

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 As an example, Patent Literature 1 discloses a method for peeling a laminated film, the method at least including: unwinding and feeding a laminated film; feeding hot water onto a surface of the unwound and fed laminated film; peeling a surface laminated portion from the laminated film; and winding a base film after the surface laminated portion is peeled, where, after bringing hot water into contact with the
20 surface of the laminated film for two seconds or more, the surface laminated portion is peeled off.

CITATION LIST

PATENT LITERATURE(S)

25 [0003]

Patent Literature 1: JP 2004-363140 A

SUMMARY OF THE INVENTION

PROBLEM(S) TO BE SOLVED BY THE INVENTION

30 [0004]

The laminated film used in Patent Literature 1, which includes a water-soluble resin layer sandwiched between a water-insoluble base film and a surface functional

layer, is low in speed for separating (peeling) the surface laminated portion (the water-soluble resin layer and the surface functional layer) from the laminated film.

[0005]

5 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 passed in roll-to-roll processing.

MEANS FOR SOLVING THE PROBLEM(S)

10 [0006]

[1] A method for removing a coating layer, including:

preparing a roll formed with a wound laminated film including a base film and a coating layer;

feeding the laminated film from the roll;

15 stretching the fed laminated film;

immersing the stretched laminated film in hot water in a water vessel to remove the coating layer from the laminated film; and

winding the base film left after the coating layer is removed to be roll-shaped, in which

20 the coating layer includes an intermediate layer and a release agent layer, and

the intermediate layer is interposed between the base film and the release agent layer.

[0007]

25 [2] 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 after the stretched laminated film is immersed in the hot water.

[0008]

30 [3] The method according to the above [1] or [2], further including: overflowing the hot water from an upper part of the water vessel to discharge debris of the coating layer fallen off from the laminated film to an outside of the water vessel.

[0009]

[4] The method according to any one of the above [1] to [3], in which the stretching of the laminated film is conducted while heating the laminated film.

[0010]

[5] The method according to any one of the above [1] to [4], further including:
5 removing foreign matters on the base film after taking the base film, which is left after the coating layer is removed, out of the hot water and before winding the base film to be roll-shaped.

[0011]

[6] The method according to any one of the above [1] to [5], in which the base
10 film and the intermediate layer are in direct contact with each other.

[0012]

[7] The method according to any one of the above [1] to [6], in which the intermediate layer is hydrophilic and water-insoluble.

[0013]

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

[0014]

[9] Removal equipment configured to remove a coating layer from a laminated
20 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;

a stretching unit configured to stretch the fed laminated film;

an immersion unit including a water vessel, in which the stretched laminated
25 film is immersed in hot water; and

a winding unit configured to wind the base film taken out of the water vessel to be roll-shaped.

[0015]

[10] The removal equipment according to the above [9], in which the immersion
30 unit includes a scraping unit configured to scrape the coating layer off from the base film in the water vessel, and

the scraping unit is a blade or a wire brush.

[0016]

[11] The removal equipment according to the above [9] or [10], in which the immersion unit includes a mechanism configured to overflow the hot water from an upper part of the water vessel to discharge debris of the coating layer fallen off from the laminated film to an outside of the water vessel.

[0017]

[12] The removal equipment according to any one of the above [9] to [11], in which the stretching unit includes a heater configured to heat the laminated film.

[0018]

[13] The removal equipment according to any one of the above [9] to [12], further including: a foreign-matter removal unit provided between the immersion unit and the winding unit, the foreign-matter removal unit being configured to remove foreign matters on the base film.

[0019]

[14] The removal equipment according to any one of the above [9] 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.

[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.

BRIEF EXPLANATION OF DRAWINGS

[0021]

Fig. 1 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.

Fig. 2A is an example of a cross-sectional view showing the laminated film shown in Fig. 1, which is stretched in a longitudinal direction in a stretching step.

Fig. 2B 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.

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 an immersion unit and a foreign-matter removal unit according to a third exemplary embodiment.

Fig. 5 schematically illustrates an example of an immersion unit and a foreign-matter removal unit according to a fourth exemplary embodiment.

Fig. 6 schematically illustrates an example of an immersion unit and a foreign-matter removal unit according to a fifth 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 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 by immersing the stretched laminated film in hot water in a water vessel (sometimes also referred to as a “stretching step” hereinafter); removing the coating layer from the stretched 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).

The coating layer includes an intermediate layer and a release agent layer. The intermediate layer is interposed between the base film and the release agent layer.

[0023]

Fig. 1 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.

The laminated film 50 includes a base film 51 and a coating layer 52. The

coating layer 52 includes an intermediate layer 521 and a release agent layer 522. The intermediate layer 521 is interposed between the base film 51 and the release agent layer 522. In other words, the base film 51, the intermediate layer 521, and the release agent layer 522 of the laminated film 50 are laminated in this order.

