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(54) Title: ANTI-ABRASIVE AND ANTI-FRICTION POLYAMIDE COMPOSITION

(57) Abstract: Provided is an anti-abrasive and anti-friction polyamide composition containing a polyamide resin containing polyamide 6.6 and polyamide 6, a carbon nanotube, and a lubricant. The polyamide composition may prevent properties such as toughness, elongation, and the like from being deteriorated, while having excellent abrasion resistance, friction resistance, and surface hardness.

Description

Title of Invention: ANTI-ABRASIVE AND ANTI-FRICTION POLYAMIDE COMPOSITION

Technical Field

[1] The present invention relates to a polyamide resin composition capable of having improved properties such as surface Shore hardness, toughness, elongation, and the like, and being easily applied to a component requiring excellent abrasion resistance and friction resistance.

[2]

Background Art

[3] According to the related art, as a resin applied to a component requiring abrasion resistance and friction resistance, engineering plastic having advantages of ease of injection work and excellent mechanical properties, for example, nylon 6.6, or the like, has been generally used. However, since properties such as abrasion resistance, friction resistance, and the like, of the engineering plastic are still poor due to a low surface Shore hardness, it is impossible to use the engineering plastic in the component requiring abrasion resistance and friction resistance for a long period of time.

[4] Further, super engineering plastics such as nylon 4.6, or the like, have properties such as a high surface Shore hardness, excellent abrasion resistance and friction resistance, and the like, but are significantly sensitive to moisture absorption, such that an exterior of a product to be injected may be poor, and injection work is not easy due to a high process temperature of 300°C or more. Therefore, it is difficult to actually use the super engineering plastics.

[5] Therefore, in order to solve the above-mentioned problems, methods of adding an additive such as a silicone resin, MoS_2, and the like, have been suggested, but in resins prepared as described above, there are problems in that toughness, which is a unique characteristic of a polyamide resin, may be deteriorated, mechanical strength may be decreased, nevertheless, a usable range is restrictive due to a still low surface hardness.

[6]

Disclosure of Invention

Technical Problem

[7] An object of the present invention is to provide a polyamide composition having properties such as excellent abrasion resistance and friction resistance, and the like, by improving a surface Shore hardness, in order to overcome the above-mentioned problems of a polyamide 4.6, or polyamide 6.6, which has been used according to the related art.

[8] Further, another object of the present invention is to provide a polyamide composition capable of preventing properties such as toughness, elongation, and the like, from being deteriorated even with the improvement of properties such as abrasion resistance, friction resistance, and the like.

[9]

Solution to Problem

[10] In one general aspect, an anti-abrasive and anti-friction polyamide composition contains a polyamide resin containing polyamide 6.6 and polyamide 6, a carbon nanotube, and a lubricant.

[11] The polyamide composition may contain 0.05 to 10 parts by weight of the carbon nanotube and 0.01 to 3 parts by weight of the lubricant, based on 100 parts by weight of the polyamide resin.

[12] The polyamide resin may contain 50 to 90 wt% of polyamide 6.6, and 10 to 50 wt% of polyamide 6.

[13] The polyamide composition may further contain polytetrafluoroethylene at a content of 0.1 to 5 parts by weight, based on 100 parts by weight of the polyamide resin.

[14] The lubricant may include any one or two or more stearic acid based compounds selected among stearic acid, stearic acid metal salt based compounds, stearic acid amide based compounds, stearic acid olefin based compounds, stearic acid silicon based compounds, and the like.

[15] The anti-abrasive and anti-friction polyamide composition may be used in molding products requiring abrasion resistance and friction resistance such as various engineering components, and the like.

[16]

Advantageous Effects of Invention

[17] A polyamide composition according to the present invention may have properties such as excellent abrasion resistance and friction resistance, and the like, by improving a surface Shore hardness.

[18] A polyamide composition according to the present invention may have an excellent effect capable of preventing properties such as toughness, elongation, and the like, from being deteriorated even with the improvement of properties such as abrasion resistance, friction resistance, and the like.

