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(54) Title: MOISTURE RESISTANT BIODEGRADABLE COMPOSITION

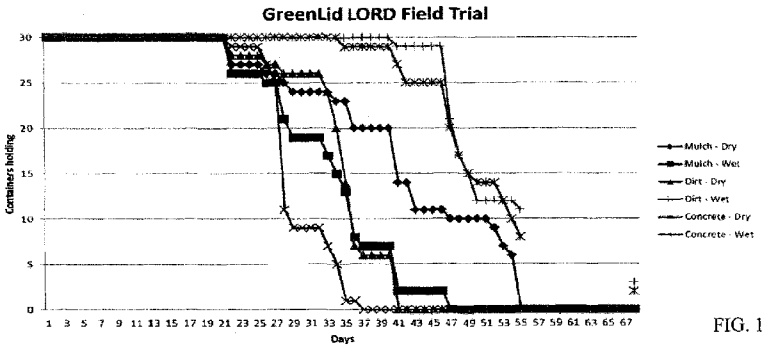

FIG. 1

(57) Abstract: A biodegradable composition having resistance to moisture and organic waste is provided.

MOISTURE RESISTANT BIODEGRADABLE COMPOSITION

FIELD

[0001] The present description relates to a moisture resistant biodegradable composition.

BACKGROUND

[0002] Temporary environmentally friendly storage of certain materials such as wet organic waste or water has associated with it a range of problems. Containers made of biodegradable materials may not sufficiently store the waste in that the organic waste may too quickly break down the container in which the waste is stored. Containers made of other materials may sufficiently store organic waste but may not adequately degrade themselves or may present with additional problems.

[0003] For example, compost containers are typically made of plastic or other water-resistant material. These compost containers must be able to effectively store organic waste while avoiding leakage. To facilitate transport of the compost from, for example, a kitchen compost bin to a larger organic waste collection, biodegradable liners such as bags are often used with compost containers. These bags or liners, however, are not immune to leakage from the liquid naturally resulting from the organic waste. Further, the bags do not always line the plastic compost bin properly, resulting in compost that is not always contained within the liner but spills onto the container walls which must be cleaned to avoid offensive odors and to maintain cleanliness.

[0004] Similarly, temporary environmentally friendly storage of water or other liquids has its own problems. Currently, plastic containers filled with water are used to control water-breeding insect populations such as mosquitoes. Certain insect populations are responsible for the spread of diseases, such as mosquito borne diseases, affecting humans across the world in tropical climates. Approximately 3.4 billion people are at risk of being infected by Malaria or Dengue with over 500,000 and 25,000 deaths attributed to these diseases, respectively, each year. Additionally, the recent Zika outbreak in Brazil associated with mosquito has prompted further investigation into vector control (i.e., killing mosquitoes).

[0005] Presently, plastic containers filled with water are used as mosquito traps in areas such as Australia to combat Dengue or Malaria. One hundred plastic traps may be used in response to a single infection. However, once the insecticide in the water-filled traps wears off, the plastic traps must be collected to avoid having the traps become a breeding pool for new mosquitoes. This collection process requires the use of resources to track the locations of the plastic bins and to subsequently collect these bins.

[0006] Given the foregoing, it would be desirable to develop a biodegradable moisture resistant composition for use in a variety of applications including as a disposable container suitable for use as a compost container.

SUMMARY

[0007] A moisture resistant biodegradable composition is described herein.

[0008] According to an aspect of the present disclosure, a moisture resistant biodegradable composition is provided comprising a pulp component comprising between about 75% to about 100% wood-based fiber and optionally up to about 25% non-wood-based fiber, and a sizing agent in an amount of about 2% to 10% for every about 100 kg of the pulp component.

[0009] According to another aspect of the present disclosure, a moisture and waste resistant biodegradable composition is provided comprising a pulp component comprising about 90% double lined kraft corrugated scrap (DLK), about 10% newsprint, and alkyl ketone dimer (AKD) in an amount of about 6% for every 100 kg of the pulp component.

[0010] According to another aspect of the present disclosure, a container made of the above composition is provided.

[0011] According to another aspect of the present disclosure, a moisture resistant biodegradable insect trap is provided comprising a container as defined above which incorporates an insecticide.

[0012] In still another aspect of the present disclosure, a method of making the above container is provided comprising the steps of preparing the pulp component by blending about 75% to about 100% of wood-based fiber and optionally up to about 25% non-wood-based fiber; mixing a sizing agent into the pulp component in an amount of about 2% to about 10% for every about 100 kg of said pulp component to form the composition; and forming the composition into the shape of a container and allowing the composition to dry.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features of the disclosure will become more apparent from the following description in which reference is made to the appended drawings wherein:

FIGURE 1 is a chart showing the water holding capability of an exemplary biodegradable container over an approximately nine-week period;

FIGURE 2 is a chart showing the temperature evolution in test and control bins during a composting test;

FIGURE 3 is a chart showing CO_2 production rate during the composting test referenced in Figure 2;

FIGURE 4 is a chart showing O_2 concentration in exhaust air during the composting test referenced in Figure 2;

FIGURE 5 is a chart showing the pH evolution in test and control bins during the composting test referenced in Figure 2;

FIGURE 6 is a chart showing the trend in NH_4^+-N in test and control bins during the composting test referenced in Figure 2;

FIGURE 7 is a chart showing the trend in NO_x^--N in test and control bins during the composting test referenced in Figure 2; and

FIGURE 8 is a top perspective view of an exemplary container having a frusto-conical shape.

DETAILED DESCRIPTION

[0013] According to an aspect of the present invention, a moisture resistant biodegradable composition is provided comprising between about 75% to about 100% wood–based fiber and optionally up to about 25% non-wood-based fiber to form a pulp component, and comprising a sizing agent in an amount of between about 2% to about 10% for every about 100 kg of the pulp component.

