

PALLET AND METHOD FOR MANUFACTURING THE SAME

Background of the Invention

1. Field of the Invention

5 The present invention relates generally to a pallet for handling, storing, or moving materials and packages.

2. Description of the Related Art

 Pallets are widely used for assembling, storing, stacking, handling and transporting goods as a unit load, and are primarily constructed from wood, metal or
10 plastic.

 Wooden pallets are most commonly used. However, in recent years, wooden pallets have been continually placed in the spotlight by environmentalists and various government agencies because of deforestation issues and environmental problems resulting from the disposal of waste woods by landfill and the importation and
15 exportation of wood-boring parasites between countries and continents. Consequently, many countries have imposed a number of restrictions such as ISPM 15 (International Standard for Phytosanitary Measure 15) from WHO (World Health Organization) on the use of solid wood packaging materials.

 Pallets made from plastic and metal are currently an alternative to wooden pallets.
20 However, the use of such pallets is kept to a minimum, as pallets made of plastic and metal are more costly. Apart from higher costs, plastic and metal pallets also present a disposal problem since plastic and metal are not biodegradable and cannot therefore be disposed of effectively. Further, the use of recycled plastic in the manufacture of plastic pallets is detrimental to the environment because the breakdown of plastics releases
25 noxious fumes into the atmosphere, contributing to land and water pollution.

 In view of the foregoing, it is desirable to have a biodegradable pallet made from a readily renewable resource and a method for manufacturing the same.

Summary of the Invention

The present invention fills these needs by providing a biodegradable pallet and a method for manufacturing the same. It should be appreciated that the present invention can be implemented in numerous ways, including as a process, an apparatus, a system, a device or a method. Several inventive embodiments of the present invention are described below.

One embodiment of the present invention provides a biodegradable pallet comprising a pallet body, a skid to reinforce the pallet body and means to interlock the pallet body and the skid. The pallet body and the skid are moulded from a mouldable composition comprising between about 40 to 60 wt % of a fibre mixture and between about 15 to 45 wt % of an adhesive.

A moisture content of the mouldable composition is preferably less than about 20 %. More preferably, the moisture content of the mouldable composition is between about 4 to 15 %. Most preferably, the moisture content of the fibre mixture is less than about 15 %.

Preferably, the mouldable composition further comprises not more than about 40 wt % of an additive. The additive may be one or more of a group consisting of a hardener, a flow promoter and a mould release agent.

Preferably, the fibre mixture comprises a plurality of fibres and wherein each of the plurality of fibres is of a length of up to about 50 mm. Each of the plurality of fibres is preferably of a thickness of up to about 2 mm and a length to a thickness ratio of between about 2:1 to 25:1.

Preferably, the fibre mixture includes between about 5 to 30 wt % of an oil palm fibre. The fibre mixture may include one of a group consisting of oil palm fibres, beer malt, sugarcane pulp, a plasticizer, a toughening agent and an impact modifier.

Preferably, the adhesive is a thermosetting resin. More preferably, the adhesive is an amino resin. Even more preferably, the adhesive is a melamine. Most preferably, the

adhesive is one of a group consisting of melamine formaldehyde and melamine urea formaldehyde.

In a preferred embodiment, the pallet body comprises a load-bearing member having a leg. Preferably, the load-bearing member has a substantially constant overall wall
5 thickness of between about 3 to 5 mm. Preferably, the load-bearing member includes a plurality of ribs, each rib comprising an open channel having a tapering channel wall and is designed to have a draft angle of between about 6 to 12 degrees ($^{\circ}$) from perpendicular to the surface of load-bearing member 18.

The leg is preferably formed as a concave depression in the load-bearing member.
10 Preferably, the leg tapers inwards towards a base and is designed to have a draft angle of between about 11 to 12 $^{\circ}$ from perpendicular to the surface of load-bearing member 18 and a minimum vertical height of about 95 mm.

In a preferred embodiment, a blind hole is preferably provided on the base. The blind hole is preferably designed to have a draft angle of less than about 0.5 $^{\circ}$ from
15 perpendicular to the surface of load-bearing member 18.

Preferably, a first fillet is formed where the leg meets the load-bearing member. A fin is preferably provided around a periphery of the load-bearing member.

In a preferred embodiment, the skid comprises a framework formed from a plurality of ties. A second fillet is preferably formed at a junction where the plurality of
20 ties is joined. Preferably, the skid includes a protruding plug corresponding to the blind hole in the base of the leg. The blind hole interlocks the protruding plug. A circumferential dimension of the protruding plug is preferably between about 0.05 mm to 0.1 mm larger than a circumferential dimension of the blind hole, so that an interference fit secures the skid to the pallet body when a force is applied to interlock the blind hole and
25 the protruding plug. Preferably, the protruding plug is designed to have a draft angle of less than about 0.5 $^{\circ}$ from perpendicular to a surface of skid 14.

In a preferred embodiment, the pallet is designed to have at least about 60 % top deck coverage and at least about 35 % bottom deck coverage.

Another embodiment of the present invention provides a method to form a high strength moulded product. The method begins by preparing a mouldable composition. The mouldable composition comprises between about 40 to 60 wt % of a fibre mixture and between about 15 to 45 wt % of an adhesive. A mould cavity is loaded with the mouldable composition up to about 90 % of the capacity of the mould cavity before applying a packing pressure of between about 435 to 870 psi to the mouldable composition. A predetermined clearance of between about 0.1 to 0.5 mm is maintained between a first mould part defining the mould cavity and a second mould part. The moulded product is removed from the mould cavity when the mouldable composition is substantially cured. The pressure is preferably applied for a period of between about 20 to 60 s.

Preferably, the first mould part and the second mould part are maintained at a temperature of between about 110 to 180°C. More preferably, the first mould part is maintained at a temperature of about 20 °C higher than a temperature of second mould part.

The predetermined clearance between the first mould part and the second mould part is preferably increased to about 10 mm when the mouldable composition is about 90 % cured.

The moulded product is preferably compressed to a desired thickness and a surface of the moulded product is preferably ironed by reducing the predetermined clearance between the first mould part and the second mould part to between about 0.05 to 0.3 mm for between about 15 to 60 s.

Preferably, the mouldable composition includes not more than about 40 wt % of an additive. The additive may be one of a group consisting of a hardener, a flow promoter and a mould release agent.

Preferably, a moisture content of the mouldable composition is less than about 20 %. More preferably, a moisture content of the mouldable composition is between about 4 to 15 %. A moisture content of the fibre mixture is preferably less than about 15 %.

