

DESCRIPTION

METHOD FOR REMOVING COATING LAYER AND DEVICE FOR REMOVING COATING LAYER

5 TECHNICAL FIELD

[0001]

The present invention relates to a method for removing a coating layer and equipment for removing a coating layer.

10 BACKGROUND ART

[0002]

Recently, in order to protect global resources and environment, activities for constructing a recycling-based society through reduction, re-use, recycle, and the like of wastes are being intensified in various fields.

15 For example, Patent Literature 1 discloses a method for processing painted plastic components, where painted plastic components with a paint film being formed on the surface thereof are exposed to a high-temperature atmosphere in a range from 400 to 1000 degrees C to embrittle and remove the paint film.

20 CITATION LIST

PATENT LITERATURE(S)

[0003]

Patent Literature 1: JP 2012-167213 A

25 SUMMARY OF THE INVENTION

PROBLEM(S) TO BE SOLVED BY THE INVENTION

[0004]

30 However, the processing method disclosed in Patent Literature 1, in which the plastic components of various sizes are directly exposed to a high-temperature atmosphere to embrittle the paint film on the surface of the plastic components, possibly causes insufficiently embrittlement to occur in some areas of the paint film, so that the paint film possibly cannot be sufficiently removed.

[0005]

An object of the invention is to provide a removal method of a coating layer and removal equipment of a coating layer that are capable of easily removing a coating layer from a laminated film that is provided with a base film and the coating layer and is delivered in roll-to-roll processing.

MEANS FOR SOLVING THE PROBLEM(S)

[0006]

[1] A method for removing a coating layer, including:
10 preparing a roll formed with a wound laminated film including a base film and a coating layer;
feeding the laminated film from the roll;
stretching the fed laminated film;
removing the coating layer from the stretched laminated film; and
15 winding the base film left after the coating layer is removed to be roll-shaped.

[0007]

[2] The method according to the above [1], in which in the removing of the coating layer, the coating layer is transferred from the base film to an adhesion roll.

[0008]

20 [3] The method according to the above [1], in which in the removing of the coating layer, the coating layer is scraped off from the base film using a blade or a wire brush.

[0009]

[4] The method according to the above [1], in which in the removing of the coating layer, the coating layer is chipped off from the base film using blast media.

[0010]

[5] The method according to any one of the above [1] to [4], in which the stretching of the laminated film is conducted while heating the laminated film.

[0011]

30 [6] The method according to any one of the above [1] to [5], further including: spraying superheated water vapor onto the coating layer of the stretched laminated film after stretching the laminated film and before removing the coating layer.

[0012]

[7] The method according to any one of the above [1] to [6], in which the laminated film is a laminated film used for manufacturing a ceramic green sheet and left after the ceramic green sheet is peeled off.

5 [0013]

[8] Removal equipment configured to remove a coating layer from a laminated film including a base film and the coating layer, the removal equipment including:

a feeder configured to feed the laminated film from a roll formed with the wound laminated film;

10 a stretching unit configured to stretch the fed laminated film;

a removal unit configured to remove the coating layer from the stretched laminated film; and

a winding unit configured to wind the base film to be roll-shaped.

[0014]

15 [9] The removal equipment according to the above [8], in which the removal unit includes an adhesion roll and is configured to transfer the coating layer from the base film to the adhesion roll.

[0015]

[10] The removal equipment according to the above [8], in which the removal unit
20 includes a blade or a wire brush and is configured to scrape the coating layer off from the base film.

[0016]

[11] The removal equipment according to the above [8], in which the removal unit
25 includes a blast processing unit and is configured to chip off the coating layer from the base film using blast media.

[0017]

[12] The removal equipment according to any one of the above [8] to [11], further including: a water vapor spray, in which the water vapor spray is configured to spray superheated water vapor onto the coating layer of the stretched laminated film.

30 [0018]

[13] The removal equipment according to any one of the above [8] to [12], in which the stretching unit includes a heater configured to heat the laminated film.

[0019]

[14] The method according to any one of the above [8] to [13], in which the laminated film is a laminated film used for manufacturing a ceramic green sheet and left after the ceramic green sheet is peeled off.

5 [0020]

The above aspects of the invention can provide a removal method of a coating layer and removal equipment of a coating layer that are capable of easily removing a coating layer from a laminated film including a base film and the coating layer and which is delivered in roll-to-roll processing.

10

BRIEF EXPLANATION OF DRAWINGS

[0021]

Fig. 1A is an example of a cross-sectional view showing a laminated film usable for a method for removing a coating layer according to a first exemplary embodiment.

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Fig. 1B is an example of a cross-sectional view showing the laminated film shown in Fig. 1A, which is stretched in a longitudinal direction in a stretching step.

Fig. 2 is a microscopic picture showing cracks caused in the coating layer, which is a top plan view showing the laminated film viewed from a side of the coating layer.

