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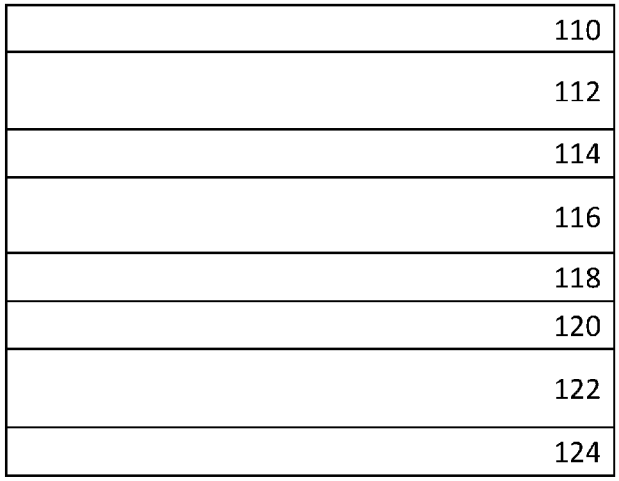

Fig. 1

(57) **Abstract:** A laminated packaging material is described, the material including an outer layer comprising a barrier paper with a grammage of between 25gsm and 200gsm, a middle layer comprising a translucent tracing paper with gas barrier properties at a grammage of between 30gsm and 100gsm and an inner layer comprising a barrier paper with a grammage of between 25gsm and 200gsm. The material may be used to form a cup, container, box, lid, tray or tube, particularly for packaging food.

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Laminated Packaging Material

The invention relates to the field of packaging, in particular a laminated packaging material. The packaging material finds particular application in food packaging, in particular in the formation of packaging containers for food products.

Cup, food tray and tube packaging solutions that are suitable for long shelf life products (e.g. dry, instant noodles and potato chips and other dry food snacks as well as meats and other proteins), are generally made by including materials based on aluminium metalised plastics such as metalised BOPP, metalised OPP, metalised PP and metalised PE. Alternatively, heavy weight plastics can be used. Many products are sensitive to oxygen. Fats and oils upon exposure to oxygen, especially in the presence of light, undergo chemical changes which lead to flavor alterations referred to as rancidity. The goal of these materials is to provide a barrier to light, oxygen, and moisture vapour as well as grease and oil. In the case of cups, the aim is also to provide liquid water barrier. A light and oxygen barrier is required to stop protein materials becoming rancid over time and a moisture vapour barrier is required to keep dry foods from absorbing moisture and “clumping” or “softening” over time. Often snacks packaging is gas flushed to remove oxygen. Meat trays are also often gas flushed to remove oxygen and extend shelf life. In such flushed products it is important to provide a robust oxygen barrier in order to prevent degradation of the product during the ingress of oxygen.

These materials, due to the high plastic content and often mixed plastics and metalised content are generally difficult to recycle and are also not compostable.

The requirements for particular packaging products are governed by their intended use. Three examples are given below.

Noodle Cups

Instant dry noodles are often packaged in a heavy gauge plastic cup which is sealed with a metalised plastic film lid or plastic laminated aluminium foil lid and then overwrapped with a printed paper board wrap. The heavy gauge plastic provides a secure liquid barrier so that

the cup can be used when the product is consumed, but the packaging as a whole is also required to provide an oxygen and a moisture barrier for storage of the product prior to use.

Paper based cups are typically produced using a polyethylene lined board to provide liquid water barrier with heat sealability properties to allow conversion of cup forming machines that use heat to weld the cup side and bottom together.

A great deal of work has been carried out to replace polyethylene with "plastic free" coatings to produce materials that can form cups that are recyclable and compostable. However, these materials only provide a barrier to liquid water. To the extent that grease barriers or heat seal properties are provided, the replacement material is significantly less effective than the original polyethylene lined board. Moreover, as these materials do not provide an oxygen barrier or a moisture vapour barrier, they are not suitable as solutions for dry noodles or dry food snacks.

Snack Tubes

Tubes made for dry snack packaging are often made using spiral wound board with layers of metalised plastic on the inside and a metalised plastic film lid to seal the tube. A moisture and oxygen barrier is required to prevent softening of the snack.

Modified atmosphere meat trays

Trays made for fresh meat and poultry are designed for gas flushing and are made from non-recyclable and non-compostable plastics. They are designed to provide an oxygen and liquid barrier to prevent the meat from degrading. Similar trays are also used for some fruit and vegetable packaging.

It is the desire of many food producers to find sustainable packaging solutions for these products that can be readily recycled and are compostable.

Summary

According to one aspect, there is provided a laminated packaging material comprising:
an outer layer comprising a barrier paper with a grammage of between 25gsm and 200gsm;
a middle layer comprising a translucent tracing paper with gas barrier properties at a grammage of between 30gsm and 100gsm; and
an inner layer comprising a barrier paper with a grammage of between 25gsm and 200gsm.