The fibre mixture preferably comprises a plurality of fibres, each of the plurality of fibres having a length of up to about 50 mm and a thickness of up to about 2 mm. Preferably, each of the plurality of fibres is of a length to a thickness ratio of between about 2:1 to 25:1. The fibre mixture preferably includes between about 5 to 30 wt % of an oil palm fibre. Preferably, the fibre mixture includes one of a group consisting of oil palm fibres, beer malt, sugarcane pulp, a plasticizer, a toughening agent and an impact modifier.

The adhesive is preferably a thermosetting resin. More preferably, the adhesive is an amino resin.

10 Preferably, the adhesive includes melamine. The adhesive may be one of a group consisting of melamine formaldehyde and melamine urea formaldehyde.

The mouldable composition is preferably prepared by weighing each component of the mouldable composition individually before combining each component of the mouldable composition in a mixer to form a substantially homogeneous and well-coated mouldable composition. Preferably, each liquid component of the mouldable composition is combined in a second mixer to form a liquid mixture, which is preferably sprayed into the mixer. The mixer is preferably operated at a rotor speed of about 29 rpm.

In yet another embodiment of the invention, a method to form a moulded product is provided. The method begins by loading a cavity of a mould with a mouldable composition comprising between about 40 to 60 wt% of a fibre mixture and between about 15 to 45 wt% of an adhesive. The cavity is loaded up to about 90% of the capacity of the cavity. Thereafter, the mould is activated so as to apply a packing pressure in the range 435 to 870 psi to the mouldable composition therein. A moisture vapour vent is provided. The moisture vapour vent is responsive to pressure in the mouldable composition and set to provide a predetermined control of moisture vapour content and thereby pressure in the composition, whereby to produce a moulded product having predetermined density and strength. The moulded product is removed from the mould cavity when the mouldable composition is substantially cured.

Preferably, the vent is provided by maintaining a predetermined clearance between

respective parts of the mould adjacent the mouldable composition. The vent may be temporarily occluded by the mouldable composition in the mould to temporarily prevent release of moisture vapour for a predetermined period.

- 5 The moisture vapour content is preferably controlled to generate bubbles of the vapour in the mouldable composition and thereby produce a porous moulded product of predetermined density.

Other aspects and advantages of the invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

Brief Description of the Drawings

The present invention will be readily understood by the following detailed description in conjunction with the accompanying drawings. To facilitate this description, like reference numerals designate like structural elements.

5 Figure 1 illustrates a perspective view of a pallet in accordance with one embodiment of the present invention.

Figure 2 illustrates a bottom view of a pallet body in accordance with one embodiment of the present invention.

10 Figure 3 illustrates a perspective view of a skid in accordance with one embodiment of the present invention.

Figure 4 illustrates a cross-sectional view of an interlocking means in accordance with one embodiment of the present invention.

Figure 5 is a flow chart illustrating a method to prepare a mouldable composition in accordance with one embodiment of the present invention.

15 Figure 6 is a flow chart illustrating a method to prepare a fibre mixture in accordance with one embodiment of the present invention.

20 Figure 7 illustrates a press to form a moulded product in accordance with one embodiment of the present invention.

Figure 8 illustrates an enlarged view of a mould cavity and a mould plunger during the formation of a moulded product in accordance with one embodiment of the present invention.

Figure 9A illustrates a cross-sectional view of an ejection mechanism at rest in accordance with embodiment of the present invention.

25 Figure 9B illustrates a cross-sectional view of an ejection mechanism in operation in accordance with embodiment of the present invention.

Figure 10 is a flow chart illustrating a method to form a moulded product in accordance with one embodiment of the present invention.

Detailed Description of the Preferred Embodiments

A biodegradable pallet and a method for manufacturing the same are provided. In the following description, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be understood, however, to one skilled in the art, that the present invention may be practised without some or all of these specific details. In other instances, well known process operations have not been described in detail in order not to unnecessarily obscure the present invention.

Figure 1 illustrates a perspective view of a biodegradable pallet 10 in accordance with one embodiment of the present invention. Pallet 10 comprises a pallet body 12 that is reinforced when coupled to an attachable skid 14 by an interlocking means 16. Skid 14 enhances the rigidity and stability of pallet 10 and conforms pallet 10 to the specifications stipulated for material handling applications using various types of conveyor systems such as, for example, forklifts, motorized pallet jacks and manual pallet jacks.

Pallet body 12 comprises a substantially planar load-bearing member 18 with a depending leg 20 at a centre S, each corner and a midpoint along each length L and each width W of load-bearing member 18 to provide stability to pallet 10. Nonetheless, it will be appreciated by a person of ordinary skill in the art that depending leg 20 may be located at only some of these positions or at other positions on load-bearing member 18. Load-bearing member 18 may have a substantially constant overall wall thickness of between about 3 to 5 millimetres (mm).

Each leg 20 is formed as a concave depression in load-bearing member 18, allowing the nesting of pallets, which reduces space requirements and improves cube utilization in transportation and storage. Additionally, hollow leg 20 contributes to a reduction in the weight of pallet 10 and material cost. In an alternative embodiment, leg 20 may have a solid core.

With reference to Figure 2 where a bottom view of pallet body 12 is illustrated in accordance with one embodiment of the present invention, each leg 20 tapers inwards towards a base 22. Tapering of leg 20 facilitates the removal of pallet 10 from a mould and the separation of nesting pallets. A blind hole 24 is provided on base 22 of leg 20.

Leg 20 is designed to have a minimum vertical height of about 95 mm to accommodate various types of lifting equipment such as, for example, forklifts, motorized pallet jacks and manual pallet jacks.

5 A first fillet 26 is formed where leg 20 meets load-bearing member 18. First fillet 26 reduces the tendency for the formation of cracks where leg 20 and load-bearing member 18 are joined, and reinforces pallet body 12.

10 Referring back to Figure 1, a plurality of ribs 28 is provided on load-bearing member 18 to strengthen pallet body 12. Each rib 28 comprises an open channel 30 to allow the nesting of pallets in order to reduce space requirements and to improve cube utilization in transportation and storage. Hollow ribs 28 contribute to a reduction in the weight of pallet 10, as well as a reduction in material and transportation costs for pallet 10. Each open channel 30 has a tapering channel wall to facilitate the removal of pallet 10 from a mould and the separation of nesting pallets. In an alternative embodiment, rib 28 may have a solid core. The layout of the plurality of ribs 28 illustrated in this embodiment is merely exemplary; it will be appreciated that there are numerous possible layouts for the plurality of ribs 28.

20 Rib 28 is designed to have a taper or a draft angle of between about 6 to 12 degrees ($^{\circ}$) from perpendicular to the surface of load-bearing member 18 to facilitate the ejection or removal of pallet body 12 or skid 14 from a mould and also to assist in the separation of nesting pallets.

