ply paperboard substrate **4** and a barrier coating **10** on the side of the single-ply paperboard substrate **4** that corresponds to an upper side of the bottom wall **21** and optionally a topcoat **12** on the side of the single-ply paperboard substrate **4** that corresponds to a lower side of the bottom wall **21**.

(100) The separate paperboard reinforcement **32** is formed from a separate piece of paperboard than the coated paperboard **2** that forms the bottom wall, the side wall, and the flange. The coated paperboard **2** for the separate paperboard reinforcement **32** includes a single-ply paperboard substrate **4'** and a barrier coating **10'** on one side of the single-ply paperboard substrate **4'** and optionally a topcoat **12'** on the other side of the single-ply paperboard substrate **4'**. As shown in FIG. **25**, the barrier coating **10'** may correspond to bottom surface of the separate paperboard reinforcement **32** opposite to the side of the separate paperboard reinforcement **32** contacting the flange **23** and the side wall **22**. Alternatively, as shown in FIG. **26**, the barrier coating **10'** may correspond to upper surface of the separate paperboard reinforcement **32** on the side of the separate paperboard reinforcement **32** contacting the flange **23** and the side wall **22**.

(101) The separate paperboard reinforcement **32** is attached to the bottom surface of the curved flange **23** and an outside surface of the side wall **22**. By attaching the separate paperboard reinforcement **32** to the bottom surface of the curved flange **23** and the outside surface of the side wall **22**, the separate paperboard reinforcement **32** reinforces the flange **23** and the side wall **22** to provide the flange **23** and the side wall **22** of the paperboard tray **20** with improved characteristics to withstand conveying the paperboard tray **20** through belts, holding the paperboard tray **20** at a fixed point, and using the paperboard tray **20** in an overwrapping process. By reinforcing the flange **23** and the side wall **22** rather than the flange **23**, the side wall **22**, and the bottom wall **21**, less material is required for the paperboard tray **20** and better flexibility of the paperboard tray **20** is facilitated.

(102) In the example shown in FIGS. **27** and **28**, separate paperboard reinforcement **32** is attached to the bottom surface of the flange **23** and the outer surface of the side wall **22** at both longitudinal ends of the rectangular paperboard tray **20**. In an alternative, the separate paperboard reinforcement **32** may be attached to the bottom surface of the flange **23** and the outer surface of the side wall **22** at both latitudinal ends of the rectangular paperboard tray **20**. In another alternative, the separate paperboard reinforcement **32** may be attached at the corners of the rectangular paperboard tray **20**. In yet another alternative, the separate paperboard reinforcement **32** may be attached to the bottom surface of the flange **23** and the outer surface of the side wall **22** at both longitudinal ends and both latitudinal ends of the rectangular paperboard tray **20**. In yet another alternative, the separate paperboard reinforcement **32** may be attached to the bottom surface of the flange **23** and the outer surface of the side wall **22** at either the longitudinal ends or both latitudinal ends of the rectangular paperboard tray **20** and the corners of the rectangular paperboard tray **20**. In yet another alternative, the separate paperboard reinforcement **32** may be attached to the bottom surface of the flange **23** and the outer surface of the side wall **22** at both longitudinal ends, both latitudinal ends, and the corners of the rectangular paperboard tray **20**. In other alternatives, the separate paperboard reinforcement **32** may be attached to the bottom surface of the flange **23** and the outer surface of the side wall **22** at one or more of the longitudinal ends, the latitudinal ends, and the corners of the rectangular paperboard tray **20** and attached to only the bottom surface of the flange **23** at other of the longitudinal ends, the latitudinal ends, and the corners of the rectangular paperboard tray **20**. Thus, the separate paperboard reinforcements **32** can stop short of the corners such as shown in FIG. **27** or the separate paperboard reinforcements **32** can extend to the corners of the paperboard tray **20**. Stopping the separate paperboard reinforcements **32** short of the corners requires less material for the paperboard tray **20** and ensures better flexibility of the paperboard tray **20**. Extending the separate paperboard reinforcements **32** to the corners of the paperboard tray **20** enhances strength of the flange **23** and also increases the overall strength of the paperboard tray **20**. The separate paperboard reinforcements **32** reduce the likelihood of buckling along the flange **23** and reduce the likelihood of bending at the corners and twisting of the paperboard tray **20** at the corners when pressure is applied along the latitudinal or longitudinal ends of the paperboard tray **20**. Thus, extending the separate paperboard reinforcements **32** to the corners of the paperboard tray **20** decreases the likelihood of buckling along the latitudinal or longitudinal ends and decreases the likelihood of bending in the corners which could torque the tray. Other embodiments include that the paperboard tray **20** has a shape other than rectangular.

