with an upper horizontal heat weld disposed above a tapered crimp with a gap that defines an integral drinking solubility spout when the tear strip above the perforated line is removed from the individual beverage receptacle units. However, this packaging is not environmental friendly.

[009] United States Patent No. 5,756,194 discloses water-resistant starch products useful in the food industry that comprise an inner core of gelatinized starch, an intermediate layer of natural resin and an outer layer of water resistant biodegradable polyester. The gelatinized 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(epsilon-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] Therefore, there is a need in the art for a biodegradable sheet that is physically strong, though flexible, and further, has low gas permeability, a high light transmittance, a long shelf life and low haze. Such a biodegradable sheet could be used as a long term receptacle.

SUMMARY ~~OF THE INVENTION~~

[0011] The present disclosure is based in part on the discovery that a single layered or multilayered biodegradable sheet comprising PCL or PHA in combination with one or more hydrophobic biodegradable polymers exhibits surprising properties, including reduced water vapor transmission rate (WVTR) and oxygen transmission rate (OTR) and improved heat sealing, while maintaining the mechanistic features of flexible sheets. These properties cannot be explained by the properties of the individual polymers making up the sheet.

[0011a] In one aspect, there is provided a biodegradable sheet, having at least one layer, wherein the layer comprises a first hydrophobic polymer selected from the group consisting of poly(epsilon-caprolactone) (PCL), a polyhydroxyalkanoate (PHA) and a mixture thereof, and a second hydrophobic polymer selected from the group consisting of polybutylene succinate (PBS), polybutylene succinate adipate (PBSA), poly lactic acid (PLA), polybutylene adipate terphtalate (PBAT), polydioxanone (PDO), polyglycolic acid (PGA) and any mixture thereof.

[0012] In one ~~aspect~~ embodiment provided herein is a biodegradable sheet, having at least one layer that is a contact layer for direct contact with a material and optionally one or more additional layers, wherein the contact layer comprises a first hydrophobic polymer selected from the group consisting of poly(epsilon-caprolactone) (PCL), a polyhydroxyalkanoate (PHA) and a mixture thereof, and a second hydrophobic polymer selected from the group consisting of polybutylene

[00103] Layer 5: consisting of about 19% w/w PLA, 56% w/w PBS and about 25% w/w PCL;

[00104] A biodegradable sheet having Layer 1: consisting of about 75% w/w PBSA and about 25% w/w PLA;

[00105] Layer 2: consisting of about 100% w/w PBAT;

[00106] Layer 3: consisting of about 100% w/w PHA;

[00107] Layer 4: consisting of about 100% w/w PBAT;

[00108] Layer 5: consisting of about 19% w/w PLA, 56% w/w PBS and about 25% w/w PCL.

[00109] In some embodiments of all the biodegradable sheets, the material comprises liquid, semi-solid or solid matter. Preferably the material is a liquid or comprises a liquid.

[00110] In some embodiments, the biodegradable sheets are useful in packaging a material, preferably a liquid or semi-solid material or a material comprising s liquid or semi-solid. In some embodiments, the material is a food stuff or a liquid for animal consumption. The animal may be a mammal, for example a human.

[00111] In ~~a second aspect~~ one embodiment, provided herein is a method of reducing the WVTR and/or OTR of a biodegradable sheet, comprising the step of manufacturing the sheet with a contact layer comprising about 5% w/w to about 45%w/w, about 20% w/w to about 45% w/w or about 25% to about 40% of a first hydrophobic polymer selected from the group consisting of PCL, PHA and a mixture thereof and a second hydrophobic polymer selected from the group consisting of polybutylene succinate (PBS), polybutylene succinate adipate (PBSA), poly lactic acid (PLA), polybutylene adipate terphtalate (PBAT), polydioxanone (PDO), polyglycolic acid (PGA) and any mixture thereof.

