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ABSTRACT

To provide water piping equipment for which the crystal transition rate is fast, quality control and stock control are easy, and furthermore there is little effect of chlorinated water on generation of bubbles, cracking, and promotion of peeling
5 off of a surface layer resin. Water piping equipment is obtained by using a 1-butene-based polymer composition containing 0.01 to 5.0 parts by weight of acetylene black per 100 parts by weight of a specific 1-butene homopolymer and/or 1-butene-based copolymer. The acetylene black preferably has a mean particle diameter of 20 to 50 nm, and preferably has a dibutyl phthalate (DBP)
10 oil absorption amount of 100 to 250 ml/100g.

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Related Art:

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WATER PIPING EQUIPMENT COMPRISING 1-BUTENE-BASED POLYMER COMPOSITION

FIELD OF THE INVENTION

- 5 The present invention relates to water piping equipment and polymer compositions of which they may be formed.

BACKGROUND

10 Water piping equipment is generally used to transport or store water and may include for example a pipe for carrying water or a tank for storing water. Such water piping equipment is typically molded from a composition comprising a specific 1-butene homopolymer and/or a 1-butene-based copolymer together with a specific amount of black pigment.

- 15 Polymers based on 1-butene are useful from the standpoint of creep resistance properties and so on as materials for resin molded articles for storing or transporting cold or warm water.

20 However, water piping equipment molded from polymers based on 1-butene experience a crystal transition which is a phenomenon which is peculiar to such polymers. The crystal transition results from the 1-butene homopolymers and 1-butene-based copolymers adopting a metastable type II crystal structure immediately after being cooled and shaped from a molten state into a molded article. The metastable type II crystal structure then undergoes solid phase crystal transition to a
25 more stable type I crystal structure over approximately one week (Journal of Polymer

Science: Part A, Vol. 1, pages 59-84 (1963). Consequently, due to this crystal transition, changes in the dimensions and rigidity of the molded article can occur after the molding. As the transition rate from type II to type I crystal structure is slow, this produces problems for a customer's quality control and stock control. In the field of melt molding of polybutene-based resins, there is a need for 1-butene homopolymers or 1-butene-based copolymers for which the rate of the crystal transition from the type II crystal structure to the type I crystal structure is fast.

Methods to improve the crystal transition rate have been reported in the prior art. For example, a method in which a radical-treated crystalline olefinic polymer is blended in with the 1-butene based polymer (see Japanese Patent Application Laid-open No. 61-037833), and a method in which an additive is added to the 1-butene based polymer (see Japanese Patent Application Laid-open No. 57-036140 and Japanese Patent Application Laid-open No. 57-092038) have been described. Such methods however, are still not satisfactory in terms of the cost of molding pipes and tanks and the effect of improving the crystal transition rate, and hence there are demands for further improvements.

In addition, water piping equipment is often exposed to chlorinated water. Chlorine is generally used in sterilizing agents contained in tap water (i.e. drinking water etc.). There has been a problem that depending on the type of the pigment contained in water-transporting pipes and so on, the reaction of chlorine with the surface of the pipe may promote pipe degradation and pipe blockages. In consideration of cases in which resin pipes comprising a 1-butene-based polymer are used or stored outdoors, pipes are sometimes colored a dark black color to improve the weather resistance.

Furnace method carbon black has been used to color the resin (see Japanese Patent Application Laid-open No. 62-263242). However, it has been shown that resin pipes containing furnace method carbon black react with chlorine to generate of bubbles on the inner surface of the pipe. This then results in cracking of the pipe and the peeling
5 off of a surface layer of resin from the pipe, which leads to pipe degradation and blockage. Consequently, the reaction of the pipes with chlorine has been a problem from the perspective of the durability of the resin pipes (see Japanese Patent Application Laid-open No. 10-310705).

- 10 The discussion of documents, acts, materials, devices, articles and the like is included in this specification solely for the purpose of providing a context for the present invention. It is not suggested or represented that any or all of these matters formed part of the prior art base or were common general knowledge in the field relevant to the present invention as it existed in Australia before the priority date of
15 each claim of this application.

Throughout the description and claims of the specification, the word "comprise" and variations of the word, such as "comprising" and "comprises", is not intended to exlude other additives, components, integers or steps.

