

Method and Device for Producing Containers Made of
Thermoplastic and Containers so Produced

The invention relates to a method for producing containers made of thermoplastic in which an extruded plastic tube is inserted into a mold whose movable mold parts are moved into a position which opens the mold, at least the mold parts which form the transition from the main part of the container and the bottom of the container being closed, the container bottom being welded, the tube being widened by a pressure gradient acting on it and the tube being placed against the wall of the mold parts to form the container mold and the mold parts being moved into the position which opens the mold for removal of the formed container from the mold. Moreover, the invention relates to a device for executing the method and containers so produced.

Methods of this type, such as the bottelpack® system, are widely used to produce containers of various shapes, sizes, and for different purposes. In particular, they can be transparent, flexible containers of polyethylene or polypropylene. Often the containers are both produced and also filled with sterile contents, such as pharmaceuticals, and sealed in aseptic operation in one process. In particular, when the contents are very expensive, as can be the case for certain pharmaceuticals, for the performance characteristics of the pertinent container it is essential that the contents can be removed in a suitable manner. More precisely, it must be ensured that very expensive media, when they are squeezed out by squeezing the flexible container together, can be forced out of the

container without residue and/or that an exact dosage can be delivered, which is essential particularly for pharmaceuticals.

With respect to these requirements, embodiments of the invention seek to devise a process for producing containers whose performance characteristics are optimized with respect to the removal of the contents.

According to a first aspect of the invention, there is provided a method for producing containers made of thermoplastic in which an extruded plastic tube is inserted into a mold whose movable mold parts are moved into a position which opens the mold, at least the mold parts which form the transition from the main part of the container and the bottom of the container being closed, the container bottom being welded, the tube being widened by a pressure gradient acting on it, and the tube being placed against the wall of the mold parts to form the container mold and the mold parts being moved into the position which opens the mold for removal of the formed container from the mold, whereby the container bottom is made in the form of cup-like bottom part which axially extends the main part of the container and that the bottom part is everted into the interior of the container to form a bottom elevation which extends into the main part of the container, and whereby the cup-shaped bottom part before final removal of the container from the mold is everted into its interior, wherein the cup-like bottom part is formed by bottom mold parts which can be moved relative to the main mold parts which mold the main part of the container, and which bottom mold parts weld the bottom part in the closed position and that the bottom mold parts are moved into the position which partially opens the mold for everting the bottom part by applying to the bottom part a mold die which is driven to be movable along the axis of the container.

Accordingly, one essential particularity of embodiments of the invention consist in that in a process according to the type of bottelpack® system, in the blow mold or vacuum mold a cup-like bottom part, which axially extends the main part of the container, is formed and that this bottom part is then everted into the interior of the container, so that it forms a bottom elevation which extends into the container interior as a cup which is open to the exterior on the container bottom. If the contents of such a container are to be delivered such that the container is pressed together from the bottom, this bottom elevation acts as a displacement body which can move into the head region of the container for completely emptying the latter and forces out the volume of contents located therein and in this way minimizes the remaining volume.

This is especially important in containers in which the main part of the container is made as a bellows which is pressed together to deliver the contents such that the folds of the bellows come into contact with one another. When this state is reached in the course of squeezing, the bellows, based on the number of folds, has a certain dead length which cannot be shortened by further pressing together so that at the end of the process of pressing the bellows together, a considerable residual volume remains. When the bottom elevation, which has been formed according to embodiment of the invention, is matched in shape and dimensions to this residual volume in the optionally tapered head

region of the container, for containers with bellows the residual volume which remains with the bellows pressed together can also be minimized.

Preferably, the cup-shaped bottom part before final removal of the container from the mold is everted into its interior. Since, in this case, the container is still fixed within the mold, the process of everting in the desired, exactly calibrated manner can be executed without difficulties. Moreover, in this case the eversion process can be carried out in a controlled manner at a temperature level at which the plastic material can still be plastically deformed in a suitable manner to form a residual bottom elevation. Accordingly, it can be advantageous to evert the bottom part before filling the container with the contents, that is, before cooling caused by the contents.

In advantageous embodiments of the process the cup-like bottom part is formed by bottom mold parts which can be moved relative to the main mold parts which mold the main part of the container, which weld the bottom part in the closed position, and which are moved into the position which partially opens the mold for everting the bottom part. Everting can thus be done by mechanical engagement between the bottom mold parts which are moved apart from one another as required.

In advantageous embodiments the procedure can be such that the bottom part is mechanically everted by applying to the bottom part the mold die which is driven to be movable concentrically to the axis of the container.

In this connection, preferably the procedure is such that before everting the bottom part, the scrap material, which is located at its weld, is trimmed by means of a trimming element.

According to a second aspect of the invention, there is provided a device for executing the process, which device preferably has movable mold parts which form a blow mold, the pair of mold

parts which forms the main part of the container adjoining the pair of bottom mold parts which can be moved independently thereof, which bottom mold parts in the closed position define a cup-shaped mold cavity for formation of a cup-shaped bottom part which axially extends the main part of the container.

