Modified hot runner systems for injection blow molding

FIELD OF THE INVENTION

The present invention relates in general to new developments of thermoplastic preforms in particular of the type used for blow molding containers, and more particularly to preforms having a crystallized neck for resistance to deformation at elevated temperatures. It also relates to a method for producing said containers and, in particular, to preforms used for their production, as well as a method for producing said preforms.

BACKGROUND OF THE INVENTION

Any discussion of the prior art throughout the specification should in no way be considered as an admission that such prior art is widely known or forms part of common general knowledge in the field.

The use of plastic containers as a replacement for glass or metal containers in the packaging of beverages has become increasingly popular. Several types of plastics have been used, ranging from aliphatic and aromatic polyolefins (polyethylene, polypropylene, polystyrene) over halogenated polymers (polyvinyl chloride, polyvinylidene chloride) and aliphatic polyamides (nylons) to aromatic polyesters. As far as the rigid food packaging sector is concerned, polyethylene terephthalate (PET), an aromatic polyester, is by far the most widely used resin. This choice is driven by its unique material properties, combining amongst others shatter resistance, lightweight, high mechanical strength, transparency, recyclability,... Beverage applications, both for carbonated and non-carbonated products, constitute the single largest application area for PET containers. Most PET containers are made by stretch blow molding of preforms which have been made by processes including injection molding. In some circumstances, it is preferred that the preform resin is amorphous or only slightly semi-crystalline in nature, as this allows for stretch blow molding. Highly crystalline

From the above it is clear that it would be desirable to provide a method of manufacturing a preform made out of crystallizable polymers for a container having a neck finish which resists deformation, particularly at elevated temperatures, ~~characterized in that~~ wherein it is produced within the standard processing time frame and/or limited extensions thereof.

It is equally clear that it would be desirable to provide a method of manufacturing a preform made out of crystallizable polymers for a container having, at optimized wall thicknesses, equal or superior end performance properties including, amongst others, gas permeation resistance and mechanical strength.

It is an object of the present invention to overcome or ameliorate at least one of the disadvantages of the prior art, or to provide a useful alternative.

According to a first aspect of the invention there is provided an injection blow molding method for making a container comprising the steps of injecting a molten crystallizable polymer in a preform mold via a hot runner system and biaxially stretching the preform by blowing, thereby forming a container, wherein the step of injecting comprises inducing in the preform regular or irregular sequence of variations in molecular pre-alignment/orientation between different locations of the wall cross-section of the preform.

According to a second aspect of the invention there is provided a preform suitable for blow molding made out of crystallizable polymers further wherein said preform comprises regular or irregular sequence of variations in molecular pre-alignment/orientation between different locations of the wall cross-section of the preform.

According to a third aspect of the invention there is provided a container made by blow molding out of crystallizable polymers further wherein said container comprises regular or irregular sequence of variations in molecular pre-alignment/orientation and

regular or irregular sequence of variations in crystallinity between different locations of the wall cross-section of the container.

According to a fourth aspect of the invention there is provided use of a container as defined in accordance with the third aspect for use in hot-fill applications.

According to a fifth aspect of the invention there is provided use of a container as defined in accordance with the third aspect for use in carbonated or non-carbonated beverage applications.

Unless the context clearly requires otherwise, throughout the description and the claims, the words “comprise”, “comprising”, and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of “including, but not limited to”.

According to a first embodiment of the present invention, the present invention is directed to a method for making out of crystallizable polymers an article in general, or more specifically a preform and resulting stretch blow molded container, providing equal or superior end performance characteristics. Said method includes hot runner system modifications, thereby inducing new structures both at the level of preform and/or container.

Another embodiment of the present invention provides a method and apparatus for the cost-effective manufacture of such articles in general, specifically injection molded preforms and stretch blow molded containers.

The scope of the invention is set forth in the following claims:

CLAIMS:

1. An injection blow molding method for making a container comprising the steps of injecting a molten crystallizable polymer in a preform mold via a hot runner system and biaxially stretching the preform by blowing, thereby forming a container, characterized in that the preform comprises regular or irregular sequence of variations in molecular pre-alignment/orientation between different locations of the cross-section of the preform.