[19]

Best Mode for Carrying out the Invention

[20] Hereinafter, an anti-abrasive and anti-friction polyamide resin composition according to the present invention will be described in detail with reference to accompanying drawings.

[21] Here, technical terms and scientific terms used in the present specification have the meaning generally understood by those skilled in the art to which the present invention pertains unless otherwise defined, and a description for the known function and configuration obscuring the present invention will be omitted in the following description.

[22] In addition, unless particularly described, "%" as used herein refers to "wt%".

[23]

[24] The present applicant confirmed that an effect capable of preventing properties such as toughness, elongation, and the like from being deteriorated while having excellent abrasion resistance and friction resistance due to improvement of a surface Shore hardness may be remarkably exhibited by preparing a polyamide composition using a polyamide resin containing polyamide 6.6 and polyamide 6, a carbon nanotube, and a lubricant, thereby completing the present invention.

[25] Further, in various aspects of the present invention, although a local carbonization phenomenon may be prevented, changes in physical properties may be prevented by adding a specific lubricant to be described below. For example, there is a remarkable effect that a surface roughness due to formation of carbonization particles on an exterior does not occur. In detail, the present invention may prevent a problem that the carbonization particle remains in or is attached to an outer surface or an interior of a molding product by local carbonization during a process. In addition, the present invention may also have a specific effect of preventing formation of surface roughness.

[26] Further, according to the present invention, even in a case of using another ingredient except for a specific lubricant to be described below, the desired effect of the present invention may be exhibited, but in a case of using the specific lubricant, the effect of preventing the carbonization phenomenon as described above may be more effectively exhibited.

[27]

[28] According to an exemplary embodiment of the present invention, a polyamide composition having excellent abrasion resistance and friction resistance contains a polyamide resin including polyamide 6.6 and polyamide 6, carbon nanotube, and a lubricant.

[29] According to the exemplary embodiment of the present invention, the polyamide composition may contain 0.05 to 10 parts by weight of the carbon nanotube and 0.01 to 3 parts by weight of the lubricant, based on 100 parts by weight of the polyamide resin. In this case, properties such as abrasion resistance, friction resistance, and the like, may be remarkably improved without deterioration of properties such as toughness, elongation, and the like.

[30] According to the preferable exemplary embodiment of the present invention, the polyamide resin may contain 50 to 90 wt% of polyamide 6.6, and 10 to 50 wt% of

polyamide 6. In this case, workability may be improved at the time of performing an injection process, properties such as toughness, elongation, and the like, may be improved, and heat resistance is hardly deteriorated, as compared to a case in which only polyamide 6.6 is used as the polyamide resin.

[31] Polyamide 6.6 and polyamide 6 are previously known materials, and Polyamide 6.6 and polyamide 6 known in the art may be also used. As a preferable example, in view of further improving properties such as abrasion resistance, friction resistance, and the like, and properties such as toughness, elongation, and the like, it is preferable to use a polyamide 6.6 having a relative viscosity of 2.1 to 3.1 or a molecular weight of 10,000 to 30,000 g/mol, and a polyamide 6 having a relative viscosity of 2.7 to 3.3 or a molecular weight of 14,000 to 25,000 g/mol. However, as only a preferable example, the relative viscosity or the molecular weight within a specific range is disclosed, but the present invention is not limited thereto.

[32] The carbon nanotube is a previously known material, and carbon nanotubes known in the art may also be used. As a preferable example, a carbon nanotube may be a nano-sized carbon nanotube having an average diameter of 0.5 to 5.0 nm, and an average length of 0.5 to 50 μm. In this case, hardness may be further improved, and dispersibility may be excellent at the time of the process, such that a more homogenous composition may be prepared.

[33] As the lubricant, various kinds of lubricants may be used. Examples of the lubricant may include any one or two or more stearic acid based compounds selected among stearic acid, stearic acid metal salt based compounds, stearic acid amide based compounds, stearic acid olefin based compounds, stearic acid silicon based compounds, and the like. Preferably, in a case of using ethylene bis stearylamide, which is a stearic acid amide based compound, a specific effect that a surface roughness due to formation of the carbonization particle on the exterior of the molding product in the process does not occur may be exhibited without a change in physical properties. Further, the lubricant may be mixed with ingredients according to the present invention, such that properties such as toughness, elongation, and the like, may be remarkably improved in addition to improvement of hardness.

