polyamide composition demonstrates an impact resilience of greater than 17 kJ/m^2, as measured at 23°C. In some cases, the amide polymer has an amine end group level greater than 65 μeq/gram; the amide polymer comprises PA-6,6; the composition further comprises an additional polyamide; the lanthanoid-based compound comprises a cerium-based compound; the second heat stabilizer comprises a copper-based compound; and when heat aged for 3000 hours at a temperature of 210°C; the polyamide composition demonstrates a tensile strength greater than 82 MPa, as measured at 23°C; and when heat aged for 3000 hours at a temperature of 210°C; the polyamide composition demonstrates a tensile strength retention greater than 41%, as measured at 23°C; and when heat aged for 3000 hours at a temperature of 210°C; the polyamide composition demonstrates an impact resilience greater than 13 kJ/m^2, as measured at 23°C.

[0015a] In one aspect, the present disclosure refers to a heat-stabilized polyamide composition comprising:

from 25 wt% to 99 wt% of an aliphatic amide polymer having an amine end group level greater than 50 μeq/gram;

a first stabilizer comprising a lanthanoid-based compound;

a second stabilizer;

less than 0.3 wt% of a stearate additive; and

from 0 wt% to 65 wt% filler;

wherein a weight ratio of the halide additive to the stearate additive is less than 45.0, and

wherein, when heat aged for 3000 hours over a temperature range of from 190°C to 220°C, the polyamide composition demonstrates a tensile strength retention of greater than 51%, as measured at 23°C.

[0016] In one aspect, the present disclosure relates to an automotive part comprising the heat-stabilized polyamide composition as disclosed herein, wherein, when heat aged for 3000 hours at a temperature of 210°C, the automotive part demonstrates an impact resilience greater than 13 kJ/m^2, as measured at 23°C. In another aspect, the present disclosure relates to an article for use in high temperature applications, wherein the article is formed from the heat-stabilized polyamide composition as disclosed herein, wherein the article is used for fasteners, circuit breakers, terminal blocks, connectors, automotive parts, furniture parts, appliance parts, cable ties, sports equipment, gun stocks, window thermal breaks, aerosol valves, food film packaging, automotive/vehicle parts, textiles, industrial fibers, carpeting, or electrical/electronic parts.

DETAILED DESCRIPTION

[0017] This disclosure relates to heat-stabilized polyamide compositions that employ amide polymers having specific levels of amine end groups (AEG), which provide for significant improvements in performance, e.g., tensile strength and/or impact resilience, at higher temperatures and under heat age conditions. Conventional polyamide compositions typically utilize heat stabilizer packages to address high temperature performance. Unfortunately, many of these heat stabilizer packages, standing alone, suffer from stability/performance gaps over broad temperature ranges, e.g., the 190°C to 220°C temperature range. As a result, the polyamide structures formed from the compositions are prone to performance and/or structural failures.

[0018] The disclosed polyamide compositions and structures take a different approach to address heat stability of polyamides compositions – utilization of particular AEG levels, optionally in

We Claim:

1. A heat-stabilized polyamide composition comprising:

from 25 wt% to 99 wt% of an aliphatic amide polymer having an amine end group level greater than 50 μeq/gram;

a first stabilizer comprising a lanthanoid-based compound;

a second stabilizer;

less than 0.3 wt% of a stearate additive; and

from 0 wt% to 65 wt% filler;

wherein a weight ratio of the halide additive to the stearate additive is less than 45.0, and

wherein, when heat aged for 3000 hours over a temperature range of from 190°C to 220°C, the polyamide composition demonstrates a tensile strength retention of greater than 51%, as measured at 23°C.

2. The polyamide composition of claim 1, wherein, when heat aged for 2500 hours over a temperature range of from 190°C to 220°C, the polyamide composition demonstrates a tensile strength retention of greater than 59%, as measured at 23°C.

3. The polyamide composition of claim 1, wherein, when heat aged for 3000 hours over a temperature range of from 190°C to 220°C, the polyamide composition demonstrates a tensile strength of greater than 102 MPa, as measured at 23°C.

4. The polyamide composition of claim 1, wherein, when heat aged for 2500 hours over a temperature range of from 190°C to 220°C, the polyamide composition demonstrates a tensile strength of greater than 119 MPa, as measured at 23°C.

5. The polyamide composition of claim 1, wherein, when heat aged for 3000 hours over a temperature range of from 190°C to 220°C, the polyamide composition demonstrates a tensile modulus of greater than 11110 MPa, as measured at 23°C.

6. The polyamide composition of claim 1, wherein, when heat aged for 3000 hours over a temperature range of from 190°C to 220°C, the polyamide composition demonstrates an impact resilience of greater than 17 kJ/m^2, as measured at 23°C.

7. The polyamide composition of claim 1, wherein, when heat aged for 2500 hours at a temperature of 210°C; the polyamide composition demonstrates a tensile strength greater than 99 MPa, as measured at 23°C.

8. The polyamide composition of claim 1, wherein, when heat aged for 3000 hours at a temperature of 210°C; the polyamide composition demonstrates a tensile strength greater than 82 MPa, as measured at 23°C.