2. An injection blow molding method for making a container comprising the steps of injecting a molten crystallizable polymer in a preform mold via a hot runner system and biaxially stretching the preform by blowing, thereby forming a container, characterized in that the preform comprises regular or irregular sequence of variations in molecular pre-alignment/orientation and regular or irregular sequence of variations in crystallinity between different locations of the cross-section of the preform.

3. An injection blow molding method for making a container comprising the steps of injecting a molten crystallizable polymer in a preform mold via a hot runner system and biaxially stretching the preform by blowing, thereby forming a container, characterized in that said method further comprises means to selectively modify the flow path of the molten crystallizable polymer within the hot runner system.

4. An injection blow molding method for making a container comprising the steps of injecting a molten crystallizable polymer in a preform mold via a hot runner system and biaxially stretching the preform by blowing, thereby forming a container, characterized in that the container comprises regular or irregular sequence of variations in molecular pre-alignment/orientation and regular or irregular sequence of variations in crystallinity between different locations of the cross-section of the container.

5. A method according to claims 1-4, wherein in the hot runner system the polymer melt flow path comprise profiling within the needle, within the bus or combinations thereof.

6. A method according to claims 1-4, wherein in the hot runner system the polymer melt flow path comprise placing inserts within the hot runner system.

7. A method according to claims 2-3, wherein the injection molding cavity has the proper cooling provisions to influence the regular or irregular sequence of variations in molecular pre-alignment/orientation and variations in crystallinity between different locations of the cross-section of the preform.

8. A method according to claims 1-4, wherein the crystallisable polymer is PET, high IV PET or modified PET or a combination thereof.

9. A method according to claim 8, further comprising the step of providing copolymers suitable for modifying the preform's

physical characteristics, such as, but not limited to polyamide, PGA, PEN, or mixtures thereof.

10. A method according to claim 8, further comprising the step of providing additives, such as anti-oxidants, UV-absorbers, dyes, colorants, nucleating agents, fillers and mixtures thereof.

11. A preform suitable for blow molding made out of crystallizable polymers further characterized in that said preform comprises regular or irregular sequence of variations in molecular pre-alignment/orientation.

12. A preform suitable for blow molding made out of crystallizable polymers further characterized in that said preform comprises regular or irregular sequence of variations in molecular pre-alignment/orientation and regular or irregular sequence of variations in crystallinity between different locations of the cross-section of the preform.

13. A preform according to claim 11, 12, wherein the crystallizable polymer is PET, high IV PET or modified PET or a combination thereof.

14. A preform according to claim 13, further com prising the step of providing copolymers suitable for modifying the container's physical characteristics, such as, but not limited to polyamide, PGA, PEN, or mixtures thereof.

15. A preform according to claim 13, further comprising the step of providing additives, such as anti-oxidants, UV-absorbers,

dyes, colorants, nucleating agents, fillers and mixtures thereof.

16. A container made by blow molding out of crystallisable polymers further characterized in that said container comprises regular or irregular sequence of variations in molecular pre-alignment/orientation and regular or irregular sequence of variations in crystallinity between different locations of the cross-section of the container.

17. A container according to claim 16, wherein the crystallizable polymer is PET, high IV PET or modified PET or a combination thereof.

18. A container according to claim 17, further comprising the step of providing copolymers suitable for modifying the container's physical characteristics, such as, but not limited to polyamide, PGA, PEN, or mixtures thereof.

19. A container according to claim 17, further comprising the step of providing additives, such as anti-oxidants, UV-absorbers, dyes, colorants, nucleating agents, fillers and mixtures thereof.

20. A container according to claim 16, the shrinkage percentage of said container during hot fill operations being less than about 4%.

21. A container according to claims 16 or 20, having parts with wall thickness less than about 1 mm, preferably about 0.2 mm.

