detrimental to the quality of the ingredient contained therein, after storage periods. During heat-sealing with usual heat-sealing heads, the wrinkles remain in some extent and sealing is not ensured in the wrinkles. Thus, even though a partially effective seal may be created, the container contents are nonetheless exposed to some amount of external air and moisture seeping through these wrinkles. This in turn accelerates the spoiling of the container's content. Oxygen and vapor barrier properties in the rim are insufficiently obtained.

A known solution is to add a plastic rim to ensure smooth and regular rim surface. Such containers with encapsulated rim features are disclosed by EP1485178. Indeed, EP1485178 proposes various container bodies having fully or partially-encapsulated rim or flange. The encapsulating material is generally made of a plastic such as polyolefin, nylon, polyethylene terepthalate, polycarbonate, or other engineering thermoplastic resins. This encapsulating material covers at least a portion of the rim or flange and may extend a distance from the rim's outer edge. The exterior of the encapsulating material is substantially smooth, even those portions filling or overlying irregularities in the rim. Further, the encapsulated rim presents a hermetic barrier to gases and moisture, and may be sealed with a film or other material to completely insulate the container interior.

But the polymer used for the encapsulation is expensive and the amount used increases the cycle time required to form useful container bodies. Besides, the manufacturing process becomes complex.

To reduce the impact of the encapsulating of the rim on manufacturing costs and time, EP1485178 proposes to reduce the amount of polymer by encapsulating only a portion of the rim or flange. For example, only the underside of the rim is covered with the encapsulating material. By injecting resin only on the under or backside of the rim during the injection-molded process, the exposed paperboard pleats on the upper surface of the rim are pressed upwardly against a surface of the metal mold by the hot, high-pressure injectant,

which compresses or "irons" the pleats on the upper surface of the flange. This creates an improved sealing surface on the upper side that helps ensuring that a hermetic seal is obtained across the now-flattened pleats. Moreover, the smooth surface of the encapsulated underside of the rim can also be bound to the lid while this latter is bent downwardly.

Nevertheless this solution still uses encapsulating material and injection of this material into a mold. So the manufacturing costs and time are reduced but only in a quite low extent. Besides, this solution does not come up to the consumers' expectations for more natural and recyclable products.

Another solution that is disclosed in Billerud's WO 2015/082268 patent application, wherein the wrinkles created by the three-dimensional deformation of the paper layer of the container body, are reclosed by spraying or otherwise coating a material to "fill" the wrinkles before the top lid is sealed thereto. This solution has the drawback that it requires an additional component to the structure of the pod (i.e. the rim coating material) and also an additional spraying step and equipment which adds cost and complexity to the process.

Consequently, a need exists to develop a method for ensuring proper sealing of Paper/PLA laminates, that uses current manufacturing technologies and that does not add any additional container element.

Summary of the invention

An object of the present invention is to provide a simpler and cost-saving manufacturing process for producing hermetic single-use food containers such as coffee pods. In particular, the object of the invention is to avoid the need for encapsulating, even partially, the rim of the pod.

The manufacturing method of the present invention also aims to obtain an efficient sealing on the rim of single-use food containers to ensure in-cup

As to the forming gap, it can be noted that this distance is varied, among others, according to the thickness of the material from which the blank is made. Too small a forming gap increases the out-of-plane and in-plane shear and forces. This can lead to the formation of cracks and eventual failure of material in the formed shape. Typically, the gap is around 0.7times the thickness of the paperboard (it can be noticed that dimensions and ratios are not respected at **Figure 3**, which is very schematic). On the other hand, too large a forming gap leads to the poor appearance of the shape and to significant wrinkles that create voids which restrict the possibility of gas-tight sealing of such shapes.

As a negative consequence of the forming process, the container body 100 exhibits wrinkles 103 (see **Figure 1**) essentially in the rim 102 and at the junction between the rim 102 and the sidewall 101 and on a large part of the sidewall 101.