(103) In the illustrated example as shown, the shape of the separate paperboard reinforcement **32** at the bottom surface of the flange **23** matches the shape of the flange **23**. Alternatively, the separate paperboard reinforcement **32** at the bottom surface of the flange **23** may have a different shape than the bottom surface of the flange **23** such there is an air gap between the separate paperboard reinforcement **32** and the bottom surface of the flange **23**. The air gap facilitates for de-nesting of multiple paperboard trays stacked upon each other in a nesting relationship. The air gap may be positioned at any point between the separate paperboard reinforcement **32** and the bottom surface of the flange **23**. In an example, the air gap may be positioned between the separate paperboard

reinforcement **32** and the bottom surface of the flange **23** at an end portion of the flange **23**. In another example, the air gap may be positioned between the separate paperboard reinforcement **32** and the bottom surface of the flange **23** at a middle portion of the flange **23**. In yet another, the air gap may be positioned between the separate paperboard reinforcement **32** and the bottom surface of the flange **23** at a beginning portion of the flange **23** near the side wall **22**. The purpose of the air gaps is to produce a section of the reinforced flange that aids in separating the paperboard trays when stacked on each other, which can be useful for de-nesting of the paperboard trays.

(104) FIGS. **29** and **30** illustrate a third example of a separate paperboard reinforcement. As shown, a rectangular paperboard tray **20** includes a coated paperboard **2** (FIG. **4**) in the form of a bottom wall **21**, a side wall **22** extending upwardly around the bottom wall **21**, and a curved flange **23** extending outwardly around the side wall **22**. The coated paperboard **2** includes a single-ply paperboard substrate **4** and a barrier coating **10** on the side of the single-ply paperboard substrate **4** that corresponds to an upper side of the bottom wall **21** and optionally a topcoat **12** on the side of the single-ply paperboard substrate **4** that corresponds to a lower side of the bottom wall **21**.

(105) The separate paperboard reinforcement **32** is formed from a separate piece of paperboard than the coated paperboard **2** that forms the bottom wall, the side wall, and the flange. The coated paperboard **2** for the separate paperboard reinforcement **32** includes a single-ply paperboard substrate **4'** and a barrier coating **10'** on one side of the single-ply paperboard substrate **4'** and optionally a topcoat **12'** on the other side of the single-ply paperboard substrate **4'**. As shown in FIG. **25**, the barrier coating **10'** may correspond to bottom surface of the separate paperboard reinforcement **32** opposite to the side of the separate paperboard reinforcement **32** contacting the flange **23**, the side wall **22**, and the bottom wall **21**. Alternatively, as shown in FIG. **26**, the barrier coating **10'** may correspond to upper surface of the separate paperboard reinforcement **32** on the side of the separate paperboard reinforcement **32** contacting the flange **23**, the side wall **22**, and the bottom wall **21**.

(106) The separate paperboard reinforcement **32** is attached to the bottom surface of the curved flange **23**, the outside surface of the side wall **22**, and the bottom surface of the bottom wall **21**. By attaching the separate paperboard reinforcement **32** to the bottom surface of the curved flange **23**, the outside surface of the side wall **22**, and the bottom surface of the bottom wall **21**, the separate paperboard reinforcement **32** reinforces the flange **23**, the side wall **22**, and the bottom wall **21** to provide the flange **23**, the side wall **22**, and the bottom wall **21** of the paperboard tray **20** with improved characteristics to withstand conveying the paperboard tray **20** through belts, holding the paperboard tray **20** at a fixed point, and using the paperboard tray **20** in an overwrapping process. As shown, only a portion of the bottom wall **21** is reinforced, leaving a remaining portion of the bottom wall **21** not reinforced by the separate paperboard reinforcement **32**. By reinforcing the flange **23**, the side wall **22**, and a portion of the bottom wall **21** rather than the flange **23**, the side wall **22**, and the entire bottom wall **21**, less material is required for the paperboard tray **20** and better flexibility of the paperboard tray **20** is facilitated.