The arrangement here is preferably such that the bottom mold parts spread the welding jaws for welding the cup-shaped bottom part.

To evert the bottom part into the interior of the container, there is preferably a plunger which can be driven for reciprocal axial motion and which can be aligned to the longitudinal axis of the container and by means of which the cup-shaped bottom part can be everted into the main part of the container when the bottom mold parts are opened accordingly.

In order to make available a contact surface which is free of irregularities for contact of the plunger, in preferred embodiments there is a mechanically movable trimming element which can be aligned to the longitudinal axis of the container when the bottom mold parts are opened accordingly for removing the bottom scrap forming at the weld of the cup-shaped bottom part.

According to a third aspect of the invention, there is provided a container which is produced according to the process as described above by means of the device as described above, the container being provided with a bottom elevation which projects into the interior of the main part of the container.

The invention is detailed below using the drawings.

- FIG. 1 shows a schematically simplified representation of an opened blow mold and an extrusion head which is located above for forming the tube of plasticized plastic material;

- FIG. 2 shows the partially closed blow mold from FIG. 1 in the operating state of widening the tube which has been welded on the bottom side by means of air blasts for forming the container mold;
- FIG. 3 shows the operating state of filling the container with contents;
- FIG. 4 shows the operating state with bottom mold parts which have been partially moved apart from one another for exposing the bottom scrap on the bottom-side weld;
- FIG. 5 shows the operating state after trimming the bottom scrap, the bottom mold parts being moved farther apart and a movable trimming element being shown in the axially aligned position;
- FIG. 6 shows the operating state in which a movable plunger is shown in the axially aligned position;
- FIG. 7 shows the operating state with the bottom part everted by means of the plunger and the fill level raised compared to FIG. 6;
- FIG. 8 shows the operating state with the raised fill level, but after formation of the head closure part of the container by closing of the head mold parts;
- FIG. 9 shows a side view of one embodiment of a container produced according to the invention in the form of a bellows which can be axially pressed together, and
- FIG. 10 shows a perspective of another embodiment of the container with bellows which taper conically toward the head region.

FIGS. 1 to 8 show a part of a device as is used within the scope of the known bottelpack® system for producing plastic containers in a blow molding process, by means of an extruder device 1 the tube 3 of molten plastic material being extruded between movable mold parts of a blow mold which is shown in FIG. 1 in the opened state, and which has paired head mold parts 5, main mold parts 7 of the container, and bottom mold parts 9. After extruding the tube 3 into the opened mold the tube 3 is cut between the nozzle exit of the extruder device 1 and the top of the head mold parts 5. In FIG. 1 the cutting line is shown by a broken line and is designated as 8.

FIG. 2 shows the operating state in which the mold is partially closed by moving the main mold parts 7 and the bottom mold parts 9 together and instead of the extruder means 1 a blow mandrel 11 is inserted into the upper end of the tube 3 in order to widen the tube 3 by an air blast and to place it against the mold walls of the main mold parts 7 and the bottom mold part 9 and in this way to form the mold of the container 13. The closed bottom mold parts 9 are provided with welding jaws (not shown in the figure) in order to weld the tube 3 on the bottom side before blowing in the air blast. The bottom scrap which is formed in this connection at the weld is designated as 15 in FIG. 2. While the main mold parts 7 have inner mold walls which are circularly cylindrical over most of their axial length, aside from the head region which tapers to the inside, which is designated as 16 in FIG. 1, and which borders the head mold parts 5, the inner mold walls of the bottom mold parts 9 form partial shells which in the closed position define a hemispherical mold so that the tube 3, which has been widened by an air blast, is molded into a container 13 which has a cup-shaped bottom part 19 that is formed by the bottom mold parts 9 and that is connected to the main part 18 of the container as an axial extension. While the bottom mold parts 9 in FIGS. 1 to 6 are shown as partial shells with smooth mold walls, they can also be staggered as steps so that the formed bottom part 19 has bellows-like folds.

FIG. 3 shows the state in which the blow mandrel 11 is replaced by a fill mandrel 17 in order to introduce a predetermined amount of flowable filling material. The mold parts here are

shown in the same position as is shown in FIG. 2. Instead of using separate mandrels 11 and 17 for blow molding and filling, a combined blow-fill mandrel can be used.

FIG. 4 shows that while the head mold parts 5 and the main mold parts 7 are in an unchanged position, the bottom mold parts 9 are moved apart out of the closed position by a distance which is sufficient to make accessible the bottom scrap 15 for a trimming element 21 (shown only in FIGS. 5 and 6), by means of which the bottom scrap 15 is removed from the bottom part 19.

