- an inlet orifice disposed in a circular face or the shell face of the upper section,
- a first outlet orifice disposed in a wall of the lower section,
- a second outlet orifice disposed in the shell face of the upper section opposite the first outlet orifice, and

a removal device which is disposed so as to be rotatable about the longitudinal cylinder axis and is in contact with both circular faces and the shell face.

SUMMARY

The disclosure firstly provides an apparatus for synthesis of a polymer with separation of a gaseous substance comprising a reaction space comprising an essentially circular cylindrical upper section which is bounded by two circular faces and one shell face and has a longitudinal cylinder axis, and a lower section, an inlet orifice disposed in a circular face or the shell face of the upper section, a first outlet orifice disposed in a wall of the lower section, a second outlet orifice disposed in the shell face of the upper section essentially opposite the first outlet orifice, and a removal device which is disposed so as to be rotatable about the longitudinal cylinder axis and is in contact with both circular faces and the shell face.

The disclosure further provides a process for synthesizing a polymer, in which a prepolymer melt is fed into a reaction space through an inlet orifice, a polymerization of the prepolymer melt is performed to give a polymer melt, the polymer melt is removed from the reaction space through a first outlet orifice in the reaction space and the gaseous substance is removed from the reaction space through a second outlet orifice in the reaction space, deposits on at least one inner wall of the reaction space are removed by a removal device and transported into the prepolymer melt. The process according to the disclosure is especially suitable for a continuous polymer synthesis. It is preferable that the removal device removes the deposits continuously and thus keeps the inner wall of the reaction space free of deposits.

In an aspect, there is provided a process for synthesizing a polymer by polymerizing a prepolymer melt to give a polymer melt with separation of a gaseous substance in an apparatus comprising

- a reaction space comprising an essentially circular cylindrical upper section which is bounded by two circular faces and one shell face and has a longitudinal cylinder axis, and a lower section,
- an inlet orifice disposed in a circular face or the shell face of the upper section,

- a first outlet orifice disposed in a wall of the lower section,
- a second outlet orifice disposed in the shell face of the upper section opposite the first outlet orifice and
- a removal device which is disposed so as to be rotatable about the longitudinal cylinder axis and is in contact with both circular faces and the shell face, the removal device taking the form of a rotor with several rotor blades, and which is immersed into the prepolymer melt, and wherein the cross section of the reaction space which encloses at least one circular face of the upper section is essentially droplet-shaped,

having the following process steps:

a) feeding a prepolymer melt into a reaction space through an inlet orifice,
b) polymerizing the prepolymer melt to give a polymer melt,
c) removing the polymer melt from the reaction space through a first outlet orifice in the reaction space, and
d) removing a gaseous substance from the reaction space through a second outlet orifice in the reaction space,

wherein deposits on at least one inner wall of the reaction space are removed by a removal device immersed into the prepolymer melt, and transported into the prepolymer melt.

A specific embodiment is a process for synthesizing an aliphatic or semiaromatic polyamide, in which a prepolymer of the aliphatic or semiaromatic polyamide is provided and supplied to the apparatus used in accordance with the disclosure.

DESCRIPTION OF THE INVENTION

A prepolymer in the context of the invention refers to a composition comprising polymeric compounds having complementary functional groups capable of a condensation reaction to increase the molecular weight.

Claims

1. A process for synthesizing a polymer by polymerizing a prepolymer melt to give a polymer melt with separation of a gaseous substance in an apparatus comprising

- a reaction space comprising an essentially circular cylindrical upper section which is bounded by two circular faces and one shell face and has a longitudinal cylinder axis, and a lower section,
- an inlet orifice disposed in a circular face or the shell face of the upper section,
- a first outlet orifice disposed in a wall of the lower section,
- a second outlet orifice disposed in the shell face of the upper section opposite the first outlet orifice and
- a removal device which is disposed so as to be rotatable about the longitudinal cylinder axis and is in contact with both circular faces and the shell face, the removal device taking the form of a rotor with several rotor blades, and which is immersed into the prepolymer melt, and wherein the cross section of the reaction space which encloses at least one circular face of the upper section is essentially droplet-shaped,

having the following process steps:

a) feeding a prepolymer melt into a reaction space through an inlet orifice,
b) polymerizing the prepolymer melt to give a polymer melt,
c) removing the polymer melt from the reaction space through a first outlet orifice in the reaction space, and
d) removing a gaseous substance from the reaction space through a second outlet orifice in the reaction space,

wherein deposits on at least one inner wall of the reaction space are removed by a removal device immersed into the prepolymer melt, and transported into the prepolymer melt.

2. The process according to claim 1, wherein

- the inlet orifice is disposed in a shell face of a cylindrical first section of the reaction space,

- the removal device is rotated about the longitudinal cylinder axis of the first section in the direction in which the prepolymer melt runs out of the inlet orifice into the reaction space.

3. The process according to claim 1 or 2, wherein the speed with which the polymer melt moves toward the first outlet orifice increases with falling distance from the first outlet orifice.

4. The process according to any of claims 1 to 3, wherein the polymer is selected from thermoplastic polymers, preferably polyamides, thermoplastic polyurethanes, polyolefins, vinylaromatic polymers, polyesters, polyacetals, polycarbonates, polysulfones, polyether sulfones and mixtures thereof.

5. The process according to any of claims 1 to 4, wherein the polymer is a polyamide and the gaseous substance is steam.

6. The process according to any of claims 1 to 5, wherein the polymer is a semiaromatic polyamide comprising at least one incorporated repeat unit having an aromatic group and at least one incorporated repeat unit having an aliphatic or cycloaliphatic group.

7. The process according to any of claims 1 to 6, wherein the polymer is a polyamide 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.