(107) In the example shown in FIGS. **29** and **30**, separate paperboard reinforcement **32** is attached to the bottom surface of the flange **23**, the outer surface of the side wall **22**, and a portion of the bottom wall **21** at both longitudinal ends of the rectangular paperboard tray **20**. In an alternative, the separate paperboard reinforcement **32** may be attached to the bottom surface of the flange **23**, the outer surface of the side wall **22**, and a portion of the bottom wall **21** at both latitudinal ends of the rectangular paperboard tray **20**. In another alternative, the separate paperboard reinforcement **32** may be attached at the corners of the rectangular paperboard tray **20**. In yet another alternative, the separate paperboard reinforcement **32** may be attached to the bottom surface of the flange **23**, the outer surface of the side wall **22**, and a portion of the bottom wall **21** at both longitudinal ends and both latitudinal ends of the rectangular paperboard tray **20**. In yet another alternative, the separate paperboard reinforcement **32** may be attached to the bottom surface of the flange **23**, the outer surface of the side wall **22**, and a portion of the bottom wall **21** at either the longitudinal ends or

both latitudinal ends of the rectangular paperboard tray **20** and the corners of the rectangular paperboard tray **20**. In yet another alternative, the separate paperboard reinforcement **32** may be attached to the bottom surface of flange **23**, the outer surface of the side wall **22**, and a portion of the bottom wall **21** at both longitudinal ends, both latitudinal ends, and the corners of the rectangular paperboard tray **20**. In other alternatives, the separate paperboard reinforcement **32** may be attached to the bottom surface of flange **23**, the outer surface of the side wall **22**, and a portion of the bottom wall **21** at one or more of the longitudinal ends, the latitudinal ends, and the corners of the rectangular paperboard tray **20** and attached to only the bottom surface of the flange **23** or to the bottom surface of the flange **23** and the outer surface of the side wall **22** at other of the longitudinal ends, the latitudinal ends, and the corners of the rectangular paperboard tray **20**. Thus, the separate paperboard reinforcements **32** can stop short of the corners such as shown in FIG. **29** or the separate paperboard reinforcements **32** can extend to the corners of the paperboard tray **20**. Stopping the separate paperboard reinforcements **32** short of the corners requires less material for the paperboard tray **20** and ensures better flexibility of the paperboard tray **20**. Extending the separate paperboard reinforcements **32** to the corners of the paperboard tray **20** enhances strength of the flange **23** and also increases the overall strength of the paperboard tray **20**. The separate paperboard reinforcements **32** reduce the likelihood of buckling along the flange **23** and reduce the likelihood of bending at the corners and twisting of the paperboard tray **20** at the corners when pressure is applied along the latitudinal or longitudinal ends of the paperboard tray **20**. Thus, extending the separate paperboard reinforcements **32** to the corners of the paperboard tray **20** decreases the likelihood of buckling along the latitudinal or longitudinal ends and decreases the likelihood of bending in the corners which could torque the tray. Other embodiments include that the paperboard tray **20** has a shape other than rectangular.

(108) In the illustrated example as shown, the shape of the separate paperboard reinforcement **32** at the bottom surface of the flange **23** matches the shape of the flange **23**. Alternatively, the separate paperboard reinforcement **32** at the bottom surface of the flange **23** may have a different shape than the bottom surface of the flange **23** such that there is an air gap between the separate paperboard reinforcement **32** and the bottom surface of the flange **23**. The air gap facilitates for de-nesting of multiple paperboard trays stacked upon each other in a nesting relationship. The air gap may be positioned at any point between the separate paperboard reinforcement **32** and the bottom surface of the flange **23**. In an example, the air gap may be positioned between the separate paperboard reinforcement **32** and the bottom surface of the flange **23** at an end portion of the flange **23**. In another example, the air gap may be positioned between the separate paperboard reinforcement **32** and the bottom surface of the flange **23** at a middle portion of the flange **23**. In yet another, the air gap may be positioned between the separate paperboard reinforcement **32** and the bottom surface of the flange **23** at a beginning portion of the flange **23** near the side wall **22**. The purpose of the air gaps is to produce a section of the reinforced flange that aids in separating the paperboard trays when stacked on each other, which can be useful for de-nesting of the paperboard trays.

