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(71) Applicant *(for all designated States except US)*: **LS CABLE LTD.** [KR/KR]; 19-20F ASEM Tower, 159 Samsung-dong, Gangnam-gu, Seoul 135-090 (KR).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **LEE, Ju-Ha** [KR/KR]; 111-403, Olympic Seonsuchon Apt., Oryun-dong, Songpa-gu, Seoul 138-787 (KR). **NAM, Gi-Joon** [KR/KR]; 1503, B-dong, Jungang Heights, 71-17, Jamwon-dong, Seocho-gu, Seoul 137-909 (KR). **KIM, Won-Jung** [KR/KR]; 105-1402, Byeoksan Baekhap Apt., Ojeon-dong, Uiwang-si, Gyeonggi-do 437-729 (KR). **PARK, Jung-Won** [KR/KR]; 204-1703, Samsung 2-cha Apt., Pungdeokcheon 1-dong, Suji-gu, Yongin-si, Gyeonggi-do 448-763 (KR).

(74) Agent: **PHIL & ONZI INT'L PATENT & LAW FIRM**; Jinsuk B/D 8F., 1536-7, Seocho-dong, Seocho-gu, Seoul 137-872 (KR).

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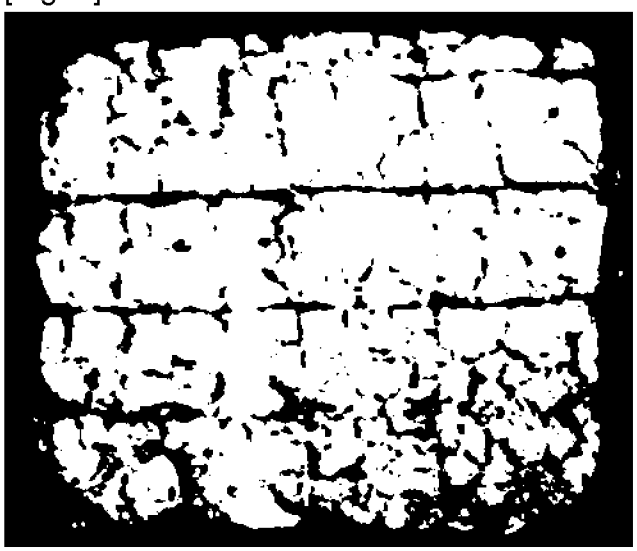
(54) **Title:** FLAME RETARDANT POLYMER COMPOSITION

[Fig. 1]



(57) **Abstract:** The present invention relates to a flame retardant polymer composition comprising 50 to 200 parts by weight of an inorganic flame retardant, as a first flame retardant, including at least one selected from the group consisting of aluminium hydroxide surface-treated with a predetermined polymer and magnesium hydroxide surface-treated with a predetermined polymer; 20 to 120 parts by weight of an antimony -based compound, as a second flame retardant, including at least one selected from the group consisting of antimony trioxide, antimony pentoxide, and sodium antimonate; and 1 to 15 parts by weight of a nano-clay, as a flame retardant aid, obtained by organizing and exfoliating at least one selected from the group consisting of montmorillonite, hectorite, saponite and beidellite, based on 100 parts by weight of a basic resin including a polyolefin-based resin and a reactive polyolefin-based resin having a polar group.

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Description

FLAME RETARDANT POLYMER COMPOSITION

Technical Field

[1] The present invention relates to a flame retardant polymer composition, and in particular, to a flame retardant polymer composition that can easily ensure mechanical characteristics and remarkably improve thermal characteristics, specially flame retardance.

Background Art

[2] Conventionally, a high flame retardant resin composition was prepared by adding magnesium hydroxide or an inorganic filler to a polypropylene resin singularly.

[3] For example, Korean Patent Application No. 2000-0040961 added a free-halogen amine flame retardant agent and organized layered clay minerals to a polypropylene resin, thereby ensuring excellent dispersion and improving mechanical characteristics and flame resistance. U.S. Patent Application No. 10/546,176 discloses a flame retardant composition comprising a polyolefin polymer, a metal hydroxide and a nano-silicate, and a coating, a wire or a cable prepared from the flame retardant composition. PCT/GB00/01652 discloses a polymer composition comprising a polymer and a flame retardant additive combination which comprises a nano-clay and a second filler, and a strong char is formed during combustion.

[4] However, in the case that an inorganic flame retardant agent is used singularly as mentioned above, there is a limitation in obtaining a sufficient flame retardance while maintaining mechanical characteristics or thermal characteristics.

