starch can be made water-resistant by coating with biodegradable polyesters such as poly(beta-hydroxybutyrate-co-valerate) (PHBV), poly(lactic acid) (PLA), and poly(.di-elect cons.-caprolactone) (PCL). Adherence of the two dissimilar materials is achieved through the use of an intervening layer of a resinous material such as shellac or rosin which possesses a solubility parameter (hydrophobicity) intermediate to that of the starch and the polyesters. Coating is achieved by spraying an alcoholic solution of the shellac or rosin onto the starch-based article and subsequently coating with a solution of the polyester in an appropriate solvent. However, these products are not optimally designed for allowing a user to carry them easily while being in a physical activity. In addition, they are not designed to provide different liquid volumes that can be consumed according to instant needs.

[0010] All of the aforementioned prior art constructions are deficient with respect to their failure to provide a simple, efficient, and practical packaging arrangement for liquids that will provide the user with easy access to flexible compartmented packaging for liquids. Consequently, there is a need for a new and improved type of a biodegradable liquid receptacle.

SUMMARY

[0010a] In one aspect, there is provided a biodegradable sheet comprising a nanoclay and polyvinyl alcohol (PVOH).

[0010b] In another aspect, there is provided a biodegradable sheet comprising an inner layer, wherein said inner layer comprises PVOH, wherein said sheet consists of solids having an aspect ratio of less than 10:1.

[0010c] In one aspect, there is provided a biodegradable sheet comprising an inner layer, wherein said inner layer comprises PVOH the sheet consisting of the following five layers:

Layer 1: consisting of 20-80% w/w PLA and 80-20% w/w PBSA;

Layer 2: consisting of 100% w/w PBSA;

Layer 3: consisting of 100% w/w PVOH;

Layer 4: consisting of 100% w/w PBSA; and

Layer 5: consisting of 20-80% w/w PLA and 80-20% w/w PBSA.

[0010d] In one aspect, there is provided a biodegradable sheet comprising an inner layer, wherein said inner layer comprises PVOH, the sheet consisting of the following five layers:

Layer 1: consisting of 20-80% w/w PLA and 80-20% w/w PBSA;

Layer 2: consisting of 90-85% PBSA and 10-15% w/w nanoclays;

Layer 3: consisting of 100% w/w PVOH;

Layer 4: consisting of 90-85% PBSA and 10-15% w/w nanoclays; and

Layer 5: consisting of 20-80% w/w PLA and 80-20% w/w PBSA.

[0011] One embodiment of the disclosure is directed to a biodegradable sheet comprising a gas barrier material. According to some embodiments, the gas barrier material is a nanoclay, according to other embodiments, the gas barrier material is polyvinyl alcohol (PVOH), and according to further embodiments, the gas barrier material is a combination of a nanoclay and PVOH.

[0011a] In one aspect, there is provided a receptacle unit prepared from the biodegradable sheet as defined herein, comprising a compartment for storing liquids and a means by which the liquids are removed therefrom.

[0012] Another embodiment of the disclosure is directed to a receptacle unit prepared from a biodegradable sheet that comprises a gas barrier material, wherein the receptacle unit comprises a compartment for storing liquids and a means by which the liquids are removed therefrom. According to some embodiments, the receptacle unit comprises a hanger.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The above and other characteristics and advantages of the invention will be better understood through the following illustrative and non-limitative detailed description of preferred embodiments thereof, with reference to the appended drawings, wherein:

[0014] Fig. 1 illustrates the construction of an array of receptacle units of different volume, according to an embodiment of the invention;

biodegradable polymer. The softeners used may be selected from the group comprising paraloid®, sukano®, tributyl acetyl citrate (A4®) or any combination thereof.

[0047] According to some embodiments, the biodegradable sheet of the invention comprises at least one nanoclay and/or at least one nano-composite. The addition of the nanoclay and/or the nano-composite lowers the water vapor transmission rate and the oxygen transmission rate of the biodegradable sheet of the invention, thus acting as barriers in the sheet. Further, according to certain embodiments of this invention, the nanoclays and the nano-composites added to the biodegradable sheet are naturally occurring materials, and therefore, the sheets remain biodegradable. According to one embodiment, montmorillonite, vermiculite or any combination thereof are added to the composition of the biodegradable sheet.

[0048] According to one embodiment, nanoclays based on montmorillonite with polar organophilic based surface treatment and/or nanoclays based on vermiculite, heat treated and polar organophilic base surface treated are added to the biodegradable composition in order to create a well dispersed material. According to one embodiment, the nanoclay based gas barrier is dispersed in the bulk of the biodegradable composition, preferably added during the melt compounding process. The dispersment of nanoclay platelets creates a tortuous path in the bulk of the composition, thus leading to a reduction in gas permeation rates though the biodegradable sheet produced. According to another embodiment, the nanoclay based gas barrier is implemented as an internal gas barrier layer in a multilayer biodegradable sheet, wherein the barrier layer reduces the gas permeation rate.