[34] According to an exemplary embodiment of the present invention, the polyamide composition may further contain polytetrafluoroethylene. In a case in which the polyamide composition further contains polytetrafluoroethylene, flexural modulus may be further improved without deterioration of properties such as toughness, elongation, and the like, and surface hardness may be remarkably improved, such that properties such as abrasion resistance and friction resistance may be improved. Preferably, the polyamide composition contains 0.1 to 5 parts by weight of polytetrafluoroethylene, based on 100 parts by weight of the polyamide resin, which is more effective in view

of improving the above-mentioned properties.

[35] The polyamide composition according to the present invention may be used in various components as an engineering plastic, and preferably, the polyamide composition may be used in various engineering components requiring abrasion resistance and friction resistance such as a timing chain guide, and the like.

[36]

[37] Hereinafter, the present invention will be described in detail through the Examples, but they are provided only for describing the present invention in more detail, and the scope of the present invention is not limited thereby.

[38]

[39] [Example 1]

[40] A polyamide resin composed of 70 wt% of polyamide 6.6 (Rhodia Stabamid 27AE1) having a relative viscosity of 2.7 and 30 wt% of polyamide 6 (Hyosung, 1021BRT) having a relative viscosity of 3.0, and 2 parts by weight of carbon nanotube (KNANOS 100T, Kumho Petrochemical) having an average diameter of 35 μm and 0.2 parts by weight of ethylene bis stearylamide (HI-LUBE, Sinwon Chemical), based on 100 parts by weight of the polyamide resin were injected into a twin-screw extruder (Diameter 31.6 mm, L/D 36), and mixed with each other to thereby be pelletized. The obtained mixture was molded at 275 °C using an injection molding machine, and injection members (a test piece for measuring mechanical physical properties, satisfying the international organization for standardization (ISO) measurement standards, a test piece for evaluating friction abrasion properties, having an outer diameter of 25.6 mm, an inner diameter of 20.0 mm, and a height of 15 mm, and a plate for evaluating friction abrasion resistance, having a thickness of 3 mm) were obtained.

[41] Friction abrasion properties of the injection members were evaluated, and the results were illustrated in the following Table 1. In detail, force of 500 N was applied to the injection member using a multi-purpose wear tester (MPW 110, Neoplus), and an abrasion test was performed at a speed of 50 mm/s for 120 minutes. In this case, as a ring used to evaluate abrasion resistance, KEPITAL TS-25A (Korea Engineering Plastics) was used, and after dust (application amount: 0.3 g) was applied thereto, kinetic friction coefficient, surface roughness of the plate, and a noise maintenance time were measured. Further, in order to evaluate friction abrasion properties against a metal, a test was performed using a stainless steel (S45C) ring at a speed of 200 mm/s and a load of 170N for 4 hours, and a change in weight was measured.

[42] [Example 2]

[43] A test was performed in the same manner as in Example 1 except for using a polyamide resin composed of 60 wt% of polyamide 6.6 and 40 wt% of polyamide 6 instead of the polyamide resin composed of 70 wt% of polyamide 6.6 and 30 wt% of

polyamide 6 in Example 1.

[44] [Example 3]

[45] A test was performed in the same manner as in Example 1 except that 2 parts by weight of polytetrafluoroethylene (Solvay Polymist XPP 511) having a particle size of D50= 20 μm was further mixed to thereby be palletized, based on 100 parts by weight of the polyamide resin in Example 1.

[46] [Comparative Example 1]

[47] A test piece for evaluating friction abrasion properties according to Example 1 was manufactured only using polyamide 6.6 in Example 1, and friction abrasion properties were evaluated in the same manner as in Example 1.

[48] [Comparative Example 2]

[49] A test was performed in the same manner as in Example 1 except for using a polyamide resin containing 100 wt% of polyamide 6.6 instead of the polyamide resin composed of 70 wt% of polyamide 6.6 and 30 wt% of polyamide 6 in Example 1.

