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(54) Polycarbonate composition for profile extrusion

Polycarbonatmischung für die Profilextrusion

Composition de polycarbonate pour extrusion de profile

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Description

[0001] The present invention relates to a process for producing a molded product. More particularly, the present invention relates to a process for producing a molded product which comprises profile extruding a thermoplastic resin composition, which comprises a thermoplastic aromatic polycarbonate resin and a polyethylene, and which is light-weight and has excellent heat-resistance, excellent impact resistance, excellent appearance, excellent draw-down and excellent swell properties. Furthermore, generation of mold deposit from a die, especially at the tip end of an extrusion die, during profile extrusion is effectively prevented. Even if a mold deposit from a die is formed, it can be readily removed from the die.

[0002] It is known that an aromatic polycarbonate resin has excellent mechanical strength, durability and dimensional stability. Accordingly, such resins have been utilized in various fields such as electrical and electronic apparatus, office automation equipment, precision machinery equipment, medical treatment equipment, automobile equipment, miscellaneous goods and building materials and the like. Aromatic polycarbonate resins are usually molded by an injection molding process, and there have been proposed many aromatic polycarbonate resin compositions suitable for injection molding. Aromatic polycarbonate resins to be used as building materials are subjected to profile extrusion to produce complicated molded products. However, such profile extrusion causes many problems.

[0003] These problems arise because aromatic polycarbonate resins exhibit highly temperature dependent melt viscosity and have a low melt strength. This results in unsatisfactory draw-down and shaping properties during profile extrusion.

[0004] In order to overcome the afore-mentioned defects, high-viscosity aromatic polycarbonate resins and branched-polycarbonate resins have been proposed. However, even these resins are unsatisfactory for obtaining a complicated molded product by profile extrusion.

[0005] Further, the molding temperature of aromatic polycarbonate resins is not less than 250°C. Consequently, when they are subjected to continuous profile extrusion at such a high temperature, undesirable mold deposits are formed out of the die at the tip end. Such mold deposits grow with time, and finally adhere to a surface of the molded product. This gives the molded product a poor appearance, and makes it impossible to introduce the molded product into a sizing die. Thus, problems result such as defective shaping property and inapplicability to a continuous production process.

[0006] Where an aromatic polycarbonate resin is to be applied to building materials requiring a high mechanical strength and rigidity, an adequate amount of a filler (such as an inorganic filler, e.g., glass fiber) may be often added to achieve a flexural modulus of not less than 50,000 kg/cm². However, the addition of such an inorganic filler or of various additives results in an increase in specific gravity. This makes it difficult to achieve a light-weight molded product. Further, addition of the inorganic filler or of various additives induces formation of mold deposit from the die, so that it becomes particularly difficult to achieve a continuous profile extrusion of the aromatic polycarbonate resin.

[0007] Various solutions to the afore-mentioned defects have been proposed including optimizing extruder screw design, providing a vent in the extruder, improving materials and shape for the die of the extruder and the like. However, these attempts are still unsuccessful to provide a complicated molded product using the profile extrusion process.

[0008] As a result of intense studies and investigations made by the present inventors to solve the afore-mentioned technical problems, it has been found that by blending ethylene and a specific styrene-based resin with a thermoplastic aromatic polycarbonate resin at a specific blending ratio, resin composition can be obtained that is light-weight and has excellent heat-resistance, rigidity, impact resistance and extrudability. Furthermore, when such a thermoplastic resin composition is subjected to continuous profile extrusion, the formation of mold deposit from the die is rarely observed, and even if any such mold deposit is eventually formed, it can be readily removed from the die. On the basis of the finding, the present invention has been attained.

[0009] Thus, the present invention provides a process for producing a molded product which comprises profile extruding a thermoplastic resin composition comprising: (A1) 50 to 95% by weight of a thermoplastic aromatic polycarbonate resin; (A2) 3 to 40% by weight of a styrene-based resin selected from the group consisting of acrylonitrile-butadiene-styrene resin (ABS), acrylonitrile-(ethylene-propylene-diene terpolymer)-styrene resin (AES), acrylonitrile-acrylic-styrene resin (AAS) and methylmethacrylate-butadiene-styrene resin (MBS); (B) 0.5 to 30% by weight of a polyethylene; and (C) 5 to 30% by weight of a filler.