[00112] Embodiments of the method are directed to a biodegradable sheet, having at least one layer that is a direct contact layer and optionally one or more additional layers, In some embodiments, the direct contact layer comprises polycaprolactone (PCL) and/or a PHA. In some embodiments, the direct contact layer comprises mixture of PCL and PBAT, PCL and PBS, PCL and PBSA, or PCL and PLA.

[00113] Provided herein is a biodegradable sheet comprising at least one layer comprising about 0-20% w/w PLA, 45.0-80.0% w/w PBS, PBSA or a mixture of PBS and PBSA and 20.0%-30.0% w/w PCL. In some embodiments the sheet is a single layered sheet. In some embodiment, the sheet is a multilayered sheet.

[00114] Some embodiments are directed to a single layered biodegradable sheet comprising at least one layer comprising about 18-%-20% w/w PLA, 50.0-75.0% w/w PBS, PBSA or a mixture of PBS and PBSA and 20.0%-30.0% w/w PCL. Some embodiments are directed to a multi layered biodegradable sheet comprising at least one layer comprising about 18-%-20% w/w PLA, 50.0-75.0% w/w PBS, PBSA or a mixture of PBS and PBSA and 20.0%-30.0% w/w PCL. Some embodiments are directed to a multi layered biodegradable sheet comprising at least one layer comprising about 18%-20% w/w PLA, 75.0% w/w PBS, PBSA or a mixture of PBS and PBSA and 25.0% w/w PCL.

[00115] In some embodiments, the sheet further comprises a layer comprising PVOH. In some embodiments, the sheet further comprises a layer comprising an adhesive, for example a "tie layer". Provided herein is a five layered biodegradable sheet comprising two layers, Layers 1 and 5, each 35% of the total thickness and comprising 18%-20% w/w PLA 45%-65% w/w PBS, PBSA or a mixture of PBS and PBSA and 20%-30% w/w PCL; Layers 2 and 4, each 8% of the total thickness and comprising 90%-100% w/w tie layer; Layer 3 is 13% of the total thickness and comprises 70%-100% w/w PVOH. In some embodiments, the five layered biodegradable sheet comprises two layers, Layers 1 and 5, each 35% of the total thickness and consisting of: 20% w/w PLA, 55% w/w PBS and 25% w/w PCL; Layers 2 and 4, each 8% of the total thickness and consisting of 100% w/w tie layer; Layer 3 is 13% of the total thickness and consists of 100% w/w PVOH. In some embodiments, the internal layer comprises about 70%-99% PVOH and 1%-30% PBS or PBSA or PLA or PBAT or PCL.

[00116] In another ~~aspect~~embodiment, the biodegradable sheets disclosed above are useful for contact with a material, preferably a liquid or semi-solid material, for example water, carbonated water, sweetened liquid, carbonated sweetened liquid, fruit or vegetable liquid such a juice, a jelled material.

[00117] In another ~~aspect~~embodiment, provided is a method for reducing the WVTR and/or OTR of a biodegradable sheet to a value of less than 1 $g/(m^2 \times d)$ and 1 $cm^3/(m^2 \times d \times bar)$, respectively,, comprising the step of manufacturing the sheet with at least one layer comprising about 5% w/w to about 45%w/w, about 20% w/w to about 45% w/w or about 25% to about 40% of a first hydrophobic polymer selected from the group consisting of PCL, PHA and a mixture thereof. In some embodiments, the biodegradable sheet comprises two or more layers. In some embodiments, the contact layer comprises PCL. In some embodiments, the contact layer comprises about 5% w/w to about 45%w/w, about 20% w/w to about 45% w/w or about 25% to about 40% of a first hydrophobic polymer selected from the group consisting of PCL, PHA and a mixture thereof.

