

DESCRIPTION

TITLE OF THE INVENTION: FLAME-RETARDANT POLYAMIDE RESIN
COMPOSITION AND MOLDED ARTICLE COMPRISING SAME

TECHNICAL FIELD

[0001]

The present invention relates to a non-halogen-based flame-retardant polyamide resin composition. Specifically, the present invention relates to a non-halogen-based flame-retardant polyamide resin composition having high flame retardancy, good snap-fit properties, and excellent heat discoloration resistance.

BACKGROUND ART

[0002]

Polyamide resins are used in various fields of electric and electronic parts, automobile parts and the like by utilizing their excellent mechanical properties, electrical properties, chemical resistance and the like. In these fields, when flame retardancy is required to be imparted by a non-reinforced and non-halogenated flame retardant, a melamine cyanurate is used as the flame retardant (for example, Patent Documents 1 and 2).

However, the melamine cyanurate has disadvantages such as poor dispersibility in the polyamide resin, deterioration in the mechanical properties of the polyamide

resin, bleeding, decomposition into melamine and cyanuric acid by thermal decomposition, which easy sublimation, and occurrence of silver color on the surface of a molded article and easy contamination of the surface of a mold during molding processing due to the influence of the sublimated melamine and cyanuric acid as the blending amount increases.

[0003]

In recent years, various required levels for electric and electronic components, automobile components and the like have increased. A level of UL 94 V-0 has been required for flame retardancy at various thicknesses, and heat discoloration resistance, moldability, snap-fit properties of parts, and the like have been desired at higher levels without bleeding of the flame retardant.

PRIOR ART DOCUMENTS

PATENT DOCUMENT

[0004]

Patent Document 1: JP-B-58-25379

Patent Document 2: JP-B-58-35541

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005]

An object of the present invention is to provide a flame-retardant polyamide resin composition which has flame retardancy at a UL94V-0 level in a wide range of thickness, causes less bleeding of a flame retardant, and is also excellent in heat discoloration resistance, moldability, snap-fit properties of parts, and the like.

MEANS FOR SOLVING THE PROBLEMS

[0006]

As a result of diligent studies to solve the above problems, the present inventors have completed the present invention.

[0007]

That is, the present invention has the following configuration.

A flame-retardant polyamide resin composition including a polyamide resin (A) and a melamine cyanurate (B), wherein the flame-retardant polyamide resin composition contains 90 to 98 parts by mass of the polyamide resin (A), 2 to 10 parts by mass of the melamine cyanurate (B), 0.01 to 1 parts by mass of a phosphorus-based antioxidant (C), 0.01 to 1 parts by mass of a hindered phenol-based antioxidant (D), and 0.1 to 1 parts by mass of a fatty acid metal salt-based lubricant (E) having 22 or less carbon atoms based on a total of 100

parts by mass of the components (A) and (B), and the polyamide resin (A) contains 55 to 85% by mass of a polyamide 66 resin (A1) and 15 to 45% by mass of a polyamide 6 resin (A2).

[2] The flame-retardant polyamide resin composition of [1], wherein the fatty acid metal salt-based lubricant (E) is a metal salt of stearic acid.

[3] A molded article including the flame-retardant polyamide resin composition of any one of [1] or [2].

[4] The molded article of [3], wherein the molded article is any one of a ferrite core cover, an SC lock, a binding band, and an electric wiring protection member.

EFFECT OF THE INVENTION

[0008]

The flame-retardant polyamide resin composition of the present invention is not only excellent in heat discoloration resistance and moldability, but also has flame retardancy at a UL94V-0 level in a wide range of thickness without significantly impairing breaking intensity and toughness.

MODE FOR CARRYING OUT THE INVENTION

[0009]

Hereinafter, the present invention will be

specifically described.