22. Use of a container as defined in accordance with claims 16 or 20 for use in hot-fill applications.

23. Use of a container as defined in accordance with claims 16 or 20 for use in carbonated or non-carbonated beverage applications.

CLAIMS

1. An injection blow molding method for making a container comprising the steps of injecting a molten crystallizable polymer in a preform mold via a hot runner system and biaxially stretching the preform by blowing, thereby forming a container, wherein the step of injecting comprises inducing in the preform regular or irregular sequence of variations in molecular pre-alignment/orientation between different locations of the wall cross-section of the preform.

2. An injection blow molding method for making a container according to claim 1, wherein the step of injecting comprises inducing in the preform regular or irregular sequence of variations in crystallinity between different locations of the wall cross-section of the preform.

3. An injection blow molding method for making a container according to claim 1, wherein said method further comprises selectively modifying the flow path of the molten crystallizable polymer within the hot runner system so that the preform comprises regular or irregular sequence of variations in molecular pre-alignment/orientation between different locations of the wall cross-section of the preform.

4. A method according to any one of claims 1 to 3, wherein in the hot runner system the polymer melt flow path is modified by profiling of the needle, within the bus or combinations thereof.

5. A method according to any one of claims 1 to 3, wherein the polymer melt flow path is modified by placing inserts within the hot runner system.

6. A method according to claim 2 or claim 3, comprising adjusting the cooling/quenching rate in the injection cavity appropriately such as to influence the regular or irregular sequence of variations in molecular pre-alignment/orientation and variations in crystallinity between different locations of the wall cross-section of the preform.

7. A method according to any one of claims 1 to 3, wherein the crystallizable polymer is PET, high IV PET or modified PET or a combination thereof.

8. A method according to claim 7, further comprising the step of providing copolymers of polyamide, PGA, PEN, or mixtures thereof.

9. A method according to claim 7, further comprising the step of providing additives, such as anti-oxidants, UV-absorbers, dyes, colorants, nucleating agents, fillers and mixtures thereof.

10. A preform suitable for blow molding made out of crystallizable polymers further wherein said preform comprises regular or irregular sequence of variations in molecular pre-alignment/orientation between different locations of the wall cross-section of the preform.

11. A preform suitable for blow molding made out of crystallizable polymers according to claim 10, further comprising regular or irregular sequence of variations in crystallinity between different locations of the wall cross-section of the preform.

12. A preform according to claim 10 or claim 11, wherein the crystallizable polymer is PET, high IV PET or modified PET or a combination thereof.

13. A preform according to claim 12, further comprising copolymers suitable for modifying the container's physical characteristics, such as, but not limited to polyamide, PGA, PEN, or mixtures thereof.

14. A preform according to claim 12, further comprising additives, such as anti-oxidants, UV-absorbers, dyes, colorants, nucleating agents, fillers and mixtures thereof.

15. A container made by blow molding out of crystallizable polymers further wherein said container comprises regular or irregular sequence of variations in molecular pre-alignment/orientation and regular or irregular sequence of variations in crystallinity between different locations of the wall cross-section of the container.

16. A container according to claim 15, wherein the crystallizable polymer is PET, high IV PET or modified PET or a combination thereof.

17. A container according to claim 16, further comprising copolymers suitable for modifying the container's physical characteristics, such as, but not limited to polyamide, PGA, PEN, or mixtures thereof.

18. A container according to claim 16, further comprising additives, such as anti-oxidants, UV-absorbers, dyes, colorants, nucleating agents, fillers and mixtures thereof.

19. A container according to claim 15, the shrinkage percentage of said container during hot fill operations being less than about 4%.

20. A container according to any one of claims 15 to 19, having parts with wall thickness less than about 1 mm.

21. A container according to claim 20 wherein the wall thickness is about 0.2 mm.

22. Use of a container as defined in accordance with any one of claims 15 to 19 for use in hot-fill applications.

23. Use of a container as defined in accordance with any one of claims 15 to 19 for use in carbonated or non-carbonated beverage applications.