

DESCRIPTION

TITLE OF THE INVENTION:

COATING FILM REMOVING METHOD AND COATING FILM REMOVING
5 DEVICE

Field

[0001] The present invention relates to a removing
method and a removing device capable of efficiently
10 removing a coating film on a surface of a thermoplastic
resin film.

Background

[0002] While a plastic is used in various fields, a
plastic such as a microplastic is considered to be a cause
15 of marine pollutions, and reduction of environmental load
by a plastic is urgently needed.

In recent years, with evolution of Internet of Things
(IoT), the number of electronic devices mounted on
computers and smartphones, such as CPU, has increased, and
20 as a result, the number of multilayer ceramic capacitors
(MLCCs) required to drive the electronic devices has also
rapidly increased. A general method for manufacturing this
MLCC includes a step of forming a ceramic green sheet layer
on a release film obtained by forming a release layer on a
25 plastic base film using the release film as a carrier
sheet, and a step of removing the ceramic green sheet layer
to form a ceramic green sheet. In these steps, the release
film from which the ceramic sheet has been removed is
discarded as an unnecessary material.

30 [0003] That is, an increase in the number of release
films as a waste due to a rapid increase in the number of
MLCCs in recent years is an environmental problem, and
efforts for reuse of a plastic base film have been

activated. A component of the release layer contained in the release film generally has a different composition from a component constituting the base film from a viewpoint of releasability. Therefore, when the release film with the release layer is remelted as it is to form a regenerated film, the component of the release layer is present as a foreign substance, and therefore stable film formation cannot be performed.

[0004] As a method for removing a release component from a release film, Patent Literature 1 discloses a method in which a release film having a water-soluble resin layer formed between a base film and a release layer is immersed in a warm water tank for two seconds or more, and then a surface of the release film is rubbed with a brush roll to remove the release layer.

Patent Literature 2 discloses, as a method for removing a coating film from a coating film-attached base film formed by coating, a device including a dissolution tank storing an organic solvent, in which a scraper capable of being brought into contact with a surface of a coating film is disposed at a bottom of the dissolution tank, and the coating film is dissolved and removed from a coating film-attached base film to be conveyed.

Citation List

Patent Literature

[0005] Patent Literature 1: JP 2004-363140 A

Patent Literature 2: JP 2021-146682 A

Summary

Technical Problem

[0006] However, the coating film removing method disclosed in Patent Literature 1 has a problem that since a water-soluble resin layer is eluted into a hot water tank, a resin concentration in the hot water increases with a

lapse of treatment time, and initial removing ability cannot be continuously exhibited. Even when a method for increasing the supply amount of water is adopted in order to suppress the increase in the resin concentration, the amount of wastewater increases together with the supply amount of water, and thus there is a problem that not only cleaning cost increases significantly but also an environmental load increases.

[0007] The coating film removing method disclosed in Patent Literature 2 uses an organic solvent in order to dissolve and remove a coating film, and requires a large amount of organic solvent in order to continuously exhibit initial removing ability similarly to Patent Literature 1, and thus has a problem that an environmental load significantly increases. In addition, as a device structure, the scraper disposed at the bottom of the dissolution tank is brought into direct contact with a surface of a coating film of a coating film-attached base film to be conveyed and scrapes the coating film. Since the base film is conveyed in a liquid, an organic solvent is likely to be interposed between the surface of the coating film and the scraper when the coating film is scraped with the scraper, and sufficient scraping ability cannot be obtained in some cases. In order to improve the scraping ability, it is conceivable to make an angle formed by a film surface on an upstream side and a film surface on a downstream side in a conveyance direction of the base film via the scraper an acute angle. However, since it is necessary to make the dissolution tank deep, the volume of the dissolution tank increases, and the amount of an organic solvent used is further increased, which further deteriorates an environmental load.