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SUMMARY

The present invention provides a 1-butene based polymer composition comprising acetylene black pigment mixed in with a homopolymer and/or a copolymer of 1-butene. The inclusion of acetylene black enhances the crystal transition rate of the 1-

butene homopolymer or 1-butene-based copolymer, and provides a composition with excellent pigment dispersion and excellent resistance to chlorinated water.

In one aspect, the present invention provides water piping equipment comprising a polymer composition comprising 0.01 to 5.0 parts by weight of acetylene black per 100 parts by weight of a 1-butene homopolymer and/or copolymer, wherein said 1-butene homopolymer and/or copolymer has a melt flow rate of 0.01 to 50 g/10min at 190°C and a load of 2.16 kg according to ASTM D1238 and comprises (a) 80 to 100 mol% of polymer units derived from 1-butene and (b) 0 to 20 mol% of polymer units derived from at least one α -olefin having 2 to 10 carbon atoms other than 1-butene.

The present invention also provides a composition comprising acetylene black and at least one polymer selected from the group consisting of homopolymers and copolymers of 1-butene, wherein said composition comprises 0.01 to 5.0 parts by weight of acetylene black per 100 parts by weight of polymer and wherein said polymer has a melt flow rate of 0.01 to 50 g/10min at 190°C and a load of 2.16 kg according to ASTM D1238 and comprises (a) 80 to 100 mol% of polymer units derived from 1-butene and (b) 0 to 20 mol% of polymer units derived from at least one α -olefin having 2 to 10 carbon atoms other than 1-butene.

Water piping equipment made in accordance with an aspect of the present invention provide a short crystal transition time, and hence quality control and stock control is easier to maintain. Furthermore, water piping equipment made in accordance with an aspect of the present invention display excellent resistance to chlorinated water

and pigment dispersibility, and hence prolonged usage of the water piping equipment is possible.

DETAILED DESCRIPTION

- 5 The present invention will now be described in detail with reference to the following preferred embodiments.

1-butene homopolymer and/or a 1-butene-based copolymer

10 The 1-butene homopolymer and/or 1-butene-based copolymer of the present invention comprises preferably 80 to 100 mol%, more preferably 90 to 100 mol%, of polymer units (a) derived from 1-butene, and preferably 0 to 20 mol%, more preferably 0 to 10 mol%, of polymer units (b) derived from at least one α -olefin monomer having 2 to 10 carbon atoms, which is other than 1-butene. (Here, the amount of (a) plus the amount of (b) is taken to be 100 mol%.)

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Examples of the α -olefin(s) having 2 to 10 carbon atoms other than 1-butene include ethylene, propylene, 1-pentene, 4-methyl-1-pentene, 1-hexene, 1-octene, 1-decene, and so on. One of these other α -olefins alone, or two or more of these other α -olefins, may be contained in the 1-butene-based copolymer.

20

The poly-1-butene in the present invention preferably has a melt flow rate of 0.01 to 50 g/10min at 190°C and a load of 2.16 kg (ASTM D1238). More preferably, the melt flow rate is 0.01 to 20 g/10min. Even more preferably the melt flow rate is 0.02 to 10 g/10min. The poly-1-butene in the present invention also has an isotactic index that

25 is at least 90, preferably at least 93, more preferably at least 95.

Acetylene black

Acetylene black is produced using acetylene gas as a raw material.

- 5 The acetylene black in the present invention preferably has a mean particle diameter of 20 to 50 nm, more preferably 30 to 50 nm. It is preferable for the mean particle diameter to be within such a range, since then the crystal transition rate will be increased.
- 10 Moreover, the acetylene black in the present invention preferably has a DBP (dibutyl phthalate) oil absorption amount of 100 to 250 ml/100g, more preferably 140 to 220 ml/100g. It is preferable for the DBP oil absorption amount to be within such a range, since then pigment dispersion is good. The method of measuring the DBP oil absorption is in accordance with JIS K6217-4.

15

1-butene-based polymer composition

- The 1-butene-based polymer composition in the present invention contains 0.01 to 5.0 parts by weight, preferably 0.05 to 2.0 parts by weight, more preferably 0.1 to 0.4 parts by weight, of the acetylene black per 100 parts by weight of the 1-butene
- 20 homopolymer and/or 1-butene-based copolymer. It is preferable for the acetylene black content to be at least 0.01 parts by weight, since then the crystal transition time will be short. Moreover, it is preferable for the acetylene black content to be not more than 5.0 parts by weight, since then the resistance to chlorinated water will be high.

