



(51) International Patent Classification:

C08L 77/06 (2006.01)

(21) International Application Number:

PCT/EP2017/066801

(22) International Filing Date:

05 July 2017 (05.07.2017)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

201610567160.3	19 July 2016 (19.07.2016)	CN
16180682.3	22 July 2016 (22.07.2016)	EP

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(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: HIGH MECHANICAL RESISTANCE PLASTIC MATERIALS

(57) Abstract: The present invention relates to a non-fibrous polyamide composition for the manufacture of high strength plastic articles, wherein composition consists of: at least 50 wt. % of a first polyamide having a C/N ratio (C/N)₁, 1-49.5 wt. % of a second polyamide having a C/N ratio (C/N)₂, 0.1-20 wt. % of a semi-aromatic polyamide and 0.1-30 wt. % of at least one additive. Further, the present invention relates to a method for preparing the non-fibrous polyamide composition and to a molding composition comprising the non-fibrous polyamide composition.



HIGH MECHANICAL RESISTANCE PLASTIC MATERIALS

The present invention relates to a non-fibrous polyamide composition for the manufacture of high strength plastic articles. Further, the present invention
5 relates to a moulding composition comprising said non-fibrous polyamide composition and to a method for preparing the non-fibrous polyamide composition.

Polyamides are widely used in a wide range of applications, such as in applications requiring good heat management properties, constructive elements in electrical and electronic assemblies, lamps, engines and other products comprising a
10 heat source. However, heat can also destroy material properties. Prolonged heat degrades polymers. Thermal expansion and contraction leads to warping, distortion, and even part failure. Reducing the temperature swing reduces these problems. Reducing the temperature of the part helps to improve longevity and also cooler materials retain material properties better. Further, it is common to include additives
15 suitable for heat ageing into polyamide compositions in order to obtain a suitable heat resistance, but often electrical resistance also has to be considered. Other polyamide compositions include other thermoplastics into the polyamide composition running the risk of miscibility or compatibility during preparation and/or molding, resulting in manufactured parts which are less performant with respect to wear and friction as well
20 as mechanical properties, such as elongation at break, modulus, and strength.

The aim of the present invention is to provide a plastic material which shows an improved, stable and high elongation at break and does not have the drawbacks of other plastic materials. This aim, among other aims, is achieved by the non-fibrous polyamide composition according to the present invention. The non-fibrous
25 polyamide composition according to the present invention consists of:

- a) at least 50 wt. %, preferably 50-70 wt. %, more preferably 50-60 wt. % of a first aliphatic polyamide having a melting temperature T_{m-1} of at least 240°C;
- b) 1-49.5 wt. %, preferably 5-49.5 wt.%, more preferably 20-49.5 wt. %, even more preferably 20-40 wt.%, most preferably 30-40 wt.% of a second aliphatic
30 polyamide having a melting temperature T_{m-2} of at least 20°C below the melting temperature of the first aliphatic polyamide T_{m-1} ;
- c) 0.1-40 wt. %, preferably 0.1-20 wt. %, more preferably 0.1-10 wt.%, most preferably 0.5-5 wt.% of a third polyamide wherein the third polyamide is a

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semi-crystalline semi-aromatic polyamide or amorphous semi-aromatic polyamide;

d) 0.1-30 wt. % of at least one additive,
wherein component d) comprises 0.1- 5 wt. % of a carbon-based component selected
5 from the group consisting of exfoliated carbon, nanoclay, expanded graphite, carbon
nanotubes, carbon black ,
and wherein the above wt. % are relative to the total weight of the non-fibrous
polyamide composition. In the context of the present invention, all ranges (e.g. 1-49.5)
are to be understood from... to ... and are understood to include minimum and
10 maximum values. In the context of the present invention, the term "non-fibrous
polyamide composition" designates that the polyamide composition does not comprise
a fibrous agent, such as for example glass fibers. A fibrous agent is herein understood
to be a material consisting of particles with a number average aspect ratio of at least
20. A non-fibrous agent is herein understood to be a material consisting of particles
15 with a number average value of the aspect ratio of less than 20. The number average
value of the aspect ratio of a material can be determined via ashing of the composition
followed by optical microscopy on the filler residue and measure length and diameter of
a sufficiently large number of fibers to determine aspect ratio distribution from which a
number average value of the aspect ratio is determined.