[0008] Therefore, the present invention provides a

coating film removing method and a coating film removing device capable of dissolving a water-soluble resin using a small amount of cleaning liquid and efficiently and reliably removing the coating film from a surface of a coating film-attached base film containing a water-soluble resin on one surface of the base film in order to obtain a base film in which a regenerated film can be stably formed from the coating film-attached base film after use even when remelting is performed.

10 Solution to Problem

[0009] [1] A coating film removing method according to the present invention to solve the above problems is a coating film removing method for removing a coating film containing a water-soluble resin from a base film having

15 the coating film on at least one surface of the base film, the method including: applying a cleaning liquid containing water as a main component to the coating film in an amount in a range of 3 to 650 ml per 1 m² of a surface area of the coating film; and bringing a removing member into contact

20 with a surface of the coating film to which the cleaning liquid is applied, and removing the coating film from the base film by relatively moving the base film with respect to the removing member in a longitudinal direction of the base film while setting an angle formed by the base films

25 via the removing member to a range of 20 to 150° and applying a tension in a range of 10 to 1000 N/m in at least one longitudinal direction of the base film.

[0010] [2] In the coating film removing method according to the [1], in a range in which the removing member is in

30 contact with a surface of the coating film, when a length of the base film in a longitudinal direction is represented by a contact length L, a surface passing through a center position of the contact length and vertical to a surface of

the removing member is referred to as a vertical surface, a side on which the base film relatively approaches the removing member is referred to as an upstream side, and a side on which the base film relatively separates from the removing member is referred to as a downstream side, it is preferable that the contact length L [m] is in a range of 1×10^{-5} to 1×10^{-3} m, and it is preferable that an angle (acute angle) θ_1 [°] formed by the vertical surface and the base film on the upstream side of the vertical surface, an angle (acute angle) θ_2 [°] formed by the vertical surface and the base film on the downstream side of the vertical surface, a tension T_1 [N/m] applied to the base film on the upstream side of the vertical surface, and a tension T_2 [N/m] applied to the base film on the downstream side of the vertical surface satisfy the following formula (1).

$$\text{Formula (1): } 1.0 \times 10^6 \leq \{T_1 \times \cos(\theta_1) + T_2 \times \cos(\theta_2)\} / L \leq 2.4 \times 10^8$$

[0011] [3] In the coating film removing method according to the [1] or the [2], it is preferable that an angle formed by one surface among two surfaces constituting the removing member and the base film before being in contact with the ridgeline is set to 5° or more, the ridgeline being a ridgeline of the removing member where the removing member starts to be in contact with a surface of the coating film and being sandwiched between the two surfaces of the removing member, the one surface of the removing member being on a side facing the base film before being in contact with the ridgeline.

[4] In the coating film removing method according to any one of the [1] to the [3], it is preferable that the coating film contains a curable silicone resin.

[0012] [5] A coating film removing device according to

the present invention to solve the above problems is a coating film removing device for removing a coating film containing a water-soluble resin from a base film having the coating film on at least one surface of the base film, 5 the device including: a cleaning liquid applying mechanism for applying a cleaning liquid to the coating film; a removing member for removing the coating film to which the cleaning liquid is applied from the base film; a driving device for relatively moving the base film with respect to 10 the removing member in a longitudinal direction of the base film; and a tension applying mechanism for applying a tension in at least one longitudinal direction of the base film, wherein the cleaning liquid applying mechanism is set to apply the cleaning liquid in an amount in a range of 3 15 to 650 ml per 1 m² of a surface area of the coating film, the removing member is disposed such that the removing member is in contact with a surface of the coating film to which the cleaning liquid is applied, and an angle formed by the base films via the removing member is in a range of 20 20 to 150°, and the tension applying mechanism is set to apply a tension in a range of 10 to 1000 N/m.

[0013] [6] In the coating film removing device according to the [5], it is preferable that the removing member has a length of 1×10^{-5} to 1×10^{-3} m in a longitudinal direction 25 of the base film in a range in which the removing member is in contact with a surface of the coating film.