(109) In a fourth example of a separate paperboard reinforcement (not shown), the separate paperboard reinforcement **32** may be attached to the bottom surface of the curved flange **23**, an outside surface of the side wall **22**, and the bottom surface of the bottom wall **21**, in which the integral paperboard reinforcements **31** at opposing side of the of the paperboard tray **20** meet or overlap at the center. By attaching the separate paperboard reinforcement **32** to the bottom surface of the curved flange **23**, the outside surface of the side wall **22**, and the across the entire bottom surface of the bottom wall **21**, the separate paperboard reinforcement **32** reinforces the flange **23**, the side wall **22**, and the entire bottom wall **21** to provide the paperboard tray **20** with improved characteristics to withstand conveying the paperboard tray **20** through belts, holding the paperboard tray **20** at a fixed point, and using the paperboard tray **20** in an overwrapping process.

(110) According to an embodiment of the present description, the paperboard reinforcement includes a spiral paperboard reinforcement at an end of the flange, wherein the spiral paperboard

reinforcement is formed from the same coated paperboard that forms the bottom wall, the side wall, and the flange.

(111) FIGS. **31** and **32** illustrate an example of a spiral paperboard reinforcement **33**. As shown, a rectangular paperboard tray **20** includes a coated paperboard **2** (FIG. **4**) in the form of a bottom wall **21**, a side wall **22** extending upwardly around the bottom wall **21**, a curved flange **23** extending outwardly around the side wall **22**, and the spiral paperboard reinforcement **33** at an end of the flange **23**. The coated paperboard **2** includes a single-ply paperboard substrate **4** (FIG. **4**) and a barrier coating **10** (FIG. **4**) on the side of the single-ply paperboard substrate **4** that corresponds to an upper side of the bottom wall **21** and, optionally, a topcoat **12** (FIG. **4**) on the side of the single-ply paperboard substrate **4** that corresponds to a lower side of the bottom wall **21**. The spiral paperboard reinforcement **33** is positioned at the end of the curved flange **23**. By positioning the spiral paperboard reinforcement **33** at the end of the curved flange **23**, the spiral paperboard reinforcement **33** reinforces the flange **23** to provide the flange **23** of the paperboard tray **20** with improved characteristics to withstand conveying the paperboard tray **20** through belts, holding the paperboard tray **20** at a fixed point, and using the paperboard tray **20** in an overwrapping process.

(112) In the example shown in FIGS. **31** and **32**, spiral paperboard reinforcement **33** is positioned at the end of the flange **23** at both longitudinal ends of the rectangular paperboard tray **20**. In an alternative, the spiral paperboard reinforcement **33** may be positioned at the end of the flange **23** at both latitudinal ends of the rectangular paperboard tray **20**. In another alternative, the spiral paperboard reinforcement **33** may be positioned at the corners of the rectangular paperboard tray **20**. In yet another alternative, the spiral paperboard reinforcement **33** may be positioned at the end of the flange **23** at both longitudinal ends and both latitudinal ends of the rectangular paperboard tray **20**. In yet another alternative, the spiral paperboard reinforcement **33** may be positioned at the end of the flange **23** at either the longitudinal ends or both latitudinal ends of the rectangular paperboard tray **20** and the corners of the rectangular paperboard tray **20**. In yet another alternative, the spiral paperboard reinforcement **33** may be positioned at the end of the flange **23** at both longitudinal ends, both latitudinal ends, and the corners of the rectangular paperboard tray **20**. Thus, the spiral paperboard reinforcement **33** can stop short of the corners such as shown in FIG. **31** or the spiral paperboard reinforcement **33** can extend to the corners of the paperboard tray **20**. Stopping the spiral paperboard reinforcement **33** short of the corners requires less material for the paperboard tray **20** and ensures better flexibility of the paperboard tray **20**. Stopping the spiral paperboard reinforcement **33** short of the corners requires less material for the paperboard tray **20** and ensures better flexibility of the paperboard tray **20**. Extending the spiral paperboard reinforcement **33** to the corners of the paperboard tray **20** enhances strength of the flange **23** and also increases the overall strength of the paperboard tray **20**. The spiral paperboard reinforcement **33** reduce the likelihood of buckling along the flange **23** and reduce the likelihood of bending at the corners and twisting of the paperboard tray **20** at the corners when pressure is applied along the latitudinal or longitudinal ends of the paperboard tray **20**. Thus, extending the spiral paperboard reinforcement **33** to the corners of the paperboard tray **20** decreases the likelihood of buckling along the latitudinal or longitudinal ends and decreases the likelihood of bending in the corners which could torque the tray. Other embodiments include that the paperboard tray **20** has a shape other than rectangular.

