

DESCRIPTION

METHOD FOR MANUFACTURING A FLEXIBLE SHEET

5

TECHNICAL FIELD

[0001]

The present invention relates to a method for manufacturing a flexible sheet such as a sheet gasket. More specifically, the present invention relates to a method for manufacturing a flexible sheet that is provided with a homogeneous property and that is obtained by cutting and rolling a mixture that has been extruded and molded by using an extrusion machine.

BACKGROUND ART

15 [0002]

A filled fluororesin sheet is produced by filling a fluorine resin containing a filler and by processing the fluorine resin in a sheet shape. The filled fluororesin sheet is provided with a function and a characteristic that are peculiar to a filler in addition to a chemical resistance property, a heat resistance property, a nonadhesive property, and a low frictional property with which a fluorine resin is provided. The filled fluororesin sheet is used in a variety of ways for a seal material or the like by improving a wear and abrasion resistance property and a creep

resistance property that are weak points of a fluorine resin.

[0003]

As a method for manufacturing a flexible sheet that is typified by the filled fluororesin sheet, a forming method is adopted in which the materials are stirred and mixed, a mixture that is obtained by heating the materials is extruded in a plate shape by using an extrusion machine, and the mixture is cut and rolled in a sheet shape.

[0004]

Fig. 4 and Fig. 5 are the explanatory drawings of a method for manufacturing a flexible sheet in accordance with the conventional art. Fig. 4 shows an extrusion process in which a material 110 is extruded and molded as a continuous long object 120 in a sheet shape by using an extrusion machine 100. Fig. 5 shows a process in which a continuous long object 120 in a sheet shape is cut and rolled to form a flexible sheet 130.

[0005]

As shown in Fig. 4, the material 110 that has been input in a hopper 104 is heated and pressurized in a cylinder 108 to be integrated. The integrated material 110 is extruded in a leading end direction of the extrusion machine 100 and passes through a die 102 that is mounted at a leading end the extrusion machine 100. The die 102 is a co-called flat die for extruding and molding a mixture, that is, the material 110 in a mixed state, in a sheet

shape. The mixture passes through a cross sectional opening 102a of the die 102, whereby the continuous long object 120 in a sheet shape is extruded.

[0006]

5 In the next place, the continuous long object 120 in a sheet shape that has been formed by using the extrusion machine 100 is cut in the prescribed dimensions in a cutting process that is shown in Fig. 5(A) to obtain a cut object 122. The cut object 122 is then folded and rolled to be in the prescribed thickness in a
10 repetitive manner in a rolling process that is shown in Fig. 5(B). At this time, the cut object 122 is folded and rolled in a repetitive manner in order to remove an internal air gap and to provide strength by orientating a molecular chain. In other words, a great number of rolling steps is required in order to accelerate
15 a fiber forming step of a fluorine resin. In addition, an edge part 124 of the sheet that has been dried and deteriorated due to a repeated rolling step is cut as shown in Fig. 5(C). After that, a flexible sheet 130 is produced as shown in Fig. 5(D) after a variety of processes such as a drying process, a burning process,
20 and a modifying process that are not shown in the figure.

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0007]

The rolling process takes over a large weight in a manufacturing process of a flexible sheet in the above described forming process. Consequently, it is necessary that the rolling process is foreshortened in order to encourage the efficiency of a manufacturing process of a flexible sheet.

[0008]

The present invention was made in consideration of such conditions, and an object of the present invention is to provide a method for manufacturing a flexible sheet that is provided with a homogeneous property in a more efficient manner as compared with a conventional method.