50 Fig. 1 is a cross-sectional view schematically showing a hollow profile-extruded article prepared from the thermoplastic resin composition according to the present invention.

[0010] The thermoplastic aromatic polycarbonate resin as the component (A1) of the thermoplastic resin composition used in the present invention is a polymer produced by reacting an aromatic dihydroxy compound or a mixture of the aromatic dihydroxy compound and a small amount of polyhydroxy compound with phosgene or dicarbonate, which thermoplastic aromatic polycarbonate polymer may be branched. Examples of the aromatic dihydroxy compounds may include 2, 2-bis(4-hydroxyphenyl) propane (= bisphenol A), tetramethylbisphenol A, tetrabromobisphenol A, bis(4-hy-

droxyphenyl)-p-diisopropyl benzene, hydroquinone, resorcinol, 4, 4'-dihydroxydiphenyl or the like. The preferred aromatic dihydroxyl compound is bisphenol A.

[0011] For production of the branched aromatic polycarbonate resin by the afore-mentioned reaction, a part, for example, 0.1 to 2 mole %, of the aromatic dihydroxy compound may be substituted with a polyhydroxy compound or a bisphenol compound. Examples of the suitable polyhydroxy compound may include chloroglycine, 4, 6-dimethyl-2, 4, 6-tri(4-hydroxyphenyl) heptene-2, 4, 6-dimethyl-2, 4, 6-tri(4-hydroxyphenyl) heptane, 2, 6-dimethyl-2, 4, 6-tri(4-hydroxyphenyl) heptene-3, 4, 6-dimethyl-2, 4, 6-tri(4-hydroxyphenyl) heptane, 1, 3, 5-tri(4-hydroxyphenyl) benzene, 1, 1, 1-tri(4-hydroxyphenyl) ethane or the like. Examples of the suitable bisphenol compound may include 3, 3-bis(4-hydroxyaryl)-oxyindole (= isatinbisphenol), 5-chloroisatinbisphenol, 5, 7-dichloroisatinbisphenol, 5-bromoisatinbisphenol or the like.

[0012] The blending percentage of the thermoplastic aromatic polycarbonate resin is in the range of 50 to 95 % by weight, preferably 60 to 95 % by weight, more preferably 70 to 95 % by weight based on the weight of thermoplastic resin composition.

[0013] Further, a monovalent aromatic hydroxy compound may be used for controlling a molecular weight of the thermoplastic aromatic polycarbonate resin. As the preferred monovalent aromatic hydroxy compound, m-methyl phenol, p-methyl phenol, m-propyl phenol, p-propyl phenol, p-bromophenol, p-tert-butylphenol, p-long chain alkyl-substituted phenol or the like may be exemplified. Typical examples of the thermoplastic aromatic polycarbonate resins may include bis-(4-hydroxyphenyl) alkane-based compounds, especially polycarbonates prepared from bisphenol A as a main raw material, a polycarbonate copolymer prepared by jointly using at least two aromatic dihydroxy compounds, a branched polycarbonate prepared by using a small amount of a trivalent phenol-based compound or the like. The thermoplastic aromatic polycarbonate resins may be used singly or in the form of a mixture of two or more.

[0014] The thermoplastic resin includes, in addition to the thermoplastic aromatic polycarbonate resin as a component (A1) and ethylene as component (B), a component (A2) which is a styrene-based resin. The blending percentage of component (A2) is 3 to 40, preferably 3 to 30 by weight, based on the weight of the thermoplastic resin composition.

[0015] The thermoplastic aromatic polycarbonate resin is mixed with the styrene-based resin in order to lower the melt temperature thereof and, therefore, to decrease the molding temperature thereof. The styrene-based resin is selected from the group consisting of acrylonitrile-butadiene-styrene resin (ABS), acrylonitrile-(ethylene-propylene-diene terpolymer)-styrene resin (AES), acrylonitrile-acrylic-styrene resin (AAS) and methylmethacrylate-butadiene-styrene resin (MBS). Furthermore, these may additionally be present general purpose polystyrene resin (GPPS), high impact polystyrene resin (HIPS), styrene-butadiene rubber (SBR), styrene-ethylene-butadiene-styrene resin (SEBS), styrene-ethylene-propylene-styrene resin (SEPS), or the like. These styrene resins can be used singly or in the form of a mixture of two or more.

