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(54) Title: AUTOMOBILE FUEL TANK

(57) Abstract: A blow moulded automobile fuel tank having a wall defining a fuel chamber wherein the minimum wall thickness of the wall is from 2.4mm to less than 3mm, the tank being composed of a high density polyethylene having a density of from 0.945 to 0.955g/cm^3, a high load melt index of from 5 to 9.5g/10min, the high density polyethylene optionally having a carbon black content of up to 0.5wt%, and the fuel tank having a fire resistance and an impact resistance both complying with the respective standards defined in ECE 34, ANNEX 5.

AUTOMOBILE FUEL TANK

The present invention relates to a blow moulded automobile fuel tank composed of high density polyethylene.

Such fuel tanks are required to exhibit high safety performance, particularly with regard to fire resistance and impact resistance. Plastics automobile fuel tanks are required to meet minimum statutory and industry specified performance criteria both with respect to creep resistance when the tank is subjected to a fire and crash test resistance when the tank is subjected to an impact. Known blow moulded automobile fuel tanks suffer from the disadvantage that in order to meet the specified criteria the fuel tanks are required by automobile manufacturers to have a minimum wall thickness of at least 3mm so as to provide sufficient impact strength and creep resistance for the fuel tank as a whole. However, the use of such high wall thicknesses leads to a number of disadvantages. First the high wall thickness increases the weight of the fuel tank, although there is a general desirability to reduce the weight of automobile components. Second, the high wall thickness increases the amount of plastics material employed to produce a fuel tank of a given volume, thereby increasing the material cost of the fuel tank. Finally, the high wall thickness increases the moulding time of the plastics fuel tank, thereby increasing the production cost.

US-A-4719135 discloses a fuel tank having a polymer substrate, e.g. of HDPE, coated with a particular cured varnish agent. The tank is blow moulded. The HDPE has a density of from 0.935 to 0.950g/cm^3 and an HLMI of less than about 10g/10min.

DE-A-3435992 discloses an extrusion blown fuel tank of HDPE, the HDPE also having a density of from 0.935 to 0.950g/cm^3 and an HLMI of less than about 10g/10min.

WO-A-91/09732 discloses a multi-layer container for use as a fuel tank having an interlayer of highly sulphonated high density polyethylene. The tank is blow moulded. A central interlayer is provided between inner and outer layers of HDPE each of thickness 1.5 to 5mm. It is stated that with a thickness less than 1.5mm the inner and outer layers do not provide the multi-layer container with sufficient mechanical strength and impact resistance.

It is an aim of the present invention at least partially to overcome these disadvantages of known fuel tanks.

It is also an aim of the invention to provide a blow moulded automobile fuel tank which may have a lower

weight than those using high density polyethylene of standard fuel tank grades yet still meeting stringent industry test specifications, in particular with regard to fire resistance and impact resistance.

Accordingly, the present invention provides a blow moulded automobile fuel tank having a wall defining a fuel chamber wherein the minimum wall thickness of the wall is from 2.4mm to less than 3mm, the tank being composed of a high density polyethylene having a density of from 0.945 to 0.955g/cm^3 and a high load melt index of from 5 to 9.5g/10min, the high density polyethylene optionally having a carbon black content of up to 0.5wt%, and the fuel tank having a fire resistance and an impact resistance both complying with the respective standards defined in ECE 34, ANNEX 5.

Preferably, the density is around 0.95g/cm^3. In this specification, the density is measured at 23°C using the procedures of ASTM D 1505.

Preferably, the high load melt index is around 8g/10min. In this specification, the high load melt index is measured using the procedures of ASTM D 1238 at 190°C using a load of 21.6kg.

The preferred high density polyethylene has a stress crack resistance (F50) measured in accordance with the procedures of ASTM D 1693 of greater than 360 hours. The preferred high density polyethylene has a flexural modulus measured in accordance with the procedures of ISO 178 at a temperature of 23°C of 1100 MPa. The preferred high density polyethylene has a stress and an elongation at yield of 25 MPa and 11% respectively, both measured in accordance with the procedures of ISO 527.