A fin 32 is provided around a periphery of load-bearing member 18 to facilitate extraction of pallet body 12 from a mould and handling of pallet 10. Fin 32 also serves to reinforce the periphery, preventing the formation of cracks or foils when pallet 10 is dropped.

25 Essentially, fin 32 and the plurality of ribs 28 impart tensile and compressive strength to pallet body 12, enabling pallet 10 to withstand any impact with minimum deflection during loading, stacking and warehousing, and also when in transit.

Figure 3 illustrates a perspective view of skid 14 in accordance with one embodiment of the present invention. Skid 14 comprises a framework formed from a plurality of ties 34. A second fillet 36 is formed at a junction where at least two ties 34 meet. Second fillet 36 reduces the tendency for the formation of cracks at junctions where ties 34 are joined, and reinforces skid 14.

Skid 14 includes a plurality of protruding plugs 38. Each protruding plug 38 corresponds to blind hole 24 in base 22 of leg 20 illustrated in Figure 2.

Pallet 10 is designed to have at least about 60 % top deck coverage to provide adequate support for an object that is loaded on pallet 10 and at least about 35 % bottom deck coverage to ensure stability of pallet 10. Minimum anti-skid requirements are met with a top deck coverage of at least about 60 % and a bottom deck coverage of at least about 35 %. Top deck coverage is defined as the surface area of load-bearing member 18 expressed as a percentage of the total surface area of pallet 10, which is calculated by multiplying length L and width W of pallet 10. Bottom deck coverage is defined as the total surface area of bases 22 on legs 20 or the surface area of skid 14, depending on whether skid 14 is attached to pallet body 12, expressed as a percentage of the total surface area of pallet 10.

Figure 4 illustrates a cross-sectional view of interlocking means 16 in accordance with one embodiment of the present invention. Interlocking means 16 couples blind hole 24 in base 22 of leg 20 to protruding plug 38. The circumferential dimension of protruding plug 38 is between about 0.05 to 0.1 mm larger than that of blind hole 24 to achieve an interference fit, that is, a fit in which two tolerated mating parts will always interfere when assembled because one part is larger than the other. The interference fit secures skid 14 to pallet body 12 when a force is applied to interlock skid 14 and pallet body 12.

Each leg 20, blind hole 24 and protruding plug 38 is designed to have a taper or a draft angle D_{leg} , $D_{blind\ hole}$, $D_{protruding\ plug}$ of between about 11 to 12°, less than about 0.5° and less than about 0.5°, respectively, from perpendicular to the surface of load-bearing member 18 or skid 14 to facilitate the ejection or removal of pallet body 12 or skid 14 from a mould and also to assist in the separation of nesting pallets.

The pallet may be manufactured by a thermoforming process such as that described more fully in a co-pending patent application titled "Method to Form a High Strength Moulded Product" incorporated herein by reference. A moulded product consisting of either the pallet body or the skid may be constructed of a mouldable composition comprising between about 40 to 60 percentage by weight (wt %) of a fibre mixture and between about 15 to 45 wt % of an adhesive. The mouldable composition may include not more than about 40 wt % of an additive.

The moisture content of the mouldable composition is preferably less than about 20%, more preferably between about 4 to 15 %. A higher moisture content dilutes the concentration of the adhesive in the mouldable composition. Hence, a longer processing time is required to cure a mouldable composition with higher moisture content.

Further, in keeping the moisture content of the mouldable composition to less than about 20%, the need for a further post curing process to remove moisture from the moulded product to prevent fungus growth is done away with. By minimising the number of processing steps, the moulded product may be produced at a lower cost and in a shorter production cycle time.

As moisture is inherent in the fibre mixture and possibly in the adhesive and additive as well, addition of water is not required. The moisture content of the fibre mixture is preferably less than about 15%. Rather, the moisture content of the mouldable composition may be reduced by adding between about 10 to 20 wt % of a co-solvent with a lower boiling point than water, such as, for example, alcohol.

The fibre mixture may comprise wood waste from building construction, used furniture, used wooden pallets and sawdust, and/or agricultural and horticultural waste such as, for example, leaves, stems and branches. Fibres from wood waste and agricultural and horticultural waste are readily available at a low cost and give good acoustic and thermal insulation properties to the moulded product. In addition, such fibres also confer stiffness to the moulded product, making it resistant to deformation when subjected to stresses.

Fibres with a length of up to about 50 mm, a thickness of up to about 2 mm and a

length to thickness ratio of between about 2:1 to 25:1 are preferred. Because the moulded product derives its strength from the fibre, and not the bonding provided by the adhesive, the use of a longer fibre is preferred even though longer fibres provide less surface area for bonding. Accordingly, a smaller quantity of adhesive is required when longer fibres are
5 used in the mouldable composition.

Between about 5 to 30 wt % of an oil palm fibre may be included in the fibre mixture to increase the elasticity and ductility of the moulded product, making the moulded product less brittle. However, a higher content of oil palm fibre may reduce the strength of the moulded product as oil palm fibres are generally smaller in size, typically
10 having a length of up to about 50 mm and a thickness of between about 0.3 to 1 mm. Accordingly, the composition of oil palm fibre in the fibre mixture may be varied according to the desired properties of the moulded product.

The addition of oil palm fibre is also preferred because oil palm fibre has low moisture content and contains lignin, which is a good dispersing agent and serves as a
15 binder when subjected to pressure.

The oil palm fibre may be obtained from various parts of an oil palm such as, for example, the trunk, fronds and fruit. These parts of the oil palm are usually junked. Hence, the present invention provides a way to reduce wastage and to minimise environmental pollution caused by the incineration of the oil palm.

20 Apart from being low in cost, oil palm fibres are readily available throughout the year in various sizes.

Although less preferred, alternatives, such as, for example, beer malt and sugarcane pulp or a chemical such as a plasticizer, a toughening agent or an impact modifier, may be employed in place of oil palm fibres to improve the ductility and elasticity
25 of the moulded product.

The adhesive is preferably a thermosetting resin such as, for example, an amino resin, an epoxy resin, an allylic resin, a phenolic resin, a polyimide, silicone, a polyester, a polyaromatic or a furan. More preferably, the adhesive is an amino resin because such

resins blend well with the fibre mixture to form a homogeneous mixture and result in the formation of a moulded product that is resistant to heat, stress and chemicals. Amino resins are thermosetting plastic materials that are produced by reacting a compound bearing an amino group ($-NH_2$) such as aniline, ethylene urea, guanamines, melamines, sulphonamide, thiourea and urea with a formaldehyde.

