

MOULDING METHOD FOR EXPANDABLE POLYPROPYLENE

FIELD

The present invention relates to a moulding method for expandable polypropylene, especially to a vacuum thermoforming process-combined secondary moulding method for expandable polypropylene.

BACKGROUND

Currently, foamed plastics have been widely applied in the fields of commodities, traffics, industrial productions, aeronautics and the like due to their superior properties such as low density, high specific strength, strong energy absorption ability and good performance in sound insulation and thermal insulation, etc.

In the manufacture of helmets such as those for bicycle, skiing/skating, ice hockey, mountain climbing, horse riding, aquatics, industrial uses, and the like, since there is a strict requirement for the strength of the final products, a vacuum thermoforming process is normally required for the expandable polypropylene plastic used in above products to further increase their strength.

Combination of the expandable polypropylene with the vacuum thermoforming process generally adopts a one-step integrate moulding method, which involves an operation of placing a thermoforming part into a EPP shape moulding mould, followed by incorporating expandable polypropylene and moulding. Although the expandable polypropylene can combine well with the thermoforming part, this method may pose an adverse influence on the appearance of the product. The main reason is that both the pressure and the temperature for moulding the expandable polypropylene are high, and the product may be affected as the temperature reaches 140°C. For example, the expandable polypropylene bead may mess up the

silk-screen printing ink on the blister, and thus affect the appearance of the product and lead to a degradation of quality.

SUMMARY

5 We describe a moulding method for producing an expandable polypropylene blister product with good appearance.

We specifically describe a moulding method for expandable polypropylene, comprising a step of silk screen printing on a blister sheet and a step of vacuum thermoforming the blister sheet to provide a thermoforming part, the method further comprises the following steps:

- 10 (1) foam moulding the expandable polypropylene to provide a EPP foam part;
- (2) spray coating the surface of the EPP foam part obtained in step (1) with ink; and
- (3) integrate moulding the EPP foam part obtained in step (2) and the thermoforming part.

15 The ink used in step (2) of the moulding method above may comprise an ink for expandable polypropylene.

The expandable polypropylene used in step (1) of the moulding method may comprise a modified expandable polypropylene.

The operating pressure for the integrate moulding in step (3) of the moulding method may be between 80 kPa to 100 kPa, and the operating temperature may be 140° C or less.

20 The operating temperature for the integrate moulding in step (3) of the moulding method may be between 120° C to 130° C.

The operating time for the integrate moulding in step (3) of the moulding method may be between 19 s to 25 s.

The thus obtained expandable polypropylene blister product may exhibit good impact resistance and possesses good appearance.

5 **BRIEF DESCRIPTION OF THE DRAWING**

Figure 1 is a flow chart showing a moulding method for expandable polypropylene plastic.

DETAILED DESCRIPTION

In order to further describe the principle and the structure of the moulding method, a
 10 detailed description of the examples will be made in reference to the accompanying drawing. However, the examples are only provided for illustration and explanation, which cannot be considered as a limitation of the protection scope of the present application.

Example 1

The moulding method will be exemplified with expandable polypropylene (EPP)
 15 below. As shown in Fig. 1, the moulding method includes 5 steps: silk screen printing of blister sheet, vacuum thermoforming and processing of blister sheet, foam moulding of EPP (first moulding), spray coating the surface of EPP foam with ink and integrate moulding of EPP foam part and thermoforming part (second moulding).

Step 1: silk screen printing of blister sheet

20 1) Silk screen printing with two layers of colour paint. Each silk screen printed layer is subjected to baking at 100° C for 5 min.

2) Silk screen printing with three layers of EPP adhesive paint. Each silk screen printed layer is subjected to baking at 100° C for 5 min. The next layer of ink is allowed for

subsequent silk screen printing after substantially cooling. The adhesive paint is an ink for expandable polypropylene, which can adhere to EPP moulded shape and thermoforming part.

Step 2: vacuum thermoforming and processing of blister sheet

1) Sheet baking. The blister sheet is subjected to baking at about 95° C for 90 min.

5 2) Adjusting the parameters of the vacuum thermoforming machine. Heating temperature is about 500° C, heating period is 18 s, and cooling period is 10 s.

3) Vacuum forming a thermoforming part with specific shape by using a vacuum thermoforming mould.

4) Processing the thermoforming part, including punching and trimming.

10 Step 3: injection foam moulding of EPP bead (first moulding).

1) Adjusting the parameters of the foam-moulding machine. The steam pressure is 300 kPa, the steaming period is 19 s, the cooling period is 60 s, the vacuum period is 25 s, and the temperature in the mould during moulding is about 150° C.

15 2) Turning on the machine, filling the materials, and conducting EPP shape moulding according to the parameter setting, and results in the production of an EPP foam part.

Step 4: spray coating the surface of EPP foam part with transparent ink. The ink is subjected to baking at 50°C for 15 min. The ink is an ink for expandable polypropylene, which plays an important role in bonding the thermoforming part with EPP foam part.