(113) In the illustrated example, the spiral paperboard reinforcement **33** is preferably positioned at an underside of the flange **23**. In an alternative, the spiral paperboard reinforcement **33** may be positioned atop the flange **23**.

(114) Referring to FIGS. **33-36**, various alternative configurations of the spiral paperboard reinforcement **33** are also contemplated. As shown in FIG. **33**, the example paperboard reinforcement shown in FIG. **6** can be modified to include a spiral paperboard reinforcement **33** disposed proximate the top of the side wall **22**. As shown in FIG. **34**, the example paperboard reinforcement shown in FIG. **6** can be modified to include a spiral paperboard reinforcement **33**

disposed proximate the apex of the curved flange 23. As shown in FIG. 35, the example paperboard reinforcement shown in FIG. 24 can be modified to include a spiral paperboard reinforcement 33 disposed at the outward end of the reinforcement, with the spiral paperboard reinforcement 33 spiraling inward. As shown in FIG. 25, the example paperboard reinforcement shown in FIG. 24 can be modified to include a spiral paperboard reinforcement 33 disposed at the outward end of the reinforcement, with the spiral paperboard reinforcement 33 spiraling outward.

(115) FIGS. 37 and 38 are side sectional views of yet additional paperboard trays according to the present description. As shown, the flange has a double reinforcement, i.e., two layers of paperboard reinforcement layers and one flange layer. In the case of FIG. 37, there is a z-shaped fold where the exposed edge is oriented away from the tray. Alternatively, in the case of FIG. 38, there can be a second score and fold where the exposed edge is folded under and is hidden.

(116) According to the present description, there is a method for manufacturing a reinforced paperboard tray. The method includes thermoforming a paperboard tray. The paperboard tray includes: a coated paperboard in the form of a bottom wall, a side wall extending upwardly around the bottom wall, and a curved flange extending outwardly around the side wall, the coated paperboard comprising a single-ply paperboard substrate having a first major side and a second major side, the first major side corresponding to an upper side of the bottom wall; and a barrier coating on the first major side of the single-ply paperboard substrate. The method further includes forming a paperboard reinforcement attached to a curved flange, the curved flange and the side wall, or the curved flange, the side wall, and a portion of the bottom wall. Forming the paperboard reinforcement attached to the curved flange occurs before thermoforming the paperboard tray, during thermoforming the paperboard tray, or after thermoforming the paperboard tray.

(117) The method may include attaching a separate paperboard reinforcement to the curved flange. In one or more aspects, the paperboard reinforcement 30 may be in the form of strips of paperboard to add an additional layer in locations requiring increased rigidity. The strips may be flat, curved, or spiral. The strips can be applied through gluing, adhesive or heat-activated coatings. Glue can further provide rigidity by tacking and providing an extra support. Application of the strips can occur either before, during or post thermoforming. Methods of production before thermoforming include, for example, gluing strips before die cutting and scoring. Additionally, strips can be fed into thermoforming tooling used for forming the overall shape of the paperboard tray and combined with flange through heat and pressure by heat-activating coatings. Finally, strips can be applied post thermoforming by, for example, gluing and attaching strips with or without pressure.

(118) In another aspect, the method may include attaching an integral paperboard reinforcement to the curved flange. Attaching an integral paperboard reinforcement to the curved flange may be performed by folding a portion of the coated paperboard and attaching the folded portion of the coated paperboard to curved flange. This may include scoring the coated paperboard along a score line prior to folding the scored portion of the coated paperboard along the score line, and then attaching the folded portion of the coated paperboard to curved flange.

(119) In an aspect, attaching the paperboard reinforcement to the curved flange includes bonding the paperboard reinforcement to the curved flange. Bonding the paperboard reinforcement to the curved flange may include adhering the paperboard reinforcement to the curved flange. Bonding the paperboard reinforcement to the curved flange may include heat sealing the paperboard reinforcement to the curved flange.

