Accordingly, there is a need to code preparation information on the container. Various codes have been developed. An example is provided in EP 2594171 A1, wherein a periphery of a flange of a capsule comprises a code arranged thereon. The code comprises a sequence of symbols that can be printed on the capsule during manufacture. A drawback of such a code is that its encoding density is limited, i.e. the amount of preparation information that it can encode is limited. A further drawback is that the code is highly visible and may be considered aesthetically displeasing. EP2525691 A1 discloses a container with a 2D barcode, which has a higher albeit limited encoding density. WO 2016/173737 A1 and EP 3031748 A1 also describe a container for preparing a beverage or foodstuff with a code.

Thus in spite of the considerable effort already invested in the development of said systems further improvements are desirable.

Accordingly, an aim of the present invention is to provide a system and a container with a code allowing for a high density of preparation information.

Another aim of the present invention is to provide a system and a container with a code having a minimal visual impact on the container's appearance.

SUMMARY OF THE INVENTION

These aims and other advantages are achieved by a container for a beverage or foodstuff preparation machine, the container for containing beverage or foodstuff material and comprising a code encoding preparation information, the code comprising a reference portion and a data portion. The reference portion comprises three reference units defining a reference line, the three reference units being arranged at the vertices of an isosceles reference triangle having a reference apex angle. The data portion comprises discrete positions at locations determined relative to the reference line, each discrete position either comprises or does not comprise a data unit to at least partially encode the preparation information, wherein the discrete positions are arranged at vertices of a grid of isomorphic tessellating isosceles data triangles, the data triangles having a data apex angle different from the reference apex angle.

The three reference units are for example three distinct elements, for example three dots separated from each other, or at least partly integrated in another element

the units 82, 86 are formed, for example printed, with invisible ink, such that they can only be distinguished from the surround when lightened with a particular wavelength radiation, such as for example ultraviolet light, and/or captured by an appropriate image capturing device.

The units 82, 86 may have one or a combination of the following shapes: circular; triangular; polygonal, in particular a quadrilateral such as square or parallelogram; other known suitable shape. It will be appreciated that due to formation error, e.g. printing error, the aforesaid shape can be an approximation of the actual shape. The units 82, 86 preferably have a unit length of 50 – 200 μm, e.g. 60, 80, 100, 120, 150 μm. The unit length is a suitably defined distance of the unit, e.g.: for a circular shape the diameter; for a square a side length; for a polygon a diameter or distance between opposing vertices; for a triangle a hypotenuse. The units 82, 86 are preferably arranged with a precision of a few microns, preferably of about 1 μm.

Whilst the code is referred to as comprising a plurality of units 82, 86 it will be appreciated that the units 82, 86 may alternatively be referred to as elements 82, 86 or markers 82, 86.

Typically the units 82, 86 are formed by: printing e.g. by means of an ink printer; embossing; engraving; other known means; a combination thereof. As an example of printing the ink may be conventional printer ink and the substrate may be: polyethylene terephthalate (PET); aluminium coated with a lacquer, as found for example on Nespresso™ capsules, or other suitable substrate. As an example of embossing the shape may be pressed into a plastically deformable substrate, such as for example the aforesaid aluminium coated with a lacquer, by a stamp. The costs of forming the code on a container or on an attachment of the invention may thus be kept low by using conventional and inexpensive technologies, e.g. ink-jet, off-set, or laser printing, such that they don't significantly impact the costs of production of the container or attachment.

As illustrated in figure 4B, the code comprises a virtual planform 104, within which the units 82, 86 are arranged. The planform 104 may be circular, rectangular, or polygonal, for example hexagonal as shown in figure 4A. Typically the planform 104 has a length (i.e. a diameter for a circular or polygonal planform and a side length for a square planform) of 600 – 1600 μm, or about 1100 μm. The size of the

planform may however be defined to be larger, depending for example on the amount of information to be encoded, as will be explained further below.

The units 82, 86 are organised into a data portion 78 to encode preparation information and a reference portion 80 to provide a reference for the data portion 78.

The reference portion 80 comprises a reference configuration defining a preferably virtual reference line 81, which provides a reference direction for angular reference by the data portion 78 as will be discussed. In embodiments, the reference configuration comprises reference units 86 arranged in a specific pattern. The reference units 86 are for example arranged at the periphery, typically at the vertices, of a preferably virtual two-dimensional reference geometric shape. In preferred embodiments, the reference portion 80 for example comprises three reference units 86 arranged at the vertices of a virtual reference triangle 88, preferably an isosceles triangle. A virtual reference point 102 is for example defined relative to the reference triangle 88, from which the virtual reference line 81 extends in a direction, which is also defined relative to the reference configuration. The virtual reference point 102 is for example defined as the middle point of the basis of the reference triangle 88, while the direction of the virtual reference line 81 is defined as being parallel to a leg of the reference triangle 88, as illustrated in figure 4B.

Other arrangements of the reference units 86 are however possible within the frame of the invention. In particular, the number of reference units 86 and/or the reference shape formed therewith may be different from the embodiment described above and illustrated in the figures. Furthermore, the reference configuration may alternatively or additionally comprise one or more elements other than reference units 86 in order to provide a reference for the data portion 78, such as for example a non-virtual two-dimensional shape, from which a reference point and a reference direction may be univocally determined by the image processing device of the preparation machine of the invention. An advantage, however, of a reference portion 80 comprising three reference units 86 arranged at the vertices of a reference triangle 88 is that it provides for a simple and compact reference configuration allowing to univocally define a reference direction and a reference point, from which, for example, any appropriate two-dimensional coordinate system, for example a polar or a scalar coordinate system, may be derived.

vertices of the virtual reference triangle 88. The reference triangle 88 is for example a right-angled isosceles triangle with known dimensions.

In a second step, the position and orientation of the virtual reference line 81 is determined on the basis of the reference configuration, based for example on the location and orientation of the reference triangle 88. In embodiments, the virtual reference point 102 from which the virtual reference line 81 extends is for example determined to be the midpoint of the basis of the virtual reference triangle 88. The reference line 81 is then determined to extend in a direction defined relative to the reference configuration, for example parallel to a direction defined by at least two reference points 86. In preferred embodiments, the reference line 81 is for example defined to extend in a direction parallel to the upright leg of the “L” formed by the three reference units 86 arranged at the vertices of the right-angled reference triangle 88.

In a next step, the virtual triangular grid is defined within the planform 104 of the code 74. The grid is preferably arranged around the reference configuration. The virtual triangular grid comprises tessellating virtual data triangles, which are preferably isosceles triangles, more preferably congruent equilateral triangles as illustrated in figure 6A. In embodiments, the length of the sides of the data triangles is preferably chosen to be different from the length of the sides of the reference triangle 88 in order to facilitate discrimination of the reference units 86 from data units 82 located at vertices of a same data triangle. According to the invention, the orientation of the triangular grid is defined relative to the direction of the virtual reference line 81. The triangular grid is for example aligned with the reference line 81 in that a side of each data triangle is oriented parallel to the reference line 81. In preferred embodiments, at least some of the tessellating data triangles have a side aligned on the reference line 81, as illustrated for example in the embodiment of figure 6A.

In a next step, virtual discrete position 75 are defined at selected intersections of the triangular grid, i.e. at selected vertices of the data triangles. The discrete position 75 is preferably defined at intersections that are located at a distance from the reference configuration equal to or greater than a predefined minimal distance in order to allow a clear discrimination, by the code processing subsystem of the preparation machine of the invention, between a data unit 82 arranged at one of the