

(19)



(11)

EP 3 668 804 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
20.10.2021 Bulletin 2021/42

(21) Application number: **18749399.4**

(22) Date of filing: **09.08.2018**

(51) Int Cl.:
B65D 85/808 ^(2006.01)

(86) International application number:
PCT/EP2018/071647

(87) International publication number:
WO 2019/034531 (21.02.2019 Gazette 2019/08)

(54) **INFUSION PACKETS**

AUFGUSSPAKETE

SACHETS D'INFUSION

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **16.08.2017 EP 17186362**

(43) Date of publication of application:
24.06.2020 Bulletin 2020/26

(73) Proprietors:
• **Unilever PLC**
London, Greater London EC4Y 0DY (GB)
Designated Contracting States:
CY GB IE MT
• **Unilever IP Holdings B.V.**
3013 AL Rotterdam (NL)
Designated Contracting States:
AL AT BE BG CH CZ DE DK EE ES FI FR GR HR HU IS IT LI LT LU LV MC MK NL NO PL PT RO RS SE SI SK SM TR

(72) Inventors:
• **AXE, Suzanne, Emma**
Sharnbrook
Bedfordshire MK44 1LQ (GB)
• **BENINATI, Fabio**
47521 Cesena (IT)
• **HAY, Gareth, Ian**
Sharnbrook
Bedfordshire MK44 1LQ (GB)

(74) Representative: **Warner, Guy Jonathan**
Unilever PLC
Unilever Patent Group
Bronland 14
6708 WH Wageningen (NL)

(56) References cited:
DE-A1- 3 307 046 DE-U1- 29 621 889

EP 3 668 804 B1

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

Field of the invention

[0001] The present invention relates to infusion packets. More particularly, the present invention is directed towards infusion packets (such as tea bags) which expand to adopt a three-dimensional shape upon immersion in water.

Background of the invention

[0002] For many years infusion packets (for instance tea bags) were typically flat and available primarily as square or round sheets of porous filter material with infusible material (for instance tea leaves) sandwiched between the sheets. Such packets restrict the movement of the infusible material within the infusion packets to substantially two dimensions. As a result the infusion performance of such packets is limited.

[0003] DE 296 21 889 U1 (Holthoff) discloses an infusion packet containing coffee powder being a comparatively compact and dense beverage precursor. The package expands in the presence of hot water; this expansion process includes a conversion of volume and geometric shape of the packet.

[0004] More recently, mass-produced infusion packets having a more three-dimensional state have been developed. Of particular success have been the tetrahedral-shaped packets such as those whose production is described in WO 95/01907 (Unilever). This type of infusion packet is thought to improve infusion performance by allowing the infusible material more room to move.

[0005] Multiple infusion packets are usually packaged together in cartons for sale. For example, PG Tips pyramid tea bags are sold in cartons containing 20, 40, 80, 160 or 240 tea bags. A drawback of providing three-dimensional infusion packets is that they have a larger volume than two dimensional packets and consequently cannot be packaged for sale as efficiently.

[0006] Efforts have been made to provide three-dimensional infusion packets that have a flattened configuration for packing.

[0007] EP 0 053 204 (Unilever) discloses a tea bag with a generally tetrahedral shape that has at least one fold permitting its collapse to a flattened configuration. A pull means affixed to the bag facilitates unfolding of the bag.

[0008] WO 2013/174710 (Unilever) discloses an infusion packet comprising a gusset which is substantially flat prior to use, and can swell upon immersion in an infusion liquid such that it adopts a more three-dimensional shape.

[0009] EP 0 846 632 (Fuso Sangyo Kabushiki Kaisha) discloses a liquid-permeable flexible bag body that is folded so that it can easily be accommodated in an external pack, and unfolded at the time of extraction so that the bag body has its internal space enlarged.

[0010] The flattened (or unexpanded) format of such infusion packets is achieved by folding of the three-dimensional infusion packets in a defined manner. The three-dimensional shape that the infusion packets are intended to adopt when in use will inevitably influence the shape of their flattened format. Moreover, in order to facilitate mass-production of such infusion packets, the flattened format must be achievable via a relatively simple folding pattern. Thus the expandable infusion packets described in the prior art only have a very limited number of possible configurations in their unexpanded format.

[0011] Therefore, there remains scope to provide an infusion packet format which provides the infusion performance associated with three-dimensional packets and which can be packaged for sale in a more convenient and/or efficient manner than is currently the case.

Summary of the invention

[0012] In a first aspect, the present invention relates to an expandable infusion packet containing a beverage precursor, wherein the infusion packet is in a permanently compressed state in the absence of water and converts to an expanded state in the presence of water, wherein the infusion packet has a density of at least 0.5 g/cm³ when it is in the permanently compressed state, and wherein the infusion packet is substantially rigid and has a Vickers hardness (H_v) of at least 0.2 when it is in the permanently compressed state.

[0013] The compressed nature of such infusion packets means that they can be conveniently and efficiently packed. This is advantageous from an environmental perspective, since less secondary packaging material is needed to package a given number of infusion packets (e.g. when compared to standard infusion packets having essentially the same expanded state).

[0014] In a second aspect, the present invention relates to a package comprising a plurality of expandable infusion packets according to the first aspect of the invention.

Detailed description of the invention

[0015] The present invention relates to an expandable infusion packet containing a beverage precursor, wherein the infusion packet is in a permanently compressed state in the absence of water and converts to an expanded state in the presence of water, and wherein the infusion packet has a density of at least 0.5 g/cm³ when it is in the permanently compressed state.

[0016] As used herein, the term "permanently compressed state" refers to a format which is intended to remain stable for an indefinite period of time. The format of the infusion packet in itself is permanently compressed, and does not convert to an expanded state in the absence of water. In other words, the infusion packet of the present invention does not rely on an envelope or similar secondary packaging to maintain its compressed

format.

[0017] When the infusion packets of the present invention are in their permanently compressed state, they cannot be unfolded simply by gently pulling or handling their constituent material. This is in contrast to infusion packets which have been folded to achieve a flattened format, which readily adopt a more expanded format on being treated in this manner, even in the absence of water.

[0018] The infusion packets have a density of at least 0.5 g/cm^3 when they are in the permanently compressed state. Preferably the density of the infusion packets when they are in the permanently compressed state is at least 0.55 g/cm^3 , more preferably at least 0.6 g/cm^3 , still more preferably at least 0.65 g/cm^3 . Preferably the density of the infusion packets when they are in the permanently compressed state is less than 2 g/cm^3 , more preferably less than 1.6 g/cm^3 , still more preferably less than 1.2 g/cm^3 .

[0019] As such, the density of the compressed infusion packets is typically greater than the bulk density of the beverage precursor. This is in contrast to the density of a standard (non-compressed) infusion packet where the density of the infusion packet will typically be less than or equal to the bulk density of the beverage precursor.

[0020] The bulk density of the beverage precursor in its dry (i.e. uninfused) form is the mass of the beverage precursor divided by the total volume occupied. This bulk density is referred to herein as "uncompressed bulk density" (or ρ_{normal}) and can be measured by filling a known mass of the beverage precursor into a measuring cylinder, tapping the cylinder several times and then measuring the volume occupied by the beverage precursor. The uncompressed bulk density (ρ_{normal}) represents the bulk density of the beverage precursor in a standard infusion packet (i.e. a non-compressed infusion packet). For example, the uncompressed bulk density (ρ_{normal}) of leaf tea in its dry (uninfused) form is around 0.4 g/cm^3 .