(120) In another aspect, the method includes cutting the coated paperboard and the paperboard reinforcement together while in a bonded state, such as by scoring the paperboard, folding the paperboard along a score line, bonding the folded paperboard, and then cutting the coated paperboard to form the shape of the reinforced paperboard tray. Alternatively, the cutting of the coated paperboard may be performed prior to bonding the paperboard reinforcement to the remainder of the paperboard tray. Thus, the method may include, for example, cutting a coated paperboard to form a paperboard blank, scoring the coated paperboard blank along a score line,

folding the scored portion of the coated paperboard along the score line, and then attaching the folded portion of the coated paperboard to a curved flange portion of the paperboard tray.

(121) In another aspect, the method includes thermoforming the coated paperboard, such as by thermoforming the paperboard reinforcement together with the remainder of the paperboard tray while in a bonded state to form the bottom wall, the side wall, and the reinforced curved flange.

(122) By way of specific examples, the method of manufacturing the paperboard container may include the following exemplary preferred methods of manufacturing.

(123) According to a first method of manufacturing, an integrally reinforced flange may be made by providing a coated paperboard sheet, folding the coated paperboard sheet while in sheet form, blanking the folded paperboard sheet, and then thermoforming the blanked paperboard sheet to result in the final form of the reinforcement paperboard tray. The attaching of the paperboard reinforcements to the remainder of the paperboard may be preferably performed by heat sealing during thermoforming.

(124) According to a second method of manufacturing, an integrally reinforced flange may be made by providing a coated paperboard sheet, blanking the coated paperboard sheet to form the shape of a coated paperboard blank having wings that will be the paperboard reinforcements, then folding the wings to form the paperboard reinforcements, and then thermoforming to result in the final form of the reinforced paperboard tray. The attaching of the paperboard reinforcements to the remainder of the paperboard may be preferably performed by heat sealing during thermoforming.

(125) According to a third method of manufacturing, an integrally reinforced flange may be made by providing a coated paperboard sheet, blanking the coated paperboard sheet to form the shape of a coated paperboard blank having wings, then thermoforming to result in the final form of the unreinforced paperboard tray having wings, and then folding the wings to form the paperboard reinforcements, and then attaching the wings to the remainder of the paperboard tray. The attaching of the paperboard reinforcements to the remainder of the paperboard may be preferably performed by heat sealing during hot pressing.

(126) In another aspect, an air gap between an integral paperboard reinforcement and the bottom surface of the flange may be made by folding the coated paperboard, either before, during or after thermoforming, with a creasing feature in toolset that creates air pocket when pressing the flange.

(127) In another one or more aspects, the paperboard tray may have stiffening members lateral to the flange (stiffeners) structures that can fold over during or post thermoforming. The stiffeners may come as a result of extensions from the flange(s). The stiffeners can either be folded or rolled to the original distance of an arced flange. Folds or rolls can be held in place by the following: lug to lock it in place, crimper, welder or glue. Glue can further provide rigidity by tacking and providing an extra support while stiffeners are folded over. Folds can be created and reinforced during thermoforming by a pre-step of folding and placing in the thermoforming tooling wherein it is reinforced to the inside portion of the flange by applying heat and pressure. Another method to create the fold as well as the roll would occur post-thermoforming. During thermoforming the stiffeners can extend outside the tooling to form the tray. After thermoforming the trays can stay in the tooling or be conveyed to a secondary step that folds or rolls the extensions to the underside of the flange(s). Folds/rolls can be held in place by an adhesive or glue as well as physical features such as slits that hold the stiffeners into place.

(128) According to an aspect of the present description, a method for using the paperboard tray **20** includes positioning a food product within the paperboard tray **20** and wrapping a film over the product and the paperboard tray **20**.

(129) In an aspect, the food product may be a moist food product, such as meat, poultry, seafood, and produce, and the food product may be positioned with the paperboard tray **20** manually or by way of an automated process.

(130) The step of wrapping the film over the product and the paperboard tray **20** may including a manual overwrapping process or an automatic overwrapping process using an overwrapping



machine.