Moreover, the 1-butene-based polymer composition may contain antioxidants, weather resistance stabilizers, heat-resistance stabilizers, pigments, fungus-proofing agents and so on as required. Examples of heat-resistance stabilizers include phenolic antioxidants, phosphor-based antioxidants and so on. The heat-resistance
 5 stabilizers can be used alone, or two or more can be used in combination.

Specific examples of such phenolic or phosphor-based antioxidants include 2,6-t-butyl-4-hydroxybenzoate, n-hexadecyl-3,5-di-t-butyl-4-hydroxybenzoate, 1,3,5-trimethyl-2,4,6-tris(3,5-di-t-butyl-4-hydroxybenzyl)benzene, 1,3,5-tris(4-t-butyl-3-
 10 hydroxy-2,6-dimethylphenyl)isocyanate, tris(3,5-di-t-butyl-4-hydroxyphenyl)-isocyanate, n-octadecyl-3-(3,5-di-t-butyl-4-hydroxyphenyl)propionate, bis(3,5-di-t-butyl-4-hydroxybenzoylphosphonic acid) monoethyl ester nickel salt, 2,2'-dihydroxy-3,3'-di(α -methylcyclohexyl)-5,5'-dimethyl-diphenylmethane, 4,4'-thio-bis(3-methyl-6-t-butyl-phenol),
 1,1,3-tris(2-methyl-4-hydroxy-5-t-butyl-phenyl(butane),
 15 tetrakis[methylene-3(3,5-di-t-butyl-4-hydroxyphenyl) propionate]methane, 2,6-di-t-butyl-p-cresol, 4,4'-methylene-bis(2,6-di-t-butyl-phenol), tris(2,4-di-t-butyl-phenyl)phosphite, and vitamin E.

In the case that the polymer composition contains such antioxidant(s), the amount
 20 added thereof is generally approximately 0.01 to 2.0 wt%, preferably approximately 0.1 to 1.5 wt%, relative to the 1-butene homopolymer and/or 1-butene-based copolymer. In the case that the polymer composition contains a weather resistance stabilizer, a pigment, a fungus-proofing agent or the like, the amount added thereof may be any amount within a range such that the purpose of the present invention is
 25 not impaired.

Water piping equipment

In the present invention, water piping equipment means a molded body used for carrying or storing water such as tap water. Examples of such molded bodies include
5 water or hot water supply pipes and water storage tanks. Such a molded body may comprise a single layer, or may be a laminated structure of two or more layers. Where the molded body comprises a laminated structure, at least one of these layers comprises the 1-butene-based polymer composition containing acetylene black described above. The pipe or tank is molded using any molding method, for example
10 single-layer or multi-layer (two or more layers) extrusion, or blow molding.

The polymer composition of the present invention has better resistance to chlorinated water than conventional polymer compositions having a black pigment mixed therein. Hence even when the polymer composition of the present invention is used on the
15 side of the water piping equipment that comes into contact with water, for example, the inside of a water or hot water supply pipe, or the inside of a water storage tank, prolonged usage of the equipment is possible. Thus the present invention assists to make quality control and stock control easier and moreover, assists to prevent or reduce the generation of bubbles, the cracking of resin pipes and the peeling off of a
20 surface layer of resin in pipes carrying tap water or the like, due to the presence of chlorine.

EXAMPLES

The following is a more concrete description of the present invention, giving
25 examples and comparative examples. However it would be appreciated by those

skilled in the art that various other modifications and/or alterations may be made without departing from the spirit of the present invention as outlined herein. The following examples are illustrative of the present invention and it is not intended that the scope of the invention be limited to the specific embodiments described.

5

Examples 1 to 8

Manufacture of 1-butene homopolymer composition

100 parts by weight of a 1-butene homopolymer (P5050, made by Mitsui Chemicals Inc.) and 40 parts by weight of acetylene black (Denka Black powder, Denka Black
10 HS-100 or Denka Black FX-35, made by Denki Kagaku Kogyo K.K.) were subjected to melt kneading at a molding temperature of 200°C using a twin screw extruder, thus manufacturing a high-density master batch containing 40 wt% of the acetylene black relative to the 1-butene homopolymer. The master batch obtained and the 1-butene homopolymer were then subjected to melt kneading at a molding temperature of
15 200°C using a single screw extruder, thus obtaining a 1-butene homopolymer composition containing 0.1 wt% or 2.0 wt% of the acetylene black relative to the 1-butene homopolymer.