20

Fig. 3 schematically illustrates an example of removal equipment of a coating layer according to a second exemplary embodiment.

Fig. 4 schematically illustrates an example of removal equipment of a coating layer according to a third exemplary embodiment.

25

Fig. 5 schematically illustrates an example of removal equipment of a coating layer according to a fourth exemplary embodiment.

Fig. 6 schematically illustrates an example of removal equipment of a coating layer according to a fifth exemplary embodiment.

30

Fig. 7 schematically illustrates an example of removal equipment of a coating layer according to a sixth exemplary embodiment.

DESCRIPTION OF EMBODIMENT(S)

[0022]

First Exemplary Embodiment

Method for Removing Coating Layer

A method for removing a coating layer according to the exemplary
5 embodiment includes: preparing a roll formed with a wound laminated film including
a base film and a coating layer (sometimes also referred to as a “preparation step”
hereinafter); feeding the laminated film from the roll (sometimes also referred to as a
“feeding step” hereinafter); stretching the fed laminated film (sometimes also referred
to as a “stretching step” hereinafter); removing the coating layer from the stretched
10 laminated film (sometimes also referred to as a “removal step” hereinafter); and
winding the base film left after the coating layer is removed to be roll-shaped
(sometimes also referred to as a “winding step” hereinafter).

[0023]

Fig. 1A is an example of a cross-sectional view showing a laminated film 50
15 usable for the coating-layer removal method according to the first exemplary
embodiment.

The laminated film 50 includes a base film 51 and a coating layer 52. The
base film 51 and the coating layer 52 of the laminated film 50 are in direct contact
with each other.

20 Fig. 1B is an example of a cross-sectional view showing a laminated film 50A
that is the laminated film 50 shown in Fig. 1A after being stretched in a longitudinal
direction (delivery direction) in the stretching step.

Fig. 1B shows a plurality of cracks 522 caused in a coating layer 52A of the
stretched laminated film 50A.

25 [0024]

In the exemplary embodiment, the stretching step is for cracking the coating
layer. Cracking the coating layer means that cracks (fissures) are caused in a
thickness direction of the coating layer. It is preferable that the caused cracks reach
an interface with the base film (as shown in, for instance, Fig. 1B). The cracks in the
30 coating layer are initially caused in a direction substantially orthogonal to a stretching
direction and, by further stretching of the laminated film, are caused in the stretching
direction. It is preferable that the coating layer on the base film turns into small pieces

of the layer material whose outer periphery is surrounded by the cracks after stretching the laminated film. Fig. 2 is a microscopic picture showing cracks caused in the coating layer, which is a top plan view showing the laminated film viewed from a side of the coating layer.

5 It sometimes occurs that the base film and the coating layer are partially peeled off by impact applied when the cracks are caused in the coating layer. In the microscopic picture shown in Fig. 2, areas whose polygonal outer peripheries appear white are areas near the cracks, where the coating layer is peeled off at the interface with the base film to trap air therebetween. Such occurrence of peeling is preferable
10 because the coating layer can be more reliably removed in the next step.

According to the coating-layer removal method of the exemplary embodiment, the steps are continuously performed in a roll-to-roll processing, so that the coating layer can be efficiently removed and the base film can be efficiently wound.

[0025]

15 The coating-layer removal method according to the exemplary embodiment can be performed using, for instance, equipment for removing a coating layer according to any one of second to sixth exemplary embodiments.

Initially, coating-layer removal equipment 100 according to the second exemplary embodiment will be described below.

20 [0026]

Second Exemplary Embodiment

Removal Equipment 100 of Coating Layer

Fig. 3 schematically illustrates an example of the coating-layer removal equipment 100 according to the second exemplary embodiment.

25 Hereinbelow, the laminated film and the coating layer after being stretched will be sometimes referred to as a “stretched laminated film” and a “stretched coating layer,” respectively.

It should be noted that X axis, Y axis, and Z axis shown in Figs. 3 to 7 are orthogonal to each other, where X axis and Y axis are in a predetermined plane and
30 Z axis is orthogonal to the predetermined plane.

[0027]

The coating-layer removal equipment 100 according to the second

exemplary embodiment, which is configured to remove the coating layer 52 from the laminated film 50 including the base film 51 and the coating layer 52, includes a feeder 10 that feeds the laminated film 50 from a roll 1 of the wound laminated film 50, a stretching unit 20 that stretches the fed laminated film 50, a removal unit 30 that
5 removes the coating layer (stretched coating layer 52A) from the stretched laminated film 50A, and a winding unit 40 that winds the base film 51 to be roll-shaped.

The coating-layer removal equipment 100 according to the second exemplary embodiment in which the removal unit 30 includes an adhesion roll 5 will be described.