The preferred high density polyethylene is produced by a low pressure slurry loop polymerisation process. Typically, the catalyst is a chromium-based catalyst incorporating titanium and having a pore volume of from 1.0 to 3cm^3/g and a specific surface area of from 350 to 700m^2/g. The preferred chromium-based catalyst may be obtained by deposition of chromium onto a support matrix comprising a blend of silica and titania; the co-deposition of chromium and titanium compounds onto a silica support-matrix; the deposition of a titanium compound onto a support matrix comprising a blend of chromia and silica; or the terprecipitation of silicon, titanium and chromium compounds.

The present inventors have found surprisingly that the use of a high density polyethylene having a density of from 0.945 to 0.955g/cm^3, preferably 0.947 to 0.955g/cm^3, and a high load melt index of from 5 to 9.5g/10min, preferably 6 to 9.5g/10min, for the manufacture of blow moulded automobile fuel tanks enables the fuel tank not only to have a fire resistance and an impact resistance complying with the specified industry standards defined in ECE 34, ANNEX 5, but also surprisingly to have wall thicknesses which are less than the 3mm threshold which, prior to the present invention, was required by automobile manufacturers as an absolute minimum wall thickness to enable the required properties of the fuel tank to be achieved. Thus the present inventors have overcome a technical prejudice present in the art which

specified a minimum wall thickness for the fuel tank of at least 3mm.

In overcoming this technical prejudice, the present inventors have enabled a fuel tank to be produced which, by having a reduced wall thickness, in particular having a wall thickness which may be as low as from 2.4mm to less than 3mm, maintains the structural integrity of the fuel tank whereby the fuel tank maintains compliance with statutory and industry-specified fire and impact safety standards, yet achieves weight savings of around 10% or even greater over known high density polyethylenes employed in conjunction with minimum wall thicknesses of at least 3mm. The minimum wall thickness may range from 2.4mm to 2.7mm. This provides specific technical advantages with regard to weight reduction of the automobile component, reduced material costs, reduced recycling costs, energy saving in production of the fuel tank, and faster blow moulding cycle times, without compromising the impact resistance and fire resistance of the fuel tank.

The fire resistance standard defined in ECE 34, ANNEX 5, briefly requires the fuel tank to resist an open/semi open fire for two minutes. A blow moulded fuel tank produced in accordance with the invention exceeded this requirement, in particular by providing enhanced creep resistance at elevated temperature. Briefly, the impact resistance standard defined in ECE 34, ANNEX 5 requires the tank to be filled with ethylene glycol and subjected to cold impact at a temperature of -40°C. A fuel tank produced in accordance with the invention was deformed but did not split open when subjected to that impact test.

CLAIMS:

1. A blow moulded automobile fuel tank having a wall defining a fuel chamber wherein the minimum wall thickness of the wall is from 2.4mm to less than 3mm, the tank being composed of a high density polyethylene having a density of from 0.945 to 0.955g/cm^3 and a high load melt index of from 5 to 9.5g/10min, the high density polyethylene optionally having a carbon black content of up to 0.5wt%, and the fuel tank having a fire resistance and an impact resistance both complying with the respective standards defined in ECE 34, ANNEX 5.

2. A blow moulded automobile fuel tank according to claim 1 wherein the high density polyethylene has a high load melt index of from 6 to 9.5g/10min.

3. A blow moulded automobile fuel tank according to claim 2 wherein the high density polyethylene has a high load melt index of around 8g/10min.

4. A blow moulded automobile fuel tank according to any one of claims 1 to 3 wherein the high density polyethylene has a density of from 0.947 to 0.955g/cm^3.

5. A blow moulded automobile fuel tank according to claim 4 wherein the high density polyethylene has a density of around 0.95g/cm^3.

6. A blow moulded automobile fuel tank according to any foregoing claim wherein the minimum wall thickness is from 2.4mm to 2.7mm.

INTERNATIONAL SEARCH REPORT

Inter nal Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B60K15/03

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B60K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 719 135 A (GERDES ERNST ET AL) 12 January 1988 (1988-01-12) cited in the application column 2, line 43 - line 50 column 5, line 27 - line 32	1,2,4
X	DE 34 35 992 A (HUELS CHEMISCHE WERKE AG) 10 April 1986 (1986-04-10) cited in the application page 3, line 11 - line 22	1,2,4
A	WO 91 09732 A (TONEN SEKIYUKAGAKU KK) 11 July 1991 (1991-07-11) cited in the application claim 2	1,6

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

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..nformation on patent family members

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