[0021] It will be appreciated that the bulk density of the beverage precursor contained within the infusion packet will not be the same when the infusion packet is in the permanently compressed state. In fact, the bulk density of the beverage precursor will be significantly higher when the infusion packet is in this state. In other words, a given mass of beverage precursor will occupy a smaller volume when the infusion packet is in the permanently compressed state than the volume it will occupy when the infusion packet is in the expanded state. The bulk density of the beverage precursor in the compressed infusion packet is referred to herein as "compressed bulk density" (or $\rho_{\text{compressed}}$). The compressed bulk density can be determined by applying the same amount of pressure as used to make the compressed infusion packet to a known mass of the beverage precursor, and then determining the volume of the beverage precursor after the pressure has been applied (the compressed bulk density is the mass of the beverage precursor divided by the volume of the beverage precursor after the pressure has been applied).

[0022] Preferably the compressed bulk density ($\rho_{\text{compressed}}$) of the beverage precursor is greater than the uncompressed bulk density (ρ_{normal}) of the beverage precursor by a factor of 1.5 to 3, more preferably by a factor of 1.8 to 2.6 and most preferably by a factor of 2 to 2.4. The infusion packet of the present invention converts to an expanded state in the presence of water. Both hot and cold water will elicit this conversion, although (all other parameters being equal) the time taken for the infusion packet to adopt the expanded state will usually be quicker in hot water than it is in cold water. As such, the expandable infusion packet is suitable for preparing both hot and cold beverages.

[0023] When the infusion packets of the present invention are in their permanently compressed state they do not deform when handled and preferably have a substantially rigid structure. When they adopt their expanded state in the presence of water, they become deformable and preferably have a flexible structure (in other words they lose the rigidity they preferably possess in their permanently compressed state).

[0024] The rigidity of the infusion packets in the permanently compressed state can be expressed in terms of Vickers hardness (H_v). The Vickers hardness number is a measure of the sample's resistance to plastic deformation.

[0025] The Vickers hardness test is an indentation test that consists of indenting the sample with an indenter. The geometry of the indenter used in the Vickers hardness test is standardised (136° pyramidal diamond indenter that forms a square indent). The indenter is pressed into the sample by an accurately controlled test force, and then removed leaving an indent in the sample that appears square shaped on the surface. The area (A) of the indent is determined by assuming that the indentation has the same geometry as the indenter that formed it, and can be determined according to the formula: $A = 24.5 h^2$, where h is the indent depth (in mm).

[0026] The Vickers hardness number (H_v) is a function of the test force divided by the surface area of the indent, and can be calculated using the following formula: $H_v = F/A$ where F is the force applied to the indenter (in kgf) and A is the surface area of the resulting indentation (in mm^2).

[0027] The infusion packets are substantially rigid and have a Vickers hardness (H_v) of at least 0.2, preferably at least 0.25, more preferably at least 0.3, and most preferably at least 0.35. Preferably the Vickers hardness (H_v) of the infusion packets in the compressed state is less than 1, more preferably less than 0.9, still more preferably less than 0.8, and most preferably less than 0.75.

[0028] The time taken for the infusion packet to convert from the compressed to the expanded state in the presence of hot water (e.g. at a temperature of 90 to 100°C) is typically relatively rapid, and will usually be a matter of seconds. Thus the expandable infusion packet is particularly suitable for brewing beverages which are prepared with hot water, for instance tea or herbal infusions.

Consumers want to prepare such beverages as quickly and conveniently as possible, and the total brewing time is usually no more than 6 minutes. Thus, in the presence of hot water, the infusion packet preferably converts from the compressed to the expanded state in a time of no more than 30 seconds, more preferably no more than 20, most preferably no more than 10 seconds.

[0029] The expandable infusion packets are also appropriate for brewing beverages which are prepared with cold water (e.g. iced tea brewed from Lipton® Cold Brew tea bags). The brewing time for such beverages is typically longer than for hot beverages, for example it may be 5 minutes or longer. Therefore, rapid conversion of the infusion packet from the compressed to the expanded state is less important as far as consumer acceptance of the product is concerned. In the presence of cold water (e.g. at a temperature of 15 to 25°C) the infusion packet preferably converts from the compressed to the expanded state in a time of no more than 240 seconds, more preferably no more than 180 seconds, still more preferably no more than 120 seconds and most preferably no more than 90 seconds.

[0030] The conversion of the expandable infusion packet from the permanently compressed state to the expanded state results in a "tumbling" motion. Without wishing to be bound by theory, the inventor believes that this motion improves the infusion performance of the infusion packet.

[0031] The expandable infusion packets preferably contain a beverage precursor. As used herein the term "beverage precursor" refers to a fabricated composition suitable for preparing a beverage. The beverage precursor may be contacted with an aqueous liquid such as water to provide a beverage (i.e. a substantially aqueous drinkable composition which is suitable for human consumption). This process is referred to as brewing. During brewing the beverage precursor typically releases certain soluble substances into the aqueous liquid, e.g. flavour and/or aroma molecules.

[0032] The beverage precursor preferably comprises plant material, with tea and/or herb plant material being particularly preferred. As used herein "tea plant material" refers to dried leaf and/or stem material derived from *Camellia sinensis* (i.e. "leaf tea"). The term "herb plant material" refers to material which is commonly used as a precursor for herbal infusions. Preferably the herb plant material is selected from chamomile, cinnamon, elderflower, ginger, hibiscus, jasmine, lavender, lemongrass, mint, rooibos, rosehip, vanilla and verbena. The beverage precursor may additionally or alternatively comprise fruit pieces (e.g. apple, blackcurrant, mango, peach, pineapple, raspberry, strawberry, etc.) and/or other flavor ingredients (e.g. bergamot, citrus peel, synthetic flavor granules, and the like). The beverage precursor preferably excludes plant material which requires pressure for optimum brewing. In particular, the beverage precursor preferably excludes plant material derived from coffee (especially ground coffee).

[0033] It is preferred that the mass of the beverage precursor is at least 1 g, as smaller amounts are difficult to accurately portion and dose. More preferably the mass is at least 1.2 g, and most preferably at least 1.4 g. It is further preferred that the mass of the beverage precursor is less than 4 g, as larger amounts become inconvenient to store and/or handle. More preferably the mass is less than 3.5 g, and most preferably less than 3 g.

[0034] The expandable infusion packet preferably has a first geometric shape in its permanently compressed state and a second geometric shape in its expanded state. Although it is possible for the second geometric shape to be an expanded version of the first geometric shape, it is preferred that the first and second geometric shapes are distinct. In other words, the infusion packet preferably has a particular geometric shape in the permanently compressed state, and converts to the expanded state wherein it adopts a different geometric shape.

[0035] For example, the infusion packet could have an essentially disc-shaped, cylindrical conformation in the compressed state (i.e. the first geometric shape is a cylinder), and then, on the addition of water, convert so as to have an essentially tetrahedral conformation in the expanded state (i.e. the second geometric shape is a tetrahedron).