Manufacture of pipes

20 Using each of the above 1-butene homopolymer compositions, pipes of outside diameter 27 mm and wall thickness 2.4 mm were manufactured using an extruder (ϕ 90 mm single screw, made by Ikegai Ltd.) combined with a single-layer die with a molding temperature of 200°C.

25 Manufacture of tanks

Using each of the above 1-butene homopolymer compositions, 500 cc tanks having a rectangular parallelepiped shape (external dimensions 180 mm × 120 mm × 28 mm) and a thickness of approximately 3 mm were manufactured using a blow molding machine (ϕ 40 mm single screw, made by Japan Steel Works Ltd.) with a molding
5 temperature of 200°C.

Measurement Methods

In the present examples and so on, measurements were carried out using the following methods:

10

Measurement of crystal transition rate

Tensile measurement was carried out in accordance with JIS K7113 one, two, three, four and seven days after molding, and the yield point strength was measured. Taking the value when the yield point strength was a maximum to be 100%, the time
15 required to reach 98% was taken as the crystal transition time.

Measurement of resistance to chlorinated water

The specimen was submerged in chlorinated water of concentration 100 ppm and temperature 90°C, and the time until the surface of the specimen turned completely
20 white was measured.

Measurement of carbon dispersion

The carbon dispersion was measured in accordance with ISO 18553.

25 The results of testing Examples 1 to 8 are shown in Table 1.

Comparative Examples 1 and 2

1-butene homopolymer compositions were prepared using the same method as in Example 1 except that the acetylene black was changed to furnace method carbon black. 1-butene homopolymer compositions containing 0.1 wt% or 2.0 wt% of the furnace method carbon black relative to the 1-butene homopolymer were obtained. Using each of these comparative homopolymer compositions, pipes were molded as in Example 1, and the crystal transition rate, the resistance to chlorinated water, and the carbon dispersion were measured. The results are shown in Table 1.

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Comparative Examples 3 and 4

1-butene homopolymer compositions were prepared using the same method as in Example 1 except that the acetylene black was changed to iron black. The 1-butene homopolymer compositions containing 0.1 wt% or 2.0 wt% of the iron black relative to the 1-butene homopolymer were obtained. Using each of these homopolymer compositions, pipes were molded as in Example 1, and the crystal transition rate, the resistance to chlorinated water, and the pigment dispersion were measured. The results are shown in Table 1.

Comparative Examples 5 and 6

1-butene homopolymer compositions were prepared using the same method as in Example 1 except that the acetylene black was changed to furnace method carbon black. 1-butene homopolymer compositions containing 0.1 wt% or 2.0 wt% of the furnace method carbon black relative to the 1-butene homopolymer were obtained. Using each of these homopolymer compositions, tanks were obtained by blow

molding as in Example 7, and the crystal transition rate, the resistance to chlorinated water, and the carbon dispersion were measured. The results are shown in Table 1.

Table 1

	Units	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Example 7	Example 8
Form of molded article	-	Pipe	Pipe	Pipe	Pipe	Pipe	Pipe	Tank	Tank
Type of black pigment	-	Powder	Powder	HS-100	HS-100	FX-35	FX-35	Powder	Powder
Mean particle diameter	nm	35	35	48	48	26	26	35	35
DBP oil absorption amount	ml/100g	160	160	140	140	220	220	160	160
Amount added of black pigment	wt%	0.1	2.0	0.1	2.0	0.1	2.0	0.1	2.0
Crystal transition rate	hours	121	90	116	80	130	101	126	85
Resistance to chlorinated water	weeks	>12	8	>12	7	>12	7	>12	8
Carbon (pigment) Dispersion	grade	-	1.3	-	1.8	-	1.8	-	1.3

