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(72) Inventeur/Inventor:
BECKMANN, FRIEDHELM, DE

(73) Propriétaire/Owner:
MOELLER PLAST GMBH, DE

(74) Agent: SHAPIRO COHEN

(54) Titre : METHODE ET DISPOSITIF POUR LA PRODUCTION D'UN COMPOSANT PLASTIQUE RENFORCE AINSI QU'UN COMPOSANT PRODUIT EN Y FAISANT APPEL

(54) Title: METHOD AND DEVICE FOR PRODUCING A REINFORCED PLASTIC COMPONENT, AS WELL AS A COMPONENT PRODUCED THEREBY

(57) Abrégé/Abstract:
The invention relates to a method for the production f a reinforced plastic component, in particular, by injection moulding, extruding or extrusion blowing, whereby a thermoplastic base material is prepared as a melt and a reinforcing material obtained from plant material is introduced. Said reinforcing material is in the form of comminuted shavings which may be poured and dispensed, in particular, derived from annual plants and/or similarly comminuted woody components from china red. The above material is added to the melt of the base material and mixed to give a homogeneous material, whereby the reinforcing material essentially contains no fractions of fibrous material which effect the ability thereof to be poured or dispensed.

Abstract

The invention relates to a method for the production f a reinforced plastic component, in particular, by injection moulding, extruding or extrusion blowing, whereby a thermoplastic base material is prepared as a melt and a reinforcing material obtained from plant material is introduced. Said reinforcing material is in the form of comminuted shavings which may be poured and dispensed, in particular, derived from annual plants and/or similarly comminuted woody components from china red. The above material is added to the melt of the base material and mixed to give a homogeneous material, whereby the reinforcing material essentially contains no fractions of fibrous material which effect the ability thereof to be poured or dispensed.

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METHOD AND DEVICE FOR PRODUCING A REINFORCED PLASTIC COMPONENT, AS WELL AS A COMPONENT PRODUCED THEREBY

The invention relates to a method for producing a reinforced plastic component, particularly by injection molding, extrusion, or extrusion blowing, in which a thermoplastic base material is prepared as a melt and a reinforcing material, obtained from plant materials, is introduced. The invention furthermore relates to a device for producing a reinforced plastic component, particularly for implementing the inventive method, having a feed station for feeding in thermoplastic material that is to be treated, and a plasticizing and mixing segment for plasticizing and homogenizing the base material. Furthermore, the invention relates to a reinforced plastic component, particularly a component produced by injection molding, extrusion, or extrusion blowing, having a thermoplastic base material and a reinforcing material obtained from plant materials.

In the production of components made from a thermoplastic base material, the usual processing methods for thermoplastic materials, such as injection molding, extrusion blowing, profile extrusion, etc., are generally employed. Such components are used in many different kinds of industries, for example the automotive industry, the construction industry, and the electrical industry. In most cases, components having a high degree of component rigidity are required. In such cases, fiberglass can be added as reinforcing material, in the form of short glass fibers having a length of 1 mm to 4 mm, or in the form of long glass fibers having a length of 10 mm to 12 mm. However, since fiberglass has disadvantageous recycling properties and results in pollution-causing residues in the case of thermal recycling, attempts have been made to replace fiberglass with natural fibers, for example of flax, hemp, jute, sisal, kenaf, ramie, or nettle plants. Since the length of the fibers, which are to be used with the methods mentioned, is limited, the homogeneous introduction of the fibers into a plastic melt is a major problem.

One possible procedure is to produce a card sliver first by parallelizing the fibers and, subsequently, to spin this into a yarn, by twisting. The yarn is then impregnated with a plastic melt in an extrusion system, and cut to the desired length in a subsequent cutting unit. This method is complicated and expensive.

It is not possible to introduce natural fibers into a melt directly, since the natural fibers become felted or tangled and cannot be mixed into a melt homogeneously.

It is an object of the invention to provide a method and a device, with which it is possible to mix a reinforcing material obtained from plant materials homogeneously into a plasticized base material in the simplest manner possible.