(131) By way of example, an exemplary overwrapping machine may take a length of heat sealable film from a roll and fold it around a paperboard tray containing a product. The folded film may then be closed to itself by means of a heated sealing device. However, the overwrapping is not so limited. In a variation, overwrapping may include folding a film around the paperboard tray and lightly sealing the film to itself, such as by way of light heating or adhesive. In another variation, overwrapping may include folding a film around the paperboard tray and sealing the film to the paperboard tray, such as by way of heating or adhesive.

(132) In one example, the film may be CRYOVAC® SES-340 oxygen permeable stretch-shrink poultry film. In another example, the film may be formed from a transparent wrapping material, such as CRYOVAC® D-940 Polyolefin Shrink Film Roll—60 gauge. In a variation, the film may be formed from a non-transparent wrapping material. In another variation, the transparent wrapping material or non-transparent wrapping material may be printable such as to permit printing of graphics and/or text on the film.

(133) In an aspect, the present description enables providing a paperboard tray that is compostable. In another aspect, the present description enables providing a paperboard tray that is recyclable. In yet another aspect, the present description enables providing a paperboard tray that is printable or capable of being dyed.

(134) The invention may be used, for example, in the following commercial areas: raw and cooked meat, seafood, vegetable substitutes for meat, produce, and consumables.

(135) This present description may have at least the following advantages: increased rigidity of the tray; enables assisting in de-nesting trays by creating a separation between stacked trays; stiffeners may hide raw edge that may be susceptible to moisture pickup; and reduction of cost due to more efficient use of materials.

(136) Although various embodiments of the disclosed reinforced paperboard tray, method for manufacturing the reinforced paperboard tray, and method for using the reinforced paperboard tray have been shown and described, modifications may occur to those skilled in the art upon reading the specification. The present application includes such modifications and is limited only by the scope of the claims.

## Claims

1. A reinforced paperboard tray comprising: a coated paperboard in a form of a bottom wall, a side wall extending upwardly around the bottom wall, and a curved flange extending outwardly around the side wall, the coated paperboard comprising a single-ply paperboard substrate having a first major side and a second major side, the first major side corresponding to an upper side of the bottom wall; and a barrier coating on the first major side of the single-ply paperboard substrate; and a paperboard reinforcement attached to the curved flange, wherein the paperboard reinforcement comprises an integral paperboard reinforcement attached to a bottom surface of the curved flange, wherein the integral paperboard reinforcement is attached to an outer surface of the side wall and to a portion of the bottom wall such that the integral paperboard reinforcement extends to a center of the bottom wall meeting or overlapping an opposing integral paperboard reinforcement, wherein the integral paperboard reinforcement is formed from the same coated paperboard that forms the bottom wall, the side wall, and the curved flange.

2. The reinforced paperboard tray of claim 1 wherein the paperboard reinforcement comprises a coated paperboard comprising a single-ply paperboard substrate having a first major side and a second major side; and a barrier coating on the first major side of the single-ply paperboard substrate.

3. The reinforced paperboard tray of claim 2 wherein the barrier coating for the paperboard reinforcement is a single coating layer positioned directly on the first major side of the single-ply

paperboard substrate.

4. The reinforced paperboard tray of claim 2 wherein the coated paperboard for the paperboard reinforcement include a topcoat on the second major side of the coated paperboard.

5. The reinforced paperboard tray of claim 1 wherein a shape of the paperboard reinforcement at the bottom surface of the flange matches a shape of the flange.

6. The reinforced paperboard tray of claim 1 wherein the shape of the paperboard reinforcement at the bottom surface of the flange is different from the shape of the flange such there is an air gap between the paperboard reinforcement and the bottom surface of the flange.

7. The reinforced paperboard tray of claim 1, wherein the coated paperboard is substantially rectangular in shape and wherein the integral paperboard reinforcement is attached to the bottom surface of the curved flange at opposite sides of the rectangle.

8. The reinforced paperboard tray of claim 1, wherein the coated paperboard is substantially rectangular in shape, and wherein the integral paperboard reinforcement is attached to the bottom surface of the curved flange at corners of the rectangle.

9. The reinforced paperboard tray of claim 1, wherein the coated paperboard is substantially rectangular in shape, and wherein the integral paperboard reinforcement is attached to the bottom surface of the curved flange at opposite sides and at corners of the rectangle.

