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(54) **INFUSION PACKETS**

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## 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]** 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.

**[0004]** 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.

**[0005]** Efforts have been made to provide three-dimensional infusion packets that have a flattened configuration for packing.

**[0006]** 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.

**[0007]** DE 296 21 889 U1 relates to an infusion bag for the preparation of a coffee beverage.

**[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, 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 substantially rigid structure such that it does not deform when handled 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.

**[0015]** In a third aspect, the present invention relates to a method of manufacturing an expandable infusion packet according to the first aspect of the invention.

### Detailed description of the invention

**[0016]** The present invention relates to an expandable infusion packet, 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.

**[0017]** 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.

**[0018]** 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.

**[0019]** 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.

**[0020]** When the infusion packets of the present invention are in their permanently compressed state they do not deform when handled and have a substantially rigid structure. When they adopt their expanded state in the presence of water, they become deformable and have a flexible structure (in other words they lose the rigidity they preferably possess in their permanently compressed state).

**[0021]** 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.

**[0022]** 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.

**[0023]** 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.

**[0024]** 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.

**[0025]** 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).

**[0026]** 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.

**[0027]** 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.

**[0028]** 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).

**[0029]** 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.

**[0030]** It is preferred that the first geometric shape is a cylinder or a prism.

**[0031]** 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.

**[0032]** 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).

**[0033]** 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.

**[0034]** 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.

**[0035]** The first geometric shape preferably has a width (*W*), wherein the width (*W*) is greater than or equal to the length (*L*).

**[0036]** 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.

**[0037]** 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 4mm. 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.

**[0038]** 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.

**[0039]** 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.

**[0040]** 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.

**[0041]** 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.

**[0042]** 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).

**[0043]** 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.

**[0044]** The expandable infusion packet has a volume Vc in the permanently compressed state and a volume $V_E$ in the expanded state. In order 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 $6V_C$.

**[0045]** 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).

**[0046]** 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.

**[0047]** 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.

**[0048]** 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 sufficiently compact that the infusion packets can be conveniently carried around by the consumer or kept at work.

**[0049]** 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).

**[0050]** 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).

**[0051]** 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.

**[0052]** 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.

**[0053]** 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.*

**[0054]** 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 that conventional non-compressed infusion packets. 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.

**[0055]** 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).

**[0056]** 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-shapes, 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).

**[0057]** In a third aspect, the present invention relates to a method of manufacturing an expandable infusion packet according to the first aspect of the invention.

**[0058]** In particular, the invention relates to a method comprising the following steps:

(a) providing an infusion packet in an expanded state;

(b) inserting the infusion packet in a die;

(c) applying pressure so as to convert the infusion packet to a permanently compressed state, wherein the infusion packet has a substantially rigid structure such that it does not deform when handled in the

permanently compressed state.

**[0059]** 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. Thus 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.

**[0060]** 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.

**[0061]** The pressure applied in step (c) is preferably from 3000 to 4200 kPa, more preferably from 3100 to 4100 kPa. Factors which influence the appropriate pressure include 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. The pressure is preferably applied via a piston which fits into the die. It is preferred that the piston is metallic, for example it can conveniently be made of aluminium. The die and the piston are preferably made from different metals.

**[0062]** 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**

**[0063]** 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.

**[0064]** 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.

**[0065]** 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.

**[0066]** Figure 2 illustrates the conversion of an expandable 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.

**[0067]** 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.

**[0068]** As shown by Figure 3, the compressed infusion packets of the present invention can be conveniently packaged.

**[0069]** 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).

**[0070]** 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.

**[0071]** 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).

**[0072]** Although not illustrated, it will be appreciated that yet more secondary packaging formats are possible (e.g. a cardboard or plastic tube, *etc*.).

**[0073]** The shape of the expandable infusion packet in its permanently compressed state may be prismatic. Figure 4 shows some possible prismatic configurations.

**[0074]** 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.

**[0075]** 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.

**[0076]** 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.

**[0077]** 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.

**[0078]** 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.

**[0079]** 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.

**[0080]** 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.

**[0081]** 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 tessalate, thus resulting in a very efficient use of the internal space within the carton.

**[0082]** Figure 7 illustrates different arrangements a plurality of compressed infusion packets. 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).

**[0083]** 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 tessalate. The layer of expandable infusion packets can be packaged so as to maintain this arrangement (e.g. by packaging them in a cardboard carton).

**[0084]** 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 tessalate. 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.

**[0085]** 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

**[0086]** 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 $mm^3$.

**[0087]** 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 500 psi (~3447 kPa) pressure 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 ~34 mm, and the length (*L*) was ~7.5 mm. The volume of the tea bag in the permanently compressed state ($V_C$) was -6809 $mm^3$.