Preferably, the adhesive contains melamine, which confers durability, as well as heat and water resistance, to the moulded product. Examples of melamine containing adhesives include melamine formaldehyde and melamine urea formaldehyde. A moulded product formed with melamine urea formaldehyde will have an almost negligible amount of formaldehyde because during the moulding process, almost all the formaldehyde in the amino resin vaporises, leaving a negligible quantity of formaldehyde in the moulded product. Accordingly, the free formaldehyde emission from such a moulded product is minimal and will therefore not pose a health threat.

The additive may include between about 0.1 to 0.4 wt % of a hardener such as ammonium chloride to accelerate the curing process of the adhesive, between about 6 to 18 wt % of a flow promoter such as tapioca flour to enhance the flow of the mouldable composition and between about 0.2 to 0.9 wt % of a mould release agent, preferably, soy lecithin, to assist in the removal of the moulded product from a mould.

Soy lecithin is a preferred mould release agent because it is plant-based, renewable, biodegradable, does not contain any toxic additive and will not release any toxic vapours during moulding.

Tables 1A, 1B and 1C illustrate examples of mouldable compositions that may be used to form a biodegradable pallet in accordance with one embodiment of the present invention.

Table 1A

(all amounts in wt %)

	Example 1	Example 2	Example 3	Example 4
Plant Fibre	53.2	44.1	46.2	49.9
Tapioca Flour	8.7	8.6	9.5	8.2
Melamine Urea Formaldehyde	34.8	44.7	41.6	39.0
Ammonium Chloride	0.7	0.9	0.8	0.8
Soya Extract	0.9	1.7	1.9	2.1
Impact Modifier	1.7	0.0	0.0	0.0

Table 1B

(all amounts in wt %)

	Example 5	Example 6	Example 7
Plant Fibre	50.0	51.7	52.0
Tapioca Flour	8.6	8.9	9.3
Melamine Urea Formaldehyde	38.5	37.7	37.1
Ammonium Chloride	0.8	0.8	0.7
Soya Extract	2.1	0.9	0.9
Impact Modifier	0.0	0.0	0.0

Table 1C

(all amounts in wt %)

		Example 8	Example 9
Plant Fibre	Agricultural and/or Horticultural Waste	47.8	47.4
	Oil Palm Fibre	2.1	4.6
Tapioca Flour		8.2	9.3
Melamine Urea Formaldehyde		39.0	37.1
Ammonium Chloride		0.8	0.7
Soya Extract		2.1	0.9
Impact Modifier		0.0	0.0

Figure 5 is a flow chart illustrating a method 100 to prepare a biodegradable mouldable composition in accordance with one embodiment of the present invention. The mouldable composition comprises about 40 to 60 percentage weight (wt %) of a fibre mixture, about 15 to 45 wt % of melamine urea formaldehyde, about 0.1 to 0.4 wt % of

ammonium chloride, about 6 to 18 wt % of tapioca flour and about 0.2 to 0.9 wt % of soy lecithin.

Method 100 begins by weighing 102 each of the components of the biodegradable mouldable composition individually using a gain-in-weight principle or under vacuum.

- 5 The components of the mouldable composition are sequentially combined 104 in a mixer for between about 300 to 600 seconds (s) to form a substantially homogeneous and well-coated mouldable composition.

- 10 The fibre mixture is first added to the mixer and blended for about 10 seconds (s) prior to the addition of tapioca flour. The tapioca flour and the fibre mixture are blended for about 20 s. After which, soy lecithin, followed by melamine urea formaldehyde, and then ammonium chloride is added to the mixer and blended for another period of about 300 s to achieve homogeneity in the mouldable composition.

The liquid components such as melamine urea formaldehyde and ammonium chloride may be fed into the mixer by a pneumatic actuator or a volumetric screw feeder.

- 15 In a preferred embodiment, the liquid components are sprayed 106 into the mixer to coat the fibres in the fibre mixture evenly. Spraying 106 of the liquid components into the mixer ensures an even distribution of the liquid components in the mouldable composition. An air operated diaphragm pump or a spraying nozzle may be used to spray 106 the liquid components into the mixer.

- 20 Where the mouldable composition includes more than one liquid component, the liquid components may be combined 108 in a second mixer for about 200 s to form a liquid mixture before spraying 106 into the mixer. The combination 108 of the liquid components may take place concurrently with the combination 102 of the components of the mouldable composition.

- 25 The use of a mixer with twin rotor shafts and overlapping paddles is preferred to reduce the mixing time required to achieve homogeneity of the mouldable composition and to create a fluidising zone in the mixer. The creation of a fluidising zone reduces friction during mixing and therefore minimises heat generation to prevent premature

curing of the mouldable composition.

Although the mixer may be operated at a rotor speed of between about 10 to 200 revolutions per minute (rpm), it is preferable to operate the mixer at a rotor speed of about 29 rpm to minimise the shearing force acting on the mouldable composition and the heat generated. High shearing force will cause the fibres to disintegrate.

The mixer may be provided with side doors measuring at least about 600 mm in height by at least about 600 mm in width to allow an efficient discharge of the mouldable composition with minimal residue remaining. The provision of large side doors also allows for quick inspection, fast cleaning and good access.

10 The moisture content of the mouldable composition is preferably less than about 20%, more preferably between about 4 to 15 %. A higher moisture content will cause the mouldable composition to have insufficient viscosity to distribute the shearing force from the mixer to coat the fibres uniformly.

Figure 6 is a flow chart illustrating a method 150 to prepare a fibre mixture in accordance with one embodiment of the present invention. Method 150 begins when a quantity of wood waste, agricultural or horticultural waste is received in a first grinder where it is ground 152 into a plurality of pieces of waste, each piece of waste measuring between about 10 to 80 mm in length and between about 2 to 20 mm in width.

20 The plurality of pieces of waste may be sieved 154 with a first wire mesh having a plurality of apertures measuring about 80 mm in diameter, prior to being conveyed to a second grinder for grinding 156 into a plurality of fibres. The plurality of fibres, each fibre measuring between about 5 to 50 mm in length and between about 2 to 10 mm in width, may then be sieved 158 with a second wire mesh having a plurality of apertures measuring about 50 mm in diameter.

25 The plurality of fibres is screened 160 for metal pieces using a metal detector. The metal pieces are removed from the plurality of fibres before it is fed together with a plurality of oil palm fibres into a third grinder. The resultant fibre mixture is then ground 162 into fibres having a length of up to about 50 mm and a thickness of up to about 2 mm.

Following which, the fibre mixture may be sieved 164 with a third wire mesh having a plurality of apertures measuring about 20 mm in diameter.

