- passing the polymer melt feed through the apertures, thereby forming polymer strands in a devolatilization vessel;
- collecting the polymer strands in a collector by letting the polymer strands drop over a strand drop height into the collector; thereby obtaining a devolatilised polymer in the collector and removed volatiles;
- recovering the volatiles through a gas outlet of the devolatilization vessel; and,
- recovering the resulting devolatilised polymer from the collector through a polymer outlet of the collector;

characterized in that

the polymer melt viscosity at temperature T is at least 100 000 cP and at most 5 000 000 cP, wherein the polymer melt viscosity is measured using a capillary rheometer Rosand with a die of 1 mm diameter and 16 mm length;
the average throughput per aperture is at least 5 g/h and at most 75 g/h;
the ratio of average distance between adjacent apertures / average aperture diameter is at least 1.5 to at most 4.0;
the average aperture diameter is at least 0.5 mm and at most 8.0 mm; and,
the ratio of strand drop height / average aperture diameter is at least 1.0 m/mm to at most 6.0 m/mm.

In some preferred examples, the polymer melt viscosity at temperature T is at least 200 000 cP and at most 2 500 000 cP, preferably at least 500 000 cP and at most 2 000 000 cP; preferably at least 750 000 cP and at most 1 500 000 cP; most preferably about 1 000 000 cP.

In some preferred examples, the average throughput per aperture is at least 10 g/h and at most 75 g/h; preferably at least 20 g/h and at most 50 g/h; most preferably about 25 g/h;

- a polymer outlet, configured to remove the collected polymer from the collector; and,
- a gas outlet, configured to remove the volatiles from the devolatilization vessel,

wherein the average throughput per aperture is at least 5 g/h and at most 75 g/h; wherein the average aperture diameter is at least 0.5 mm and at most 8.0 mm;
wherein the ratio of average distance between adjacent apertures / average aperture diameter is at least 1.5 to at most 4.0; and,
wherein the ratio of strand drop height / average aperture diameter is at least 1.0 m/mm to at most 6.0 m/mm.

In some preferred examples, the average aperture diameter is at least 0.5 mm and at most 8.0 mm; and the strand drop height is at least 1.0 m and at most 20.0 m.

The present disclosure thereto provides a devolatilised polymer, obtained through a process as described herein, and examples thereof, or with an apparatus as described herein, and examples thereof. The devolatilised polymer preferably comprises a residuals concentration of volatiles at the outlet of at most 3 000 ppm.

CLAIMS

1. Process for reducing volatiles in a polymer melt feed in a devolatilization apparatus, the process comprising the steps of:
   - providing a polymer melt feed to a devolatilization nozzle; the nozzle comprising an inlet part, a polymer distribution part comprising headers, and an outlet part comprising a number of apertures,
     wherein the polymer melt feed is provided to the inlet part at a temperature T;
   - passing the polymer melt feed through the apertures, thereby forming polymer strands in a devolatilization vessel;
   - collecting the polymer strands in a collector by letting the polymer strands drop over a strand drop height into the collector; thereby obtaining a devolatilised polymer in the collector and removed volatiles;
   - recovering the volatiles through a gas outlet of the devolatilization vessel; and,
   - recovering the resulting devolatilised polymer from the collector through a polymer outlet of the collector;

   characterized in that

   the polymer melt viscosity at temperature T is at least 100 000 cP and at most 5 000 000 cP, wherein the polymer melt viscosity is measured using a capillary rheometer Rosand with a die of 1 mm diameter and 16 mm length;
   the average throughput per aperture is at least 5 g/h and at most 75 g/h;
   the ratio of average distance between adjacent apertures / average aperture diameter is at least 1.5 to at most 4.0;
   the average aperture diameter is at least 0.5 mm and at most 8.0 mm; and,
   the ratio of strand drop height / average aperture diameter is at least 1.0 m/mm to at most 6.0 m/mm.

2. Process according to claim 1, wherein the polymer melt viscosity at temperature T is at least 200 000 cP and at most 2 500 000 cP, preferably at least 500 000 cP and at most 2 000 000 cP; preferably at least 750 000 cP and at most 1 500 000 cP; most preferably 1 000 000 cP.

