A tubular structure wherein the tubular structure is constructed solely of a polybutylene terephthalate or a polybutylene naphthalate tubular structure having an inner surface and an outer surface wherein the polybutylene terephthalate or polybutylene naphthalate extends throughout the entire wall structure from the inner surface to the outer surface thereof. The polybutylene terephthalate or polypropylene tubular structure is useful in a variety of automotive, industrial or domestic applications where there is no need to dissipate any static electricity buildup.
POLYBUTYLENE TEREPTHALATE AND POLYBUTYLENE NAPHTHALATE TUBULAR STRUCTURES

RELATED APPLICATIONS


BACKGROUND OF THE INVENTION

[0002] The present invention relates to the field of polymeric hoses, and particularly to the field of flexible polybutylene terephthalate or polybutylene naphthalate hoses. Rubber hoses are generally used in a variety of uses such as automobile fuel feed hoses, fuel vent hoses, torque converter hoses, power steering hoses, air conditioner hoses, brake fluid hoses, industrial hydraulic hoses and compressed gas hoses, refrigerator hoses, garden hoses, propane gas hoses, etc.

[0003] Polybutylene terephthalate has been used as a thin barrier layer in multilayer hoses or tubes as disclosed in U.S. Pat. Nos. 5,996,642; 5,910,544; and 5,474,109. Other examples of prior art patents which teach multilayer polymer hoses or tubes containing polybutylene terephthalate in one of the layers for use in fuel line applications include U.S. Published patent application Ser. Nos. 20010037795 and 20010033130; and U.S. Pat. No. 5,390,705 to Brunnhofer and U.S. Pat. No. 6,192,942 to Hsich et al., U.S. Pat. No. 6,179,008 to Kawazura, et al. teach rubber hoses composed of an inner tube of polybutylene terephthalate. U.S. Pat. No. 5,792,532 to Pfleger discloses a corrugated hose containing a polybutylene terephthalate layer for use in automotive air conditioner or radiator lines.

[0004] It is clear that there have been many problems and many proposed solutions to the problems. However, there remains an urgent need, particularly in the automotive and industrial hose industries, for a flexible, single layer hose which is simple to manufacture using single extruder methods, eliminates the problem of delamination while maintaining manufacturing costs at an acceptable level.

SUMMARY OF THE INVENTION

[0005] The present invention provides a tubular structure formed solely of polybutylene terephthalate (PBT) or polybutylene naphthalate (PBN) for use in automotive, industrial or domestic applications where there is no need to dissipate static electricity buildup. Since the tubular structure of the invention consists of a single layer of polybutylene terephthalate or polybutylene naphthalate, the problem of delamination is non-existent. Furthermore, the polybutylene terephthalate or polybutylene naphthalate tubular structure of the invention possesses superior strength and durability, and is resistant to heat and chemical degradation. Both polybutylene terephthalate and polybutylene naphthalate area relatively stiff materials, but are considered adequate for the purpose of this invention. In certain situations where more flexibility is desired, the poly-butylene terephthalate can be built having a corrugated structure which allows additional flexibility depending upon the extent and degree of the corrugation and upon the particular use of the hose.

[0006] Copending U.S. patent application Ser. No. 09/951,181 relates to fuel transport hoses for use in the automotive industry to transport fuel. The polybutylene terephthalate or polybutylene naphthalate is employed solely throughout the entire wall of the hose to provide reduced permeability without the need for a separate barrier layer. Typically, such polybutylene terephthalate or polybutylene naphthalate hose exhibits a fuel liquid and vapor permeation of less than about 1 g/m²/day of CE-10 at 40°C. In addition to reduced permeability, the hose has adequate strength and durability over long periods of time, and is resistant to chemical degradation by the fluids being transported therein. Since it is well known in the industry that hoses used to transport fuels are required to contain a conductive agent or otherwise exhibit conductive characteristics in order to dissipate any electrical buildup which may occur during the flow of fuel through the hose, the hose of copending U.S. patent application Ser. No. 09/951,181 also contains therein such a conductive agent. While the single layer hose of polybutylene terephthalate or polybutylene naphthalate exhibits all of the above desirable characteristics, it has now been found that the strength and durability of such hose which contains a conductive agent are less than the strength and durability of a polybutylene terephthalate or polybutylene naphthalate hose which does not contain a conductive agent. Therefore, it is a particular object of the present invention to provide a polybutylene terephthalate or polybutylene naphthalate hose which does not require the presence of a conductive agent in the hose.