[0036] The first geometric shape preferably has a first face and a second face connected along a length (*L*), wherein the cross-section along the length (*L*) is constant, and is the same shape as the first and second faces. The first and second face are preferably parallel to one another.

[0037] It is preferred that the first geometric shape is a cylinder or a prism.

[0038] Where the first geometric shape is a cylinder, the first face and the second face are circular or elliptical, and are connected along the length (*L*) by a curved surface.

[0039] When the first geometric shape is a prism, the first face and the second face are polygonal and are connected along the length (*L*) by a plurality of joining faces, which are delimited from one another by a plurality of joining edges. The joining faces are preferably square or rectangular (i.e. the prism is preferably a right prism). Nevertheless, it will be appreciated that in a less preferred configuration the joining faces could be parallelograms (i.e. the prism could be an oblique prism).

[0040] The first and second faces can have any simple polygonal shape (i.e. a shape wherein the boundary of the polygon does not cross itself); as such the polygonal shape can be concave or convex. Non-limiting examples of suitable polygonal shapes include: triangles, quadrilaterals, pentagons, hexagons, heptagons, octagons, nonagons, decagons, or the like.

[0041] The geometry and dimensions of the infusion packet in its permanently compressed state will determine how efficiently a plurality of such packets can be packaged.

[0042] The first geometric shape preferably has a width

(W), wherein the width (W) is greater than or equal to the length (L).

[0043] The width (W) is the widest dimension of the first or second face in a plane which is perpendicular to the length (L). For example, for a cylinder with a circular cross-section, the width (W) is the diameter of the circular cross-section, whilst for a cylinder with an elliptical cross-section, the width (W) represents the major axis of the elliptical cross-section. Similarly, for a prism with a square cross-section, the width (W) represents the diagonal of the square cross-section.

[0044] The length (L) of the cylindrical or prismatic infusion packet in the permanently compressed state is preferably greater than 2 mm, more preferably greater than 3 mm, and most preferably greater than 4 mm. The length (L) is preferably no more than 20 mm, more preferably no more than 18 mm, and most preferably no more than 16 mm.

[0045] The width (W) of the cylindrical or prismatic infusion packet in the permanently compressed state is preferably greater than 14 mm, more preferably greater than 17 mm, and most preferably greater than 20 mm. The width (W) is preferably no more than 45 mm, more preferably no more than 40 mm, and most preferably no more than 35 mm.

[0046] The expandable infusion packet preferably has a second geometric shape in its expanded state. As set out above, this second geometric shape is preferably a different shape to the first geometric shape.

[0047] An embodiment wherein the second geometric shape is essentially flat (e.g. an infusion packet comprising infusible material sandwiched between square or round sheets of porous material) is not precluded. However, such an embodiment is less preferred, since infusion packets of this type are believed to restrict the movement of the infusible material to substantially two dimensions, thereby limiting their infusion performance. Furthermore, packaging a plurality of this type of infusion packets is already relatively efficient due to their essentially flat nature.

[0048] Thus it is preferred that the second geometric shape is a three-dimensional shape. There is no particular limitation with regard to the second geometric shape, and it can be any three-dimensional shape. However, it is desirable that infusion packets having the second geometric shape can be readily manufactured on a large-scale. Thus preferred examples of the second geometric shape include shapes such as tetrahedral, pyramidal, hemispherical, spherical, cubic, and the like. It is particularly preferred that the second geometric shape is a sphere, a hemisphere, a tetrahedron or a pyramid.

[0049] The present invention envisages compressing conventional infusion packets so as to achieve a format wherein the infusion packets are in a permanently compressed state. Non-limiting examples of conventional infusion packets include spherical or hemispherical infusion packets such as those described in EP 0811562 (Unilever), WO 2012/095247 (Unilever) or WO

2005/051797 (Tetley), and tetrahedral-shaped infusion packets such as those described in WO 95/01907 (Unilever), WO 2004/033303 (I.M.A. SPA), or WO 2012/004169 (Unilever).

[0050] The expandable infusion packet preferably has a first geometric shape in its permanently compressed state and a second geometric shape in its expanded state. Although it is possible for the second geometric shape to be an expanded version of the first geometric shape, it is preferred that the first and second geometric shapes are distinct. In other words, the infusion packet preferably has a particular geometric shape in the permanently compressed state, and converts to the expanded state wherein it has a different geometric shape.

[0051] The expandable infusion packet has a volume V_c in the permanently compressed state and a volume V_E in the expanded state. In order to achieve a significant reduction in the packaging space occupied by each compressed infusion packet without impacting infusion performance, a significant increase in volume occurs when the infusion packet converts from its permanently compressed state to its expanded state on the addition of water. Thus, V_E is preferably at least $2V_c$, more preferably at least $2.5V_c$, and most preferably at least $3V_c$. The expandable infusion packet should be able to convert from its permanently compressed state to its expanded state in an efficient manner on the addition of water. Thus V_E is preferably no more than $10V_c$, more preferably no more than $8V_c$, and most preferably no more than $6V_c$.

[0052] The expandable infusion packet of the present invention can be made from any suitable material. Non-woven materials are particularly preferred, since these materials typically have relatively little "memory" in the fibres, and therefore readily convert from the compressed state to the expanded state on the addition of water. Non-limiting examples of non-woven materials include non-woven materials made with continuous filaments (e.g. PET, PLA, PP) and wet laid non-woven materials (e.g. cellulose/polymer blends comprising cellulose and polymers such as PP, PE, or PLA).

[0053] In a second aspect, the invention relates to a package comprising a plurality of expandable infusion packets according to the first aspect of the invention.

[0054] As mentioned above, the geometry of the expandable infusion packet in its permanently compressed state will determine how efficiently a plurality of such packets can be packaged. Nevertheless, the infusion packets of the present invention will require less storage space in their compressed state than in their expanded state, regardless of the particular geometry chosen.

[0055] The format of the package is not limited. For cost reasons, it is preferred that the package chosen is not overly complicated to manufacture. From the standpoint of simplicity, it is preferred that the package is a tube or a carton. A further benefit of such packaging solutions is that the packaged product only requires a small amount of storage space in the consumer's home. Indeed, it is preferred that the secondary packaging is suf-

ficiently compact that the infusion packets can be conveniently carried around by the consumer or kept at work.

[0056] Examples of such tubular packages include cardboard, plastic, or metallic tubes having an appropriately shaped cross-section. For example, if the expandable infusion packet has a triangular cross-section in the compressed shape, a hollow tube having a triangular cross-section could efficiently package a plurality of such infusion packets. It is also envisaged that the tubular package could be formed around the compressed infusion packets. For example, a plurality of compressed infusion packets could be arranged in a stack, and packaged in a tubular manner by way of a sheet of flexible packaging material (e.g. paper or plastic) being wrapped around the stacked infusion packets in a circumferential manner and sealed where the edges of the sheet meet (i.e. in a longitudinal direction such that the seal is essentially parallel to the length (L) of the compressed infusion packets).

[0057] In one preferred embodiment, the package is a tube and the first geometric shape is a cylinder (i.e. the expandable infusion packet has an essentially disc-shaped, cylindrical conformation in the permanently compressed state).

[0058] The tube does not need to have the same cross-section as the expandable infusion packet. Thus, in embodiments wherein the package is a tube and the first geometric shape is a cylinder, the tube may have a circular or elliptical cross-section and hence match the cross-section of the first geometric shape.