Although a single grinder may be employed to prepare a fibre mixture with the desired fibre dimensions, three separate grinders are preferred to minimise material
5 handling and cutter alignment, and also to prevent jamming of the grinder. As an alternative to sieving, foreign materials, oversized particles and big fibres may be removed manually.

The fibre mixture is then dried 166 to a moisture content of less than about 15%. The fibre mixture may be spread out on a cemented floor of a drying shelter to dry for
10 between about 1 to 2 weeks. The fibre mixture may be dried using spotlights, a dry air blower, ultraviolet (UV) light from the sun or a rotary dryer with a heating system. Occasionally, the fibre mixture may be redistributed to achieve a uniform dryness. Random samples of the fibre mixture may be analysed to determine if the desired fibre
15 size, moisture content and composition has been achieved prior to delivery or to storage in a silo.

The fibre mixture may be transported around a manufacturing plant with a screw conveyor. The fibre mixture may be conveyed from the screw conveyor to the storage silo using an aeromechanical conveyor.

A press for manufacturing a moulded product from the mouldable composition is
20 illustrated in Figures 7 and 8 in accordance with one embodiment of the present invention.

Figure 7 illustrates a press 200 to form the moulded product in accordance with one embodiment of the present invention. Press 200 comprises a frame 202 having a first platen 204 and a plunger 206 coupled to a second platen 208. A first or female mould part 210 defining a mould cavity 211 is provided on first platen 204, while a second or
25 male mould part 212 defining a mould plunger 213 is coupled to second platen 208. Plunger 206 is to move mould plunger 213 towards and away from mould cavity 211. Second mould part 212 may be provided with one or more guide pin(s) 214 that co-operate with complementary elongate recesses 215 in first mould part 210 to align mould plunger 213 with mould cavity 211 when plunger 206 is in operation.

Press 200 may be a mechanical press, a pneumatic press or a hydraulic press. The use of a hydraulic press is preferred as it offers greater control flexibility — the force applied, the direction, the speed, the duration of pressure dwell, *et cetera*, may be adjusted accordingly.

5 To form the moulded product, mould cavity 211 is first loaded with a biodegradable mouldable composition 216, up to about 90 % of the capacity of mould cavity 211. The degree to which mould cavity 211 is filled is dependent on the compression ratio of the moulded product, that is, the ratio of the wet weight to the dry weight of the moulded product. The wet weight of a moulded product is the weight of the
10 mouldable composition used to form the moulded product, while the dry weight of a moulded product is the weight of the moulded product after curing. The compression ratio is preferably between about 4:1 to 14:1. A shrinkage factor of about 1% in a transverse direction and 1.5% in a longitudinal direction is preferred.

First mould part 210 and second mould part 212 are maintained at a temperature
15 of between about 110 to 180 °C by a first thermal oil heating system 230 and a second thermal oil heating system 232, respectively. A thermal controller (not illustrated) is provided to regulate the temperature of first mould part 210 and second mould part 212. First mould part 210 is preferably maintained at a temperature that is about 20 °C higher than a temperature of second mould part 212 to compensate for heat loss when mouldable
20 composition 216 is loaded into mould cavity 211 and to prevent first mould part 210 and second mould part 212 from jamming due to thermal expansion of first mould part 210 and second mould part 212.

Mould plunger 213 is moved towards mould cavity 211 at a speed of about 80 millimetres per second (mm/s) until just before mould plunger 213 contacts mouldable
25 composition 216. The speed is then reduced to between about 0.5 to 3 mm/s to prevent the application of a sudden impact on mouldable composition 216, which is undesirable as it induces stresses in mould plunger 213 and mouldable composition 216. A limit switch (not illustrated) may be used to reduce the speed at which mould plunger 213 approaches mould cavity 211.

The period of time between loading mouldable composition 216 into mould cavity 211 and bringing mould plunger 213 into contact with mouldable composition 216 is preferably minimised to ensure that mouldable composition 216 is cured uniformly.

As mould plunger 213 is gradually contacted with mouldable composition 216, a packing pressure of between about 435 to 870 pressure per square inch (psi) is applied to mouldable composition 216 and maintained during the moulding process. Packing pressure is defined as press tonnage divided by the surface area of mould cavity 211 and the volume of mouldable composition 216 in mould cavity 211.

Movement of mould plunger 213 towards mould cavity 211 ceases when a predetermined clearance of between about 0.1 to 0.5 mm is left between first mould part 210 and second mould part 212. Second mould part 212 is held at this position for between about 20 to 60 s to allow mouldable composition 216 to cure substantially.

Heat from first mould part 210 and second mould part 212 causes moisture in mouldable composition 216 to vaporise, resulting in an expansion of mouldable composition 216. The pressure applied to and the expansion of mouldable composition 216 causes it to fill a space in mould cavity 211 between first mould part 210 and second mould part 212. Moisture in the form of water vapour is released through the predetermined clearance between first mould part 210 and second mould part 212.

As the temperature of mouldable composition 216 increases, the adhesive in mouldable composition 216 begins to cure, increasing the viscosity of mouldable composition 216.

Figure 8 illustrates an enlarged view of first mould part 210 and second mould part 212 during the formation of the moulded product in accordance with one embodiment of the present invention. A predetermined clearance C of between about 0.1 to 0.5 mm is maintained between first mould part 210 and second mould part 212, forming a vent 218.

Because an exterior surface layer 220 of mouldable composition 216 receives heat directly from first mould part 210 and second mould part 212, exterior surface layer 220 is of a higher temperature than the rest of mouldable composition 216 and cures at a faster

rate, forming a skin 222 around mouldable composition 216. Skin 222 acts as insulation, reducing heat transmission from first mould part 210 and second mould part 212 to mouldable composition 216.

As mouldable composition 216 expands, vent 218 becomes occluded, preventing
5 the release of water vapour. Accordingly, the pressure in mouldable composition 216 increases as moisture in mouldable composition 216 vaporises but is unable to escape. The trapped water vapour forms a plurality of vapour pockets 224 in mouldable composition 216, precipitating the formation of a porous structure 226 within mouldable composition 216.

10 Heat loss through the escape of water vapour from mouldable composition 216 is also prevented, resulting in an increase in the temperature of mouldable composition 216. The size of the plurality of vapour pockets 224 increases with an increase in the temperature of mouldable composition 216.

When first mould part 210 and second mould part 212 are maintained at
15 temperatures below 90 °C, the quantity of moisture which vaporises is reduced and fewer vapour pockets are formed. Correspondingly, a moulded product with a higher density is produced. Conversely, higher temperatures of first mould part 210 and second mould part 212 will result in the formation of a moulded product with a lower density.