[0007] It is another object of the present invention to provide a polybutylene terephthalate or polybutylene naphthalate hose which is useful in a variety of automotive, industrial and domestic applications.

[0008] Typically, the hoses of the present invention are useful in a variety of applications such as automobile fuel vent hoses, torque converter hoses, power steering hoses, air conditioner hoses, brake fluid hoses, industrial hydraulic hoses and compressed gas hoses, refrigerator hoses, garden hoses, propane gas hoses, etc.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is a perspective view illustrating a polybutylene terephthalate or a polybutylene naphthalate tube of the present invention;

[0010] FIG. 2 is a perspective view illustrating the polybutylene terephthalate or polybutylene naphthalate hose of FIG. 1 including a protective cover;

[0011] FIG. 3 is a sectional view through the polybutylene terephthalate or polybutylene naphthalate hose of FIG. 1; and

[0012] FIG. 4 is a sectional view through the polybutylene terephthalate or polybutylene naphthalate hose of FIG. 2.

DETAILED DESCRIPTION OF THE INVENTION

[0013] In accordance with the present invention, polybutylene terephthalate or polybutylene naphthalate is employed as the sole material used to form the wall structure of a tubular structure which is useful in a variety of automotive, industrial and domestic applications. For example, the polybutylene terephthalate or polybutylene naphthalate hose of the present invention is advantageously used as a fuel vent hose, torque converter hose, power steering hose, air conditioner hose, brake fluid hose, industrial hydraulic hose and compressed gas hose, refrigerator hose, garden hose, propane gas hose, etc.

[0014] Polybutylene terephthalate and polybutylene naphthalate are relatively stiff materials and are generally not the
best choice as a material for forming a tube which includes bends and turns. In one aspect of the invention, the poly
butylene terephthalate or polybutylene naphthalate tubing is formed having a corrugated configuration which makes the
tube more flexible so that it can be conveniently shaped in
any configuration desired.

[0015] With reference to the figures, FIGS. 1 and 3
illustrate one embodiment of the present invention wherein
the entire wall 12 of the hose 10 is constructed of polybuty-
lene terephthalate or polybutylene naphthalate. FIGS. 2
and 4 illustrate another embodiment of the invention
wherein the entire wall 12 of the tube 10 is constructed of a
polybutylene terephthalate or polybutylene naphthalate and
the hose 10 further includes a protective cover 14 adjacent
the inside surface 16 of the polybutylene terephthalate or
polybutylene naphthalate wall 12. The cover 14 may be
made of any material commonly used in the industry to
cover a fuel tube and to provide flame resistance to the tube.
Typically, the cover layer is constructed of a polymer,
copolymer, blend or alloy of a thermoplastic material such
as polyesters, polyamides such as nylons, polyurethanes,
polyvinyl chloride, polyolefins, chlorinated polyolefins,
polyalkylene terephthalate, polyalkylene naphthalates, and
the like.

[0016] It may be desirable to incorporate a tie layer
between the polybutylene terephthalate or polybutylene
naphthalate tube and the cover. Where such tie layer is
desired, any of the commonly recognized tie layers which
will adhere to the polybutylene terephthalate or polybutyl-
ene naphthalate, and to the cover material will be satisfac-
tory. Anhydride-modified linear low density polyethylene
available from Du Pont under the name Bynel®, or from
Mitsui under the name Admer® are examples of two such
materials.

[0017] Having described the invention in detail and by
reference to preferred embodiments thereof, it will be appar-
ent that modifications and variations are possible without
departing from the scope of the invention defined in the
 appended claims.

