b) the composition supplied in step a) is subjected to an oligomerization in the oligomerization zone without mass transfer with the environment at a temperature of 170 to 290°C and an absolute pressure of at least 20 bar.

In a first aspect, there is provided a process for continuously preparing aliphatic or semiaromatic polyamide oligomers, in which

a) an aqueous composition comprising at least one component which is suitable for polyamide formation and is selected from dicarboxylic acids, diamines, salts of at least one dicarboxylic acid and at least one diamine, lactams, ω-amino acids, aminocarbonitriles and mixtures thereof is provided, and the composition provided is supplied to an oligomerization zone,

b) the composition supplied in step a) is subjected to an oligomerization in the oligomerization zone without mass transfer with the environment, wherein no introduction and also no discharge of components, from the interior of the vessel into the environment, or vice versa, takes place, at a temperature of 170 to 290°C and an absolute pressure of at least 20 bar, and wherein step b) is affected monophsically in the liquid phase, and

c) an output comprising the polyamide oligomers is withdrawn from the oligomerization zone.

In a specific embodiment, the oligomerization zone used for oligomerization in step b) is not backmixed.

In a further specific embodiment, the oligomerization in step b) is effected monophasically in the liquid phase.

In a first variant, for a subsequent step d), the output from the oligomerization zone withdrawn in step c) is subjected to a further processing operation without previously isolating a liquid phase comprising the oligomers and having a reduced water content.

In a second variant, for a subsequent step d), the output from the oligomerization zone withdrawn in step c) is fed into a flash zone and subjected to an expansion to obtain a water-containing gas phase and a liquid phase comprising the oligomers, and at least a portion of the water-containing gas phase is removed. Specifically, no solid phase comprising polyamide oligomers is obtained here. In a specific implementation of this second variant, the liquid phase comprising the polyamide oligomers is subjected to a postpolymerization in the flash zone (= step e).

In another embodimentaspect, there is provided polyamide oligomers obtainable by a process as defined above and hereinafter.

In another aspect, there is provided a process for preparing a polyamide, in which a polyamide oligomer obtainable by a process as defined above and hereinafter is subjected to a further polymerization. The disclosure also provides the polyamides thus obtainable.

The disclosure further provides for the use of a semiaromatic polyamide obtainable by a process as defined above and hereinafter, preferably for production of electrical and electronic components and for high-temperature automotive applications.

In another aspect, there is provided the use of a semiaromatic polyamide obtainable by a process as defined above and herein after for production of electrical and electronic components and for high-temperature automotive applications.

The disclosure further provides for the use of an aliphatic polyamide obtainable by a process as defined above and hereinafter for production of films, monofilaments, fibers, yarns or textile fabrics.

BRIEF DESCRIPTION OF THE FIGURES

Claims

1. A process for continuously preparing ~~aliphatic or~~ semiaromatic polyamide oligomers, in which

a) an aqueous composition comprising at least one component which is suitable for polyamide formation and is selected from dicarboxylic acids, diamines, salts of at least one dicarboxylic acid and at least one diamine, lactams, ω-amino acids, aminocarbonitriles and mixtures thereof is provided, and the composition provided is supplied to an oligomerization zone,

b) the composition supplied in step a) is subjected to an oligomerization in the oligomerization zone without mass transfer with the environment, wherein no introduction and also no discharge of components, from the interior of the vessel into the environment, or vice versa, takes place, at a temperature of 170 to 290°C and an absolute pressure of at least 20 bar, and wherein step b) is affected monophasically in the liquid phase, and

c) an output comprising the polyamide oligomers is withdrawn from the oligomerization zone.

2. The process according to claim 1, wherein the composition provided in step a) has a water content of 20 to 55% by weight, based on the total weight of the composition.