[00118] The first (1st) hydrophobic polymers are super hydrophobic polymer, referring to the tendency of non-polar composition to exclude water from its surface. The hydrophobic interaction is mostly an entropic effect originating from the disruption of highly dynamic hydrogen bonds between molecules of liquid water by the nonpolar surface (The Real Reason Why Oil and Water Don't Mix Todd P. Silverstein, J. Chem. Educ. 1998, 75 (1), p 116). A hydrocarbon chain or a similar nonpolar region or a large molecule is incapable of forming hydrogen bonds with water. Hydrophobicity can be calculated by the ratio of non-polar groups such as pure hydrocarbon molecule to polar groups such as hydroxyl, carbonyl, or ester groups. Super hydrophobic polymers shows high non-polar to polar ratio (higher than 60%; see Table with PCL and PHA examples), and low hydrophobic polymers shows low non-polar to polar ratio (lower than 60%; See table with PLA example).

		# elements			element weight					
	formula	**C**	**H**	**O**	**C**	**H**	**O**	**Hydrophobic elements**	**polar elements**	**non-polar to total mass ratio**
PCL	$C_6H_{10}O_2$	6	10	2	72.06	10.1	31.98	82.16	31.98	**72%**
PHV	$C_5H_8O_2$	5	8	2	60.05	8.08	31.98	68.13	31.98	**68%**
PHB	$C_4H_6O_2$	4	6	2	48.04	6.06	31.98	54.10	31.98	**63%**
PLA	$C_3H_4O_2$	3	4	2	36.03	4.04	31.98	40.07	31.98	**56%**

[00119] In another ~~aspect~~embodiment, provided herein is a biodegradable sheet that has a sealing window in a range of about 20-50°C, 20-30°C, 30-40°C, 40-50°C, comprising at least one layer comprising about 5% w/w to about 45%w/w, about 20% w/w to about 45% w/w or about 25% to about 40% of a first hydrophobic polymer selected from the group consisting of PCL, PHA and a mixture thereof. In some embodiments, the biodegradable sheet comprises two or more layers. In some embodiments, the contact layer comprises PCL. In some embodiments, the contact layer comprises about 5% w/w to about 45%w/w, about 20% w/w to about 45% w/w or about 25% to about 40% of a first hydrophobic polymer selected from the group consisting of PCL, PHA and a mixture thereof.

[00120] Tie layer resins used in multilayer structures are usually anhydride-modified polymers that bond dissimilar polymers together, primarily in multilayer, co-extruded structures.

[00121] In some embodiments, the biodegradable sheet has a compostability time up to 6 months when placed into an approved compost facility, as hereinafter defined.

[00122] Embodiments of the ~~invention~~disclosure are directed to a biodegradable sheet, having at least one layer that is a contact layer and optionally one or more additional layers, wherein the direct contact layer comprises a hydrophobic polymer selected from poly(epsilon-caprolactone) (PCL); polydioxanone (PDO); polyglycolic acid (PGA); polybutylene succinate (PBS); polybutylene succinate adipate (PBSA); poly lactic acid (PLA); polybutylene adipate terphtalate (PBAT); a polyhydroxyalkanoate (PHA) such as polyhydroxybutyrate (PHB), polyhydroxyvalerate (PHV) and polyhydroxybutyrate-hydroxyvalerate copolymer (PHBV); or any mixture thereof.

[00123] In some embodiments, the contact layer comprises polycaprolactone (PCL). In some embodiments, the direct contact layer comprises mixture of polymers which include PCL and a second polymer, for example, PCL and PBAT, or PCL and PBS, or PCL and PBSA, or PCL and PLA or PCL and PBS and PBSA.

[00124] Further embodiments of the ~~invention~~disclosure are directed to a multilayered biodegradable polymer comprising:

Layer 1: about 5-40% w/w PCL and the remaining 60-95% comprising a mixture of PBS or PBSA with PLA at about 75% w/w PBS or PBSA and 25%w/w PLA;

Layer 2: about 100% w/w PBSA; and

Layer 3: about 25% w/w PLA and about 75% w/w PBSA.

