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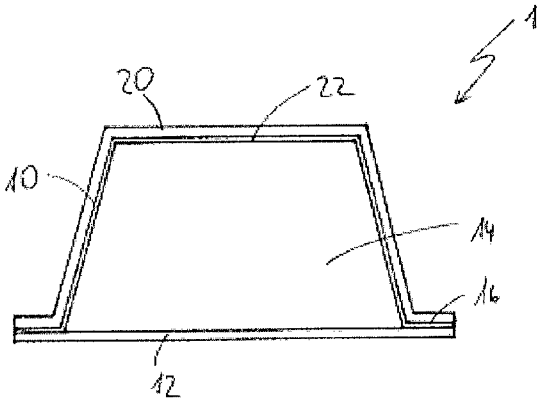

Fig. 1

(57) **Abstract**: The present invention refers to a method for the preparation of container for a food product, beverage or pharmaceutical product - in particular a coffee capsule (1). Said container comprises a dimensionally stable body (20), a barrier film (22), and optionally also a food protection layer. The barrier film (22) has a thickness of less than 500 µm, preferably of less than 75 µm, more preferably of less than 50 µm, and is made of a barrier polymer selected from the group consisting of liquid-crystal polymers (LCP), cross-linked thermoplastic epoxy- based polymers, Nylon-MXD6, cross-linked polyvinyl alcohol (PVOH), cross-linked ethylene vinyl alcohol (EVOH), polyglycolide (PGA), and mixtures thereof.

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CONTAINER FOR A FOOD, BEVERAGE OR PHARMACEUTICAL PRODUCT AN METHOD OF PREPARATION THEREOF

The present invention refers to a method for the preparation of a container for a food product, beverage or pharmaceutical product comprising a dimensionally stable body and a barrier film applied to said body.

Consumers are continuously changing their eating and purchasing behaviors. A century ago, food was bought fresh and directly from the source. Today, our daily food requirements have changed dramatically to match our lifestyle. We buy food in a supermarket, often some distance from its origin.

Food packaging protects the integrity of the product during transport and storage. In order to keep the products fresh for a longer period of time, it is important that they are protected from moisture, gas, and aroma, while at the same time providing the aromas of the product itself.

Packaging materials are generally used to protect and preserve food products and beverages. All these materials have specific properties: For instance, glass is transparent and is an excellent moisture barrier material, but it is less good against light, and it breaks under high impact. Aluminum foil, on the other hand, is a very good barrier against moisture, gases, contamination, and light, but it provides very little protection against mechanical impact and is very brittle. Furthermore, from an ecological point of view, the use of aluminum is not desirable because of its large carbon footprint.

Plastic films are very flexible, and most of them offer medium protection against moisture, gases, and aromas. Furthermore, many of the polymers typically used today are readily recyclable, biodegradable and/or biocompostable.

Beverages, on the other hand, are often provided in bottles made from glass or PET, which offer the desired stability.

As a special type of food/beverage packaging, capsules for the preparation of a beverage or liquid food, containing a beverage concentrate, coffee, tea or instant soup, for instance, should be mentioned. Nowadays, especially coffee capsules that are to be used in a corresponding extraction machine are very common. As an example, EP 0 512 468 discloses such capsules. These capsules are generally produced in two components: An aluminum body with a lid. This provides the desired protection for the contained coffee. However, a high percentage of the capsules are not recycled, which is very bad from an ecologic point of view, especially because they contain aluminum having a high carbon foot print.

Also for pharmaceutical products, an efficient protection against moisture, gas, and other potentially hazardous influences is essential in order to ensure their stability and effectiveness. Nowadays, pharmaceutical products are often packaged in so-called blister containers, consisting of a plastic barrier container sealed with an aluminum foil.

It is therefore a problem of the present invention to provide a container for a food product, beverage or pharmaceutical product that offers an efficient protection against oxygen, moisture and aroma loss, while at the same time being easily prepared and recyclable and/or biodegradable or bio compostable.

This problem is solved by the method according to claim 1, by the capsules according to claims 9 and 10, and the use according to claim 12. Preferred embodiments are subject of the dependent claims.

The present invention refers to a method for the preparation of a container for a food product, beverage or pharmaceutical product. According to this method, a barrier film having a thickness of less than 500 µm is over-molded with a thermoplastic polymer, such that the thermoplastic polymer forms a dimensionally stable body, with the barrier film covering the inner surface of the body. The barrier film comprises a barrier polymer selected from the group consisting of liquid-crystal polymers (LCP), cross-linked thermoplastic epoxy-based polymers, Nylon-MXD6, cross-linked polyvinyl alcohol (PVOH); cross-linked ethylene alcohol (EVOH), polyglycolide (PGA), and mixtures thereof.

The dimensionally stable body defines the shape and size of the container. Depending on the product to be stored in the container, the body may have various different shapes and sizes, e.g. that of a bottle, of a cup, of a block-shaped box or a capsule. The body is made from a thermoplastic polymer. These materials allow for simple and cost-efficient preparation of a dimensionally stable body of almost any desired shape and size.

The barrier film provides the container with the necessary gas- and moisture-tightness. This barrier film is in the form of a very thin film having a thickness of only a few micrometers. Thanks to the special barrier polymers used for the barrier film, it is possible to achieve a high amount of protection with a very low amount of material.

Liquid-crystal polymers or anisotropic melt-forming polymers, generally abbreviated as LCP's, are a class of aromatic polyester polymers. They are extremely unreactive and inert, and highly resistant to fire. LCP's are sold by different manufacturers under a variety of trade names. These include: Vectra (by Ticona), which is chemically an aromatic polyester produced by the polycondensation of 4-hydroxybenzoic acid and 6-hydroxynaphthalene-2-carboxylic acid, Zenite (by Ticona), Kevlar (by DuPont), Sumikasuper (by Sumimoto Chemical Industry) or Xydar (by Solvay). LCP's offer a unique combination of high barrier to oxygen, aromas, and water vapor, together with chemical resistance superior to that of conventional barrier resins like ethylene vinyl alcohol (EVOH) or polyvinylidene chloride (PVDC). In addition, LCP is inert, stable under heat and is FDA approved for food contact. Furthermore, LCP's can be coextruded in standard equipment with conventional packaging resins. LCP's may be used alone or in combination with other materials (see below) and may also be continuously mono-oriented, machine oriented, loosely axially oriented or in the form of a fiber web.

Suitable cross-linked thermoplastic epoxy-based polymers include BLOX resins from Dow Plastics or the epoxy-amine barrier coatings by PPG Industries (see e.g. US 5,637,365).