In accordance with a first aspect of the present invention, there is provided a method for producing a reinforced plastic object, comprising:

homogeneously mixing a reinforcing material comprised of at least one selected from the group consisting of: comminuted shives and comminuted woody components of China reed into a melt of a thermoplastic base material, the reinforcing material being pourable; and

shaping the resultant mixture into a reinforced plastic object, wherein

said shives are of a length of between 0.5 mm and 10 mm,

said shaping comprises a step selected from injection molding, extrusion, and extrusion blowing, and

said thermoplastic base material comprises at least one selected from the group consisting of a thermoplastic polymer and a biological material.

In accordance with a second aspect of the present invention, there is provided a device for producing a reinforced plastic object, having a first feed station for feeding in thermoplastic base material that is to be treated, and a plasticizing and mixing means for plasticizing and homogenizing the base material, and a second feed station provided proximate the plasticizing and mixing means constructed and arranged to receive dumpable or pourable reinforcing material comprising material selected from comminuted shives and comminuted woody components of China reed.

In accordance with a third aspect of the present invention, there is provided a reinforced plastic object produced by a process selected from injection molding, extrusion and extrusion blowing, comprising a thermoplastic base material and a reinforcing material obtained from plant materials, wherein the reinforcing material comprises material in dumpable or pourable form selected from comminuted shives and comminuted woody components of China reed.

With regard to the method, this objective is accomplished in that comminuted shives, particularly of annual plants, and/or similarly comminuted woody components of China reed (i.e. in a dumpable or pourable form) are supplied in a dumpable and pourable form to the melt of the base material as a reinforcing material, and are mixed homogeneously into it, the reinforcing material not containing any portions of (residual) fiber material, which significantly impair the dumpability of pourability.

The shives or the woody components of the China reed can be comminuted either in advance of or directly in conjunction with the preparation of the thermoplastic material and the production of components.

Preferably, shives of green starting material are used. Green starting material is understood to be plant material, such as straw of flax or hemp, which remains outdoors or on the field several days, such as five to eight days, after

having been harvested, so that the green shives retain almost their original strength, in contrast to so-called land retted material, which remains on the field for approximately five to eight weeks.

Preferably, the length of the shives is 0.5 mm to 10 mm, preferably 0.5 mm to 5 mm and especially 0.5 mm to 3 mm.

Preferably, shives of flax and/or hemp and/or kenaf are used.

In an embodiment of the invention, additional reinforcing materials, such as glass fibers and/or natural fibers, are used (particularly in a separate step of the method).

Compatibility-producing agents may be used, particularly in an amount of between 0.5 and 3 %, for example when polypropylene is the base material.

A thermoplastic plastic and/or a biological material, such as lignin or PHB (polyhydroxybutyrate), may be used as the thermoplastic base material.

Shives have a porous, sponge-like structure, which does not withstand the high pressure, which occurs during extrusion, for example, and results in compacting and an undesirable partial loss of the weight advantage, particularly in conjunction with the higher temperatures, which are unavoidable in the processing of thermoplastic materials. Therefore, in a further embodiment of the invention, before the reinforcing material (in the form of comminuted shives or comminuted woody components of China reed) is introduced into a thermoplastic base material, a stabilizing material may be introduced into the pores of the reinforcing material and/or the reinforcing material is mantled with the stabilizing material, so that the latter has a greater resistance to compression.

The pores and cavities of the reinforcing material may be filled with the stabilizing material to the greatest possible extent, for example, by dipping the material into a correspondingly liquid stabilizing material. Alternatively, the reinforcing material can be coated essentially exclusively, for example, by being sprayed with a highly viscous material, which is cured as rapidly as possible.

The stabilizing material may be applied by means of spraying and/or by dip impregnation.

A foamable stabilizing material may be used so that the weight advantage of shives, for example, can largely be maintained.

A first stabilizing material may be applied in a first step and at least one other stabilizing material in at least one other step.

Sodium silicate, epoxide resin, expandable epoxide resin and/or varnish-like substances can be used as the stabilizing material.

Synthetic and/or biological materials may be used as the stabilizing material.

The stabilizing material may be cured thermally at a temperature between 100°C and 220°C, preferably between about 120°C and 200°C and especially between about 120°C and 150°C.

In a concrete embodiment, sodium silicate, for example, may be used and is applied to shives by the spray method or by dip impregnation. The sponge-like structure of the shives absorbs the sodium silicate solution because of the high hygroscopicity or by capillary action, the amount metered being determined by the spray method itself or by the residence time in a dip bath.