[0014] The wood-based fiber component of the composition may be obtained from any biodegradable wood-based fiber product. For example, the wood-based fiber component may be obtained, using procedures well-established in the art (e.g. macerating and blending) from various types of board prepared from wood pulp having a thickness of at least about 0.010 inches (or 10 points). Examples of suitable wood pulp-based boards for use include, but are not limited to, paperboard or cardboard, such as chipboard, kraft board, containerboard, bleached or unbleached paperboard, corrugated or uncorrugated. For example, the wood-based board component may be double lined kraft corrugated scrap (DLK). This wood-based fiber component can be obtained from waste paper. The wood-based fiber is present in the composition in an amount between about 75% to about 100% of the composition. In one embodiment, it is about 90% of the composition, for example, 90% DLK. In another embodiment, it is about 100% of the composition, for example, 100% DLK.

[0015] The non-wood-based fiber component of the composition may be obtained from waste paper. This non-wood-based fiber may be any biodegradable non-wood based fiber. For example, it may be based on agricultural residue such as straw. It may also be based on annual plants and grasses such as miscanthus, jute, bamboo, sorghum, switchgrass, kenaf, and hemp among others as will be known to one skilled in the art. This non-wood-based fiber may be obtained from any recycled paper that is not cardboard. For example, it may be newsprint as identified by particular recycling facilities. The non-wood-based fiber component may be used as is to make the present composition, without processing to provide it in fibrous form. The non-wood-based fiber component is present in the composition in an

amount between about 0% to about 25% of the composition. In one embodiment, it is about 10% of the composition, for example, 10% newsprint.

[0016] The composition also includes a sizing agent in an amount between about 2% to about 10% for every about 100 kg of the pulp component. Preferably, an amount of about 4% to 8% of sizing agent is incorporated within the composition. The sizing agent may be any suitable sizing agent such as a basic or neutral sizing agent, e.g. alkyl succinic anhydride (ASA), alkene ketone dimer (AKD) or other wax-like chemicals known to one skilled in the art, or an acidic sizing agent, e.g. rosin and derivatives thereof. The sizing agent may also be a modified starch or hydrocolloid such as gelatin, or an acrylic co-polymer such as styrene acrylate or other polyacrylamides. In one embodiment, the composition comprises a sizing agent such as AKD in the amount of 6% for every about 100 kg of the pulp component formed by the wood-based fiber and non-wood-based fiber. In another embodiment, the composition comprises about 8% sizing agent (e.g. AKD) for every 100 kg of pulp component.

[0017] The composition may be made by combining the wood-based fiber and non-wood-based fiber and macerating the combination. It may also be made by macerating the wood-based fiber alone without the non-wood based fiber. Water may be added to turn the combination into a pulp slurry. For example, an industrial 'blender' may be used to macerate and blend the combination into a pulp slurry. After the slurry is created, a sizing agent is added in an amount of about 2% to about 10% for every about 100 kg of the pulp component to the pulp component and mixed to yield the present composition.

[0018] The composition may be formed into a desired shape for use. Accordingly, to mould the composition into a desired shape, a pulp moulding machine may be used. The composition is then formed into the desired shape by, for example, using appropriate moulds. The moulded composition is then dried, for example, on a conveyor belt that passes through a drying chamber such as an oven.

[0019] More particularly, containers from the present composition may be made on a pulp moulding machine using a two step moulding process. First, a female mould is provided that is perforated and covered in mesh whereby a vacuum can be applied to pull the present pulp composition into the female mould. The female mould is placed into a reservoir containing the composition, a vacuum is applied to pull composition into the mould, and the mould is removed from the slurry containing a coating of pulp composition that will become the final desired shape. A male mould designed to fit into the female mould may also be provided that is used as a wet press to further define the desired shape. Finally, excess moisture is removed from the shaped containers by drying, for example, in an oven.

[0020] As known to one skilled in the art, other moulding methods may also be employed. For example, the composition may also be moulded using thermoformed pulp moulding presses and other similar machinery common in the industry or any other method as known to one skilled in the art.

[0021] The composition maybe used in a variety of applications including biodegradable moisture resistant products, such as containers. Products made by this process are biodegradable over time while also providing moisture resistance properties to permit retention of moist or wet matter for limited periods of time without leakage, e.g. for at least about 1 week (7 days), preferably for at least about 2 weeks (14 days), and more preferably for at least 3 weeks (21 days) or longer. For example, a moisture resistant container is useful as a biodegradable container for organic waste, a biodegradable insect trap, a food container, a beverage container, or an indoor plant pot, among other uses. These biodegradable containers may be any suitable shape capable of holding a volume. For example, the container may have a circular cross-section and be of a generally frusto-conical shape, or the container may assume any other suitable shape, such as that of a square, rectangular, hexagonal or other cross-sectional shape.

[0022] Containers made with the present composition may additionally include a cover or lid to limit spills, to limit access to the contents of the container or to contain odours. To achieve these purposes, the lid or cover will advantageously correspond in shape to the open end of

the container and be sized to fit snuggly thereon, either within the internal perimeter of the open-end of the container or snuggly about the outer perimeter of the open-end of the container. The lid may be made of the same or similar biodegradable composition as the container. Alternatively, the lid may be made of another material such as paper or, for example, a non-biodegradable material for re-use, e.g. such as a plastic material.

[0023] With respect to using the biodegradable container as an insect trap, for example, for water-breeding insects such as mosquitoes, bed bugs, wasps, centipedes, earwigs, and other insect pests, the containers made of the present composition may incorporate an insecticide, a larvicide, or both. The term "incorporate" is used herein with respect to inclusion of the insecticide in the present container, to refer to either a surface coating of the insecticide on the container, or combination of the insecticide directly within the composition prior to making of the container.