Nylon-MXD6 - or N-MDX6 - is a barrier resin produced by polymerization of m-xylenediamine (MXDA) and adipic acid. Nylon-MXD6 has excellent gas barrier properties, especially in high humidity conditions. In addition, it offers important processing benefits for multilayer bottle manufacture. In particular, Nylon-MXD6 is known as multi-gas barrier resin, contributing both oxygen and CO_2 barrier in PET bottles.

Polyvinyl alcohol, generally abbreviated as PVOH, is a water-soluble synthetic polymer having excellent film forming, emulsifying and adhesive properties. It has a high tensile strength and flexibility, as well as high oxygen and aroma barrier properties. However, these properties are dependent on humidity, since more water is absorbed with higher humidity. PVOH is preferably used in combination with a suitable stabilizer, such as a PET film, and can be cross-linked to stabilize against moisture.

Ethylene vinyl alcohol, generally abbreviated as EVOH, is a formal co-polymer of ethylene and vinyl alcohol. The plastic resin is commonly used in food applications and has lately found some application in plastic gasoline tanks for automobiles. Its primary purpose is to provide barrier properties, primarily as an oxygen barrier for improved food packaging shelf life and as a hydrocarbon barrier for fuel tanks. EVOH is typically co-extruded or laminated as a thin layer between cardboard, foil, or other plastics.

Polyglycolide or polyglycolic acid, generally abbreviated as PGA, is a biodegradable, thermoplastic polymer. PGA has been known since 1954 as a tough fiber-forming polymer. The hydrolytic stability has been improved, hence allowing the use of PGA in rigid packaging applications without direct food contact. By combining, blending or laminating films or resins of PGA with PET, PLA or PHB, it can be sufficiently stabilized to serve as a barrier material for food packaging.

In general, the over-molding of the barrier film (film over molding; IOF) with the thermoplastic body material may be performed according any of the methods well-known to the person skilled in the art. These include, in particular, the following sequences of steps:

- Positioning the barrier film over a standard injection molding cavity; pushing the barrier film into the cavity, e.g. by a robot or by means of a gas stream; cutting the barrier film upon closing of the mold; and over-molding the barrier film with the body material.
- Positioning the barrier film over a standard injection molding cavity; pushing the barrier film into the cavity, e.g. by a robot; cutting the barrier film upon closing of the mold; and over-molding the barrier film with the body material.
- Pre-cutting the barrier film; positioning the barrier film on a core of a standard injection molding machine, with the film being held on the core by means of reduced pressure or vacuum; inserting the core with the barrier film into the cavity; and over-molding the barrier film with the body material.
- Pre-cutting the barrier film; positioning the barrier film into a cavity of a standard injection molding machine, e.g. by means of a robot; cutting the barrier film upon closing of the mold; and over-molding the barrier film with the body material.

In the above embodiments, the barrier film may be an extruded film or a "pre-form" obtained by thermoforming. The pre-form may be a thermoformed sheet or individual pre-forms.

Preferably, the barrier film, and preferably the pre-formed film, is applied to the core. This has the advantage that the core may be cooled, e.g. with water, thereby avoiding potential problems arising from the contact of the barrier film to the hot melt of the thermoplastic material used for forming the body.

Alternatively, it is also possible to use an "inject over inject" (IOI) process, where the barrier film is prepared by injection molding and then over-molded with the thermoplastic polymer. Such an IOI process is described, e.g., in US 6,391,408; in US 6,808,820; and US 7,588,808, which are herewith incorporated by reference in this respect. Also in this case, the over-molding may be performed according to one of the above-mentioned sequences of steps, for instance. Also, this method may essentially be used for all barrier film materials described herein, and in particular for those comprising LCP or a blend of LCP with a thermoplastic material, such as PET, PEN, PC or PBT.

As a further alternative, the barrier film may also be prepared by lamellar injection molding (LIM). This process uses a feedblock and layer multipliers to combine melt streams from dual injection cylinders.

Depending on the type and thickness of the barrier film, the positioning into the cavity or on the core is achieved by means of a roll index, of a robot, of a gas stream or of reduced-pressure or vacuum.

In a preferred embodiment, the over-molding of the barrier film is performed in an "INDEX" machine, as developed by Husky Injection Molding Systems Ltd. This allows for a continuous over-molding process, and thus for a very fast and cost-effective preparation. By means of a turning carrier, the INDEX machine allows for consecutive positioning of a barrier film (optionally pre-formed or pre-cut), over-molding, cooling, and cutting/releasing.

In a preferred embodiment, the formation of the extruded sheet into pre-forms is integrated in the over-molding tooling and apparatus. The sheet heating is accomplished with "hot rollers" heating the film prior to introduction of over-molding tooling. The hot film is moldable by compression when the core closes on the film for over-molding ("hot roller welding"). The water cooled cores provide instant and simultaneous cooling of the film prior to over-molding. This provides uniform coverage and shape of the pre-form to exact dimensions of the inner surface of the body. The hot film also facilitates easier cutting of the sheet when the mold closes.

Preferably, the barrier film of the present invention essentially consists of the barrier polymer alone or of a composite of the barrier polymer with another material. Depending on the barrier polymer used, it may be advantageous to enhance its properties, e.g. its toughness, barrier properties or workability, by combining it with another material. If, on the other hand, the barrier polymer itself already has all the desired properties, it is preferably used alone in order to lower the carbon footprint and also costs.

In a preferred embodiment, the barrier film further comprises an oxygen scavenger, such as a reactive metal compound. This oxygen scavenger may be applied to the barrier film by impregnation, for instance. Alternatively, it is also possible to co-extrude the barrier film and the oxygen scavenger. Preferably, the oxygen scavenger is arranged on the inner side of the barrier film.

In a preferred embodiment, the barrier film further comprises a stabilizer. This stabilizer may serve for enhancing the resilience of the barrier polymer, for facilitating its workability or for stiffening the barrier film, for instance.

The stabilizer is preferably selected from the group consisting of polyhydroxyalkanoates (PHA), high heat polylactic acid (PLA), a starch-based polymer, a furan-based polymer, polyethylene (PE), polypropylene (PP), polystyrene (PS), polyethylene terephthalate (PET), polyethylene naphthalate (PEN), and mixtures thereof.

The stabilizer materials are generally laminated, thermoformed, co-extruded or blended and then injection molded with the above-mentioned barrier polymers. The stabilizer material may also be a mono- or biaxially oriented film.

