

Polymer particles

The present invention relates to polymer particles which have a very specific ratio of volume to surface area, to a process for the production thereof and to the use thereof
5 for the production of moulding compositions.

Polymer manufacturers offer their products for sale in the most varied particle shapes and sizes. Polymer particles are thus known which have a diameter of between 2.5 and 4 mm. Polymers are, however, also commercially available in powder form with a
10 particle size of between 100 and 2000 μm .

Polymer particles are conventionally produced by extruding the polymer, for example in the form of a round or angular filament, and then subdividing it in accordance with the desired particle size using a chopping machine.

15

Large polymer particles have the advantage that they may be produced at lower cost, as not such severe demands need be placed on the chopping machine, in particular on the cooling thereof, and energy consumption is lower. A disadvantage of such particles is, however, that they are difficult to convey, for example from silos or
20 through piping, or they cause blockages in such plant, such that large polymer particles are the cause of frequent complaints from processors.

In contrast, polymers in powder form do not exhibit this disadvantage, but, for the above-stated reasons, are more costly to produce. Polymer powder is furthermore
25 often disadvantageous to extrude. In this processing method, the polymer particles are fused, for example in a screw compounder, by the heat arising from friction between the particles, and are then extruded into the desired shape. However, in the case of pulverulent particles, the friction prevailing between the particles is often too low and the resultant heat thus inadequate to achieve the appropriate melting temperatures
30 throughout the polymeric material. As a result, at certain points the polymer powder

fuses either not at all or incompletely, such that the resultant moulding compositions often exhibit optical and/or mechanical defects.

5 The object of the present invention is accordingly to provide polymer particles which do not exhibit the disadvantages of either large polymer particles or polymers in powder form.

10 This object is achieved according to the invention by polymer particles in which the ratio of volume to surface area is <0.5 mm and the length of which is between 1.5 and 3 mm.

For the purposes of the invention, length is the distance between the two cut surfaces.

15 The polymer particles preferably have a ratio of volume to surface area which is between 0.49 and 0.38 mm. Particularly preferably, the ratio of volume to surface area of the particles is between 0.43 and 0.3 mm.

20 These cylindrical or approximately cylindrical polymer particles preferably have a length of between 2.0 and 2.8 mm, particularly preferably of between 2.4 and 2.6 mm.

In principle, the polymer particles may be of any desired shape. Preferably, however, the polymer particles have the shape of a cylinder or an elliptical cylinder, wherein, as a result of the comminution operation, the end faces need not be straight, such that the polymer particles particularly preferably only approximately have the shape of a
25 cylinder.

The diameter of the cylindrical particle is also preferably between 2.0 and 3.3 mm, particularly preferably between 2.3 and 2.7 mm. In the event that the polymer particles assume the form of an elliptical cylinder, the long axis of the ellipse is preferably of a
30 length of 2.2 to 3.5 mm, particularly preferably of a length of 2.3 to 2.7 mm, while the

short axis of the ellipse is preferably 1.5 to 2.5 mm, particularly preferably 1.7 to 2.3 mm long.

5 The polymer particles according to the invention may consist of any polymer known to the person skilled in the art. Preferably, however, they are of thermoplastic polymers. According to the invention, thermoplastics are any plastics which flow under the action of pressure and heat. Examples which may be mentioned in this connection are polystyrene, polyurethane, polyamide, polyester, polyacetal, polyacrylate, polycarbonate, polyethylene, polypropylene, polyvinyl chloride, 10 styrene/acrylonitrile and the copolymers thereof and corresponding blends.

Preferably, however, the polymer particles according to the invention are of polycarbonate. For the purposes of the present invention, polycarbonates comprise both homopolycarbonates and copolycarbonates. The polycarbonates may be linear or 15 branched in known manner.

A proportion of up to 80 mol%, preferably of 20 mol% to 50 mol%, of the carbonate groups in suitable polycarbonates may be replaced by aromatic dicarboxylic acid ester groups. Such polycarbonates, which contain both acid residues of carbonic acid and 20 acid residues of aromatic dicarboxylic acids incorporated into the molecular chain, are more precisely known as aromatic polyester carbonates. These are taken to be included within the superordinate term of thermoplastic, aromatic polycarbonates.