5 In Fig. 1, a represents a surface of the intermediate layer 521 close to the base film and b represents a surface of the intermediate layer 521 close to the release agent layer. d represents an outer surface of the release agent layer 522 and c represents a surface of the release agent layer 522 close to the intermediate layer.

 In the laminated film according to the exemplary embodiment, it is preferable
10 that the base film and the intermediate layer are in direct contact with each other. In the laminated film 50 illustrated in Fig. 1, the base film 51 and the intermediate film 51 are in direct contact with each other and the intermediate layer 521 and the release agent layer 522 are in direct contact with each other.

 Fig. 2A is an example of a cross-sectional view showing a laminated film 50A
15 (i.e. the laminated film 50 illustrated in Fig. 1 after being stretched in a longitudinal direction (delivery direction) in the stretching step).

 Fig. 2A illustrates a plurality of cracks 523 caused in a coating layer 52A (an intermediate layer 521A and a release agent layer 522A) of the stretched laminated film 50A. In Fig. 2A, the plurality of cracks 523 are caused in both of the intermediate
20 layer 521A and the release agent layer 522A.

[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
25 an interface with the base film (as shown in, for instance, Fig. 2A).

 It should be noted that the cracks (fissures) in the thickness direction of the coating layer are only required to occur in at least one of the intermediate layer and the release agent layer, however, preferably occur in both of the intermediate layer and the release agent layer.

30 The cracks in the 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. The cracks caused in the coating layer

increases an area for hot water to be infiltrated into the coating layer when the laminated film is immersed in the hot water in the subsequent step, thereby enabling acceleration of separating (peeling) the coating layer.

5 It should be noted that it is believed that the laminated film used in Patent Literature 1, which is immersed into hot water without experiencing any stretching step, is low in speed for separating (peeling) the surface laminated portion (water-soluble resin layer and surface functional layer) as compared with the removal method of the exemplary embodiment.

10 It is preferable that the laminated film is stretched to turn the coating layer on the base film into small pieces of the layer material whose outer peripheries are surrounded by the cracks. Fig. 2B 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.

15 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. 2B, 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. With such peeling, the peeled portion increases the area for the hot water to be infiltrated into the coating layer
20 when the laminated film is immersed in the hot water in the subsequent step. Accordingly, the speed for separating (peeling) the coating layer can be further increased.

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
25 layer can be efficiently removed and the base film can be efficiently wound.

[0025]

In the laminated film according to the exemplary embodiment, it is preferable that the intermediate layer is hydrophilic and water-insoluble, which will be described with reference to Figs. 1 and 2A.

30 With the use of hydrophilic intermediate layer, the effect of the exemplary embodiment (i.e. easily removing the coating layer from the laminated film) is more effectively exhibited. Presumably, the reason thereof is as below.

In the laminated film 50 before the stretching step is conducted, the intermediate layer 521 is closely attached to the base film 51 mainly by hydrogen bonding and anchor effect (Fig. 1). A plurality of cracks 523 are caused in the intermediate layer 521A and the release agent layer 522A in the laminated film 50A after the stretching step is conducted. In the removal step, the laminated film 50A illustrated in Fig. 2A is immersed in hot water to be passed. At this time, with the use of the hydrophilic intermediate layer 521A, the hot water more easily infiltrates to the interface between the base film 51 and the intermediate layer 521A through the cracks 523 to weaken the hydrogen bonding and anchor effect between the intermediate layer 521A and the base film 51. Consequently, the intermediate layer 521A is more easily peeled off from the base film 51 together with the release agent layer 522A.

[0026]

With the use of the water-insoluble intermediate layer, elution of the component of the intermediate layer 521A into the hot water is restrained. Accordingly, with the intermediate layer 521A being water-insoluble, contamination of the hot water used in the step for removing the coating layer 52A (removal step) can be prevented, so that the hot water is more easily recycled.

[0027]

Herein, whether the intermediate layer is hydrophilic is determined: the intermediate layer is defined to be "hydrophilic" when the contact angle of water on the base-film-side surface of the intermediate layer is 55 degrees or less.

According to the laminated film 50 illustrated in Fig. 1, when the contact angle of water on the base-film-side surface (represented by "a" in Fig. 1) of the intermediate layer 521 is 55 degrees or less, the intermediate layer 521 is hydrophilic.

Further, in order to allow the base film to be more easily separated, the contact angle is preferably 50 degrees or less, more preferably 45 degrees or less. The contact angle is a value determined as follows: after the base film is separated from the laminated film, specifically, after the intermediate layer is brought into contact with water to peel the interface between the base film and the intermediate layer, the contact angle of water on a surface (peeling surface) of the intermediate layer previously contacted with the base film is measured to determine the contact

angle.