A polyamide resin (A) in the present invention is not particularly limited as long as the crystalline polyamide resin (A) is a polymer having an amide bond (-NHCO-) in its main chain. The polyamide resin (A) is preferably crystalline, and examples thereof include, but are not limited to, crystalline polyamide resins such as polyamide 6 (PA6), polyamide 66 (PA66), polyamide 46 (PA46), polyamide 11 (PA11), polyamide 12 (PA12), polyamide 610 (PA610), polyamide 612 (PA612), polymethaxylylene adipamide (PAMXD6), hexamethylenediamine-terephthalic acid polymer (PA6T), a copolymer of hexamethylenediamine-terephthalic acid and adipic acid (PA6T/66), a copolymer of hexamethylenediamine-terephthalic acid and ϵ -caprolactam (PA6T/6), a trimethylhexamethylenediamine-terephthalic acid polymer (PATMD-T), a copolymer of m-xylylenediamine with adipic acid and isophthalic acid (PAMXD6/MXDI), a copolymer of trihexamethylenediamine with terephthalic acid and ϵ -caprolactam (PATMDT/6), and a copolymer of diaminodicyclohexylenemethane with isophthalic acid and lauryllactam, and blends thereof.

[0010]

The blending amount (content) of the polyamide resin (A) is 90 to 98 parts by mass based on the total of 100 parts by mass of the polyamide resin (A) and the melamine

cyanurate (B). When the blending amount of the polyamide resin (A) is within this range, it is possible to suppress the bleeding of a flame retardant and to apply the retention of high flame retardancy to a composition. The blending amount (content) of the polyamide resin (A) is preferably 92 to 96 parts by mass, and more preferably 93 to 95 parts by mass. In a flame-retardant polyamide resin composition of the present invention, the blending amount of each component is the content as it is.

[0011]

A preferable aspect of the polyamide resin (A) in the present invention is a mixture of a polyamide 66 resin (A1) and a polyamide 6 resin (A2) from the viewpoint of excellent moldability, melt fluidity, flame retardancy and the like.

[0012]

Examples of the polyamide 66 resin (A1) in the present invention include a polyamide 66 resin obtained by the polycondensation of adipic acid and hexamethylenediamine as raw materials. The relative viscosity of the polyamide 66 resin (A-1) is a value measured at a concentration of 1% in 98% sulfuric acid and a temperature of 25°C according to JIS K6810, and is preferably 2.2 to 3.5. When the relative viscosity of the polyamide 66 resin (A1) is less than 2.2, mechanical

characteristics are apt to be deteriorated, and when the relative viscosity of the polyamide 66 resin (A1) is more than 3.5, melt fluidity is apt to be insufficient. The relative viscosity of the polyamide 66 resin (A1) is more preferably 2.3 to 3.0. The relative viscosity of the polyamide 66 resin (A1) may be adjusted to a preferable range by mixing polyamide 66 resins having different relative viscosities.

[0013]

The terminal amino group concentration of the polyamide 66 resin (A1) is not particularly limited, but is preferably 50 to 90 eq/ton, and more preferably 60 to 80 eq/ton from the viewpoint of heat discoloration resistance.

[0014]

The blending amount of the polyamide 66 resin (A1) is preferably 55 to 85 parts by mass based on 100 parts by mass of the polyamide resin (A). When the blending amount of the polyamide 66 resin (A1) is more than 85 parts by mass, hinge properties (snap-fit properties) are deteriorated, and when the blending amount is less than 50 parts by mass, molding processability is apt to be deteriorated. The blending amount of the polyamide 66 resin (A1) is more preferably 60 to 80 parts by mass from the viewpoint of a balance between snap-fit properties and molding processability.

[0015]

The polyamide 6 resin (A2) in the present invention is a polyamide 6 resin obtained by the polycondensation of ϵ -caprolactam as a raw material. The relative viscosity of the polyamide 6 resin (A2) is a value measured at a concentration of 1% in 98% sulfuric acid and a temperature of 25°C according to JIS K6810, and is preferably 1.5 to 4.0. When the relative viscosity of the polyamide 6 resin (A2) is less than 1.5, mechanical characteristics are apt to be deteriorated, and when the relative viscosity of the polyamide 6 resin (A2) is more than 3.6, flame retardancy and fluidity are apt to be impaired. The relative viscosity of the polyamide 6 resin (A2) is more preferably 1.8 to 3.6. The relative viscosity of the polyamide 6 resin (A-2) may be adjusted to a preferable range by mixing polyamide 6 resins having different relative viscosities.

[0016]

The terminal amino group concentration of the polyamide 6 resin (A2) is not particularly limited, but is preferably 50 to 90 eq/ton, and more preferably 60 to 80 eq/ton from the viewpoint of heat discoloration resistance.