[0016] Furthermore, the thermoplastic aromatic polycarbonate resin may be mixed with aromatic polyester resins in order to improve a chemical resistance thereof. The aromatic polyester resin is, for example, a polyester prepared from an aromatic dicarboxylic acid and diol. Examples of the suitable aromatic dicarboxylic acid used for the preparation of the aromatic polyester resin may include polyethylene terephthalate, polyethylene naphthalate, polybutyrene terephthalate, polybutyrene naphthalate, polycyclohexane diterephthalate or the like. The aromatic polyester resins can be used singly or in the form of a mixture of two or more. The blending percentage of the aromatic polyester resins is preferably not more than 50 % by weight based on the weight of the thermoplastic aromatic polycarbonate resin.

[0017] Component (B) of the thermoplastic resin composition used in the present invention may include polyethylenes in general or specifically polyethylenes prepared in the presence of a chromium catalyst, referred to herein respectively as components (B1) and (B2).

[0018] The polyethylenes (B1) are effective for improving a moldability of the thermoplastic resin composition when subjected to a profile extrusion. That is, as compared with the case where the thermoplastic aromatic polycarbonate resin is used singly, the addition of the polyethylenes to the thermoplastic aromatic polycarbonate resin improves a temperature dependency of its melt viscosity and enhances a die swell ratio, resulting in preventing occurrence of draw-down and exhibiting an excellent shaping property at the time of the profile extrusion.

[0019] The polyethylenes (B1) may be prepared according to either high-pressure method (conventional method), moderate-pressure method or low-pressure method known in the production of polyethylene. For example, the polyethylene may be long chain-branched polyethylenes, short chain-branched polyethylenes or linear polyethylenes. In addition, as the polyethylenes (B1) copolymers of ethylene and α -olefin such as butene-1, hexene-1, 4-methyl pentene-1 or octene-1 may be used. The polyethylenes (B1) has a melt index (MI) of 0.01 to 50 and a density of 0.88 to 0.97. The polyethylenes having a melt index of 0.01 to 5 is especially preferred.

[0020] The blending percentage of the polyethylenes (B1) is in the range of 2 to 30 % by weight based on the weight of the thermoplastic resin composition. If the blending percentage of the polyethylene (B1) is less than 2 % by weight, the thermoplastic resin composition is likely to suffer from draw-down when subjected to the profile extrusion, so that an improvement in shaping property at the time of the profile extrusion cannot be sufficiently obtained. If the blending percentage of the polyethylenes (B1) exceeds 30 % by weight, the thermoplastic resin composition is inferior in heat

resistance and mechanical strength. The blending percentage of the polyethylenes (B1) is preferably in the range of 5 to 20 % by weight based on the weight of the thermoplastic resin composition.

[0021] The polyethylenes (B2) obtained in the presence of the chromium catalyst may be prepared according to a moderate- or low-pressure polymerization process in which a chromium-based compound is used as a polymerization catalyst. Examples of the chromium compounds may include Cr 203 supported on a carrier such as silica or silica/alumina, or an organic chromium compounds such as silyl chromate or chromocene supported on silica. The polymerization process for the preparation of the polyethylenes (B2) may be conducted by using a slurry method, a solution method, a gas phase method or the like. The polyethylenes (B2) used in the present invention has a melt index (MI) of 0.01 to 50 and a density of 0.90 to 0.97. The polyethylenes (B2) preferably has a melt index (MI) of 0.01 to 5.

[0022] The blending percentage of the polyethylenes (B2) prepared by using the chromium-based polymerization catalyst is 0.5 to 30 % by weight based on the weight of the thermoplastic resin composition. When the blending percentage of the polyethylenes (B2) is less than 0.5 % by weight, the formation of the mold deposit upon profile extrusion cannot be sufficiently prevented. When the blending percentage of the polyethylenes (B2) exceeds 30 % by weight, the heat resistance and mechanical strength of the thermoplastic resin composition are undesirably deteriorated. The blending percentage of the polyethylenes (B2) prepared by using the chromium compound is preferably in the range of 5 to 20 % by weight based on the weight of the thermoplastic resin composition.

[0023] By blending the polyethylenes (B2) prepared by using the chromium-based polymerization catalyst with the thermoplastic aromatic polycarbonate resin, the formation of the mold deposit out of die is effectively prevented and, even if any mold deposit out of die is formed, the removal procedure thereof can be easily carried out, which enables the thermoplastic resin composition to be continuously extruded into a complicated molded product by using the profile extrusion.