10 [0028]

The laminated film 50, which is to be set in the removal equipment 100, is preferably a laminated film used for manufacturing a ceramic green sheet and left after the ceramic green sheet is peeled off. The ceramic green sheet thus produced is preferably used for manufacturing laminated ceramic capacitors (MLCC).

15 [0029]

Feeder 10

The feeder 10 includes the roll 1 formed with the wound laminated film 50, a support member (not illustrated) that supports the roll 1 in a rotatable manner, and a drive roller (not illustrated).

20 [0030]

Stretching Unit 20

The stretching unit 20 includes a first stretching roll 3A, a second stretching roll 3B provided downstream of the first stretching roll 3A, a rolling speed controller 3C configured to control rolling speeds of the first stretching roll 3A and the second
25 stretching roll 3B, and first nip roll 2A and second nip roll 2B facing the first stretching roll 3A and the second stretching roll 3B, respectively.

Drive motors M1, M2 are respectively connected to the shafts of the first stretching roll 3A and the second stretching roll 3B. The rolling speed controller 3C is configured to control the drive motors M1, M2 to control the rolling speeds of the
30 first stretching roll 3A and the second stretching roll 3B. The rolling speed controller 3C is, for instance, a computer.

[0031]

The stretching unit 20 is preferably provided with a heater that heats the laminated film 50.

Examples of the heater, which are not specifically limited, include infrared heaters, halogen heaters, UV lamps, and hot air generators.

5 In order to allow the base film to be easily stretched, the heater is preferably provided on a side of the base film 51 of the laminated film 50 to heat the laminated film 50 from the side of the base film 51. The heater is optionally provided on a side of the coating layer 52 of the laminated film 50 to heat the laminated film 50 from the side of the coating layer 52.

10 In the example illustrated in Fig. 3, a heater 80 that heats the laminated film 50 from the side of the base film 51 is provided in a section between the first stretching roll 3A and the second stretching roll 3B.

[0032]

Removal Unit 30

15 The removal unit 30, which is provided with the adhesion roll 5, is a unit configured to transfer the coating layer (stretched coating layer 52A) from the base film 51 to the adhesion roll 5.

The adhesion roll 5 is, for instance, a roll with an adhesive sheet 60 wound thereon, the adhesive sheet 60 including a base material sheet and an adhesive layer.

20 Examples of the base material sheet, which are not specifically limited, include paper and a resin sheet. Any type of known adhesive layer, which is not specifically limited, is usable as the adhesive layer.

The removal unit 30 includes the adhesion roll 5, an adhesive paper winding roll 6, and a guide roll 7 provided facing the adhesion roll 5.

25 In the example illustrated in Fig. 3, the coating layer (stretched coating layer 52A) is transferred onto the adhesive layer of the adhesive sheet 60. The adhesive paper winding roll 6 winds the adhesive sheet with the coating layer 52A transferred (sometimes also referred to as a “coating-layer-attached adhesive sheet 61” hereinafter).

30 [0033]

Winding Unit 40

The winding unit 40 includes a winding roll 4 that winds the base film 51 to

be roll-shaped, a support member (not illustrated) that supports the winding roll 4 in a rotatable manner, and a drive roller (not illustrated).

[0034]

5 With the use of the coating-layer removal equipment 100 according to the second exemplary embodiment, the coating-layer removal method according to the first exemplary embodiment is performed, for instance, through steps described below.

[0035]

Preparation Step

10 In the preparation step, the roll 1 formed with the wound laminated film 50 including the base film 51 and the coating layer 52, is prepared.

In the preparation step, a roll (roll 1 formed with the wound laminated film 50) produced in advance may be simply prepared or, alternatively, the roll 1 with the laminated film 50 being wound may be produced.

15 The laminated film 50 is preferably a laminated film used for manufacturing a ceramic green sheet and left after the ceramic green sheet is peeled off.

[0036]

Feeding Step

20 In the feeding step, the laminated film 50 is fed from the roll 1 formed with the wound laminated film 50.

In the example illustrated in Fig. 3, the laminated film 50 having been fed from the roll 1 by the feeder 10 is delivered toward the first nip roll 2A (in the X-axis direction in Fig. 3).

25 An enlarged view of the laminated film in a region R1 in Fig. 3 is, for instance, as illustrated in Fig. 1A. In the region R1 illustrated in Fig. 3, the base film 51 and the coating layer 52 are sequentially laminated on each other in this order in the Z-axis direction in the laminated film 50 fed from the roll 1.

[0037]

Stretching Step

30 In the stretching step, the laminated film 50 is stretched.

In the example illustrated in Fig. 3, the laminated film 50 is fed from the roll 1 to pass through the first nip roll 2A and the first stretching roll 3A while being bent in

a substantially S-shape and then the laminated film 50 is stretched in a region R2 for the laminated film 50 to be delivered from the first stretching roll 3A to the second stretching roll 3B. The stretching step causes cracks in the coating layer 52. An enlarged view of the laminated film 50A stretched in the region R2 in Fig. 3 is, for instance, as illustrated in Fig. 1B. Further, the stretched laminated film 50A in the region R2 as viewed in the Z axis is, for instance, as shown in Fig. 2.

