

PORTION CAPSULE FOR PREPARING A BREWED PRODUCT

The invention relates to the preparation of drinks or likewise, from an extraction material, for example ground coffee, which is contained in a capsule. In particular, it relates to a capsule with an extraction material, as well as to a method for manufacturing such a capsule.

Extraction appliances for preparing drinks from an extraction material present in a portion package are known for example as coffee machines, espresso machines or also tea machines and are enjoying increasing popularity as was hitherto the case. In many corresponding systems, the portion packages are designed as capsules, in which the extraction material is closed off, for example in an airtight manner. The capsule is pierced at two opposite sides, for the extraction. A brewing fluid - generally hot water - is introduced at the first side. The brewed product is led out of the capsule at the second side. Thereby, a considerable pressure for example of 5 - 20 bar must prevail in the inside of the capsule - also less for filter coffee or tea - depending on the drink to be prepared and the system.

In particular, aluminium and plastics, for example polypropylene have become known as capsule materials. Aluminium capsules provide a very good durability (aroma protection) of the extraction material, but are very energy-costly in manufacture. Polypropylene capsules are advantageous with regard to the energy expense and disposal, but impose increased demands on the piercing mechanism and the aroma protection.

A coffee portion capsule which approximately has a cube shape and in contrast to the known beaker-like capsules has no peripheral collar on the plane of the one (upper-side) cover surface is known from WO 2010/118543. Such a peripheral collar is required with capsule systems according to the state of the art, firstly so as to guide the capsule on insertion into the extraction appliance and to hold it in an intermediate position after insertion. Secondly, the collar on the plane of the upper-side cover surface is necessary, in order to be able to seal off the capsule when introducing the brewing fluid, by way of clamping in the collar between suitable sealing elements of the extraction appliance, so that the brewing fluid which is under pressure cannot flow past the capsule. Thirdly, such a collar is necessary for the closure of the capsule by way of ultrasound welding or thermal sealing by way of a flat cover (which can also be designed as a foil). The collar is required, in order to accommodate an energy director, given a closure by way of ultrasound welding. If the capsule is closed by way of thermal sealing, the collar is necessary, so that the cover lies on a sufficiently large surface. In contrast to this, an arched cover is used according to WO 2010/118543, and the closure is effected for example by way of ultrasound cut'n'seal. The capsule manufactured according to the teaching of WO 2010/118543 accordingly, independently of its ("cube") shape, has a welding bead which is peripheral

between the planes defined by the cover surface, forms only a minimal collar and whose extension / lateral projection however is significantly reduced in comparison to the collar of known capsules.

The capsule according to WO 2010/118543 has significant advantages, which are also described in this document. However, it remains a challenge to reliably fasten the cover on the main body whilst taking into consideration to limitations in the dimensioning of the peripheral welding bead.

Accordingly, it is an object of the present invention, to further develop capsules of the type described in WO 2010/118543, to the extent that a reliable and particularly pressure-resistant closure of the capsule is rendered possible.

According to an aspect of the invention, a capsule with an extraction material is provided, said capsule comprising:

- a main body with a bottom region and with a peripheral side wall; and
- a cover which is fastened on the main body;
- wherein the cover is fastened on the main body along a peripheral collar, wherein the collar towards a cover side connects to the peripheral side wall;
- wherein the main body in the region of the collar has an essentially rectangular cross section;
- wherein the cover forms an outward arching, so that the cover contributes to a capsule volume;
- wherein a peripheral surface facing the cover side is formed, said surface extending from an outer edge of the collar up to a base of the arching;
- and wherein the base of the arching is offset inwards in comparison to the transition between the side wall and the collar.

The main body with the bottom region and the peripheral side wall form a type of beaker which is closed by the cover. Thereby, the bottom region can be flat, but this is not a necessity. The extraction material is firstly filled into the beaker on manufacture of the capsule. The collar of the main body and/or also the corresponding counter-piece of the cover can have an overdimension in this condition, wherein these regions are separated away later in the method.

As is known per se, the extraction material can be slightly compressed by way of a suitable pressing, on being filled into the main body. On closure of the capsule by the cover, the main body is then held such that its axis is vertical, whereupon the cover is placed on at the top and then fastened. Thereby, in particular the collar can be held from below by a supporting tool.

The offset – measured between the locations of the greatest curvature, in the transition between the cover-side surface formed by the collar and the arching, and in the transition between the main-body-side surface formed by the collar and the main body outer surface - is at least 0.15 mm or 0.2 mm, for example at least 0.3 mm.

