

PROCESS FOR PRODUCING METHACRYLIC RESIN MOLDING MATERIAL

FIELD OF THE INVENTION

[0001]

5 The present invention relates to a process for producing a methacrylic resin molding material.

BACKGROUND OF THE INVENTION

[0002]

10 The methacrylic resins have long been used for car lamp covers, lighting covers, signboards, optical lenses, transparent tableware, etc. due to their superior transparency and weatherability. Recently, they have also been used for stationary articles or containers having
15 relatively thick walls, accessories, etc. because of their transparency. These methacrylic resin moldings are generally produced by injection molding methods, and therefore, the methacrylic resins are processed into pellets and the pellets are supplied as molding materials
20 for the methods.

[0003]

 The typical injection molding method is outlined below. The injection molding machine used for the method is composed of a die, a die closing device for moving the die
25 in the die closing direction or the die opening direction,

and a device for injecting a molten resin into the closed die. The die consists of a core plate and a cavity plate, wherein a sprue for passing a molten resin therethrough is formed in the cavity plate, a runner and a gate are formed
5 along a parting line between the core plate and the cavity plate, and a cavity for molding an article between both plates is formed. In some cases, the cavity plate may be installed with a hot runner for passing a molten resin therethrough while keeping it warm, and may also be
10 structured such that the molten resin reaches through a hot chip to the gate formed along the parting line. The core plate may have a push-out device for taking out a molded article. The injection device is used for plasticizing and melting a molding material, and then injecting and filling
15 the molten material into the cavity of the die. The injection device is composed of a cylinder, a screw rotating in the cylinder, an injection nozzle attached to the top of the cylinder, a hopper for supplying a molding material into the cylinder, a motor for rotating the screw,
20 a ram mechanism for moving the screw forward, etc. The screw is equipped on its periphery with a heater for melting an internal molding material.

[0004]

The molding material is supplied into a cylinder by
25 the rotation of the screw, heated by an energized heater,

melt-kneaded under the shear and frictional heat and/or the pressure due to the rotation of the screw, fed into the top of the screw, and accumulated therein. At this time, the screw is gradually moved backward by the pressure of the molten resin accumulated in the top of the screw, and stopped when it is reached a desired position. When the screw gradually moves backward while rotating, the decomposed gases of the molten resin, air, water vapor, etc., which are caught in the resin, are exhausted backward by applying an appropriate back pressure from behind the screw, and degassed from a hopper part. Then, the screw is moved forward by a ram mechanism to inject and fill the molten resin into the cavity of the die from a nozzle and to apply a holding pressure for compensating a volumetric shrinkage caused by the cooling solidification of the molten resin. Then, the cooling of the molding in the die and the metering of a molten resin for the next molding are concurrently carried out. After the completion of cooling, the die is opened by moving the core plate to remove the molding.

[0005]

When a molding having a relatively thick wall or a large volume is produced by such injection molding methods, a large amount of molten resin must be accumulated in the cylinder in the step (a plasticization step) of feeding the

molten resin to the top of the screw and accumulating it therein, and therefore, a lot of time is needed for metering. In addition, when the molten resin filled in a die is cooled by the heat exchange with the die surface, it is likely that the predetermined dimensions of the molding are not obtained because of the mold shrinkage of the methacrylic resin if the molding is not sufficiently cooled and solidified up to its central layer. Therefore, a long cooling time is necessary, and one cycle time becomes longer.

[0006]

When a molding material in a molten state accumulates in a cylinder for a long time, as described above, the molding material as a whole melts more than necessary and the adhesion of the half-molten molding material (solid) staying in the channel of the screw with the cylinder inner wall is enhanced, so that it becomes hard to feed the molten resin forward. In addition, a molding material melts early in a supply zone of screw and the molten film is easily formed in the periphery of the screw, so that it becomes hard to exhaust the decomposed gases and/or water vapor during metering backward. Therefore, the feeding is delayed and thereby the decomposition of the molding material is further promoted, so that the generation of the decomposed gases is significantly increased. As a result,

the molten resin accumulates in the top of the screw while containing the decomposed gases and/or air therein due to lack of the degassing. When such a molten resin is filled in a die, bubbles may occur inside of the molding, and a defect of shiny silver streak, so-called "silver", caused by bubbles may occur on the surface of the molding.

[0007]

To solve such problems, for example, JP 08 217945 A (patent document 1) suggests to use, as a molding material, methacrylic resin pellets containing an amide compound attached to their surface and having an angle of repose adjusted to a predetermined range after attaching the amide compound thereto. There were, however, problems that a uniformity in angle of repose of the resulting methacrylic resin molding material was hard to obtain and an effect to inhibit the generation of the bubbles and/or the silver was hard to stably obtain when the molding material was applied to the injection molding methods.

[0008]

[Patent document 1] JP 08 217945 A

SUMMARY OF THE INVENTION

[0009]

Accordingly, an object of the present invention is to provide a process that can produce a methacrylic resin

molding material having a high uniformity in angle of repose.