MEANS FOR SOLVING THE PROBLEMS

[0009]

The present invention was made in order to solve the above problems of the conventional art and to achieve the purpose described above. A method for manufacturing a flexible sheet in accordance with the present invention is characterized by comprising:

an extrusion process for preparing a mixture that is a raw material of the flexible sheet and a die that is provided with a cross sectional opening through which the mixture passes, and forming a continuous long object by making the mixture pass through the cross sectional opening of the die;

a cutting process for obtaining a prescribed cut object by cutting the continuous long object that has been formed in the extrusion process; and

a rolling process for forming a sheet by rolling the
5 prescribed cut object that has been obtained in the cutting process,

wherein a material of the mixture is a composition in which a mineral filler is compounded in a fluorine resin, and

a cross sectional shape of the continuous long object that
10 has been formed in the extrusion process is in the form of a ring.
[0010]

In accordance with the above configuration of the present invention, a fiber forming step of a fluorine resin in the extrusion process can be accelerated by increasing an extrusion
15 rate in the extrusion process, whereby a number of rolling steps can be reduced in the rolling process. In addition, the available percentage efficiency can also be improved, whereby a flexible sheet can be produced in a more efficient manner as compared with a conventional method.

20 [0011]

The method for manufacturing a flexible sheet in accordance with the present invention is characterized in that the fluorine resin is a polytetrafluoroethylene resin.

[0012]

In accordance with the above configuration of the present invention, a flexible sheet that is provided with a homogeneous property can be produced with less rolling steps, whereby an effect of the present invention can be achieved in a prominent manner.

5 [0013]

The method for manufacturing a flexible sheet in accordance with the present invention is characterized in that a rate of the mineral filler in a material of the mixture is at least 20% of part weight.

10 [0014]

In accordance with the above configuration of the present invention, a flexible sheet that is provided with a homogeneous property can be produced with less rolling steps, whereby an effect of the present invention can be achieved in a prominent manner.

15 [0015]

The method for manufacturing a flexible sheet in accordance with the present invention is characterized in that an extrusion rate in the extrusion process is in the range of 5 to 10.

[0016]

20 In accordance with the above configuration of the present invention, the efficiency in the extrusion process is not deteriorated and a flexible sheet can be produced with less rolling steps in a more efficient manner as compared with a conventional method.

EFFECT OF THE INVENTION

[0017]

By the method for manufacturing a flexible sheet in accordance with the present invention, a fiber forming step of a fluorine resin in the extrusion process can be accelerated by increasing an extrusion rate in the extrusion process, whereby the rolling process can be foreshortened as compared with a conventional method. In addition, the available percentage efficiency can also be improved, whereby a flexible sheet can be produced in a more efficient manner as compared with a conventional method.

BRIEF DESCRIPTION OF THE DRAWINGS

15 [0018]

Fig. 1 is a view showing an extrusion process for a method for manufacturing a flexible sheet in accordance with the present invention.

Fig. 2 is a view showing a process for forming a flexible sheet by cutting and rolling for a method for manufacturing a flexible sheet in accordance with the present invention.

Fig. 3 is a view showing a cross sectional shape of another continuous long object in accordance with the present invention.

Fig. 4 is a view showing an extrusion process for a method

for manufacturing a flexible sheet in accordance with the conventional art.

Fig. 5 is a view showing a process for forming a flexible sheet by cutting and rolling for a method for manufacturing a flexible sheet in accordance with the conventional art.

BEST MODE OF CARRYING OUT THE INVENTION

[0019]

An embodiment of the present invention will be described below in detail with reference to the drawings. While the preferred embodiments in accordance with the present invention will be described below, the present invention is not restricted to the embodiments.

[0020]

Fig. 1 and Fig. 2 are the explanatory drawings of a method for manufacturing a flexible sheet in accordance with the present invention. Fig. 1 shows an extrusion process in which a material 10 is extruded and molded as a continuous long object 20 in a circular ring shape by using an extrusion machine 1. Fig. 2 shows a process in which a continuous long object 20 in a circular ring shape is cut and rolled to form a flexible sheet 30.

[0021]

As shown in Fig. 1, a material 10 that has been input in a hopper 4 is heated in a cylinder 8 to be in a mixed state. It

is preferable that the material 10 is a composition in which a mineral filler is compounded in a polytetrafluoroethylene resin.

[0022]

The material 10 that has been in a mixed state is extruded
5 in a leading end direction of the extrusion machine 1 and passes
through a die 2 that is mounted at a leading end the extrusion
machine 1. The die 2 is a so-called circular die for extruding
and molding a mixture, that is, the material 10 in a mixed state,
in a circular ring shape. The mixture passes through a cross
10 sectional opening 2a of the die 2, whereby the continuous long
object 20 in a circular ring shape is extruded.