[7] The coating film removing device according to the [5] or the [6] further includes: an unwinding device for unwinding the coating film-attached base film wound in a 30 roll shape; and a winding device for winding the base film from which the coating film has been removed.

Here, although the base film before being in contact with the removing member is the "base film having the

coating film" and the base film after being in contact with the removing member is the "base film from which the coating film has been removed", in the coating film removing methods of the [1] to the [4] and the coating film removing devices of the [5] to the [7], the "base film" is used without any particular distinction.

.Advantageous Effects of Invention

[0014] According to the coating film removing method and the coating film removing device of the present invention, a coating film can be efficiently and reliably removed from a coating film-attached base film containing a water-soluble resin on one surface of the base film with a small amount of cleaning liquid.

Brief Description of Drawings

[0015] FIG. 1 is a schematic view of a removing device according to an embodiment of the present invention.

FIG. 2 is a schematic view of a removing member according to a first embodiment in the removing device of the present invention.

FIG. 3 is a schematic view of a removing member according to a second embodiment in the removing device of the present invention.

FIG. 4 is a schematic view of a removing member according to a third embodiment in the removing device of the present invention.

FIG. 5 is a graph illustrating a result of removing a coating film under conditions of Example 1.

FIG. 6 is a graph illustrating a result of removing a coating film under conditions of Example 2.

FIG. 7 is a graph illustrating a result of removing a coating film under conditions of Example 3.

Description of Embodiments

[0016] The present inventors have intensively studied a

method for efficiently and reliably removing a coating film from a surface of a coating film-attached film having a coating film containing a water-soluble resin on one surface of a base film using a very small amount of
5 cleaning liquid, and as a result, have found the following coating film removing method and coating film removing device.

[0017] [Target coating film-attached base film]

The method for removing a coating film from a coating
10 film-attached base film of the present invention is a method for removing a coating film from a base film by cleaning the coating film for a coating film-attached base film containing a water-soluble resin on at least one surface of the base film. The coating film may be present
15 on one surface or both surfaces of the base film, and is not particularly limited.

[0018] The target coating film-attached base film may be, in addition to a coating film containing a water-soluble resin in consideration of an environmental load and
20 the like, a coating film-attached base film containing another water-soluble resin. In particular, as the water-soluble resin, those containing at least one of a water-soluble polyester-based resin, a polyester urethane-based resin, an acrylic resin, an ethylene ionomer-based resin, a
25 polyvinyl alcohol-based resin, a polyvinyl pyrrolidone-based resin, an ethylene-vinyl alcohol-based resin, and starch as a main component are more preferable.

[0019] The coating film containing a water-soluble resin may be a single layer body containing a water-soluble
30 resin, a laminate of two or more layers containing a water-soluble resin, or a laminate of a layer containing a water-soluble resin and a layer not containing a water-soluble resin.

[0020] A coating film-attached release film containing a release component in addition to a water-soluble resin in a part of the coating film is particularly preferable, and can efficiently exhibit a coating film removing effect.

5 The release component mentioned herein is a component that increases a contact angle of a surface of the coating film with respect to water, that is, reduces surface energy of the coating film, and examples thereof include: a curable silicone resin such as a thermosetting silicone resin
10 compound having dimethylsiloxane as a main skeleton or a UV-curable silicone resin compound cured by blending a photopolymerization initiator with an organopolysiloxane having an acryloyl group or a methacryloyl group and irradiating the blended product with UV light; a compound
15 having a long chain alkyl group; and a compound having fluorine. In the coating film, the water-soluble resin and the release component may be mixed, or a layer of the water-soluble resin and a layer of the release component may be laminated. In a case of a laminated coating film,
20 preferably, a layer containing the water-soluble resin is formed immediately above the base film, and then a layer containing the release component is formed on an outermost surface. As the release component, it is particularly preferable to use a thermosetting silicone resin compound
25 having dimethylsiloxane having high water permeability as a main skeleton.