Tracing paper has useful packaging properties in providing a gas-barrier, which can reduce the degradation of food products stored within. However, it is not generally used as a commercial packaging material, particularly within the food packaging industry, since it has little resistance to liquid or water vapour and can become damp and lose its integrity. Moreover, when not wet, tracing paper is often too brittle to withstand modern mechanised production lines and supply chains.

However, these same properties make tracing paper straightforward to recycle through standard repulping methods and also mean that it is readily biodegradable.

The present aspect provides a packaging material that combines the advantages of tracing paper with additional outer and inner layers of barrier paper to provide protection for the translucent tracing paper layer. This results in a laminating packaging material that is conventionally repulpable and biodegradable, cost-effective and has many uses, as set out in more detail herein.

In one embodiment, the translucent tracing paper is metalised with a metal layer having a thickness of less than 50nm, preferably less than 40nm, further preferably 20 nm. It has been found that depositing a nano-thick layer of metal, such as aluminium (or aluminum) onto the translucent tracing paper can improve the barrier properties of the packaging material without effecting its recyclability. In particular, even a metalised layer of a nano-thickness can significantly improve the light barrier properties of the packaging material.

In some embodiments, the metalised layer may be applied to the inner or outer paper layer. However, it has been found that the effectiveness of the metalised layer is significantly

enhanced if applied to the translucent paper layer, since it provides a very smooth surface for its application. The metalised layer can also enhance the gas barrier properties of the translucent paper.

Preferably, each barrier paper comprises a barrier coating that allows the paper to be repulpable and biodegradable. That is all of the barrier coatings in the packaging material are preferably repulpable and biodegradable. This enables the material to be more easily recycled when compared to some plastics-coated packaging materials.

Optionally, at least one barrier paper comprises a moisture vapour barrier coating, optionally wherein both the inner and outer layers comprise barrier papers having a moisture vapour barrier coating. Since the translucent tracing paper itself does not provide a barrier to moisture vapour, which can cause degradation of the paper, one or both of the outer and inner layers of the packaging material preferably prevents the ingress of water vapour by having a moisture vapour barrier coating. The arrangement of this coating may depend on the application of a particular packaging material; for example packaging for dried goods may have the moisture vapour barrier coating provided on the outside layer.

Optionally, the barrier paper comprises a coating that provides at least one of a grease barrier, a light barrier and a liquid water barrier. The barrier coating of the outer and/or inner layer may be arranged to have one ore more additional properties depending on the intended use of the packaging as described in more detail herein.

In one embodiment, the barrier coating of the inner layer comprises a heat sealable barrier coating. The heat sealable coating can be used to cause the inner layer to adhere to other packaging products (for example to form a lid) with the application of heat to parts of the material. It can also be used to cause the packaging material to adhere to itself, for example to form a bag or packet or a spiral wound tube. This increases the number of potential uses of the packaging material. The heat sealable barrier coating may be an additional coating to other barrier coatings already applied to the inner layer, or preferably other barrier coatings are provided with additional heat seal properties and a single barrier coating with multiple properties can therefore be provided.

Optionally, the barrier coating of the outer layer is heat sealable to a barrier coating on the inner layer. A heat seal coating on the outer layer, in addition to the heat seal coating on the inner layer, can improve the adherence of layers of the packaging material to itself. This can be useful in forming a more solid structure, for example a spiral wound tube.

In some embodiments, the outer layer comprises an over-printable coating.

Preferably, the packaging is repulpable and biodegradable using conventional techniques.

Optionally, the middle layer comprises a transfer metallized or vacuum metallized layer. That is, the nano-thick metalised layer may be applied to the translucent tracing paper using transfer metallization or vacuum metallization techniques. This can provide a uniform nano-thick metal layer.

Preferably, the layers are laminated together using a water based adhesive, optionally a PVA adhesive.

Optionally, the layers are laminated together using a solvent based or pressure sensitive adhesive lamination technique.

In a particular embodiment, the laminated packaging material includes:

an outer layer comprising paper with a grammage of between 50gsm and 150gsm, a barrier coating that provides a moisture vapor barrier, a liquid water barrier, and a grease barrier;

a middle layer comprising an aluminium metalised translucent tracing paper with a grammage of between 40gsm and 100gsm; and

an inner layer comprising paper with a grammage of between 50gsm and 150gsm with a heat sealable coating that provides a liquid water barrier and grease barrier;

wherein the barrier coating on the outer layer is heat sealable to the barrier coating on the inner layer.

The packaging material may be shaped and heat sealed to form a receptacle, preferably a generally cylindrical cup.

Such a cup may be particularly useful to hold dried food products, for example dried noodles. Such products require light barrier, oxygen barrier, moisture vapor barrier, liquid water barrier, grease barrier and heat sealability properties, as provided by the present embodiment, which also remains conventionally repulpable and compostable/biodegradable.