**[0088]** 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.

**[0089]** 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.

## Claims

1. Expandable infusion packet, wherein the infusion packet is in a permanently compressed state (**1**) in the absence of water and converts to an expanded state (**5**) in the presence of water, and wherein the infusion packet has a substantially rigid structure such that it does not deform when handled in the permanently compressed state (**1**).

2. Expandable infusion packet as claimed in claim 1 wherein the infusion packet has a volume $V_C$ in the permanently compressed state (**1**) and a volume $V_E$ in the expanded state (**5**) and wherein $V_E$ is from $2V_C$ to $10V_C$.

3. Expandable infusion packet as claimed claim 1 or claim 2 wherein the infusion packet has a first geometric shape in its permanently compressed state (**1**) and a second geometric shape in its expanded state (**5**), wherein the first and second geometric shapes are distinct.

4. Expandable infusion packet as claimed in claim 3 wherein the first geometric shape is a cylinder.

5. Expandable infusion packet at claimed in claim 3 wherein first geometric shape is a prism.

6. Expandable infusion packet as claimed in any one of claims 3 to 5 wherein the second geometric shape is a sphere, a hemisphere, a tetrahedron or a pyramid.

7. Expandable infusion packet as claimed in any one of claims 1 to 6 wherein the infusion packet is made from a non-woven material.

8. A package (9, 15) comprising a plurality of expandable infusion packets as claimed in any one of claims 1 to 7.

9. A package (**9, 15**) as claimed in claim 8 wherein the package (**9, 15**) is a tube or a carton.

10. A package (**9, 15**) as claimed in claim 9 wherein the package (**9, 15**) is a tube and the first geometric shape is a cylinder.

11. A package (**9, 15**) as claimed in claim 9 wherein the package (**9, 15**) is a carton and the first geometric shape is a square or rectangular prism.

12. A package (**9, 15**) as claimed in claim 9 wherein the package (**9, 15**) is a carton and the first geometric shape is a cylinder.

13. A method of manufacturing an expandable infusion packet as claimed in any one of claims 1 to 7, the method comprising:

(a) providing an infusion packet in an expanded state (5);
(b) inserting the infusion packet in a die;
(c) applying pressure so as to convert the infusion packet to a permanently compressed state (1), wherein the infusion packet has a substantially rigid structure such that it does not deform when handled in the permanently compressed state (1).

14. A method as claimed in claim 13 wherein the pressure applied in step (c) is from 3000 to 4200 kPa.

**Patentansprüche**

1. Expandierbare Aufgusspackung, wobei sich die Aufgusspackung in Abwesenheit von Wasser in einem dauerhaft komprimierten Zustand (1) befindet und in Anwesenheit von Wasser in einen expandierten Zustand (5) übergeht und wobei die Aufgusspackung einen im Wesentlichen starren Aufbau aufweist, so dass sie sich nicht verformt, wenn sie in dem dauerhaft komprimierten Zustand (1) gehandhabt wird.

2. Expandierbare Aufgusspackung nach Anspruch 1, wobei die Aufgusspackung in dem dauerhaft komprimierten Zustand (1) ein Volumen $V_C$ aufweist und in dem expandierten Zustand (5) ein Volumen $V_E$ aufweist, und wobei $V_E$ im Bereich von $2V_C$ bis $10V_C$ liegt.

3. Expandierbare Aufgusspackung nach Anspruch 1 oder Anspruch 2, wobei die Aufgusspackung eine erste geometrische Form in ihrem dauerhaft komprimierten Zustand (1) und eine zweite geometrische Form in ihrem expandierten Zustand (5) aufweist, wobei sich die erste und die zweite geometrische Form unterscheiden.

4. Expandierbare Aufgusspackung nach Anspruch 3, wobei die erste geometrische Form ein Zylinder ist.

5. Expandierbare Aufgusspackung nach Anspruch 3, wobei die erste geometrische Form ein Prisma ist.

6. Expandierbare Aufgusspackung nach einem der Ansprüche 3 bis 5, wobei die zweite geometrische Form eine Kugel, eine Halbkugel, ein Tetraeder oder eine Pyramide ist.

7. Expandierbare Aufgusspackung nach einem der Ansprüche 1 bis 6, wobei die Aufgusspackung aus einem Vliesmaterial hergestellt ist.