[0010]

5 As the result of extensive researches, the present inventor found that the above-mentioned object can be achieved by attaching an amide compound to the surface of methacrylic resin pellets at a certain temperature, and thus, the present invention has been completed.

[0011]

10 Namely, the present invention provides a process for producing a methacrylic resin molding material, comprising attaching an amide compound to the surface of methacrylic resin pellets at not less than 35°C.

[0012]

15 According to the present invention, a methacrylic resin molding material having a high uniformity in angle of repose can be produced.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

20 [0013]

The present invention is explained in detail below. The methacrylic resin pellets to be used as a raw material in the present invention are pellets (granules) of a methacrylic resin composition containing a methacrylic
25 resin, or containing, in addition to the resin, mold

release agents, ultraviolet light absorbers, colorants, oxidation inhibitors, flame retarders and the like.

[0014]

The methacrylic resin may be a polymer obtained by
5 polymerizing a monomer mainly comprising methyl methacrylate, for example, a monomer comprising not less than 50% by weight of methyl methacrylate. The resin may be a homopolymer of methyl methacrylate, or may be a copolymer of not less than 50% by weight of methyl
10 methacrylate with not more than 50% by weight of a monomer other than methyl methacrylate. The monomer other than methyl methacrylate includes, for example, methacrylic acid esters such as ethyl methacrylate, propyl methacrylate, butyl methacrylate, benzyl methacrylate, 2-ethylhexyl
15 methacrylate, cyclohexyl methacrylate, bornyl methacrylate, adamantyl methacrylate, and cyclopentadienyl methacrylate; acrylic acid esters such as methyl acrylate, ethyl acrylate, propyl acrylate, butyl acrylate, benzyl acrylate, 2-ethylhexyl acrylate, cyclohexyl acrylate, bornyl acrylate,
20 adamantyl acrylate, and cyclopentadienyl acrylate; unsaturated carboxylic acids and acid anhydrides thereof such as acrylic acid, methacrylic acid, maleic acid, itaconic acid, maleic anhydride, and itaconic anhydride; hydroxyl group-containing monomers such as 2-hydroxyethyl
25 acrylate, 2-hydroxypropyl acrylate, monoglycerol acrylate,

2-hydroxyethyl methacrylate, 2-hydroxypropyl methacrylate, and monoglycerol methacrylate; nitrogen-containing monomers such as acrylamide, methacrylamide, acrylonitrile, methacrylonitrile, diacetone acrylamide, and
5 dimethylaminoethyl methacrylate; epoxy containing monomers such as allyl glycidyl ether, glycidyl acrylate, and glycidyl methacrylate; styrene monomers such as styrene, and α -methylstyrene; and the like.

[0015]

10 The methacrylic resin can be produced, for example, by mass polymerization, preferably by continuous mass polymerization. According to the continuous mass polymerization, the methacrylic resin having an improved transparency can be produced with reducing impurities as
15 much as possible. Then, the resin can be formed into a strand, and the strand can be cut off to provide methacrylic resin pellets. In this case, the forming can be conducted by using an apparatus consisting of an extruder having a heating cylinder and a screw rotating
20 therein, for example, a single screw extruder, a twin screw extruder or a vent-type extruder, and a die having a plurality of holes placed at the exit of the extruder.

[0016]

Thus obtained strand in a molten state is cooled and
25 cut off, for example, by a water stream strand cutting

method, into pellets (molding material) having a diameter of from 2 to 4 mm and a length of from 2 to 5 mm. The water stream strand cutting method used herein is a method comprising cooling a strand in a molten state by moving the strand down on a falling chute with a water film formed by a cooling water and cutting off the cooled strand into pellets.

[0017]

The methacrylic resin pellets can be also produced by melt-kneading a methacrylic resin in an extruder, extruding the resin from die holes, and cutting off the extrudate into pellets when the extrudate is attained a predetermined length.

[0018]

The methacrylic resin molding material can be produced by attaching an amide compound to the surface of thus obtained methacrylic resin pellets. In the present invention, the attaching temperature is not less than 35°C. By attaching an amide compound to the surface of methacrylic resin pellets at the predetermined temperature, the uniformity in angle of repose of the resulting methacrylic resin molding material can be increased, and an effect to inhibit the generation of bubbles and/or the silver can be stably obtained when the molding material is applied to injection molding methods. The attaching

temperature is preferably from 40 to 100°C, and more preferably from 40 to 80°C.

[0019]

The amide compound may be, for example, a monoamide
5 compound or a bisamide compound, but preferably a bisamide compound.

The monoamide compound includes, preferably, an aliphatic monoamide compound represented by the formula: $RCONH_2$ [wherein R represents a monovalent aliphatic
10 hydrocarbon group], and specific examples thereof include stearamide, palmitamide, oleamide, erucamide, and the like.