In another particular embodiment, the laminated packaging material includes:

an outer layer comprising paper with a grammage of between 50gsm and 150gsm, the paper having an over-printable barrier coating that provides a moisture vapor barrier and a grease barrier;

a middle layer comprising an aluminium metalised translucent tracing paper with a grammage of between 40gsm and 100gsm; and

an inner layer comprising paper with a grammage of between 50gsm and 150gsm with a coating that provides a moisture vapor barrier and a grease barrier.

The packaging material may be spiral wound and fixed to form a tubular structure.

Such a structure may be particularly useful to hold dried goods such as crisps (chips) that require a high barrier functionality against light, water, moisture vapour, oxygen and grease. However, the packaging also remains conventionally repulpable and compostable/biodegradable.

In another particular embodiment, the laminated packaging material includes:

an outer layer comprising paper with a grammage of between 50gsm and 150gsm, an over-printable barrier coating that provides a moisture vapor barrier, a liquid water barrier and a grease barrier;

a middle layer comprising an aluminium metalised translucent tracing paper with a grammage of between 40gsm and 100gsm; and

an inner layer comprising paper with a grammage of between 50gsm and 150gsm with a coating that provides a liquid water barrier, a moisture vapor barrier and a grease barrier.

The packaging material may be formed and fixed to create a container, optionally a box or tray container.

The packaging material may be formed into a container to hold wet food products such as meat, fruit or vegetables, since the packaging provides a light barrier, oxygen barrier, water barrier, grease barrier and moisture vapor barrier whilst remaining conventionally repulpable and compostable/biodegradable.

In another particular embodiment, the laminated packaging material includes:

an outer layer comprising paper with a grammage of between 25gsm and 50gsm, the paper having an over-printable barrier coating that provides a moisture vapour barrier, a liquid water barrier and a grease barrier;

a middle layer comprising an aluminium metalised translucent tracing paper with a grammage of between 30gsm and 50gsm; and

an inner layer comprising paper with a grammage of between 25gsm and 50gsm, the paper having a heat-sealable barrier coating that provides a moisture vapour barrier, a liquid water barrier and a grease barrier.

The packaging may be cut to form a lid for heat sealing to a container.

The packaging material of this embodiment is made from a thinner grade of paper than the previously-described embodiments to provide a more flexible material suitable for use as a lid on many packaging products. However, the material still provides a light barrier, oxygen barrier, water barrier, grease barrier and moisture vapor barrier whilst remaining conventionally repulpable and compostable/biodegradable.

Embodiments are illustrated in the following numbered drawings in which:

Figure 1 is a schematic illustration of a laminated packaging material according to one embodiment;

Figure 2 is a schematic illustration of a laminated packaging material according to a second embodiment.

In general terms, the laminated packaging material comprises a three-layer structure including a middle layer comprising a translucent tracing paper.

Translucent or transparent paper is also referred to as tracing paper. This is paper produced using cellulose fibres from wood pulp that have been refined to a level that produces a paper with minimum air content within the paper sheet. The extensive refining of the fibres creates micro-fibrillated cellulose fibres and intense inter-fibre hydrogen bonding. This creates a strong, dense and clean paper without any need for fillers and the elimination of air within the sheet provides transparency or translucency. The additional benefit is that translucent paper of the required specification has a natural barrier to oxygen and grease.

By itself, the material has very little resistance to water or water vapour. However, as described herein by either coating each side of the translucent paper, or by metalising, or by combining additional layers either side of the translucent paper that themselves provide the barrier to water and water vapour, a useful packaging material can be achieved. The additional layers can also provide the required physical properties needed to be used for certain applications that the translucent paper itself could not meet, for example resulting in a less brittle and more flexible material.

The packaging material includes two additional layers arranged on either side of the translucent tracing paper. These comprise paper layers wherein each paper is provided with a barrier coating.

Water-based dispersion barrier coatings are used in embodiments described herein to provide barrier properties against moisture, gases, and grease and where required, to provide heat seal properties. The main component of a suitable coating that can be used in the packaging described herein is synthetic latex that binds the coating to the substrate paper and forms a continuous, non-porous film that provides good barrier properties. Pigments can be used to provide a surface with the desired appearance, printability, and barrier properties.

Besides styrene-butadiene, a variety of latexes are used in barrier dispersions. One common group is acrylate based polymers, such as ethyl acrylate, butyl acrylate, methyl acrylate, and methyl methacrylate. They are produced by copolymerization of vinyl acetate monomer and

acrylic monomer(s) and are formulated to vary from very soft (Tg = -60°C) to hard (Tg = 105°C) where Tg indicates the glass transition temperature of the material. Acrylics have good water resistance, binding strength, and UV resistance, but they are relatively expensive. Polyvinyl acetate (PVAc) coatings can also be used and have reasonably good grease resistance, but quite low water resistance and strength. PVAc can be used because of the good heat sealability and low cost. The formulation of the barrier coating can be selected based on the required properties of the particular application, as described herein.

While it is preferred that a single barrier coating is provided on each laminate paper layer, the coating being selected to provide the appropriate properties for the final application of the end product, the skilled person will appreciate that it would be possible to coat one or more of the paper layers with multiple barrier coatings, for example a liquid water barrier coating could be overlaid with a heat-seal coating in order to impart the necessary properties to a particular layer of the laminate.