To close the container body thus obtained, a closing lid (not shown at **Figure 1**) is later sealed on the upper surface of the rim 102 after the container body 100 has been filled with food. The wrinkles 103 compromise the perfect sealing of the closing lid with the rim and a hermetic seal cannot be obtained. In particular, the wrinkles formed at the surface of the rim are oriented in the radial direction of the container body 100, and they impair the correct flatness of the rim. Therefore, when the upper lid is sealed onto said rim, radial channels are created along the wrinkles, through which oxygen and moisture are able to circulate from outside the container, into the internal compartment of said container, hence rapidly degrading the quality of the food contained therein.

To solve this problem, the invention proposes to use a sealing head one die of which has a sealing surface with a specific profile. An example of a sealing head according to the invention is partially represented at **Figure 4** with a container body 30 and a closing lid 34 therein. The sealing head includes a fixed lower die (first die) 2 with an annular top sealing surface 4 and a movable upper die (second die) 8 with a bottom sealing surface 10, the cooperating sealing

Claims

1. Manufacturing process for producing hermetic single-use food containers, the hermetic single-use food containers are coffee pods to be used in beverage system, the process includes:

- forming a container body (30) having a peripheral rim (31), the container body and the rim have a circular section,
- placing the container body in a sealing head having a first die (2) and a second die (8), at least one of which being mobile, the first die and the second die having cooperating annular sealing surfaces (4, 10) facing the rim (31),
- applying a closing lid (34) over the container body (30),
- sealing the closing lid (34) with the rim (31) of the container body by applying the first die (2) and the second die (8) one against the other,

characterized in that the first die (2) is provided with an annular rib (6) in its sealing surface (4), the rib having a height (h) which is at least equal to a maximum depth of wrinkles that might appear on the rim upon forming the container body, whereby a sealing groove (12) is formed by the rib (6) in a side of the rim when sealing the closing lid (34) to the container body (30), the closing lid being bound to the rim in front of the sealing groove,

wherein the container body (30) is made from a sheet of paper/ polylactic acid laminate,

wherein the first die (2) is a lower die of a vertical press and the second die (8) is an upper die, whereby the sealing groove (12) is engraved in an underside of the rim (31).

2. Manufacturing process according to claim 1, wherein the container body (30) is made from a sheet of polylactic acid-polyvinyl alcohol-polylactic acid of 50 µm laminated with a formable paper of 130g/m^2 and wherein the closing lid (34) is made from a sheet including a polylactic acid barrier laminated with a paper of 30g/m^2.

3. Manufacturing process according to claim 1 or 2, wherein the sealing surface (10) of the second die (8) is flat and rigid.

4. Hermetic single-use food container, the hermetic single-use food containers are coffee pods to be used in beverage system, the hermetic single-use food containers include a container body (30) with a peripheral rim (31), and a closing lid (34) closing the container body, the container body and the rim have a circular section, **characterized in that**:

- the container body is made in a paper-laminated material and have wrinkles at least at the rim, the wrinkles extending essentially radially,
- the hermetic single-use container shows an annular sealing groove (12) engraved on a side of the rim which extends continuously essentially in a circumferential direction all around the rim and which has a depth at least equal to a maximum depth of the wrinkles whereby the wrinkles are flattened by the sealing groove, the closing lid (34) being bound to the rim of the container body at least in a region of the sealing groove (12),
- the sealing groove (12) engraved in the rim is formed in an underside of the rim,
- the container body is made from a sheet of paper/ polylactic acid laminate.

5. Hermetic single-use food container according to claim 4, wherein the closing lid has a top surface which is flat at least at the rim.

6. Hermetic single use food container according to claim 4 or 5, wherein the sealing groove (12) engraved in the rim has a width of between 0.15mm and 5mm, and a height of between 0.05mm and 3mm.

7. Hermetic single use food container according to claim 4 or 5, wherein the container body (30) is made from a sheet of polylactic acid-polyvinyl alcohol-polylactic acid of 50 µm laminated with a formable paper of 130g/m^2 and wherein the closing lid (34) is made from a sheet including a polylactic acid barrier laminated with a paper of 30g/m^2.