Examples of a method for stretching the laminated film 50 include:

a method for controlling the rolling speed of the second stretching roll 3B provided downstream in the delivery path to be faster than the rolling speed of the first stretching roll 3A provided upstream in the delivery path; and

a method for providing one or more additional stretching rolls between the first stretching roll 3A and the second stretching roll 3B and delivering the laminated film 50 while being rolled over the first stretching roll 3A, the additional stretching roll(s), and the second stretching roll 3B.

The method for stretching the laminated film 50 is preferably the method for controlling the rolling speed of the second stretching roll 3B provided downstream in the delivery path to be faster than the rolling speed of the first stretching roll 3A provided upstream in the delivery path.

[0038]

The stretching step is preferably performed while heating the laminated film 50.

In the example illustrated in Fig. 3, the laminated film 50 is heated using the heater 80 from the side provided with the base film 51 in the region R2 for the laminated film 50 to be delivered from the first stretching roll 3A to the second stretching roll 3B.

By performing the stretching step while heating the laminated film 50, the cracks are more likely to be caused in the coating layer 52 as compared with an instance where the stretching step is performed at room temperature.

The heating in the stretching step is more effective when the laminated film 50 is, for instance, a laminated film left after a ceramic green sheet is peeled off.

The laminated film left after the ceramic green sheets has been peeled off (i.e. used laminated film) has been punched out for each ceramic green sheet. The

remaining surface of the laminated film sometimes has minute cuts, whereby the laminated film is easily ruptured from the minute cuts. Accordingly, when the used laminated film is to be used, the laminated film is less likely to be ruptured by performing the stretching step while heating the laminated film. Consequently, the coating layer can be reliably removed and the base film can be wound in a roll-to-roll processing even with the use of the laminated film left after each ceramic green sheet having been cut into a predetermined size and then having been peeled off.

The time and temperature for heating the laminated film 50 are determined depending on the material of the base film 51 and the coating layer 52.

[0039]

The laminated film 50 is preferably heated at a temperature equal to or more than a glass transition temperature $Tg1$ of the base film 51 for the reason described below.

The glass transition temperature $Tg1$ of the base film 51 and a glass transition temperature $Tg2$ of the coating layer 52 of the laminated film 50, which are determined according to a method defined by JIS K7121 (2012), are measured using a differential scanning calorimeter (DSC). It should be noted that the temperature during the stretching process is preferably equal to or more than the glass transition temperature $Tg1$ of the base film 51, more preferably in a range from the glass transition temperature $Tg1$ of the base film 51 to the glass transition temperature $Tg2$ of the coating layer 52 in order for the base film 51 to be easily stretched without being ruptured while allowing the coating layer 52 to be easily cracked.

[0040]

Removal Step

In the removal step, the coating layer (stretched coating layer 52A) is removed from the stretched laminated film 50A.

In the example illustrated in Fig. 3, the stretched coating layer 52A is transferred from the base film 51 to the adhesion roll 5 in the removal step.

The laminated film 50A stretched in the stretching step passes through the second stretching roll 3B and the second nip roll 2B while being curved in a substantially S-shape, and then is delivered toward the adhesion roll 5. While the stretched laminated film 50A passes through between the adhesion roll 5 and the

guide roll 7, the coating layer 52A is transferred from the base film 51 to the adhesive layer of the adhesive sheet 60. The adhesive sheet with the coating layer 52A being transferred (coating-layer-attached adhesive sheet 61) is wound by the adhesive paper winding roll 6.

5 [0041]

Winding Step

In the winding step, the base film 51 left after the coating layer (stretched coating layer 52A) is removed is wound to be roll-shaped.

In the example illustrated in Fig. 3, the base film 51 is wound to be roll-shaped
10 by the winding roll 4.

[0042]

Third Exemplary Embodiment

Removal Equipment 100A of Coating Layer

Coating-layer removal equipment 100A according to a third exemplary
15 embodiment will be described below.

The third exemplary embodiment will be described below, where difference(s) from the second exemplary embodiment will be focused and the same or similar components and features will be, for instance, denoted by the same reference numerals, thereby omitting or simplifying the description thereof.

Fig. 4 schematically illustrates an example of the coating-layer removal
20 equipment 100A according to the third exemplary embodiment. The removal equipment 100A illustrated in Fig. 4 is the same as the removal equipment 100 described in the second exemplary embodiment except for a difference in the removal unit.

25 [0043]

Removal Unit 30A

A removal unit 30A, which is provided with a blade 5A, is a unit configured to scrape the stretched coating layer 52A off from the base film 51.