Higher temperatures of first mould part 210 and second mould part 212 also
20 reduce the production time for a moulded product. However, temperatures greater than about 180 °C are undesirable as such high temperatures will burn the fibres in mouldable composition 216 and vaporise too much of the moisture in mouldable composition 216, resulting in the formation of a moulded product that is too dry.

Therefore, the temperatures of first mould part 210 and second mould part 212 are
25 preferably maintained between about 110 to 180°C. Experiments have shown that when the temperatures of first mould part 210 and second mould part 212 are within such a range, the temperature of mouldable composition 216 is between about 100 to 160 °C. By controlling the distribution of heat within mouldable composition 216, vaporisation of moisture from mouldable composition 216 may be controlled to ensure an even

distribution of the plurality of vapour pockets 224 within porous structure 226 to form a moulded product with uniform density.

When the pressure in mouldable composition 216 exceeds the external pressure, the occlusion to vent 218 ruptures, allowing excess mouldable composition 216, water
5 vapour from mouldable composition 216 and vapour from the curing of the adhesive to escape through vent 218, reducing the pressure in mouldable composition 216.

Clearance C is calculated to allow the release of water vapour during the moulding process, while maintaining sufficient pressure to fill the space in mould cavity 211 between first mould part 210 and second mould part 212. By regulating clearance C between first
10 mould part 210 and second mould part 212, the size of vent 218, the pressure in and temperature of mouldable composition 216 and the volume of excess mouldable composition 216 discharged may be controlled.

For example, a larger clearance C allows more water vapour and mouldable composition to escape, resulting in a lower pressure build-up, reduced vapour expansion
15 and the formation of a moulded product with a higher density. Conversely, a smaller clearance C restricts the release of water vapour, induces vapour expansion and produces a moulded product with a lower density.

However, too large a clearance C is undesirable as then mouldable composition 216 will not be able to occlude vent 218. Consequently, there will be no pressure build-up
) 20 and the mouldable composition will not fill the space in mould cavity 211 between first mould part 210 and second mould part 212. When this happens, the moulded product formed will not be of a desired shape.

The size of clearance C is also dependent on the moisture content in mouldable composition 216. The use of a smaller clearance C is preferred when mouldable
25 composition 216 contains less moisture; the use of a larger clearance C is preferred when mouldable composition contains more moisture as under such circumstances, more water vapour is emitted.

The moulded product is formed when mouldable composition 216 is substantially

cured, preferably about 90 % cured. The moisture content of the moulded product is preferably between about 2 to 5 %. Plunger 206 is then activated to increase clearance C to about 10 mm to release all the unwanted vapours discharged in the course of the moulding process.

5 If clearance C is increased before mouldable composition 216 is substantially cured, the amount of moisture removed from mouldable composition 216 will be inadequate, and the moulded product will be soft and will tend to adhere to mould cavity 211 and mould plunger 213. Separation of mould plunger 213 from mould cavity 211 would then distort exterior surface layer 220 and damage porous structure 226.
10 Therefore, the removal of moisture from mouldable composition 216 is vital to achieving a moulded product with sufficient strength to withstand stress and strain during processing and handling.

Subsequent to the release of unwanted vapours, clearance C may be reduced to between about 0.05 to 0.3 mm and held there for between about 15 to 60 s to compress
15 the moulded product to a desired thickness and to iron the surface of the moulded product to give a good surface texture. Further vaporisation of moisture occurs, resulting in the formation of a stable moulded product.

Thereafter, plunger 206 is activated to draw mould plunger 213 away from mould cavity 211 and the moulded product is removed for subsequent processing. The moulded
20 product may be removed from mould cavity 211 with a pick and place mechanism.

Mould cavity 211 is preferably provided with an ejection mechanism to lift the moulded product from mould cavity 211 when clearance C is increased to about 10 mm to release the unwanted vapours and also to assist in the extraction of the moulded product from mould cavity 211.

25 Figures 9A and 9B illustrate a cross-sectional view of an ejection mechanism 234 in accordance with embodiment of the present invention. Figure 9A is an illustration of ejection mechanism 234 at rest, while Figure 9B is an illustration of ejection mechanism 234 in operation.

Referring first to Figure 9A, ejection mechanism 234 is housed in mould cavity 211 and positioned under a moulded product 236. Ejection mechanism 234 comprises a head 238 coupled to a base 240 by a shaft 242 and a spring 244 around shaft 242. At rest, spring 244 is in an uncompressed state.

5 In this embodiment, ejection mechanism 234 is operated by a pneumatic system (not illustrated). Shaft 242 may be provided with an O-ring 246 to prevent a loss of air from the pneumatic system. In an alternative embodiment, ejection mechanism 234 may be operated by a hydraulic system

10 When clearance C is increased or when moulded product 236 is to be removed from mould cavity 211, the pneumatic system is activated and exerts a force on base 240, driving ejection mechanism 234 in a direction X as illustrated in Figure 9B and compressing spring 244 in the process. Accordingly, moulded product 236 is lifted from mould cavity 211.

15 Ejection mechanism 234 is returned to the position of rest illustrated in Figure 9A by deactivating the pneumatic system. Correspondingly, spring 244 is released from its compressed state. The expansion of spring 244 exerts a force on base 240, driving ejection mechanism 234 in an opposite direction relative to direction X until the position of rest is attained.

20 The pneumatic or hydraulic system may be operated with the same limit switch that is used to reduce the speed at which mould plunger 213 approaches mould cavity 211.

Referring back to Figure 8, mouldable composition 216 should not be left in mould cavity 211 for an extended period of time as then the adhesive and the fibre mixture may absorb too much heat and become burnt. Cracks and deformation may also occur if
25 mouldable composition 216 is left in mould cavity 211 for an extended period of time as then too much moisture will be lost.

The degree to which mould cavity 211 is filled affects the density of the moulded product. If insufficient mouldable composition 216 is loaded into mould cavity 211, there

will not be enough of mouldable composition 216 to fill the space in mould cavity 211 between first mould part 210 and second mould part 212 and there will be insufficient pressure build-up to form porous structure 226. As such, a dense moulded product with high moisture content is formed when insufficient mouldable composition 216 is loaded
5 into mould cavity 211.

Figure 10 is a flow chart illustrating a method 250 to form a moulded product in accordance with another embodiment of the present invention. Method 250 begins by loading 252 a mould cavity of a first mould part with a mouldable composition. The mould cavity may be loaded 252 up to about 90 % of the capacity of the mould cavity.