[0017]

The blending amount of the polyamide 6 resin (A2) is preferably 15 to 45 parts by mass based on 100 parts by mass of the polyamide resin (A). When the blending amount

of the polyamide 6 resin (A2) is less than 15 parts by mass, hinge properties (snap-fit properties) are apt to be deteriorated, and when the blending amount is more than 45 parts by mass, molding processability is apt to be deteriorated. The blending amount of the polyamide 6 resin (A2) is more preferably 20 to 40 parts by mass from the viewpoint of a balance between snap-fit properties and molding processability.

[0018]

In order to improve the appearance of a molded article, an amorphous polyamide resin (A3) can also be blended.

Examples of the amorphous polyamide resin include polymers, copolymers obtained by the polycondensation of diamines such as 4,4'-diamino-3,3'-dimethyldicyclohexylmethane (CA), 4,4'-diaminodicyclohexylmethane (PACM), meta-xylylenediamine (MXD), trimethylhexamethylenediamine (TMD), isophoronediamine (IA), 4,4'-diaminodicyclohexylpropane (PACP), and hexamethylenediamine with dicarboxylic acids such as terephthalic acid, isophthalic acid, adipic acid, sebacic acid, and dodecanedicarboxylic acid and lactams such as caprolactam and lauryllactam, or blends thereof. The blending amount of the amorphous polyamide resin (A3) is more preferably 0 to 15 parts by mass from the viewpoint

of a balance between snap-fit properties and molding processability.

[0019]

[Melamine cyanurate (B)]

Preferred examples of the melamine cyanurate (B) in the present invention include an equimolar reactant of cyanuric acid and melamine. Some of amino groups or hydroxyl groups in the melamine cyanurate may be substituted with other substituents. The melamine cyanurate can be obtained, for example, by mixing an aqueous solution of cyanuric acid and an aqueous solution of melamine, reacting them under stirring at 90 to 100°C, and filtering the generated precipitate. The obtained solid can be used as it is, but it is preferable to use the pulverized solid as necessary. The particle diameter of the pulverized solid is not particularly limited, but from the viewpoint of flame retardancy and toughness, the average particle diameter of the pulverized solid is preferably 0.5 to 20 μm , and more preferably 1 to 15 μm .

[0020]

The blending amount (content) of the melamine cyanurate (B) is 2 to 10 parts by mass based on the total of 100 parts by mass of the polyamide resin (A) and the melamine cyanurate (B). The blending amount is 2 parts by mass or more from the viewpoint of flame retardancy, and 10

parts by mass or less from the viewpoint of snap-fit properties and bleeding. The blending amount is more preferably 3 to 9 parts by mass, and still more preferably 4 to 8 parts by mass.

[0021]

[Phosphorus-based antioxidant (C)]

A phosphorus-based antioxidant (C) in the present invention may be an inorganic compound or an organic compound, and is not particularly limited. Preferred examples of the phosphorus-based compound include inorganic phosphates such as monosodium phosphate, disodium phosphate, trisodium phosphate, sodium phosphite, calcium phosphite, magnesium phosphite and manganese phosphite; triphenyl phosphite, trioctadecyl phosphite, tridecyl phosphite, triisodecyl phosphite, trinonylphenyl phosphite, diphenyl isodecyl phosphite, diphenyl alkyl phosphite, phenyl dialkyl phosphite, tris(nonylphenyl)phosphite, trilauryl phosphite, distearyl pentaerythritol diphosphite, tris(2,4-di-tert-butylphenyl)phosphite, diisodecyl pentaerythritol diphosphite, bis(2,4-di-tert-butylphenyl)pentaerythritol diphosphite, bis(2,6-di-tert-butyl-4-methylphenyl)pentaerythritol diphosphite, diisodecyloxypentaerythritol diphosphite, bis(2,4-di-tert-butyl-6-methylphenyl)pentaerythritol diphosphite, bis(2,4,6-tris(tert-butylphenyl))pentaerythritol

diphosphite, tristearyl sorbitol triphosphite, tetrakis(2,4-di-tert-butylphenyl)-4,4'-biphenylenediphosphonite, 6-isooctyloxy-2,4,8,10-tetra-tert-butyl-12H-dibenzo[d,g]-1,3,2-dioxaphosine, 6-fluoro-2,4,8,10-tetra-tert-butyl-12-methyl-dibenzo[d,g]-1,3,2-dioxaphosphocin, bis(2,4-di-tert-butyl-6-methylphenyl)methyl phosphite, and bis(2,4-di-tert-butyl-6-methylphenyl)ethyl phosphite, and these compounds are blended in order to enhance heat discoloration resistance. [0022]