The blade 5A is provided at any position downstream of the laminated film
30 50A stretched in the stretching step.

In the example illustrated in Fig. 4, the blade 5A is provided downstream of the guide roll 7 in a manner to be in contact with the laminated film (stretched

laminated film 50A). The removal unit 30A includes the blade 5A that scrapes the stretched coating layer 52A and a receiver pan 63 that collects the scraped coating layer 52A.

A material used for the blade 5A is not particularly limited.

5 [0044]

With the use of the coating-layer removal equipment 100A according to the third exemplary embodiment, the coating-layer removal method according to the first exemplary embodiment is performed, for instance, through steps described below.

10 The following description will be focused on the difference from the second exemplary embodiment.

[0045]

Removal Step

In the removal step, the stretched coating layer 52A is scraped off from the base film 51 using the blade 5A.

15 The coating layer (stretched coating layer 52A) scraped using the blade 5A is collected into the receiver pan 63.

[0046]

Fourth Exemplary Embodiment

Removal Equipment 100B of Coating Layer

20 Coating-layer removal equipment 100B according to a fourth exemplary embodiment will be described below.

The fourth exemplary embodiment will be described below, where difference(s) from the second exemplary embodiment will be focused and the same or similar components and features will be, for instance, denoted by the same reference numerals, thereby omitting or simplifying the description thereof.

25 Fig. 5 schematically illustrates an example of the coating-layer removal equipment 100B according to the fourth exemplary embodiment. The removal equipment 100B illustrated in Fig. 5 is the same as the removal equipment 100 described in the second exemplary embodiment except for a difference in the removal unit.

[0047]

Removal Unit 30B

The removal unit 30B, which is provided with a wire brush 5B, is a unit configured to scrape the stretched coating layer 52A off from the base film 51.

The wire brush 5B is rotatably provided at any position downstream of the stretched laminated film 50A.

5 In the example illustrated in Fig. 5, the wire brush 5B is provided facing the guide roll 7. The removal unit 30B includes the wire brush 5B that scrapes the stretched coating layer 52A and the receiver pan 63 that collects the scraped coating layer 52A.

A material used for the wire brush 5B is not particularly limited.

10 As illustrated in Fig. 5, by horizontally placing the wire brush 5B and the guide roll 7 to face each other and scraping the coating layer 52A downward, the coating layer 52A can be efficiently collected.

[0048]

15 With the use of the coating-layer removal equipment 100B according to the fourth exemplary embodiment, the coating-layer removal method according to the first exemplary embodiment is performed, for instance, through the step described below.

The following description will be focused on the difference from the second exemplary embodiment.

20 [0049]

Removal Step

In the removal step, the stretched coating layer 52A is scraped off from the base film 51 using the wire brush 5B.

25 When the stretched laminated film 50A passes through between the wire brush 5B and the guide roll 7, the coating layer (stretched coating layer 52A) is scraped off from the base film 51 by the rotation of the wire brush 5B. The scraped coating layer (stretched coating layer 52A) is collected into the receiver pan 63.

[0050]

Fifth Exemplary Embodiment

30 Removal Equipment 100C of Coating Layer

Coating-layer removal equipment 100C according to a fifth exemplary embodiment will be described below.

The fifth exemplary embodiment will be described below, where difference(s) from the second exemplary embodiment will be focused and the same or similar components and features will be, for instance, denoted by the same reference numerals, thereby omitting or simplifying the description thereof.

Fig. 6 schematically illustrates an example of the coating-layer removal equipment 100C according to the fifth exemplary embodiment. The removal equipment 100C illustrated in Fig. 6 is the same as the removal equipment 100 described in the second exemplary embodiment except for difference in the removal unit.

[0051]

Removal Unit 30C

A removal unit 30C, which is provided with a blast processing unit 5C, is a unit configured to chip off the stretched coating layer 52A from the base film 51 with blast media.

The blast processing unit 5C, which is provided at any position downstream of the stretched laminated film 50A, is configured to spray the blast media onto the coating layer (stretched coating layer 52A) to chip off the coating layer 52A.

In the example illustrated in Fig. 5, the removal unit 30C includes the blast processing unit 5C and the receiver pan 63 that collects the chipped coating layer 52A together with the blast media (not illustrated).

Any known blast processing unit is usable as the blast processing unit 5C.

Examples of the blast media include, for instance, silica particles, calcium carbonate particles, silicon carbide particles, alumina particles, dry ice particles, and melamine resin particles. Dry ice particles, which dissipate after blasting process when being used as the blast media, are preferable because it is not necessary to remove particles. A particle diameter of the blast media is preferably in a range from 5 μm to 40 μm .

The conditions for spraying the blast media are determined depending on a material of the coating layer.

[0052]

With the use of the coating-layer removal equipment 100C according to the fifth exemplary embodiment, the coating-layer removal method according to the first

exemplary embodiment is performed, for instance, through the step described below.

