A preform comprising an open-ended mouth forming portion, an intermediate body forming portion, and a closed base forming portion comprising a stress cracking resistant polyester composition comprising poly(ethylene terephthalate) based resin and an impact modifier. The preform is blow molded to form a corresponding container. Polyester compositions and methods are also disclosed. The impact modifier improves the stress cracking resistance of low IV PET such that the containers perform similar to those made of high IV PET.
PET WITH STRESS CRACKING RESISTANCE, PREFORM AND CONTAINER MADE THEREWITH AND METHOD

TECHNICAL FIELD

[0001] This application relates to poly(ethylene terephthalate)—based compositions and more particularly to stress cracking resistance of articles such as containers made with poly(ethylene terephthalate)—based compositions.

BACKGROUND OF THE INVENTION

[0002] Poly(ethylene terephthalate)-based resins, which are commonly referred to in the industry simply as “PET” even though they may and often do contain minor amounts of additional components, have widely been used to make containers for carbonated soft drink, juice, water and the like due to their excellent combination of mechanical and gas barrier properties. Unfortunately, a phenomenon known as environmental stress cracking (ESC) has been a persistent annoyance in PET containers used for carbonated beverages since the advent of the one-piece container design. The ultimate failure caused by ESC is a rupture in the base of the container resulting in the loss of the container’s contents and subsequent contamination of the surroundings. Clean-up is laborious. Product and liability losses can be expensive. Usually 10 to 20 stress crack failure containers per million is considered excessive.

[0003] Direct causes for failures are often difficult to determine. The factors affecting ESC of PET containers include, but are not limited to, container production conditions, the stress due to the pressurization of the carbonated beverage, and the conditions in container handling and storage.

[0004] Production conditions are critical contributors to the ESC phenomenon. Manufacturing variations can play a significant role in determining the ESC resistance. Minor changes in processing conditions are reported to have significant effect on stress crack resistance. During line conveying and container cleaning stress crack agents in the form of chemicals contact PET container. The origin of a crack in a PET container is normally located at the areas where stress concentration exists. The stress cracking agent can attack the base by many mechanisms, but normally starts from craze development as a result of the cracking agent attack. Crazes can then develop into cracks and failure may occur in forms of a rupture or leakage. Optimum processing conditions, which are difficult to manage consistently, are required to prevent ESC.

[0005] ESC can be also caused by excessive stress seen in the carbonation of beverages. Beverages are often over pressurized during the filling process to increase shelf life. However, over pressurization creates added stress to the container and thus a higher possibility for rupture.

[0006] Physical aging has been found to be an important contributing factor for ESC of PET containers. Studies have shown that the container ESC resistance decreases exponentially with hours of aging. The physical aging that containers experience before filling may be a primary factor responsible for the increased rate of failures often observed during the hot summer months.

[0007] Several methods have been reported to improve ESC resistance of one-piece PET containers for carbonated soft drinks (CSDs). Proper and robust base design of the PET container is one method used to reduce ESC. A well-designed base is required to tolerate manufacturing variations and can protect containers from excess stress. Base design is a critical component in today’s container manufacture. However, base design can not protect containers from contact with stress-inducing chemical agents.

[0008] Another method for reducing ESC is a modification to the blow molding process. The modification achieves optimal base weight, minimum residual stress, and/or maximum crystallinity in the base. This method, however, has the same problem inherent with all the methods above: the nature of the material is not changed. Therefore, the reduction of stress cracking is just a matter of degree, depending on the nature of the chemical agent, the contact time and other factors.

[0009] A third method is the use of special lubricants on container line conveyors. These lubricants have fewer tendencies to attack PET containers as stress cracking agents and thus reduce the stress cracking of PET containers. This method, however, can not solve problems associated with other chemicals such as cleansers, contaminants from water, and the like that can cause stress cracking. So ESC still occurs, just to a lesser degree during filling.

[0010] Still another method is to coat the PET container, at least around the base. The coating itself is very inert to chemical agents which are normally strong enough to attack PET. This method, however, requires additional steps in the container making process and thus adds more cost to the container. The method is not applicable in all container making or filling sites either due to space limitations.