Details of the production of polycarbonates have been described in hundreds of 25 patents over the last 40 years or so. Reference is made purely by way of example to "Schnell Chemistry & Physics of Polycarbonates", *Polymer Reviews*, vol. 9, Interscience Publishers, New York, London, Sydney 1946, to D.C. Prevorsek, B.T. Debona & Y. Kesten, Corporate Research Center, Allied Chemical Corporation, Morristown, New Jersey 07960, "Synthesis of poly(ester carbonate) copolymers" in 30 *Journal of Polymer Science, Polymer Chemistry Edition*, vol. 19, 75-90 (1980), to D. Freitag, U. Grigo, P.R. Müller, N. Nouvertne', Bayer AG, "Polycarbonates" in

Encyclopedia of Polymer Science & Engineering, vol. 11, 2nd edition, 1988, pp. 648-718 and finally to Dr. U. Grigo, Dr. K. Kirchner and Dr. P.R. Müller, "Polycarbonates" in Becker/Braun, *Kunststoff-Handbuch*, vol. 3/1, *Polycarbonate, Polyacetale, Polyester, Celluloseester*, Carl Hanser Verlag, Munich/Vienna, 1992, pp. 117-299.

The polymer particles according to the invention are preferably produced by continuously extruding the molten polycarbonate in the desired shape, preferably as a continuous cylinder, and then performing comminution. Numerous different methods are available for comminution. The polymer may, for example, thus be subdivided into the particles according to the invention immediately after leaving the extruder. Preferably, however, the polymer is first cooled after extrusion, such that it is already at least partially hardened, and is then chopped.

The polymer particles according to the invention are favourable to produce and exhibit very good conveying characteristics, for example from silos or in piping. Moulding compositions which have been produced using the polymer particles according to the invention have substantially fewer optical or mechanical defects than do moulding compositions which have been produced with polymers in powder form.

The present invention accordingly also provides the use of the polymer particles according to the invention for the production of moulding compositions.

For the purposes of the invention, moulding compositions are any moulding compositions known to the person skilled in the art which may be produced with the above-stated polymers.

Particularly preferably, however, the polymer particles according to the invention are used to make optical articles of polycarbonate.

For the purposes of the invention, optical articles are glassy articles of any kind, preferably lenses or spectacle lenses, as well as optical mass storage media, such as for example CD or CD-R.

Examples**Example 1**

- 5 The drain time of polycarbonate particles of an elliptical cross-section from a funnel was investigated with reference to DIN 53 492. The particles were of the following average dimensions:

- long axis of the ellipse = 3.3 mm
- 10 - short axis of the ellipse = 2.3 mm
- length, measured between the two cut surfaces of the particle = 2.5 mm.

On the basis of these values, a ratio of volume to surface area of 0.48 mm may be calculated.

15

The tests were performed by placing 300 ml portions of the particles in funnels having different outlet diameters of between 5 and 34 mm and then opening the outlet orifice in order to investigate bridging and drain time. The smaller is the outlet diameter at which satisfactory funnel drain behaviour may still be observed, the better is the flow
20 behaviour.

It is found that the particles having the characteristics according to the invention still exhibit satisfactory funnel drain behaviour at a diameter of 15 mm.

- 25 Mouldings which were produced with these polycarbonate particles exhibited no optical or mechanical defects.

Comparative Example 2

- 30 The same test was performed with polycarbonate particles having an elliptical cross-section and a length of the long axis of the ellipse of 3.3 mm and a length of the short

axis of the ellipse of 2.7 mm and a length between the two cut surfaces of 3.1 mm. The resultant ratio of volume to surface area is 0.5 mm.

- 5 It is found that, with these particles, satisfactory funnel drain behaviour could only be achieved with a diameter of >20 mm, from which it may be concluded that the flow behaviour is poorer than for the polycarbonate particles according to Example 1.

**Patent Claims**

1. Polymer particles in which the ratio of volume to surface area is $<0.5 \text{ mm}$ and the length of which is between 1.5 mm and 3 mm.
- 5 2. Polymer particles according to claim 1, characterised in that the ratio is between 0.49 and 0.38 mm.
3. Polymer particles according to any one of claims 1 or 2, characterised in that
10 the length is between 2.2 mm and 2.8 mm.
4. Polymer particles according to any one of claims 1 to 3, characterised in that the particles approximately have the shape of a cylinder.
- 15 5. Polymer particles according to claim 4, characterised in that the cross-section of the cylinder is elliptical.
6. Polymer particles according to any one of claims 1 to 5 of polycarbonate.
- 20 7. Process for the production of polymer particles according to one of claims 1 to 6, characterised in that the polymer is extruded through a die, cooled and then chopped to the desired length.
8. Use of the polymer particles according to any one of claims 1 to 6 for the
25 production of moulding compositions.
9. Use according to claim 8, characterised in that the moulding compositions are of polycarbonate.
- 30 10. Use according to claim 9, characterised in that the moulding compositions are optical articles.