8. Verpackung (9, 15), die Folgendes umfasst: mehrere expandierbare Aufgusspackungen nach einem der Ansprüche 1 bis 7.

9. Verpackung (9, 15) nach Anspruch 8, wobei die Verpackung (9, 15) eine Röhre oder eine Schachtel ist.

10. Verpackung (9, 15) nach Anspruch 9, wobei die Verpackung (9, 15) eine Röhre ist und die erste geometrische Form ein Zylinder ist.

11. Verpackung (9, 15) nach Anspruch 9, wobei die Verpackung (9, 15) eine Schachtel ist und die erste geometrische Form ein quadratisches oder rechteckiges Prisma ist.

12. Verpackung (9, 15) nach Anspruch 9, wobei die Verpackung (9, 15) eine Schachtel ist und die erste geometrische Form ein Zylinder ist.

13. Verfahren zum Herstellen einer expandierbaren Aufgusspackung nach einem der Ansprüche 1 bis 7, wobei das Verfahren die folgenden Schritte umfasst:

(a) Bereitstellen einer Aufgusspackung in einem expandierten Zustand (5);
(b) Einlegen der Aufgusspackung in einen Stempel;
(c) Aufbringen von Druck, um die Aufgusspackung in einen dauerhaft komprimierten Zustand (1) zu versetzen, wobei die Aufgusspackung einen im Wesentlichen starren Aufbau aufweist, so dass sie sich nicht verformt, wenn sie in dem dauerhaft komprimierten Zustand (1) gehandhabt wird.

14. Verfahren nach Anspruch 13, wobei der in Schritt (c) aufgebrachte Druck im Bereich von 3000 bis 4200 kPa liegt.

**Revendications**

1. Infusette expansible, laquelle infusette est dans un état comprimé en permanence (1) en l'absence d'eau et se convertit en un état expansé (5) en présence d'eau, et laquelle infusette a une structure sensiblement rigide telle qu'elle ne se déforme pas lorsqu'elle est manipulée dans l'état comprimé en permanence (1).

2. Infusette expansible selon la revendication 1, laquelle infusette a un volume Vc dans l'état comprimé en permanence (1) et un volume $V_E$ dans l'état expansé

(5), dans laquelle $V_E$ vaut de 2Vc à 10$V_C$.

**3.** Infusette expansible selon la revendication 1 ou 2, laquelle infusette a une première forme géométrique dans son état comprimé en permanence (1) et une deuxième forme géométrique dans son état expansé (5), dans laquelle les première et deuxième formes géométriques sont distinctes.

**4.** Infusette expansible selon la revendication 3, dans laquelle la première forme géométrique est un cylindre.

**5.** Infusette expansible selon la revendication 3, dans laquelle la première forme géométrique est un prisme.

**6.** Infusette expansible selon l'une quelconque des revendications 3 à 5, dans laquelle la deuxième forme géométrique est une sphère, une demi-sphère, un tétraèdre ou une pyramide.

**7.** Infusette expansible selon l'une quelconque des revendications 1 à 6, laquelle infusette expansible est faite en un matériau non tissé.

**8.** Conditionnement (9, 15) comprenant une pluralité d'infusettes expansibles selon l'une quelconque des revendications 1 à 7.

**9.** Conditionnement (9, 15) selon la revendication 8, lequel conditionnement (9, 15) est un tube ou une boîte en carton.

**10.** Conditionnement (9, 15) selon la revendication 9, lequel conditionnement (9, 15) est un tube et la première forme géométrique est un cylindre.

**11.** Conditionnement (9, 15) selon la revendication 9, lequel conditionnement (9, 15) est une boîte en carton et la première forme géométrique est un prisme carré ou rectangulaire.

**12.** Conditionnement (9, 15) selon la revendication 9, lequel conditionnement (9, 15) est une boîte en carton et la première forme géométrique est un cylindre.

**13.** Procédé de fabrication d'une infusette expansible selon l'une quelconque des revendications 1 à 7, le procédé comprenant :

(a) l'obtention d'une infusette dans un état expansé (5) ;
(b) l'insertion de l'infusette dans une matrice ;
(c) l'application de pression de façon que l'infusette soit convertie en un état comprimé en permanence (1), laquelle infusette a une structure sensiblement rigide telle qu'elle ne se déforme pas lorsqu'elle est manipulée dans l'état comprimé en permanence (1).

