

Method and Apparatus for Producing Plastic Containers

The invention relates to a method and an apparatus for producing blow-molded two-layer or multilayer containers made of a thermoplastic material and plastic containers produced with this method having viewing strips, in particular for storing and transporting liquid contents.

Such a plastic container has typically vertical container walls with a horizontal container lid and base, wherein a gas- and liquid-tight closable fill and drain opening is disposed at least in the container lid or the container cover.

The plastic container can be formed as a canister, fassett, bunged barrel with lid and clamping ring, or as a large volume interior container of a pallet container, wherein this type of container typically includes a bottom drain fitting.

State of the art:

Frequently, plastic containers - with respect to multilayer containers, at least the outer layer - are colored, for example blue bunged barrels or black plastic containers colored with carbon black with an electrically dischargeable outer layer.

It is desirable to be able to identify at any time the respective fill or drain level of the container of plastic containers having a colored outer layer. For this purpose, colored plastic containers are typically provided with a narrow vertical viewing strip made of natural color (virgin) plastic, through which the respective level of the contents in the container can be readily identified. However, producing plastic containers with a viewing strip by blow molding is somewhat complex and requires a corresponding additional structural configuration of the extrusion head (continuous or discontinuous) and a corresponding separate extruder for the material of the viewing strip.

Another field of application concerns the storage and transport of flammable liquids. For example, when filling or emptying a pallet container (DE 196 05 890 A1; published

February 2, 1996) or more generally, when stirring liquids in plastic containers for the purpose of mixing and the like, electric charges generated by friction between the liquid and the inner container surface are discharged to ground via an electrically conducting outside coating of the inner container and the metallic support frame (steel pallet). This prevents an electric discharge between the plastic in a container and the outer frame formed by a metal lattice, which may cause sparking capable of igniting flammable content of the pallet container and of explosive mixtures of gases and vapors in enclosed spaces. Disadvantageously, conventional pallet containers do not have a viewing strip, so that the fill level cannot be identified with optical monitoring due to the black color of the inner plastic container.

DE 38 44 605 (Sch. June 11, 1988) discloses a pallet container with at least one viewing strip is made of a translucent or transparent plastic material, which forms a unit with the black colored plastic material; a level indicator is provided next to the viewing strip. The conventional complex machine configuration is required for producing the plastic container with inserted viewing strip,.

DE 41 36 766 (Ro. November 8, 1991) discloses a multilayer container wall with an outer colored container layer with an interrupted layer region in form of a strip. The strip-shaped interrupted layer region is materially connected with the colored plastic material of the container wall. The corresponding apparatus for discontinuous production of a tubular preform for blow molding the containers is described in the published document DE-U-91 07 812.

DE 202 06 436 (Pro. April 23, 2002) another pallet container with a multilayer inner container, with a permanently antistatic outer layer made of carbon black with at least one integrated viewing strip made of transparent plastic material. For example, EP 0 333 956 B1 describes an apparatus for producing plastic containers with a viewing strip embodied in an extrusion storage head.

Drawback of the state of the art: All conventional multilayer embodiments have a continuous viewing strip made of the colorless plastic material of the inner layer. Both

the apparatus and the method for fabricating a viewing strip of this type are quite complex. For example, when associating the viewing strip and the volume graduation, the circumferential position of the viewing strip of the inner container must be exactly matched to the circumferential position of the volume graduation. Moreover, an exact vertical orientation of the viewing strip on the inner container is difficult to maintain due to different degrees of expansion when the inner container is manufactured by blow molding.

It is therefore an object of the present invention to provide a corresponding apparatus and a method, which allows a simple and cost-effective manufacture of a colored plastic container with a viewing strip, wherein an additional extruder with lines carrying the molten plastic material for the viewing strip is no longer required. In addition, the apparatus of the invention should have a simple design and should be constructed so that it can be installed in existing multilayer extrusion heads even at a later date.

This object is attained with the invention with the features of claim 1. According to the invention, colorless plastic material is partially removed with a suitable device from the inner layer in the annular gap of the extrusion head shortly before the material exits from the annular nozzle, is deflected and rerouted in the radial direction and introduced into the separate outer layer (transfer of virgin material from the inner layer to the outer layer).