[0028]

Specifically, the intermediate layer is separated from the base film and the contact angle of water on the base-film-side surface of the intermediate layer is measured according to the method described below. The obtained value is determined to be the contact angle of water on the base-film-side surface of the intermediate layer.

A 50-mm width adhesion tape (manufactured by Nitto Denko Corporation, product name "polyester adhesion tape No. 31B") is attached to the release-agent-layer surface of the laminated film and then is cut into pieces of 50 mm × 50 mm to prepare test pieces.

Next, 300-ml hot water is put into a glass beaker of 500-ml volume. Each of the test pieces is fully immersed in the hot water at 90 degrees C and is left still for three hours. Subsequently, it is confirmed that each of the test pieces is separated into a laminate and the base film, the laminate being integrated release agent layer and intermediate layer and being carried on the adhesion tape. The adhesion tape carrying the release agent layer and the intermediate layer is taken out of the hot water and dried for 24 hours at room temperature. The contact angle on the surface of the intermediate layer carried on the adhesion tape (i.e. the surface of the intermediate layer that has been in contact with the surface of the base film) is measured. The contact angle is measured using a contact angle gauge (manufactured by Kyowa Interface Science Co., Ltd., product name "DM-701") by sessile drop method according to JIS R3257 (1999). Distilled water is used as liquid droplets.

[0029]

Herein, whether the intermediate layer is water-insoluble is determined: the intermediate layer is defined to be "water-insoluble" when the difference between a contact angle of water on the release-agent-layer surface (represented by "d" in Fig. 1) and the contact angle of water on the base-film-side surface (represented by "a" in Fig. 1) of the intermediate layer is 30 degrees or more. The difference between the contact angles is preferably 40 degrees or more, more preferably 50 degrees or more. If the value of the difference is small, it means that the components forming the

intermediate layer have eluted into the water and a partially exposed release agent layer was measured.

The contact angle of water on the release-agent-layer surface, which is not particularly limited, is usually 80 degrees or more, preferably 85 degrees or more, more preferably 90 degrees or more. The upper limit of the contact angle of water on the release-agent-layer surface is usually 150 degrees, preferably 140 degrees, more preferably 130 degrees.

The contact angle of water on the release-agent-layer surface is measured using a contact angle gauge (manufactured by Kyowa Interface Science Co., Ltd., product name "DM-701") by sessile drop method according to JIS R3257 (1999). Distilled water is used as liquid droplets.

[0030]

Details of the base film, the intermediate layer, and the release agent layer will be described later.

[0031]

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 fifth exemplary embodiments.

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

[0032]

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.

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 Fig. 3 are orthogonal to each other, where X axis and Y axis are in a predetermined plane and Z axis is orthogonal to the predetermined plane.

[0033]

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, an immersion unit 30 including a water vessel 32 for the stretched laminated film 50A to be immersed in hot water HW, and a winding unit 40 that winds the base film 51 taken out of the water vessel 32 to be roll-shaped.

The removal equipment 100 includes a foreign-matter removal unit 70 provided between the immersion unit 30 and the winding unit 40, the foreign-matter removal unit being configured to remove foreign matters on the base film 51.

[0034]

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).

[0035]

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).

[0036]

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 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 first stretching roll 3A and the second stretching roll 3B. The rolling speed controller

3C is, for instance, a computer.

[0037]

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

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

 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
10 of the coating layer 52 of the laminated film 50 to heat the laminated film 50 from the side of the coating layer 52.

 In the example illustrated in Fig. 3, a heater 60 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.

15 [0038]

Immersion Unit 30

 The immersion unit 30 includes the water vessel 32 for immersing the stretched laminated film 50A in the hot water HW. The water vessel 32 is a heat-resistant water vessel.

20 In the example illustrated in Fig. 3, the immersion unit 30 includes: the water vessel 32 storing the hot water HW; and a plurality of guide rolls 31 provided in the hot water HW and configured to pass the stretched laminated film 50A therebetween while reeling the stretched laminated film 50A thereon.

 The number of the guide rolls 31 provided in the hot water HW is determined
25 as appropriate according to the size of the water vessel. The number of the guide rolls 31 is usually two or more.

 The immersion unit 30 is preferably provided with a heater that adjusts the temperature of the hot water to a predetermined temperature.

 The heater may be provided inside the water vessel 32 (e.g. as illustrated in
30 Fig. 6) or may be provided outside the water vessel 32. Any known heater is usable as the heater.