[0024] Thus, in one embodiment, the container may be coated on its internal surface, i.e. the surface of the container which comes in contact with the content of the container, with an insecticide, filled with water, and placed in an appropriate area. Any suitable insecticide may be used to target a given insect, such as but not limited to bifenthrin or lambda-cyhalothrin (pyrethroids), organophosphates, such as malathion, Neonicotinoids such as Imidacloprid, Ryanoids, biological control agents such as Bacillus thuringiensis, organochlorides, Insect Growth Regulators, Carbamates, and larvicide such as Bacillus thuringiensis israelensis, Bacillus sphaericus, Methoprene, Temephos, monomolecular films (e.g. Arosurf MSF and Agnique MMF) and oils (e.g. Bonide, BVA2, and Golden Bear-1111 (GB-1111)). The container is coated with an amount of insecticide which wets the container. One or more coats of insecticide may be used. In another embodiment, the container may be pre-treated with insecticide, e.g. soaked in insecticide.

[0025] Alternatively, the insecticide may be included directly in the composition used to make the container in an amount suitable to provide insecticidal/larvicidal activity. Such amounts are known to those of skill in the art. In still other embodiments, a small piece of fabric, a biodegradable composition, or other material soaked, coated, or otherwise treated

with insecticide may be attached to the container to provide a landing or egg-laying zone for mosquitoes or other water-borne insects. Insecticide may be incorporated into the container in other ways known to one with skill in the art.

[0026] Embodiments of the present invention are described by reference to the following specific examples which are not to be construed as limiting.

[0027] **EXAMPLE 1: Method for making a biodegradable container**

[0028] The biodegradable containers referenced in Table 1 were created from a pulp slurry formed by maceration and blending of the wood-based fiber and non-wood-based fiber in water. A sizing agent was then mixed into the slurry to give the final product a moisture-resistance property. The slurry was then formed into a container using a pulp moulding machine in a two step moulding process. A perforated female mould was provided covered in mesh. The female mould was then placed into the slurry, a vacuum applied, and the mould was then removed from the slurry containing a coating of pulp that would become the container. A male mould was also provided and used as a wet-press to further define the container. Finally, the containers were ejected onto a conveyor belt that entered into an oven to remove excess moisture from the container.

[0029] **EXAMPLE 2: Containers with Organic Waste**

[0030] An organic waste resistance test was conducted in which organic ingredients were mixed within pulp containers of varied compositions. The organic ingredients included: 1 cup cooked rice, 1 cup coffee grinds, ½ cup crushed tomatoes, 1 banana and peel, and water for the balance so that it reached the top of each container. About 10 containers of each composition were observed in a home industrial compost tumbler (home compost pile) for a period of about six (6) weeks. Similarly, about 5 containers of each composition were observed in an industrial compost facility (industrial compost pile comprising aerobic tunnels) for a period of about two (2) weeks.

[0031] **First Container Composition:** A pulp container was used with the following composition: approximately 50% DLK and approximately 50% newsprint with approximately 4% AKD added as a sizing agent (Fennosize KD 266MB NA, Kemira®).

[0032] **Second Container Composition:** A pulp container was used with the following composition: approximately 90% DLK and approximately 10% newsprint with approximately 8% AKD.

[0033] **Third Container Composition:** A pulp container was used with the following composition: approximately 100% DLK and approximately 8% AKD.

[0034] **Fourth Container Composition:** A pulp container was used with the following composition: approximately 90% DLK with approximately 10% No 9 Newsprint, pulped to 98% dilution with water, and approximately 6% AKD. The pulping time was 18 minutes and was produced with Type II moulded fibre production line.

[0035] The AKD in all tested compositions was Fennosize KD 266MB NA, Kemira®.

[0036] The results of the organic waste resistance test are shown in Table 1, including an indication of the time within which the container degraded (e.g. to the point of leaking) and other observations.

TABLE 1: Time for Degradation of Container in the Presence of Wet Organic Waste in a Home Compost Pile and an Industrial Compost Pile

Container Composition	Wet Waste Resistance in a Home Compost Pile	Wet Waste Resistance in an Industrial Compost Pile	Other Observations
50% DLK; 50% newsprint; 4% AKD	1-2 days	1-2 days	

Container Composition	Wet Waste Resistance in a Home Compost Pile	Wet Waste Resistance in an Industrial Compost Pile	Other Observations
90% DLK; 10% newsprint; 8% AKD	7 days	7 days	Container degraded in about 10 days
100% DLK; 8% AKD	7 days	7 days	Definition of the container was reduced after 7 days Container degraded in about 12 days
90% DLK; 10% newsprint pulped to 98% dilution with water; 6% AKD	2 weeks	7 days	

[0037] **EXAMPLE 3: Biodegradability in Field**

[0038] The biodegradability of the containers was tested in the field. The following container composition was used, 100% DLK + 8% AKD. The containers were filled with water to one inch of the top of the container and left in a garden bed in a natural environment.

[0039] Within two weeks of exposure, beads of water were present on the outsides of the biodegradable container. Within three weeks of exposure in the garden bed, the underside of the containers had softened considerably. Within three weeks of exposure in the garden bed, plant roots were evident underneath the container searching for moisture.