The subsequent dependent claims recite advantageous modified embodiments of the invention.

With respect to the apparatus, the invention includes an extrusion head for producing blow-molded multilayer hollow plastic bodies, with a housing provided with two or more fittings for extruders, wherein molten plastic materials are supplied through the fittings. The molten plastic materials are distributed through two or more circumferential distributors along the circumference to form a two-layer or multilayer tubular preform. The preform flows through a cylindrical reservoir and can be ejected through a controllable annular nozzle, whereby the ejected tubular reform is provided with a

viewing strip. An additional fitting is provided on the side of the housing below the circumferential distributor and above the annular nozzle. A hollow tube is inserted through the fitting into the cylindrical reservoir, whereby the hollow tube has an upwardly pointing inlet opening facing the inner surface of the reservoir and a downwardly pointing outlet opening facing the outer surface of the reservoir. Plastic material can hereby be deflected from the inner layer to the colored outer layer for incorporating the plastic material from the inner layer in the colored outer layer for providing the viewing strip.

In an embodiment of the invention, a helical screw with a drive is provided inside the hollow tube for transporting plastic material. The quantity of plastic material withdrawn from the inner layer of the tubular preform can then be easily controlled and changed. The helical screw can be driven, for example, with a hydraulic motor or an electric motor.

According to another embodiment of the invention, the hollow tube may be pulled out of the housing and the corresponding additional fitting may be constructed to be closable with an applied lid or solid plug. In this way, depending on the requirements, the extrusion head of the invention can be used to produce plastic containers with or without viewing strip.

Advantageously, the hollow tube with the helical screw and the drive may be configured as a retrofit kit that can be installed in any existing extrusion head. The extrusion head can be configured as a continuous tubular head (or Conti-Head) or as discontinuous extrusion head with injection piston (= storage head, Accu-Head). Manufacturers of blow-molded plastic hollow bodies can then retrofit their existing blow molding machines in a simple and cost-effective manner so that - depending on the requirements - different plastic containers, such as plastic bunged barrels or lidded barrels, can be manufactured with or without a viewing strip, without requiring costly retrofitting with an additional extruder.

According to another embodiment of the invention, the hollow tube with the helical screw may be configured for movement in the radial direction and may advantageously also be provided with a corresponding drive for movement in the radial direction.

With respect to the method, according to the invention, molten plastic material is deflected inside the cylindrical reservoir of the extrusion head from the inner layer to the colored outer layer and incorporated in the colored outer layer for providing the viewing strip. Optionally, deflection and incorporation of the molten plastic material from the inner layer in the colored outer layer for providing the viewing strip may be performed only sequentially (discontinuously) such that the viewing strip is disposed only in the vertical wall of the finished blown container and not in the lid and bottom of the finished blown container.

Additional advantages: Deflecting the material from the inside to the outside inside the tubular wall of the preform eliminates the typical continuous separation lines (vertical separation lines in the container wall) in the wall of the finished blown product, and hence also eliminates the disadvantageous effects on the performance data (e.g. drop test, hydraulic interior pressure test, etc.) of the finished container. The inner surface of the tube or of the finished container remains undisturbed and is not separated. Containers having different volumes from about 60 liters to about 1000 liters can be produced with an extrusion head according to the invention with an inserted hollow tube and a driven helical screw, for instance canisters, drums or large volume plastic inner containers for pallet containers. An additional extruder or an additional mass storage device (for sequential operation) is then no longer required.

The invention will now be described in more detail with reference to an exemplary embodiment schematically illustrated in the drawings.

- Figure 1 shows an extrusion head according to the invention with schematically indicated transverse conveyor for the melt,
- Figure 2 shows the lower part of an extrusion head according to the invention with transverse melt conveyor on an enlarged scale,
- Figure 3 shows a plastic lidded barrel with viewing strip, and
- Figure 4 shows a large volume plastic inner container with viewing strip.