[0021] [Method for removing coating film from coating film-attached base film]

The coating film removing method of the present
30 invention is a method for removing a coating film from a coating film-attached base film, the method including: applying a cleaning liquid containing water as a main component to a surface of a coating film containing the

water-soluble resin in a base film having the coating film in at least one surface thereof in an amount of 3 to 650 ml per 1 m² of a surface area of the coating film; and bringing a removing member into contact with the surface of the coating film to which the cleaning liquid is applied, and removing the coating film from the coating film- attached base film by relatively moving the base film with respect to the removing member in a longitudinal direction of the base film while setting an angle formed by the base films via the removing member to a range of 20 to 150° and applying a tension in a range of 10 to 1000 N/m in at least one longitudinal direction of the base film.

[0022] A method for applying the cleaning liquid to the surface of the coating film in the coating film removing method of the present invention may be any method. For example, the cleaning liquid may be applied in a form of droplets using a spray nozzle, or the cleaning liquid at a high pressure or a high temperature may be applied using a high-pressure cleaning machine or a steam generator. The application amount of the cleaning liquid is preferably adjusted appropriately depending on the properties and thickness of the coating film to be removed, and is preferably managed appropriately by a method for applying the cleaning liquid. For example, the application amount of the cleaning liquid may be managed by feeding the cleaning liquid by a metering pump, a flow meter may be disposed in the middle of a flow path through which the cleaning liquid is fed, or the cleaning liquid applied to the surface of the coating film may be collected and the mass thereof may be measured. Alternatively, when the water-soluble resin contains the cleaning liquid and it is difficult to measure the mass of the cleaning liquid, the application amount of the cleaning liquid may be calculated

by collecting all of the coating film-attached base film, the applied cleaning liquid, and the coating film after removing.

[0023] As a result of intensive studies by the present
5 inventors, it has been confirmed that when the thickness of the coating film containing the water-soluble resin is between 20×10^{-6} mm and 1.0 mm, a coating film removing effect can be obtained by setting the application amount of the cleaning liquid to 3 ml or more per 1 m² of a surface
10 area of the coating film. It has been confirmed that when the application amount of the cleaning liquid is less than 3 ml per 1 m² of a surface area of the coating film, the coating film removing effect may be reduced. Particularly when the humidity of a surrounding environment is low,
15 drying of the cleaning liquid proceeds before the cleaning liquid dissolves or swells the coating film containing the water-soluble resin, and the coating film removing effect cannot be obtained in some cases. On the other hand, as the application amount of the cleaning liquid is larger,
20 the coating film containing the water-soluble resin can be more reliably dissolved or swollen, and the coating film removing effect is improved. In particular, even when the thickness of the coating film containing the water-soluble resin is 1.0 mm, it has been confirmed that the coating
25 film removing effect is obtained by applying 650 ml of the cleaning liquid per 1 m² of a surface area of the coating film to the surface of the coating film.

[0024] As the cleaning liquid used in the coating film removing method of the present invention, any solvent
30 exhibits an effect thereof as long as the solvent can dissolve the water-soluble resin, but water is preferably used in order to reduce an environmental load. In addition, by adding a surfactant or the like using water as

a main component, wettability between the cleaning liquid and the surface of the coating film may be improved, and the cleaning liquid may be easily spread over the entire coating film.

5 [0025] Examples of the removing member in the coating film removing method of the present invention include a scraper, a fabric, a metal plate, and a rotated brush roll, but are not limited thereto, and any means may be used as long as the removing member can physically remove the
10 coating film by being brought into direct contact with the coating film-attached base film. In addition, preferably, the removing member is in direct contact with a surface of the base film having the coating film such that the removing member is pressed against the surface, and the
15 coating film can be removed from the base film by relatively moving the base film with respect to the removing member in a longitudinal direction of the base film while keeping the base film bent or curved by the removing member. In the bent or curved base film,
20 preferably, an angle formed by the base films via the removing member is in a range of 20 to 150°, and a tension is applied in a range of 10 to 1000 N/m in at least one longitudinal direction. As a result, the removing member can be strongly pressed against the surface of the coating
25 film of the base film, and therefore the coating film dissolved or swollen by the cleaning liquid can be efficiently and reliably removed. Therefore, as a range of the removing member in contact with the coating film-attached base film is narrower, the removing member can be
30 locally and more strongly pressed against the surface of the coating film of the base film, which is preferable. Among the removing members exemplified above, a scraper, a corner of a metal plate, and the like are suitably used.