**14.** Procédé selon la revendication 13, dans lequel la pression appliquée dans l'étape (c) est de 3000 à 4200 kPa.

Fig. 1a

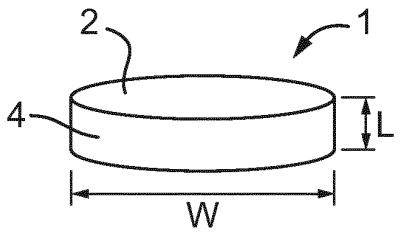



Fig. 1b

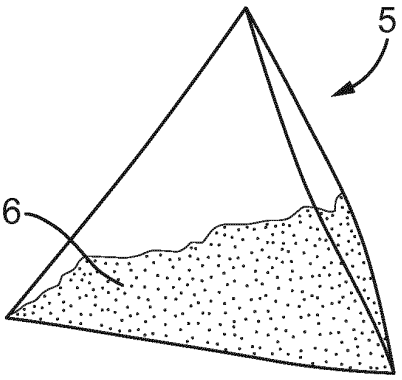



Fig. 2a

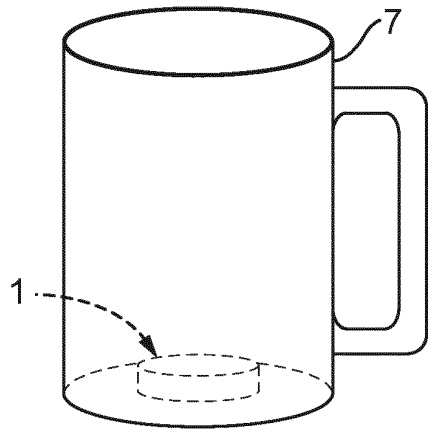



Fig. 2b

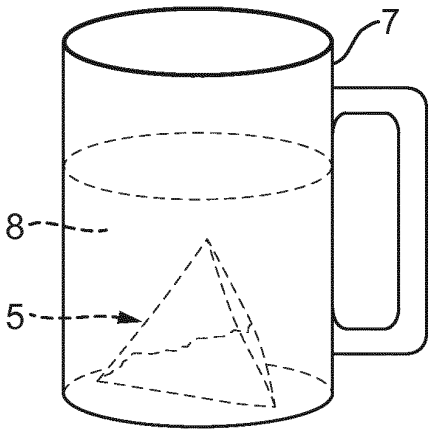



Fig. 3a

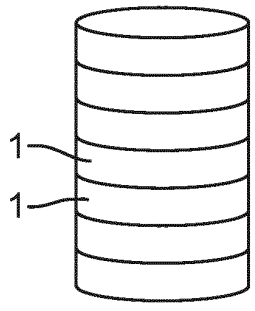



Fig. 3b

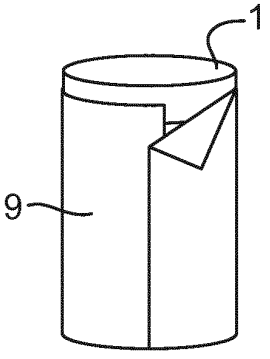



Fig. 3c

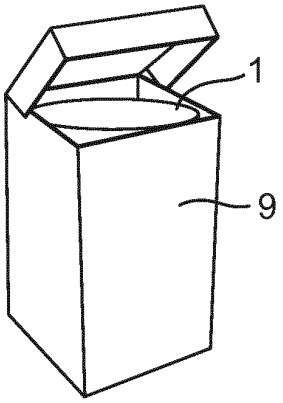


Fig. 4a

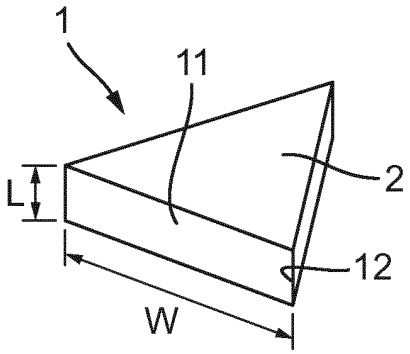



Fig. 4b

