A plastic monofilament has a matrix, which includes a first plastic material at least in a first area, and at least one rib, which extends in the longitudinal direction of the monofilament. The plastic monofilament includes a second plastic material. The second plastic material is held in the first area of the matrix in a positive-locking manner.
PLASTIC MONOFILAMENT AND TOOTHBRUSH BRISTLE MADE OF A CORRESPONDING MONOFILAMENT

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a U.S. National Phase Application of International Application PCT/EP2014/001200 filed May 6, 2014 and claims the benefit of priority under 35 U.S.C. §119 of German Patent Application 10 2013 007 870.9 filed May 8, 2013, the entire contents of which are incorporated herein by reference.

FIELD OF THE INVENTION

The present invention pertains to a plastic monofilament and to a toothbrush bristle manufactured from a corresponding monofilament.

BACKGROUND OF THE INVENTION

The cleaning action of a bristle depends essentially on the geometry of the individual bristles and the material of which the bristles consist. In particular, it proved to be advantageous to structure or profile the bristles on their lateral surface, so that the bristles have a scraping action.

Bristles, which have a plurality of axially parallel ribs, which are formed integrally at their radially inner end with a core forming the matrix, are known from EP 0 850 004 B1 or EP 0 874 925 B1. The core and the rib may consist of different plastics in order to adapt the strength and bonding properties of the bristle, on the one hand, and the cleaning action by the rib to the desired intended use, on the other hand. If the bristle is used in a toothbrush, it shall, moreover, be ensured by selecting the material that the user cannot be injured.

It was found that the selection of the material for the rib, on the one hand, and for the matrix, on the other hand, is greatly limited by the need for the two materials to become connected to one another during the manufacture of the corresponding monofilament in order to prevent the rib from becoming separated from the matrix during the use of the bristle. This limitation in selecting the material is highly disadvantageous, so that an optimized cleaning action can rarely be achieved.

SUMMARY OF THE INVENTION

A basic object of the present invention is to create a monofilament for manufacturing a bristle or a toothbrush bristle manufactured therefrom, in which the possibilities of selecting and combining the materials for the rib and the matrix are improved.

This object is accomplished according to the present invention by a monofilament comprising a matrix of a first plastic material at least in a first area and at least one rib, which extends in the longitudinal direction of the monofilament and which is comprised of a second plastic material and which is held in the first area of the matrix in a positive-locking manner.

Based on the positive-locking connection between the rib and the first area of the matrix, secure holding of the rib in the matrix can be achieved independently from whether or not there is additionally a connection in substance and/or a non-positive connection between the first plastic material of the first area of the matrix and the second plastic material of the rib. It is possible, on the one hand, to hold the rib solely via positive-locking connection in the first area of the matrix, but it is also possible, as an alternative, to additionally provide especially a connection in substance or a non-positive connection between said materials. In a preferred embodiment of the present invention, the materials and the parameters with which the monofilament is extruded are selected so that the rib is also welded to the first area of the matrix in addition to the positive-locking connection. As an alternative or in addition hereto, provisions may, however, also be made for the rib to be bonded to the first area of the matrix in addition to the positive-locking connection.

Provisions are made in a possible embodiment of the present invention for the rib to have a radially outwardly tapering cross section, for example, a triangular or drop-shaped cross section, so that it tapers to a tip in its radially outer cross-sectional area.

To guarantee good positive-locking connection between the rib and the first area of the matrix, the rib should be provided with undercuts at its radially inner end area embedded into the first area of the matrix. Provisions are preferably made for a broadened foot, around which the first plastic material of the first area of the matrix extends, to be provided in the radially inner end area of the rib.

Depending on the field of use, the monofilament may have a single rib or a plurality of ribs, and the ribs should be preferably distributed uniformly over the circumference of the monofilament in case a plurality of ribs are arranged.

The rib or ribs may also extend straight axially parallel in the longitudinal direction of the monofilament, but it is also possible that the ribs extend around the matrix in the manner of a coil. This can be achieved especially if the monofilament is twisted in the known manner after the extrusion. The twisting is preferably performed at 50 to 400 revolutions per running meter.

Provisions may be made in a possible embodiment of the present invention for the first area to form the entire matrix, i.e., the matrix consists exclusively of the first plastic material, in which the rib or ribs is/are held in a positive-locking manner.

As an alternative, provisions may be made for the first area of the matrix to have a ring-shaped cross section and to surround at least an inner, second area of the matrix, which area consists of a third plastic material. The use properties of the monofilament or of the bristle manufactured from same can be adapted in this manner even better to the desired intended use.

To strengthen the holding of the ribs in the matrix, provisions may be made in a variant of the present invention for the ribs to be connected to one another by means of the inner, second area of the matrix.

The plastic materials may be selected extensively freely based on the positive-locking connection. Provisions may be made in a first possible embodiment for the first plastic material of the first area of the matrix to be a rigid thermoplastic polyester and especially PBT (polybutylene terephthalate). However, provisions may also be made, as an alternative, for the first plastic material of the first area of the matrix to be a soft thermoplastic plastic and especially a thermoplastic elastomer.

The second plastic material of the rib may also be a rigid thermoplastic polyester and especially PBT (polybutylene terephthalate) or a soft thermoplastic plastic and especially a thermoplastic elastomer.
The third plastic material of the inner, second area of the matrix may be selected freely within broad limits. If the ribs are connected to one another at their radially inner ends by means of the second area of the matrix, provisions are preferably made for the third plastic material of the second area of the matrix to be identical to the second plastic material of the ribs.

Provisions are made in a preferred embodiment of the present invention for at least one rib to be dyed and to be distinguished thereby in color from the rest of the monofilament. It is possible in this manner to visualize to the user the fact that the monofilament is twisted in order to thereby avoid confusion in the use of the monofilament.