[0040] **EXAMPLE 4: Disintegration Evaluation in a Pilot-Scale Aerobic Composting Test**

[0041] An exemplary water-resistant container as used in Example 3, having a thickness of approximately 2.7 mm and grammage of approximately 819 g/m^2, was evaluated for disintegration in a pilot-scale aerobic composting test. The exemplary frusto-conical container had an approximate height of 14.6 cm, maximum diameter of approximately 21.7 cm, and minimum diameter of approximately 14.2 cm. The purpose of the test was to simulate as closely as possible a real and complete composting process in pilot-scale composting bins of 200 L. The exemplary container was cut into eight pieces for evaluation of disintegration. A portion of the container along with a paper lid was also milled to form a milled material. The cut pieces formed approximately 1% and the milled material formed approximately 9% of the material to be tested for disintegration. This test material was added to biowaste and introduced into an insulated composting bin after which composting spontaneously begins. The biowaste comprised a Vegetable, Garden, and Fruit (VGF) mixture and structural material. Control and testing bins were filled to the top with the biowaste which had characteristics as shown in Table 3.

TABLE 2: Characteristics of Biowaste in Control and Test Bins

Characteristics	Biowaste in Control Bin	Biowaste and Test Material in Test Bin
Total solids (TS, %)	27.5	33.5
Moisture content (%)	72.5	66.5
Volatile solids (VS, % on TS)	82.0	84.5
Ash content (% on TS)	18.0	15.5
Total N (g/kg TS)	19.5	15.0
C/N	21	28

[0042] As can be seen in Figures 2-4, the temperature evolution, CO_2 production, and O_2 concentration in the exhaust air of the Test Bins (labeled MWY-1/2-03 and MWY-1/2-04)

closely tracked that of the Control Bins (labeled MWY-1/2-01 and MWY-1/2-02). Similarly, as can be seen in Figures 5-7, the pH evolution, Ammonium-Nitrogen (NH_4^+-N), and Nitrate and nitrite – nitrogen (NO_x^--N) trends of the Test Bins generally followed the upward or downward trends of the Control Bins.

[0043] At the end of twelve weeks, the compost in the Control Bins and Test Bins were stable and mature, demonstrated by a Rottegrad of V as measured on the < 10 mm fraction. Additionally, none of the bins had volatile fatty acids. A normal average pH of 8.4 and 7.8 was measured for the Control Bins and Test Bins, respectively. Lower salt levels were found in the Test Bins (2390 µS/cm) when compared to the Control Bins (3000 µS/cm) which is beneficial for compost quality. Additionally, low NH_4^+-N levels were obtained and an increase in the NO_x^-N content was observed for the Test and Control Bins. The increase in the NO_x^-N content to an average of 65 mg NO_x^-N /l for the Control Bins and 495 mg NO_x^-N /l for the Test Bins indicates the nitrification process had started and was proceeding well.

[0044] Finally, a rather comparable average N content was found for the Control and Test Bins, while a somewhat higher P, K, and Mg content was observed for the Control Bins.

[0045] **EXAMPLE 5: Biodegradable Mosquito Traps**

[0046] The biodegradable container has also been used in the context of a mosquito trap. For example, containers made with the composition, 100% DLK and 8% AKD, were field tested. One hundred eighty (180) containers having the above composition and of a frusto-conical shape were filled with water to within 1 inch of the top of the container and placed on various substrates. These substrates existed in duplicate in a dry zone which remained protected from water other than what was in the container, and a wet zone where the substrate was watered every few days to simulate rain. Thus, 90 containers were in the dry zone and 90 containers were in the wet zone. Three substrate types were used as follows: mulch, soil/dirt, and concrete. Thus, 30 containers were placed in each substrate in each zone.

[0047] Prior to filling with water, the internal surface of the containers was coated with a pesticide, either 0.1% bifenthrin (a pyrethroid), or Lambda-cyhalothrin to kill mosquitoes. A

non-pesticide control group was also present in each substrate and zone as indicated above. Other pesticide equivalents may also be used. The containers were coated with the insecticide by spraying the internal surface of the containers. Thus, each substrate in each zone had 10 containers coated with 0.1% bifenthrin, 10 containers coated with Lambda-cyhalothrin, and 10 containers that remained uncoated. All containers were then observed over approximately a 9 week period to determine their water holding capability over that period.

[0048] Figure 1 is a chart showing the containers' water holding ability over an approximately 9 week period in the various substrates in both the dry and wet zones. As shown in the chart, all thirty containers in all substrates and in both the dry and wet zone held water for at least approximately 21 days or three weeks. Not surprisingly, the containers on the concrete substrate in the dry zone held water for a longer period. For example, the first container on the concrete substrate in the dry zone held water for about 37 days (a little over 5 weeks), whereas the first container on the concrete substrate in the wet zone held water for about 41 days (almost 6 weeks).

[0049] All containers in the wet soil substrate held water for about 37 days. All containers in the dry soil substrate held water for about 41 days. All containers in the wet mulch substrate held water for about 47 days, whereas all containers in the dry mulch held water for about 55 days. At 9 weeks, two containers remained on the dry concrete and three containers remained on the wet concrete.

[0050] The biodegradable containers also successfully functioned as a mosquito trap. For example, containers were double sprayed with lambda-cyalothrin filled with water and placed in a closed area with a known number of mosquitoes. After about 4 weeks, mosquito mortality was measured by counting the number of live mosquitoes compared to the dead mosquitoes. 100% mosquito mortality was achieved.

[0051] One or more currently preferred embodiments have been described by way of example. It will be apparent to persons skilled in the art that a number of variations and

modifications can be made without departing from the scope of the invention as defined in the claims.

WHAT IS CLAIMED IS:

1. A moisture and waste resistant biodegradable composition comprising:

   - a pulp component comprising between about 75% to about 100% wood based fiber and optionally up to about 25% non-wood-based fiber; and

   - a sizing agent, wherein said sizing agent is in an amount of about 2% to about 10% for every about 100 kg of said pulp component.

2. The moisture resistant biodegradable composition of claim 1, wherein the wood based fiber is obtained from corrugated or uncorrugated chipboard, kraft board, containerboard or bleached or unbleached paperboard.