 The immersion unit 30 preferably includes a water-flow guide that guides

debris of the coating layer, which have fallen off from the base film into the hot water HW, to a predetermined point of the water vessel 32.

The predetermined point refers to a point for the debris of the coating layer to be easily collected, for example, an upper end of the water vessel 32.

5 Examples of the water-flow guide include a rotary vane, and a pump.

 In the example illustrated in Fig. 3, it is preferable that the water-flow guide is configured to guide the debris of the coating layer to a region (e.g. the upper end of the water vessel 32) on the water surface provided with none of the plurality of guide rolls 31 as viewed from an upper side of the water vessel 32 (i.e. as viewed in
10 a direction (-Z-axis direction) opposite the Z-axis direction).

 The water-flow guide provided for the immersion unit 30 enables the debris of the coating layer to be efficiently collected.

[0039]

Foreign-Matter Removal Unit 70

15 The foreign-matter removal unit 70, which is provided between the immersion unit 30 and the winding unit 40, is configured to remove foreign matters on the base film 51 taken out of the water vessel 32.

 The foreign matters are, for instance, the coating layer remaining on the base film 51 and water drops attached on the base film 51.

20 Examples of the foreign-matter removal unit 70, which are not specifically limited, include an air knife and a drier. It is only necessary for the foreign-matter removal unit 70 to be provided at least on a side for the coating layer 52A to be attached on the base film 51.

 In the example illustrated in Fig. 3, the foreign-matter removal unit 70 is in a
25 form of air knives 71, which face each other across the base film 51. The air knives 71 are each configured to blow air onto corresponding one of the sides of the base film 51 taken out of the water vessel 32 to remove the coating layer remaining on the base film 51 and water drops attached on the base film 51.

 Another type of the foreign-matter removal unit, which is in a form of a drier,
30 is configured to blow hot air onto the base film 51.

[0040]

Winding Unit 40

The winding unit 40 includes a winding roll 4 that winds the base film 51 taken out of the water vessel 32 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).

[0041]

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.

[0042]

10 Preparation Step

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
15 laminated film 50 being wound may be produced.

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.

[0043]

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, shown by an illustration rotating Fig. 1 at 180 degrees in a vertical direction.

In the region R1 illustrated in Fig. 3 in the laminated film 50 fed from the roll 1, the base film 51, the intermediate layer 521, and the release agent layer 522 are laminated in this order in the Z-axis direction.

30 [0044]

Stretching Step

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 in a region R2 in Fig. 3 is, for instance, shown by an illustration rotating Fig. 2A at 180 degrees in a vertical direction. Further, the stretched laminated film 50A in the region R2 as viewed in the Z axis is, for instance, as shown in Fig. 2B.

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 passing the laminated film 50 between the first stretching roll 3A, the additional stretching roll(s), and the second stretching roll 3B while reeling the laminated film 50 thereon.

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.

[0045]

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 60 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 likely to be caused in the coating layer 52 (intermediate layer 521 and release agent layer 522) 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 sheet 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.

[0046]

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 (intermediate layer 521 and release agent layer 522).

[0047]

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.

[0048]

30 Removal Step

In the removal step, the stretched laminated film 50A is immersed in the hot water HW in the water vessel 32 to remove the coating layer (stretched coating layer

52A) from the laminated film 50A.

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 passes through a guide roll 31a, and then is immersed in the hot water HW in the water vessel 32.

The laminated film 50A is passed in the hot water HW while being sequentially reeled on the plurality of guide rolls 31 provided in the hot water HW. In the process of delivery, the coating layer (stretched coating layer 52A) falls off from the base film to be released into the hot water HW.

The temperature of the hot water HW is preferably, for instance, 40 degrees C or more, more preferably 60 degrees C or more. Further, the temperature of the hot water is preferably less than 100 degrees C, more preferably 98 degrees C or less.

[0049]

Foreign-Matter Removal Step

The coating-layer removal method according to the first exemplary embodiment further includes a step for removing foreign matters on the base film (sometimes referred to as a “foreign-matter removal step” hereinafter) after taking the base film, which is left after the coating layer is removed, out of the hot water and before winding the base film to be roll-shaped.

In the example illustrated in Fig. 3, in the foreign-matter removal step, the foreign matters on the base film 51 are removed by blowing air through an outlet port (not illustrated) of each of the air knives 71 (an example of the foreign-matter removal unit 70) onto corresponding one of the sides of the base film 51 having been taken out of the hot water.

The coating layer remaining on the base film 51 and water drops attached on the base film 51 are removed by performing the foreign-matter removal step.

[0050]

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 from which foreign

matters are removed by the air knives 71 is wound to be roll-shaped by the winding roll 4 after passing through the guide roll 31b.