As used herein, the term “outer” and “inner” describe the layers laminated to either side of the middle translucent paper layer. The terms are used in this way since, once the packaging is formed into a cup, tube or other packaging product, the “inner” layer is intended to be arranged on the inside of the packaging, nearest to the food or other packaged product, while the “outer” layer is arranged on the outside. However, the layers may equally be termed a “first” and “second” layer, with the middle layer arranged therebetween and this terminology may be more appropriate in some circumstances, for example if the packaging material is arranged for use as a flat wrap product. Moreover, as described herein, the inner and outer layers may be identical in some embodiments.

To provide enhanced barrier properties, one or more of the layers, preferably the translucent tracing paper layer, may be metalised with a nano-thick coating of a metal such as aluminium. The layer may be transfer metallized or vacuum metallized and a typical thickness for the metal layer would be 25 nanometers. However, as the skilled person will appreciate, other layer thicknesses may be achieved for certain applications. For example, a high optical density version can be produced with a metallised layer of up to 40 nanometers. This further increases the light barrier properties of the material. However, even a metal thickness of 40 nanometers is considered insignificant within standard recycling processes so and both layers

are readily repulpable and compostable. By way of reference, this nano-thick layer compares to standard aluminium foil used in packaging lamination which is 6.5 to 8 microns and is therefore not repulpable or compostable.

In some embodiments, in particular where the tracing paper layer is metalised, the inner or outer layers may be omitted from the laminate.

Each layer is "wet glue" laminated together on a laminating machine using water based adhesives such as PVA adhesives that are conventionally repulpable and biodegradable. Other lamination techniques can be used including solvent based and pressure sensitive adhesive lamination.

As used herein, the term compostable refers to industrial composting, in which the packaging meets the requirements set out in standard EN13432 (Requirements for packaging recoverable through composting and biodegradation. Test scheme and evaluation criteria for the final acceptance of packaging.) where it needs to compost within 6 weeks at elevated temperatures, and compost to at least 90% carbon dioxide at a temperature of 58°C +/- 2°C within 6 months. Alternatively, the packaging may be home compostable, disintegrating without the need for artificially raised temperature (for example according to the Belgian Vincotte certification scheme under which it needs to biodegrade to at least 90% carbon dioxide under ambient temperatures of 20-30°C within a year). A compostable product degrades to carbon dioxide, water and biomass that is non toxic over a reasonably short time. The term biodegrade refers more broadly to the material degrading either in aerobic or anaerobic conditions or marine conditions over longer time periods.

Fig. 2 is a schematic diagram of a laminated packaging material according to one embodiment. The packaging material includes

1. An outer layer of paper or paper board (212). This paper/board is be coated with an barrier coating (210).
2. A middle layer comprising a translucent paper (tracing paper) (216)
3. An inner layer of paper or paperboard (222) with a barrier coating (224).

The layers are laminated together using water based adhesives (214, 220) such as PVA adhesives that are conventionally repulpable and biodegradable. Alternatively, solvent based or pressure sensitive adhesive lamination techniques can be used.

Each of the layers, and the laminated packaging material as a whole, is conventionally repulpable and biodegradable.

Particular non-limiting embodiments and applications of specific examples of the packaging material and its properties will now be described in more detail.

Cup

A particular embodiment provides a solution for a cup for packaging products such as dried noodles. The material provides an effective light barrier, oxygen barrier and moisture vapor barrier in addition to providing a liquid water barrier and grease barrier. It also enables heat sealing whilst maintaining recyclability by conventional paper-making repulping and compostability.

The cup is illustrated schematically in Fig. 1 and is manufactured from a paper based three or more layer laminate material including:

1. An outer layer of paper or paper board (112) with a grammage of between 50gsm and 150gsm. This paper/board may be coated with a coating (110) that also provides some moisture vapour barrier, grease barrier and liquid water barrier and is heat sealable to the barrier coating on the inner layer. This layer is conventionally repulpable and biodegradable.
2. A middle layer comprising an aluminium metalised (118) translucent paper (tracing paper) (116) at a grammage of between 40gsm and 100gsm. Metalising can be via transfer metallization or vacuum metallization. This middle layer exhibits excellent oxygen and moisture vapour barrier. The combination of translucent paper and nano thin aluminium is conventionally repulpable and biodegradable.
3. An inner layer of paper or paperboard (122) with a grammage of between 50gsm and 150gsm with a heat sealable barrier coating (124) suitable for use with hot beverages in terms of liquid water barrier and grease barrier with heat seal properties suitable

for cup manufacture. This barrier coating may also contribute to moisture barrier resistance. This layer is conventionally repulpable and biodegradable.

As with other examples described herein, each layer is "wet glue" laminated together on a laminating machine using water based adhesives (114, 120) such as PVA adhesives that are conventionally repulpable and biodegradable. Alternatively, solvent based or pressure sensitive adhesive lamination techniques can be used.