10 A packing pressure of between about 435 to 870 psi is applied 254 to the mouldable composition for between about 20 to 60 s to allow the mouldable composition to cure. A predetermined clearance of between about 0.1 to 0.5 mm is maintained 256 between the first mould part and a second mould part to allow the discharge of excess mouldable composition, water vapour and other vapours released during the curing of the
15 mouldable composition. The first mould part and the second mould part are maintained at a temperature of between about 110 to 180°C. The first mould part is preferably maintained at a temperature of about 20 °C higher than a temperature of the second mould part to compensate for heat loss when the mouldable composition is loaded into the mould cavity and to prevent the first mould part and the second mould part from jamming due to
20 thermal expansion of the first mould part and the second mould part.

The predetermined clearance between the first mould part and the second mould part is increased 258 to about 10 mm when the mouldable composition is substantially cured, preferably about 90 % cured, forming the moulded product. When the water vapour and other vapours released during the curing of the mouldable composition are
25 substantially discharged, the predetermined clearance is reduced 260 to between about 0.05 to 0.3 mm for between about 15 to 60 s. This is done to compress the moulded product to a desired thickness and to iron the surface of the moulded product before removing 262 the moulded product from the mould cavity.

Tables 2A and 2B illustrate examples of process parameters that may be used to
30 form a biodegradable pallet in accordance with one embodiment of the present invention.

Table 2A

	Example 1	Example 2	Example 3
Percentage Volume of Mould Cavity Filled (vol %)	70	80	90
Temperature of Mould Cavity (°C)	125	125	125
Temperature of Mould Plunger (°C)	105	105	105
Packing Pressure (psi)	870	870	870
Curing Time (s)	60	60	40
Curing Clearance (mm)	0.8	0.6	0.5
Ironing Time (s)	60	60	60
Ironing Clearance (mm)	0.5	0.3	0.1

Table 2B

	Example 4	Example 5	Example 6
Percentage Volume of Mould Cavity Filled (vol %)	85	87	92
Temperature of Mould Cavity (°C)	125	130	130
Temperature of Mould Plunger (°C)	105	110	110
Packing Pressure (psi)	870	870	870
Curing Time (s)	50	60	60
Curing Clearance (mm)	0.4	0.2	0.5
Ironing Time (s)	60	40	60
Ironing Clearance (mm)	0.1	0.05	0.2

- 5 Other embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention. The word “comprising” and forms of the word “comprising” as used in the description and in the claims are not meant to exclude variants or additions to the invention. Furthermore, certain terminology has been used for the purposes of descriptive clarity, and not to limit
- 10 the present invention. The embodiments and preferred features described above should be considered exemplary, with the invention being defined by the appended claims.

CLAIMS

1. A biodegradable pallet comprising:
a pallet body;
5 a skid to reinforce the pallet body; and
means for interlocking the pallet body and the skid, wherein the pallet body and
the skid are moulded from a mouldable composition comprising:
between about 40 to 60 wt % of a fibre mixture; and
between about 15 to 45 wt % of an adhesive.
10
2. The pallet according to claim 1, wherein a moisture content of the
mouldable composition is less than about 20 %.
3. The pallet according to claim 2, wherein a moisture content of the
15 mouldable composition is between about 4 to 15 %.
4. The pallet according to claim 2, wherein a moisture content of the fibre
mixture is less than about 15 %.
- 20 5. The pallet according to claim 3, wherein the mouldable composition
further comprises not more than about 40 wt % of an additive.
6. The pallet according to claim 5, wherein the additive is one or more of a
group consisting of a hardener, a flow promoter and a mould release agent.
25
7. The pallet according to claim 1, wherein the fibre mixture comprises a
plurality of fibres and wherein each of the plurality of fibres is of a length of up to about
50 mm.
- 30 8. The pallet according to claim 7, wherein each of the plurality of fibres is
of a thickness of up to about 2 mm.

9. The pallet according to claim 8, wherein each of the plurality of fibres is of a length to a thickness ratio of between about 2:1 to 25:1.

5 10. The pallet according to claim 1, wherein the fibre mixture further comprises between about 5 to 30 wt % of an oil palm fibre.

11. The pallet according to claim 1, wherein fibre mixture further comprises one of a group consisting of oil palm fibres, beer malt, sugarcane pulp, a plasticizer, a
10 toughening agent and an impact modifier.

12. The pallet according to claim 1, wherein the adhesive is a thermosetting resin.

15 13. The pallet according to claim 12, wherein the adhesive is an amino resin.

14. The pallet according to claim 12, wherein the adhesive is a melamine.

15. The pallet according to claim 14, wherein the adhesive is one of a group
20 consisting of melamine formaldehyde and melamine urea formaldehyde.

16. The pallet according to claim 1, wherein the pallet body comprises a load-bearing member having a leg.

25 17. The pallet according to claim 16, wherein the load-bearing member has a substantially constant overall wall thickness of between about 3 to 5 mm.

18. The pallet according to claim 16, wherein the load-bearing member includes a plurality of ribs.

30

19. The pallet according to claim 18, wherein each of the plurality of ribs comprises an open channel.

20. The pallet according to claim 19, wherein the open channel has a tapering
5 channel wall.

21. The pallet according to claim 18, wherein each of the plurality of ribs is designed to have a draft angle of between about 6 to 12° from perpendicular to a surface of the load-bearing member.

10

22. The pallet according to claim 16, wherein the leg is formed as a concave depression in the load-bearing member.

23. The pallet according to claim 16, wherein the leg tapers inwards towards a
15 base.

24. The pallet according to claim 23, wherein the leg is designed to have a draft angle of between about 11 to 12° from perpendicular to a surface of the load-bearing member.

20

25. The pallet according to claim 23, wherein the leg is designed to have a minimum vertical height of about 95 mm.

26. The pallet according to claim 23, wherein a blind hole is provided on the
25 base.

27. The pallet according to claim 26, wherein the blind hole is designed to have a draft angle of less than about 0.5° from perpendicular to a surface of the load-bearing member.

30

28. The pallet according to claim 16, wherein a first fillet is formed where the leg meets the load-bearing member.

29. The pallet according to claim 16, wherein a fin is provided around a periphery of the load-bearing member.

5 30. The pallet according to claim 1, wherein the skid comprises a framework formed from a plurality of ties.

31. The pallet according to claim 30, wherein a second fillet is formed at a junction where the plurality of ties is joined.

10

32. The pallet according to claim 26, wherein the skid includes a protruding plug corresponding to the blind hole in the base of the leg.

15 33. The pallet according to claim 32, wherein the blind hole interlocks the protruding plug.

34. The pallet according to claim 33, wherein a circumferential dimension of the protruding plug is between about 0.05 mm to 0.1 mm larger than a circumferential dimension of the blind hole.

20

35. The pallet according to claim 34, wherein an interference fit secures the skid to the pallet body when a force is applied to interlock the blind hole and the protruding plug.