[0011] Additionally, increasing the molecular weight or intrinsic viscosity (IV) of PET has been found helpful in reducing the occurrence of ESC in PET containers used for carbonated beverage. A minimum IV of 0.60 dl/g is desirable in making a CSD container, with preferred IV’s being reported to be 0.82 dl/g or higher. Higher IV or higher molecular weight PET has fewer chain ends and is believed to have less interaction with chemical attacking agents, which is believed to result in less stress cracking. In addition, higher IV PET (above 0.80 dl/g) is believed to have more chain entanglement, which can dissipate more stress than traditionally lower IV PET (below 0.76 dl/g). Normally, when a craze forms in PET during the attack of the chemical agent, stress is localized at the point of craze formation and is transferred through the expansion of crazes to form cracks. A higher IV resin is believed to be able to reduce the effect by transferring the stress partially to the other chains without further expansion of the crazes to form cracks. However, higher IV PET requires longer solid state polymerization (SSP) time, and higher injection molding temperature due to higher melt viscosity. Unfortunately, this means higher IV PET is more expensive to make than lower IV PET. Nevertheless, the general trend in recent years is to use higher IV PET of about 0.84 dl/g to avoid the annoyance of the ESC problem even though higher IV PET costs more to produce and convert from resin to container.

[0012] Lower IV PETs, such as 0.72 to 0.76 dl/g, however, have been used for a few container applications, such as still water containers, where stress cracking is seldom an issue. Application of such lower IV PETs in one-piece-CSD containers has been limited solely because of its bad per-
formance in stress cracking resistance. Modifications to PET compositions have been reported in an effort to counter ESC
effects so that lower IV PET can be used for CSDs. One example is the addition of a comonomer, such as naphtha-
lene dicarboxylate to enhance the stress cracking resistance. In any case, a higher IV PET has always been used for
carbonated beverage applications. Having different resins for packaging different products, however, creates more
inventories in the converting facilities. Some facilities do
not have enough capability to have so many inventories.
Thus, having a lower IV PET that resists stress cracking
problems would be greatly desired by the industry so that a
lower IV resin can be used for both CSD and water applica-
tion reducing resin cost as well as inventory cost.

[0013] Impact modifiers have been used in amorphous
polymer as well as high crystalline polymers to improve the
impact resistance of these polymers. For polyesters, impact
modifiers are widely used to improve the low temperature or
room temperature impact resistance of highly crystallized
PET homopolymers (often referred to as “CPET”) or amor-
phous polyesters made using high levels of glycol modifi-
cation (more than 10 mole percent of non-ethylene glycol
modifiers). The impact stress is normally applied in a rapid
movement, such as dropping the article from a high distance or
applying a rapid high stress to the article through an
external force. These modifiers are believed to form a
two-phase morphology in the polymer. The modifiers form
a rubber-like phase which can absorb the impact energy and
effectively transfers the stress from the CPET or amorphous
polyester phase. Although impact modifiers are generally
known for the above applications, there has been no attempt
of using the same family of chemicals to improve the stress
cracking resistance of PET containers for carbonated bev-
earage application, especially those made with lower IV PET.

[0014] Although much effort has been made to understand
and solve the stress cracking problem, the root causes of the
stress cracking are still unknown. Stress cracking can have
costly ramifications in terms of clean-up or liability. As can
be seen, no one method currently available solves the stress
cracking problems of PET containers used for CSDs. Rather,
the stress cracking problem of PET containers has been
carefully managed through optimized bottle design, bottle
making, and product filling processes. Therefore, there
remains a need to prevent or decrease environmental stress
cracking in PET containers. Accordingly, it is to the provi-
sion of such that the present invention is primarily directed.

SUMMARY OF THE INVENTION

[0015] This invention addresses the foregoing issues in the
prior art by providing a preform having an open ended
mouth forming portion, an intermediate body forming por-
tion, and a closed base forming portion and being made of
a stress cracking resistant polyester composition comprising
a poly(ethylene terephthalate) based resin and an impact
modifier. This invention also encompasses a container made
by blow molding such preform made of the stress cracking
resistant polyester composition.