[00125] Further embodiments of the ~~invention~~disclosure are directed to a multilayered biodegradable polymer comprising:

Layer 1: about 5-40% w/w PCL and the remaining 60-95% comprising a mixture of PBS or PBSA with PLA about 75% w/w PBS or PBSA and 25%w/w PLA;

Layer 2: about 25% w/w PLA and about 75% w/w PBSA.

Layer 3: about 40% w/w PVOH grafted with about 60% PBSA;

Layer 4: about 25% w/w PLA and about 75% w/w PBSA.

[00126] Further embodiments of the ~~invention~~disclosure are directed to a multilayered biodegradable sheet comprising;

Layer 1: about 5-40% w/w PCL and the remaining 60-95% comprising about a mixture of PBS or PBSA with PLA at about 75% w/w PBS or PBSA and 25%w/w PLA;

Layer 2: about 90-95% w/w PVOH or EVOH grafted with maleic anhydride (MAH) and compounded with 5-10%w/w PBSA or PBS

Layer 3: about 98-85% PBSA and about 2-15% w/w nanoclays;

Layer 4: consisting of about 90-95% w/w PVOH or EVOH grafted with maleic anhydride (MAH) and compounded with 5-10%w/w PBSA or PBS

Layer 5: about 5-40% w/w PCL and the remaining 60-95% comprising a mixture of PBS or PBSA with PLA at about 75% w/w PBS or PBSA and 25%w/w PLA.

[00127] Further embodiments of the ~~invention~~disclosure are directed to a single layer biodegradable sheet comprising about 20.0% w/w PLA, 60.0% w/w PBS and 20.0% w/w PCL.

[00128] Further embodiments of the ~~invention~~disclosure are directed to a single layered biodegradable sheet comprising about 17.5% w/w PLA and 52.5% w/w PBS and 30.0% w/w PCL.

[00129] Further embodiments of the ~~invention~~disclosure are directed to a single layer biodegradable sheet comprising about 20.0% w/w PLA, 60.0% w/w PBS and 20.0% w/w PCL with 0.5% w/w maleic anhydride (MAH) and 0.2% azobisisobutyronitrile (AIBN).

[00130] Further embodiments of the ~~invention~~disclosure are directed to a single layered biodegradable sheet comprising about 17.5% w/w PLA and 52.5% w/w PBS, 30.0% w/w PCL with 0.5% w/w MAH and 0.2% AIBN.

[00131] Further embodiments of the ~~invention~~disclosure are directed to a single layered biodegradable sheet comprising about 15.0% w/w PLA and 45.0% w/w PBS, 40.0% w/w PCL with 0.5% w/w MAH and 0.2% AIBN.

[00 bodiments of the ~~invention~~disclosure are directed to a single layered biodegradable sheet comprising about 31% w/w PBS, 35% w/w PBSA, 12% w/w PLA, 20%w/w PCL and 2% w/w polyvinyl alcohol (PVOH).

[00133] Further embodiments of the ~~invention~~disclosure are directed to a multilayered biodegradable sheet comprising:

Layer 1: about 31% w/w PBS, 35% w/w PBSA, 12% w/w PLA, 20%w/w PCL and 2% w/w polyvinyl alcohol (PVOH);

Layer 2: about 99.5% PVOH cross linked using 0.5%w/w of a crosslinker and

Layer 3: about 31% w/w PBS, 35% w/w PBSA, 12% w/w PLA, 20%w/w PCL and 2% w/w PVOH.

[00134] Further embodiments of the ~~invention~~disclosure are directed to a multilayered biodegradable sheet comprising two or more layers wherein one layer comprises about 31% w/w PBS, 35% w/w PBSA, 12% w/w PLA, 20%w/w PCL and 2% w/w polyvinyl alcohol (PVOH).

[00135] Further embodiments of the ~~invention~~disclosure are directed to a biodegradable sheet comprising at least one layer comprising about 40% PVOH, 20% PCL, 20% PBS and 20% PBSA.