[5] Therefore, the related industry has attempted to solve the above-mentioned problems of prior arts, and the present invention was devised under this technical background.

Disclosure of Invention

Technical Problem

[6] An object of the present invention is to provide a flame retardant polymer composition capable of solving the problem that it is difficult to ensure a sufficient flame retardance when an inorganic flame retardant agent is used singularly with a great amount.

Technical Solution

[7] A flame retardant polymer composition comprises 50 to 200 parts by weight of an inorganic flame retardant, as a first flame retardant, including at least one selected from the group consisting of aluminium hydroxide; magnesium hydroxide; aluminium

hydroxide surface-treated with a polymer selected from the group consisting of vinylsilane, a fatty acid and amino polysiloxane; and magnesium hydroxide surface-treated with a polymer selected from the group consisting of vinylsilane, a fatty acid and amino polysiloxane; 20 to 120 parts by weight of an antimony-based compound, as a second flame retardant, including at least one selected from the group consisting of antimony trioxide, antimony pentoxide, and sodium antimonate; and 1 to 15 parts by weight of a nano-clay, as a flame retardant aid, obtained by organizing and exfoliating at least one selected from the group consisting of montmorillonite, hectorite, saponite and beidellite, based on 100 parts by weight of a basic resin including 50 to 99 weight% of a polyolefin-based resin and 1 to 50 weight% of a reactive polyolefin-based resin having a polar group.

Brief Description of the Drawings

[8] Preferred embodiments of the present invention will be more fully described in the following detailed description, taken accompanying drawings. However, it should be understood that the description proposed herein is just a preferable example for the purpose of illustrations only, not intended to limit the scope of the invention.

[9] FIG. 1 is a photograph of a char formed after burning a flame retardant polymer composition prepared according to an embodiment of the present invention using a cone calorimeter.

Best Mode for Carrying Out the Invention

[10] Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings. The description proposed herein is just a preferable example for the purpose of illustrations only, not intended to limit the scope of the invention, so it should be understood that other equivalents and modifications could be made thereto without departing from the spirit and scope of the invention. The preferred embodiments of the present invention are provided to help persons having ordinary skills in the art understand the present invention more completely.

[11] A flame retardant polymer composition of the present invention is prepared by an adequate combination of a small amount of a clay, an inorganic flame retardant and an antimony-based compound, and thus can ensure excellent mechanical characteristics and remarkably improve thermal characteristics, specially flame retardance in comparison with a singular use of an inorganic flame retardant.

[12] The flame retardant polymer composition of the present invention comprises 50 to

200 parts by weight of an inorganic flame retardant as a first flame retardant, 20 to 120 parts by weight of an antimony-based compound as a second flame retardant, and 1 to 15 parts by weight of a nano-clay as a flame retardant aid, based on 100 parts by weight of a basic resin including 50 to 99 weight% of a polyolefin-based resin and 1 to 50 weight% of a reactive polyolefin-based resin having a polar group.

[13] The basic resin is a blend of a polyolefin-based resin and a reactive polyolefin-based resin having a polar group.

[14] Preferably, the polyolefin-based resin is at least one selected from the group consisting of high-density, intermediate-density, low-density or linear low-density polyethylene, polypropylene, ethylene-1-octene copolymer, ethylene-1-butene copolymer, alphaolefin block or random copolymer having 3 to 15 carbon atoms, ethylene vinyl acetate copolymer, ethylene ethylacrylate polymer and ethylene methylacrylate polymer. In particular, preferably the polyolefin-based resin is ethylene vinyl acetate copolymer containing 10 to 40% vinyl acetate.

[15] Preferably, the polyolefin-based resin is included with a content of 50 to 99 weight% based on 100 parts by weight of the basic resin. In the case that the content of the polyolefin-based resin is within the above-mentioned range, it is preferable because mechanical characteristics of the composition are improved.

[16] The reactive polyolefin-based resin having a polar group may be polyethylene, ethylene vinyl acetate copolymer or ethylene ethylacrylate copolymer that is grafted with a polar group of maleic anhydride or glycidylmetacrylate.

[17] The reactive polyolefin-based resin is grafted with the polar group, so that affinity with other resins is improved, and when a flame retardant is added, compatibility is increased, consequently reactivity is increased.