The bisamide compound includes, preferably, an aliphatic bisamide compound represented by the formula: $R^1CONH-R^2-NHCOR^3$ [wherein each of R^1 and R^3 represents a
15 monovalent aliphatic hydrocarbon group, and R^2 represents a divalent aliphatic hydrocarbon group], and specific examples thereof include methylene bis stearamide, ethylene bis stearamide, ethylene bis oleamide, hexamethylene bis stearamide, methylene bis stearamide, ethylene bis
20 stearamide, and the like.

[0020]

The amount of the amide compound to be used is generally from 0.003 to 0.5 part by weight, and preferably from 0.008 to 0.015 part by weight, based on 100 parts by
25 weight of the methacrylic resin pellets. If the amount of

the amide compound to be used is too small, the effect to inhibit the generation of bubbles and/or the silver becomes hard to obtain when the molding material is applied to injection molding methods. If the amount of the amide
5 compound to be used is too much, the metering of the molding material becomes hard to carry out because of their excessive slipperiness when the molding material is applied to injection molding methods.

[0021]

10 The melting point of the amide compound is preferably from 30 to 200°C, and more preferably from 70 to 170°C. If the melting point is too low, the resulting methacrylic resin molding material becomes sticky. If the melting point is too high, the amide compound becomes hard to
15 attach to the methacrylic resin pellets.

[0022]

The method for attaching the amide compound to the surface of methacrylic resin pellets includes, for example, a method comprising mixing the methacrylic resin pellets
20 and the amide compound by stirring, etc., a method comprising spraying the amide compound to the methacrylic resin pellets, and the like. In the method, an aqueous solution of the amide compound may be used, and in this case, it is preferable to dry the pellets after the
25 attaching step. In addition, the attaching step may be

carried out before or after accumulating the methacrylic resin in the hopper of an injection molding machine, etc.

[0023]

5 The attaching temperature may be adjusted, for example, by heating the methacrylic resin pellets and/or the amide compounds before attaching or by heating an atmospheric gas in the attaching system. The heating may be carried out such that the temperature of the pellets, particularly the surface temperature of the pellets, in the attaching step
10 is within the above-mentioned range of the attaching temperature. In addition, the attaching time can be appropriately adjusted, but it is generally from about 10 seconds to 10 minutes.

[0024]

15 Thus obtained methacrylic resin molding material can be optionally subjected to a pretreatment such as predrying, and then can be preferably used as a material for melt molding methods including injection molding methods. In particular, the methacrylic resin molding material can be
20 preferably used as an injection molding material for producing a molding having a relatively thick wall (e.g. not less than 3 mm) or a large volume.

EXAMPLES

25 [0025]

The present invention will be illustrated by the following examples, which do not limit the scope of the present invention in any way.

[0026]

5 Examples 1 to 3 and Comparative Example 1

The "SUMIPEX LG2" (transparent), manufactured by Sumitomo Chemical Co., Ltd., was used as methacrylic resin pellets. The "KAO WAX EB-FF" (ethylene bis stearamide, melting point: from 141.5 to 146.5°C), manufactured by Kao Corporation, was used as an amide compound.

[0027]

Firstly, 3,000 g of the methacrylic resin pellets was heated by an oven to the temperatures shown in Table 1 and added into a plastic bag. Subsequently, 0.36 g of the amide compound was added into the plastic bag, and then, the plastic bag was closed and shaken up for 30 seconds. At that time, the temperature of the pellets in the plastic bag was measured as an attaching temperature. The results are shown in Table 1.

20 [0028]

Secondly, 300 g of the pellets containing the amide compound attached thereto was taken out from the plastic bag eight times. Each sample was left overnight (for 15 hours) at a room temperature. After that, 200 g of pellets was taken out from each sample and measured for an angle of

repose with a rotating-type angle of repose measuring instrument. The angle of repose of each sample is shown along with the mean and its standard deviation in Table 1. In addition, the angle of repose of the pellets without the
5 amide compound was 36°.

[0029]

Table 1

Examples	Heating Temp. (°C)	Attaching Temp. (°C)	Angle of repose (°)								S.D.	
			No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8		Ave.
Comparative Example 1	20 (w/o heating)	17.5	30	29	29	29	31	31	29	29	29.63	0.916
Example 1	40	35.8	29	29	29	29	29	29	29	28	28.88	0.354
Example 2	60	54.1	28	29	29	29	29	28	29	29	28.75	0.463
Example 3	80	75.3	28	29	28	29	29	29	28	29	28.50	0.535

[0030]

The present application has been filed claiming the Paris Convention priority based on the Japanese Patent Application No. 2007-223701 (filed on August 30, 2007), the
5 entire content of which is herein incorporated by reference.

WHAT IS CLAIMED IS:

1. A process for producing a methacrylic resin molding material, comprising attaching an amide compound to the surface of methacrylic resin
5 pellets at not less than 35°C by stirring a mixture consisting of methacrylic resin pellets and an amide compound.
2. The process of claim 1, wherein the amount of the amide compound to be used is from 0.003 to 0.05 part by weight, based on 100 parts by weight of
10 the methacrylic resin pellets.
3. The process of claim 1 or 2, wherein the amide compound is a bisamide compound.