[00136] Further embodiments of the ~~invention~~disclosure are directed to a five layers biodegradable sheet , wherein the layers 1 and 5 were prepared as compounds of about 75% PBSA and 25% PLA, layers 2 and 4 were prepared from a compound of about 31% w/w PBS, 35% w/w PBSA, 12%

w/w PLA, 20%w/w PCL and 2% w/w polyvinyl alcohol (PVOH) and layer 3 is prepared from about 99.5%w/w PVOH cross linked using 0.5%w/w of a cross-linker.

[00137] Embodiments of the ~~invention~~disclosure are directed to a biodegradable sheet, having at least one layer, wherein the layer comprises a first hydrophobic polymer selected from the group consisting of poly(epsilon-caprolactone) (PCL), a polyhydroxyalkanoate (PHA) and a mixture thereof, and a second hydrophobic polymer selected from the group consisting of polybutylene succinate (PBS), polybutylene succinate adipate (PBSA), poly lactic acid (PLA), polybutylene adipate terphtalate (PBAT), polydioxanone (PDO), polyglycolic acid (PGA) and any mixture thereof.

[00138] According to some embodiments the first hydrophobic polymer is PCL. According to further embodiments, the first hydrophobic polymer is a PHA. According to some embodiments, the PHA is selected from the group consisting of polyhydroxybutyrate (PHB), polyhydroxyvalerate (PHV), polyhydroxybutyrate-hydroxyvalerate copolymers (PHBV); and any derivative or mixture thereof.

[00139] According to some embodiments, the biodegradable sheet has a degradation time in the range of 4 to 24 months. According to further embodiments, the biodegradable sheet has a shelf life of about 6 months up to about 18 months.

[00140] According to some embodiments, the amount of the highly hydrophobic polymer is about 5% w/w to about 45%w/w of the contact layer, about 20% w/w to about 45% w/w or about 25% to about 40%. According to some embodiments, the second hydrophobic polymer is present in at least one layer and is selected from the group consisting of PLA, PBS, PBSA and PBAT.

[00141] According to some embodiments, the second hydrophobic polymer is present in at least one layer and is a mixture of PBS and PBSA, a mixture of PBS and PLA, a mixture of PBSA and PLA or a mixture of PBAT and PLA. According to some embodiments, the second hydrophobic polymer is present in the layer in an amount of about 55% w/w to about 95% w/w of the weight of the layer.

[00142] According to some embodiments, the sheet is a single layered sheet. According to other embodiments, the sheet is a multi-layered sheet. According to some embodiments, the multi-layered sheet consists of 2, 3, 4, 5, 6 or 7 layers. According to some embodiments, the sheet is a two-layered sheet.

[00143] According to some embodiments, the two-layered sheet comprises a first layer comprising about 70%-80% w/w PBS or PBSA and about 20%-30% PLA and a second layer

comprising about 15%-25% w/w PLA, about 50%-60% w/w PBS or PBSA and about 5% -30% w/w PCL.

[00144] According to some embodiments, the sheet is a three-layered sheet. According to some embodiments, the three layered sheet comprises a first layer comprising about 70%-80% w/w PBS or PBSA and about 20%-30% PLA; a second layer comprising about 70%-80% w/w PBS or PBSA and about 20%-30% PLA; and a third layer comprising about 5% -45% w/w PCL or PHA and about 55% to about 80% w/w PLA, PBS, PBSA, PBAT or a mixture thereof, wherein the second layer is an internal layer and the third layer is the contact layer.

[00145] According to some embodiments, the three layered sheet comprises a first or third layer comprising about 100% w/w PBS or PBSA. According to some embodiments, the three layered sheet comprises a second layer comprising about 100% PBS or PBSA. According to some embodiments, the three layered sheet comprises a third layer comprising about 15%-25% w/w PBSA or PLA, about 50% -60% w/w PBAT or PBS and about 5%-30% PCL. According to some embodiments, the three layered sheet comprises a first layer comprising about 15%-25% w/w PBSA, about 50% -60% w/w PBS and about 20%-30% PCL.