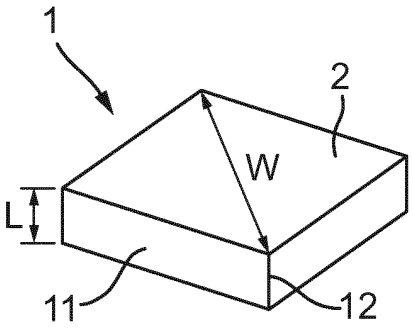



Fig. 4c

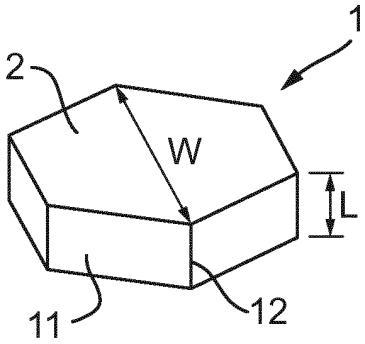



Fig. 4d

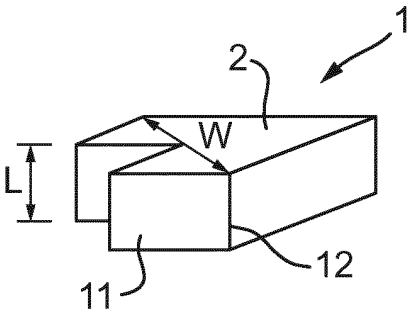



Fig. 5a

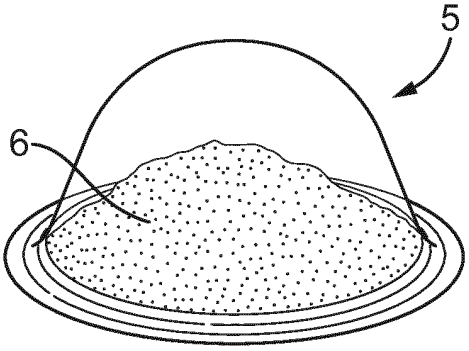



Fig. 5b

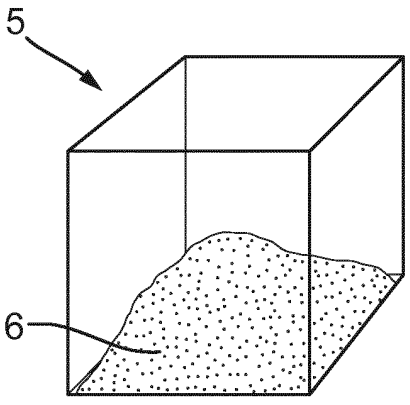


Fig. 6

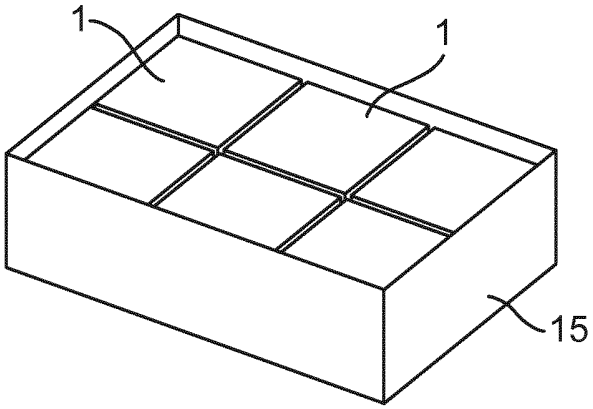



Fig. 7a

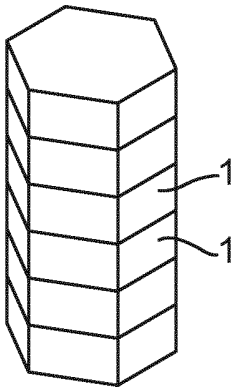



Fig. 7b

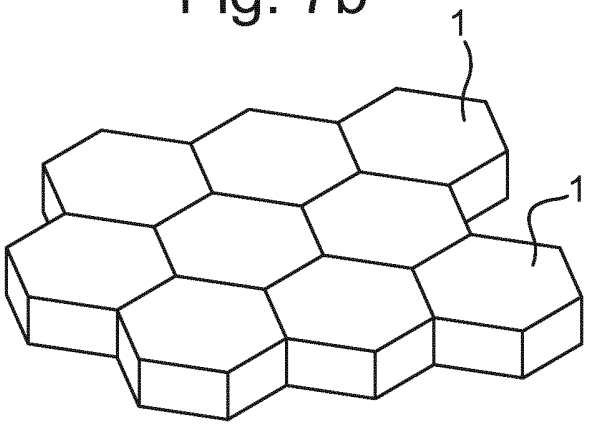
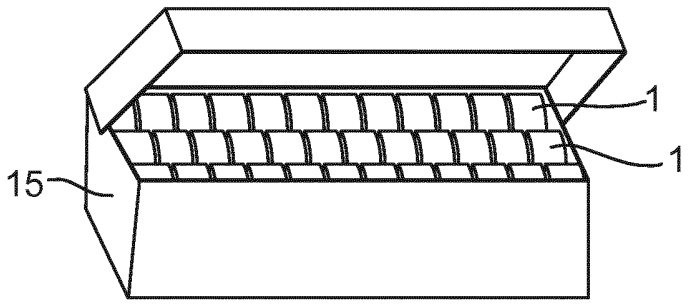



Fig. 8



## REFERENCES CITED IN THE DESCRIPTION

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