[0026] When the angle formed by the base films via the removing member is less than 20° , a space for disposing the removing member is very narrow, which is not realistic. On the other hand, when the angle is larger than 150° , a force of pressing the removing member against the surface of the coating film of the base film is weak, but it has been confirmed that some coating films with easily removable properties can be removed. However, it has been confirmed that, in a case where tension fluctuation occurs or a removing speed is increased when the base film and the removing member are relatively moved in a longitudinal direction of the base film, air may be easily entrained between the base film and the removing member, and a part of the coating film may pass without being removed to remain on the base film.

[0027] It has been confirmed that by setting the tension applied to at least one longitudinal direction of the base film to 10 N/m or more, the coating film removing effect is exhibited. When the base film is conveyed with an applied tension of less than 10 N/m, stable conveyance cannot be performed due to the low tension, and the coating film cannot be removed in some cases due to a large fluctuation in tension or occurrence of meandering during conveyance. On the other hand, when a tension exceeding 1000 N/m is applied, the base film is strongly pulled in one direction. Therefore, a plurality of tetanic wrinkles in a width direction of the base film are generated in a longitudinal direction, and some of the tetanic wrinkles become folding wrinkles at a portion where the tetanic wrinkles are in contact with the removing member. The coating film cannot be removed at the portion of the folding wrinkles.

[0028] In the coating film removing method of the present invention, by relatively moving the coating film-

attached base film in the above preferable form with respect to the removing member in a longitudinal direction of the base film, the coating film is removed from the base film having the coating film. A means for relatively
5 moving the base film with respect to the removing member may be any means, and only the base film may be conveyed with the removing member fixed, or the removing member may be caused to travel with respect to the stationary base film. Alternatively, both the removing member and the base
10 film may move, or the removing member and the base film may move in the same direction or in different directions. When the base film is conveyed, it is preferable to keep a tension applied to the base film constant, and it is preferable to keep the tension constant even when a
15 conveyance speed of the base film is changed or conveyance stop and conveyance start are repeated.

[0029] When the target coating film-attached base film has a coating film continuously or intermittently in a longitudinal direction of the base film, it is preferable
20 to perform coating film removing by conveying the base film and making the removing member extended and fixed in a short direction of the base film.

In particular, when the coating film-attached base film has a coating film intermittently in a longitudinal
25 direction of the base film, or the amount of a coating film formed on the base film varies in the longitudinal direction of the base film, a conveyance speed of the base film is made variable to change time during which the coating film is dissolved or swollen by a cleaning liquid,
30 or time during which a portion having the coating film and the removing member are in contact with each other is changed, whereby appropriate adjustment is preferably performed such that coating film removing can be more

efficiently performed. The time during which the coating film is dissolved or swollen, that is, time from application of the cleaning liquid to removing of the coating film with the removing member is preferably
5 appropriately determined depending on properties of the coating film, but is preferably 0.05 to 10 seconds in view of a device size and the like.

[0030] When the coating film-attached base film has a coating film at a certain interval in a longitudinal
10 direction of the base film, coating film removing may be performed by conveying the base film by a certain length and then stopping the conveyance or changing a conveyance speed to relatively move the removing member with respect to a portion where the base film has the coating film.
15 After the coating film is removed, by starting the conveyance again or returning the conveyance speed to the original speed, coating film removing may be performed reliably with high efficiency. In addition, preferably, by stopping the conveyance or changing the conveyance speed in
20 the middle of coating film removing, the base film from which the coating film has been removed during that time is checked, and whether or not the coating film remains is inspected and checked. The inspection method may be any means as long as remaining of the coating film can be
25 detected.