[0049] According to one embodiment, the nanoclay added to the biodegradable sheet creates a tortuous structure that resists the penetration of moisture, oil, grease and gases, such as oxygen, nitrogen and carbon dioxide. According to one embodiment of the invention, the nanoclay is based on nano-kaolin. According to another embodiment, the nanoclay added to the biodegradable sheet is based on bentonite, which is an absorbent aluminium phyllosilicate. According to one embodiment, the nanoclay is based on Cloisite®. According to one embodiment, a mixture of any appropriate nanoclays may be added to the biodegradable sheet.

[0050] According to one embodiment, the nanoclay is dispersed in the bulk of the biodegradable composition, resulting in the dispersment of the nanoclay in at least one layer of the biodegradable sheet. According to some embodiments, the nanoclay is added during the melt compounding process. According to another embodiment, the nanoclay is added to the biodegradable sheet in a separate layer, together with a biodegradable polymer, thus forming a nano-composite layer. According to one embodiment, the nanoclay layer in the

CLAIMS

What is claimed is:

1. A biodegradable sheet comprising a nanoclay and PVOH.

2. A biodegradable sheet comprising an inner layer, wherein said inner layer comprises PVOH, wherein said sheet consists of solids having an aspect ratio of less than 10:1.

3. The biodegradable sheet according to claim 1, wherein the nanoclay is based on montmorillonite, vermiculite, nano-kaolin, bentonite, Cloisite® or any combination thereof.

4. The biodegradable sheet according to claim 1, wherein the nanoclay is dispersed in the bulk of the biodegradable sheet.

5. The biodegradable sheet according to claim 1, wherein the nanoclay is added to the biodegradable sheet as a separate nanocomposite layer comprising a biodegradable polymer and the nanoclay.

6. The biodegradable sheet according to claim 5, wherein the separate nanocomposite layer is an internal layer.

7. The biodegradable sheet according to claim 2, further comprising a compatibilizer.

8. A biodegradable sheet comprising an inner layer, wherein said inner layer comprises PVOH the sheet consisting of the following five layers:
Layer 1: consisting of 20-80% w/w PLA and 80-20% w/w PBSA;
Layer 2: consisting of 100% w/w PBSA;
Layer 3: consisting of 100% w/w PVOH;
Layer 4: consisting of 100% w/w PBSA; and
Layer 5: consisting of 20-80% w/w PLA and 80-20% w/w PBSA.

9. A biodegradable sheet comprising an inner layer, wherein said inner layer comprises PVOH, the sheet consisting of the following five layers:
Layer 1: consisting of 20-80% w/w PLA and 80-20% w/w PBSA;
Layer 2: consisting of 90-85% PBSA and 10-15% w/w nanoclays;
Layer 3: consisting of 100% w/w PVOH;

Layer 4: consisting of 90-85% PBSA and 10-15% w/w nanoclays; and
Layer 5: consisting of 20-80% w/w PLA and 80-20% w/w PBSA.

10. A receptacle unit prepared from the biodegradable sheet according to any one of claims 1 or 2, comprising a compartment for storing liquids and a means by which the liquids are removed therefrom.

11. The biodegradable sheet according to any one of claims 1 or 2, wherein the biodegradable sheet further comprises an external laminate layer.

What is claimed is:

1. A biodegradable sheet comprising a nanoclay and polyvinyl alcohol (PVOH).

2. A biodegradable sheet comprising an inner layer, wherein said inner layer comprises PVOH.

3. The biodegradable sheet according to claim 1, wherein the nanoclay is based on montmorrilonite, vermiculite, nano-kaolin, bentonite, Cloisite® or any combination thereof.

4. The biodegradable sheet according to claim 1, wherein the nanoclay is dispersed in the bulk of the biodegradable composition.

5. The biodegradable sheet according to claim 1, wherein the nanoclay is added to the biodegradable sheet as a separate nanocomposite layer comprising a biodegradable polymer and the nanoclay.

6. The biodegradable sheet according to claim 5, wherein the separate nanocomposite layer is an internal layer.

7. The biodegradable sheet according to claim 2, further comprising a compatibilizer.

8. The biodegradable sheet according to claim 7, wherein the compatibilizer is maleic anhydride, benzoyl peroxide or 2,2-azobis(isobutyronitrile).

9. The biodegradable sheet according to claim 2, consisting of the following five layers:
Layer 1: consisting about 20-80% w/w PLA and about 80-20% w/w PBSA;
Layer 2: consisting about 100% w/w PBSA;
Layer 3: consisting about 100% w/w PVOH;
Layer 4: consisting about 100% w/w PBSA; and
Layer 5: consisting about 20-80% w/w PLA and about 80-20% w/w PBSA.

10. The biodegradable sheet according to claim 2, consisting of the following five layers:
Layer 1: consisting about 20-80% w/w PLA and about 80-20% w/w PBSA;
Layer 2: consisting of about 90-85% PBSA and about 10-15% w/w nanoclays;
Layer 3: consisting about 100% w/w PVOH;
Layer 4: consisting of about 90-85% PBSA and about 10-15% w/w nanoclays; and
Layer 5: consisting about 20-80% w/w PLA and about 80-20% w/w PBSA.

11. A receptacle unit prepared from the biodegradable sheet according to any one of claims 1 or 2, comprising a compartment for storing liquids and a means by which the liquids are removed therefrom.

12. The biodegradable sheet according to any one of claims 1 or 2, wherein the biodegradable sheet further comprises an external laminate layer.