Figure 1 shows with the reference numeral 10 an extrusion head for producing blow-molded two-layer plastic hollow bodies embodied as a storage head (Accu-Head) with a housing 12, on which (not shown in the partial view) two connections for two extruders are provided. Two circumferential distributors 14, 16 are supplied with molten plastic material from the connected extruders. The two circumferential distributors 14, 16 are constructed as concentric cylinder sleeves with built-in helical channels for circumferentially distributing the plastic material flows that are received from the extruders as a full strand. The circumferential distributor 16 is covered by an additional cylinder sleeve 42. The three concentric cylinder sleeves 14, 16, 42 with interior, or covered, helical channels are fixed in position relative to one another and form together the so-called ejection piston. The ejection piston encompasses a central mandrel 46 and is supported in the housing for vertical movement and provided with a corresponding ejection drive.

The plastic material, which is completely distributed about the circumference, exits at the bottom end of the cylinder sleeves or of the ejection piston as a two-layer tubular preform 18, flows through a cylindrical reservoir 20 in which a viewing strip is applied during the extrusion process, and is then ejected from the extrusion head 10 through a controllable annular nozzle 22. In the discontinuous operating mode of the storage head, the tubular preform 18 is sequentially ejected from the reservoir 20 by the ejection piston through the controllable annular nozzle 22. The central mandrel 46 is also movably arranged in the housing 12. By lowering the cone-shaped mandrel tip, the nozzle gap of the annular nozzle 22 opens and widens; when the cone-shaped mandrel tip is raised, the nozzle gap narrows and can close completely. The extrusion head 10 can, of course, also be designed as continuous extrusion head with continuous tube discharge. According to the present invention, a particular device for redistributing the material is arranged inside the reservoir 20, below the circumferential distributors 14, 16 and above the controllable annular nozzle 22. Redistribution of the material is performed by a hollow tube 28 such that, as viewed in the radial direction from the inside to the outside, plastic material is initially withdrawn from the inner layer 34, which consists of original natural material, of the almost finished preform 18, deflected in the

radial direction and pushed to the outside, where it is then again deflected to flow in the axial direction and introduced into the outer colored layer 36 of the preform 18 as a transparent viewing strip.

As a result of the partial redistribution of the material, slight changes in the layer thickness occur in a local region about the introduced viewing strip (decrease in the thickness of the inner layer and corresponding increase of the outer layer), which is immaterial for the finished product and has no disadvantageous effect on the mechanical performance (inside pressure test, drop resistance, stack loading) of the container.

With particular container designs, for example, closed bunged barrels with high stretching rates of the tubular preform in regions that are offset by 90° with respect to the mold separation plane in the injection mold halves, it is desirable to arrange the viewing strips in a particular circumferential position. To this end, the lower housing part 48, in which the hollow tube 28 for providing the viewing strip 24 is arranged, is rotatably attached on the housing 12 of the extrusion head, so that the viewing strip in the ejected preform can be positioned exactly in the desired position, for example at the mold separation plane. The lower housing part 48 can also be equipped with a stepping motor for rotating the lower housing part in both rotation directions and thereby adjust the position of the viewing strip with reference to the blow-mold and its position in the blown container, respectively.

In an exemplary actual design of medium size, the hollow tube 28 inserted in the lower housing part 48 has an outside diameter of about 45 mm and extends into the reservoir 20 to a depth of about 50 mm. The upper opening 30 has a width of about 30 mm and about the same length, wherein the lower opening 32 is about 35 mm long, but only 10 mm wide. The helical screw 38 is preferably designed as a double-lead screw and has a length of only about 55 mm. The hollow tube 28 is completely sealed to the outside at the driveshaft behind the helical screw 38 by corresponding sealing rings.

With colored containers having a two-layer or three-layer wall structure, the outer layer colored with admixed dye pigments or with carbon black is relatively thin, since dye

pigments or carbon black are relatively expensive. Advantageously, the colored outer layer has a thickness of only 5 to 20%, preferably about 10%, of the container wall.

The layer thickness of the inner layer made of new material (HD-PE High Density Poly Ethylene) should not be thinner than about 50%. With a three-layer wall structure, the middle layer has a layer thickness between 20% and 60% and is typically made of high density polyethylene, whereby recycled pellets or ground material can be used (colorless or natural color HD-PE).

For use in explosive areas or with flammable content, the plastic containers are provided - through addition of carbon black - with a black, electrically conducting outer layer. This outer layer should also be as thin as possible to save costs.