[0016] Without wishing to be bound by theory, the impact
modifier is believed to improve the relaxation phenomenon
of the poly(ethylene terephthalate) based resin such that a
lower molecular weight (i.e. lower intrinsic viscosity) poly-
(ethylene terephthalate) based resin behaves as a higher
molecular weight resin and resists stress cracking. In pre-
ferred embodiments the poly(ethylene terephthalate) based
resin has an IV of from about 0.65 to about 0.90 dL/g, more
preferably from about 0.65 to about 0.86 dL/g, even more
preferably from about 0.65 to about 0.80 dL/g and still even
more preferably from about 0.68 to about 0.76 dL/g. Thus,
as a result of this invention, less expensive, lower IV poly(ethylene terephthalate) based resin when combined
with the impact modifier can be used to make such preforms
and containers. Further the same preform and container
can be used for a variety of applications including CSD and
bottled water containers.

[0017] Other objects, features, and advantages of this
invention and the preferred embodiments will be appreciated
from the following drawings, detailed description of
embodiments, and claims.

BRIEF DESCRIPTION OF DRAWINGS

[0018] FIG. 1 is a sectional elevation view of an injection
molded container preform made in accordance with a pre-
ferred embodiment of this invention.

[0019] FIG. 2 is a sectional elevation view of a blow
molded container made from the preform of FIG. 1 in
accordance with a preferred embodiment of this invention.

[0020] FIG. 3 is a perspective view of a packaged bev-
 erage made in accordance with a preferred embodiment
of this invention.

DETAILED DESCRIPTION OF EMBODIMENTS
OF THE INVENTION

[0021] The present invention encompasses a preform and
a container made by blow molding the preform, both having
an open ended mouth forming portion, an intermediate body
forming portion, and a closed base forming portion and
comprising a stress cracking resistant polyester composition
comprising a poly(ethylene terephthalate) (PET) based resin
and at least one impact modifier. Preferably, the PET based
resin has a low intrinsic viscosity (IV), that is below about
0.76 dL/g. The impact modifier surprisingly enhances the
stress cracking resistance of the low IV PET based resin
such that the low IV PET based resin behaves as a higher IV
resin. Thus, the container made utilizing this invention is
particularly suited for use as a carbonated soft drink (CSD)
container. The use of the impact modifier makes it possible
to use a cheaper low IV PET based resin for the CSD
container, and use the same container for other applications
such as bottled water, alcoholic beverages, juices, and the
like.

[0022] Conventionally, impact modifiers have been used
in thermal formed high crystallinity PET (CPET) articles to
improve the low temperature impact resistance. Such
articles include amorphous polyester films or thermal
formed high crystallinity PET trays used in low temperature
freezer storage and high temperature oven-able applications.
The high crystallinity is normally achieved through thermal
crystallization. Therefore, a PET homopolymer is normally
used to enhance the thermal crystallization rate. The high
crystalline PET homopolymers used for such application
normally also have high IVs of above 0.80 dl/g and
preferably above 0.90 dl/g to achieve the good impact
resistance in low temperature applications. Further, in order
to improve the impact resistance, normally a loading level of 10 weight percent or more of the impact modifier has to be incorporated into CPET. In this invention, the same family of chemicals that are used as impact modifiers improves the stress cracking resistance of low IV PET based resins at much lower loading, preferably lower than 10 weight percent, such that the low IV PET based resin can perform similar to that of high IV PET materials in applications including, but not limited to CSD containers. The containers are made through injection blow molding processes, where the thermal crystallization is minimized in the injection molding to obtain clear preforms and the crystallinity is achieved through strain induced crystallization during the blow molding process.

[0025] Suitable impact modifiers for use in this invention include any impact modifier compatible with PET based resins. Preferred impact modifiers include elastomers. Still more preferred suitable impact modifiers include elastomers based on polyethylene, butadiene or isoprene, such as polybutadiene, polyisoprene, natural rubber, styrene-butadiene (SBR), acrylonitrile-butadiene, styrene-butadiene-styrene or hydrogenated SBS block copolymers, or acrylonitrile-butadiene-styrene polymers containing high levels of butadiene.

[0024] The impact modifiers that are especially useful are the ones modified to enhance the compatibility with PET based resins, such as polyethylene based elastomers. Examples of desirable polyethylene based elastomers include ethylene-acrylate copolymers such as ethylene/methylacrylate, ethylene/ethyl acrylate, ethylene/butyl acrylate and ethylene/methylacrylate/glycidyl methacrylate, or ethylene/vinyl acetate copolymers, or the copolymers of butadiene/MMA/styrene. U.S. Pat. Nos. 5,409,967 and 5,652,306 and PCT application WO00/15717 disclose the composition of such impact modifiers, and the specifications thereof are expressly incorporated herein by reference.