The surface which faces the cover side extends further inwards in comparison to the dimension of the collar on account of the discussed offset. Surprisingly, it has been found that this entails advantages with regard to manufacturing technology. A tool which during an ultrasound welding procedure - an ultrasound cut'n'seal procedure or an ultrasound welding procedure which is not combined with a separating / cutting procedure - is applied from above, i.e. from the cover side, during a thermal connection process or as the case may be also during another connection process (for example by way of bonding), specifically can engage along a greater area without the collar having to be extended further by way of this. What is surprising is the fact that this is advantageous, despite the fact that, in contrast to the complete state of the art, on account of the offset, the tool also engages where no counter-part in the form of a further tool supporting the collar is present, and for example even radially within the beaker volume.

The fact that this can function and does not simply lead to an ineffectual pressing of the cover inwards during manufacture, amongst other things is due to the self-stiffening effect of the cover arching. The rectangular basic shape with the stiffening corners forming by way of this can also contribute to this. Finally, the main body in the region of the portion connecting to the collar can optionally also be provided with an inward thickening, which likewise contributes to a counter-pressure also counteracting the pressure of the tool, where the tool does not directly have a counter-part in the form of a counter-tool to be applied below the collar.

In reality, the positioning accuracy of the cover on the main body is not perfect on manufacture. Fluctuations in the claimed offset arise due to this. The position of the cover will fluctuate in the x and y direction, at most by up to 0.2 mm. Moreover, the cover can be slightly twisted with respect to the main body, specifically only in a range of up to 2° or even up to 3°. The values which are described and claimed in this text always relate to an average value for these reasons.

The shape of the capsule is such that the main body in the region of the collar is essentially rectangular, for example essentially square in cross section. The collar itself - for example its outer edge - can also be essentially rectangular, in particular square. "Essentially rectangular" or "essentially square" in particular does not exclude rounded corners.

The capsule as a whole - with the exception of the discussed offset and the collar - can have the shape of a cube or cuboid, in particular of a cube. In embodiments, the collar can project

laterally maximally by 2 mm, in particular maximally by 1.5 mm. The cube shape does not rule out an inclination of the peripheral side surfaces to the axis (perpendicular to the bottom surface and/or cover surface) of for example maximal 3°, in particular maximal 2° or maximal 1.5°, which for example is inherent of manufacture with deep-drawn capsules.

The shape of the cover, from the outside to the inside, can comprise the collar region forming the surface facing the cover side, an arcuate transition region and a middle flat region forming the actual upper-side cover surface. Such a flat region is set away, which is to say shouldered outwards from the plane of the collar, on account of the transition region effecting the arching. The transition region for example can be curved in an S-shaped manner or run in a constantly curved manner from an outer portion which is at an angle to the collar plane, towards the middle flat region. The dimensioning is thereby selected for example such that the middle flat region is optically dominant, for example by way of it being as equally large as or only insignificantly (for example by maximal 10%) smaller than the bottom surface. In particular, one can envisage this flat region assuming more than 60% of the diameter and accordingly at least 40% of the surface.

The main body as well as the cover for example are manufactured of plastic. In particular, one can envisage the main body and the cover consisting of the same plastic. Polypropylene is mentioned as an example of a material, wherein a barrier layer can be incorporated and this has barrier characteristics for oxygen and prevents a diffusion of oxygen into the capsule. Such a barrier layer for example comprises an ethylene vinylalcohol copolymer (EVOH). The wall thickness in the region of the main body in particular is between 0.1 mm to 0.5mm, preferably between 0.2 mm and 0.4 mm, for example between 0.25 mm and 0.35 mm. The same can also apply to the wall thickness of the cover. In an embodiment, the wall thickness of the cover roughly corresponds to the wall thickness of the main body.

Other plastics are also considered instead of polypropylene. The application of the invention to non-plastics is also not to be ruled out.

The main body can be manufactured with the deep drawing method. Alternatively, the manufacture by way of injection moulding is also considered. The same applies to the cover, wherein the deep drawing method can also be considered as an embossing method due to its limited depth. Combinations with an injection moulded main body and a deep-drawn cover and vice versa are possible.

With an embodiment essentially with a cube shape, the outer length of the cube edges for example is between 24 and 30 mm for a filling quantity of approx. 6 g and approx. 10 g of

coffee. Larger dimensions, for example of up to 35 mm, are not to be ruled out for larger filling quantities.

A method for manufacturing a capsule of the described type can comprise the following steps:

- providing a main body;
- filling the main body with the extraction material;
- placing the cover upon the main body, so that the main body and the cover together form the peripheral collar;
- fastening the cover on the main body along the peripheral collar amid the introduction of energy.

The fastening of the cover on the main body according to a first embodiment is effected by way of ultrasound welding. According to a first possibility, the ultrasound cut'n'seal method is applied, with which a possibly projecting edge of the cover and of the main body is also separated away by way of the effect of the ultrasound. According to a second possibility, such a separation is effected in a separate machining step, for example by way of punching.