As the phosphorus-based antioxidant (C), phosphite compounds are preferably used. Among the phosphite compounds, the compounds having a pentaerythritol diphosphite skeleton are preferable. Specifically, those having a pentaerythritol diphosphite skeleton such as bis(2,6-di-tert-butyl-4-methylphenyl)pentaerythritol diphosphite ("ADK STAB PEP-36", molecular weight: 633), bis(2,4-di-tert-butylphenyl)pentaerythritol diphosphite ("ADK STAB PEP-24G", molecular weight: 604), distearyl pentaerythritol diphosphite ("ADK STAB PEP-8", molecular weight: 733), or bis(nonylphenyl)pentaerythritol diphosphite ("ADK STAB PEP-4C", molecular weight: 633) and having a molecular weight of about 600 to 800 are particularly preferable in terms of being capable of further improving releasability without reducing flame

retardancy and also being suitable for snap-fit properties.

[0023]

The blending amount (content) of the phosphorus-based antioxidant (C) is 0.01 to 1 part by mass based on the total of 100 parts by mass of the polyamide resin (A) and the melamine cyanurate (B). When the blending amount of the phosphorus-based antioxidant (C) is within this range, discoloration during extrusion processing can be suppressed, and secondary oxidative degradation due to phosphorus-derived radicals can be prevented from being induced. The blending amount of the phosphorus-based antioxidant (C) is preferably 0.1 to 0.5 parts by mass.

[0024]

[Hindered phenol-based antioxidant (D)]

Examples of a hindered phenol-based antioxidant (D) in the present invention include N,N'-hexamethylene-bis-3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionamide, bis(3,3-bis-(4'-hydroxy-3'-tert-butylphenyl)butanoic acid)glycol ester, 2,1'-thioethylbis(3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate, 4,4'-butylidene-bis(3-methyl-6-tert-butylphenol), and triethylene glycol-3-(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate "SONGNOX 2450", molecular weight: 633), and mixtures of two or more thereof can also be used.

[0025]

The blending amount (content) of the hindered phenol-based antioxidant (D) is 0.01 to 1 part by mass based on the total of 100 parts by mass of the polyamide resin (A) and the melamine cyanurate (B). When the blending amount of the hindered phenol-based antioxidant (D) is within this range, oxidation degradation over time can be prevented with an appropriate formulation amount according to the coordination bond of the polyamide composition. The blending amount of the hindered phenol-based antioxidant (D) is preferably 0.1 to 0.5 parts by mass.

[0026]

[Fatty acid metal salt-based lubricant (E) having 22 or less carbon atoms]

Examples of a fatty acid metal salt-based lubricant (E) having 22 or less carbon atoms in the present invention include metal salts of fatty acids such as stearic acid, palmitic acid, and behenic acid. When the fatty acid metal salt-based lubricant having 22 or less carbon atoms is used, not only releasability is improved, but also flame retardancy tends to be more favorably exhibited because the generation start temperature of a combustion gas derived from a fatty acid during combustion is close to the generation start temperature of a non-flammable gas generated by the decomposition of the melamine cyanurate, and therefore the ignition of a flammable gas can be

prevented.

[0027]

A metal salt of an aliphatic carboxylic acid having 18 or less carbon atoms is more preferable, and an alkali metal or alkaline earth metal salt of stearic acid or palmitic acid or the like is more preferable from the viewpoint of achieving both releasability and flame retardancy. Examples of the alkali metal or alkaline earth metal include lithium, sodium, magnesium, and calcium salts. In particular, the alkali metal or alkaline earth metal salt of stearic acid is optimal because the generation start temperature of a flammable gas derived from a fatty acid due to the decomposition of a fatty acid metal salt during combustion is the same as that of a non-flammable gas generated by the decomposition of the melamine cyanurate, and therefore releasability can be improved without causing reduction in flame retardancy due to addition.

[0028]

The blending amount (content) of the fatty acid metal salt-based lubricant (E) is 0.1 to 1 part by mass based on the total of 100 parts by mass of the polyamide resin (A) and the melamine cyanurate (B). When the blending amount is more than 1 part by mass, flame retardancy may be deteriorated. The blending amount of the fatty acid metal

salt-based lubricant (E) is preferably 0.2 to 0.8 parts by mass.