FIG. 5 shows the state after removal of the bottom scrap 15, the trimming element 21 which can be break-off pins or mandrels being moved out of the region of the bottom mold parts 9 after the completed trimming process. Compared to FIG. 4, they are moved apart by a greater distance so that after the trimming element 21, as shown with arrow 23, has been moved laterally away, a plunger 25, after it is aligned axially to the bottom part 19, as indicated with another arrow 27 (this position is shown in FIG. 6), can enter between the opened bottom mold parts 9. At this point the cup-shaped bottom part 19 can be everted into the main part 18 of the container by a lifting motion as is indicated in FIG. 6 with the arrow 29. As is shown in FIG. 7, in this way the axial extension of the main part 18 of the container formed by the cup-shaped bottom part 19 is transferred into a bottom elevation 31 which projects into the interior of the container. In this way the fill level rises from the level designated as 33 in FIG. 6 to the level designated as 35 in FIG. 7. In the filling process this is taken into account with respect to calculating the filling amount.

FIG. 8 differs from FIG. 7 merely in that by transferring the head mold parts 5 into the closed position, the mold of the head closure 36 is formed, the latter being effected, for example, supported by a vacuum, in connection with the closing process caused by welding.

While in FIGS. 1 to 8 the interior wall of the main mold parts 7 is shown and described as having a smooth surface, the blow mold can be designed in the conventional manner such that the main part of the container forms a bellows 37, see FIG. 9, which shows an embodiment of a container 13 which has been formed in this way. Such containers 13, which are made as bellows, are preferably used to deliver the contents by axially pressing the bellows 37 together. The problem of a considerable residual volume remaining upon squeezing out is exacerbated in bellows because the bellows 37 can be axially shortened only until the folds are closed, a dead length remaining which corresponds at least to twice the wall thickness of the container, multiplied by the number of folds. The bottom elevation 31 which is provided according to the invention forms a displacement body which fills the otherwise considerable residual volume when the bellows 37 are pressed together.

This is especially advantageous for containers 13 in which the bellows 37 have a conically tapered shape against the head closure 36, as is the case for the example shown in FIG. 10. By the corresponding shaping of the cup-shaped bottom part 19 during the molding process, the shape and dimensions of the bottom elevation 31 here can be made such that the bottom elevation 31 is matched to the interior of the compressed bellows 37 in the head region as fitting as closely as possible, as a result of which the residual volume which remains when the bellows 37 is pressed completely together is minimized.

For containers which have a tapered neck part in the head region, by the corresponding shaping of the mold walls of the bottom mold parts 9, the bottom part 19 which forms the bottom elevation can be molded such that it is tapered in the central region in such a way that the everted bottom elevation 31 has an end part which fits into the neck part of the container so that the contents can be squeezed completely out of the container.

Claims

1. A method for producing containers made of thermoplastic in which an extruded plastic tube is inserted into a mold whose movable mold parts are moved into a position which opens the mold, at least the mold parts which form the transition from the main part of the container and the bottom of the container being closed, the container bottom being welded, the tube being widened by a pressure gradient acting on it, and the tube being placed against the wall of the mold parts to form the container mold and the mold parts being moved into the position which opens the mold for removal of the formed container from the mold, whereby the container bottom is made in the form of cup-like bottom part which axially extends the main part of the container and that the bottom part is everted into the interior of the container to form a bottom elevation which extends into the main part of the container, and whereby the cup-shaped bottom part before final removal of the container from the mold is everted into its interior, wherein the cup-like bottom part is formed by bottom mold parts which can be moved relative to the main mold parts which mold the main part of the container, and which bottom mold parts weld the bottom part in the closed position and that the bottom mold parts are moved into the position which partially opens the mold for everting the bottom part by applying to the bottom part a mold die which is driven to be movable along the axis of the container.
2. The process according to claim 1, wherein before everting the bottom part the scarp material, which is located at its weld, is trimmed by means of a trimming element.
3. A device for executing the process according to claim 1 or 2, with preferably movable mold parts which form a blow mold, whereby the pair of mold parts which forms the main part of the container adjoins the pair of bottom mold parts which can be moved independently thereof and which in the closed position define a cup-shaped mold cavity for formation of a cup-shaped bottom part which axially extends the main part of the container, wherein there is a plunger which can be driven for reciprocal axial motion and which can be aligned to the longitudinal axis of the container, by means of which the cup-shaped bottom part can be everted into the main part of the container when the bottom mold parts are opened accordingly.

4. The device according to claim 3, wherein the welding jaws are spread when the bottom mold parts are in the opened position.
5. The device according to claim 3 or 4, wherein there is a mechanically movable trimming element which can be aligned to the longitudinal axis of the container when the bottom molds part are opened accordingly for removing the bottom scarp which has formed at the weld of the cup-shaped bottom part.
6. A container produced according to the process according to one of claims 1 or 2 by means of the device according to one of claims 3 to 5, with a bottom elevation which projects into the interior of the main part of the container.
7. The container according to claim 6, wherein at least the main part of the container is made in the form of a bellows and the bottom elevation is made with respect to shape and dimensions such that it minimizes the residual volume located in the head region of the container when the bellows have been pressed together.