In general, a barrier film comprising a stabilizer will be oriented in such a way that the stabilizer faces the inside of the container, while the barrier polymer faces toward the stable body. In this arrangement, the stabilizer may also serve as a food protection layer (see also further below). Alternatively, it is also possible that the barrier polymer faces the inside of the container and the stabilizer is arranged between the barrier polymer and the stable body.

Polyhydroxyalkanoates, generally abbreviated as PHA's, are biodegradable linear polyesters. They can be either thermoplastic or elastomeric materials, with melting points ranging from 40 to 180 °C. In industrial production, PHA's are produced by microbial fermentation of sugar or glucose and extracted and purified from the bacteria. PHA's are mainly processed via injection molding, extrusion and extrusion bubbles into films and hollow bodies.

The simplest and most commonly occurring form of PHA is polyhydroxybutyrate, generally abbreviated as PHB. Thus, PHB is a bio-derived and biodegradable plastic. PHB is non-toxic and biocompatible, and is hence suitable for medical applications. Further, PHB is a relatively good oxygen barrier. PHB is preferably used in combination with a high barrier resins, such as LCP or N-MXD6 as a support. Furthermore, it is an advantageous material for the dimensionally stable body, since it is biodegradable and biocompostable.

Polylactic acid or polylactide, generally abbreviated as PLA, is a thermoplastic aliphatic polyester derived from renewable resources, such as corn starch or sugarcane. PLA is available both as a single enantiomer polymer, i.e. as poly-L-lactide (PLLA) or poly-D-lactide (PDLA), or as a mixture of the two enantiomers. PLA can be processed by extrusion, injection molding, film and sheet casting, as well as spinning. PLA can be recycled to the monomer by thermal depolymerizaton or hydrolysis. When purified, said monomer can be used for the manufacture of virgin PLA with no loss of original properties.

Purac has recently developed a special type of PLA, so-called "high heat PLA". This high heat PLA is produced by stereo-complex technology starting from D-lactide, and can withstand temperatures of up to 180 °C. For this reason, high heat PLA will not melt during the over-molding process. PLA is particularly well suited as a support for a high barrier material, such as LCP or N-MXD6. Furthermore, it is preferably used for the dimensionally stable body, since it is biodegradable and even biocompostable.

The starch-based materials that are suitable for the present application are generally biodegradable and/or biocompostable. In particular, starch-modified thermo-plastics, such as PE or PP, can be used.

Furan-based polymers are polyesters that emerged as renewable polymers made from sugar. The polyester is made from furan dicarboxylic acid and ethylene glycol. This polyester forms a good gas barrier.

Polyethylene or polythene, generally abbreviated as PE, is also a thermoplastic polymer of the polyolefin family. Nowadays, PE is the most common plastic, with its primary use being within packaging. One of the main problems of PE is that without special treatment, it is not readily biodegradable.

Polypropylene or polypropene, generally abbreviated as PP, is a thermoplastic polymer of the polyolefin family. Melt processing of PP can be achieved via extrusion and molding, with injection molding being the most common shaping technique. PP is recyclable and is often used for bottle tops, cups, bottles, and fittings.

Polystyrene, generally abbreviated as PS, is a synthetic aromatic polymer that can be rigid or foamed. It is a rather poor barrier to oxygen and water vapor, and is chemically very inert, being resistant to acids and bases. PS is commonly injection molded or extruded, with extruded PS being about as strong as an unalloyed aluminum, but much more flexible and much lighter.

Polyethylene terephthalate, generally abbreviated as PET, is a thermoplastic polymer resin of the polyester family. PET is a good gas and fair moisture barrier, and is often used for beverage, food and other liquid containers. However, in order to further reduce its oxygen and moisture permeability, an additional barrier layer is often required. PET is commonly recycled.

Polyethylene naphthalate or poly(ethylene 2,6-naphthalate), generally abbreviated as PEN, is a polyester with good barrier properties. In particular, it provides a very good oxygen and moisture barrier.

Of the above materials, PLA, PHA, starch-based polymers, and furan-based polymers are particularly preferred because they are biodegradable and/or biocompostable.

In a preferred embodiment, the barrier film consists of a single LCP ply, which is preferably extruded, of several coextruded or laminated LCP plies oriented in different directions, of a mono- or biaxially oriented film of LCP, of a laminate of LCP with a thermoplastic film, of a laminate of LCP with paper, of a blend of LCP with PET, of a blend of LCP with PEN, of a blend of LCP with a polycarbonate (PC), of a blend of LCP with polybutylene terephthalate (PBT), of a single ply of a cross-linked thermoplastic epoxy-based polymer, which is preferably extruded, of several coextruded or laminated plies of cross-linked thermoplastic epoxy-based polymers, of a laminate of a cross-linked thermoplastic epoxy-based polymer with a thermoplastic film, of a laminate of a cross-linked thermoplastic epoxy-based polymer with paper, of a cross-linked thermoplastic epoxy-based polymer coated with SiO_x, of a cross-linked thermoplastic epoxy-based polymer coated with amorphous carbon, of Nano-Nylon-MXD6, of a laminate of PGA with PET, of a laminate of PGA with PEN, of a laminate of PGA with PLA, of a laminate of PGA with PHB, of injection molded LCP or of an injection molded blend of LCP with PET, PEN or PC. These materials provide a particularly well oxygen and moisture barrier. Furthermore, these materials have a suitable ductility for puncturing and a high heat deflection.

LCP's are particularly well suited as barrier material because they provide a highly efficient moisture, oxygen and aroma barrier. Furthermore, they have a small carbon footprint, which is ecologically favorable. However, for a long time it has not been possible to obtain thin films of LCP. Only recently, a new group of LCP's has been developed that can be extruded, thus allowing for the preparation of very thin foils. US 6,132,884 discloses such a new group of LCP's, for instance, and is herewith incorporated by reference.

The required thin LCP films can be prepared, for instance, by the processes described in US 2011/0227247. This document is herewith incorporated by reference with regard to the method of preparation and the LCP's used.

Preferably, the LCP film is prepared according to one of the processes described in WO 2010/063846 and WO 2013/102647, which are herewith incorporated by reference. In addition, also the laminate of LCP films described in WO 2010/063846 may be used for the barrier film.