[0029]

[Other components]

In addition to the above-described (A), (B), (C), (D), and (E), other components, for example, colorants such as pigments and dyes, additives such as heat stabilizers, weather resistance improvers, nucleating agents, plasticizers, release agents, and antistatic agents, and other resin polymers and the like can be added to the flame-retardant polyamide resin composition of the present invention as long as the object of the present invention is not impaired. The flame-retardant polyamide resin composition of the present invention preferably occupies 80% by mass or more, more preferably 90% by mass or more, and still more preferably 95% by mass or more in the total of the above-mentioned components (A), (B), (C), (D), and (E).

[0030]

Specific examples of suitable molded parts obtained using the flame-retardant polyamide resin composition of the present invention include molded parts such as connectors, coil bobbins, circuit breakers, electromagnetic switches, holders, plugs, sockets, switches, cases, and covers used in fields of electric and electronic parts,

automobile parts and the like, and more specific examples thereof include parts required to have heat discoloration resistance and snap-fit properties, such as ferrite core covers, SC locks, binding bands, and electric wiring protection members.

[0031]

A method for producing the flame-retardant polyamide resin composition of the present invention is not particularly limited, and a general single screw extruder, twin screw extruder, pressure kneader and the like can be used as a kneader, but a twin screw extruder is particularly preferable in the present invention. As one aspect, the above (A), (B), (C), (D), and (E), and a pigment and the like depending on the application are mixed, and the mixture is charged into a twin-screw extruder. The polyamide-based resin composition having excellent toughness and flame retardancy can be produced by uniform kneading with the twin screw extruder. The kneading temperature of the twin screw extruder is preferably 220 to 300°C, and the kneading time thereof is preferably about 2 to 15 minutes.

EXAMPLES

[0032]

Hereinafter, the present invention will be described

in more detail with reference to Examples, but the present invention is not limited to these Examples at all.

[0033]

The following components were used.

Polyamide resin (A);

A1-1: Polyamide 66 (RV=2.8), Vydyne 21Z (manufactured by Ascend), melting point: 265°C

A1-2: Polyamide 66 (RV=2.4), EPR24 (manufactured by Shanghai Shenma Plastics Technology Co., Ltd.), melting point 265°C

A2-1: Polyamide 6 (RV=2.0), M2000 (manufactured by MEIDA), melting point: 225°C

A2-2: Polyamide 6 (RV=3.6), ZISAMIDE TP6603 (manufactured by ZIG SHENG INDUSTRIAL CO., LTD.), melting point: 225°C

[0034]

Melamine cyanurate (B);

B: MC6000 (manufactured by Nissan Chemical Corporation)

[0035]

Phosphorus-based antioxidant (C);

C: ADK STAB PEP-36 (manufactured by ADEKA Corporation)

[0036]

Hindered phenol-based antioxidant (D);

D: SONGNOX2450 (manufactured by Songwon
International Japan K.K.)

[0037]

Fatty acid metal salt-based lubricant (E);

E1: Magnesium stearate, N.P.1500-S (manufactured by
TANNAN KAGAKU KOGYO CO., LTD.)

Other release agents;

E2: Calcium montanate, CS-8-CP (manufactured by
Nitto Chemical Industry Co., Ltd.)

E3: Aliphatic ester, Licolub WE-40 (manufactured by
Clariant Japan Co., Ltd.)

[0038]

[Examples 1 to 12, Comparative Examples 1 to 7]

In the production of evaluation samples, raw materials were weighed in blending ratios for polyamide resin compositions shown in Table 1 and mixed in a tumbler. The mixture was then charged into a twin screw extruder. The set temperature of the twin screw extruder was set to 250°C to 300°C, and the kneading time thereof was set to 5 to 10 minutes. Various evaluation samples were molded from the obtained pellets using an injection molding machine. The cylinder temperature and mold temperature of the injection molding machine were respectively set to 250°C to 280°C and 80°C.

[0039]

Various evaluation methods are as follows. The evaluation results are shown in Table 1.

1. Relative viscosity [RV] of polyamide resin (98% sulfuric acid solution method)

Measurement was performed using an Ubbelohde's viscometer at a polyamide resin concentration of 1 g/dl at 25°C in a 98% by mass sulfuric acid solution.