In an embodiment – and this is an option for both possibilities – an energy director is present on the cover and not on the main body, for the ultrasound welding method. This has been found to be particularly advantageous for the connection between the main body and the cover.

In a second embodiment, the fastening of the cover on the main body is effected by way of heat transfer from a heated tool. In a third embodiment, the fastening is effected by way of laser welding. In a fourth embodiment this is effected by bonding.

Combinations, for example with the melting-on of an adhesive by way of ultrasound and/or heat (thus actually a soldering method) or with the use of a heated sonotrode in a combined thermal / ultrasound method etc. are possible

Embodiment examples of the invention are hereinafter described by way of drawings. In the drawings, the same reference numerals indicate the same or analogous elements. The drawings are not true to scale and show elements which partly correspond to one another in sizes which differ from figure to figure. There are shown in:

Fig. 1 a capsule in a lateral view;

Fig. 2 the capsule according to Fig. 1 in an alternative view;

- Fig. 3 a sectioned representation of the capsule in the region of the collar;
- Fig. 4 a sectioned representation according to Fig. 3, with schematically represented tools;
- Fig. 5 a view of a cover represented in a sectioned manner; and
- Fig. 6 a view of an alternative cover which is likewise represented in a sectioned manner.

The capsule 1 according to **Figures 1 and 2** and which is filled with an extraction material – in particular ground coffee - essentially has the shape of a cube with rounded edges. The expanse however increases slightly towards to side lying at the top, so that the capsule has a truncated pyramid shape in the strict mathematical sense. The inclination angle of the surfaces which are lateral in the figure, with respect to the perpendicular to the base surface 5 - what is meant of course is that plane which is perpendicular to the base surface and which runs through the edge between the base (bottom) surface and the corresponding lateral surface - is very small and at the most is preferably 2° , for example only approx. 1° . Moreover, the height of the capsule above the base surface corresponds approximately to the length of the bottom surface edges.

The capsule comprises a main body (or beaker) 2 and a cover 3 which is fastened thereon along a peripheral collar 4. The main body forms a capsule bottom 5 and a peripheral side wall 6 which, at its end which is at the outside with respect to the axial directions (axis 10) and which is at the top in the figure, is terminated by the collar 4. The cover is arched outwards, by way of the cover surface 9 which is essentially parallel to the capsule bottom 5 being offset outwards with respect to the peripheral collar 4.

The peripheral collar forms a surface 8 which faces the cover side and which extends from the outer edge 7 of the collar up to the base 12 of the arching. **Figure 3** shows an enlarged detail of the capsule in a sectioned representation. As one can see particularly well in this figure, the base 12 is offset inwards with respect to the transition between the collar 4 and the peripheral side wall formed by the main body 2. The offset v is thereby relevant compared to the thickness of the capsule wall; in particular it is at least 0.2 mm. The offset v , as is illustrated in Figure 3, is measured between the planes which are parallel to the outer surface of the main body in the region of the collar 4 and which go through the location of maximal concave curvature in the transition between the cover-side surface 8 of the collar and arching of the cover, and between the main-body-side surface 18 of the collar 4 and the outer surface of the main body.

As one can particularly see in Figures 1 and 3, the cover 8 between the collar region and the actual cover surface 9 forms a transition region 13, in which the wall has a curvature and thus forms the arching. In the drawn example, this region, departing from a portion which is almost at a right angle to the collar plane and the cover surface 9, merges with a continuous convex curvature into the flat region forming the cover surface. The concave curvature is therefore large (i.e. the radius of curvature is small) at the base 12. However, it would also be conceivable to assimilate the concave and the convex curvature to one another to a greater extent, by which means a course which is S-shaped in cross section would then result. It is ensured that the middle flat region makes up a large part of the cover surface (at least 40%) and therefore that the cube or cuboid shape as a whole is not compromised, by way of the surfaced limitation of the transition region.

Figures 2 and 3 also show a groove 11 in the region of the peripheral collar 4 in the surface 8. Such a groove can be present if the cover is manufactured by way of deep-drawing (or embossing) and an energy director 23 is present on the cover for the welding of the cover 3 to the main body 2. Such a groove is not present in other embodiments - for example if the energy director is not present on the cover or if the cover is manufactured by way of injection moulding despite comprising an energy director.

An optional thickening 14 is likewise visible in the transition between the peripheral side wall and the collar, in Figure 3. Such a thickening serves for the additional stiffening.