[0059] Alternatively, the tube may have a cross-section which does not match that of the first geometric shape. The space between the infusion packet and the tube in such an embodiment is believed to facilitate removal of the infusion packet from the carton (by allowing the consumer to easily grip the curved surface of the infusion packet). A tube with a square or rectangular cross-section is particularly preferred, since such cartons are easily manufactured.

[0060] It will be appreciated that a similar effect can be achieved with other shapes of infusion packets. For example, an expandable infusion packet wherein the first geometric shape is a hexagonal prism could be packaged in a tube having a square cross-section, etc.

[0061] As set out above, the secondary packaging can be a carton. The tubular format described above relates to a packaging solution for a stack of compressed infusion packets. In contrast, a carton provides a solution for packaging layers or rows of the compressed infusion packets (wherein each layer or row comprises two or more compressed infusion packets). It is possible to package compressed infusion packets in this manner regardless of the first geometric shape of such infusion packets. For maximum packaging efficiency, it is preferred that the first geometric shape tessalates. Nevertheless, this is not an essential requirement, and non-tessalating shapes will also be packaged more efficiently than conventional non-compressed infusion packets.

[0062] Furthermore, the space between rows of compressed infusion packets having non-tessalating shapes may facilitate convenient removal of the individual infusion packets from the carton by the consumer.

[0063] In a preferred embodiment, the package is a carton and the first geometric shape is a square or rectangular prism (i.e. the expandable infusion packet has a prismatic conformation with a square or rectangular cross-section in the permanently compressed state).

[0064] In a further preferred embodiment, the package is a carton and the first geometric shape is a cylinder (i.e. the expandable infusion packet has an essentially disc-shaped, cylindrical conformation in the permanently compressed state). A carton with a square or rectangular cross-section is particularly preferred, since such cartons are easily manufactured. The space between the rows of infusion packets and the carton is believed to facilitate removal of the infusion packet from the carton (by allowing the consumer to easily grip the curved surface of the infusion packet).

[0065] As already discussed, the present invention envisages compressing conventional infusion packets so as to achieve a format wherein the infusion packets are in a permanently compressed state. This can be achieved by a method comprising the steps of (a) providing an infusion packet in an expanded state; (b) inserting the infusion packet in a die; and (c) applying pressure so as to convert the infusion packet to a permanently compressed state. The infusion packet provided in step (a) is preferably a conventional infusion packet, and can be manufactured by any known method. Tetrahedral-shaped infusion packets are particularly preferred.

[0066] The infusion packet provided in step (a) is inserted into a die. It is preferred the die is metallic, for example it can conveniently be made of steel.

[0067] The pressure applied in step (c) is preferably applied via a piston which fits in the die. It is preferred that the piston is metallic, for example it can conveniently be made of aluminium. The dies and the piston are preferably made from different metals. Factors which influence the appropriate pressure applied in step (c) include the area of the cross-section of the die used in step (b), the type of material the infusion packet is made from and the size/weight of the infusion packet. The pressure applied in step (c) will typically be higher where a greater degree of compression is desired, and lower where a smaller degree of compression is desired.

[0068] It will be appreciated that the amount of infusible material contained within the infusion packet has a given volume (e.g. the volume occupied by 3 g of infusible material will be greater than that occupied by 2 g of infusible material). As a general rule, the more infusible material contained within the infusion packet, the greater the volume occupied by that infusible material. As such, infusion packets comprising higher amounts of infusible material will typically be compressed to a lesser degree than infusion packets comprising lower amounts of infusible material.

Figures

[0069] By way of example, the present invention is illustrated with reference to the following figures, in which:

Figure 1a is a perspective view of an expandable infusion packet in a permanently compressed state; Figure 1b is a perspective view of the expandable infusion packet of Figure 1a in an expanded state; Figure 2a is a perspective view of a compressed infusion packet according to the invention which has been placed in a receptacle ready for brewing; Figure 2b is a representation of the infusion packet of Figure 2a once water has been added to the receptacle so as to prepare a beverage; Figure 3a is a perspective view showing an arrangement of a plurality of compressed infusion packets; Figure 3b is a perspective view showing one embodiment of a package comprising a plurality of compressed infusion packets; Figure 3c is a perspective view showing an alternative embodiment of a package comprising a plurality of compressed infusion packets; Figure 4 shows a series of perspective views illustrating possible shapes for expandable infusion bags according to the present invention in their permanently compressed state. Figure 5a is a perspective view of an infusion packet with a hemispherical expanded state; Figure 5b is a perspective view of an infusion packet with a cubic expanded state; Figure 6 is a perspective view showing a carton comprising a plurality of compressed infusion packets; Figure 7 illustrates different arrangements a plurality of compressed infusion packets; Figure 8 is a perspective view showing a carton comprising a plurality of compressed infusion packets.

[0070] Figure 1a shows an expandable infusion packet according to the invention in its permanently compressed state. The compressed infusion packet (1) is cylindrical and has a circular cross-section. In this format, the infusion packet has a circular first face (2) and circular second face (which is opposite the first face, and thus not visible in Figure 1a) connected along a length (L) by a curved surface (4). The cross-section along the length (L) is constant, and is the same shape as the first and second faces (i.e. circular). In the illustrated embodiment, the width (W) is the diameter of the circular cross-section.

[0071] Figure 1b shows the infusion packet of Figure 1a in its expanded state. The expanded infusion packet (5) has adopted a three-dimensional tetrahedral shape. As such, the infusion packet has a different shape in its expanded state than it had in its compressed state. The three-dimensional expanded state allows the infusible material (6) room to move within the infusion packet (5), which is believed to improve infusion performance.

[0072] Figure 2 illustrates the conversion of an expand-

able infusion packet according to the present invention from its permanently compressed state to its expanded state. This conversion occurs under the conditions typically used by a consumer to prepare an infusion from a conventional infusion packet.

[0073] Figure 2a shows the infusion packet prior to the start of brewing. The compressed infusion packet (1) has been placed in a receptacle (7) which is suitable for receiving a quantity of hot water (in this case a mug). In order to prepare a beverage from the compressed infusion packet the consumer adds hot water to the receptacle. The infusion packet converts to an expanded state in the presence of water (8). The volume of water used by consumers to prepare a beverage from a conventional infusion packet varies, and is not constant from one geography to another. Thus, it is preferably that the volume of water that will cause the infusion packet to convert from its permanently compressed state to its expanded state is not very large, although it will be appreciated that this volume is typically greater than V_E (100 ml of water will usually be sufficient). Figure 2b shows the infusion packet during brewing. The infusion packet is now in its expanded state (5), and has adopted a three-dimensional tetrahedral shape.

[0074] As shown by Figure 3, the compressed infusion packets of the present invention can be conveniently packaged.

[0075] Figure 3a shows a plurality of compressed infusion packets (1), which have been stacked one on top of the other. Since the infusion packets have a regular shape in the compressed state, this arrangement results in a format with a constant cross-section (in this case, a circular cross-section).

[0076] Figure 3b shows a possible way of packaging a plurality of compressed infusion packets (1). The stack of expandable infusion packets is kept together by secondary packaging (9). In Figure 3b this secondary packaging (9) is tubular and takes the form of a sheet (e.g. formed of paper or plastic) which extends around the infusion packets in a circumferential manner and is sealed where its edges meet.