The following description will be focused on the difference from the second exemplary embodiment.

[0053]

5 Removal Step

In the removal step, the coating layer (stretched coating layer 52A) is chipped off from the base film 51 with the blast media.

When the stretched laminated film 50A passes through between the blast processing unit 5C and the guide roll 7, the stretched coating layer 52A is chipped
10 off from the base film 51 by the blast media (not illustrated) being sprayed from the blast processing unit 5C. The chipped coating layer (stretched coating layer 52A) is collected into the receiver pan 63 together with the blast media.

[0054]

Sixth Exemplary Embodiment

15 Removal Equipment 100D of Coating Layer

Coating-layer removal equipment 100D according to a sixth exemplary embodiment will be described below.

The sixth exemplary embodiment will be described below, where difference(s) from the second exemplary embodiment will be focused and the same
20 or similar components and features will be, for instance, denoted by the same reference numerals, thereby omitting or simplifying the description thereof.

Fig. 7 schematically illustrates an example of the coating-layer removal equipment 100D according to the sixth exemplary embodiment.

[0055]

25 The removal equipment 100D illustrated in Fig. 7 is the same as the removal equipment 100 described in the second exemplary embodiment except for the presence of a water vapor spray provided between the stretching unit and the removal unit.

[0056]

30 Water Vapor Spray

The water vapor spray is configured to spray superheated water vapor onto the coating layer (stretched coating layer 52A) of the stretched laminated film 50A.

It is only necessary for the water vapor spray to include a heater that heats the water vapor and water vapor spray nozzles that spray the superheated water vapor.

5 The water vapor spray is provided between the stretching unit 20 and the removal unit 30.

[0057]

In the example illustrated in Fig. 7, the water vapor spray is a superheater 70 including a plurality of water vapor spray nozzles 70a and a process chamber 72. The superheater 70 is provided between a boiler 71 and the process chamber 72.
10 The superheater 70, which is connected to the boiler 71, heats water vapor generated in the boiler 71 to generate superheated water vapor and sprays the superheated water vapor from the water vapor spray nozzles 70a onto the coating layer (stretched coating layer 52A) in the process chamber 72.

[0058]

15 With the use of the coating-layer removal equipment 100D according to the sixth exemplary embodiment, the coating-layer removal method according to the first exemplary embodiment is performed, for instance, through the step described below.

The following description will be focused on the difference from the second exemplary embodiment.

20 [0059]

Water Vapor Spraying Step

In the water vapor spraying step, the superheated water vapor is sprayed onto the coating layer (stretched coating layer 52A) of the stretched laminated film 50A after the stretching step and before the removal step.

25 In the example illustrated in Fig. 7, after the superheated water vapor is sprayed from the water vapor spray nozzles 70a onto the coating layer 52A, the stretched laminated film 50A is delivered out of the process chamber 72 to be rapidly cooled. The coating layer 52A is likely to be warped due to a difference in thermal expansion coefficient between the coating layer 52A and the base film 51 caused by
30 this rapid cooling, so that interfacial peeling of the coating layer 52A is promoted. Consequently, the coating layer 52A is more easily removed from the base film 51 in the subsequent removal step.

The temperature of the superheated water vapor is preferably in a range from 100 degrees C to 450 degrees C, more preferably in a range from 150 degrees C to 400 degrees C, and still more preferably in a range from 200 degrees C to 350 degrees C.

5 The time for spraying the superheated water vapor is determined depending on a material of the coating layer, the delivery speed of the laminated film 50, and the like.

[0060]

Modification of Embodiment(s)

10 In the removal equipment according to the second to sixth exemplary embodiments, the heater 80 is optionally provided between the feeder 10 and the first stretching roll 3A. In other words, the heater 80 is also optionally suitably located to heat the laminated film 50 before the laminated film 50 is stretched. In this case, the removal method according to the first exemplary embodiment further includes a
15 heating step of the laminated film 50 after the feeding step and before the stretching step. Cracks are more likely to be caused in the coating layer 52 by heating the laminated film 50 before performing the stretching step.

 The invention is by no means limited to the above exemplary embodiments. The invention can encompass any modifications, improvements, and the like within
20 the scope of the invention that an object of the invention is achievable.

[0061]

 The configuration of the laminated film used in the coating-layer removal method according to the first exemplary embodiment and in the equipment for removing the coating layer according to the second to sixth exemplary embodiments
25 will be described.

[0062]

Laminated Film

 The laminated film used in any of the above exemplary embodiments includes the base film and the coating layer.

30 The coating layer is a single layer or a multi-layer formed of two or more coating layers of the same or different materials. The coating layer is optionally formed on both sides of the base film.