[18] Preferably, the reactive polyolefin-based resin having the polar group is included with a content of 1 to 50 weight% based on 100 parts by weight of the basic resin. In the case that the content of the reactive polyolefin-based resin having the polar group is within the above-mentioned range, it is preferable because mutual affinity is increased and mechanical characteristics and processing are improved. However, in the case that the content of the reactive polyolefin-based resin having the polar group is not in the above-mentioned range, mechanical characteristics may be deteriorated.

[19] A flame retardant polymer composition may be prepared by using a blend of the polyolefin-based resin and the reactive polyolefin-based resin having the polar group as a basic resin, and adding a flame retardant and a flame retardant aid to the basic resin.

[20] The flame retardant may be a mixture of an inorganic flame retardant and an antimony-based compound.

[21] The inorganic flame retardant may be an inorganic flame retardant with or without surface treatment. At this time, surface treatment of the inorganic flame retardant may increase affinity with a resin composition to increase relatively mechanical characteristics and flame retardant characteristics of the resin composition.

[22] The inorganic flame retardant may be magnesium hydroxide or aluminium hydroxide, and surface-treated by vinyl silane, a fatty acid or aminopolysiloxane.

[23] Preferably, the inorganic flame retardant is included with a content of 50 to 200 parts by weight based on 100 parts by weight of the basic resin. In the case that the content of the inorganic flame retardant is less than the above-mentioned minimum, it is not preferable because the required flame retardant characteristics may be satisfied, and in the case that the content of the inorganic flame retardant is more than the above-mentioned maximum, it is not preferable because mechanical characteristics such as elongation and processing may be reduced.

[24] The antimony-based compound may be antimony trioxide, antimony pentoxide or sodium antimonate.

[25] Preferably, the antimony-based compound is included with a content of 20 to 120 parts by weight based on 100 parts by weight of the basic resin. In the case that the content of the antimony-based compound is less than the above-mentioned minimum, it is not preferable because flame retardant characteristics may be reduced, and in the case that the content of the antimony-based compound is more than the above-mentioned maximum, it is not preferable because dripping phenomenon prevention of the flame retardant characteristics is reduced.

[26] And, the flame retardant aid may be a nano-clay.

[27] The nano-clay may be obtained by organizing and exfoliating a layered clay, such as montmorillonite, hectorite, saponite or beidellite.

[28] Preferably, the nano-clay is included with a content of 1 to 15 parts by weight based on 100 parts by weight of the basic resin. In the case that the content of the nano-clay is less than the above-mentioned minimum, it is not preferable because effects of the nano-clay are not obtained due to its small content, and in the case that the content of the nano-clay is more than the above-mentioned maximum, it is not preferable because the nano-clay reduces mechanical characteristics such as elongation.

[29] The flame retardant polymer composition of the present invention, comprising the above-mentioned ingredients may further comprise an antioxidant, a lubricant and a cr

osslinking agent.

[30] The antioxidant may be a thioester-based compound, a phenol-based compound, or mixtures thereof, and included with a content of 0.5 to 10 parts by weight based on 100 parts by weight of the basic resin.

[31] The lubricant and the crosslinking agent may be typical ones used in the art, and each may be included with a content of 0.5 to 10 parts by weight based on 100 parts by weight of the basic resin.

[32] The flame retardant polymer composition according to the present invention, comprising a blend of a polyolefin-based resin and a polyolefin-based resin having a polar group as a basic resin, an inorganic flame retardant and an antimony-based compound as a flame retardant and a nano-clay as a flame retardant aid has the improved flame retardance than a conventional polymer composition using only a large amount of an inorganic flame retardant due to mutual and complementary effects between ingredients.

Mode for the Invention

[33] Hereinafter, for understanding of the present invention, the present invention is described in more detail through comparison of examples with comparative examples.

[34] Example 1

[35] A sample was manufactured by mixing 100 parts by weight of a basic resin, i.e. a blend of 80 weight% of ethylene vinyl acetate copolymer resin containing 28% vinyl acetate and 20 weight% of ethylene vinyl acetate copolymer grafted with maleic anhydride, an inorganic flame retardant, i.e. 90 parts by weight of magnesium hydroxide without surface treatment, and an antimony-based compound, i.e. 50 parts by weight of antimony hydroxide, a flame retardant aid, i.e. 10 parts by weight of a clay obtained by organizing and exfoliating a layered clay of montmorillonite, 1 part by weight of a lubricant, 2 parts by weight of an antioxidant, and 3 parts by weight of a crosslinking agent using a roll mill at 130℃ for 10 minutes, and compressing the mixture at 170℃ for 20 minutes.