Figure 3 shows in form of an exemplary embodiment of a blow-molded container produced with the method of the invention a 220 liter plastic lidded barrel 50 with a viewing strip 52 and measuring graduation 54 in the vertical barrel wall. Figure 4 shows a different exemplary embodiment in form of a large-volume plastic inner container 56 with viewing strip 58 and a measuring graduation 60 for a pallet container with a capacity of 1000 liters.

The viewing strip should have - when viewed in the circumferential direction - a width of about 10 mm to 20 mm, so that the respective the level of the liquid contents can be readily identified at any time.

List of Reference Numbers

10	extrusion head
12	housing
14	circumferential distributor I inside
16	circumferential distributor II outside
18	preform
20	reservoir
22	annular nozzle
24	viewing strip
26	additional fitting (28)
28	hollow tube
30	inlet opening
32	outlet opening
34	inner layer
36	outer layer
38	helical screw
40	rotary drive (38)
42	cover cylinder sleeve
44	displacement drive (28)
46	central mandrel
48	lower housing part (rotatable)
50	plastic lidded barrel
52	viewing strip
54	measuring graduation
56	plastic inner container
58	viewing strip
60	measuring graduation

Patent Claims

1. Extrusion head (10) for producing blow-molded multilayer hollow plastic bodies, with a housing (12), on which two or more fittings for extruders are provided, with molten plastic materials being supplied through the fittings, the molten plastic materials being distributed along the circumference through two or more circumferential distributors (14, 16) to form a two-layer or multilayer tubular preform (18), wherein the preform flows through a cylindrical reservoir (20) and can be ejected through a controllable annular nozzle (22), wherein the ejected tubular reform (18) is provided with a viewing strip (24),

characterized in that

an additional fitting (26) is provided on the side of the housing (12) below the circumferential distributor (14, 16) and above the annular nozzle (22), with a hollow tube (28) being inserted through the fitting (26) into the cylindrical reservoir (20), wherein the hollow tube (28) has on the inside of the reservoir (20) an upward pointing inlet opening (30) and on the outside of the reservoir (20) a downward pointing outlet opening (32), through which plastic material can be deflected and incorporated from the inner layer (34) in the colored outer layer (36) for providing the viewing strip (24).

2. Extrusion head according to claim 1,

characterized in that

a helical screw (38), which is provided with a drive (40), is provided inside the hollow tube (28) for transporting plastic material.

3. Extrusion head according to claim 1 or 2,

characterized in that

the hollow tube (28) can be pulled out of the housing (12) and the corresponding additional fitting (26) can be constructed to be closable with an applied lid or solid plug.

4. Extrusion head according to claim 1, 2 or 3,
characterized in that
the hollow tube (28) with the helical screw (38) and the drive (40) is configured as a retrofit kit that can be installed in any existing extrusion head.
5. Extrusion head according to claim 1, 2, 3 or 4,
characterized in that
the hollow tube (28) with the helical screw (38) is configured for displacement in the radial direction.
6. Extrusion head according to claim 5,
characterized in that
the hollow tube (28) with the helical screw (38) is provided with a drive (**42**) for displacement in the radial direction.
7. Extrusion head according to claim 1, 2, 3, 4, 5 or 6,
characterized in that
the lower housing part (48) with inserted hollow tube (28) with helical screw (38) is attached on the housing (12) so as to be rotatable in both rotation directions.
8. Method for producing blow-molded multilayer hollow plastic bodies, wherein two or more molten plastic materials are fed from corresponding extruders into an extrusion head (10) and are distributed by two or more circumferential distributors (14, 16) along the circumference into a two-layer or multilayer tubular preform (18), whereafter the multilayer tubular preform (18) flows through a cylindrical reservoir (20), is provided with a viewing strip (24), and is ejected via a controllable annular nozzle (22),
characterized in that
within the cylindrical reservoir (20) molten plastic material is deflected and incorporated from the inner layer (34) in the colored outer layer (36) for providing the viewing strip (24).

9. Method according to claim 8,

characterized in that

the deflection and incorporation of the molten plastic material from the inner layer (34) for providing the viewing strip (24) in the colored outer layer (36) is only performed sequentially (discontinuously) such that the viewing strip (24) is only disposed in the vertical wall of the finished blown container.