In order to facilitating removing the coating layer from the laminated film and collecting the remaining base film, the base film and the coating layer of the laminated film are preferably directly laminated. Herein, the term “directly laminated” means that, for instance, no layer is interposed between the base film and the coating layer, where the base film and the coating layer are in direct contact with each other.

[0063]

Base Film

As the base film, a resin film formed of a resin component planned to be collected is used.

Examples of the resin film include: polyester films such as a polyethylene terephthalate film, polybutylene terephthalate film, and polyethylene naphthalate film; polyolefin films such as a polyethylene film and polypropylene film; polyimide film; polyamide film; polycarbonate film; polyacetate film; ethylene-vinyl acetate (EVA) film; ethylene-(meth)acrylic acid copolymer film; ethylene-(meth)acrylate copolymer film; cycloolefin polymer film; polyurethane film; polyphenylene sulfide film; and cellophane.

Among the above, a polyester film is preferable in terms of heat resistance and strength. In terms of facilitating collecting and recycling of resins, the polyester film is preferably a film whose main component is any of polyethylene terephthalate, polybutylene terephthalate, and polyethylene naphthalate.

The resin film optionally additionally contains known filler(s), coloring agent(s), antistatic agent(s), antioxidant(s), organic lubricant(s), catalyst(s), and the like. The resin film is optionally transparent, or colored or the like as desired. At least one of the surfaces of the base film is optionally subjected in advance to a surface treatment, for instance, sputtering, corona discharge, flame treatment, ultraviolet irradiation, electron beam irradiation, or etching such as oxidation treatment, as necessary.

[0064]

A thickness of the base film, which is not particularly limited, is preferably in a range from 10 μm to 500 μm , more preferably from 15 μm to 300 μm , and still more preferably from 20 μm to 200 μm in terms of strength, rigidity, and the like.

[0065]

Coating Layer

The coating layer is preferably a functional layer. Examples of the functional layer include a release agent layer, print layer, hard coat layer, easy-adhesion layer, and adhesive layer. Among the above, the coating layer is preferably a release agent layer.

When the coating layer is a release agent layer, the release agent layer is preferably formed of a release agent composition.

The release agent composition to be used for forming the release agent layer is not particularly limited as long as the release agent composition exhibits releasability. For instance, a release agent composition whose main component is a silicone compound, a fluorine compound, a compound including a long-chain alkyl group, a thermoplastic resin material such as an olefin resin and diene resin is usable. It is also preferable to use a release agent composition whose main component is an energy-ray curable resin or a thermosetting resin. One of the above release agent compositions may be used alone, or two or more of the above may be used in combination.

[0066]

In a release agent composition whose main component is a silicone compound, an example of the silicone compound is a silicone compound including organopolysiloxane as a basic skeleton. Examples of the silicone compound include thermosetting silicone compounds (e.g. addition reaction silicone compounds and condensation reaction silicone compounds) and energy-ray (e.g. ultraviolet and electron beam) curable silicone compounds.

[0067]

In a release agent composition whose main component is a fluorine compound, examples of the fluorine compound include a fluorosilicone compound, a fluoroboron compound, and a compound including a poly(perfluoroalkylene ether) chain.

[0068]

In a release agent composition whose main component is a compound including a long-chain alkyl group, examples of the compound including a long-chain alkyl group include polyvinyl carbamate produced by reacting long-chain alkyl

isocyanate with a polyvinyl alcohol polymer, alkyl urea derivative produced by reacting long-chain alkyl isocyanate with polyethylene imine, and long-chain alkyl (meth)acrylate copolymer. Additionally, a long-chain alkyl-modified alkyd resin, which is produced by applying a long-chain fatty acid as a modifying agent to an alkyd resin produced by condensation reaction of a polyvalent alcohol and a polybasic acid, is optionally used.

[0069]

Preferable example of the release agent composition whose main component is an energy-ray curable resin is a composition containing polyorganosiloxane and an energy-ray curable compound including a reactive functional group selected from a (meth)acryloyl group, alkenyl group, and maleimide group. In the release agent layer formed of the above-described release agent composition that uses energy-ray curable compound and polyorganosiloxane whose molecular structures, polarity, and molecular weights are mutually different, before the release agent layer is cured, the component derived from polyorganosiloxane segregates near an outer surface of the release agent layer to be subsequently cured by an energy beam to immobilize the segregation. As a result, releasability of the release agent layer can be improved. The release agent composition whose main component is an energy-ray curable resin optionally further contains a photoinitiator.

[0070]

Examples of a release agent composition whose main component is a thermosetting resin include a release agent composition whose main component is a melamine resin and a release agent composition whose main component is an epoxy resin. An example of a release agent composition whose main component is a melamine resin is a composition containing a melamine resin (base compound), an acid catalyst for thermally curing the melamine resin, and polyorganosiloxane that provides releasability for the release agent layer. An example of a release agent composition whose main component is an epoxy resin is a composition containing an epoxy resin (base compound), an acidic or basic thermosetting catalyst for thermally curing the epoxy resin, and polyorganosiloxane that provides releasability for the release agent layer. The component derived from polyorganosiloxane segregates at and near an outer surface of the release agent layer before the release

agent layer is cured, and is subsequently cured to immobilize the segregation. As a result, releasability of the release agent layer can be improved.