The laminate construction provides high barrier functionality against light, water, moisture vapour, oxygen and grease whilst remaining conventionally repulpable and compostable.

The laminated packaging material may be manufactured as a sheet material or in a reel. For a cup, both sheet and reel material is typically used, with the side walls being made from sheets and the base being made from material formed as a narrow reel. However, the skilled person will appreciate that the type of material used to form the final packaging product may be selected depending on the manufacturing process. The material is then joined in places by a heat sealing method, for example along the seam of the cup and around the base, to form the final packaging product.

In a variation on the cup embodiment, the material may be formed into the shape of a container or box. The material may be particularly suitable for using to form containers for holding dry powdered goods, such as baby formula or powdered drinks or cooking sauces. In particular embodiments, a container may be formed by curving sheets of laminated material into a rectangular shape with rounded corners to form the sides of the container and then heat-sealing a base to the formed container sides. Alternatively, or in addition, the base may be fixed to the container side walls using an adhesive. A lid may also be formed using the materials described herein (for example as described in more details in the section entitled Lids below). This enables the entire container to be repulped or composted as a single unit. Alternatively, a lid may be formed from a plastics-based material that can be removed as a whole unit before the rest of the packaging is sent for repulping.

As for the cup, a container manufactured from the material provides a barrier against light, oxygen and moisture vapor as well as against liquid water and grease. These are important

factors in ensuring any powdered or dried product does not degrade by absorbing moisture and clumping together or lose flavour or colouring. As noted above, the material also enables heat sealing whilst maintaining recyclability by conventional paper-making repulping and compostability.

Tubes

A further embodiment provides a paper based snack tube.

Existing tubes are typically produced using a spiral wound multilayer construction consisting of a printed paper (outside), paper board (middle) and metalised multilayer plastic film (inside) to provide moisture vapour, grease, light and oxygen barrier. This combination of materials renders the construction to be non recyclable.

The packaging material described below enables the manufacture of tubes providing an effective light barrier, oxygen barrier, grease barrier and moisture vapor barrier whilst remaining conventionally repulpable and compostable.

The tube is manufactured from a paper based three or more layer laminate material including:

4. An outer layer of paper or paper board (112) with a grammage of between 50gsm and 150gsm. This paper/board may be coated with an over-printable coating (110) that provides moisture vapour barrier and grease barrier. This layer is conventionally repulpable and biodegradable.

5. A middle layer comprising an aluminium metalised (118) translucent paper (tracing paper) (116) at a grammage of between 40gsm and 100gsm. Metalising can be via transfer metallization or vacuum metallization. This middle layer exhibits excellent oxygen and moisture vapour barrier. The combination of translucent paper and nano thin aluminium is conventionally repulpable and biodegradable.

6. An inner layer of paper or paperboard (122) with a grammage of between 50gsm and 150gsm with a barrier coating (124) that provides grease and moisture vapour barrier. This layer is conventionally repulpable and biodegradable.

As with other examples described herein, each layer is "wet glue" laminated together on a laminating machine using water based adhesives (114, 120) such as PVA adhesives that are conventionally repulpable and biodegradable. Alternatively, solvent based or pressure sensitive adhesive lamination techniques can be used.

The laminate construction provides high barrier functionality against light, water, moisture vapour, oxygen and grease whilst remaining conventionally repulpable and compostable.

The laminated packaging material may be manufactured as a sheet material or in a reel. For a tube, it is more likely that a reel form of the material will be used to form the tube in a spiral winding method. The material is then joined in places by water-based adhesive, to form the tube. However, the skilled person will appreciate that the type of material used to form the final packaging product may be selected depending on the manufacturing process.

Tray

A further embodiment enables the production of trays, in particular for the packaging of meat products.

Most meat tray utilise gas flushing to extend the shelf life of the food contents. As such, the trays are made of plastic materials that provide high gas barrier but are not readily recyclable. Some use dark colours such as black to minimise light transmittance and so further reduce the recyclability.

The present embodiment provides a product with an effective light barrier, oxygen barrier, water barrier, grease barrier and moisture vapor barrier whilst remaining conventionally repulpable and compostable. The construction can be used to create a glued tray construction or a pressed paper tray construction.

The tray is illustrated schematically in Fig. 1 and is manufactured from a paper based three or more layer laminate material including:

1. An outer layer of paper or paper board (112) with a grammage of between 50gsm and 150gsm. This paper/board may be coated with a printable barrier coating (110) that provides moisture vapour barrier, water and grease barrier. This layer is conventionally repulpable and biodegradable.
2. A middle layer comprising an aluminium metalised (118) translucent paper (tracing paper) (116) at a grammage of between 40gsm and 100gsm. Metalising can be via transfer metallization or vacuum metallization. This middle layer exhibits excellent oxygen and moisture vapour barrier. The combination of translucent paper and nano thin aluminium is conventionally repulpable and biodegradable.
3. An inner layer of paper or paperboard (122) with a grammage of between 50gsm and 150gsm with a barrier coating (124) that provides grease, water and moisture vapour barrier. This layer is conventionally repulpable and biodegradable.