LCP may be used alone - in the form of a discrete layer or of a cross-laminated film - or in combination with another material, e.g. as a laminate with a thermoplastic film or paper or as a blend with a thermoplastic material, such as PET, PEN, PC or PBT. The resulting films have a better workability, an improved stability, and also result in lower costs than the previously used materials. In general, LCP can be combined with other materials by co-extrusion, lamination, injection molding or lamellar injection molding. Furthermore, LCP may also be provided with an oxygen scavenger.

If several layers of LCP are laminated, these layers may be oriented in different directions. For instance, varying angles between 3 and 10° may be used. Also, both sonic welding and hot roll welding are possible.

Polycarbonates, generally abbreviated as PC's, are thermoplastic polymers. They are easily worked, molded and thermoformed.

Polybutylene terephthalate, generally abbreviated as PBT, is a thermoplastic polyester. It is usually (semi-) crystalline and is resistant to solvents, shrinks very little during forming, is mechanically strong and heat-resistant up to about 150 °C.

Cross-linked thermoplastic epoxy-based polymers may be used alone or combination with other materials. Such combinations may be prepared by coating or lamination. For instance, such an epoxy-based polymer may be coated on a carrier layer, such as PET, PEN or PC. Alternatively, it may also be laminated with a thermoplastic film or with paper or coated with SiO_x or amorphous carbon.

A suitable amorphous carbon coating provides, for instance, the "Actis" treatment developed by Sidel. This treatment involves the treatment of a surface with acetylene gas, which is then treated with microwave energy in order to reach its plasma state, and the deposition of amorphous carbon thereon. Thereby, a thin layer of hydrogen rich carbon is formed on the surface.

Nano-Nylon-MXD6, or Nano-N-MXD6, is an improved multi-gas barrier resin, which is ideal for multilayer PET construction. Nano-N-MXD6 is approved for PET bottles when used as a non-contact layer in conjunction with an inner PET contact layer of 2.0 mils thickness or greater. Furthermore, Nano-N-MXD6 can be separated from PET by normal recycle methods. Alternatively, because it is miscible with PET at a layer thickness of 5% or lower, recyclers have the option of reprocessing thin-layer bottles in total, eliminating the separation step. Nano-N-MXD6 generally tends to migrate, especially if the material is stretched. However, since the method of the present invention applies a film, which is not stretched, this has no adverse effects.

Alternative preferred barrier materials include laminates of PGA with PET, PEN, PLA or PHB. Also these materials achieve the desired moisture, oxygen and aroma barrier properties.

In a preferred embodiment, the barrier film is prepared by lamination, thermoforming, coating, co-extrusion, injection molding or lamellar injection molding. This allows for a cost efficient and straight forward preparation of the barrier film in the desired thickness.

Preferred materials for lamination have been mentioned above.

Thermoforming is particularly favorable for the preparation of LCP films displaying exceptional barrier properties against humidity and oxygen permeation. Preferably, several plies of unidirectional LCP foils are stacked on top of each other and "cross-linked" by means of a heat treatment under pressure. Vectra LCP is especially well suited for this type of process.

Co-extrusion or blending is typically used for the preparation of barrier films comprising LCP in combination with PET, PEN or PC. This allows for the preparation of a barrier layer having a thickness of less than 75 µm, preferably of less than 50 µm.

Alternatively, it is also possible to prepare the barrier film by injection molding LCP alone or a blend of LCP with PET, PEN, PC or PBT. This will typically afford a barrier layer having a thickness of about 100 µm to 500 µm.

As a further alternative, the barrier film may also be prepared by lamellar injection molding (LIM).

In a preferred embodiment, a food protection layer is applied to the barrier film. This requires that the barrier film is over-molded in such a way that the food protection layer forms the inner surface of the container.

The food protection layer enables the use of a barrier polymer that is not necessarily approved for food contact.

The food protection layer is preferably made of a material selected from the group consisting of PHA, high heat PLA, a starch-based polymer, a furan-based polymer, PE, PP, PS, PET, PEN, and mixtures thereof.

Preferably, the food protection layer is applied to the barrier film by co-extrusion of the barrier material with the food protection material.

In general, it is preferred that the barrier film forms only a very minor part of the container. Therefore, the container preferably comprises no more than 10 wt% of the barrier film, more preferably less than 5 wt% of the barrier film, and most preferably about 2 to 3 wt%.

According to a preferred embodiment, the barrier film has a thickness of less than 250 μm, preferably of less than 150 μm, more preferably of less than 100 μm, and most preferably of less than 75 μm. It is even more preferred that the barrier film has a thickness of less than 50 μm, preferably of less than 25 μm, more preferably of less than 10 μm, and most preferably of less than 5 μm.

The body of the container, which forms by far the major part, is preferably made from a biodegradable, biocompostable and/or recyclable material. This is particularly favorable from an ecologic point of view.

In a preferred embodiment, the body is made from a material selected from the group consisting of PET, polyesters, polyolefins, polyamides, and cellulose-derived materials.

More preferably, the dimensionally stable body is formed from a thermoplastic polymer selected from the group consisting of PHA, high heat PLA, a starch-based polymer, a furan-based polymer, PE, PP, PS, PET, PEN, and mixtures thereof.

Recycled PET is advantageous from an ecologic point of view. However, it has not been approved for direct contact with food products. As the inner surface of the body - and thus the surface of the container, that will be in contact with the food, beverage or pharmaceutical product - is covered with the barrier film and optionally a food protection layer, not only virgin PET but also recycled PET can be used for the body.

It is also possible that the container further comprises an adhesive for connecting the different layers to each other. Preferably, an adhesive that has been approved for food contact is used, in particular an ethylene acrylic acid-base or polyurethane-based adhesive.

Preferably, the container does not comprise a chemical adhesive, since this will allow for separating the different layers and directing them separately to the appropriate recycling stream, depending on the material.

In a preferred embodiment, the different layers are connected mechanically, e.g. by means of a seam. This will enhance the stability while at the same time allowing for a mechanical separation - e.g. by cutting off the seam - in order for separate recycling of the different materials.

Alternatively, the layers may also be connected by ultrasonic welding or be heat adhered to each other.

In a further aspect, the present invention also refers to a container for a food product, beverage or pharmaceutical product, obtainable by the method according to the present invention. This method allows for a straight forward and cost efficient preparation of a container providing an efficient moisture, oxygen and aroma barrier, thereby protecting the contained product.

The container of the present invention is generally suitable for almost all kind of food products, beverages or pharmaceutical products.

It is particularly preferred, however, for storing coffee or similar products used for the preparation of beverages in a suitable machine. Therefore, in a preferred embodiment, the container of the present invention is a capsule for the preparation of a beverage or liquid food. The container allows not only for protecting the contained product from oxygen and other gases, put also for preserving its aroma. Furthermore, the container is easily recycled.