[0024] Examples of the suitable filler (C) used in the thermoplastic resin composition used in the present invention, may include glass fiber, glass flakes, glass beads, carbon fiber, needle-like titanium oxide, potassium titanate whiskers, aluminum borate whiskers, zinc oxide whiskers, magnesium sulfate, calcium sulfate, wollastonite, clay, talc, mica, silicon carbide and silicon nitride. The afore-mentioned fillers may be used singly or in the form of a mixture of two or more.

[0025] The glass fiber usable in the present invention, may include chopped strands having an average fiber diameter of 2 to 30 μm and especially an average fiber length of 3 to 10 mm, milled strands having a length of 30 to 1,000 μm , roving-type strands, or the like. The glass flakes usable in the present invention has an average thickness of 0.1 to 50 μm and an average maximum length of 10 to 2,000 μm . The glass beads usable in the present invention has an average particle size of 5 to 500 μm .

[0026] In addition, the carbon fiber usable in the present invention may be commercially available ones having a fiber diameter of 1 to 30 μm , such as polyacrylonitrile (PAN)-based or pitch-based chopped or milled strands or the like. The carbon fiber is suitably treated with a coupling agent, an oxazoline ring-containing organic compounds or other surface-treating agents. Carbon fibers bundled by polycarbonate resin is also suitably used in the present invention.

[0027] The potassium titanate whiskers usable in the present invention have an average fiber diameter of 0.1 to 2 μm and an average fiber length of 5 to 50 μm . Suitably, the potassium titanate whiskers are treated with a coupling agent or other surface-treating agents.

[0028] The aluminum borate whiskers usable in the present invention have an average fiber diameter of 0.1 to 2 μm and an average fiber length of 5 to 50 μm . Suitably, the aluminum borate whiskers are treated with a coupling agent or other surface-treating agents.

[0029] The blending percentage of the filler (component (C)) is 5 to 30 % by weight based on the weight of the thermoplastic resin composition.

[0030] Depending upon whether or not polyethylene prepared in the presence of chromium catalyst, is used as component (B), the preferred blending percentage of the filler are set forth below.

[0031] The blending percentage of the filler added is in the range of 5 to 30 % by weight based on the weight of the thermoplastic resin composition. When the blending percentage of the filler in the thermoplastic resin composition is less than 5 % by weight, the dimensional stability (low shrinkage ratio), mechanical strength or rigidity of the resultant molded product may be deteriorated, so that the filler may not exhibit the function as a reinforcing material. On the other hand, when the blending percentage of the filler exceeds 30 % by weight, the flowability of the thermoplastic resin composition is insufficient, so that the extrusion of the thermoplastic resin composition becomes difficult and remarkable wear is likely to occur at an extrusion cylinder. The blending percentage of the filler is more preferably in the range of 8 to 20 % by weight based on the weight of the thermoplastic resin composition.

[0032] Where component (B) is specifically a polyethylene prepared in the presence of the chromium catalyst, the blending percentage of the filler is more preferably in the range of 5 to 20 % by weight based on the weight of the thermoplastic resin composition.

[0033] In the present invention, various additives such as ultraviolet (UV) absorbers, stabilizers, pigments, dyes and lubricants, and/or reinforcing materials such as organic fibrous materials may be added to the thermoplastic resin composition, if desired. In this case, the blending percentage of the additives and/or reinforcing materials added is not

more than 30 % by weight based on the weight of the thermoplastic resin composition.

[0034] Further, resin materials other than the afore-mentioned resin components (A1), (A2) and (B) may be added to the thermoplastic resin composition used in the present invention, if necessary. In this case, the blending percentage of the resin materials added is not more than 30 % by weight based on the weight of the thermoplastic resin composition.

[0035] The extrusion of the thermoplastic resin composition can be conducted by known methods in which the thermoplastic resin composition is kneaded by adequately using extruders, mixers such as Banbury mixer or the like, rolls, or the like.

[0036] The molded product produced from the thermoplastic resin composition according to the present invention, suitably has a bending strength of not less than 1,300 kg/cm² and a flexural modulus of 50,000 kg/cm².