20 Good results have been obtained when the melting temperature T_{m-1}
of the first aliphatic polyamide is at least 240°C, particularly at least 260°C, more
particularly at least 280°C, most particularly at least 290°C or at least 300°C.
Good results have been obtained when the melting temperature T_{m-2} of the second
aliphatic polyamide is at least 20°C, particularly at least 30°C, more particularly at least
25 40°C, most particularly at least 50°C or at least 60°C below the melting temperature of
the first aliphatic polyamide T_{m-1} .

In one embodiment of the present invention, the melting temperature
 T_{m-3} or glass transition temperature of the third polyamide (the semi-crystalline semi-
aromatic polyamide or amorphous semi-aromatic polyamide) is at least 200°C.
30 Preferably, the third polyamide is a semi-crystalline polyamide having a melting
temperature (T_{m-3}) or an amorphous polyamide having a glass transition temperature
(T_{g-3}), wherein the said temperature, being either the T_{m-3} of the semi-crystalline
polyamide or the T_{g-3} of the amorphous polyamide is preferably at least 220°C, 250
°C, 270°C, 280°C, or even at least 290°C.

In another embodiment, the third polyamide is an amorphous polyamide having a glass transition temperature (T_g -3) of at least 80°C, such as at least 100°C, at least 120°C, in the range from 80°C to 160°C, more preferably from 120°C to 150°C.

5 With the term melting temperature is herein understood the melting temperature measured by DSC according to standard ISO 11357-3 (2009) with a heating rate of 10°C/minute and determined as the temperature with the highest melting enthalpy. With the term glass transition temperature is herein understood the temperature measured by DSC according to standard ISO 11357-3 (2009) with a
10 heating rate of 20°C/minute and determined as the temperature at the peak of the first derivative (with respect of time) of the parent thermal curve corresponding with the inflection point of the parent thermal curve.

The polyamides in a) and b) are also characterized in that they have a C/N ratio. The C/N ratio is herein understood to be ratio between the number of
15 carbon atoms (C) in the polyamide and the number of nitrogen atoms (N) in the polyamide. The first aliphatic polyamide has a C/N ratio designated as (C/N)₁ which is at least 5. The C/N ratios of both polyamides in a) and b) may be identical or different and in any cases, the first and second polyamide in a) and b) are different polyamides. In the context of the present invention, (C/N)₁ is at least 5 and the absolute difference
20 of the two C/N ratios ((C/N)₁ and (C/N)₂) may be at least 0.5 (such as 0.5 or more, 1 or more, 1.5 or more, 2 or more, 2.5 or more, 3 or more). Thus (C/N)₂ is also at least 5. The term "absolute difference of the two C/N ratios is at least 0.5" is to be understood as (C/N)₁-(C/N)₂=1 or (C/N)₂-(C/N)₁=1. Advantageously, (C/N)₂ is at least 6 and thus (C/N)₂-(C/N)₁=1. The term at least 5 is to be understood as 5 or more, 5.5 or more, 6
25 or more, 6.5 or more, 7 or more, 7.5 or more, 8 or more, 8.5 or more, 9 or more, 9.5 or more.

According to the present invention, excellent results have been obtained when the composition comprises carbon black in d) or mixed together with component a) or b). In particular, when carbon black is present in an amount in the
30 range from 0.1 to 10 wt.%, preferably from 0.1 to 5wt.%, more preferably from 0.1 to 2 wt.% of carbon black relative to the total weight of the non-fibrous polyamide composition.

The non-fibrous polyamide composition according to the present invention provides the advantage that it can be molded into highly rigid parts responding to demanding applications.

The term "component" designates any one of the features of the non-fibrous polyamide composition.

According to the present invention, excellent mechanical results have been obtained when the combination of three polyamides a), b), c) are present: elongation at break and tensile tests are showing significant improvements compared to compositions not comprising all three components a), b) and c) in the amounts indicated in the present invention.

According to one embodiment of the present invention, the first polyamide having a C/N ratio of at least 5, such as a C/N ratio of 5, 6, or 7, or 8, or 9, or 10. In an advantageous embodiment of the present invention, the first polyamide is polyamide-46 (PA46) or polyamide-66 (PA66).

In an embodiment of the present invention, the second polyamide is a polyamide having a C/N ratio of at least 6. The second polyamide can be selected from polyamide-6 (PA6), polyamide-66 (PA66) (provided the first polyamide is not PA66), polyamide-6/66 (PA6/66), polyamide-410 (PA410), polyamide-610 (PA610), polyamide-1010 (PA1010), and copolymers thereof. When polyamide-6, polyamide-66, polyamide-6/66, polyamide-410, polyamide-610, polyamide-1010 and copolymers thereof are present in the composition, the composition presents particularly good properties.