[0025] Suitable impact modifiers also include those with a core-shell structure which are described in U.S. Pat. No. 5,409,967 and PCT application WO00/15717. These core-shell modifiers normally contain a hard shell from methylmethacrylate copolymers and a core made from either butadiene methacrylate/butadiene-styrene copolymer or butyl acrylate copolymers. Examples of suitable core-shell impact modifiers include those available from Rohm & Haas Company under the trade name Paraloid.

[0026] Impact modifiers can contain added or reacted-to-the-chain compatibilizers. The compatibilizers are those functional groups that can enhance the compatibility or the miscibility of the impact modifiers with PET based resin. These modifiers include those described in PCT application WO 00/15717.

[0027] Normal impact modifiers have a different reflective index than that of PET based resins, and the resultant container is white or hazy. One way to solve this is to use modified impact modifiers. Impact modifiers can be modified to match the reflective index of the impact modifiers to that of PET based resins so that the resultant container is clear. The impact modifiers can also be modified with core-shell technology such that the compatibility as well as the reflective index is matched with PET based resins. Further, the impact modifiers can be modified by manipulating the particle sizes of the modifiers such that they are below the visible light wave length, normally below 0.1 microns. All these modifications can be achieved by those skilled in the art.

[0028] The impact modifier is present in the stress cracking resistant polyester composition in an amount effective to enhance the stress cracking resistance thereof relative to a polyester composition not including the impact modifier. Preferably, the impact modifier is present in the stress cracking resistant polyester composition in an amount from about 1 to about 10 weight percent of the stress cracking resistant polyester composition. More desirably, the impact modifier is present in an amount from about 3 to about 10 weight percent and even more preferably in an amount from about 3 to about 6 weight percent.

[0029] The PET based resin preferably comprises a diacid component having repeat units from terephthalic acid with less than about 5 mole percent modification and a diol component having repeat units from ethylene glycol with less than about 5 mole percent diol modification based on 100 mole percent diacid component and 100 mole percent diol component. The diacid modification can be a comonomer from any of a number of diacids, including adipic acid, succinic acid, isophthalic acid, phthalic acid, 4,4'-biphenyl dicarboxylic acid, 2,6-naphthalenedicarboxylic acid, and the like. The diol modification can be a comonomer such as cyclohexanecarboxaldehyde, diethylene glycol, 1,2-propanediol, neopentylene glycol, 1,3-propanediol, and 1,4-butanediol, and the like. The PET base resin preferably further comprises a comonomer for reducing the thermal crystallization rate thereby allowing for the manufacture of relatively clear containers.

[0030] In preferred embodiments, the IV of the PET based resin, as measured according to ASTM D4603-96, is from about 0.65 to about 0.90 Dl/g, more preferably from about 0.65 to about 0.86 Dl/g, still more preferably from 0.65 to 0.80 and further more preferably from about 0.68 to 0.76 Dl/g. According to ASTM D4603-96, the IV of PET based resin was measured at 30° C. with 0.5 weight percent concentration in a 60/40 (by weight fraction) phenol/1,1,2,2-tetrachloroethane solution.

[0031] As is well known to those skilled in the art, containers can be made by blow molding an injection molded preform. Examples of suitable preform and container structures and methods for making the same are disclosed in U.S. Pat. No. 5,888,598, the disclosure of which is expressly incorporated herein by reference in its entirety.

[0032] Turning to FIG. 1, a container preform 10 is illustrated. This preform 10 is made by injection molding the stress cracking resistant polyester compositions of this invention and comprises a threaded neck finish 12 which terminates at its lower end in a capping flange 14. Below the capping flange 14, there is a generally cylindrical section 16 which terminates in a section 18 of gradually increasing external diameter so as to provide for an increasing wall thickness. Below the section 18 there is an elongated body section 20.

[0033] The preform 10 illustrated in FIG. 1 can be blow molded to form a container 22 illustrated in FIG. 2. The container 22 comprises a shell 24 comprising a threaded neck finish 26 defining a mouth 28, a capping flange 30 below the threaded neck finish, a tapered section 32 extend-
ing from the capping flange, a body section 34 extending below the tapered section, and a base 36 at the bottom of the container. The container 10 is suitably used to make a packaged beverage 38, as illustrated in FIG. 3. The packaged beverage 38 includes a beverage such as a carbonated soda beverage disposed in the container 22 and a closure 40 sealing the mouth 28 of the container.