25 36. The pallet according to claim 32, wherein the protruding plug is designed to have a draft angle of less than about 0.5° from perpendicular to a surface of the skid.

37. The pallet according to claim 1, wherein the pallet is designed to have at least about 60 % top deck coverage.

30

38. The pallet according to claim 1, wherein the pallet is designed to have at least about 35 % bottom deck coverage.

39. A method for manufacturing a biodegradable pallet, the method
5 comprising:

preparing a biodegradable mouldable composition, the mouldable composition comprising:

between about 40 to 60 wt % of a fibre mixture; and

between about 15 to 45 wt % of an adhesive,

10 loading a mould cavity with the mouldable composition, wherein the mould cavity is loaded up to about 90 % of the capacity of the mould cavity;

applying a packing pressure of between about 435 to 870 psi to the mouldable composition;

maintaining a predetermined clearance of between about 0.1 to 0.5 mm between a
15 first mould part defining the mould cavity and a second mould part; and

removing the moulded product from the mould cavity when the mouldable composition is substantially cured.

40. The method according to claim 39, wherein the pressure is applied for a
20 period of between about 20 to 60 s.

41. The method according to claim 40, wherein the first mould part and the second mould part are maintained at a temperature of between about 110 to 180°C.

25 42. The method according to claim 41, wherein the first mould part is maintained at a temperature of about 20 °C higher than a temperature of the second mould part.

43. The method according to claim 40, further comprising:
30 increasing the predetermined clearance between the first mould part and the second mould part when the mouldable composition is about 90 % cured.

44. The method according to claim 43, wherein the predetermined clearance is increased to about 10 mm.

5 45. The method according to claim 44, further comprising:
compressing the moulded product to a desired thickness.

46. The method according to claim 45, further comprising:
ironing a surface of the moulded product.

10

47. The method according to claim 46, wherein compressing the moulded product to the desired thickness and ironing the surface of the moulded product further comprises:

reducing the predetermined clearance to between about 0.05 to 0.3 mm.

15

48. The method according to claim 47, wherein the predetermined clearance is reduced for between about 15 to 60 s.

49. The method according to claim 39, wherein a moisture content of the
20 mouldable composition is less than about 20 %.

50. The method according to claim 49, wherein a moisture content of the mouldable composition is between about 4 to 15 %.

25 51. The method according to claim 49, wherein a moisture content of the fibre mixture is less than about 15 %.

52. The method according to claim 50, wherein the mouldable composition further comprises not more than about 40 wt % of an additive.

30

53. The method according to claim 52, wherein the additive is one or more of a group consisting of a hardener, a flow promoter and a mould release agent.

54. The method according to claim 39, wherein the fibre mixture comprises a plurality of fibres and wherein each of the plurality of fibres is of a length of up to about 50 mm.

5

55. The method according to claim 54, wherein each of the plurality of fibres is of a thickness of up to about 2 mm.

56. The method according to claim 55, wherein each of the plurality of fibres is of a length to a thickness ratio of between about 2:1 to 25:1.

10

57. The method according to claim 39, wherein the fibre mixture further comprises between about 5 to 30 wt % of an oil palm fibre.

58. The method according to claim 39, wherein fibre mixture further comprises one of a group consisting of oil palm fibres, beer malt, sugarcane pulp, a plasticizer, a toughening agent and an impact modifier.

15

59. The method according to claim 39, wherein the adhesive is a thermosetting resin.

20

60. The method according to claim 59, wherein the adhesive is an amino resin.

61. The method according to claim 59, wherein the adhesive is a melamine.

25

62. The method according to claim 61, wherein the adhesive is one of a group consisting of melamine formaldehyde and melamine urea formaldehyde.

63. The method according to claim 39, wherein preparing the mouldable composition comprises:

30

weighing each component of the mouldable composition individually; and

combining each component of the mouldable composition in a mixer to form a substantially homogeneous and well-coated mouldable composition.

64. The method according to claim 63, wherein preparing the mouldable
5 composition further comprises:

combining each liquid component of the mouldable composition in a second mixer to form a liquid mixture.

65. The method according to claim 64, wherein preparing the mouldable
10 composition further comprises:

spraying the liquid mixture into the mixer.

66. The method according to claim 65, wherein the mixer is operated at a rotor
speed of about 29 rpm.

67. The method according to claim 39, wherein a vent is provided by
maintaining a predetermined clearance between respective parts of the mould adjacent the
mouldable composition.

68. The method according to claim 67, wherein the vent is temporarily
20 occluded by the mouldable composition in the mould to temporarily prevent release of
moisture vapour for a predetermined period.

69. The method according to claim 68, wherein the moisture vapour content is
25 controlled to generate bubbles of the vapour in the mouldable composition and thereby
produce a porous moulded product of predetermined density.

70. A method for manufacturing a biodegradable pallet, the method
comprising:

30 loading a cavity of a mould with a biodegradable mouldable composition
comprising between about 40 to 60 wt% of a fibre mixture and between about 15 to 45
wt% of an adhesive, wherein the cavity is loaded up to about 90% of the capacity of the

cavity;

activating the mould so as to apply a packing pressure in the range 435 to 870 psi to the mouldable composition therein;

providing a moisture vapour vent responsive to pressure in the mouldable composition and set to provide a predetermined control of moisture vapour content and thereby pressure in the composition, whereby to produce a moulded product having predetermined density and strength; and

removing the moulded product from the mould cavity when the mouldable composition is substantially cured.

10

71. The method according to claim 70 wherein the vent is provided by maintaining a predetermined clearance between respective parts of the mould adjacent the mouldable composition.

15 72. The method according to claim 70 wherein the vent is temporarily occluded by the mouldable composition in the mould to temporarily prevent release of moisture vapour for a predetermined period.

20 73. The method according to claim 70 wherein the moisture vapour content is controlled to generate bubbles of the vapour in the mouldable composition and thereby produce a porous moulded product of predetermined density.

25 74. The method according to claim 70, further comprising:
increasing the predetermined clearance between the first mould part and the second mould part when the mouldable composition is about 90 % cured.

75. The method for manufacturing a pallet according to claim 74, wherein the predetermined clearance is increased to about 10 mm.

30 76. The method for manufacturing a pallet according to claim 75, further comprising:
compressing the moulded product to a desired thickness.

77. The method for manufacturing a pallet according to claim 76, further comprising:

ironing a surface of the moulded product.

5

78. The method for manufacturing a pallet according to claim 77, wherein compressing the moulded product to the desired thickness and ironing the surface of the moulded product further comprises:

reducing the predetermined clearance to between about 0.05 to 0.3 mm.

10

79. A pallet produced by the method according to any one of claims 39 to 73.