The non-fibrous polyamide composition according to the present invention can comprise at least one additive (component d)). Component d) at least comprises a carbon-based component as defined above. Further, component d) can comprise other additives, such as non-fibrous agents, thermally conductive fillers, other fillers not considered thermally conductive such as non-conductive reinforcing fillers, pigments, dispersing aids, processing aids for example lubricants and mould release agents, impact modifiers, plasticizers, crystallization accelerating agents, nucleating agents, flame retardants, UV stabilizers, antioxidants, and heat stabilizers. Non-fibrous agents are for example mineral agents, which may for example have a plate or needle shape structure. Non-fibrous agents include for example wollastonite, calcium carbonate, calcium sulfate, mica, calcined clay and talcum.

The other (second) additives in c) can also be at least one heat stabilizer. The heat stabilizer can be present in the composition in an amount ranging preferably in an amount from 0.1 to 5 wt. % or even as low as from 0.1 to 2 wt.% relative to the total weight of the non-fibrous polyamide composition. Preferably, the non-fibrous polyamide composition comprises a heat stabilizer, such as phenolic antioxidants and aromatic amines, and copper, either in the form of a copper salt in combination with potassium iodide or potassium bromide, or in the form of elementary copper, iron either in the form of an iron salt or an iron oxide, or in the form of elementary iron and mixture thereof. In the context of the present invention, the term “a heat stabilizer” is to be understood as one or more components selected from the group consisting of phenolic thermostabilizers, organic phosphites, aromatic amines and metal salts of elements from Group IB, IIB, III and IV of the Periodic Table, a metal oxide of Group VB, VIB, VIIB and VIIIB of the Periodic Table, or a mixture thereof, or a salt of a transition metal element of Group VB, VIB, VIIB and VIIIB of the Periodic Table, or a mixture thereof. These metals are further herein also denoted as “Group VB-VIIIB transition metals”. These metals include the following metals: Group VB: vanadium (V), niobium (Nb), tantalum (Ta); Group VIB: chromium (Cr), molybdenum (Mo), and tungsten (W), Group VIIB: manganese (Mn), technetium (Tc) and rhenium (Re); and Group VIIIB: iron (Fe), ruthenium (Ru), osmium (Os), cobalt (Co), rhodium (Rh), iridium (Ir), nickel (Ni), palladium (Pd), and platinum (Pt).

The metal oxide as mentioned above, includes salts of the same metal oxide(s) and is thereafter referred to as metal oxide. Thus, unless indicated otherwise, the term metal oxide is to be interpreted as to include salts thereof as well.

Suitable salts of the metal oxide are, for example, metal phosphates and metal hypophosphates, chlorides and acetates, oxalates.

Preferably, the metal oxide is an oxide, or salt thereof, of a metal chosen from the group consisting of V, Cr, Mo, W, Mn, Fe, Co, and Rh, or a mixture thereof, more preferably V, Mo, Fe and Co, and still more preferably Fe. Moulding compositions comprising metal oxides of these metals, or salts thereof, have even better thermal stability.

Suitable iron oxides include FeO, Fe₂O₃, or Fe₃O₄ or a mixture thereof. Suitable iron oxide salts include ferrites, such as Zn-ferrite and Mg-ferrite, and iron phosphorus oxides, i.e. salts of iron oxides with phosphor based acids, like iron phosphate and iron hypophosphate.

Preferably, the Group VB-VIIIB transition metal oxide comprises an iron oxide, a ferrite or an iron phosphorus oxide, or a mixture thereof, more preferably, FeO, Fe₂O₃, Fe₃O₄ or an iron phosphorus oxide, or a mixture thereof. The advantage of the inventive composition, wherein the Group VB-VIIIB transition metal oxide
5 comprises FeO, Fe₂O₃, Fe₃O₄, or an iron phosphorus oxide, or a mixture thereof, is that the heat ageing properties thereof are further improved. Still more preferably, Group VB-VIIIB transition metal oxide is FeO, Fe₂O₃, or Fe₃O₄, or a mixture thereof. These oxides gives even better heat ageing properties.