More preferably, the container is a coffee capsule. Said coffee capsule may have any of the generally used shapes, such as those disclosed in EP 0 512 468, EP 0 844 194, EP 2 230 195, EP 2 364 930 or US 2010/0260896, for instance. These five documents are herewith incorporated by reference with regard to the shapes of the capsules disclosed therein.

The shape and design of the capsule or body may be shaped specifically for the product to be packaged. For pharmaceuticals, for instance, the package may be shaped for pills or "capsule in capsule" applications.

These capsules generally comprise a cup-shaped shell according to the present invention, which is sealed with a lid or closure. Said lid or closure is preferably made from the same material as the shell, which can be heat sealed or sonic welded. Alternatively, the lid or closure may also be made of a different material, such as aluminum. Said lid is preferably made from a thermoplastic film, which is more preferably also biodegradable, biocompostable and/or recyclable.

The container of the present invention may also be used for applications, wherein the container (and its contents) is microwaved, e.g. for ready-to-eat meals.

In a further aspect, the present invention also refers to a container for a food product, beverage or pharmaceutical product, comprising a dimensionally stable body, a barrier film, and optionally a food protection layer. The barrier film has a thickness of less than 500 μm, more preferably of less than 75 μm, and covers the inner surface of the body, and the food protection layer, if present, forms the inner surface of the container. The container is characterized in that the barrier film comprises a liquid-crystal polymer (LCP) or a cross-linked thermoplastic epoxy-based polymer.

More preferably, the barrier film consists of a single LCP ply, which is preferably extruded, of several coextruded or laminated LCP plies oriented in different directions, of a mono- or biaxially oriented film of LCP, of a laminate of LCP with a thermoplastic film, of a laminate of LCP with paper, of a blend of LCP with PET, of a blend of LCP with PEN, of a blend of LCP with a PC, of a blend of LCP with PBT, of a single ply of a cross-linked thermoplastic epoxy-based polymer, which is preferably extruded, of several coextruded or laminated plies of cross-linked thermoplastic epoxy-based polymers, of a laminate of a cross-linked thermoplastic epoxy-based polymer with a thermoplastic film, of a laminate of a cross-linked thermoplastic epoxy-based polymer with paper, of a cross-linked thermoplastic epoxy-based polymer coated with SiO_x or amorphous carbon, of Nano-Nylon-MXD_6, of a laminate of PGA with PEN, of a laminate of PGA with PLA, of a laminate of PGA with PHB, of injection molded LCP or of an injection molded blend of LCP with PET, PEN, PC or PBT. All these materials provide a particularly efficient barrier material, which is at the same time extraordinarily stable. Furthermore, these materials have a suitable ductility for puncturing and a high heat deflection. In addition to the above embodiments, the barrier film may also be a laminate including a thicker outer layer which may be thermoformed to produce the article comprising the thin barrier film and the thicker structural outer body.

In a preferred embodiment, the barrier film further comprises an oxygen scavenger, such as a reactive metal compound. This oxygen scavenger may be applied to the barrier film by impregnation, for instance. Alternatively, it is also possible to co-extrude the barrier film and the oxygen scavenger.

In a preferred embodiment, the container further comprises a lid or closure. Said lid or closure preferably comprises a barrier film comprising a barrier polymer selected from the group consisting of liquid-crystal polymers (LCP), cross-linked thermoplastic epoxy-based polymers, Nylon-MXD6, cross-linked polyvinyl alcohol (PVOH), cross-linked ethylene vinyl alcohol (EVOH), polyglycolide (PGA), and mixtures thereof.

According to a further preferred embodiment, the lid or closure is made of the same material as the cup-shaped shell. More preferably, also the lid or closure comprises an oxygen scavenger.

In a further aspect, the present invention also refers to a capsule for the preparation of a beverage or liquid food, preferably a coffee capsule. Said capsule comprises a cup-shaped shell and a lid or closure, with the cup-shaped shell comprising a dimensionally stable body, a barrier film, and optionally a food protection layer. The barrier film has a thickness of less than 500 µm, more preferably of less than 75 µm, and covers the inner surface of the body, and the food protection layer, if present, forms the inner surface of the capsule. The capsule is characterized in that the barrier film comprises a barrier polymer selected from the group consisting of LCP, cross-linked thermoplastic epoxy-based polymers, Nylon-MXD6, cross-linked PVOH, cross-linked EVOH, PGA, and mixtures thereof.

According to a preferred embodiment, the barrier film consists of a single LCP ply, of several coextruded or laminated LCP plies oriented in different directions, of a laminate of LCP with a thermoplastic film, of a laminate of LCP with paper, of a blend of LCP with PET, of a blend of LCP with PEN, of a blend of LCP with a PC, of a blend of LCP with PBT, of a single ply of a cross-linked thermoplastic epoxy-based polymer, of several coextruded or laminated plies of cross-linked thermoplastic epoxy-based polymers, of a laminate of a cross-linked thermoplastic epoxy-based polymer with a thermoplastic film, of a laminate of a cross-linked thermoplastic epoxy-based polymer with paper, of a cross-linked thermoplastic epoxy-based polymer coated with SiO_x, of a cross-linked thermoplastic epoxy-based polymer coated with amorphous carbon, of Nano-Nylon-MXD6, of a laminate of PGA with PET, of a laminate of PGA with PEN, of a laminate of PGA with PLA, of a laminate of PGA with PHB, of injection molded LCP or of an injection molded blend of LCP with PET, PEN, PC or PBT.

In a preferred embodiment, the lid or closure also comprises a barrier film comprising a barrier polymer selected from the group consisting of liquid-crystal polymers (LCP), cross-linked thermoplastic epoxy-based polymers, Nylon-MXD6, cross-linked polyvinyl alcohol (PVOH), cross-linked ethylene vinyl alcohol (EVOH), polyglycolide (PGA), and mixtures thereof.

According to a further preferred embodiment, the lid or closure is made of the same material as the cup-shaped shell.

In a further aspect, the present invention also refers to the use of a polymer selected from the group consisting of LCP, cross-linked thermoplastic epoxy-based polymers, Nylon-MXD6, cross-linked PVOH, cross-linked EVOH, PGA, and mixtures thereof as a barrier film having a thickness of less than 500 μm, more preferably of less than 75 μm, most preferably of less than 50 μm, in a capsule for the preparation of a beverage or liquid food, in particular in a coffee capsule.