[0077] Figure 3c shows an alternative way of packaging a plurality of compressed infusion packets (1). In Figure 3c the secondary packaging (9) is a cardboard tube having a square cross-section. This carton has the form of a square prism. Although the compressed infusion packets do not fill the entire volume of the carton, the packaging efficiency is still improved (i.e. a carton designed to accommodate an equivalent number of conventional infusion packets having an expanded format would have a significantly larger volume).

[0078] Although not illustrated, it will be appreciated that yet more secondary packaging formats are possible (e.g. a cardboard or plastic tube, etc.).

[0079] The shape of the expandable infusion packet in its permanently compressed state may be prismatic. Figure 4 shows some possible prismatic configurations.

[0080] In Figure 4a the compressed infusion packet

has the form of a triangular prism. In this format, the first and second faces of the infusion packet are triangular, and are connected along the length (L) by three rectangular joining faces (11), which are delimited from one another by three joining edges (12). In this embodiment, the width (W) is the distance between two adjacent vertices of the triangular cross-section.

[0081] In Figure 4b the compressed infusion packet is a square prism. In this format, the first and second faces of the infusion packet are square, and are connected along the length (L) by four rectangular joining faces (11), which are delimited from one another by four joining edges (12). In this embodiment, the width (W) is the diagonal of the square cross-section.

[0082] Figures 4c and 4d illustrate two possible hexagonal prism configurations for the compressed infusion packet. In both instances, the first and second faces of the infusion packet are hexagonal, and are connected along the length (L) by six rectangular joining faces (11), which are delimited from one another by six joining edges (12). The compressed infusion packet of Figure 4c has a convex hexagonal cross-section, whereas the compressed infusion packet of 4d has an L-shaped concave hexagonal cross-section.

[0083] The shape of the expandable infusion packet in its expanded state is not limited, and can be any geometric shape. Figure 5 shows some possible configurations.

[0084] In Figure 5a the expanded infusion packet (5) has a three-dimensional hemispherical shape, whilst in Figure 5b it has a cubic shape in its expanded form.

[0085] It will be appreciated that there is no particular link between the shape of the expandable infusion packet in its compressed state and in its expanded shape. In particular, an infusion packet having any one of the expanded shapes shown in Figures 1b, 5a and 5b can be compressed so as to have any one of the configurations shown in Figures 1a, 4a, 4b, 4c and 4d.

[0086] The shape of the infusion packet in its compressed state could be used as a code help consumers identify the appropriate product. For example, a range of products are often sold by a particular manufacturer (such as green tea, black tea, fruit and herbal infusions, etc.). Conventionally, each member of the range uses the same shaped infusion packet (e.g. tetrahedral). Each type of product is sold in a separate package (e.g. a carton containing a certain number of infusion packets), and the information provided on the package identifies the particular product type. The present invention allows each product in the range to have a different shape in the permanently compressed state (whilst still maintaining a common shape in the expanded state). For example, infusion packets containing black tea could have the form of a cylinder, whilst those containing green tea could have the form of a hexagonal prism, and so on. In this way, even if the compressed infusion packets had been removed from the package in which they were sold, the consumer would still be able to visually identify each

product in the range.

[0087] Figure 6 shows a possible way of packaging a plurality of compressed infusion packets. In this Figure, a number of compressed infusion packets (1) are arranged inside a cardboard carton (15). The square cross-section of the infusion packets (1) means that they tessellate, thus resulting in a very efficient use of the internal space within the carton.

[0088] Figure 7 illustrates different arrangements a plurality of compressed infusion packets.

[0089] Figure 7a shows a plurality of compressed infusion packets (1) having a hexagonal cross-section which have been stacked one on top of the other. The regular shape of these infusion packets in the compressed state means that the stack of infusion packets has a constant cross-section. The stack of expandable infusion packets can be packaged so as to maintain this arrangement (e.g. in a similar manner to that illustrated for in Figure 3b).

[0090] Figure 7b shows an alternative arrangement of compressed infusion packets (1) having a hexagonal cross-section. In this arrangement, the compressed infusion packets are arranged in a single layer. The regular hexagonal cross-section of the infusion packets (1) means that they tessellate. The layer of expandable infusion packets can be packaged so as to maintain this arrangement (e.g. by packaging them in a cardboard carton).

[0091] Figure 8 shows a possible way of packaging a plurality of compressed infusion packets. In this Figure, a number of compressed infusion packets (1) are arranged inside a cardboard carton (15). The circular cross-section of the infusion packets (1) means that they do not tessellate. Nevertheless, the compressed infusion packets are still very efficiently packaged, whilst the small amount of space around the compressed infusion packets allows the consumer to easily remove an individual infusion packet by gripping the curved surface thereof.

[0092] Although not illustrated, it will be appreciated that the final packaging arrangement could comprise multiple layers of the compressed infusion packets. Indeed, it is also envisaged that each layer of infusion packets could have a different shape in the compressed format. For example, a first layer could consist of infusion packets having a hexagonal cross-section, with a second layer consisting of infusion packets having a square cross-section.

Examples

[0093] A commercially available PG Tips pyramid tea bag (bag weight 2.9 g) was provided. The shape of this tea bag in the expanded state was essentially tetrahedral (edge length 65 mm). The volume of the tea bag in the expanded state (V_E) was 32365 mm³.

[0094] The tea bag was inserted into a steel die having the form of a hollow cylinder and converted into a permanently compressed state by applying 4200 kPa pres-

sure via an aluminium piston that slides within the cylindrical die thereby compressing the tea bag. The shape of this tea bag in the permanently compressed state was essentially cylindrical (with a circular cross-section). The width (W) of the compressed cylindrical format of the tea bag was 32 mm, and the length (L) was 5 mm. The volume of the tea bag in the permanently compressed state (V_c) was 4021 mm³. The density of the tea bag in the permanently compressed state was calculated to be 0.72 g/cm³.

[0095] The Vickers hardness (H_v) of a permanently compressed tea bag was determined. Measurements were conducted on an Instron universal testing machine (type 5500R) running Bluehill2™ software (version 2.17). The sample was positioned on the base plate and indenter lowered manually until it was close to the sample surface. A preloading cycle was run with a displacement of 1 mm/min until a load of 0.1N was measured, at which point an autocalibration for displacement and load was made. Force (in kgf) and displacement (in mm) were measured during the indentation loading cycle and the unloading cycle. The loading cycle was run at a displacement of 2 mm/min until the tip of the indenter was pushed into the sample to a depth of 2.5 mm. The unloading cycle was run at a displacement of 2 mm/min until the load had returned to zero. The permanently compressed tea bag had a Vickers hardness H_v of 0.46.

[0096] The permanently compressed tea bag was placed in an empty cup, and 200 ml of hot water was added. The tea bag converted to its expanded form in a matter of seconds. Moreover, this conversion caused the tea bag to "tumble". This movement facilitates rapid brewing of the tea leaves contained within the tea bag without the need for stirring or otherwise agitating the tea bag.