[0023]

In the next place, the continuous long object 20 in a
circular ring shape that has been formed by using the extrusion
15 machine 1 is cut in the prescribed dimensions in a cutting process
that is shown in Fig. 2(A) to obtain a cut object 22. The cut object
22 is then pressed and expanded in a plate shape, and is rolled
to be in the prescribed thickness in a repetitive manner in a
rolling process that is shown in Fig. 2(B). After that, a flexible
20 sheet 30 is produced as shown in Fig. 2(C) after a variety of
processes such as a drying process, a burning process, and a
modifying process that are not shown in the figure.

[0024]

As the extrusion machine that is used in the extrusion

process, there can be used an extrusion machine that has been used widely such as an oil hydraulic press type extrusion machine and a screw type extrusion machine. In addition, as the rolling machine that is used in the rolling process, a rolling machine that has been used widely can be used. The continuous long object 20 can be cut in the extrusion machine 1 immediately after the continuous long object 20 passes through the cross sectional opening 2a, whereby the cutting process and the extrusion process can be carried out in an integrated manner.

10 [0025]

In the extrusion process described above, an extrusion molding with a higher extrusion rate can be carried out by extruding the continuous long object 20 in a circular ring shape as compared with the case in which the continuous long object 120 is extruded in a plate shape in the conventional method.

15 Consequently, a fiber forming step of a fluorine resin in the extrusion process can be accelerated. It is necessary that the extrusion rate is increased and a shearing force that is applied during an extrusion is enlarged in order to accelerate a fiber forming step of a fluorine resin in the extrusion process. In order to carry out an extrusion molding with a higher extrusion rate, it is required to extrude the continuous long object 20 in a circular ring shape.

[0026]

In the case in which the continuous long object is extruded in a plate shape in the conventional method, a shearing force that is applied to an edge part is larger as compared with a shearing force that is applied to a central part. In addition, in the case
5 in which an extrusion rate is increased, a shearing force that is applied during an extrusion is also enlarged. Consequently, in the case in which an extrusion molding in a plate shape is carried out with a higher extrusion rate, a shearing force that is applied to a central part is greatly different from a shearing
10 force that is applied to an edge part, whereby a degree of progression for a fiber forming step at a central part is different from a degree of progression for a fiber forming step at an edge part.

[0027]

15 In the case in which a fiber forming step of a fluorine resin progresses, the malleability is lost and a resistance to a contact surface of the die is enlarged during an extrusion. Consequently, in the case in which an extrusion molding in a plate shape is carried out with a higher extrusion rate, a resistance during an
20 extrusion at a central part is different from a resistance during an extrusion at an edge part, whereby the continuous long object cannot be extruded in a homogeneous manner, or a splitting occurs at a central part in some cases unfortunately.

[0028]

On the other hand, in the case in which the continuous long object in a circular ring shape in accordance with the present invention, since an edge part (a cut line) does not exist, a shearing force is applied in a uniform manner regardless of a cross sectional position, and a progression of a fiber forming step of a fluorine resin is also uniform. Consequently, since a difference in a resistance does not occur during an extrusion, the problems in a conventional method do not occur, and an extrusion molding with a higher extrusion rate can be carried out.

10 [0029]

Consequently, for the continuous long object 20 in accordance with the present invention in which an extrusion molding with a higher extrusion rate can be carried out, a fiber forming step of a fluorine resin progresses as a whole as compared with the case of the conventional continuous long object 120, whereby a number of rolling steps can be reduced in the rolling process, and it is not required that the folding of the continuous long object is carried out. Therefore, an edge part of the sheet is not dried and is not deteriorated unlike the conventional method, and a process for cutting an edge part of the sheet is not required, whereby the available percentage efficiency can also be improved.