Typically the metal oxide in the composition according to the
10 invention has a particulate form, preferably with a small particle size. Preferably, the metal oxide (c) comprises particles with a particle size of less than 1 mm, preferably less than 0.1 mm. Still more preferably, the metal oxide has a median particle size (D₅₀) of at most 0.1 mm, more preferably at most 0.01 mm and still more preferably at most 0.001 mm. The advantage of a smaller particle size and in particular a smaller
15 median article size for the metal oxide is that the heat ageing properties of the inventive composition is further improved or that the metal oxide can be used in a smaller amount for obtaining the same properties. The median particle size D₅₀ is determined with sieve methods, according to ASTM standard D1921-89, method A.

A suitable phenolic thermostabilizer is, for example Irganox 1098, available from Ciba
20 Specialty Chemicals. A suitable organic phosphate is, for example Irgafos 168 available from Ciba Specialty Chemicals. Examples of suitable metal salts are, for example, zinc chloride and zinc dithiocarbamates (like hostanox VPZnCS1), (zinc (Zn) is a Group IIB metal); tin chloride (tin (Sn) is a Group IV metal) and copper salts (copper (Cu) is a Group IB metal). Suitable copper salts are copper (I) and copper (II)
25 salts, for example, copper phosphates, copper halides, and copper acetates. Suitable alkali metal halides are chlorides, bromides and iodides of lithium, sodium and potassium. Suitable alkali metal halides are chlorides, bromides and iodides of calcium. Preferably, the thermostabilizer comprises a copper salt, more preferably a copper (I) salt, still more preferably a copper halide. Suitable halides include chloride, bromide
30 and iodide. Also preferably, the thermostabilizer comprises a combination of metal salts of elements from Group IB, IIB, III and IV of the Periodic Table and metal halides of alkali and alkali earth metals, more preferably a combination of a copper salt and an alkali halide, still more preferably a copper (I) halide / alkali halide combination. Suitable alkali ions include sodium and potassium. A suitable copper (I) halide / alkali halide

combination is, for example, CuI/KI. Excellent results have been obtained when a heat stabilizer is present in a) in an amount ranging from 0.1 to 2 wt. % relative to the total weight of the non-fibrous polyamide composition and the heat stabilizer is selected from the group consisting of a copper salt, an iron salt, an elementary iron, elementary copper, a copper oxide, an iron oxide, alkali salts and a combination thereof. The heat
5 stabilizer can also advantageously be together with component a) or b).

According to an embodiment of the present invention, the non-fibrous polyamide composition consists of:

- 10 a. at least 50 wt. % of a first aliphatic polyamide as defined above and having a C/N ratio (C/N)₁ of at least 5;
- b. 1-49.5 wt. %, preferably 20-49.5 wt. %, more preferably 20-40 wt.%, most preferably 30-45 wt.% of a second aliphatic polyamide as defined above and comprising:
 - 15 i. 75-99.8 wt.% of a polyamide selected from the group consisting of PA6, PA66, PA6/66, PA410, PA610, PA1010;
 - ii. 0.1-10 wt. % of a carbon-based component
 - iii. 0.1-15 wt. % of a heat stabilizer
- 20 c. 0.1-20 wt. %, preferably 0.5-5 wt.% of a third polyamide wherein the third polyamide is a semi-crystalline semi-aromatic or amorphous semi-aromatic polyamide;
- d. 0-30 wt. % of at least one (further) additive according to the above definition;

wherein (C/N)₁ is at least 5 and the absolute difference of (C/N)₁ and (C/N)₂ ratios is
25 at least 1 and wherein the above wt. % are relative to the total weight of the non-fibrous polyamide composition. The advantage of b. comprising the components i., ii. and iii. is that an homogenous component b. can be obtained when preparing the non-fibrous polyamide composition according to the above embodiment.

According to the present invention, very good results are obtained
30 when component b) is present in an amount from 30 to 45 wt. %, preferably from 33 wt. % to 40 wt. % relative to the total weight of the non-fibrous polyamide composition.

According to one embodiment of the present invention, the non-fibrous polyamide composition comprises 0.5-5 wt% of a semicrystalline or an amorphous semi-aromatic polyamide relative to the total weight of the non-fibrous polyamide composition.

5 According to one embodiment of the present invention, the non-fibrous polyamide composition comprises 0.5-4.5 wt% of a semicrystalline or an amorphous semi-aromatic polyamide relative to the total weight of the non-fibrous polyamide composition.