10. The reinforced paperboard tray of claim 1, wherein the coated paperboard is substantially rectangular in shape, and wherein the integral paperboard reinforcement is attached to the bottom surface of the curved flange at opposite sides around an entire periphery of the rectangle.

11. A reinforced paperboard tray comprising: a coated paperboard in a form of a bottom wall, a side wall extending upwardly around the bottom wall, and a curved flange extending outwardly around the side wall, the coated paperboard comprising a single-ply paperboard substrate having a first major side and a second major side, the first major side corresponding to an upper side of the bottom wall; and a barrier coating on the first major side of the single-ply paperboard substrate; and a paperboard reinforcement attached to the curved flange, wherein the paperboard reinforcement comprises a separate paperboard reinforcement attached to a bottom surface of the curved flange, wherein the separate paperboard reinforcement is attached to an outer surface of the side wall and to a portion of the bottom wall such that the separate paperboard reinforcement extends to a center of the bottom wall meeting or overlapping an opposing separate paperboard reinforcement, wherein the separate paperboard reinforcement is formed from a separate piece of paperboard than the coated paperboard that forms the bottom wall, the side wall, and the curved flange.

12. A method for manufacturing a reinforced paperboard tray, the method comprising: thermoforming a paperboard tray, the paperboard tray comprising: a coated paperboard in a form of a bottom wall, a side wall extending upwardly around the bottom wall, and a curved flange extending outwardly around the side wall, the coated paperboard comprising a single-ply paperboard substrate having a first major side and a second major side, the first major side corresponding to an upper side of the bottom wall; and a barrier coating on the first major side of the single-ply paperboard substrate; and forming a paperboard reinforcement attached to the curved flange, wherein the paperboard reinforcement comprises an integral paperboard reinforcement attached to a bottom surface of the curved flange, wherein the integral paperboard reinforcement is attached to an outer surface of the side wall and to a portion of the bottom wall such that the integral paperboard reinforcement extends to a center of the bottom wall meeting or overlapping an opposing integral paperboard reinforcement, wherein the integral paperboard reinforcement is formed from the same coated paperboard that forms the bottom wall, the side wall, and the curved flange.

13. The method of claim 12 wherein forming the paperboard reinforcement attached to the curved flange occurs before thermoforming the paperboard tray.

14. The method of claim 12 wherein forming the paperboard reinforcement attached to the curved flange occurs during thermoforming the paperboard tray.

15. The method of claim 12 wherein forming the paperboard reinforcement attached to the curved flange occurs after thermoforming the paperboard tray.
16. The method of claim 12 wherein forming the paperboard reinforcement comprises folding a portion of the coated paperboard and attaching the folded portion of the coated paperboard to curved flange.
17. The method of claim 12 further comprising scoring the coated paperboard along a score line, folding a portion of the coated paperboard along the score line, and attaching the folded portion of the coated paperboard to curved flange.
18. The method of claim 17 wherein bonding the paperboard reinforcement to the curved flange comprises one of adhering the paperboard reinforcement to the curved flange or heat sealing the paperboard reinforcement to the curved flange.
19. The method of claim 12 wherein attaching the paperboard reinforcement to the curved flange comprises bonding the paperboard reinforcement to the curved flange.
20. The method of claim 12 further comprising cutting the coated paperboard and the paperboard reinforcement together while in a bonded state.
21. A method for using a reinforced paperboard tray, the method comprising: positioning a food product within a reinforced paperboard tray, the reinforced paperboard tray comprising: a coated paperboard in a form of a bottom wall, a side wall extending upwardly around the bottom wall, and a curved flange extending outwardly around the side wall, the coated paperboard comprising a single-ply paperboard substrate having a first major side and a second major side, the first major side corresponding to an upper side of the bottom wall; and a barrier coating on the first major side of the single-ply paperboard substrate; and a paperboard reinforcement attached to the curved flange, wherein the paperboard reinforcement comprises an integral paperboard reinforcement attached to a bottom surface of the curved flange, wherein the integral paperboard reinforcement is attached to an outer surface of the side wall and to a portion of the bottom wall such that the integral paperboard reinforcement extends to a center of the bottom wall meeting or overlapping an opposing integral paperboard reinforcement, wherein the integral paperboard reinforcement is formed from the same coated paperboard that forms the bottom wall, the side wall, and the curved flange; and wrapping a film over the food product and the reinforced paperboard tray.
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