2. Melting point of polyamide resin

Measurement was performed using a differential scanning calorimeter (EXSTAR 6000 manufactured by Seiko Instruments) with a temperature rising rate of 20°C/min to determine a peak top temperature of an endothermic peak as a melting point.

3. Snap-fit properties (tensile strength, tensile elongation): Tensile strength (tensile intensity) and tensile elongation (tensile fracture strain) were measured in accordance with ISO527.

4. Combustibility: Measurement was performed according to UL 94, vertical combustion test. V-0 represents the highest flame retardancy.

5. Bleeding properties: A molded article having a thickness of 2 mm and a size of 100 mm × 100 mm was repeatedly left to stand in a thermo-hygrostat bath set at a temperature of 80°C and 95% RH for 96 hours at least twice or more, and then returned to room temperature to

visually confirm whether precipitates were present on the surface of the molded article with a stereoscopic microscope.

6. Heat discoloration properties: A color difference (ΔE) between a pellet left for 8 hours at a temperature of 120°C in an oven and an untreated pellet was calculated.

7. Moldability: Molding was performed under the above molding temperature conditions using a mold equipped with a mold release force measuring device, and mold release forces from the 31th shot to the 35th shot were measured to determine a mold release resistance value.

[0040]

[Table 1]

Classification		Examp e 1	Examp e 2	Examp e 3	Examp e 4	Examp e 5	Examp e 6	Examp e 7	Examp e 8	Examp e 9	Examp e 10	Examp e 11	Examp e 12
Composition (parts by mass)	A1-1: Polyamide 66	54	55	53	36	18	54	54	54	54	56	44	54
	A1-2: Polyamide 66	18	19	17	36	54	18	18	18	18	23	15	18
	A2-1: Polyamide 6	22	22	22	22	22	22	22	22	22	15	35	
	A2-2: Polyamide 6												22
	B: MC6000	6	4	8	6	6	6	6	6	6	6	6	6
	C: Phosphorus-based antioxidant	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	D: Hindered phenol-based antioxidant	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	E1: Magnesium stearate	0.6	0.6	0.6	0.6	0.6	0.1	0.2	0.4	0.8	0.6	0.6	0.6
Snap-fit properties	E2: Calcium montanate												
	E3: Aliphatic ester												
Combustibility	Tensile strength (MPa)	78	80	76	78	76	80	81	83	83	75	75	81
	Tensile elongation (%)	8	11	8	9	8	11	10	9	7	10	5	25
	UL94 / 0.3 mm	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0
	UL94 / 0.8 mm	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0
Bleeding properties	UL94 / 1.6 mm	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0
	UL94 / 3.0 mm	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0
Heat discoloration properties	Presence or absence of surface precipitates after repeated water absorption	Absence	Absence	Absence	Absence	Absence	Absence	Absence	Absence	Absence	Absence	Absence	Absence
Moldability	Color difference (ΔE) after heat treatment at 120°C for 8 hours	10	11	9	10	10	12	12	11	10	13	13	12
	Mold release resistance value (MPa)	0.5	0.7	0.3	0.5	0.5	0.9	0.8	0.6	0.3	0.7	0.7	0.4

Classification		Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5	Comparative Example 6	Comparative Example 7
Composition (parts by mass)	A1-1: Polyamide 66	60	50	30	54	54	53	54
	A1-2: Polyamide 66	20	16	10	18	18	17	18
	A2-1: Polyamide 6	19	22	54	22	22	20	22
	A2-2: Polyamide 6							
	B: MC6000	1	12	6	6	6	10	6
	C: Phosphorus- based antioxidant	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	D: Hindered phenol-based antioxidant	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	E1: Magnesium stearate	0.6	0.6	0.6				
	E2: Calcium montanate				0.6	0.2	0.6	
	E3: Aliphatic ester							0.6
Snap-fit properties	Tensile strength (MPa)	82	85	76	80	81	84	79
	Tensile elongation (%)	12	3	3	10	11	3	11
Combustibility	UL94 / 0.3 mm	V-2	V-0	V-2	V-0	V-0	V-0	V-0
	UL94 / 0.8 mm	V-2	V-0	V-2	V-2	V-2	V-2	V-2
	UL94 / 1.6 mm	V-2	V-0	V-2	V-2	V-2	V-2	V-2
	UL94 / 3.0 mm	V-2	V-0	V-2	V-2	V-2	V-2	V-2
Bleeding properties	Presence or absence of surface precipitates after repeated water absorption	Absence	Presence	Absence	Absence	Absence	Absence	Absence
Heat discoloration properties	Color difference (ΔE) after heat treatment at 120°C for 8 hours	12	9	13	11	13	10	18
Moldability	Mold release resistance value (MPa)	0.8	0.8	1.2	0.4	0.6	0.3	1.1