[0034] The preform 10, container 22, and packaged beverage 38 are but examples of applications using the stress cracking resistant compositions of the present invention. It should be understood that the compositions of the present invention can be used to make preforms and containers having a variety of configurations.

[0035] Embodiments of the present invention are further illustrated below by way of examples, which are not to be construed in any way as imposing limitations upon the scope of the invention.

EXAMPLE 1

[0036] Sample container preforms were injection molded using two different PET based resins and different stress crack resistance modifiers. Sample 1 was made with a first PET resin (R1), a commercially available CSD grade PET copolymer resin with an IV of 0.83, and Samples 2-6 were made with a second PET resin (R2), a commercially available water grade PET copolymer resin with an IV of 0.74. The compositions of the Sample preforms are set forth in Table 1.

[0037] Each preform was injection molded using 500 mL Contour design 28g preforms under conditions that were set to produce molded samples with no crystallinity, haze or other visual imperfections based on the control resin variable. The PET resins R1 and R2 were dried overnight at 280°F. to a moisture level below 50 ppm. The stress crack resistance additives, poly[ethylene-co-butyl acrylate] (PBA, Aldrich #43,077-3) and poly[ethylene-co-methyl acrylate] (PMA, Aldrich #43,266-0), were dried over the weekend in a vacuum oven with no heat applied to avoid the sticking of additives. An Arburg 320H was used for the injection molding trial.

[0038] The preforms were blow molded into containers using a Sidel SBO1/2 machine. The blow molding process conditions that produced an acceptable container with appropriate section weights was established for each variable.

[0039] The intrinsic viscosity (IV) of each Sample was measured according to ASTM D4603-96 and the results are shown in Table 1.

### TABLE 1

<table>
<thead>
<tr>
<th>Sample</th>
<th>Resin</th>
<th>Additive</th>
<th>Actual % Additive Added</th>
<th>IV (dL/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>R1</td>
<td>Control-None</td>
<td>N/A</td>
<td>0.795</td>
</tr>
<tr>
<td>2</td>
<td>R2</td>
<td>Control-None</td>
<td>N/A</td>
<td>0.696</td>
</tr>
<tr>
<td>3</td>
<td>R2</td>
<td>PBA</td>
<td>3.0</td>
<td>0.681</td>
</tr>
<tr>
<td>4</td>
<td>R2</td>
<td>FBA</td>
<td>3.0</td>
<td>0.670</td>
</tr>
<tr>
<td>5</td>
<td>R2</td>
<td>PMA</td>
<td>3.0</td>
<td>0.689</td>
</tr>
<tr>
<td>6</td>
<td>R2</td>
<td>PMA</td>
<td>5.0</td>
<td>0.679</td>
</tr>
</tbody>
</table>

[0040] The stress cracking resistance of the containers made from Samples 1-6 was measured and the results are shown in Table 2 measured by caustic stress cracking method. In the test, twenty-five containers were randomly selected. Due to the limited number of containers, the number of containers tested varied from 8 to 25 in different cases. The relative comparison was therefore used. The samples were carbonated to about 36 psi of CO2 and stored for 24 hours in an environment of 72°F. and 50% RH. The base of each sample container was immersed in a 0.1% NaOH solution. The % pass indicates the % of containers that passed the test and did not exhibit stress cracking.

### TABLE 2

<table>
<thead>
<tr>
<th>Sample</th>
<th>Average Failure Time (min.)</th>
<th>Minimum Failure Time (min.)</th>
<th>Maximum Failure Time (min.)</th>
<th>% Passed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>180</td>
<td>180</td>
<td>180</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>123</td>
<td>26</td>
<td>180</td>
<td>9%</td>
</tr>
<tr>
<td>3</td>
<td>180</td>
<td>180</td>
<td>180</td>
<td>100%</td>
</tr>
<tr>
<td>4</td>
<td>180</td>
<td>180</td>
<td>180</td>
<td>100%</td>
</tr>
<tr>
<td>5</td>
<td>175</td>
<td>150</td>
<td>180</td>
<td>75%</td>
</tr>
<tr>
<td>6</td>
<td>180</td>
<td>180</td>
<td>180</td>
<td>100%</td>
</tr>
</tbody>
</table>

[0041] The results in Table 2 clearly showed that the addition of the stress cracking resistance modifiers dramatically improved the stress cracking resistance of the containers made from low IV PET resins. The low IV resins with stress cracking resistance modifiers performed similarly to that of higher IV resins. In this case, the IV of the low molecular weight PET container is 0.68 and the IV of the high molecular weight PET container is 0.80, but their stress cracking performance is the same. Sample 2, the low IV resin without the modifier, could not pass the stress cracking test.