Alternatively, an expandable epoxy resin may be applied to the shives in similar process steps and expanded and cured in a subsequent heating segment or by supplying other energy. At the same time, the resin penetrates into the pore structures and simultaneously envelops the shives with a protective layer.

Alternatively, or in addition, varnish-like substances or liquid synthetic and/or biological materials with low viscosity, such as lignin or PHB, can be applied, which also result in stabilizing layers.

The stabilizing material can be selected from the point of view that the shives are embedded in a biological base material for producing components, so that there should also be a biological base for the stabilizing material, or from the point of view that the reinforcing material (such as shives) is introduced into a plastic melt, the stabilizing material then being a similar or compatible plastic material. In each case, the stabilizing material should result in increased resistance, so that porous materials, such as shives in particular, are less easily compressed during processing by extrusion, for example, the product also being resistant to temperatures up to about 200°C.

From the point of view of the device, the object of the invention is accomplished in that a second feed station for dumpable or pourable reinforcing material in the form of comminuted shives and/or comminuted woody components of China reed is disposed in the region of the plasticizing and mixing segment.

Downstream from the plasticizing and mixing segment, a mixing device for homogeneously mixing the reinforcing material into the base material can be provided.

A comminuting device for comminuting shives to a size between 0.5 mm and 10 mm, preferably 0.5 mm and 5 mm, and further preferably between 0.5 mm and 3 mm, may be present.

An inventive, plastic component, particularly an injection molded component, an extrusion component, or an extrusion blowing component, having a thermoplastic base material and a reinforcing material obtained from plant materials, is distinguished, pursuant to the invention, in that the reinforcing material comprises comminuted shives in dumpable or pourable form, particularly of annual plants such as flax or hemp, and/or similarly comminuted woody components of China reed.

Preferably, shives of "green" starting material (green shives), as explained above, are used. Preferably, the length of the shives is between about 0.5 mm and 10 mm, especially between 0.5 mm and 5 mm and particularly between 0.5 mm and 3 mm.

Preferably, shives of flax and/or hemp and/or kenaf are used.

Additional reinforcing material, such as glass fibers and/or natural fibers, may be contained.

Advisably, the thermoplastic base material consists of thermoplastic plastic and/or of a biological material such as lignin or PHB. These biological materials combine with the shives very well, even without an adhesion-imparting agent. Lignin, in particular, is characterized by good material properties with relation to high strength, impact resistance, and rigidity. Lignin occurs in large amounts as a by-product of cellulose production, and is thereby available inexpensively and in sufficient amounts.

The great advantage of the inventive method lies therein that the reinforcing material can be mixed directly into the flowing melt already while the thermoplastic starting material is being worked up or plasticized and homogenized in the form of a melt, so that an additional, cost-intensive process step is avoided.

In this connection, it is a prerequisite that only small portions of fiber material, if any, are contained in the shives, so that the pourable or dumpable consistency is maintained. China reed is already a pure, that is fiber-free, product which only has to be comminuted and in which there is no residual fiber.

Pursuant to the invention, reinforcing material can be mixed into the composition in an injection-molding machine, an extrusion machine, or an extrusion-blowing machine, for example, a second feed device for the dumpable or pourable reinforcing material being provided in the region subsequent to, that is, downstream from a plasticizing and mixing segment. Because of the dumpable or pourable consistency of the reinforcing material, there is no tendency to form lumps or to become felted, so that direct feed into a melt stream can be metered very well, and the material is absorbed uniformly by the melt, and therefore can be mixed homogeneously. For practical purposes, a part of the plasticizing and/or mixing segment of the extruder should still follow the second feed station, or a subsequent mixing and/or homogenization segment should be arranged, in order to ensure homogeneous mixing.

In addition, if the shives are not already delivered in the required comminuted state, a comminuting device for comminuting the shives to the stated size can be disposed on the device.

We Claim:

1. A method for producing a reinforced plastic object, comprising:

homogeneously mixing a reinforcing material comprised of at least one selected from the group consisting of: comminuted shives and comminuted woody components of China reed into a melt of a thermoplastic base material, the reinforcing material being pourable; and

shaping the resultant mixture into a reinforced plastic object, wherein

said shives are of a length of between 0.5 mm and 10 mm,

said shaping comprises a step selected from injection molding, extrusion, and extrusion blowing, and

said thermoplastic base material comprises at least one selected from the group consisting of a thermoplastic polymer and a biological material.