3. The process according to either of the preceding claims, wherein the polyamide oligomer is selected from PA 6.T, PA 9.T, PA8.T, PA 10.T, PA 12.T, PA 6.I, PA 8.I, PA 9.I, PA 10.I, PA 12.I, PA 6.T/6, PA 6.T/10, PA 6.T/12, PA 6.T/6.I, PA6.T/8.T, PA 6.T/9.T, PA 6.T/10T, PA 6.T/12.T, PA 12.T/6.T, PA 6.T/6.I/6, PA 6.T/6.I/12, PA 6.T/6.I/6.10, PA 6.T/6.I/6.12, PA 6.T/6.6, PA 6.T/6.10, PA 6.T/6.12, PA 10.T/6, PA 10.T/11, PA 10.T/12, PA 8.T/6.T, PA 8.T/66, PA 8.T/8.I, PA 8.T/8.6, PA 8.T/6.I, PA 10.T/6.T, PA 10.T/6.6, PA 10.T/10.I, PA 10T/10.I/6.T, PA 10.T/6.I, PA 4.T/4.I/46, PA 4.T/4.I/6.6, PA 5.T/5.I, PA 5.T/5.I/5.6, PA 5.T/5.I/6.6, PA 6.T/6.I/6.6, PA MXDA.6, PA IPDA.I, PA IPDA.T, PA MACM.I, PA MACM.T, PA PACM.I, PA PACM.T, PA MXDA.I, PA MXDA.T, PA 6.T/IPDA.T, PA 6.T/MACM.T, PA 6.T/PACM.T, PA 6.T/MXDA.T, PA 6.T/6.I/8.T/8.I, PA 6.T/6.I/10.T/10.I, PA 6.T/6.I/IPDA.T/IPDA.I, PA 6.T/6.I/MXDA.T/MXDA.I, PA 6.T/6.I/MACM.T/MACM.I, PA 6.T/6.I/PACM.T/PACM.I, PA 6.T/10.T/IPDA.T, PA 6.T/12.T/IPDA.T, PA 6.T/10.T/PACM.T, PA 6.T/12.T/PACM.T, PA 10.T/IPDA.T, PA 12.T/IPDA.T and copolymers and mixtures thereof.

4. The process according to any of the preceding claims, wherein the polyamide oligomer is selected from PA 4, PA 5, PA 6, PA 7, PA 8, PA 9, PA 10, PA 11, PA 12, PA 46, PA 66, PA 666, PA 69, PA 610, PA 612, PA 96, PA 99, PA 910, PA 912, PA 1212 and copolymers and mixtures thereof.

5. The process according to any of claims 1 to 4, wherein the oligomerization zone used for oligomerization comprises at least one tubular reactor or consists of at least one tubular reactor.

6. The process according to any of claims 1 to 4, wherein the oligomerization zone used for oligomerization comprises a cascade of at least two stirred tanks or consists of a cascade of at least two stirred tanks.

7. The process according to any of claims 1 to ~~6~~5, wherein the oligomerization zone used for oligomerization is not backmixed.

~~8. The process according to any of claims 1 to 5 or 7, wherein the oligomerization in step b) is effected monophasically in the liquid phase.~~

~~9.~~8. The process according to any of the preceding claims, wherein the temperature in the oligomerization zone in step b) is within a range from 200 to 290°C.

~~10.~~9. The process according to any of the preceding claims, wherein the absolute pressure in the oligomerization zone in step b) is within a range from 20 to 100 bar, preferably within a range from 25 to 60 bar.

~~11.~~10. The process according to any of the preceding claims, wherein the polyamide oligomers present in the output from the oligomerization zone have a number-average molecular weight M_n of at least 500 g/mol, preferably of at least 600 g/mol, especially of at least 700 g/mol.

~~12.~~11. The process according to any of claims 1 to ~~11~~10, wherein the output from the oligomerization zone withdrawn in step c) is subjected to a further processing operation without previously isolating a liquid phase comprising the oligomers and having a reduced water content (= step d).

~~13.~~12. The process according to claim ~~12~~11, in which

- the output from the oligomerization zone is sent without prior expansion to an apparatus for removal of water and for postpolymerization, which is preferably selected from extruders, kneaders, extrudate devolatilizers or a combination of at least two of these apparatuses,

or

- the output from the oligomerization zone is subjected to full expansion to obtain a water-containing gas phase and a solid phase comprising the oligomers, and at least a portion of the water-containing gas phase is removed.