EXAMPLE 2

[0042] Sample container preforms were injection molded using two different PET based resins and different stress crack resistance modifiers. Sample 1 was made with a first PET resin (R3), a commercially available CSD grade PET copolyester resin with an IV of 0.84, and Samples 2-4 were made with a second PET resin (R4), a commercially available water grade PET copolyester resin with an IV of 0.74. The composition of the Sample preforms is set forth in Table 3.

[0043] The stress cracking resistance additive used was a commercially available Paraloid EXL core-shell impact modifier supplied by Rohm & Haas. The preforms were injection and blow molded according to Example 1. The containers were then subjected to the same tests and the results are shown in Table 4.

### TABLE 3

<table>
<thead>
<tr>
<th>Sample</th>
<th>Resin</th>
<th>Additive</th>
<th>Actual % Additive Added</th>
<th>IV (dL/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>R3</td>
<td>Control-None</td>
<td>0</td>
<td>0.762</td>
</tr>
<tr>
<td>2</td>
<td>R4</td>
<td>Control-None</td>
<td>0</td>
<td>0.674</td>
</tr>
</tbody>
</table>
TABLE 3-continued

<table>
<thead>
<tr>
<th>Sample</th>
<th>Resin</th>
<th>Additive</th>
<th>Actual %</th>
<th>Additive Added</th>
<th>IV (dL/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>R4</td>
<td>EXL</td>
<td>3.0</td>
<td>0.65</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>R4</td>
<td>EXL</td>
<td>6.0</td>
<td>0.638</td>
<td></td>
</tr>
</tbody>
</table>

[0044] The stress cracking test was performed the same as in the Example 2. All variables had 25 containers for testing. The absolute failure time was thus used for the comparison. The average failure time for different variables is shown in the table 4. The longer the failure time, the better the stress cracking resistance. It is seen that both 3 and 6 wt % of the Paraloid EXL additive improved the stress cracking resistance of the low IV resin. For 6 wt %, it was very similar to that of the high IV resin.

TABLE 4

<table>
<thead>
<tr>
<th>Sample</th>
<th>Average failure time (minutes)</th>
<th>Standard deviation (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>168.0</td>
<td>11.3</td>
</tr>
<tr>
<td>2</td>
<td>27.0</td>
<td>34.2</td>
</tr>
<tr>
<td>3</td>
<td>112.8</td>
<td>39.5</td>
</tr>
<tr>
<td>4</td>
<td>137.4</td>
<td>7.7</td>
</tr>
</tbody>
</table>

[0045] It should be understood that the foregoing relates to particular embodiments of the present invention, and that numerous changes may be made therein without departing from the scope of the invention as defined by the following claims.