As with other examples described herein, each layer is "wet glue" laminated together on a laminating machine using water based adhesives (114, 120) such as PVA adhesives that are conventionally repulpable and biodegradable. Alternatively, solvent based or pressure sensitive adhesive lamination techniques can be used.

The laminate construction provides high barrier functionality against light, water, moisture vapour, oxygen and grease whilst remaining conventionally repulpable and compostable.

The laminated packaging material is preferably manufactured as a sheet material and is then cut and formed into the necessary shape to form the tray. The material is then joined in places by water-based adhesive, for example along the sides of the tray, to form the final packaging product. Alternatively, a pressed paper tray may be formed from shaping the laminated material.

Lids

Most oxygen barrier lidding materials are made from multilayer plastic films that give oxygen barrier and heat sealability to the tray. However, being a multi-layered plastic, they are not readily recyclable.

A further embodiment provides a solution to create an alternative material for a lid providing an effective light barrier, oxygen barrier, water barrier, grease barrier and moisture vapor barrier whilst remaining conventionally repulpable and compostable. The construction can be used to create a heat sealed lid solution for a glued or pressed paper tray and a cup.

The lid is illustrated schematically in Fig. 1 and is manufactured from a paper based three or more layer laminate material including:

1. An outer layer of paper or paper board (112) with a grammage of around 25gsm and 50gsm. This paper may be coated with a printable barrier coating (110) that provides moisture vapour barrier, water and grease barrier. This layer is conventionally repulpable and biodegradable.

2. A middle layer comprising an aluminium metalised (118) translucent paper (tracing paper) (116) at a grammage of around 40gsm. Metalising can be via transfer metallization or vacuum metallization. This middle layer exhibits excellent oxygen and moisture vapour barrier. The combination of translucent paper and nano thin aluminium is conventionally repulpable and biodegradable.

3. An inner layer of paper (122) with a grammage of around 25gsm and 50gsm with a heat sealable barrier coating (124) that provides grease, water and moisture vapour barrier. This layer is conventionally repulpable and biodegradable.

As with other examples described herein, each layer is “wet glue” laminated together on a laminating machine using water based adhesives (114, 120) such as PVA adhesives that are conventionally repulpable and biodegradable. Alternatively, solvent based or pressure sensitive adhesive lamination techniques can be used.

The laminate construction provides high barrier functionality against light, water, moisture vapour, oxygen and grease whilst remaining conventionally repulpable and compostable.

The laminated packaging material may be manufactured as a sheet material or in a reel. To form a lid, the material is preferably formed into a reel and is then cut to the required size

and shape. The material can then be heat sealed method to another packaging material, such as a cup or tray as described herein. Alternatively the material may be folded and heat sealed to itself, for example to form a bag or packet.

Barrier properties of the laminated packaging material

Typical barrier properties for the material formed as described above are set out in the table below. Similar properties are provided for the cup, tube, tray and lid. The standard tests for each of these properties are referred to in the table below and will be well known to the person skilled in the art; however further details of the relevant tests are also provided below the table.

Oxygen Transmission Rate (OTR) cm3 /m2 .d bar	ASTM D3985	<0.1
Moisture Vapour Transmission rate g/M2/day	T448	<10
Grease Resistance Kit	T559	>12
Mineral Oil Migration MOSH (P) mg/kg	DIN14338 Tenax	<2
Mineral Oil Migration MOAH (P) mg/kg	DIN14338 Tenax	<0.5
Water Resistance Cobb1800s g	ISO 535	<10
Optical Density		>1.9

ASTM D3985 is standard test method for Oxygen gas transmission rate through plastic film and sheeting using a coulometric sensor. This method covers a procedure for determination of the steady-state rate of transmission of oxygen gas through plastics in the form of film, sheeting, laminates, coextrusions, or plastic-coated papers or fabrics. It provides for the determination of (1) oxygen gas transmission rate (OTR), (2) the permeance of the film to oxygen gas (PO2), and (3) oxygen permeability coefficient (P′O2) in the case of homogeneous materials.

T448 provides a test for the water vapor transmission rate of paper and paperboard at 23 Degree C and 50% RH.

T559, or the “Kit” test, describes a procedure for testing the degree of repellency and/or the antiwicking characteristics of paper or paperboard treated with fluorochemical sizing agents. Testing involves placing a series of numbered reagents (varying in surface tension and

viscosity or "aggressiveness") onto the surface of the sample. The solutions are numbered from 1 (the least aggressive) to 12 (the most aggressive). The highest numbered solution that does not stain the surface is reported as the "kit rating."

DIN 14338 (or EN 14338) is a test for paper and board intended to come into contact with foodstuffs. This standard specifies a method to assess the transfer or migration of specific volatile and semivolatile substances from paper and board. This test method is developed for paper and board intended to come in contact with dry, non fatty foodstuffs and paper and board for baking purposes. The test provides the conditions for determination of migration from paper and board using modified polyphenylene oxide (MPPO), which may be known as Tenax®, as a food simulant.