 According to another embodiment of the present invention, the non-
10 fibrous polyamide composition comprises comprising 0.5-2 wt% of an amorphous polyamide c) relative to the total weight of the non-fibrous polyamide composition.

 Component c) can be advantageously selected from the group consisting of PA6I/6T, PA6I/10T, terpolymers of PA6I/6T/X and PA6I/10T/X, wherein X is a further polyamide. Advantageously, c) can be selected from the group consisting
15 of PADT (2-methylpentamethylene terephthalamide), polyamide-4T (PA4T), polyamide-6T (PA6T), polyamide-9T (PA9T), polyamide-10T (PA10T) and copolymers thereof. In one embodiment, c) is PA6I/6T in a weight ratio of 70/30. In another embodiment, c) is PADT or a copolymer thereof, such as PADT/DI.

 According to another aspect, the present invention relates to a
20 method for the manufacturing of a non-fibrous polyamide composition as defined herein comprising:

- i. adding separately components a), b), c) and d) into a reactor
- ii. mixing the components thereby obtaining a blend of components a), b), c) and d).

25 The advantage of the above method according to the present invention is that all components can be mixed in one step during extrusion molding, the amount of process steps is minimal and the process duration is greatly improved.

 According to yet another aspect, the present invention relates to a
method for manufacturing of a non-fibrous polyamide composition as defined herein
30 comprising:

- i. adding components a), b) and d) into a reactor
- ii. mixing the components thereby obtaining a blend of components a), b) and d),

- iii. adding component c) to the blend of a), b) and d) and mixing component c) and the blend of a), b) and d).

The advantage of the above method according to the present invention is that it allows the process to manage transamidation of the different components: it lowers the melting temperature of the whole composition and thereby extends the processing temperature window of the whole processing.

According to still another aspect, the present invention relates to a method for the manufacturing of a non-fibrous polyamide composition as defined herein comprising:

- i. adding components b), c) and d) into a reactor
- ii. mixing the components thereby obtaining a blend of components b), c) and d),
- iii. adding component a) to the blend of b), c) and d) and mixing component a) and the blend of b), c) and d).

The advantage of the above method according to the present invention is that it allows a better dispersion of the carbon-based component which is thereby better dosed into the different polyamides: the elongation at break of the material can thus be tuned.

According to another aspect, the present invention relates to a method for the manufacturing of a non-fibrous polyamide composition as defined herein comprising:

- i. adding components a), c) and d) into a reactor
- ii. mixing the components thereby obtaining a blend of components a), c) and d),
- iii. adding component b) to the blend of a), c) and d) and mixing component b) and the blend of a), c) and d) .

The above method is particularly relevant when considering film manufacturing technology because it allows the fabrication of films wherein the various components are well dispersed.

In the context of the present invention, the term "reactor" is to be understood as "vessel where a process step is carried out".

According to another aspect, the present invention relates to a molding composition comprising at least 40 wt.% of the non-fibrous polyamide composition as defined herein and from 10 wt. % to 60 wt. % of glass fibers and/or

carbon fibers and/or 10 wt. % to 60 wt. % of another polymer wherein the wt. % are relative to the total weight of the molding composition. The other polymer is advantageously a thermoplastic polymer which can be selected from the group: polyesters; polyarylene sulfides such as polyphenylene sulfides; polyarylene oxides
5 such as polyphenylene oxides; polysulfones; polyarylates; polyimides; poly(ether ketone)s such as polyetheretherketones; polyetherimides; polycarbonates, copolymers of said polymers among each other and/or with other polymers, including thermoplastic elastomers such as copolyetherester block copolymers, copolyesterester block copolymers, and copolyetheramide block copolymers; and mixtures of said polymers
10 and copolymers.

The non-fibrous polyamide composition and the molding composition according to the present invention can be used in many applications, in particular film technology, automotive or any other application wherein wear and friction are critical, extrusion molding processes, for example in the manufacture of films, fibers,
15 composites, structural components, blow or injection molding processes. More particular, the non-fibrous polyamide composition and the molding composition can be used to make articles for use in machines and engines, which can be applied, for example, in automotive vehicles, such as personal cars, motor bikes, trucks and vans, general transport means, including trains, aviation and ships, domestic appliances,
20 such as lawn mowers and small engines, and general industry installations, such as in pumps, compressors, conveyor belts, or a molded part for use in electric and electronic installations, such as in domestic power tools and portable power equipment.