[0030]

An extrusion rate is defined as (a cross sectional area in a cylinder of an extrusion machine) / (a cross sectional area of

a cross sectional opening of a die). As described above, as an extrusion rate is higher, a number of rolling steps can be less in the rolling process. On the other hand, in the case in which an extrusion rate is too higher, an extrusion becomes difficult and the efficiency in the extrusion process is deteriorated. It is preferable that an extrusion rate in accordance with the present invention is 5 or higher, in particular in the range of 5 to 10.

[0031]

While a cross sectional shape of the continuous long object is in the form of a circular ring in the above preferred embodiment, a cross sectional shape of the continuous long object in accordance with the present invention is not restricted to a circular ring. For instance, a cross sectional shape of the continuous long object can also be an elliptical shape 40 as shown in Fig. 3(A), a shape 60 in which two circles overlap with each other as shown in Fig. 3(B), or a shape 80 in which three circles overlap with each other as shown in Fig. 3(C). In other words, a cross sectional shape of the continuous long object can be a cross sectional shape without a cut line in such a manner that there is not a difference in a degree of density in any part of the continuous long object when the continuous long object is extruded from the extrusion machine. In the present specification, a form of a ring means an unbroken form without a cut line.

[0032]

While the preferred embodiments of a method for manufacturing a flexible sheet in accordance with the present invention have been described above, the present invention is not restricted to the embodiments, and various changes, modifications, and functional additions can be thus made without departing from the scope of the present invention.

[Embodiment]

[0033]

An embodiment (example) of the present invention will be described below in detail in contrast with a comparative example. In the following descriptions, a method for manufacturing a flexible sheet in accordance with the present invention as shown in Fig. 1 and Fig. 2 is an embodiment, and a method for manufacturing a flexible sheet in accordance with the conventional technology as shown in Fig. 4 and Fig. 5 is a comparative example.

[0034]

The embodiment and the comparative example are for explaining the present invention in more detail, and the present invention is not restricted to only the scope of the embodiment.

(Raw material)

A raw material of the material 10 of the embodiment and a raw material of the material 110 of the comparative example are shown in Table 1.

[0035]

[Table 1]

Table 1

Item	Product name	Company name	Embodiment	Comparative example
PTFE	Teflon 6-J	DU PONT-MITSUI FLUOROCHEMICALS COMPANY, LTD.	47% of part weight	46% of part weight
Clay	Crown Clay	Southeastern Clay Corporation	38% of part weight	37% of part weight
Solvent	Isopar M	Exxon Mobil Corporation	15% of part weight	17% of part weight

[0036]

5 (Extrusion rate)

In the present embodiment, an extrusion rate of the embodiment is 7.5, and an extrusion rate of the comparative example is 5.0.

(Dimensions of a cut object before the rolling)

10 The dimensions of a cut object 22 before the rolling for the embodiment are a width of 305 mm, a thickness of 20 mm, and a length of 490 mm as shown in Table 2. On the other hand, the dimensions of a cut object 122 before the rolling for the comparative example are a width of 365 mm, a thickness of 15 mm,
15 and a length of 620 mm as shown in Table 2. The cut object 22 and

the cut object 122 are rolled to be 1.5 mm in a sheet thickness of a completed product.

(Number of rolling steps)

As shown in Table 2, a number of rolling steps for the embodiment is 15 and is a half of a number of rolling steps for the comparative example which is 30. This is because a fiber forming step of a polytetrafluoroethylene resin (PTFE) progresses in an extrusion process for the embodiment. Moreover, an edge part of the sheet is not dried and is not deteriorated for the embodiment in which a number of rolling steps is less, and a process for cutting an edge part of the sheet is not required. It was confirmed that a reduction of a number of rolling steps and an omission of a process for cutting an edge part of the sheet enabled a rolling time for one sheet to be shortened to a large extent for the embodiment as shown in Table 2.