What is claimed is:

1. A tubular structure for use in applications where
dissipation of static electricity buildup is not required,
wherein said tubular structure consists solely of polybuty-
lene terephthalate or polybutylene naphthalate, wherein said
polybutylene terephthalate or said polybutylene naphthalene
extends throughout the entire tubular structure from an inner
surface thereof to an outer surface thereof.

2. The tubular structure of claim 1 wherein a protective
cover surrounds the outer surface of said polyalkylene
terephthalate or said polyalkylene naphthalene tubular
structure.

3. The tubular structure of claim 2 wherein said protect-
tive cover is selected from the group consisting of poly-
esters, polyamides, polyurethanes, polyvinyl chloride, poly-
olefins, chlorinated polyolefins, polyalkylene terephthalates,
and polyalkylene naphthalates.

4. The tubular structure of claim 3 wherein said protec-
tive cover is a chlorinated polyolefin.

5. The tubular structure of claim 4 wherein said protec-
tive cover is chlorinated polyethylene.

6. The tubular structure of claim 2 wherein a tie layer is
disposed between said polybutylene terephthalate or said
polybutylene naphthalate and said protective cover.

7. The tubular structure of claim 6 wherein said tie layer
is an Anhydride-modified linear low density polyethylene.

8. The tubular structure of claim 1 wherein said tubular
structure is corrugated to provide improved flexibility to said
tubular structure.

9. The tubular structure of claim 1 wherein said tubular
structure consists of a polybutylene terephthalate extending
throughout said tubular structure from said inner surface to
said outer surface.

10. The tubular structure of claim 1 wherein said tubular
structure consists of a polybutylene naphthalate extending
throughout said tubular structure from said inner surface to
said outer surface.

11. In a tubular structure for use in applications where
dissipation of static electricity buildup is not required, the
improvement wherein the tubular structure consists solely of
polybutylene terephthalate wherein said polybutylene
terephthalate extends throughout said tubular structure from
an inner surface thereof to an outer surface thereof.

12. The tubular structure of claim 11 wherein a protective
cover surrounds said inner surface of said polyalkylene
terephthalate tubular structure.

13. The tubular structure of claim 12 wherein said
protective cover is selected from the group consisting of
polyesters, polyamides, polyurethanes, polyvinyl chloride,
polyolefins, chlorinated polyolefins, polyalkylene terephtha-
late, and polyalkylene naphthalates.

14. The tubular structure of claim 13 wherein said
protective cover is a chlorinated polyolefin.

15. The tubular structure of claim 14 wherein said
protective cover is chlorinated polyethylene.

16. The tubular structure of claim 12 wherein a tie layer
is disposed between said polybutylene terephthalate and said
protective cover.

17. The tubular structure of claim 16 wherein said tie layer
is an Anhydride-modified linear low density polyethylene.

18. The tubular structure of claim 11 wherein said tubular
structure is corrugated to provide improved flexibility to said
tubular structure.

19. In a tubular structure for use in applications where
dissipation of static electricity buildup is not required, the
improvement wherein the tubular structure consists solely of
polybutylene naphthalate wherein said polybutylene naph-
thalate extends throughout said tubular structure from said
inner surface thereof to an outer surface thereof.

20. The tubular structure of claim 19 wherein a protective
cover surrounds the outer surface of said polybutylene
naphthalate tubular structure.

21. The tubular structure of claim 21 wherein said protective
cover is selected from the group consisting of poly-
esters, polyamides, polyurethanes, polyvinyl chloride,
polyolefins, chlorinated polyolefins, polyalkylene terephtha-
late, and polyalkylene naphthalates.

22. The tubular structure of claim 21 wherein said
protective cover is a chlorinated polyolefin.

23. The tubular structure of claim 22 wherein said
protective cover is chlorinated polyethylene.

24. The tubular structure of claim 20 wherein a tie layer
is disposed between said polybutylene naphthalate and said
protective cover.

25. The tubular structure of claim 21 wherein said tie layer
is an Anhydride-modified linear low density polyethylene.

26. The tubular structure of claim 19 wherein said tubular
structure is corrugated to provide improved flexibility to said
tubular structure.

* * * * *