ISO 535 ("Cobb" method) specifies a method of determining the water absorptiveness of sized paper and board, including corrugated fibreboard, under standard conditions.

Optical density is determined according to the formula:

$OD = Log_{10} (I_0/I)$ where I_0 is the incident optical intensity and I is the transmitted optical intensity. Therefore, Optical Density (OD) is measured on a logarithmic scale where:

- OD of 0 means that no light is absorbed and 100% of light is transmitted
- OD of 1 means that 90% of light is absorbed and 10% of light is transmitted
- OD of 2 means that 99% of light is absorbed and 1% of light is transmitted

In alternative embodiments of all of the applications described above, the metalised translucent paper in the middle layer of the laminate constructions can be replaced by just a translucent paper without metallisation for applications that require a lower cost, lower light barrier and/or lower overall MVTR barrier and oxygen barrier.

In summary, a laminated packaging material is described, the material including an outer layer comprising a barrier paper with a grammage of between 25gsm and 200gsm, a middle layer comprising a translucent tracing paper with gas barrier properties at a grammage of between 30gsm and 100gsm and an inner layer comprising a barrier paper with a grammage of between 25gsm and 200gsm. The material may be used to form a cup, container, box, lid, tray or tube, particularly for packaging food.

Claims

1. A laminated packaging material comprising:

an outer layer comprising a barrier paper with a grammage of between 25gsm and 200gsm;

a middle layer comprising a translucent tracing paper with gas barrier properties at a grammage of between 30gsm and 100gsm; and

an inner layer comprising a barrier paper with a grammage of between 25gsm and 200gsm.

2. The laminated packaging material according to claim 1 wherein the translucent paper is metalised with a metal layer having a thickness of less than 50nm, preferably less than 40nm, further preferably 20 nm.

3. The laminated packaging material of any preceding claim wherein the middle layer comprises an aluminium metalised translucent tracing paper.

4. The laminated packaging material of any preceding claim wherein each barrier paper comprises a plastic-free barrier coating.

5. The laminated packaging material of any preceding claim wherein at least one barrier paper comprises a moisture vapour barrier coating, optionally wherein both the inner and outer layers comprise barrier papers having a moisture vapour barrier coating

6. The laminated packaging material of claim 1 or 2 wherein the barrier paper comprises a coating that provides at least one of a grease barrier, a light barrier and a liquid water barrier.

7. The laminated packaging material of any preceding claim wherein the barrier coating of the inner layer comprises a heat sealable barrier coating.

8. The laminated packaging material of claim 7 wherein the barrier coating of the outer layer is heat sealable to a barrier coating on the inner layer.

9. The laminated packaging material of any preceding claim wherein the outer layer comprises an over-printable coating.

10. The laminated packaging material of any preceding claim wherein the packaging is repulpable and biodegradable using conventional techniques.

11. The laminated packaging material of any preceding claim wherein the middle layer comprises a transfer metallized or vacuum metallized layer.

12. The laminated packaging material of any preceding claim wherein the layers are laminated together using a water based adhesive, optionally a PVA adhesive.

13. The laminated packaging material of any preceding claim wherein the layers are laminated together using a solvent based or pressure sensitive adhesive lamination technique.

14. The laminated packaging material of claim 1 wherein:

the outer layer comprises paper with a grammage of between 50gsm and 150gsm, a barrier coating that provides a moisture vapor barrier, a liquid water barrier, and a grease barrier,;

the middle layer comprises an aluminium metalised translucent tracing paper with a grammage of between 40gsm and 100gsm; and

the inner layer comprises paper with a grammage of between 50gsm and 150gsm with a heat sealable coating that provides a liquid water barrier and grease barrier;

wherein the barrier coating on the outer layer is heat sealable to the barrier coating on the inner layer.

15. The laminated packaging material of claim 14 wherein the packaging is shaped and heat sealed to form a receptacle, preferably a generally cylindrical cup.

16. The laminated packaging material of claim 14 wherein the package is shaped and heat sealed to form a container, preferably a container with a cross section that is rectangular with rounded corners.

17. The laminated packaging material of claim 1 wherein:

the outer layer comprises paper with a grammage of between 50gsm and 150gsm, the paper having an over-printable barrier coating that provides a moisture vapor barrier and a grease barrier;

the middle layer comprises an aluminium metalised translucent tracing paper with a grammage of between 40gsm and 100gsm; and

the inner layer comprises paper with a grammage of between 50gsm and 150gsm with a coating that provides a moisture vapor barrier and a grease barrier.

18. The laminated packaging material of claim 17 wherein the packaging is spiral wound and fixed to form a tubular structure.