3. The moisture resistant biodegradable composition of claim 2, wherein the wood-based fiber is from corrugated kraft board.

4. The moisture resistant biodegradable composition of claim 1, wherein the non-wood-based fiber is obtained from grasses such as miscanthus, jute, bamboo, sorghum, switchgrass, kenaf, and hemp, recycled paper or newsprint.

5. The moisture resistant biodegradable composition of claim 4, wherein the non-wood-based fiber is newsprint.

6. The moisture resistant biodegradable composition of claim 1, wherein the sizing agent is included in an amount of from about 4% to 8%.

7. The moisture resistant biodegradable composition of claim 1, wherein the sizing agent is a basic or neutral sizing agent.

8. The moisture resistant biodegradable composition of claim 7, wherein the sizing agent is selected from the group comprising of: alkene ketone dimer (AKD) and alkyl succinic anhydride (ASA).

9. The moisture resistant biodegradable composition of claim 1, wherein the sizing agent is AKD.

10. A moisture and waste resistant biodegradable composition comprising:

- a pulp component comprising about 90% double lined kraft corrugated scrap (DLK) and about 10% newsprint; and
- alkyl ketene dimer (AKD) in an amount of about 6% for every about 100 kg of said pulp component.

11. The moisture and waste resistant biodegradable composition of claim 10, wherein the non-wood-based fiber is number 9 newsprint.

12. A container made of a composition as defined in claim 1.

13. A container made of a composition as defined in claim 10.

14. A moisture resistant biodegradable insect trap comprising a container as defined in claim 12 incorporating an insecticide.

15. The moisture resistant biodegradable insect trap of claim 14, wherein said wood based fiber is double lined kraft corrugated scrap (DLK).

16. The moisture resistant biodegradable insect trap of claim 14, wherein said insecticide is selected from pyrethroids, organophosphates, organochlorides, neonicotinoids, ryanoids, biological control agents, insect growth regulators, carbamates, monomolecular films, and oils.

17. The moisture resistant biodegradable insect trap of claim 14, wherein said insecticide is selected from: bifenthrin, lambda-cyhalothrin, malathion, imidacloprid, bacillus thuringiensis, bacillus thuringiensis israelensis, bacillus sphaericus, methropene, and temephos.

18. The moisture resistant biodegradable insect trap of claim 14, wherein the composition for the container comprises:

- a pulp component comprising about 100% double lined kraft corrugated scrap (DLK); and
- about 8% AKD for every about 100 kg of said pulp component.

19. A method of making a container as defined in claim 12, comprising the steps of:

i) preparing the pulp component by blending about 75% to about 100% of wood-based fiber and optionally up to about 25% non-wood-based fiber;

ii) mixing a sizing agent into the pulp component in an amount of about 2% to about 10% for every about 100 kg of said pulp component to form the composition; and

iii) forming the composition into the shape of a container and allowing the composition to dry.

20. The method of claim 19, including the additional step of incorporating into the container an insecticide.

21. The method of claim 20, wherein incorporating the container with an insecticide includes coating an internal surface of the container with an insecticide.

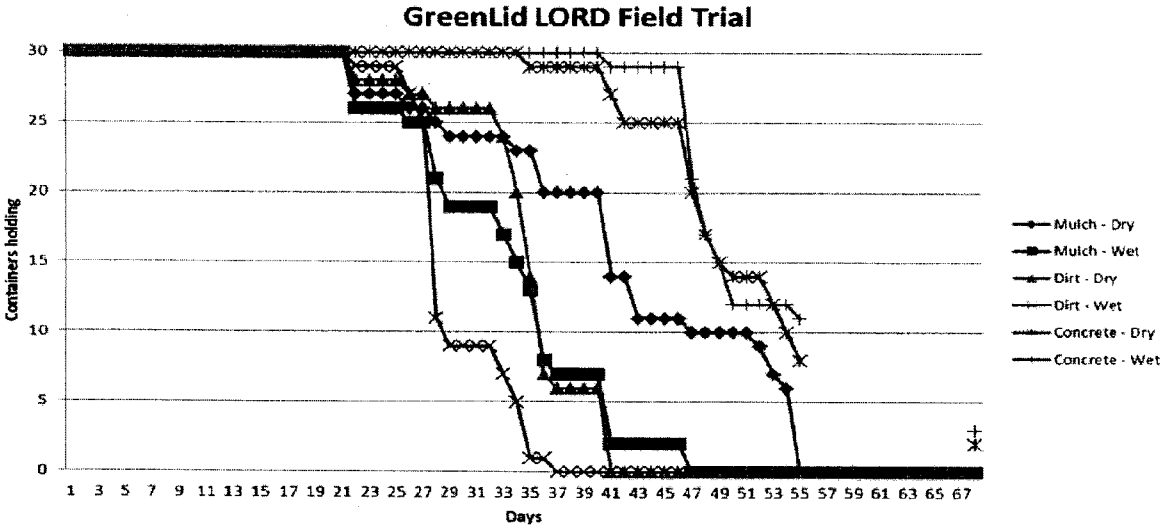
GreenLid LORD Field Trial
Containers holding
30
25
20
15
10
5
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67
Days
Mulch - Dry
Mulch - Wet
Dirt - Dry
Dirt - Wet
Concrete - Dry
Concrete - Wet