	Units	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5	Comparative Example 6
Form of molded article	-	Pipe	Pipe	Pipe	Pipe	Tank	Tank
Type of black pigment	-	Furnace method carbon black	Furnace method carbon black	Iron black	Iron black	Furnace method carbon black	Furnace method carbon black
Mean particle diameter	nm	24	24	27	27	24	24
DBP oil absorption amount	ml/100g	76	76	28	28	76	76
Amount added of black pigment	wt%	0.1	2.0	0.1	2.0	0.1	2.0
Crystal transition rate	hours	162	150	154	135	155	149
Resistance to chlorinated water	weeks	>12	6	>12	*	>12	6
Carbon (pigment) dispersion	grade	-	2.7	-	2.1	-	2.9

* Rusting occurred after 1 week of test

It can be seen from Table 1 that for the pipes/tanks of Comparative Examples 1, 3 and 5 in which furnace method carbon black or iron black was used as the pigment, the crystal transition rate was slower than for the pipes/tanks of Examples 1, 3, 5 and 7 in which acetylene black was used as the pigment. The crystal transition rate of 121 hours for Example 1 corresponds to approximately 5 days, and the crystal transition rate of 162 hours for Comparative Example 1 corresponds to approximately 7 days. This difference of 2 days is reflected as is in the delivery lead time, and hence is a large difference in terms of stock control, and thus it can be seen that the effects of the present invention are great.

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Moreover, it can be seen that for the pipes/tanks of Comparative Examples 2, 4 and 6 in which furnace method carbon black or iron black was used as the pigment, the crystal transition rate was slower, the resistance to chlorinated water was worse, and the pigment dispersion was less uniform than for the pipes/tanks of Examples 2, 4, 6 and 8 in which acetylene black was used as the pigment. Incidentally, for the pipes containing iron black of Comparative Example 4, the chlorinated water caused rusting.

15

According to the present invention, the specific 1-butene homopolymer and/or 1-butene copolymer composition containing a specific amount of acetylene black can be ideally used for water piping equipment, for which quality control and stock control are easy, this being because the crystal transition time is short, and furthermore for which prolonged usage is possible, this being because resistance to chlorinated water and pigment dispersibility are excellent.

25

The Claims Defining the Invention Are As Follows:

1. Water piping equipment comprising a polymer composition comprising 0.01 to 5.0 parts by weight of acetylene black per 100 parts by weight of a 1-butene
5 homopolymer and/or copolymer, wherein said 1-butene homopolymer and/or copolymer has a melt flow rate of 0.01 to 50 g/10min at 190°C and a load of 2.16 kg according to ASTM D1238 and comprises (a) 80 to 100 mol% of polymer units derived from 1-butene and (b) 0 to 20 mol% of polymer units derived from at least one α -olefin having 2 to 10 carbon atoms other than 1-butene.

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2. The water piping equipment according to claim 1, wherein the water piping equipment is a water supply pipe or a water storage tank.

3. The water piping equipment according to claim 1 or claim 2, wherein the
15 acetylene black has a mean particle diameter of 20 to 50 nm.

4. The water piping equipment according to any one of claims 1 to 3, wherein the acetylene black has a dibutyl phthalate (DBP) oil absorption amount of 100 to 250 ml/100g.

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5. The water piping equipment according to claim 1, wherein the 1-butene homopolymer and/or copolymer has an isotactic index of at least 90.

6. A composition comprising acetylene black and at least one polymer selected from the group consisting of homopolymers and copolymers of 1-butene; wherein said composition comprises 0.01 to 5.0 parts by weight of acetylene black per 100 parts by weight of polymer; and

5 wherein said polymer has a melt flow rate of 0.01 to 50 g/10min at 190°C and a load of 2.16 kg according to ASTM D1238 and comprises (a) 80 to 100 mol% of polymer units derived from 1-butene and (b) 0 to 20 mol% of polymer units derived from at least one α -olefin having 2 to 10 carbon atoms other than 1-butene.

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7. A molded article for water piping equipment prepared from the composition of claim 6.

8. The molded article according to claim 7, wherein the acetylene black has a
15 mean particle diameter of 20 to 50 nm.

9. The molded article according to claim 7 or claim 8, wherein the acetylene black has a dibutyl phthalate (DBP) oil absorption amount of 100 to 250 ml/100g.

20 10. The molded article according to claim 7, wherein the 1-butene homopolymer and/or copolymer has an isotactic index of at least 90.

11. The water piping equipment of claim 1 substantially as hereinbefore described.

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12. A composition according to claim 7 substantially as hereinbefore described.

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