19. The laminated packaging material of claim 1 wherein:

the outer layer comprises paper with a grammage of between 50gsm and 150gsm, an over-printable barrier coating that provides a moisture vapor barrier, a liquid water barrier and a grease barrier;

the middle layer comprises an aluminium metalised translucent tracing paper with a grammage of between 40gsm and 100gsm; and

the inner layer comprises paper with a grammage of between 50gsm and 150gsm with a coating that provides a liquid water barrier, a moisture vapor barrier and a grease barrier.

20. The laminated packaging material of claim 19 wherein the packaging is formed and fixed to create a container, optionally a box or tray container.

21. The laminated packaging material of claim 1 wherein:

the outer layer comprises paper with a grammage of between 25gsm and 50gsm, the paper having an over-printable barrier coating that provides a moisture vapour barrier, a liquid water barrier and a grease barrier;

the middle layer comprises an aluminium metalised translucent tracing paper with a grammage of between 30gsm and 50gsm; and

the inner layer comprises paper with a grammage of between 25gsm and 50gsm, the paper having a heat-sealable barrier coating that provides a moisture vapour barrier, a liquid water barrier and a grease barrier.

22. The laminated packaging material of claim 21 wherein the packaging is cut to form a lid for heat sealing to a container.

23. A method of manufacturing a laminated packaging material comprising:

providing an outer layer comprising a barrier paper with a grammage of between 25gsm and 200gsm;

providing a middle layer comprising a translucent tracing paper with gas barrier properties at a grammage of between 30gsm and 100gsm; and

providing an inner layer comprising a barrier paper with a grammage of between 25gsm and 200gsm;

laminating the outer layer, the middle layer and the inner layer together using a water based adhesive.

24. The method of claim 23 further comprising applying a nano-thick metal layer to the translucent tracing paper prior to the laminating step.

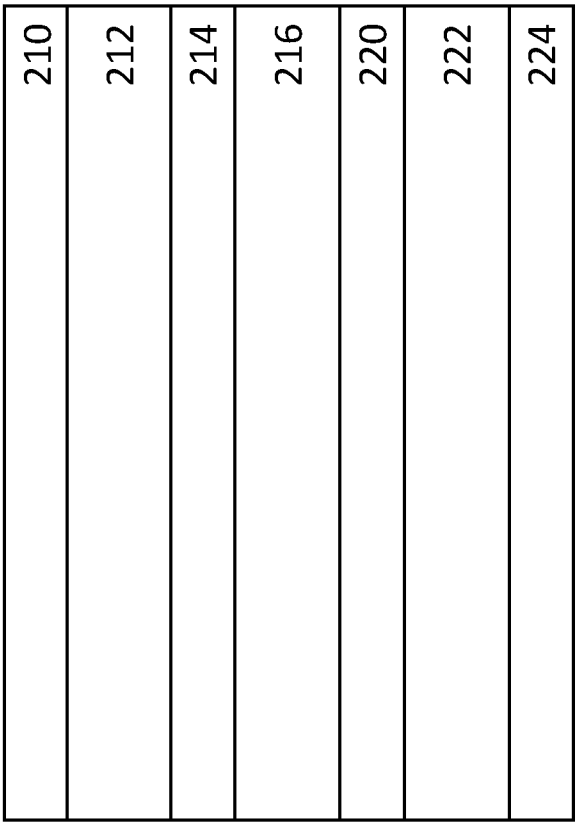

Fig. 2

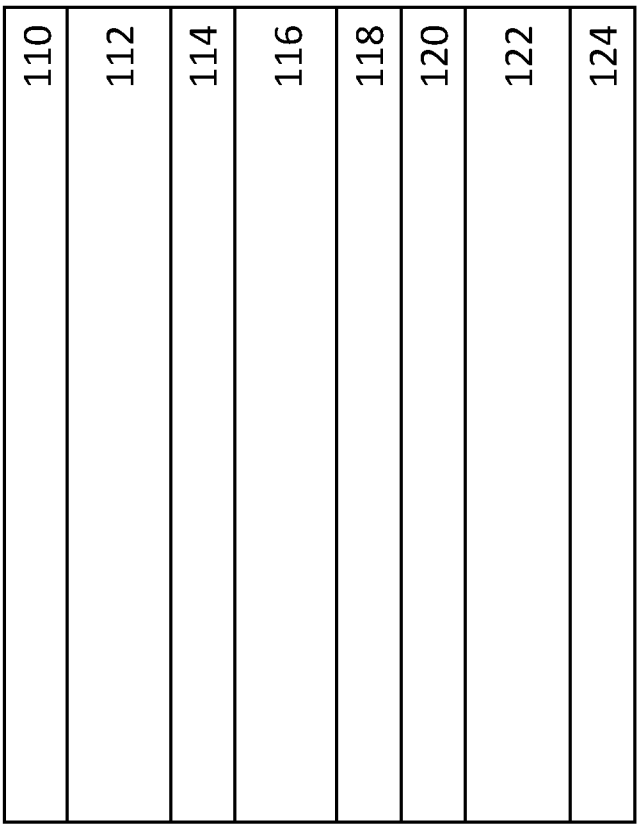

Fig. 1