[36] Example 2 and comparative examples 1 to 4

[37] The example 2 and the comparative examples 1 to 4 were practiced by the same method as the example 1 using ingredients shown in the following Table 1 with contents shown in the following Table 1.

[38] Table 1

[Table 1]

[Table]

Ingredient		Example 1	Example 2	Comparative example 1	Comparative example 2	Comparative example 3	Comparative example 4
Basic resin	Polyolefin-based resin	80	80	80	80	80	80
	Reactive polyolefin-based resin having a polar group	20	20	20	20	20	20
Flame retardant	Inorganic flame retardant	90	90	150	100	130	100
	Antimony-based compound	50	30	-	50	-	30
Flame retardant aid	Nano-clay	10	10	-	-	-	-
Lubricant		1	1	1	1	1	1
Antioxidant		2	2	2	2	2	2
Crosslinking agent		3	3	3	3	3	3
[Note]·Polyolefin resin: Ethylene vinyl acetate copolymer resin containing 28% vinyl acetate·Reactive polyolefin-based resin having a polar group: ethylene vinyl acetate copolymer grafted with maleic anhydride·Inorganic flame retardant: magnesium							

hydroxide without surface treatment·Antimony-based compound: antimony trioxide·Nano-clay: clay obtained by organizing and exfoliating montmorillonite

[39] The samples manufactured using the compositions of the examples 1 or 2 and the comparative examples 1 to 4 were evaluated by the below-mentioned method in aspect of mechanical characteristics at normal temperature and flame retardance, and the results are shown in FIG. 1 and the following Table 2. The flame retardance was measured by a sheet burning test and a cone calorimeter test.

[40] A. Characteristics at normal temperature - tensile strength and elongation were measured according to the standard of UL224 and the measured values were compared.

[41] B. Flame retardance (sheet burning test) - a sheet burning test was performed on a sample having 1.0 ㎜ thickness and 25 ㎝ length twice each for 15 seconds, a burning time was measured, and drip, complete burning and conditions of char were compared.

[42] C. Flame retardance (cone calorimeter test) - peak of heat release rate, time to ignition and time to PHRR were compared using a cone calorimeter.

[43] The cone calorimeter test was performed on a test specimen (100 ㎜ × 100 ㎜ size, 3 ㎜ thickness) at 787 ℃ with flux of 50 ㎾/㎡ in aspect of behavior of fire such as magnitude of fire, a growth rate, a smoke release rate and a toxic gas release rate. The measurement items include a rate of heat release (㎾/㎡), time to ignition, a critical ignition flux, a mass loss rate (g/s), a smoke release rate, effective heat of combustion and a rate of toxic gas release. Each item of the cone calorimeter test has the following meaning.

[44] ·PHRR (Peak Heat Release Rate): Peak in the heat release rate, i.e. magnitude of instantaneous heat occurred per surface area of a specimen. The smaller value, the better flame retardance.

[45] ·TTPHRR (Time To Peak Heat Release Rate): Time taken to peak heat release rate. The larger value, the better flame retardance.

[46] ·TTI (Time To Ignition): Time taken to ignite, a flame exists on or above the surface of a specimen after a predetermined time. The larger value, the better flame retardance.

[47] Table 2

[Table 2]

[Table]

Classification		Example 1	Example 2	Comparative example 1	Comparative example 2	Comparative example 3	Comparative example 4
Tensile strength (kgf/㎟)		1.14	1.03	0.84	1.33	1.21	1.12
Elongation (%)		481	540	490	538	510	531
Flame retardance(sheet burning test)-1.0 ㎜	Burning time (s)	40	150	140	80	210	170
	Drip	×	○	○	◎	○	◎
	Burning	×	◎	○	×	◎	◎
Flame retardance (cone calorimeter test)	PHRR	171	252	254	204	320	296
	TTPHRR	140	130	150	160	100	105
	TTI	75	71	74	82	65	68
Ranking		1	4	3	2	6	5
[Note]×(no drip, no burning) ○(a little drip, burning of 80% or more) ◎(severe drip, complete burning)							

[48] As shown in Table 1, both of the examples 1 and 2 used 10 parts by weight of a nano-clay and 90 parts by weight of an inorganic flame retardant, but there was a difference in a content of an antimony-based flame retardant between the example 1 and the example 2, that is, the example 1 used 50 parts by weight of an antimony-based flame retardant and the example 2 used 30 parts by weight of an antimony-based flame retardant. According to measurement results of characteristics at normal temperature, the examples 1 and 2 had tensile strength of similar level when compared with the comparative examples 1 to 4, but the example 1 had a relatively lower elongation and the example 2 had a relatively higher elongation. When the examples and the comparative examples were compared under conditions of the same total amount of a

flame retardant, the examples 1 and 2 had a short time to ignition at 1.0 ㎜ thickness, exhibited the extinguishment of flame in a short time and showed little or no drip. According to results of a cone calorimeter test, it was found that the example 1 had a small peak of heat release rate and exhibited stable conditions of char as shown in FIG. 1.