[00146] According to some embodiments, the sheet is a five-layered sheet. According to some embodiments, the five-layered sheet comprises a first layer and a fifth layer comprising about 25% w/w of a first hydrophobic polymer and about 75% of a mixture of a second hydrophobic polymer selected from the group of a mixture of PBS and PBSA, a mixture of PBS and PLA, a mixture of PBSA and PLA or a mixture of PBAT and PLA; and wherein the first layer or fifth layer is the contact layer. According to some embodiments, the five-layered sheet comprises of first layer and a fifth layer comprising about 40% w/w of a first hydrophobic polymer and about 60% of a second hydrophobic polymer selected from the group PBS, PBSA, PLA and PBAT and wherein the first of fifth layer is the contact layer. According to some embodiments, the five layer sheet further comprises a hydrophilic polymer selected from PVOH and EVOH or any mixtures thereof.

[00147] According to some embodiments, the biodegradable sheet comprises at least two layers attached one to another by a tie layer. According to some embodiments, the biodegradable sheet comprises an internal layer comprising about 70%-99% PVOH and 1%-30% PBS or PBSA or PLA or PBAT or PCL.

[00148] Some embodiments of the ~~invention~~disclosure are directed to a biodegradable sheet having a WVTR of below about 1-100 g/(m^2×d) and/or OTR of below about 1-200 cm^3/(m^2×d×bar),

wherein the biodegradable sheet comprises a contact layer comprising about between about 5% w/w to about 45%w/w, of a hydrophobic polymer selected from the group consisting of PCL, PHA and a mixture thereof; and a mixture of PBS and PBSA, a mixture of PBS and PLA, a mixture of PBSA and PLA, or a mixture of PBAT and PLA, in an amount of about 95% w/w to about 55%w/w

[00149] Some embodiments of the ~~invention~~disclosure are directed to a biodegradable sheet having a sealing strength > of about 20-30 (25mm/N) and a sealing window of about 20-60 °C , wherein the biodegradable sheet comprises a contact layer comprising about between 5% w/w to about 45%w/w PCL or PHA or a mixture thereof; and a mixture of PBS and PBSA, a mixture of PBS and PLA, a mixture of PBSA and PLA , or a mixture of PBAT and PLA, in an amount of about 95% w/w to about 55%w/w.

[00150] Some embodiments of the ~~invention~~disclosure are directed to a biodegradable sheet has a compostability time of up to 6 months under standard industrial conditions. According to some embodiments, at least one layer of the biodegradable sheet is a direct contact layer.

BRIEF DESCRIPTION OF THE DRAWINGS

[00151] 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:

[00152] Figure 1 is a graph showing the biodegradability of a three layered sheet prepared according to an embodiment of the invention;

[00153] Figures 2A and 2B are SEM micrographs of Sheets #7 and #5 of Example 5, respectively;

[00154] Figure 3 is a SEM micrograph of nanoclay-PCLA dispersed in a PLA matrix;

[00155] Figure 4 presents a graph describing the theoretical degradation time calculation of PCL containing compounds;

[00156] Figure 5 presents a graph describing the glass transition temperature (Tg) of the tested compounds, as a function of PCL concentration with and without the addition of a thermal bridging polymer, or the addition of a crosslinker; and

[00157] Figure 6 presents a differential scanning calorimetry (DSC) thermogram for a polymer compound containing PCL, PBS and PLA.

What is claimed is:

1. A biodegradable sheet, having at least one layer, wherein the layer comprises a first hydrophobic polymer selected from the group consisting of poly(epsilon-caprolactone) (PCL), a polyhydroxyalkanoate (PHA) and a mixture thereof, and a second hydrophobic polymer selected from the group consisting of polybutylene succinate (PBS), polybutylene succinate adipate (PBSA), poly lactic acid (PLA), polybutylene adipate terphtalate (PBAT), polydioxanone (PDO), polyglycolic acid (PGA) and any mixture thereof.