[0037]

[Table 2]

Table 2

		Embodiment	Comparative example
Dimension value	Width	300 mm	370 mm
	Length	500 mm	620 mm
	Thickness	20 mm	15 mm
Number of rolling steps		15	30
Rolling time		5 min / piece	15 min / piece

[0038]

(Physical properties of a product)

5 The physical properties of a flexible sheet that has been produced by the above described forming method are shown in Table 3. For the physical properties of No. 1 to No. 8 for the embodiment as shown in Table 3, eight test pieces were taken out by a punching processing from one product sheet (1100 mm × 1100 mm), and the

10 physical properties of each of the gaskets were measured.

[0039]

[Table 3]

[0040]

[Criterion for evaluation]

Tensile strength (longitudinal): Good in the case of 10.8 Kgf/mm² or larger

- 5 Tensile strength (transversal): Good in the case of 10.8 Kgf/mm² or larger

Compression rate: Good in the case of the range of 4% to 10%

Restoration rate: Good in the case of 40% or larger

Flexibility: Good in the case of triple or less

- 10 Specific gravity: Good in the case of the range of 2.20 to 2.40 g/mm²

Sealing property: Left to stand for 30 minutes in the environment of a temperature of 200°C and a leak level was measured

External appearance: Decided based on the boundary sample

- 15 It was confirmed that a flexible sheet of the embodiment was provided with the physical properties equivalent to those of a flexible sheet of the comparative example according to Table 3.

(Available percentage efficiency)

- 20 The available percentage efficiency of the embodiment and the available percentage efficiency of the comparative example are shown in Table 4. Since the edge part of the sheet is not cut in the rolling process for the embodiment, the available percentage efficiency of the embodiment was 85% as compared with

the available percentage efficiency of 65% for the comparative example. Consequently, it was confirmed that the available percentage efficiency was greatly improved for the embodiment.

[0041]

5 [Table 4]

Table 4

Item	Embodiment	Comparative example	Note
1) Input weight	4.5 Kg	6.0 Kg	
2) Cutting weight	0.7 Kg	2.1 Kg	Rolling process, modifying process
3) Product weight	3.8 Kg	3.9 Kg	
4) Product available percentage efficiency	85%	65%	3) / 1)

[0042]

10 In accordance with the above embodiments and comparative examples, by the method for manufacturing a flexible sheet in accordance with the present invention, it was confirmed that the rolling process can be foreshortened as compared with a conventional method, and the available percentage efficiency can also be improved, whereby a flexible sheet that is provided with
15 a homogeneous property can be produced in a more efficient manner as compared with a conventional method.

EXPLANATIONS OF LETTERS OR NUMERALS

[0043]

- 1 and 100: Extrusion machine
- 2 and 102: Dies
- 5 2a and 102a: Cross sectional openings
- 4 and 104: Hoppers
- 8 and 108: Cylinders
- 10 and 110: Mixed materials
- 20 and 120: Continuous long objects
- 10 22 and 122: Cut objects
- 30 and 130: Flexible sheets
- 40: Elliptical shape
- 60: Shape in which two circles overlap with each other
- 80: Shape in which three circles overlap with each other
- 15 124: Edge part of a sheet

CLAIMS

1. A method for manufacturing a flexible sheet, comprising:

an extrusion process for preparing a mixture that is a raw
5 material of the flexible sheet and a die that is provided with
a cross sectional opening through which the mixture passes, and
forming a continuous long object by making the mixture pass through
the cross sectional opening of the die;

a cutting process for obtaining a prescribed cut object by
10 cutting the continuous long object that has been formed in the
extrusion process; and

a rolling process for forming a sheet by rolling the
prescribed cut object that has been obtained in the cutting
process,

15 wherein a material of the mixture is a composition in which
a mineral filler is compounded in a fluorine resin, and

a cross sectional shape of the continuous long object that
has been formed in the extrusion process is in the form of a ring.

20 2. The method for manufacturing a flexible sheet as defined
in claim 1, wherein the fluorine resin is a
polytetrafluoroethylene resin.

3. The method for manufacturing a flexible sheet as defined

in claim 1 or 2, wherein a rate of the mineral filler in a material of the mixture is at least 20% of part weight.

4. The method for manufacturing a flexible sheet as defined
5 in any one of claims 1 or 2, wherein an extrusion rate in the extrusion process is in the range of 5 to 10.