[0037] Especially, when the thermoplastic resin composition according to the present invention containing the polyethylenes prepared in the presence of the chromium catalyst, is subjected to a profile extrusion in which 65 mm ϕ extruder is used, the initial formation of the mold deposit out of die can be prolonged up to at least 30 minutes from commencement of the extrusion process. Further, the time required until the mold deposit out of die is grown to 3 mm length is not less than 60 minutes.

[0038] The thermoplastic resin composition for profile extrusion used in the present invention can solve the problems in the prior art and is superior in light-weight, rigidity, wear resistance, heat resistance, profile extrusion property, whereby the thermoplastic resin composition is suitably used as building materials, especially a window frame, a sash door frame or the like, when it is extruded into a molded product by using profile extrusion.

[0039] Furthermore, even when the thermoplastic resin composition used in the present invention is continuously subjected to the profile extrusion to obtain profile extrusion products of the complicated shape, the formation of the mold deposit out of die is rarely observed. In addition, even when the formation of the mold deposit occurs, it can be readily removed from the die. Further, the thermoplastic resin composition used in the present invention is extremely excellent in profile extrusion property and mass-productivity, which enables the thermoplastic resin composition to be more suitably applied to building materials, especially a window frame, a sash door frame or the like, when it is extruded into a molded product by using profile extrusion.

EXAMPLES:

[0040] The present invention is described in more detail below by way of the following examples, in which "%" is "% by weight".

Example 1 and Comparative Examples 1 to 3:

[0041] An aromatic polycarbonate (PC) resin (A1) composed primarily of bisphenol A (Iupilon E-2000 produced by Mitsubishi Gas Chemical Company, Inc., and viscosity-average molecular weight : 28,000); polyethylene (B2) (MITSUBISHI-POLYETHY-HD HB420R produced by Mitsubishi Chemical Corporation); chopped strand glass fiber (C1) (ECS03T531DE produced by Nippon Electric Glass Co., Ltd., and fiber diameter: 6 μm and length: 3 mm) and an acrylonitrile-butadiene-styrene resin (A2) (DIAPET-ABS SE-3 produced by Mitsubishi Rayon Co., Ltd.) were mixed together in a tumbler at blending percentages shown in Table 1. The resultant mixture was extruded into pellets by using a single-screw vented extruder. The pellets were dried in a hot-air drying apparatus at a temperature of 120°C for not less than 5 hours. Thereafter, the pellets were subjected to a profile extrusion at a resin temperature of 260°C to obtain a molded product 1 as shown in Fig. 1. Test pieces were cut from the molded product 1 and subjected to measurements for physical properties thereof. The results are shown in Table 1.

[0042] The bending strength and flexural modulus of the test pieces were measured according to ASTM D-790.

[0043] The die-swell of the molded product 1 was measured in the following manner. The molded product extruded from die was allowed to stand in ambient air for cooling. A thickness of an upper wall portion 2 of the molded product 1 was measured. The die-swell was determined as a ratio of the thickness of the molded product to a thickness of the die. Further, the draw-down property of the molded product upon the profile extrusion was evaluated by observing deformation of a center rib portion 3 of the profile article as shown in Fig. 1.

[0044] The draw-down property are ranked as follows.

◎ : No deformation due to draw-down occurred;

○ : Deformation due to draw-down was within 2 mm;

△ : Deformation due to draw-down was within 5 mm; and

× : Deformation due to draw-down was not less than 5 mm.

[0045] It is desirable that the draw-down property be of rank \odot or \circ from the point of view of practical application.

Table 1

Example No.	Composition				Bending Strength (kg/cm ²)	Flexural modulus ($\times 10^2$) (kg/cm ²)	Profile extrusion property	
	(A1)	(B)	(C)	(A2)			Die-swell	Draw-down
Example 1	50	10	20	20	1540	59.2	1.74	\circ
Comparative Example 1	100	-	-	-	873	23.7	1.13	\times
Comparative Example 2	40	40	20	-	1258	48.0	1.86	\odot
Comparative Example 3	50	10	40	-	1888	89.7	1.25	\times