~~2. The biodegradable sheet according to claim 1, wherein the first hydrophobic polymer is PCL.~~

~~3. The biodegradable sheet according to claim 1, wherein the first hydrophobic polymer is a PHA.~~

42. The biodegradable sheet ~~according to~~of claim ~~3~~1, wherein the PHA is selected from the group consisting of polyhydroxybutyrate (PHB), polyhydroxyvalerate (PHV), polyhydroxybutyrate-hydroxyvalerate copolymers (PHBV); and any derivative or mixture thereof.

~~5. The biodegradable sheet according to any of claims 1-4, having a degradation time in the range of 4 to 24 months.~~

~~6. The biodegradable sheet according to any of claims 1-5, having a shelf life of about 6 months up to about 18 months.~~

~~7~~3. The biodegradable sheet ~~according to~~of any one of claims 1 ~~-5~~or 2, wherein the ~~amount of the highly~~ first hydrophobic polymer is present in an amount of about 5% w/w to about 45%w/w ~~of the contact layer~~, about 20% w/w to about 45% w/w or about 25% to about 40%.

~~8~~4. The biodegradable sheet of any one of claims 1 - 3, wherein the second hydrophobic polymer is present in at least one layer and is selected from the group consisting of PLA, PBS, PBSA and PBAT or a mixture thereof, wherein the mixture is optionally a mixture of PBS and PBSA, a mixture of PBS and PLA, a mixture of PBSA and PLA or a mixture of PBAT and PLA.

~~9. The biodegradable sheet of claim 1, wherein the second hydrophobic polymer is present in at least one layer and is a mixture of PBS and PBSA, a mixture of PBS and PLA, a mixture of PBSA and PLA or a mixture of PBAT and PLA.~~

~~10~~5. The biodegradable sheet of claim ~~8 or 9~~4, wherein the second hydrophobic polymer is present in the layer in an amount of about 55% w/w to about 95% w/w of the weight of the layer.

~~11~~6. The biodegradable sheet of any one of claims 1-~~10~~5, wherein the sheet is a single layered sheet or a multi-layered sheet optionally consisting of 2, 3, 4, 5, 6 or 7 layers.

~~12. The biodegradable sheet of any of claims 1-10, wherein the sheet is a multi-layered sheet.~~

~~13. The biodegradable sheet of claim 12, wherein the multi-layered sheet consists of 2, 3, 4, 5, 6 or 7 layers.~~

~~14. The biodegradable sheet of claim 13, wherein the sheet is a two-layered sheet.~~

7. The biodegradable sheet of any one of claims 1 to 6, wherein at least one layer consists of about 60% PLA and about 40% PCL w/w of the layer.

~~15~~8. The biodegradable sheet of claim ~~14~~6, wherein the sheet is a two-layered sheet, ~~comprises~~ optionally comprising a first layer comprising about 70%-80% w/w PBS or PBSA and about 20%-30% PLA and a second layer comprising about 15%-25% w/w PLA, about 50%-60% w/w PBS or PBSA and about 5% -30% w/w PCL.

~~16. The biodegradable sheet of claim 13, wherein the sheet is a three layered sheet.~~

~~17~~9. The biodegradable sheet of claim ~~16~~6, wherein the sheet is a three layered sheet, optionally ~~comprises~~ comprising a first layer comprising about 70%-80% w/w PBS or PBSA and about 20%-30% PLA; a second layer comprising about 70%-80% w/w PBS or PBSA and about 20%-30% PLA; and a third layer comprising about 5% -45% w/w PCL or PHA and about 55% to about 80% w/w PLA, PBS, PBSA, PBAT or a mixture thereof, wherein the second layer is an internal layer and the third layer is the contact layer.

~~18~~10. The biodegradable sheet of claim ~~16 or 17~~6, ~~wherein the three layered sheet comprises~~comprising a ~~a first or third~~ layer comprising about 100% w/w PBS or PBSA.