The article may be, for example, a bearing, a gear box, an engine cover, an air duct, an intake manifold, an intercooler end-cap, a castor, or a trolley part.

25 The invention also relates to the use of an article according to the invention in engines, machines, electric and electronic installations, and further to engines, machines and assembled articles comprising a molded part according to the invention.

The invention furthermore relates to products, including automotive
30 vehicles, general transport means, domestic appliances, and general industry installations, electric and electronic installations, comprising a molded part according to the invention.

The invention is further illustrated with the following Examples.

EXAMPLES

Materials

PA46

5 PA6

PA6I/6T (70/30)

PA DT

Carbon black

Heat stabilizer – CuI/KI

10 Processing aid – mold release agent

Glass fiber – having a number average value of the aspect ratio of 27 (number average fiber length of 27 μm and a diameter of 10 μm).

The compositions of Examples 1 to 6 (EX 1 to EX6) and Comparative Examples 1 and
15 2, 3 and 4 (CE1 and CE2 and CE3 and CE4) were prepared using a ZE25A-utx twin-screw extruder (ex KraussMaffei Berstorff). The cylinder temperature of the extruder was 330°C, rotation speed of the screws 300 RPM and the throughput 20 kg/hour. All component were added via a hopper at the throat. The compounded material was extruded in the form of strands, cooled in a water bath and cut into granules. The
20 resulting granulate was dried for 16 hours at 105°C under vacuum.

The dried granulate from the compositions as disclosed below were injection moulded to ISO 527-1A tensile bars on an injection moulding machine with 80mt clamping force (ex Engel). The temperature of the melt in the injection moulding machine was 310°C; the temperature of the mould was 120°C.

25 Test plates with dimensions of 80 x 80 x 2 mm were prepared from the compositions as disclosed below by injection moulding using an injection moulding machine equipped with a square mould with the proper dimensions and a film gate of 80 mm wide and 2 mm high positioned at one side of the square. Tensile modulus was determined at 23°C and 1 mm/min, tensile strength and elongation at break were determined at 23°C
30 and 50 mm/min according to ISO 527.

Table 1: Examples and Comparative Examples: composition in wt. % and tensile strength in MPa

Experiment number	PA46 [wt%]	PA6 [wt%]	PA6I/6T [wt%]	PAD T [wt%]	Glass fiber [wt%]	Carbon black [wt%]	Processing additive [wt%]	Heat stabilizer [wt%]	Tensile strength [MPa]
EX1	53.94	40.66	5	0	0	0.3	0.1	0	90.4
EX2	59.02	39.34	0.5	0	0	0.3	0.1	0.74	93.5
EX3	58.72	39.14	1	0	0	0.3	0.1	0.74	93.9
EX4	58.12	38.74	2	0	0	0.3	0.1	0.74	93.5
EX5	58.72	39.14	0	1	0	0.3	0.1	0.74	92.5
EX6	56.32	37.54	5	0	0	0.3	0.1	0.74	92.0
CE1	56.83	42.77	0	0	0	0.3	0.1	0	90.8
CE2	59.32	39.54	0	0	0	0.3	0.1	0.74	93.9
CE3	37.12	24.74	2	0	35	0.3	0.1	0.74	221.0
CE4	35.32	23.54	5	0	35	0.3	0.1	0.74	222.1

The Examples according to the present invention EX1 to EX6 show that when all three polyamide components and carbon black are present, the elongation at break (Eab) is increased and is more consistent over time. CE3 and CE4, which comprise glass fibers as fibrous agent, clearly show very low EAB values.

Table 2: Elongation at break data

	Eab (%)	Maximum Eab (%)	Amount samples with measured Eab<15% in 20 test bars
EX1	26.6	47.6	0
EX2	20.9	32.9	0
EX3	21.6	33.0	0
EX4	21.6	26.1	0
EX5	23.5	33.6	1
EX6	34.32	62.81	0
CE1	18.5	23.8	1
CE2	17.4	23.2	2
CE3	3.05	3.23	20
CE4	3.01	3.18	20