3. Process according to any one of the preceding claims, wherein the average throughput per aperture is at least 10 g/h and at most 75 g/h; preferably at least 20 g/h and at most 50 g/h; most preferably 25 g/h; wherein the average throughput per aperture is calculated by dividing the total throughput by the number of apertures.

4. Process according to any one of the preceding claims, wherein the pressure drop across the nozzle is least 2.0 bar and at most 30.0 bar; preferably at least 3.0 bar and at most 15.0 bar; more preferably at least 4.0 bar and at most 10.0 bar; most preferably 6.0 bar.

5. Process according to any one of the preceding claims, wherein the polymer temperature is at least 150 ˚C and at most 300 ˚C; preferably at least 170 ˚C and at most 280 ˚C; more preferably at least 190 ˚C and at most 260 ˚C; most preferably at least 200 ˚C and at most 240 ˚C.

6. Process according to any one of the preceding claims, wherein the pressure in the devolatilization vessel outside the nozzle is at least 0.5 mbar abs and at most 500.0 mbar abs; preferably at least 1.0 mbar abs and at most 200.0 mbar abs; more preferably at least 1.2 mbar abs and at most 10.0 mbar abs; most preferably 1.5 mbar abs.

7. Process according to any one of the preceding claims, wherein the average aperture diameter is at least 1.0 mm and at most 6.0 mm; more preferably at least 1.5 mm and at most 4.0 mm; most preferably 2.0 mm.

8. Process according to any one of the preceding claims, wherein the strand drop height is at least 1.0 m and at most 20.0 m; preferably at least 2.0 m and at most 10.0 m; more preferably at least 4.0 m and at most 8.0 m; most preferably 6.0 m.

9. Process according to any one of the preceding claims, wherein the ratio of polymer viscosity at temperature T / average aperture diameter is at least 50 000 cp/mm to at most 4 000 000 cp/mm; preferably at least 60 000 cp/mm to at most 2 500 000 cp/mm; preferably at least 80 000 cp/mm to at most 1 500 000 cp/mm; preferably at least 150 000 cp/mm to at most 1 200 000 cp/mm; preferably at least 200 000 cp/mm to at most 1 000 000 cp/mm; preferably at least 400 000 cp/mm to at most 600 000 cp/mm, preferably 500 000 cp/mm.

10. Process according to any one of the preceding claims, wherein the ratio of strand drop height / average aperture diameter is at least 1.0 m/mm to at most 5.0 m/mm; preferably at least 2.0 m/mm to at most 4.0 m/mm; preferably 3.0 m/mm.

11. Process according to any one of the preceding claims, wherein the ratio of average throughput per aperture / average aperture diameter is at least at least 2.0 g/h/mm to at most 50.0 g/h/mm; preferably at least 5.0 g/h/mm to at most 30.0 g/h/mm; preferably at least 10.0 g/h/mm to at most 15.0 g/h/mm.

12. Process according to any one of the preceding claims, wherein the polymer melt feed comprises polystyrene or polylactic acid.

13. Process according to any one of the preceding claims, wherein the apertures are arranged in a pitch selected from a group comprising: a triangular or isometric pitch, a square pitch, or a lozenge pitch.

14. Devolatilization apparatus for removing volatiles from a polymer melt feed, the apparatus configured to perform the process according to any one of claims 1 to 13; and wherein the apparatus comprises
    - a devolatilization nozzle comprising an inlet part, a polymer distribution part comprising headers, and an outlet part comprising a number of apertures, configured to form polymer strands in a devolatilization vessel;
    - a collector, configured to collect the polymer strands in the devolatilization vessel;
    - a polymer outlet, configured to remove the collected polymer from the collector; and,
    - a gas outlet, configured to remove the volatiles from the devolatilization vessel,

    wherein the average throughput per aperture is at least 5 g/h and at most 75 g/h;
    wherein the average aperture diameter is at least 0.5 mm and at most 8.0 mm;
    wherein the ratio of average distance between adjacent apertures / average aperture diameter is at least 1.5 to at most 4.0; and,
    wherein the ratio of strand drop height / average aperture diameter is at least 1.0 m/mm to at most 6.0 m/mm.