According to a preferred embodiment, a single LCP ply, several coextruded or laminated LCP plies oriented in different directions, a laminate of LCP with a thermoplastic film, a laminate of LCP with paper, a blend of LCP with PET, a blend of LCP with PEN, a blend of LCP with a PC, a blend of LCP with PBT, a single ply of a cross-linked thermoplastic epoxy-based polymer, several coextruded or laminated plies of cross-linked thermoplastic epoxy-based polymers, a laminate of a cross-linked thermoplastic epoxy-based polymer with a thermoplastic film, a laminate of a cross-linked thermoplastic epoxy-based polymer with paper, a cross-linked thermoplastic epoxy-based polymer coated with SiO_x, a cross-linked thermoplastic epoxy-based polymer coated with amorphous carbon, Nano-Nylon-MXD6, a laminate of PGA with PET, a laminate of PGA with PEN, a laminate of PGA with PLA, a laminate of PGA with PHB, injection molded LCP or an injection molded blend of LCP with PET, PEN, PC or PBT is used as the barrier film.

In a further aspect, the present invention also refers to a high barrier food container comprising a dimensionally stable body, a barrier film, and optionally a food protection layer, wherein the dimensionally stable body is made from a laminate of paper and or plastics and the barrier film has a thickness of less than 500 µm, more preferably of less than 75 µm, and covers the inner surface of the body, and wherein the food protection layer, if present, forms the inner surface of the container. In said container, the barrier film consists of a single LCP ply, which is preferably extruded, of several coextruded or laminated LCP plies oriented in different directions, of a mono- or biaxially oriented film of LCP, of a laminate of LCP with a thermoplastic film, of a laminate of LCP with paper, of a blend of LCP with PET, of a blend of LCP with PEN, of a blend of LCP with a polycarbonate (PC), or of a blend of LCP with polybutylene terephthalate (PBT).

Such a container has a similar barrier function as containers having an aluminum layer. However, since aluminum cannot be used in microwaves, the container of the present invention is particularly favorable for use in microwavable applications.

The present invention is further illustrated by means of the following examples:

Example 1: Preparation of a Coffee Capsule from PP and LCP

A single cavity mold is utilized to manufacture a coffee capsule. The mold design includes a "cold runner". Alternatively, it would also be possible to use a mold with a "hot runner" or valve gated "hot runners", which facilitated faster cycle times and improved part quality.

A barrier film of laminated LCP having a thickness of 3 μm is cut into 3 inch by 3 inch squares. The film is then attached to the cavity face by adhesive to simulate the larger sheet film across multiple cavities. The mold closes on the film and the core compresses the film into the cavity. The PP melt (see below) is injected over the film creating the outer body of polypropylene and an inner liner of film.

For the injection molding with PP, the following parameters can be used:

- The specific PP grade used is Washington Penn 123801 copolymer.
- The mold: Single cavity, cold runner aluminum construction
- The capsule obtained: 2.87 g (no film); 2.93 g (with film)
- The machine: Engel 200 ton toggle with 22MM general purpose plasticizing screw
- Melt temperature: Nozzle (390 F); Front (400 F); Middle (400 F); Rear (410 F)
- Injection pressure: Hydraulic 650 PSI
- Injection Hold: Hydraulic 250 PSI
- Injection hold time: 2.5 seconds
- Injection Speed: 1 inch per second
- Injection fill time: 0.66 seconds
- Cooling time: 3.5 seconds
- Shot size: 0.98 inches
- Recovery time: 1 second
- Screw rotation speed: 28 RPM

- Ejection stroke: 1.27 Inches
- Cycle time: 10 seconds
- Clamp tonnage: 35 tons

Example 2: Preparation of a Coffee Capsule from PET

According to the same method as described in example 1, it is also possible to over-mold the barrier film with PET.

For the injection molding with PET, the following parameters can be used:

The specific PET material grade used is Invista 1101 PET.

- Melt temperature: Nozzle (545 F); Front (560 F); Middle (560 F); Rear (460 F)
- Injection pressure: Hydraulic 800 PSI
- Injection Hold: Hydraulic 350 PSI
- Injection hold time: 2.8 seconds
- Injection Speed: 1.5 inch per second
- Injection fill time: 0.45 seconds
- Cooling time: 4.5 seconds
- Shot size: 0.78 inches
- Recovery time: 1 second
- Screw rotation speed: 32 RPM
- Ejection stroke: 1.27 Inches

- Cycle time: 12 seconds
- Clamp tonnage: 35 tons

For further illustration of the invention, two preferred embodiments are schematically shown in the drawings:

Fig. 1 shows a sectional drawing of a first preferred embodiment of a coffee capsule; and

Fig. 2 shows a sectional drawing of a second preferred embodiment of a coffee capsule.

The coffee capsule 1 shown in Figure 1 comprises a cup-shaped shell 10 and a lid 12 forming a chamber 14. The lid 12 is sealed to a rim 16 of the shell 10. The chamber 14 contains a material for the preparation of a beverage or liquid food, such as ground coffee, tea, or instant soup.

The shell 10 is formed of a dimensionally stable body 20 and a barrier film 22. The barrier film 22 is arranged on the inner surface of the body 20 and completely covers said inner surface. While the barrier film 22 is a thin film having a thickness of less than 75 µm, the body 20 is somewhat thicker.

The barrier film 22 comprises a polymer selected from the group consisting of liquid-crystal polymers (LCP), cross-linked thermoplastic epoxy-based polymers, Nylon-MXD6, cross-linked polyvinyl alcohol (PVOH), cross-linked ethylene vinyl alcohol (EVOH), polyglycolide (PGA), and mixtures thereof, and is preferably made of LCP.

The dimensionally stable body 20 is made from a thermoplastic polymer selected from the group consisting of polyhydroxyalkanoates (PHA), high heat polylactic acid (PLA), a starch-based polymer, a furan-based polymer, polyethylene (PE), polypropylene (PP), polystyrene (PS), polyethylene terephthalate (PET), polyethylene naphthalate (PEN), and mixtures thereof, and is preferably made of recycled PET.

The coffee capsule 25 shown in Figure 2 is very similar to that of Figure 1. It also comprises a cup-shaped shell 30 and a lid 32 forming a chamber 34. Again, the lid 32 is sealed to a rim 36 of the shell 30. The chamber 34 contains a material for the preparation of a beverage or liquid food, such as ground coffee, tea, or instant soup.