[0097] For comparison, a non-compressed, commercially available PG Tips pyramid tea bag (bag weight 2.9 g) was placed in an empty cup, and 200 ml of hot water was added. The addition of the water caused temporary flattening of the tea bag. Furthermore, although the tea bag floated once addition of the water was completed, it did not "tumble" and was essentially static during brewing. The lack of movement meant that the tea leaves contained within the tea bag did not brew as rapidly.

[0098] The bulk density of the leaf tea blend contained within the PG Tips pyramid tea bag in the expanded (or non-compressed) state was determined to be 0.46 g/cm³. The bulk density of the leaf tea blend in the compressed state was estimated to be 0.97 g/cm³. This was determined by placing a known mass of the leaf tea blend in the same steel die used to make the compressed tea bag, applying 4200 kPa pressure to the leaf tea blend and then calculating the volume of the leaf tea after the pressure had been applied. It can be seen that the bulk density of the leaf tea in the compressed tea bag is significantly higher than that of the leaf tea in the expanded (non-compressed) tea bag.

Claims

1. Expandable infusion packet (1) containing a beverage precursor (6) wherein the infusion packet is in a permanently compressed state in the absence of water (8) and converts to an expanded state in the presence of water (8), wherein the infusion packet (1) has a density of at least 0.5 g/cm³ when it is in the permanently compressed state, and wherein the infusion packet is substantially rigid and has a Vickers hardness (H_v) of at least 0.2 when it is in the permanently compressed state.
2. Expandable infusion packet (1) as claimed in claim 1 wherein the infusion packet has a density of at least 0.6 g/cm³ when it is in the permanently compressed state.
3. Expandable infusion packet (1) as claimed any one of claims 1 to 2 wherein the infusion packet being substantially rigid has a Vickers hardness (H_v) of at least 0.25 when it is in the permanently compressed state.
4. Expandable infusion packet (1) as claimed in claim 3 wherein the infusion packet has a Vickers hardness (H_v) of 0.3 to 0.8 when it is in the permanently compressed state.
5. Expandable infusion packet (1) as claimed in any one of claims 1 to 4 wherein the beverage precursor (6) has an uncompressed bulk density (ρ_{normal}) and a compressed bulk density ($\rho_{\text{compressed}}$), and wherein the compressed bulk density ($\rho_{\text{compressed}}$) of the beverage precursor is greater than the uncompressed bulk density (ρ_{normal}) of the beverage precursor by a factor of 1.5 to 3.
6. Expandable infusion packet (1) as claimed in claim 5 wherein the compressed bulk density ($\rho_{\text{compressed}}$) of the beverage precursor is greater than the uncompressed bulk density (ρ_{normal}) of the beverage precursor by a factor of 1.8 to 2.6.
7. Expandable infusion packet (1) as claimed in any one of claims 1 to 6 wherein the beverage precursor (6) comprises leaf tea.
8. Expandable infusion packet (1) as claimed in any one of claims 1 to 7 wherein the infusion packet has a volume V_C in the permanently compressed state and a volume V_E in the expanded state and wherein V_E is from $2V_C$ to $10V_C$.
9. Expandable infusion packet (1) as claimed in any one of claims 1 to 8 wherein the infusion packet has a first geometric shape in its permanently compressed state and a second geometric shape in its

expanded state, wherein the first and second geometric shapes are distinct.

10. Expandable infusion packet (1) as claimed in claim 9 wherein the first geometric shape is a cylinder. 5
11. Expandable infusion packet (1) as claimed in claim 9 wherein first geometric shape is a prism. 10
12. Expandable infusion packet (1) as claimed in any one of claims 9 to 11 wherein the second geometric shape is a sphere, a hemisphere, a tetrahedron or a pyramid. 10
13. Expandable infusion packet (1) as claimed in any one of claims 1 to 12 wherein the infusion packet is made from a non-woven material. 15
14. A package (9) comprising a plurality of expandable infusion packets (1) as claimed in any one of claims 1 to 13. 20
15. A package (9) as claimed in claim 14 wherein the package is a tube or a carton. 25

Patentansprüche

1. Expandierbares Aufgusspäckchen (1), das eine Getränkevorstufe (6) enthält, wobei das Aufgusspäckchen in Abwesenheit von Wasser (8) in einem permanent komprimierten Zustand ist und sich in Anwesenheit von Wasser (8) in einen expandierten Zustand umwandelt, wobei das Aufgusspäckchen (1) eine Dichte von mindestens $0,5 \text{ g/cm}^3$ aufweist, wenn es sich im permanent komprimierten Zustand befindet, und wobei das Aufgusspäckchen im Wesentlichen starr ist und eine Vickers-Härte (H_V) von mindestens 0,2 aufweist, wenn es sich im permanent komprimierten Zustand befindet. 30
2. Expandierbares Aufgusspäckchen (1) wie in Anspruch 1 beansprucht, wobei das Aufgusspäckchen eine Dichte von mindestens $0,6 \text{ g/cm}^3$ aufweist, wenn es sich im permanent komprimierten Zustand befindet. 35
3. Expandierbares Aufgusspäckchen (1) wie in irgendeinem der Ansprüche 1 bis 2 beansprucht, wobei das im Wesentlichen starre Aufgusspäckchen eine Vickers-Härte (H_V) von mindestens 0,25 aufweist, wenn es sich im permanent komprimierten Zustand befindet. 40
4. Expandierbares Aufgusspäckchen (1) wie in Anspruch 3 beansprucht, wobei das Aufgusspäckchen eine Vickers-Härte (H_V) von 0,3 bis 0,8 aufweist, wenn es sich im permanent komprimierten Zustand befindet. 45

befindet.

5. Expandierbares Aufgusspäckchen (1) wie in irgendeinem der Ansprüche 1 bis 4 beansprucht, wobei der Getränkevorstufe (6) eine unkomprimierte Schüttdichte (ρ_{normal}) und eine komprimierte Schüttdichte ($\rho_{\text{komprimiert}}$) aufweist und wobei die komprimierte Schüttdichte ($\rho_{\text{komprimiert}}$) der Getränkevorstufe um einen Faktor 1,5 bis 3 größer ist als die unkomprimierte Schüttdichte (ρ_{normal}) der Getränkevorstufe. 5
6. Expandierbares Aufgusspäckchen (1) wie in Anspruch 5 beansprucht, wobei die komprimierte Schüttdichte ($\rho_{\text{komprimiert}}$) der Getränkevorstufe um einen Faktor von 1,8 bis 2,6 größer ist als die unkomprimierte Schüttdichte (ρ_{normal}) der Getränkevorstufe. 10
7. Expandierbares Aufgusspäckchen (1) wie in irgendeinem der Ansprüche 1 bis 6 beansprucht, wobei die Getränkevorstufe (6) Blatttee umfasst. 15
8. Expandierbares Aufgusspäckchen (1) wie in irgendeinem der Ansprüche 1 bis 7 beansprucht, wobei das Aufgusspäckchen im permanent komprimierten Zustand ein Volumen V_C und im expandierten Zustand ein Volumen V_E aufweist und wobei V_E $2 V_C$ bis $10 V_C$ beträgt. 20
9. Expandierbares Aufgusspäckchen (1) wie in irgendeinem der Ansprüche 1 bis 8 beansprucht, wobei das Aufgusspäckchen in dessen permanent komprimierten Zustand eine erste geometrische Form aufweist und in dessen expandierten Zustand eine zweite geometrische Form aufweist, wobei die erste und zweite geometrische Form verschieden sind. 25
10. Expandierbares Aufgusspäckchen (1) wie in Anspruch 9 beansprucht, wobei die erste geometrische Form ein Zylinder ist. 30
11. Expandierbares Aufgusspäckchen (1) wie in Anspruch 9 beansprucht, wobei die erste geometrische Form ein Prisma ist. 35
12. Expandierbares Aufgusspäckchen (1) wie in irgendeinem der Ansprüche 9 bis 11 beansprucht, wobei die zweite geometrische Form eine Kugel, eine Halbkugel, ein Tetraeder oder eine Pyramide ist. 40
13. Expandierbares Aufgusspäckchen (1) wie in irgendeinem der Ansprüche 1 bis 12 beansprucht, wobei die Aufgusspäckchen aus einem Vliesmaterial ist. 45
14. Packung (9), umfassend mehrere expandierbare 50

Aufgusspäckchen (1) wie in irgendeinem der Ansprüche 1 bis 13 beansprucht.