[50] [Comparative Example 3]

[51] A test was performed in the same manner as in Comparative Example 2 except that carbon nanotube and ethylene bis stearylamide were not used in Comparative Example 2, but 85 wt% of the polyamide resin and 15 wt% of polytetrafluoroethylene were used.

[52] [Comparative Example 4]

[53] A test piece for evaluating friction abrasion properties according to Example 1 was manufactured only using polyamide 4.6, and friction abrasion properties were evaluated in the same manner as in Example 1.

[54]

[55] [Table 1]

Category		Test Method	Unit	Example			Comparative Example			
				1	2	3	1	2	3	4
Specific Gravity		ISO183	-	1.15	1.15	1.15	1.14	1.15	1.20	1.18
Tensile strength		ISO527	MPa	83	81	87	80	89	75	95
Fracture Elongation		ISO527	%	30	33	35	28	4	13	18
Flexural Modulus		ISO178	MPa	3,250	3,200	3,200	2,900	3,350	2,950	3,100
Shore Hardness		ISO868	D Type	84	84	85	80	82	80	82
Dust Friction Abrasion	Kinetic Friction Co-efficient		-	0.22	-	0.20	0.24	-	-	0.22
	Surface Roughness of Plate		Rmax	1.0	-	0.9	1.2	-	-	1.0
	Noise Maintenance Time		sec	7	-	6	251	-	-	32
Abrasion against Metal	RingAbrasion Weight		mg	7.1	-	6.9	19.2	-	-	19.9
	Abrasion Dust Ob-servation		Observed by naked eyes	Not exist	-	Not exist	severe	-	-	severe

[56]

[57] As illustrated in Table 1, it may be confirmed that the polyamide compositions according to Examples 1 to 3 had relatively excellent tensile strength and elongation, and surface hardness and surface friction properties thereof were remarkably improved.

Claims

[Claim 1] An anti-abrasive and anti-friction polyamide composition comprising a polyamide resin containing polyamide 6.6 and polyamide 6, a carbon nanotube, and a lubricant.

[Claim 2] The anti-abrasive and anti-friction polyamide composition of claim 1, wherein it contains 0.05 to 10 parts by weight of the carbon nanotube and 0.01 to 3 parts by weight of the lubricant, based on 100 parts by weight of the polyamide resin.

[Claim 3] The anti-abrasive and anti-friction polyamide composition of claim 2, wherein the polyamide resin contains 50 to 90 wt% of polyamide 6.6 and 10 to 50 wt% of polyamide 6.

[Claim 4] The anti-abrasive and anti-friction polyamide composition of claim 1, further comprising polytetrafluoroethylene.

[Claim 5] The anti-abrasive and anti-friction polyamide composition of claim 4, wherein it contains 0.1 to 5 parts by weight of polytetrafluoroethylene, based on 100 parts by weight of the polyamide resin.

[Claim 6] The anti-abrasive and anti-friction polyamide composition of claim 1, wherein the lubricant includes any one or two or more stearic acid based compounds selected among stearic acid, stearic acid metal salt based compounds, stearic acid amide based compounds, stearic acid olefin based compounds, and stearic acid silicon based compounds.

[Claim 7] An anti-abrasive and anti-friction molding product prepared using the anti-abrasive and anti-friction polyamide composition of any one of claims 1 to 6.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2016/005737

A. CLASSIFICATION OF SUBJECT MATTER

C08L 77/02(2006.01)i, C08L 27/18(2006.01)i, C08K 3/04(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)
C08L 77/02; C08L 77/06; D01D 10/06; C08L 101/00; C08L 77/00; C08L 81/02; C08K 7/14; B32B 27/34; B32B 5/28; C08L 27/18; C08K 3/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: anti-abrasive, anti-friction, polyamide 6.6, polyamide 6, carbon nanotube, lubricant, molding product

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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"A" document defining the general state of the art which is not considered to be of particular relevance
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Information on patent family members

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