20 Step 5: integrate moulding of EPP foam part and thermoforming part (second moulding)

1) Placing the EPP foam part into the thermoforming part, and then placing them together into a EPP shape moulding mould.

2) Adjusting the parameters of foam-moulding machine. The steam pressure of the steam chamber is 80 kPa, the period is 19 s, the water cooling period is 90 s, the vacuum period is 10 s and the temperature in the mould during moulding is about 120° C, the ink can withstand at this temperature.

- 5 3) After demoulding, the thermoforming part and the EPP foam part are bonded together with good appearance.

Example 2

The moulding method will be exemplified with modified expandable polypropylene below. The moulding method includes 5 steps: silk screen printing of blister sheet, vacuum
10 thermoforming and processing of blister sheet, foam moulding of modified expandable polypropylene (first moulding), spray coating the surface of modified expandable polypropylene foam with ink, integrate moulding of modified expandable polypropylene foam part and thermoforming part (second moulding).

Step 1: silk screen printing of blister sheet

- 15 1) Silk screen printing with two layers of colour paint. Each silk screen printed layer is subjected to baking at 100° C for 5 min.

2) Silk screen printing with three layers of expandable polypropylene adhesive paint. Each silk screen printed layer is subjected to baking at 100° C for 5 min. The next layer of ink is allowed for subsequent silk screen printing after substantially cooling. The adhesive paint is
20 an ink for expandable polypropylene, which can adhere to modified expandable polypropylene bead and thermoforming part.

Step 2: vacuum thermoforming and processing of blister sheet

- 1) Sheet baking. The blister sheet is subjected to baking at about 95° C for 90 min.

2) Adjusting the parameters of the vacuum thermoforming machine. The heating temperature is about 500° C, the heating period is 18 s and the cooling period is 10 s.

3) Vacuum forming a thermoforming part with specific shape by using a vacuum thermoforming mould.

5 4) Processing the thermoforming part, including punching and trimming.

Step 3: injection foam moulding of modified expandable polypropylene bead (first moulding).

1) Adjusting the parameters of foam-moulding machine. The steam pressure is 500 kPa, the steaming period is 25 s, the cooling period is 60 s, the vacuum period is 25 s and the
10 temperature in the mould during moulding is about 150° C.

2) Turning on the machine, filling the materials, and conducting the foaming of modified expandable polypropylene according to the parameter setting, and results in the production of a modified EPP foam part

Step 4: spray coating the surface of modified expandable polypropylene foam part
15 with transparent ink. The ink is subjected to baking at 50°C for 15 min. The ink is ink for expandable polypropylene, which plays an important role in bonding thermoforming part with foam part.

Step 5: integrate moulding of modified expandable polypropylene foam part and thermoforming part (second moulding)

20 1) Placing the modified expandable polypropylene foam part into the thermoforming part, and then placing them together into a EPP shape moulding mould.

2) Adjusting the parameters of foam-moulding machine. The steam pressure of the steam chamber is 100 kPa, the period is 25 s, the cooling period is 90 s, the vacuum period is

10 s, the temperature in the mould during moulding is about 130° C, the ink can withstand at this temperature.

3) After demoulding, the thermoforming part and the EPP foam part are bonded together with good appearance.

5 In step 3 of Examples 1 and 2 above, the expandable polypropylene and the modified expandable polypropylene are moulded by injection foaming process. However, a skilled person in the art can understand that the expandable polypropylene and the modified expandable polypropylene can be moulded with any other methods capable of producing the desired shape, such as extrusion moulding, compression moulding and the like.

CLAIMS

1. A moulding method for expandable polypropylene, comprising the steps of silk screen printing on a blister sheet and vacuum thermoforming the printed blister sheet to provide a thermoforming part, in which the moulding method further comprises the following steps:

- (1) foam moulding the expandable polypropylene to provide a EPP foam part;
- (2) spray coating the surface of the EPP foam part obtained in step (1) with ink; and
- (3) integrate moulding the EPP foam part obtained in step (2) and the thermoforming part.

2. A moulding method for expandable polypropylene according to Claim 1, in which the ink is an ink for expandable polypropylene.

3. A moulding method for expandable polypropylene according to Claim 1 or 2, in which the expandable polypropylene in step (1) is modified expandable polypropylene.

4. A moulding method for expandable polypropylene according to Claim 1 or 2, in which the operating pressure for the integrate moulding in step (3) is 80 kPa to 100 kPa and the operating temperature is 140° C or less.

5. A moulding method for expandable polypropylene according to Claim 3, in which the operating pressure for the integrate moulding in step (3) is 80 kPa to 100 kPa and the operating temperature is 140° C or less.

6. A moulding method for expandable polypropylene according to Claim 4, in which the operating temperature for the integrate moulding in step (3) is 120° C to 130° C.

7. A moulding method for expandable polypropylene according to Claim 5, in which the operating temperature for the integrate moulding in step (3) is 120° C to 130° C.
8. A moulding method for expandable polypropylene according to Claim 6 or 7, in which the operating time for the integrate moulding in step (3) is 19 s to 25 s.