15. Packung (9) wie in Anspruch 14 beansprucht, wobei die Packung ein Schlauch oder ein Karton ist.

Revendications

1. Sachet d'infusion extensible (1) contenant un précurseur de boisson (6), dans lequel le sachet d'infusion est dans un état comprimé permanent en l'absence d'eau (8) et se transforme en un état expansé en présence d'eau (8), dans lequel le sachet d'infusion (1) présente une densité d'au moins 0,5 g/cm³ lorsqu'il est dans l'état comprimé permanent, et dans lequel le sachet d'infusion est substantiellement rigide et présente une dureté Vickers (H_V) d'au moins 0,2 lorsqu'il est dans l'état comprimé permanent. 10
2. Sachet d'infusion extensible (1) selon la revendication 1, dans lequel le sachet d'infusion présente une densité d'au moins 0,6 g/cm³ lorsqu'il est dans l'état comprimé permanent. 15
3. Sachet d'infusion extensible (1) selon l'une quelconque des revendications 1 à 2, dans lequel le sachet d'infusion substantiellement rigide présente une dureté Vickers (H_V) d'au moins 0,25 lorsqu'il est dans l'état comprimé permanent. 20
4. Sachet d'infusion extensible (1) selon la revendication 3, dans lequel le sachet d'infusion présente une dureté Vickers (H_V) de 0,3 à 0,8 lorsqu'il est dans l'état comprimé permanent. 25
5. Sachet d'infusion extensible (1) selon l'une quelconque des revendications 1 à 4, dans lequel le précurseur de boisson (6) présente une masse volumique apparente non comprimée (ρ_{normal}) et une masse volumique apparente comprimée ($\rho_{comprimé}$), et dans lequel la masse volumique apparente comprimée ($\rho_{comprimé}$) du précurseur de boisson est supérieure à la masse volumique apparente non comprimée (ρ_{normal}) du précurseur de boisson d'un facteur de 1,5 à 3. 30
6. Sachet d'infusion extensible (1) selon la revendication 5, dans lequel la masse volumique apparente comprimée ($\rho_{comprimé}$) du précurseur de boisson est supérieure à la masse volumique apparente non comprimée (ρ_{normal}) du précurseur de boisson d'un facteur de 1,8 à 2,6. 35
7. Sachet d'infusion extensible (1) selon l'une quelconque des revendications 1 à 6, dans lequel le précurseur de boisson (6) comprend du thé en feuille. 40

8. Sachet d'infusion extensible (1) selon l'une quelconque des revendications 1 à 7, dans lequel le sachet d'infusion présente un volume V_C dans l'état comprimé permanent et un volume V_E dans l'état expansé et dans lequel V_E est de $2V_C$ à $10V_C$. 45
9. Sachet d'infusion extensible (1) selon l'une quelconque des revendications 1 à 8, dans lequel le sachet d'infusion présente une première forme géométrique dans son état comprimé permanent et une seconde forme géométrique dans son état expansé, dans lequel les première et seconde formes géométriques sont distinctes. 50
10. Sachet d'infusion extensible (1) selon la revendication 9, dans lequel la première forme géométrique est un cylindre. 55
11. Sachet d'infusion extensible (1) selon la revendication 9, dans lequel la première forme géométrique est un prisme. 60
12. Sachet d'infusion extensible (1) selon l'une quelconque des revendications 9 à 11, dans lequel la seconde forme géométrique est une sphère, un hémisphère, un tétraèdre ou une pyramide. 65
13. Sachet d'infusion extensible (1) selon l'une quelconque des revendications 1 à 12, dans lequel le sachet d'infusion est constitué d'un matériau non-tissé. 70
14. Emballage (9) comprenant plusieurs sachets d'infusion extensibles (1) selon l'une quelconque des revendications 1 à 13. 75
15. Emballage (9) selon la revendication 14, dans lequel l'emballage est un tube ou un carton. 80