~~14.~~13. The process according to any of claims 1 to ~~11~~10, in which the output from the oligomerization zone obtained in step c) is fed into a flash zone and subjected to an expansion to obtain a water-containing gas phase and a liquid phase comprising the oligomers, and at least a portion of the water-containing gas phase is removed (= step d).

~~15.~~14. The process according to claim ~~14~~13, in which no solid phase comprising polyamide oligomers is obtained in step d).

~~16.~~15. The process according to either of claims ~~14~~13 and ~~15~~14, wherein the liquid phase which comprises the polyamide oligomers and is obtained in step d) has a water content of at least 20% by weight, based on the total weight of the liquid phase.

~~17.~~16. The process according to any of claims ~~14~~13 to ~~16~~15, wherein the output from the oligomerization zone is expanded in step d) to an absolute pressure at least 5 bar, preferably at least 10 bar and especially at least 15 bar below the pressure in the oligomerization zone.

~~18.~~17. The process according to any of claims ~~14~~13 to ~~17~~16, wherein the absolute pressure in the flash zone in step d) is within a range from 20 to 50 bar, preferably from 22 to 35 bar.

~~19.~~18. The process according to any of claims ~~14~~13 to ~~18~~17, wherein the temperature in the flash zone in step d) differs by at most 30°C, preferably by at most 20°C and especially by at most 10°C from the temperature of the output from the oligomerization zone.

~~20.~~19. The process according to any of claims ~~14~~13 to ~~19~~18, wherein the temperature in the flash zone in step d) is within a range from 170 to 290°C, preferably from 200 to 290°C.

~~21.~~20. The process according to any of claims ~~14~~13 to ~~20~~19, in which the liquid phase comprising the polyamide oligomers is subjected to a postpolymerization in the flash zone (= step e).

~~22.~~21. The process according to claim ~~21~~20, wherein the residence time of the liquid phase comprising the polyamide oligomers in the flash zone in step e) is within a range from 1 minute to 1 hour, preferably from 5 minutes to 30 minutes.

~~23.~~22. The process according to either of claims ~~21~~20 and ~~22~~21, wherein the polyamide oligomers present in the output of the postpolymerization in step e) from the flash zone have a number-average molecular weight M_n of at least 650 g/mol, preferably of at least 800 g/mol.

~~24.~~23. The process according to any of claims ~~21~~20 to ~~23~~22, wherein the polyamide oligomers present in the output of the postpolymerization in step e) from the flash zone have a polydispersity PD of at most 4.5.

~~25.~~24. The process according to any of claims ~~14~~13 to ~~24~~23, wherein the liquid phase comprising the oligomers is discharged from the flash zone via a temperature-controllable draw point.

~~26.~~25. The process according to claim ~~25~~24, wherein the output from the flash zone is heated to a temperature above the melting temperature of the polyamide oligomers.

~~27. Polyamide oligomers obtainable by a process as defined in any of claims 1 to 26.~~

~~28.~~26. A process for preparing a polyamide, in which a polyamide oligomer ~~according to claim 27 or~~ obtainable by a process as defined in any of claims 1 to ~~26~~25 is subjected to a further polymerization.

~~29.~~27. The process according to claim ~~28~~26, in which step d) is followed or step e) is followed by withdrawal of a liquid output from the flash zone which is then subjected to a further polymerization in the solid phase or in the melt.

~~30. The use of an aliphatic polyamide obtainable by a process as defined in either of claims 28 and 29 for production of films, monofilaments, fibers, yarns or textile fabrics.~~

~~31.~~28. The use of a semiaromatic polyamide obtainable by a process as defined in either of claims ~~28~~ 26 and ~~29~~ 27 for production of electrical and electronic components and for high-temperature automotive applications.

~~32.~~29. The use according to claim ~~31~~ 28 in soldering operations under lead-free conditions (lead free soldering), for production of plug connectors, microswitches, microbuttons and semiconductor components, especially reflector housings of light-emitting diodes (LEDs).