[0051]

Third Exemplary Embodiment

5 Removal equipment of a coating layer according to a third exemplary embodiment is the same as the removal equipment 100 according to the second exemplary embodiment except that the immersion unit and the foreign-matter removal unit are respectively replaced by an immersion unit 30A and a foreign-matter removal unit 70A illustrated in Fig. 4.

10 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 immersion unit and the
15 foreign-matter removal unit according to the third exemplary embodiment.

[0052]

Immersion Unit 30A

 The immersion unit 30A includes a scraping unit 80 configured to scrape the coating layer (stretched coating layer 52A) off from the base film 51 in the water
20 vessel 32.

 In the example illustrated in Fig. 4, the scraping unit 80 is a blade 81.

 The blade 81 is provided at a side of the stretched laminated film 50A (i.e. a side provided with the stretched coating layer 52A) in a manner to be in contact with the laminated film 50A.

25 The location of the blade 81, which is not particularly limited, is preferably downstream in the delivery path in the water vessel 32 as illustrated in Fig. 4. The blade 81, which is provided downstream in the delivery path, can scrape the coating layer after the laminated film is sufficiently immersed in water and reduce an area for the scraped debris of the coating layer likely to be attached. The number of the blade
30 81 is optionally two or more. A material of the blade 81 is not particularly limited.

[0053]

Foreign-Matter Removal Unit 70A

In the example illustrated in Fig. 4, the foreign-matter removal unit 70A includes the air knives 71 and high-pressure water-flow nozzles 72.

The high-pressure water-flow nozzles 72 are configured to spray high-pressure water-flow onto both sides of the base film 51 pulled out of the water vessel 32 to remove the coating layer remaining on the base film 51.

[0054]

With the use of the coating-layer removal equipment according to the third exemplary embodiment, the coating-layer removal method according to the first exemplary embodiment is performed in the same manner as in the second exemplary embodiment except for the step described below.

[0055]

Removal Step

In the removal step, after immersing the stretched coating layer 52A in the hot water HW, the coating layer 52A is scraped off from the base film 51 using the blade 81 (an example of the scraping unit 80).

The coating layer (stretched coating layer 52A), which falls off from the base film while the stretched laminated film 50A is passed in the hot water HW, is further scraped off from the base film 51 by the blade 81 in the example illustrated in Fig. 4. Consequently, the coating layer 52A is less likely to remain on the base film 51.

[0056]

Foreign-Matter Removal Step

In the example illustrated in Fig. 4, the foreign-matter removal unit 70A includes the air knives 71 and high-pressure water-flow nozzles 72.

Initially, high-pressure water-flow is sprayed from the high-pressure water-flow nozzles 72 onto both sides of the base film 51 pulled out of the hot water to remove the coating layer remaining on the base film 51. Subsequently, air is blown from outlets (not illustrated) of the air knives 71 onto both sides of the base film 51 to remove water drops attached on the base film 51.

[0057]

Fourth Exemplary Embodiment

Removal Equipment of Coating Layer

Removal equipment of a coating layer according to a fourth exemplary

embodiment is the same as the removal equipment according to the third exemplary embodiment except that the foreign-matter removal unit is replaced by a foreign-matter removal unit 70B illustrated in Fig. 5.

5 The fourth exemplary embodiment will be described below, where difference(s) from the third 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. 5 schematically illustrates an example of the immersion unit and the foreign-matter removal unit according to the fourth exemplary embodiment.

10 [0058]

Foreign-Matter Removal Unit 70B

In the example illustrated in Fig. 5, the foreign-matter removal unit 70B includes the high-pressure water-flow nozzles 72 and a pair of water-absorption rolls 73a, 73b provided downstream in the delivery path with respect to the high-pressure water-flow nozzles 72. Metal rolls 74a, 74b in a pair are provided to face the water-absorption rolls 73a, 73b, respectively.

The pair of water-absorption rolls 73a, 73b is provided to face each other across the base film 51 pulled out of the water vessel 32.

20 Materials of the water-absorption rolls 73a, 73b and the metal rolls 74a, 74b are not particularly limited.

[0059]

With the use of the coating-layer removal equipment according to the fourth exemplary embodiment, the coating-layer removal method is performed in the same manner as in the third exemplary embodiment except for the step described below.

25 [0060]

Foreign-Matter Removal Step

In the example illustrated in Fig. 5, the foreign-matter removal step is performed using the high-pressure water-flow nozzles 72 and the water-absorption rolls 73a, 73b.