FIG. 1

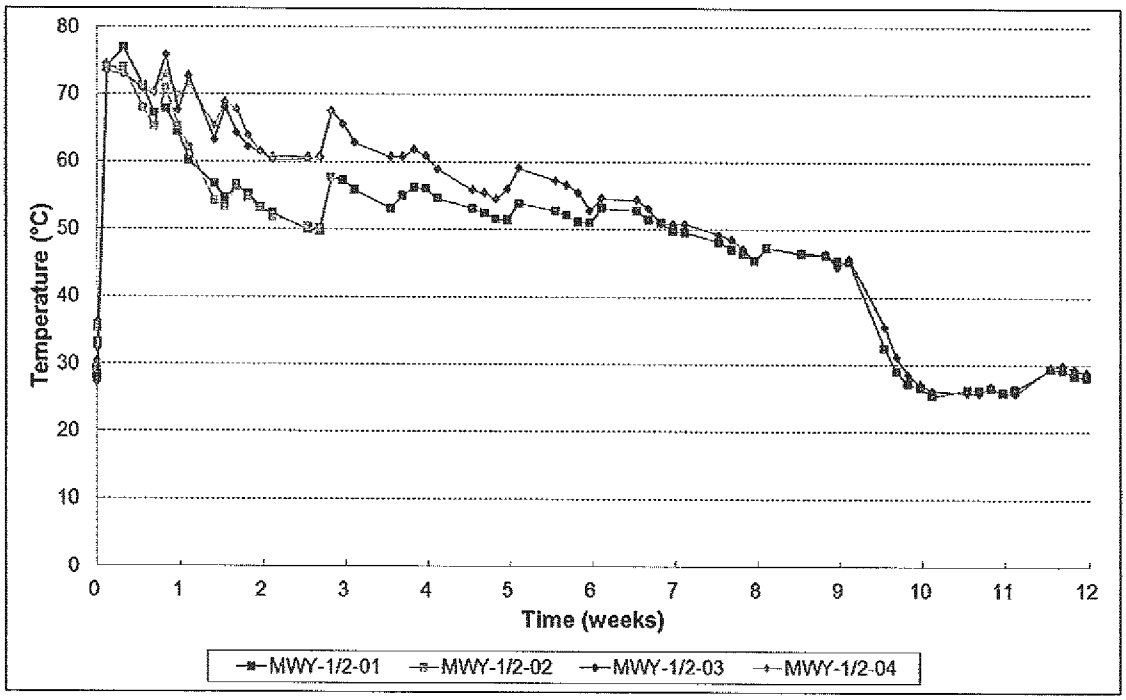
Temperature (°C)
Time (weeks)
MWY-1/2-01
MWY-1/2-02
MWY-1/2-03
MWY-1/2-04

FIG. 2

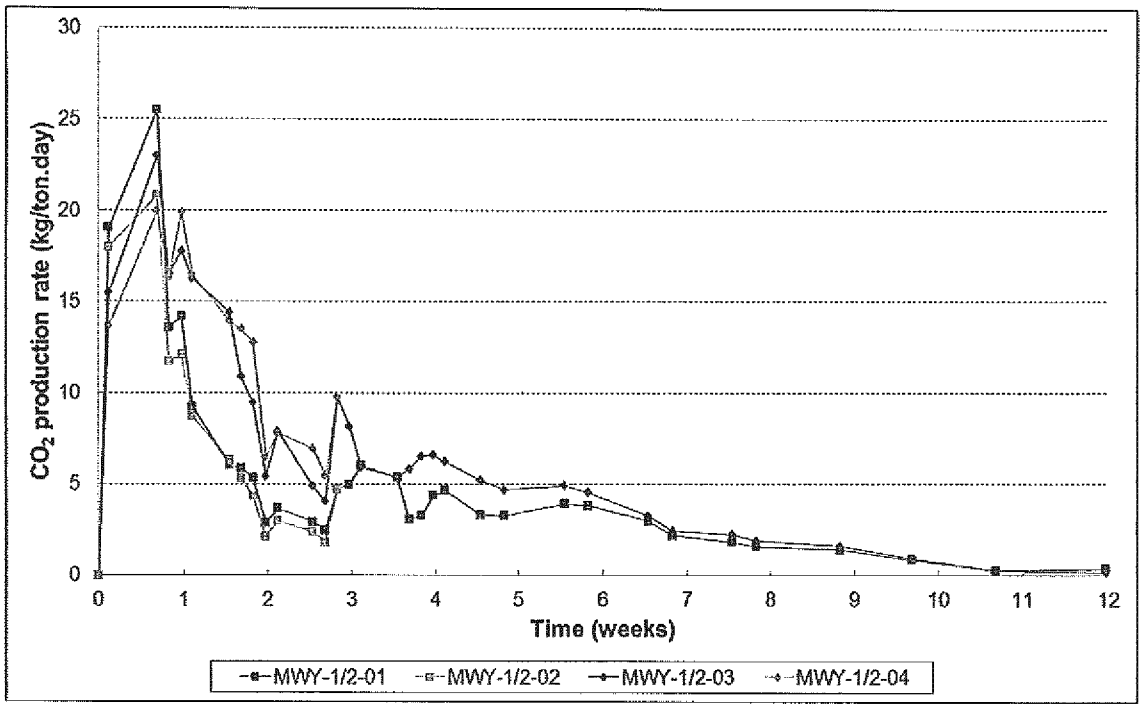
CO_2 production rate (kg/ton.day)
Time (weeks)
MWY-1/2-01
MWY-1/2-02
MWY-1/2-03
MWY-1/2-04