2. The method of claim 1, wherein the shives comprise shives of green starting material.

3. The method of claim 1 or claim 2, wherein the shives comprise at least one selected from the group consisting of flax, hemp, and kenaf.

4. The method of claim 1, wherein the reinforcing material comprises at least one selected from the group consisting of fibreglass and natural fibers.

5. The method of claim 1, further comprising admixing with the reinforcing material at least one agent which improves compatibility of the reinforcing material with the base material.

6. The method of claim 1, further comprising admixing with the reinforcing material at least one agent which improves adhesion of the reinforcing material to the base material.

7. The method of claim 1, further comprising, before the mixing of the reinforcing material into the base material, applying a stabilizing material to the reinforcing material thereby to perform at least one of introduction of the stabilizing material into pores and cavities of the reinforcing material and encasing of the reinforcing material with the stabilizing material, so that the reinforcing material has a greater resistance to compression.

8. The method of claim 7, wherein the pores and cavities of the reinforcing material are substantially completely filled with the stabilizing material.

9. The method of claim 7, wherein the reinforcing material is substantially encased by the stabilizing material.

10. The method of claim 7, wherein the applying of the stabilizing material is by at least one selected from the group consisting of spraying and dip impregnation.

11. The method of claim 7, wherein the stabilizing material is foamable.

12. The method of claim 7, further comprising applying a second stabilizing material, said stabilizing material and said second stabilizing material each being applied in a respective step.

13. The method of claim 7, wherein the stabilizing is at least one selected from the group consisting of sodium silicate, epoxy resin, expandable epoxy resin and substances which act as varnishes.

14. The method of claim 7, wherein the stabilizing material is at least one selected from the group consisting of synthetic and biological materials.

15. The method of claim 7, further comprising curing the stabilizing material thermally at a temperature of between 100°C and 220°C.

16. A reinforced plastic component which is a product of the method of any one of claims 1, 2, 4 or 7.

17. The method of claim 1, wherein the shives comprise shives of annual plants.

18. The method of claim 1, wherein the shives are of a length of between 0.5 mm and 5 mm.

19. The method of claim 1, wherein the shives are of a length of between 0.5 mm and 3 mm.

20. The method of claim 5, wherein said at least one agent is in a proportion of between 0.5 and 3% of the weight of the reinforcing material.

21. The method of claim 1, wherein the thermoplastic base material comprises at least one selected from the group consisting of lignin and PHB.

22. The method of claim 11, wherein the foamable stabilizing material comprises an epoxy resin.

23. The method of claim 15, wherein the curing temperature is between 120°C and 200°C.

24. The method of claim 15, wherein the curing temperature is between 120°C and 150°C.

25. The method of claim 1, further comprising, before mixing the reinforcing material into the base material, providing the base material in a solid state to a first processing station and melting and stirring the base material at said first station and subsequently providing the melt of the base material to a second processing station wherein the homogenous mixing of the reinforcing material into the base material is carried out.

26. A reinforced plastic object produced by a process selected from injection molding, extrusion and extrusion blowing, comprising a thermoplastic base material and a reinforcing material obtained from plant materials, wherein the reinforcing material comprises material in dumpable or pourable form selected from comminuted shives and comminuted woody components of China reed.

27. The reinforced plastic object of claim 26, wherein the shives comprise shives of green starting material.

28. The reinforced plastic object of claim 26 or claim 27, wherein the shives have a length between 0.5 mm and 10 mm.

29. The reinforced plastic object of claim 28, wherein the shives have a length between 0.5 mm and 5 mm.

30. The reinforced plastic object of claim 28, wherein the shives have a length between 0.5 mm and 3 mm.

31. The reinforced plastic object of any one of claims 26 to 30, further comprising additional reinforced material selected from at least one of glass fibers and natural fibers.

32. The reinforced plastic object of any one of claims 26 to 31, wherein the thermoplastic base material is selected from at least one of thermoplastic plastic and a biological material selected from lignin and PHB.

33. The reinforced plastic object of any one of claims 26 to 32, wherein the reinforcing material is subjected to a process selected from filling and mantling with a stabilized material before being mixed into the base material.