However, the shell 30 has a somewhat different build-up: The shell 30 of the second embodiment is formed of a food protection layer 40, a barrier film 42, and a dimensionally stable body 44. The barrier film 42 is arranged between the food protection layer 40 and the body 44 and completely covers the outer surface of the food protection layer 40 and the inner surface of the body 44. Again, the barrier film 42 is a thin film having a thickness of less than 75 µm, while the food protection layer 40 and the body 44 are somewhat thicker.

The barrier film 42 and the body 44, respectively, are formed of the same materials as the barrier film 22 and the body 20, respectively, of the first embodiment. The food protection layer 40 is made from virgin PET.

Figures 1 and 2 both show very basic embodiments of a capsule. However, these capsules may of course also have other shapes, such as those disclosed in EP 0 512 468, EP 0 844 194, EP 2 230 195, EP 2 364 930 or US 2010/0260896, for instance. In particular, the capsules may include a different type of lid or connection to the lid, as well as the shell may comprise a thin section in the base to facilitate puncturing.

Claims

1. Method for the preparation of a container for a food product, beverage or pharmaceutical product, wherein a barrier film (22, 42) having a thickness of less than 500 µm is over-molded with a thermoplastic polymer, such that the thermoplastic polymer forms a dimensionally stable body (20, 44), with the barrier film (22, 42) covering the inner surface of the body (20, 44),
characterized in that
the barrier film (22, 42) comprises a barrier polymer selected from the group consisting of liquid-crystal polymers (LCP), cross-linked thermoplastic epoxy-based polymers, Nylon-MXD6, cross-linked polyvinyl alcohol (PVOH), cross-linked ethylene vinyl alcohol (EVOH), polyglycolide (PGA), and mixtures thereof.

2. Method according to claim 1, characterized in that the barrier film (22, 42) essentially consist of the barrier polymer alone or of a composite of the barrier polymer with another material.

3. Method according to claim 1 or 2, characterized in that the barrier film (22, 42) further comprises a stabilizer selected from the group consisting of polyhydroxyalkanoates (PHA), high heat polylactic acid (PLA), a starch-based polymer, a furan-based polymer, polyethylene (PE), polypropylene (PP), polystyrene (PS), polyethylene terephthalate (PET), polyethylene naphthalate (PEN), and mixtures thereof.

4. Method according to one of claims 1 to 3, characterized in that the barrier film (22, 42) consists of a single LCP ply, which is preferably extruded, of several coextruded or laminated LCP plies oriented in different directions, of a mono- or biaxially oriented film of LCP, of a laminate of LCP with a thermoplastic film, of a laminate of LCP with paper, of a blend of LCP with PET, of a blend of LCP with PEN, of a blend of LCP with a polycarbonate (PC), of a blend of LCP with polybutylene terephthalate (PBT), of a single ply of a cross-linked thermoplastic epoxy-based polymer, which is preferably extruded, of several coextruded or laminated plies of cross-linked thermoplastic epoxy-based polymers, of a laminate of a cross-linked thermoplastic epoxy-based polymer with a thermoplastic film, of a laminate of a cross-linked thermoplastic epoxy-based polymer with paper, of a cross-linked thermoplastic epoxy-based polymer coated with SiO_x, of a cross-linked thermoplastic epoxy-based polymer coated with amorphous carbon, of Nano-Nylon-MXD6, of a laminate of PGA with PET, of a laminate of PGA with PEN, of a laminate of PGA with PLA, of a laminate of PGA with PHB, of injection molded LCP or of an injection molded blend of LCP with PET, PEN, PC or PBT.

5. Method according to one of claims 1 to 4, characterized in that the barrier film (22, 42) is prepared by lamination, thermoforming, coating, co-extrusion, injection molding or lamellar injection molding.

6. Method according to one of claims 1 to 5, characterized in that a food protection layer (40) made of a material selected from the group consisting of polyhydroxyalkanoates (PHA), high heat polylactic acid (PLA), a starch-based polymer, a furan-based polymer, polyethylene (PE), polypropylene (PP), polystyrene (PS), polyethylene terephthalate (PET), polyethylene naphthalate (PEN), and mixtures thereof, is applied to the barrier film (22, 42), wherein the barrier film (22, 42) is over-molded in such a way that the food protection layer (40) forms the inner surface of the container.

7. Method according to one of claims 1 to 6, characterized in that the barrier film (22, 42) has a thickness of less than 150 μm, preferably of less than 75 μm, more preferably of less than 50 μm, even more preferably of less than 25 μm and most preferably of less than 5 μm.

8. Method according to one of claims 1 to 7, characterized in that the dimensionally stable body (20, 44) is formed from a thermoplastic polymer selected from the group consisting polyhydroxyalkanoates (PHA), high heat polylactic acid (PLA), a starch-based polymer, a furan-based polymer, polyethylene (PE), polypropylene (PP), polystyrene (PS), polyethylene terephthalate (PET), polyethylene naphthalate (PEN), and mixtures thereof.

9. Container for a food product, beverage or pharmaceutical product, obtainable by the method according to one of claims 1 to 8, characterized in

that the container is a cup-shaped shell (10) of a capsule for the preparation of a beverage or liquid food, preferably of a coffee capsule (1, 25).

10. Container according to claim 9, further comprising a lid or closure, wherein the lid or closure comprises a barrier film comprising a barrier polymer selected from the group consisting of liquid-crystal polymers (LCP), cross-linked thermoplastic epoxy-based polymers, Nylon-MXD6, cross-linked polyvinyl alcohol (PVOH), cross-linked ethylene vinyl alcohol (EVOH), polyglycolide (PGA), and mixtures thereof.

11. Capsule for the preparation of a beverage or liquid food, preferably a coffee capsule (1, 25), comprising a cup-shaped shell (10) and a lid (12), wherein the cup-shaped shell (10) comprises a dimensionally stable body (20, 44), a barrier film (22, 42), and optionally a food protection layer (40), wherein the barrier film (22, 42) has a thickness of less than 500 µm, preferably of less than 75 µm, more preferably of less than 50 µm and covers the inner surface of the body (20, 44), and wherein the food protection layer (40), if present, forms the inner surface of the capsule,
characterized in that
the barrier film (22, 42) comprises a barrier polymer selected from the group consisting of liquid-crystal polymers (LCP), cross-linked thermoplastic epoxy-based polymers, Nylon-MXD6, cross-linked polyvinyl alcohol (PVOH), cross-linked ethylene vinyl alcohol (EVOH), polyglycolide (PGA), and mixtures thereof.