Bristles, which are preferably used as toothbrush bristle, can be manufactured from the monofilament according to the present invention in the usual manner.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is the cross sectional view of a first embodiment of the monofilament according to the present invention;
FIG. 2 is the cross sectional view of a variant of the embodiment according to FIG. 1;
FIG. 3 is the cross sectional view of a second embodiment of the monofilament according to the present invention; and
FIG. 4 is a variant of the embodiment according to FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a cross section through a plastic monofilament 10, which has a matrix 11 comprising a first area 13 with a round cross section, which consists entirely of a first plastic material, for example, a rigid thermoplastic polyester. The monofilament 10 has three ribs 12, which project radially from the matrix 11 on the outside in the longitudinal direction, i.e., at right angles to the drawing plane. Each rib 12 has a triangular, radially outwardly tapering cross section and is held with its radially inner, broad end area in the matrix 11 in a positive-locking manner. Based on the positive-locking connection, the material of the ribs 12 can be selected freely, i.e., it does not depend on the type of the first plastic material of the matrix 11. The second plastic material of the ribs 12 is preferably a soft thermoplastic plastic.

The ribs 12 may also be held in the matrix 11 by means of bonding or welding in addition to the positive-locking connection.

FIG. 2 shows an exemplary embodiment very similar to that in FIG. 1 and differs from this only in that a broadened foot 15 each, which substantially improves the holding force that can be achieved by means of the positive-locking connection, is provided in the radially inner end area of the ribs 12.

FIG. 3 shows another exemplary embodiment of the monofilament 10 according to the present invention. The matrix 11 has a first area 13 consisting of a first plastic material, which area has a ring-shaped cross section. A second area 14 of the matrix, which area consists of a third plastic material, is arranged within the first, ring-shaped area 13. The ribs 12 are held in the ring-shaped first area 13 of the matrix 11 in a positive-locking manner and are in contact by their radially inner ends with the inner, second area 14 of the matrix 11. The ribs 12 are preferably connected to the inner, second area 14 of the matrix 11 by bonding or welding.

FIG. 4 shows an embodiment corresponding to the exemplary embodiment according to FIG. 3, which differs from the latter only in that the ribs 12 and the inner, second area 14 of the matrix consist of a uniform material and are designed as a monolithic body.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.

In the claims:

1. A plastic monofilament comprising:
   a matrix, which is comprised of a first plastic material at least in a first area; and
   a plurality of ribs, each of which extends in a longitudinal direction of the monofilament and each of which is comprised of a second plastic material and which is held in the first area of the matrix in a positive-locking manner, wherein the plurality of ribs are arranged distributed over the circumference of the monofilament and the first plastic material of the first area of the matrix is a rigid thermoplastic polyester, that the second plastic material of the ribs is a soft thermoplastic plastic, and that the monofilament is twisted with 50 to 400 revolutions per running meter, so that the ribs extend around the matrix in the form of a coil.

2. A monofilament in accordance with claim 1, wherein the rib is additionally welded to the first area of the matrix.

3. A monofilament in accordance with claim 1, wherein the rib has a radially outwardly tapering cross section.

4. A monofilament in accordance with claim 3, wherein the rib has a triangular or drop-shaped cross section providing an interface for the positive locking.

5. A monofilament in accordance with claim 1, wherein a broadened foot is formed in the radially inner end area of the rib providing an interface for the positive locking.

6. A monofilament in accordance with claim 1, the first area forms the entire matrix.

7. A monofilament in accordance with claim 1, wherein the first area of the matrix has a ring-shaped cross section and surrounds an inner, second area of the matrix, which is comprised of a third plastic material.

8. A monofilament in accordance with claim 7, wherein the ribs are connected to one another by means of the second area of the matrix.

9. A monofilament in accordance with claim 1, wherein the first plastic material of the first area of the matrix is PBT (polybutylene terephthalate).
10. A monofilament in accordance with claim 1, wherein the second plastic material of the rib is a thermoplastic elastomer.

11. A monofilament in accordance with claim 7, wherein the third plastic material of the second area is identical to the second plastic material of the rib.

12. A monofilament in accordance with claim 1, wherein at least one rib is colored at least in some sections.

13. A toothbrush bristle comprising a monofilament comprising:
   a matrix, which is comprised of a first plastic material at least in a first area; and
   a plurality of ribs, each of which extends in the longitudinal direction of the monofilament and each of which is comprised of a second plastic material and which is held in the first area of the matrix in a positive-locking manner wherein the plurality of ribs are arranged distributed over the circumference of the monofilament and the first plastic material of the first area of the matrix is a rigid thermoplastic polyester, that the second plastic material of the ribs is a soft thermoplastic plastic, and that the monofilament is twisted with 50 to 400 revolutions per running meter, so that the ribs extend around the matrix in the form of a coil.

14. A monofilament in accordance with claim 13, wherein the rib is additionally welded to the first area of the matrix.

15. A monofilament in accordance with claim 13, wherein the rib has a radially outwardly tapering cross section providing an interface for the positive locking.

16. A monofilament in accordance with claim 13, further comprising at least another rib to provide a plurality of ribs arranged distributed over the circumference of the monofilament.

17. A monofilament in accordance with claim 16, wherein the first area forms the entire matrix.

18. A monofilament in accordance with claim 13, wherein the first area of the matrix has a ring-shaped cross section and surrounds an inner, second area of the matrix, which is comprised of a third plastic material.

19. A monofilament in accordance with claim 18, wherein the ribs are connected to one another by means of the second area of the matrix.

20. A monofilament Monofilament in accordance with claim 13, wherein the first plastic material of the first area of the matrix (11) is PBT (polybutylene terephthalate).