30 Initially, as in the third exemplary embodiment, high-pressure water-flow is sprayed from the high-pressure water-flow nozzles 72 onto both sides of the base film 51 pulled out of the hot water to remove the coating layer remaining on the base

film 51. Subsequently, the water drops attached on the base film 51 is absorbed by the water-absorption rolls 73a, 73b. The water-absorption rolls 73a, 73b are respectively pressed against the metal rolls 74a, 74b to push out the water absorbed by the water-absorption rolls 73a, 73b. In the example illustrated in Fig. 4, the water pushed out of the water-absorption rolls 73a, 73b drops into the water vessel 32.

[0061]

Fifth Exemplary Embodiment

Removal Equipment of Coating Layer

Removal equipment of a coating layer according to a fifth exemplary embodiment is the same as the removal equipment according to the fourth exemplary embodiment except that the immersion unit 30A is replaced by an immersion unit 30C illustrated in Fig. 6.

The fifth exemplary embodiment will be described below, where difference(s) from the fourth 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 immersion unit and the foreign-matter removal unit according to the fifth exemplary embodiment.

[0062]

Immersion Unit 30C

The immersion unit 30C includes the scraping unit 80 that scrapes the coating layer (stretched coating layer 52A) off from the base film 51 in the water vessel 32 and a mechanism (sometimes also referred to as a “discharge mechanism” hereinafter) for overflowing the hot water HW from an upper part of the water vessel 32 to discharge the debris of the coating layer 52A fallen off from the laminated film 50A toward an outside of the water vessel 32.

In the example illustrated in Fig. 6, the scraping unit 80 is a wire brush 82. The wire brush 82 is provided to face a guide roll 31c with the laminated film (stretched laminated film 50A) therebetween. The wire brush 82 is provided at a side of the laminated film 50A (i.e. the side provided with the coating layer 52A) in a manner to be in contact with the laminated film 50A. The wire brush 82, whose location is not particularly limited, is preferably provided downstream in the delivery

path in the water vessel 32 as illustrated in Fig. 6. Since the wire brush 82 is provided downstream in the delivery path, the wire brush 82 can scrape the coating layer after the laminated layer is sufficiently immersed in water and can reduce an area for the scraped debris of the coating layer likely to be attached. The number of the wire brush 82 is optionally two or more.

The immersion unit 30C is preferably provided with a heater 95 that adjusts the temperature of the hot water to a predetermined temperature. The heater 95 is provided inside the water vessel 32.

The discharge mechanism includes a coating separation bath 90 adjacent to the water vessel 32, a circulation path 93 in which the hot water discharged from a drainage port 93A of the coating separation bath 90 is circulated, and a circulating pump P that circulates the hot water.

The coating separation bath 90 includes: a filter 92 that filters the debris of the coating layer; and the drainage port 93A.

The circulation path 93 connects the drainage port 93A of the coating separation bath 90 with an input port 93B provided at the upper part of the water vessel 32.

A pore diameter of the filter 92 is preferably in a range from 1 μm to 100 μm .
[0063]

With the use of the coating-layer removal equipment according to the fifth exemplary embodiment, the coating-layer removal method is performed in the same manner as in the fourth exemplary embodiment except for the step described below.

[0064]

Removal Step

In the removal step, after immersing the stretched coating layer 52A in the hot water HW, the coating layer 52A is scraped off from the base film 51 using the wire brush 82 (an example of the scraping unit 80).

The coating layer (stretched coating layer 52A), which falls off from the base film while the stretched laminated film 50A is passed in the hot water HW, is further scraped off from the base film 51 by the blade 82 in the example illustrated in Fig. 6. Consequently, the coating layer 52A is less likely to remain on the base film 51.

[0065]

Coating Layer Discharging Step

The coating-layer removal method according to the fifth exemplary embodiment further includes: overflowing the hot water from the upper part of the water vessel to discharge debris of the coating layer fallen off from the laminated film to an outside of the water vessel (coating-layer discharging step).

Examples of the method for overflowing the hot water include: filling the water vessel with hot water or water through an injection pipe for overflowing; circulating the hot water discharged from the water vessel to feed the hot water again into the water vessel; and a combination of the above processes.

In the example illustrated in Fig. 6, the debris of the coating layer fallen off from the laminated film (stretched laminated film 50A) overflows from the water vessel 32 together with the hot water HW to be discharged into the coating separation bath 90 (coating layer discharging step).

In the coating separation bath 90, the debris of the coating layer is filtered by the filter 92. The hot water having been filtered by the filter 92 is discharged through the drainage port 93A of the coating separation bath 90, flows through the circulation path 93, and is again fed into the water vessel 32 from the input port 93B.

[0066]

According to the fifth exemplary embodiment, the hot water used in the removal step can be recycled in a simple manner. In addition, when the intermediate layer is water-insoluble, elution of the component of the intermediate layer into the hot water is restrained, so that the hot water can be kept from being contaminated.