Figure 4 in a very schematic manner shows an arrangement during the closure of the capsule. A first tool 21 – for example an “anvil” – supports the capsule from the bottom along the peripheral collar, whilst a second tool 22 engages from above. The energy for the welding of the main body 2 and the cover 3 can be coupled in for example from the second tool 22, and this energy can be present in the form of ultrasound or as thermal energy. The peripheral collar can extend further to the outside at the beginning of the fastening procedure, wherein its outer-lying portions can then be separated away for example during the fastening procedure with the ultrasound cut’n’séal method (the tools 21, 22 are then shaped accordingly, in contrast to the very schematic representation), or such further laterally protruding portions can be separated away in a separate, subsequent working step. The details of the fastening procedure and of the separating-away of the protruding collar portion are not the subject-matter of the present invention and are not explained in more detail here.

It is clear from Figure 4, that the second tool 22 which couples in the energy can be applied further radially inwards on account of the offset v discussed above. A radially inwardly lying region 25 thus begins where no counter-part in the form of the first tool is present and the tool pressure is not directly met with a counter-pressure.

It has been found that this is advantageous with regard to the strength of the connection, and specifically despite the fact that the first tool 21 cannot directly apply a counter-force in the inner region, since it is applied further outwards than the second tool 22 coupling in the energy. The advantage as explained beforehand results from the intrinsic stiffness of the main body and the cover due to their shape, wherein the intrinsic stiffness here is further increased by the thickening 14.

This advantage also exists in the case of ultrasound welding methods with an energy director - the position of such an energy director 23 is illustrated in Figure 3 and 4 - even if the energy director 23 is in the region, in which the first tool 21 can exert a counter force, as is shown in the figure.

The cover 3 can be seen before the fastening on main body, in **Figure 5**. The energy director 23 which in contrast to capsules from the state of the art is formed on the cover and not on the main body is visible in Figure 5. A lateral overhang 31 can also be seen, wherein this is separated away on or after the fastening on the main body – as the case may be, together with an overhang of the collar on the main body. A shoulder 32 is yet formed on the overhang and this serves as an aid when positioning relative to the main body.

The cover 3 according the **Figure 6** differs from that according to Figure 5 in that it is not manufactured by way of deep-drawing or embossing but by way of injection moulding. For this reason, it does not necessarily form a groove 11 on the outer side of the energy director 23. A web 33 projecting inwardly at the inner side is present as positioning aids instead of the shoulder.

PATENT CLAIMS

1. A portion capsule (1) which is filled with an extraction material, for creating a brewed product, comprising:
 - a main body (2) with a bottom region (5) and with a peripheral side wall (6); and
 - a cover (3) which is fastened on the main body (2);
 - wherein the main body and the cover enclose the extraction material, and the cover (3) is fastened on the main body (2) along a peripheral collar (4), said collar towards a cover side connecting to the peripheral side wall (6);
 - wherein the main body in the region of the collar (4) has an essentially rectangular cross section;
 - wherein the cover (6) forms an outward arching, so that the cover contributes to a capsule volume;
 - wherein a peripheral surface (8) facing the cover side is formed, said surface extending from an outer edge (7) of the collar (4) up to a base (12) of the arching;
 - **characterised in that** the base (12) of the arching is offset inwards in comparison to a transition between the side wall (6) and the collar (4).
2. A capsule according to claim 1, wherein the base (12) of the arching is offset inwards by at least 0.2 mm in comparison to the transition between the side wall (6) and the collar (4).
3. A capsule according to claim 1 or 2, wherein the main body (2) and the cover (3) are manufactured of plastic.
4. A capsule according to claim 3, wherein the main body (2) and the cover (3) are manufactured by deep-drawing.
5. A capsule according to claim 3, wherein the main body (2) and the cover (3) are manufactured by way of injection moulding.
6. A capsule according to one of the preceding claims, wherein the main body (2) and the cover (3) essentially have the same material composition.
7. A capsule according to one of the preceding claims, wherein the main body (2) and the cover (3) have essentially the same wall thickness.
8. A capsule according to one of the preceding claims, which is essentially cube-like with the exception of the collar.

9. A capsule according to one of the preceding claims, wherein the cover, from the outside to the inside, comprises a collar region forming the surface (8) facing the cover side, an actuate transition region (13) and a flat region (9) set away from a plane of the surface (8).
10. A capsule according to claim 9, wherein the flat region (9) assumes at least 40% of a cover surface.
11. A capsule according to one of the preceding claims, wherein the cover comprises an energy director and is fastened on the main body by way of ultrasound welding.
12. A method for manufacturing a capsule according to one of the preceding claims, comprising the steps
- providing a main body (2);
 - filling the main body with the extraction material;
 - placing the cover (3) upon the main body (2), so that the main body and the cover together form the peripheral collar;
 - fastening the cover on the main body along the peripheral collar amid the introduction of energy.
13. A method according to claim 12, wherein the energy introduction is effected by ultrasound.
14. A method according to claim 13, wherein the cover (3) is provided with a peripheral energy director (23).
15. A method according to claim 12, wherein the energy incorporation is effected by way of laser or by way of a heat transfer from a heated tool.