[49] On the contrary, the comparative example 1 did not use an antimony-based flame retardant and a nano-clay. The comparative example 1 used the same amount of a flame retardant as the example 1, but exhibited lower tensile strength than the example 1. The comparative example 1 is good at elongation, but is poor at flame retardance, that is, drip occurred and it was almost burned. The comparative example 2 did not use a nano-clay, and used the same amount of a flame retardant as the comparative example 1. The comparative example 2 exhibited higher tensile strength and elongation than the comparative example 1, but was poor at flame retardance, that is, it was almost burned.

[50] And, the comparative example 3 did not use an antimony-based flame retardant and a nano-clay, and used the same amount of a flame retardant as the comparative example 2. The comparative example 3 exhibited slightly higher tensile strength and slightly lower elongation than the comparative example 2, and was very poor at flame retardance, that is, drip occurred and it was completely burned. The comparative example 4 did not use a nano-clay, and used the same amount of a flame retardant as the comparative example 2. The comparative example 4 exhibited slightly higher tensile strength and similar elongation to the comparative example 2, and was very poor at flame retardance, that is, drip occurred severely and it was completely burned. But, the time to ignition was shorter than that of the comparative example 3.

[51] As such, the preferred embodiments of the present invention are described in detail with reference to the accompanying drawings. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

Industrial Applicability

[52] The present invention can easily ensure mechanical characteristics and remarkably improve thermal characteristics, in particular flame retardance through an adequate combination of a small amount of a clay, an inorganic flame retardant and an antimony-based compound.

Claims

[1] A flame retardant polymer composition, comprising:
based on 100 parts by weight of a basic resin including 50 to 99 weight% of a polyolefin-based resin and 1 to 50 weight% of a reactive polyolefin-based resin having a polar group,
50 to 200 parts by weight of an inorganic flame retardant, as a first flame retardant, including at least one selected from the group consisting of aluminium hydroxide; magnesium hydroxide; aluminium hydroxide surface-treated with a polymer selected from the group consisting of vinylsilane, a fatty acid and amino polysiloxane; and magnesium hydroxide surface-treated with a polymer selected from the group consisting of vinylsilane, a fatty acid and amino polysiloxane;
20 to 120 parts by weight of an antimony-based compound, as a second flame retardant, including at least one selected from the group consisting of antimony trioxide, antimony pentoxide, and sodium antimonate; and
1 to 15 parts by weight of a nano-clay, as a flame retardant aid, obtained by organizing and exfoliating at least one selected from the group consisting of montmorillonite, hectorite, saponite and beidellite.

[2] The flame retardant polymer composition according to claim 1,
wherein the polyolefin-based resin is at least one selected from the group consisting of high-density, intermediate-density, low-density or linear low-density polyethylene, polypropylene, ethylene-1-octene copolymer, ethylene-1-butene copolymer, alphaolefin block or random copolymer having 3 to 15 carbon atoms, ethylene vinyl acetate copolymer, ethylene ethylacrylate polymer and ethylene methylacrylate polymer.

[3] The flame retardant polymer composition according to claim 1,
wherein the reactive polyolefin-based resin having a polar group is at least one selected from the group consisting of polyethylene, ethylene vinyl acetate copolymer and ethylene ethylacrylate copolymer, grafted with maleic anhydride or glycidylmetacrylate.

[4] The flame retardant polymer composition according to any one of claims 1 to 3, further comprising:
at least one additive selected from the group consisting of an antioxidant, a lubricant and a crosslinking agent.

[5] The flame retardant polymer composition according to claim 4,

wherein each selected additive is included with 0.5 to 10 parts by weight based on 100 parts by weight of the basic resin.

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[Fig. 1]

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2008/003700

A. CLASSIFICATION OF SUBJECT MATTER

C08L 23/00(2006.01)i

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 8 : C08L 23/00

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 practicable, search terms used)

eKIPASS; PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
15 OCTOBER 2008 (15.10.2008)	**15 OCTOBER 2008 (15.10.2008)**

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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