[0041]

Examples 1 to 12 have tensile strength equivalent to that of a general polyamide 6 or 66 resin and tensile elongation of 5% or more, is not broken even beyond the tensile yield point, does not cause large brittleness, and therefore good snap-fit properties are expected to be obtained. Regarding flame retardancy at thicknesses of 0.4, 0.8, 1.6, and 3.0 mm, Examples 1 to 12 achieve UL94 V-0 evaluation, and therefore are found to have high flame retardancy in a wide thickness. Also in the heat discoloration properties, in Examples 1 to 12, ΔE after 8 hours at 120°C is 20 or less, and therefore discoloration is found to be suppressed under a heat environment. Also in terms of moldability, the molded article has a resistance value of 1 MPa or less at the time of releasing the molded article, and there is very little possibility that the molded article is deformed during mold releasing and adheres even when continuous molding is performed.

[0042]

Meanwhile, Comparative Examples 1 to 7 partially satisfy the characteristics, but Comparative Example 1 is evaluated as UL94 V-2 in flame retardancy at thicknesses of 0.4, 0.8, 1.6, and 3.0 mm, and has significantly reduced

flame retardancy, which is not preferable. Comparative Example 2 has tensile elongation of 3%, and embrittlement cannot be suppressed, which is not preferable. In Comparative Example 3, flame retardancy at thicknesses of 0.4, 0.8, 1.6, and 3.0 mm is evaluated as V-2, and tensile elongation is 3%, and therefore it is difficult to say that both sufficient flame retardancy and snap-fit properties are achieved, which is not preferable. In Comparative Examples 4, 5, and 7, flame retardancy at thicknesses of 0.8, 1.6, and 3.0 mm is evaluated as UL94 V-2, and therefore it is difficult to say that flame retardancy is high in a wide region of thickness, which is not preferable. In addition, in Comparative Example 7, a mold release resistance value, which is an index of moldability, exceeds 1 MPa, and it cannot be said that moldability is good (good releasability), which is also not preferable in this respect. Finally, in Comparative Example 6, flame retardancy at thicknesses of 0.8, 1.6, and 3.0 mm was evaluated as UL94 V-2, and tensile elongation was 3%, and therefore it is difficult to say that both sufficient flame retardancy and snap-fit properties are achieved, which is not preferable.

INDUSTRIAL APPLICABILITY

[0043]

The flame-retardant polyamide resin composition of the present invention is suitable for molded articles having a wide range of product thickness and having a hinge part. The obtained molded article has high flame retardancy at a wide range of product thickness and is also excellent in snap-fit properties, and thus can be suitably used for electric and electronic parts, automobile parts and the like in which both high flame retardancy and snap-fit properties are desired.

CLAIMS

Claim 1. A flame-retardant polyamide resin composition comprising a polyamide resin (A) and a melamine cyanurate (B), wherein the flame-retardant polyamide resin composition contains 90 to 98 parts by mass of the polyamide resin (A), 2 to 10 parts by mass of the melamine cyanurate (B), 0.01 to 1 parts by mass of a phosphorus-based antioxidant (C), 0.01 to 1 parts by mass of a hindered phenol-based antioxidant (D), and 0.1 to 1 parts by mass of a fatty acid metal salt-based lubricant (E) having 22 or less carbon atoms based on a total of 100 parts by mass of the components (A) and (B), and the polyamide resin (A) contains 55 to 85% by mass of a polyamide 66 resin (A1) and 15 to 45% by mass of a polyamide 6 resin (A2).

Claim 2. The flame-retardant polyamide resin composition according to claim 1, wherein the fatty acid metal salt-based lubricant (E) is a metal salt of stearic acid.

Claim 3. A molded article comprising the flame-retardant polyamide resin composition according to any one of claims 1 and 2.

Claim 4. The molded article according to claim 3, wherein the molded article is any one of a ferrite core cover, an SC lock, a binding band, and an electric wiring protection member.