12. Capsule according to claim 11, characterized in that the barrier film (22, 42) consists of a single LCP ply, which is preferably extruded, of several coextruded or laminated LCP plies oriented in different directions, of a mono- or biaxially oriented film of LCP, of a laminate of LCP with a thermoplastic film, of a laminate of LCP with paper, of a blend of LCP with PET, of a blend of LCP with PEN, of a blend of LCP with a polycarbonate (PC), of a blend of LCP with polybutylene terephthalate (PBT), of a single ply of a cross-linked thermoplastic epoxy-based polymer, which is preferably extruded, of several coextruded or laminated plies of cross-linked thermoplastic epoxy-based polymers, of a laminate of a cross-linked thermoplastic epoxy-based polymer with a thermoplastic film, of a laminate of a cross-linked thermoplastic epoxy-based polymer with paper, of a cross-linked thermoplastic epoxy-based polymer coated with SiO_x, of a cross-linked thermoplastic epoxy-based polymer coated with amorphous carbon, of Nano-Nylon-MXD6, of a laminate of PGA with PET, of a laminate of PGA with PEN, of a laminate of PGA with PLA, of a laminate of PGA with PHB, of injection molded LCP or of an injection molded blend of LCP with PET, PEN, PC or PBT.

13. Capsule according to claim 11 or 12, characterized in that the lid also comprises a barrier film comprising a barrier polymer selected from the group consisting of liquid-crystal polymers (LCP), cross-linked thermoplastic epoxy-based polymers, Nylon-MXD6, cross-linked polyvinyl alcohol (PVOH), cross-

linked ethylene vinyl alcohol (EVOH), polyglycolide (PGA), and mixtures thereof.

14. Use of a polymer selected from the group consisting of liquid-crystal polymers (LCP), cross-linked thermoplastic epoxy-based polymers, Nylon-MXD6, cross-linked polyvinyl alcohol (PVOH), cross-linked ethylene vinyl alcohol (EVOH), polyglycolide (PGA), and mixtures thereof as a barrier film (22, 42) having a thickness of less than 500 µm, preferably of less than 75 µm, more preferably of less than 50 µm in a capsule for the preparation of a beverage or liquid food, preferably in a coffee capsule (1, 25).

15. Use according to claim 14, characterized in that a single LCP ply, several coextruded or laminated LCP plies oriented in different directions, a laminate of LCP with a thermoplastic film, a laminate of LCP with paper, a blend of LCP with PET, a blend of LCP with PEN, a blend of LCP with a polycarbonate (PC), of a blend of LCP with polybutylene terephthalate (PBT), a single ply of a cross-linked thermoplastic epoxy-based polymer, several coextruded or laminated plies of cross-linked thermoplastic epoxy-based polymers, a laminate of a cross-linked thermoplastic epoxy-based polymer with a thermoplastic film, a laminate of a cross-linked thermoplastic epoxy-based polymer with paper, a cross-linked thermoplastic epoxy-based polymer coated with SiO_x, a cross-linked thermoplastic epoxy-based polymer coated with amorphous carbon, Nano-Nylon-MXD6, a laminate of PGA with PET, a laminate of PGA with PEN, a laminate of PGA with PLA, a laminate of PGA with PHB, injection

molded LCP or an injection molded blend of LCP with PET, PEN, PC or PBT is used as the barrier film (22, 42).

16. High barrier food container comprising a dimensionally stable body, a barrier film, and optionally a food protection layer, wherein the dimensionally stable body is made from a laminate of paper and or plastics and the barrier film has a thickness of less than 500 µm, preferably of less than 75 µm, more preferably of less than 50 µm, and covers the inner surface of the body, and wherein the food protection layer, if present, forms the inner surface of the container,
characterized in that
the barrier film consists of a single LCP ply, which is preferably extruded, of several coextruded or laminated LCP plies oriented in different directions, of a biaxially oriented film of LCP, of a laminate of LCP with a thermoplastic film, of a laminate of LCP with paper, of a blend of LCP with PET, of a blend of LCP with PEN, of a blend of LCP with a polycarbonate (PC) or of a blend of LCP with polybutylene terephthalate (PBT).

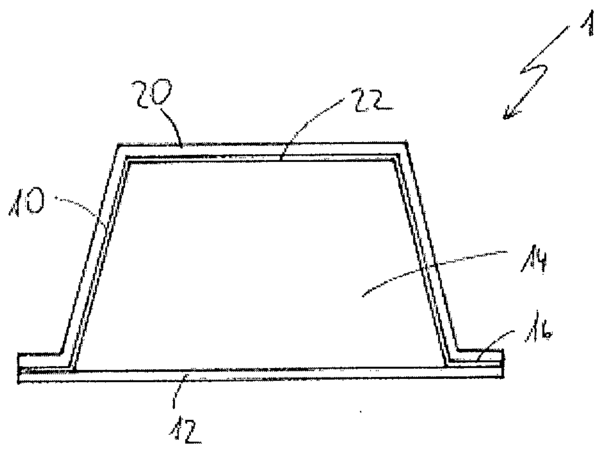

Fig. 1

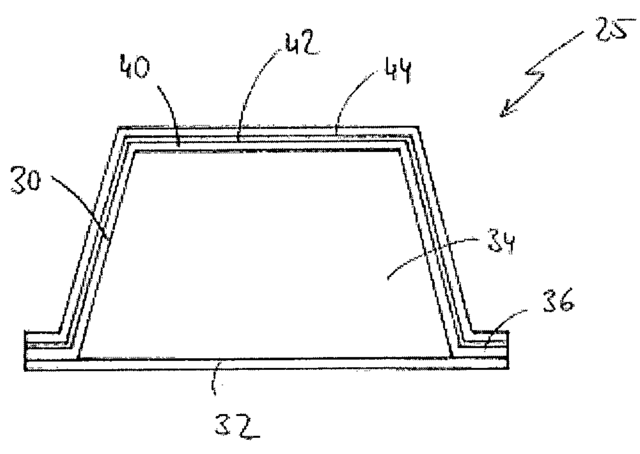

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/000866

A. CLASSIFICATION OF SUBJECT MATTER
INV. B32B27/08 B32B27/30 B32B27/32 B32B27/36 B32B27/38
B32B1/02 B65D85/804
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B32B B65D

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	EP 1 787 807 A1 (KUREHA CORP [JP]) 23 May 2007 (2007-05-23) paragraph [0042]; example 1 -----	1-8

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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 June 2014	03/07/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Flores de Paco, M

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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