1. A preform comprising an open ended mouth forming portion, an intermediate body forming portion, and a closed base forming portion and comprising a stress cracking resistant polyester composition comprising poly(ethylene terephthalate) based resin and an impact modifier.
2. A preform as in claim 1 wherein the impact modifier is an elastomer.
3. A preform as in claim 1 wherein the impact modifier is selected from the group consisting of polyethylene-based elastomers, butadiene-based elastomers, and isoprene-based elastomers.
4. A preform as in claim 1 wherein the impact modifier is a polyethylene-based elastomer.
5. A preform as in claim 1 wherein the impact modifier is a core-shell impact modifier.
6. A preform as in claim 1 wherein the impact modifier is ethylene-acrylate copolymer.
7. A preform as in claim 1 wherein the impact modifier is modified to increase compatibility of the impact modifier with poly(ethylene terephthalate) based resin.
8. A preform as in claim 1 wherein the impact modifier is modified to more closely match the reflective index of the poly(ethylene terephthalate) based resin.
9. A preform as in claim 1 wherein the impact modifier is present in an amount effective to enhance the stress cracking resistance of the stress cracking resistant polyester composition relative to a polyester composition not including the impact modifier.
10. A preform as in claim 1 wherein the impact modifier is present in an amount from about 1 to about 15% by weight of the stress cracking resistant polyester composition.
11. A preform as in claim 1 wherein the impact modifier is present in an amount from about 3 to about 10% by weight of the stress cracking resistant polyester composition.
12. A preform as in claim 1 wherein the impact modifier is present in an amount from about 3 to about 6% by weight of the stress cracking resistant polyester composition.
13. A preform as in claim 1 wherein the poly(ethylene terephthalate) based resin has an IV from about 0.65 to about 0.90 dL/g.
14. A preform as in claim 1 wherein the poly(ethylene terephthalate) based resin has an IV from about 0.65 to about 0.86 dL/g.
15. A preform as in claim 1 wherein the poly(ethylene terephthalate) based resin has an IV from about 0.65 to about 0.80 dL/g.
16. A preform as in claim 1 wherein the poly(ethylene terephthalate) based resin has an IV from about 0.68 to about 0.76 dL/g.
17. A preform as in claim 1 wherein the poly(ethylene terephthalate) based resin has an IV from about 0.76 dL/g.
18. A preform as in claim 1 wherein the poly(ethylene terephthalate) based resin comprises a comonomer for reducing the thermal crystallization rate.
19. A preform as in claim 18 wherein the comonomer is selected from the group consisting of naphthalene dicarboxylic acid, diethylene glycol, isophthalic acid, and 1,4-cyclohexanediol.
20. A preform as in claim 1 wherein the poly(ethylene terephthalate) based resin comprises a diacid component having repeat units from terephthalic acid with less than about 5 mole percent modification and a diol component having repeat units from ethylene glycol with less than about 5 mole percent diol modification based on 100 mole percent diacid component and 100 mole percent diol component.
21. A container made by blow molding the preform of claim 1, wherein the container comprises an open ended mouth forming portion, an intermediate body forming portion, and a closed base forming portion.
22. A container as in claim 21 wherein the container is a carbonated soft drink container.
23. A container comprising an open ended mouth forming portion, an intermediate body forming portion, and a closed base forming portion and comprising a stress cracking resistant polyester composition comprising poly(ethylene terephthalate) based resin and an impact modifier.
24. A stress cracking resistant polyester composition comprising poly(ethylene terephthalate) based resin having an IV of from about 0.65 dL/g to less than about 0.86 dL/g and an impact modifier.
25. A stress cracking resistant polyester composition comprising poly(ethylene terephthalate) based resin having an IV of about 0.68 to about 0.76 dL/g and an impact modifier.
26. A stress cracking resistant polyester composition comprising poly(ethylene terephthalate) based resin and an impact modifier in an amount from about 1 to about 10% by weight of the stress cracking resistant polyester composition.
27. A stress cracking resistant polyester composition as in claim 26 wherein the impact modifier is present in an amount from about 3 to about 10% by weight of the stress cracking resistant polyester composition.

28. A stress cracking resistant polyester composition as in claim 26 wherein the impact modifier is present in an amount from about 3 to about 6% by weight of the stress cracking resistant polyester composition.

29. A method for making a stress cracking resistant container comprising blow molding a preform comprising an open ended mouth forming portion, an intermediate body forming portion, and a closed base forming portion comprising the step of molding a stress cracking resistant polyester composition comprising poly(ethylene terephthalate) based resin and an impact modifier.

30. A method for making a stress cracking resistant preform comprising an open ended mouth forming portion, an intermediate body forming portion, and a closed base forming portion comprising the step of molding a stress cracking resistant polyester composition comprising poly(ethylene terephthalate) based resin and an impact modifier.

31. A method for enhancing the stress cracking resistance of a polyester composition comprising blending an impact modifier into poly(ethylene terephthalate) based resin, the impact modifier present in an amount from about 1 to about 15% by weight of the polyester composition.

32. A method for enhancing the stress cracking resistance of a polyester composition comprising blending an impact modifier into poly(ethylene terephthalate) based resin having an IV of from about 0.65 dL/g to about 0.80 dL/g.

33. A method of claim 31 wherein the poly(ethylene terephthalate) based resin has an IV of from about 0.68 to about 0.76 dL/g.

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