FIG. 3

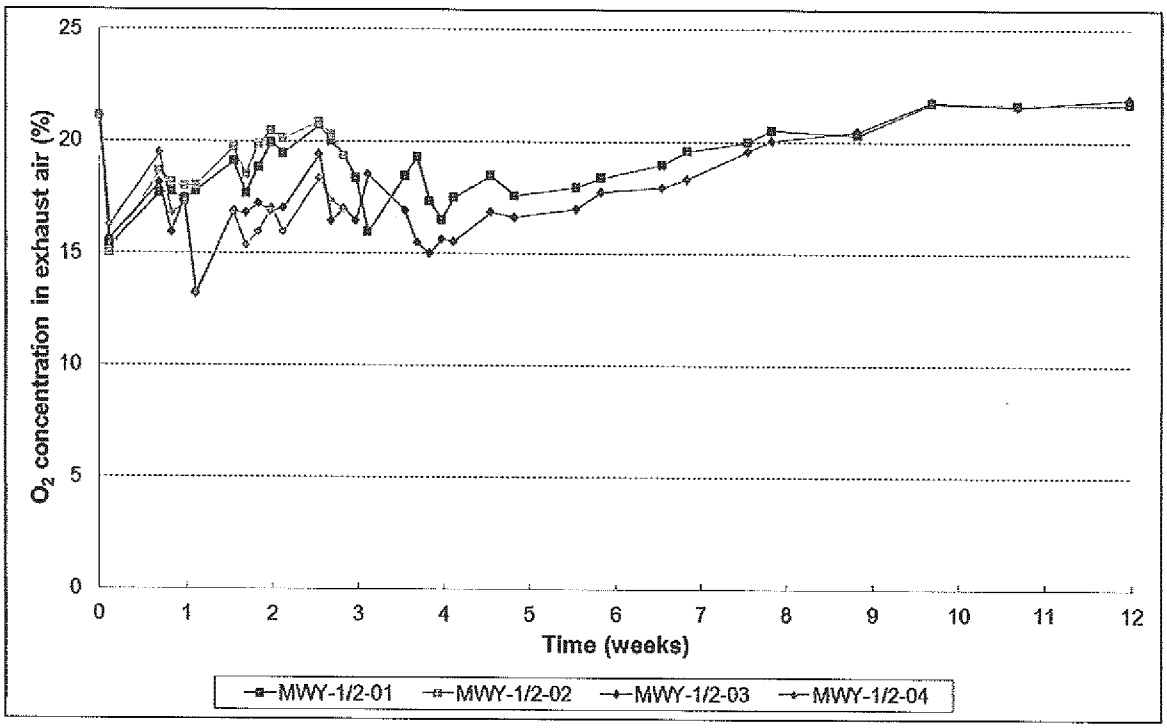
25
20
15
10
5
0
O_2 concentration in exhaust air (%)
0 1 2 3 4 5 6 7 8 9 10 11 12
Time (weeks)
MWY-1/2-01
MWY-1/2-02
MWY-1/2-03
MWY-1/2-04

FIG. 4

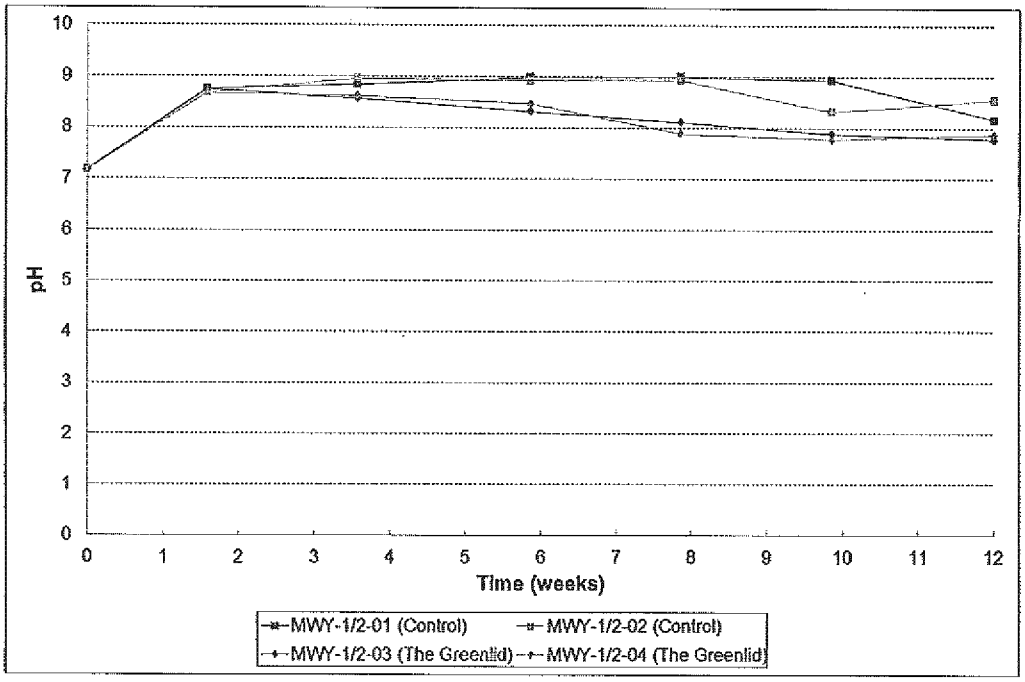
10
9
8
7
6
5
4
3
2
1
0
pH
0 1 2 3 4 5 6 7 8 9 10 11 12
Time (weeks)
MWY-1/2-01 (Control)
MWY-1/2-02 (Control)
MWY-1/2-03 (The Greenlid)
MWY-1/2-04 (The Greenlid)