[0067]

Modification of Embodiments

For instance, in the removal equipment according to the third or fourth exemplary embodiment, the blade 81, which serves as the scraping unit 80 that scrapes the coating layer (stretched coating layer 52A) from the base film 51, is optionally replaced by the wire brush 82 used in the fifth exemplary embodiment.

The wire brush 82 is preferably provided to face a guide roll 31c with the laminated film (stretched laminated film 50A) therebetween, as illustrated in Fig. 6.

In the removal equipment according to the second to fifth exemplary embodiments, the heater 60 is optionally provided between the feeder 10 and the

first stretching roll 3A. In other words, the heater 60 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 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 (the intermediate layer 521 and release agent layer 522) by heating the laminated film 50 before performing the stretching step.

[0068]

The base film 51, the intermediate layer 521, and the release agent layer 522, which are sequentially laminated in this order in the region R1 illustrated in Fig. 3 in the Z-axis direction in the laminated film 50 fed from the roll 1 in the removal equipment according to the second to fifth exemplary embodiments, are optionally reversely laminated in a vertical direction.

In the removal equipment in the third to fifth exemplary embodiments, the scraping unit 80 (the blade 81 or the wire brush 82) is provided to be in contact with one of the surfaces of the stretched laminated film 50A. However, the configuration of the removal equipment is not limited thereto. For instance, the scraping unit 80 is optionally provided to be in contact with each surface of the stretched laminated film 50A.

In the removal equipment in the third to fifth exemplary embodiments, the scraping unit 80 (the blade 81 or the wire brush 82) is provided downstream in the delivery path in the water vessel 32. However, the location of the scraping unit 80 is not limited thereto. For instance, the removal equipment is optionally provided upstream or close to the center of the delivery path in the water vessel 32.

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

[0069]

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 will be described.

[0070]

Laminated Film

The laminated film used in any of the above exemplary embodiments includes the base film and the coating layer. The coating layer includes the intermediate layer and the release agent layer. The intermediate layer is interposed between the base film and the release agent layer.

The intermediate layer may be a single layer or a multi-layer formed of two or more intermediate layers of the same or different materials. The release agent layer may be a single layer or a multi-layer formed of two or more release agent layers of the same or different materials.

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

In an exemplary arrangement of the laminated film, the base film, the intermediate layer, and the release agent layer that are directly laminated in this order. In other words, the base film, the intermediate layer, and the intermediate layer are directly in contact with each other without including any layer therebetween.

[0071]

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.

[0072]

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.

[0073]

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.

[0074]

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.

[0075]

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.

[0076]

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.

[0077]

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.

[0078]

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.

[0079]

The release agent layer optionally contains additive(s) 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.

[0080]

A thickness of the release agent 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 .

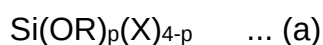
[0081]

Intermediate Layer

The intermediate layer is preferably a layer made of a silane compound that exhibits polycondensability upon being hydrolyzed, from the viewpoint that the intermediate layer exhibits hydrophilicity and water-insolubility and the coating layer is more easily removed from the base-film-side surface of the intermediate layer.

[0082]

The silane compound preferably contains at least one of a tetrafunctional silane compound represented by a formula (a) below or oligomer thereof as a main component.



In the formula (a):

R represents an alkyl group and X represents a halogen atom; when a plurality of R are present, the plurality of R are mutually the same or different; when a plurality of X are present, the plurality of X are mutually the same or different; and p is an integer from 0 to 4.

5 An alkyl group preferably has 1 to 4 carbon atoms.

It should be noted that the silane compound represented by the formula (a) may be used alone or in combination of two or more thereof.

[0083]

Examples of the silane compound represented by the formula (a) preferably
10 includes a silane compound represented by the formula (a) in which p is 4.

The silane compound represented by the formula (a) in which p is 4 (i.e., a tetrafunctional silane compound) is preferably tetraalkoxysilane. More preferable examples of the tetraalkoxysilane include tetramethoxysilane, tetraethoxysilane, tetrapropoxysilane, and tetrabutoxysilane. Among the above, In terms of ease of
15 availability and reactivity of the hydrolysis reaction, at least one of tetramethoxysilane or tetraethoxysilane, or a mixture of tetramethoxysilane and tetraethoxysilane is preferable.

[0084]

Commercially available products are usable for the hydrolytic
20 polycondensation product of the silane compound. Suitable examples of the commercially available products include "COLCOAT (Registered Trademark) N-103X," "COLCOAT (Registered Trademark) PX," "Methyl Silicate 51" (average tetramer of tetramethoxysilane), "Methyl Silicate 53A" (average heptamer of tetramethoxysilane), "Ethyl Silicate 40" (average pentamer of
25 tetraethoxysilane), "Ethyl Silicate 48" (average decamer of tetraethoxysilane), and "EMS-485" (a mixture of average decamer of tetramethoxysilane and average decamer of tetraethoxysilane) (all manufactured by COLCOAT CO., LTD.).