[0071]

5 The coating layer optionally contains an additive in addition to the above-described resin components. Examples of the additional additive include an anti-aging agent, light stabilizer, flame retardant, conducting agent, antistatic agent, and plasticizer.

[0072]

10 A thickness of the coating layer, which is designed as desired and not particularly limited, is preferably in a range from 0.02 μm to 5 μm , more preferably from 0.03 μm to 2 μm , and still more preferably from 0.05 μm to 1.5 μm .

[0073]

15 The laminated film used in the exemplary embodiments is usually usable in order to protect a surface of functional sheets and components usable in specific applications when the functional sheets and components are produced, transported, stored, and the like. After being used for protecting the components and the like, the laminated film are peeled off from the surface and are often disposed. With the use of the laminated film, the coating layer can be easily separated from the base film of the laminated film, thereby greatly contributing to resource protection and
20 environment protection.

EXPLANATION OF CODES

[0074]

25 1...roll, 2A...first nip roll, 2B...second nip roll, 3A...first stretching roll, 3B...second stretching roll, 3C...rolling speed controller, 4...winding roll, 5...adhesion roll, 5A...blade, 5B...wire brush, 5C...blast processing unit, 6...adhesive paper winding roll, 7...guide roll, 10...feeder, 20...stretching unit, 30, 30A, 30B, 30C...removal unit, 40...winding unit, 50, 50A...laminated film, 51...base film, 52, 52A...coating layer, 60...adhesive sheet, 61...adhesive sheet with a coating
30 layer, 63...receiver pan, 70...superheater, 70a...water vapor spray nozzle, 71...boiler, 72...process chamber, 80...heater, 100, 100A, 100B, 100C, 100D...removal equipment, 522...cracks

CLAIM(S)

[Claim 1]

A method for removing a coating layer, comprising:

- preparing a roll formed with a wound laminated film comprising a base film
- 5 and a coating layer;
- feeding the laminated film from the roll;
- stretching the fed laminated film;
- removing the coating layer from the stretched laminated film; and
- winding the base film left after the coating layer is removed to be roll-shaped.

10 [Claim 2]

The method according to claim 1, wherein in the removing of the coating layer, the coating layer is transferred from the base film to an adhesion roll.

[Claim 3]

- The method according to claim 1, wherein in the removing of the coating layer,
- 15 the coating layer is scraped off from the base film using a blade or a wire brush.

[Claim 4]

The method according to claim 1, wherein in the removing of the coating layer, the coating layer is chipped off from the base film using blast media.

[Claim 5]

- 20 The method according to any one of claims 1 to 4, wherein the stretching of the laminated film is conducted while heating the laminated film.

[Claim 6]

- The method according to any one of claims 1 to 4, further comprising:
- spraying superheated water vapor onto the coating layer of the stretched
- 25 laminated film after stretching the laminated film and before removing the coating layer.

[Claim 7]

- The method according to any one of claims 1 to 4, wherein the laminated film is a laminated film used for manufacturing a ceramic green sheet and left after the
- 30 ceramic green sheet is peeled off.

[Claim 8]

Removal equipment configured to remove a coating layer from a laminated

film comprising a base film and the coating layer, the removal equipment comprising:

a feeder configured to feed the laminated film from a roll formed with the wound laminated film;

a stretching unit configured to stretch the fed laminated film;

5 a removal unit configured to remove the coating layer from the stretched laminated film; and

a winding unit configured to wind the base film to be roll-shaped.

[Claim 9]

The removal equipment according to claim 8, wherein the removal unit
10 comprises an adhesion roll and is configured to transfer the coating layer from the base film to the adhesion roll.

[Claim 10]

The removal equipment according to claim 8, wherein the removal unit
comprises a blade or a wire brush and is configured to scrape the coating layer off
15 from the base film.

[Claim 11]

The removal equipment according to claim 8, wherein the removal unit
comprises a blast processing unit and is configured to chip off the coating layer from
the base film using blast media.

20 [Claim 12]

The removal equipment according to any one of claims 8 to 11, further
comprising: a water vapor spray, wherein

the water vapor spray is configured to spray superheated water vapor onto
the coating layer of the stretched laminated film.

25 [Claim 13]

The removal equipment according to any one of claims 8 to 11, wherein the
stretching unit comprises a heater configured to heat the laminated film.

[Claim 14]

The method according to any one of claims 8 to 11, wherein the laminated
30 film is a laminated film used for manufacturing a ceramic green sheet and left after
the ceramic green sheet is peeled off.