FIG. 5

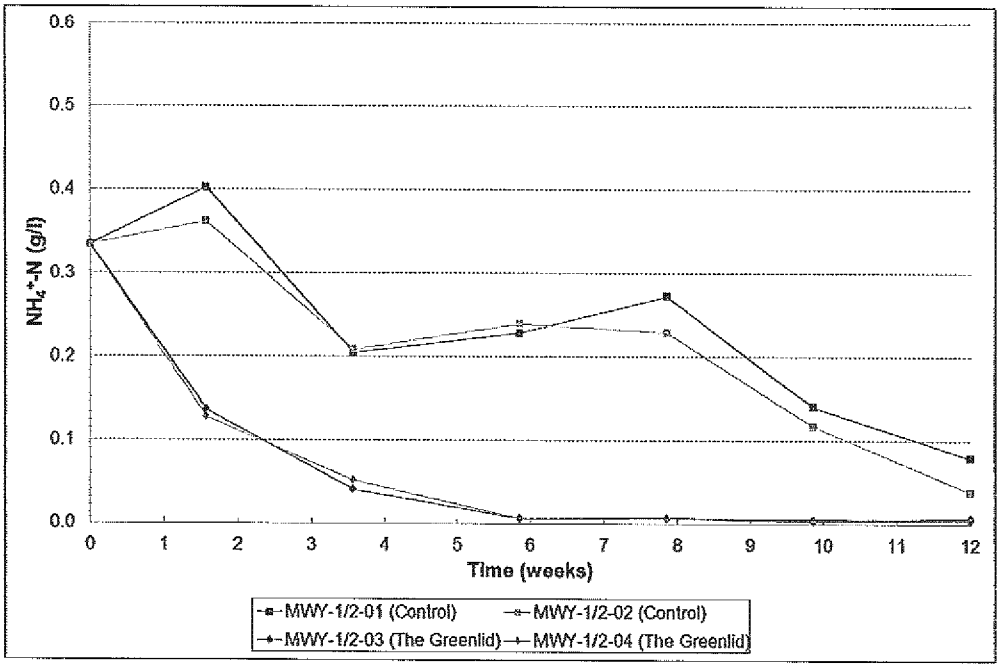
0.6
0.5
0.4
0.3
0.2
0.1
0.0
NH_4^+-N (g/l)
0 1 2 3 4 5 6 7 8 9 10 11 12
Time (weeks)
MWY-1/2-01 (Control)
MWY-1/2-02 (Control)
MWY-1/2-03 (The Greenlid)
MWY-1/2-04 (The Greenlid)

FIG. 6

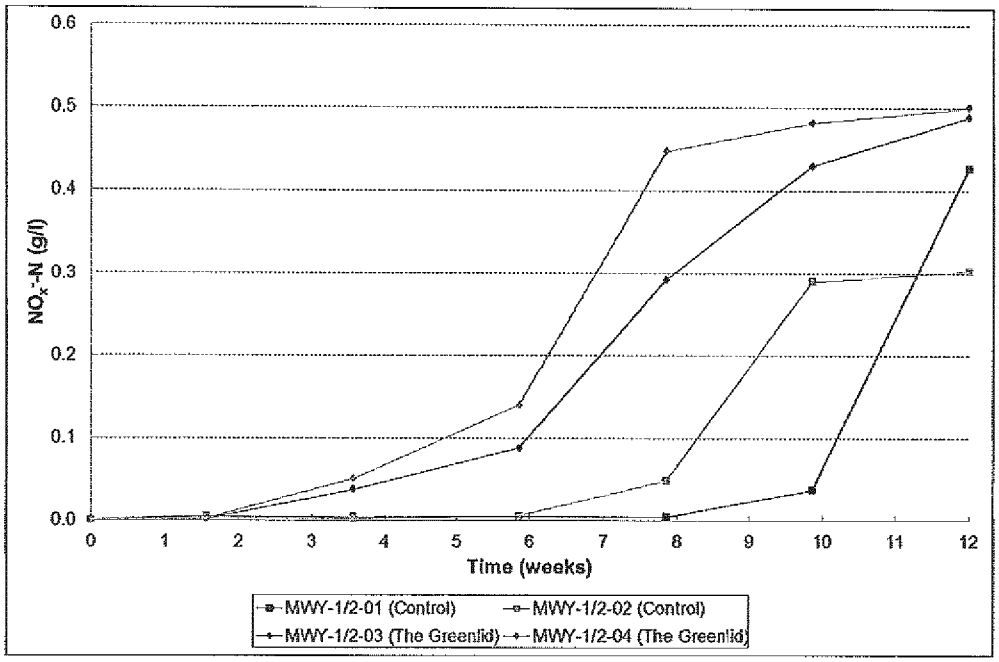
0.6
0.5
0.4
0.3
0.2
0.1
0.0
NO_x-N (g/l)
0 1 2 3 4 5 6 7 8 9 10 11 12
Time (weeks)
MWY-1/2-01 (Control)
MWY-1/2-02 (Control)
MWY-1/2-03 (The Greenlid)
MWY-1/2-04 (The Greenlid)

FIG. 7

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2016/050087

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***D21H 21/16*** (2006.01) , ***B65D 5/42*** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: ***D21H 21/16*** (2006.01) , ***B65D 5/42*** (2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Canadian Patent Database, QUESTEL-ORBIT (Keywords: biodegradable, insecticide, container, carton, siz*, pulp, bio*, newsprint, dispos*, enviro*, inect+, enviro+, dispos+, siz+)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CA 2 799 306 A1 (HEISKANEN et al.) 24 November 2011 (24-11-2011) *whole document*	1-13 and 19
Y		14-18, 20 and 21
X	KR 20120021764 (HWAN) 09 March 2012 (09-03-2012) *whole document*	1-13 and 19
Y		14-18, 20 and 21
Y	CA 2 434 210 A1 (HIRSBRUNNER et al.) 22 August 2002 (22-08-2002) *whole document*	14-18, 20 and 21

☐ Further documents are listed in the continuation of Box C.

☑ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier application or patent but published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 14 April 2016 (14-04-2016)	Date of mailing of the international search report 18 April 2016 (18-04-2016)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 819-953-2476	Authorized officer Malcolm Downey (819) 934-2329

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2016/050087

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