[0085]

In order for water to be easily infiltrated when the intermediate layer is in
30 contact with water, a thickness of the intermediate layer is preferably in a range from 0.01 μm to 1 μm , more preferably from 0.03 μm to 0.5 μm , and still more preferably from 0.05 μm to 0.3 μm .

[0086]

With the use of the laminated film including the hydrophilic and water-insoluble intermediate layer in the exemplary embodiments of the invention, the debris of the removed coating layer has the release-agent-layer surface and the hydrophilic surface of the intermediate layer. When the debris of this structure is immersed in water, the release-agent-layer surface faces the atmosphere by surface tension and the surface of the intermediate layer faces water, so that the debris is stabilized. In other words, the debris of this structure is more likely to be present at the border of water and air than in water. The debris of the coating layer, which is an ultra-thin film, can keep floating on the surface of water due to prevailing buoyant force caused by surface tension even when the density of the debris is slightly large and due to the presence of the water-insoluble intermediate layer.

[0087]

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 environment protection.

EXPLANATION OF CODES

[0088]

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, 10...feeder, 20...stretching unit, 30, 30A, 30C...immersion unit, 31, 31a, 31b, 31c...guide roll, 32...water vessel, 40...winding unit, 50, 50A...laminated film, 51...base film, 52, 52A...coating layer, 60...heater, 70, 70A, 70B...foreign-matter removal unit, 71...air knife, 72...high-pressure water-flow nozzles, 73a, 73b...water-absorption roll, 74a, 74b...metal roll, 80...scraping unit, 81...blade, 82...wire brush, 90...coating separation bath, 92...filter, 93...circulation path, 93A...drainage port, 93B...input port,

95...heater, 100...removal equipment, 521, 521A...intermediate layer, 522, 522A...release agent layer, 523...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;

immersing the stretched laminated film in hot water in a water vessel to
remove the coating layer from the laminated film; and

10 winding the base film left after the coating layer is removed to be roll-
shaped, wherein

the coating layer comprises an intermediate layer and a release agent layer,
and

the intermediate layer is interposed between the base film and the release
15 agent layer.

[Claim 2]

The method according to claim 1, wherein in the removing of the coating layer,
the coating layer is scraped off from the base film after the stretched laminated film
is immersed in the hot water.

20 [Claim 3]

The method according to claim 1 or 2, further comprising: overflowing the hot
water from an upper part of the water vessel to discharge debris of the coating layer
fallen off from the laminated film to an outside of the water vessel.

[Claim 4]

25 The method according to claim 1 or 2, wherein the stretching of the laminated
film is conducted while heating the laminated film.

[Claim 5]

The method according to claim 1 or 2, further comprising: removing foreign
matters on the base film after taking the base film, which is left after the coating layer
30 is removed, out of the hot water and before winding the base film to be roll-shaped.

[Claim 6]

The method according to claim 1 or 2, wherein the base film and the

intermediate layer are in direct contact with each other.

[Claim 7]

The method according to claim 1 or 2, wherein the intermediate layer is hydrophilic and water-insoluble.

5 [Claim 8]

The method according to claim 1 or 2, wherein the laminated film is a laminated film used for manufacturing a ceramic green sheet and left after the ceramic green sheet is peeled off.

[Claim 9]

10 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;

15 an immersion unit including a water vessel, in which the stretched laminated film is immersed in hot water; and

a winding unit configured to wind the base film taken out of the water vessel to be roll-shaped.

[Claim 10]

20 The removal equipment according to claim 9, wherein

the immersion unit comprises a scraping unit configured to scrape the coating layer off from the base film in the water vessel, and

the scraping unit is a blade or a wire brush.

[Claim 11]

25 The removal equipment according to claim 9 or 10, wherein the immersion unit comprises a mechanism configured to overflow the hot water from an upper part of the water vessel to discharge debris of the coating layer fallen off from the laminated film to an outside of the water vessel.

[Claim 12]

30 The removal equipment according to claim 9 or 10, wherein the stretching unit comprises a heater configured to heat the laminated film.

[Claim 13]

The removal equipment according to claim 9 or 10, further comprising: a foreign-matter removal unit provided between the immersion unit and the winding unit, the foreign-matter removal unit being configured to remove foreign matters on the base film.

5 [Claim 14]

The removal equipment according to claim 9 or 10, wherein the laminated film is a laminated film used for manufacturing a ceramic green sheet and left after the ceramic green sheet is peeled off.