9. The polyamide composition of claim 1, wherein, when heat aged for 2500 hours at a temperature of 210°C; the polyamide composition demonstrates a tensile strength retention greater than 50%, as measured at 23°C.

10. The polyamide composition of claim 1, wherein, when heat aged for 3000 hours at a temperature of 210°C; the polyamide composition demonstrates a tensile strength retention greater than 41%, as measured at 23°C.

11. The polyamide composition of claim 1, wherein, when heat aged for 2500 hours at a temperature of 210°C; the polyamide composition demonstrates an impact resilience greater than 17 kJ/m^2, as measured at 23°C.

12. The polyamide composition of claim 1, wherein, when heat aged for 3000 hours at a temperature of 210°C; the polyamide composition demonstrates an impact resilience greater than 13 kJ/m^2, as measured at 23°C.

13. The polyamide composition of claim 1, wherein, when heat aged for 3000 hours at a temperature of 190°C; the polyamide composition demonstrates an impact resilience greater than 17 kJ/m^2, as measured at 23°C.

14. The polyamide composition of claim 1, further comprising from 1 ppm to 1 wt% cyclopentanone.

15. The polyamide composition of claim 1, wherein the aliphatic amide polymer has an amine end group level ranging from 60 μeq/gram to 105 μeq/gram.

16. The polyamide composition of claim 1, comprising at least 1 wppm amine/metal complex.

17. The polyamide composition of claim 1, wherein the composition comprises halide and the weight ratio of the first heat stabilizer to the halide ranges from 0.1 to 25.

18. The polyamide composition of claim 1, wherein the second heat stabilizer comprises a copper-based compound and wherein the second heat stabilizer is present in an amount ranging from 0.01 wt% to 5 wt%.

19. The polyamide composition of claim 1, wherein the lanthanoid-based heat stabilizer is a cerium-based heat stabilizer and wherein the lanthanoid-based heat stabilizer is present in an amount ranging from 0.01 wt% to 10 wt%.

20. The polyamide composition of claim 1, wherein the composition comprises an additional polyamide.

21. The polyamide composition of claim 1, wherein the lanthanoid-based compound comprises a lanthanoid ligand selected from the group consisting of acetates, hydrates, oxyhydrates, phosphates, bromides, chlorides, oxides, nitrides, borides, carbides, carbonates, ammonium nitrates, fluorides, nitrates, polyols, amines, phenolics, hydroxides, oxalates, oxyhalides, chromoates, sulfates, or aluminates, perchlorates, the monochalcogenides of sulphur, selenium and tellurium, carbonates, hydroxides, oxides, trifluoromethanesulphonates, acetylacetonates, alcoholates, 2-ethylhexanoates, or combinations thereof.

22. The polyamide composition of claim 1, wherein the first stabilizer is a lanthanoid-based compound and the second stabilizer is a copper-based compound; and wherein, when heat aged for 2500 hours at a temperature of 220°C, the polyamide composition demonstrates a tensile strength greater than 99 MPa and a tensile strength retention greater than 50%.

23. The polyamide composition of claim 1, wherein:

the aliphatic amide polymer has an amine end group level greater than 65 μeq/gram;

the lanthanoid-based compound comprises cerium oxide, cerium oxyhydrate, or cerium hydrate, or combinations thereof and wherein the polyamide composition has a cerium content ranging from 10 ppm to 9000 ppm;

the second heat stabilizer comprises a copper-based compound;

the polyamide composition comprises at least 1 wppm amine/cerium/copper complex;

when heat aged for 2500 hours over a temperature range of from 190°C to 220°C, the polyamide composition demonstrates a tensile strength retention of greater than 59%, as measured at 23°C; and

when heat aged for 3000 hours over a temperature range of from 190°C to 220°C, the polyamide composition demonstrates an impact resilience of greater than 17 kJ/m^2, as measured at 23°C.

24. The polyamide composition of claim 1, wherein:

the aliphatic amide polymer has an amine end group level greater than 65 μeq/gram

the amide polymer comprises PA-6,6;

the composition further comprises an additional polyamide;

the lanthanoid-based compound comprises a cerium-based compound;

the second heat stabilizer comprises a copper-based compound; and

when heat aged for 3000 hours at a temperature of 210°C; the polyamide composition demonstrates a tensile strength greater than 82 MPa, as measured at 23°C;

when heat aged for 3000 hours at a temperature of 210°C; the polyamide composition demonstrates a tensile strength retention greater than 41%, as measured at 23°C; and

when heat aged for 3000 hours at a temperature of 210°C; the polyamide composition demonstrates an impact resilience greater than 13 kJ/m^2, as measured at 23°C.

25. An automotive part comprising the heat-stabilized polyamide composition of claim 1, wherein, when heat aged for 3000 hours at a temperature of 210°C, the automotive part demonstrates an impact resilience greater than 13 kJ/m^2, as measured at 23°C.

26. An article for use in high temperature applications, wherein the article is formed from the heat-stabilized polyamide composition of claim 1, wherein the article is used for fasteners, circuit breakers, terminal blocks, connectors, automotive parts, furniture parts, appliance parts, cable ties, sports equipment, gun stocks, window thermal breaks, aerosol valves, food film packaging, automotive/vehicle parts, textiles, industrial fibers, carpeting, or electrical/electronic parts.