CLAIMS

1. Non-fibrous polyamide composition consisting of:
- 5 a) at least 50 wt. % of a first aliphatic polyamide having a melting temperature T_m-1 of at least 240°C;
- b) 1-49.5 wt. % of a second aliphatic polyamide having a melting temperature T_m-1 of at least 20°C below the melting temperature of the first aliphatic polyamide T_m-2 ;
- 10 c) 0.1-20 wt. % of a third polyamide wherein the third polyamide is a semi-crystalline semi-aromatic or amorphous semi-aromatic polyamide;
- d) 0.1-30 wt. % of at least one additive;
- wherein component d) comprises 0.1-5wt. % of a carbon-based component selected from the group consisting of exfoliated carbon, nanoclay, expanded graphite, carbon nanotubes, carbon black
- 15 and
- wherein the above wt. % are relative to the total weight of the non-fibrous polyamide composition.
2. Non-fibrous polyamide composition according to claim 1, wherein the first aliphatic polyamide is PA46, or PA66.
- 20 3. Non-fibrous polyamide composition according to claim 1, wherein component d) comprises 0.1-5wt. % of a heat stabilizer relative to the total weight of the non-fibrous polyamide composition.
4. Non-fibrous polyamide composition according to claim 1, wherein d) comprises a heat stabilizer in an amount from 0.1 to 2 wt. % relative to the total weight of the non-fibrous polyamide composition and the heat stabilizer is selected from the group consisting of a copper salt, an iron salt, an elementary iron, elementary copper, a copper oxide, an iron oxide, alkali salts and a combination thereof.
- 25 5. Non-fibrous polyamide composition according to claim 1, wherein component b) is present in an amount of 30-45 wt. % relative to the total weight of the non-fibrous polyamide composition.
- 30 6. Non-fibrous polyamide composition according to claim 1, comprising component c) 0.5-5 wt% of a semi-crystalline or an amorphous semi-aromatic polyamide relative to the total weight of the non-fibrous polyamide composition.

7. Non-fibrous polyamide composition according to claim 1, comprising component c) 0.5-4.5 wt% of a semi-crystalline or an amorphous semi-aromatic polyamide relative to the total weight of the non-fibrous polyamide composition.
- 5 8. Non-fibrous polyamide composition according to claim 1, wherein component c) is selected from PA6I/6T, PA6I/10T, PADT, PADT/DI, polyamide-4T (PA4T), polyamide-6T (PA6T), polyamide-9T (PA9T), polyamide-10T (PA10T) and copolymers thereof.
9. Non-fibrous polyamide composition according to claim 1, wherein component c) is PA6I/6T in a weight ratio of 70/30.
- 10 10. Method for the manufacturing of a non-fibrous polyamide composition as designated in any one of claim 1 to 9 comprising:
- i. adding separately components a), b), c) and d) into a reactor
 - ii. mixing the components thereby obtaining a blend of components a), b), c) and d).
- 15 11. Method for the manufacturing of a non-fibrous polyamide composition as designated in any one of claims 1 to 9 comprising:
- i. adding components a), b) and d) into a reactor
 - ii. mixing the components thereby obtaining a blend of components a), b) and d),
 - 20 iii. adding component c) to the blend of a), b) and d) and mixing component c) and the blend of a), b) and d).
12. Method for the manufacturing of a non-fibrous polyamide composition as designated in any one of claims 1 to 9 comprising:
- i. adding components b), c) and d) into a reactor
 - 25 ii. mixing the components thereby obtaining a blend of components b), c) and d),
 - iii. adding component a) to the blend of b), c) and d) and mixing component a) and the blend of b), c) and d).
- 30 13. Method for the manufacturing of a non-fibrous polyamide composition as designated in any one of claims 1 to 9 comprising:
- i. adding components a), c) and d) into a reactor
 - ii. mixing the components thereby obtaining a blend of components a), c) and d),

- 15 -

- iii. adding component b) to the blend of a), c) and d) and mixing component b) and the blend of a), c) and d) .

- 5 14. Molding composition comprising at least 40 wt.% of the non-fibrous polyamide composition designated in any one of claims 1 to 9 and from 10 wt. % to 60 wt. % of glass fibers and/or carbon fibers and/or 10 wt. % to 60 wt. % of another polymer, wherein the wt. % are relative to the total weight of the molding composition.

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/066801A. CLASSIFICATION OF SUBJECT MATTER
INV. C08L77/06
ADD.

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

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	WO 2013/188488 A1 (DU PONT [US]) 19 December 2013 (2013-12-19) page 73; example 66; table 20 page 42, line 4 - line 13 -----	1-4,6-14 5



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

18 September 2017

Date of mailing of the international search report

26/09/2017

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/066801

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WO 2013188488 A1	19-12-2013	CN 104364315 A	18-02-2015
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