Claims

1. A process for producing a molded product which comprises profile extruding a thermoplastic resin composition comprising:
 - (A1) 50 to 95% by weight of a thermoplastic aromatic polycarbonate resin;
 - (A2) 3 to 40% by weight of a styrene-based resin selected from the group consisting of acrylonitrile-butadiene-styrene resin (ABS), acrylonitrile-(ethylene-propylene-diene terpolymer)-styrene resin (AES), acrylonitrile-acrylic-styrene resin (AAS) and methylmethacrylate-butadiene-styrene resin (MBS);
 - (B) 0.5 to 30% by weight of a polyethylene; and
 - (C) 5 to 30% by weight of a filler.
2. A process according to claim 1, wherein polyethylene (B) has a melt index of 0.01 to 50 and a density of 0.88 to 0.97.
3. A process according to claim 1, wherein polyethylene (B) is prepared in the presence of a chromium catalyst and has a melt index of 0.01 to 50 and a density of 0.90 to 0.97.
4. A process according to claim 1, wherein filler (C) is at least one of glass fibers, carbon fibers, needle-like titanium oxide, potassium titanate whiskers, aluminum borate whiskers, zinc oxide whiskers, magnesium sulfate, calcium sulfate, wollastonite, clay, talc, mica, silicon carbide and silicon nitride.

Patentansprüche

1. Verfahren zur Erzeugung eines Formprodukts, das das Profilextrudieren einer thermoplastischen Harzzusammensetzung umfasst, umfassend:
 - (A1) 50 bis 95 Gew.-% eines thermoplastischen aromatischen Polycarbonatharzes;
 - (A2) 3 bis 40 Gew.-% eines auf Styrol basierenden Harzes, gewählt aus der Gruppe, bestehend aus Arcyonitril-Butadien-Styrolharz (ABS), Acrylonitril-(Ethilen-Propylen-Dienterpolymer)-Styrolharz (AES), Acrylonitril-Acrylicsäure-Styrolharz (AAS) und Methylmethacrylat-Butadien-Styrolharz (MBS);
 - (B) 0,5 bis 30 Gew.-% eines Polyethylens und
 - (C) 5 bis 30 Gew.-% eines Füllstoffs.
2. Verfahren gemäß Anspruch 1, worin das Polyethylen (B) einen Schmelzindex von 0,01 bis 50 und eine Dichte von 0,88 bis 0,97 aufweist.
3. Verfahren gemäß Anspruch 1, worin das Polyethylen (B) in Gegenwart eines Chromkatalysators hergestellt wird und einen Schmelzindex von 0,01 bis 50 und eine Dichte von 0,90 bis 0,97 aufweist.

4. Verfahren gemäß Anspruch 1, worin der Füllstoff (C) mindestens einer ist aus Glasfasern, Kohlenstofffasern, Nadel-ähnlichem Titanoxid, Kaliumtitanatnadelkristallen, Aluminiumboratnadelkristallen, Zinkoxidnadelkristallen, Magnesiumsulfat, Kalziumsulfat, Wollastonit, Ton, Talk, Glimmer, Siliziumcarbid und Siliziumnitrid.

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Revendications

1. Procédé de production d'un produit moulé qui comprend en une extrusion profilée d'une composition de résine thermoplastique comprenant :

10 (A1) 50 à 95% en poids d'une résine de polycarbonate aromatique thermoplastique ;
(A2) 3 à 40% en poids d'une résine à base de styrène choisie dans le groupe consistant en la résine d'acrylonitrile-butadiène-styrène (ABS), la résine d'acrylonitrile-(terpolymère éthylène-propylène-diène)-styrène (AES), la résine d'acrylonitrile-acrylique-styrène (AAS) et la résine de méthacrylate de méthyle-butadiène-styrène (MBS) ;
15 (B) 0,5 à 30% en poids d'un polyéthylène ; et
(C) 5 à 30% en poids d'un agent de remplissage.

2. Procédé selon la revendication 1, dans lequel le polyéthylène (B) a un indice de fusion de 0,01 à 50 et une densité de 0,88 à 0,97.

20 3. Procédé selon la revendication 1, dans lequel le polyéthylène (B) est préparé en présence d'un catalyseur à base de chrome et a un indice de fusion de 0,01 à 50 et une densité de 0,90 à 0,97.

25 4. Procédé selon la revendication 1, dans lequel l'agent de remplissage (C) est au moins une des fibres de verre, des fibres de carbone, de l'oxyde de titane aciculaire, des agrégats de titanate de potassium, des agrégats de borate d'aluminium, des agrégats d'oxyde de zinc, du sulfate de magnésium, du sulfate de calcium, de la wollastonite, de l'argile, du talc, du mica, du carbure de silicium ou du nitre de silicium.

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FIG.1