Fig. 1a

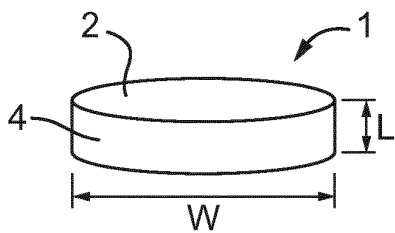


Fig. 1b

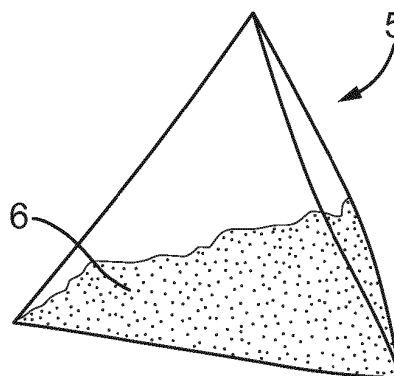


Fig. 2a

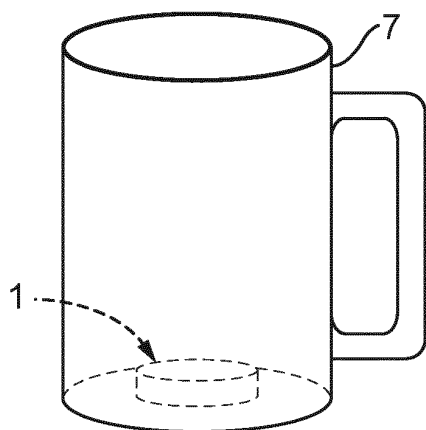


Fig. 2b

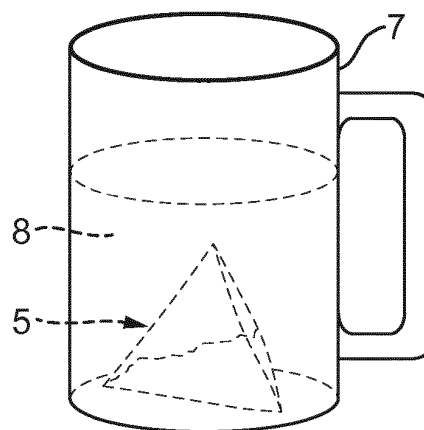


Fig. 3a

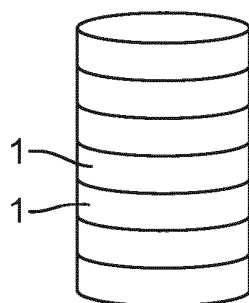


Fig. 3b

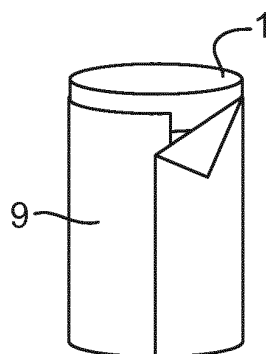


Fig. 3c

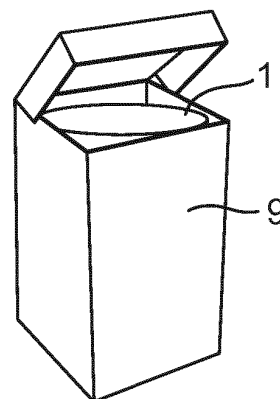


Fig. 4a

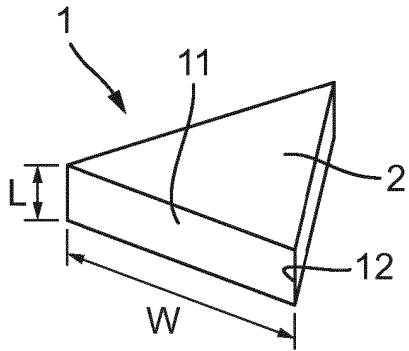


Fig. 4b

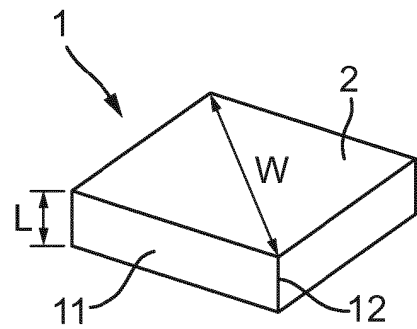


Fig. 4c

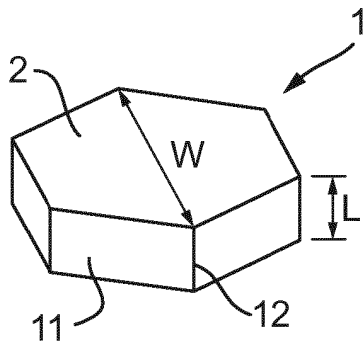


Fig. 4d

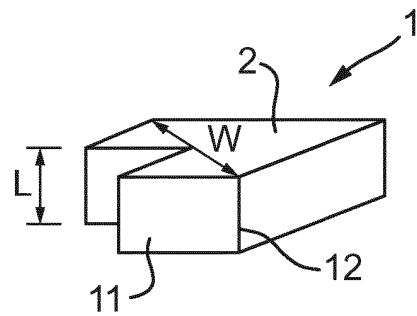


Fig. 5a

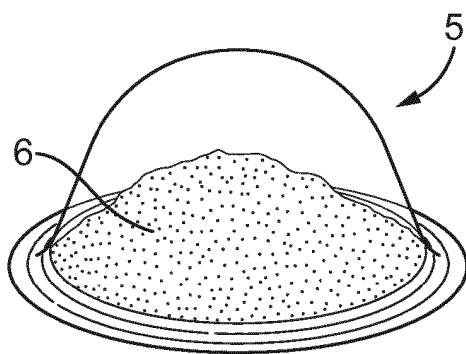


Fig. 5b

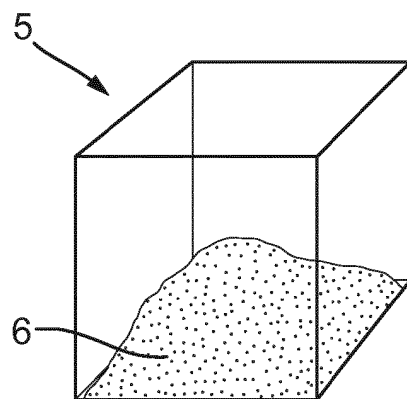


Fig. 6

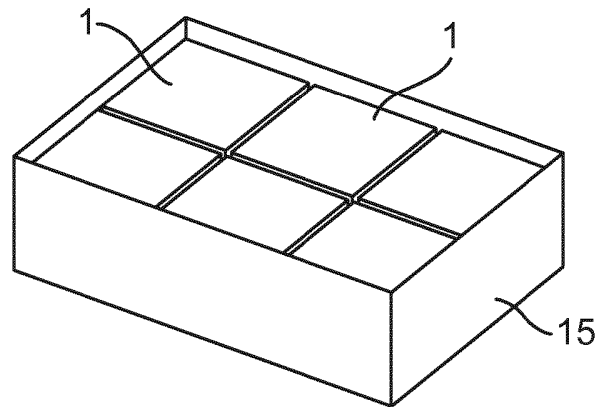


Fig. 7a

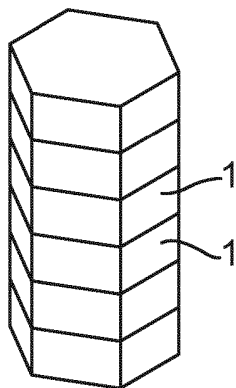


Fig. 7b

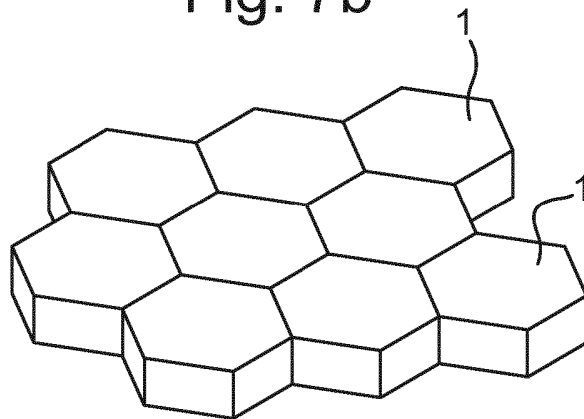
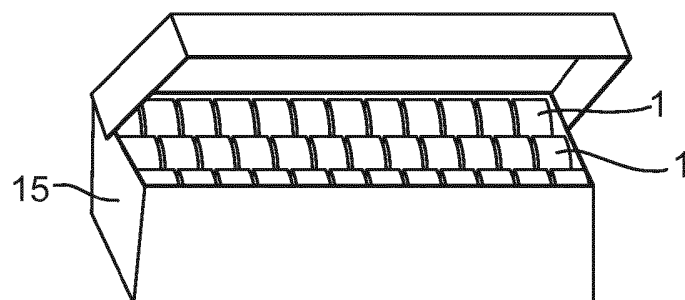


Fig. 8



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE 29621889 U1, Holthoff **[0003]**
- WO 9501907 A, Unilever **[0004]** **[0049]**
- EP 0053204 A, Unilever **[0007]**
- WO 2013174710 A, Unilever **[0008]**
- EP 0846632 A, Fuso Sangyo Kabushiki Kaisha **[0009]**
- EP 0811562 A, Unilever **[0049]**
- WO 2012095247 A, Unilever **[0049]**
- WO 2005051797 A, Tetley **[0049]**
- WO 2004033303 A **[0049]**
- WO 2012004169 A, Unilever **[0049]**