~~19. The biodegradable sheet of any of claims 16–18, wherein the three layered sheet comprises a second layer comprising about 100% PBS or PBSA~~

~~20~~11. The biodegradable sheet of ~~any of~~ claims ~~16–19~~6, wherein the sheet is a three layered sheet ~~comprises~~ comprising a third layer comprising about 15%-25% w/w PBSA or PLA, about 50% -60% w/w PBAT or PBS and about 5%-30% PCL.

~~21~~12. The biodegradable sheet of ~~any of~~ claims ~~16–19~~6, comprising a ~~wherein the~~ three layered sheet ~~comprises~~ comprising a first layer comprising about 15%-25% w/w PBSA, about 50% -60% w/w PBS and about 20%-30% PCL.

~~22. The biodegradable sheet of claim 13, wherein the sheet is a five-layered sheet.~~

~~23~~13. The biodegradable sheet of claim ~~22~~6, wherein the sheet is a five-layered sheet, optionally ~~comprises~~ comprising a first layer and a fifth layer comprising about 25% w/w of a first hydrophobic polymer and about 75% of a mixture of a second hydrophobic polymer selected from the group consisting of a mixture of PBS and PBSA, a mixture of PBS and PLA, a mixture of PBSA and PLA, ~~or~~ and a mixture of PBAT and PLAs~~; and wherein the first layer or fifth layer is the contact layer~~ optionally further comprising a hydrophilic polymer selected from the group consisting of PVOH and EVOH or any mixtures thereof.

~~24~~14. The biodegradable sheet of claim ~~22~~6, wherein the sheet is a five-layered sheet ~~comprises~~ comprising ~~of~~ a first layer and a fifth layer comprising about 40% w/w of a first hydrophobic polymer and about 60% of a second hydrophobic polymer selected from the group consisting of PBS, PBSA, PLA and PBAT, optionally further comprising a hydrophilic polymer selected from the group consisting of PVOH and EVOH or any mixtures thereof, optionally further comprising an internal layer comprising about 70%-99% PVOH and 1%-30% PBS or PBSA or PLA or PBAT or PCL ~~and wherein the first of fifth layer is the contact layer~~.

~~25. The biodegradable sheet of claim 23 or 24, further comprising a hydrophilic polymer selected from PVOH and EVOH or any mixtures thereof~~

~~26. The biodegradable sheet of claim 25, wherein said biodegradable sheet comprises at least two layers attached one to another by a tie layer.~~

~~27. The biodegradable sheet of claim 25, further comprising an internal layer comprising about 70% 99% PVOH and 1% 30% PBS or PBSA or PLA or PBAT or PCL.~~

~~28. A biodegradable sheet having a WVTR of below about 1-100 g/(m^2×d) and/or OTR of below about 1-200 cm^3/(m^2×d×bar), wherein the biodegradable sheet comprises a contact layer comprising about between about 5% w/w to about 45%w/w, of a hydrophobic polymer selected from the group consisting of PCL, PHA and a mixture thereof; and a mixture of PBS and PBSA, a mixture of PBS and PLA, a mixture of PBSA and PLA, or a mixture of PBAT and PLA, in an amount of about 95% w/w to about 55%w/w~~

~~29~~15. ~~A~~ The biodegradable sheet of claim 1, ~~having a sealing strength > of about 20-30 (25mm/N) and a sealing window of about 20-60 °C , wherein said biodegradable sheet comprises~~ comprising a contact layer comprising about between 5% w/w to about 45%w/w PCL or PHA or a mixture thereof; and a mixture of PBS and PBSA, a mixture of PBS and PLA, a mixture of PBSA and PLA , or a mixture of PBAT and PLA, in an amount of about 95% w/w to about 55%w/w.

~~30. The biodegradable sheet according to any of claims 1-4, having a compostability time of up to 6 months under standard industrial conditions.~~

~~31. The biodegradable sheet of claim 1, wherein the at least one layer is a direct contact layer.~~