[0031] In the coating film removing method of the present invention, in a range in which the removing member is in contact with a surface of the coating film of the coating film-attached base film, when a contact length of
30 the base film in a longitudinal direction is represented by L , a surface passing through a center position of the contact length and vertical to a surface of the removing member is referred to as a vertical surface, a side on

which the base film relatively approaches the removing member is referred to as an upstream side, and a side on which the base film relatively separates from the removing member is referred to as a downstream side, the coating
 5 film is preferably removed such that the contact length L [m] is in a range of 1×10^{-5} to 1×10^{-3} m, and an angle (acute angle) θ_1 [°] formed by the vertical surface and the base film on the upstream side of the vertical surface, an angle (acute angle) θ_2 [°] formed by the vertical surface
 10 and the base film on the downstream side of the vertical surface, a tension T_1 [N/m] applied to the base film on the upstream side of the vertical surface, and a tension T_2 [N/m] applied to the base film on the downstream side of the vertical surface satisfy the following formula (1).

15 Formula (1): $1.0 \times 10^6 \leq \{T_1 \times \cos(\theta_1) + T_2 \times \cos(\theta_2)\} / L \leq 2.4 \times 10^8$

[0032] As the contact length L is shorter, the removing member can be more strongly brought into contact with a surface of the coating film of the base film, but as a
 20 result of intensive studies by the inventors, the contact length L is 5×10^{-6} m at the shortest, which is a limit of machining. Even when machining was attempted such that the contact length L was less than 5×10^{-6} m, burrs were generated at the time of machining, or even when generated
 25 burrs were removed with polishing paper or a polishing cloth, polishing marks remained, and as a result, it was not possible to make the contact length L less than 5×10^{-6} m. On the other hand, when the contact length L is larger than 1×10^{-3} m, in order to satisfy the above
 30 formula (1), it is necessary to set the tensions T_1 and T_2 to be large, and furthermore to make the angles θ_1 and θ_2 formed by the vertical surface and the base films as small

as possible. In this case, even when adjustment of removing condition of the coating film is attempted according to properties of a coating film to be removed, a range that can be adjusted in the above formula (1) is narrowed, and therefore coating film removing was possible only for a coating film having properties in which removing was relatively easy.

[0033] In the coating film removing method of the present invention, when a rigid body such as a scraper or a metal plate having a distal end shape as illustrated in FIG. 2 is used as the removing member, it is preferable to remove the coating film by setting an angle θ_3 to 5° or more, in which the angle θ_3 is formed by a surface (hereinafter, also referred to as an upstream side surface r_1 of the removing member) on a side facing the base film before being in contact with a ridgeline of the removing member where the removing member starts to be in contact with a surface of the coating film among two surfaces constituting the removing member and including the ridgeline and the base film before being in contact with the ridgeline. When the angle was set to less than 5° , it was confirmed that a coating film (hereinafter, referred to as a removed product) after removing was deposited between the base film relatively approaching the removing member and the upstream side surface r_1 of the removing member. When coating film removing was continuously performed, a part of the deposited removed product flowed out so as to overflow to an end portion of the base film in a short direction, and was attached to a side surface of the end portion of the base film in the short direction or a back surface of the base film in rare cases. On the other hand, it was confirmed that by setting the angle θ_3 to 5° or

more, the amount of deposited removed product was significantly reduced. When the angle θ_3 was set to 5° or more, a phenomenon that the removed product flowed along the upstream side surface r_1 of the removing member and
5 overflowed in a short direction of the base film did not occur, and the coating film could be stably and continuously removed.

[0034] [Coating film removing device of coating film-attached base film]

10 A desirable embodiment of the coating film removing device of the present invention will be described with reference to the drawings. Note that the following description exemplifies one of embodiments according to the present invention, the present invention is not limited
15 thereto, and various modifications can be made without departing from the gist of the present invention.

[0035] FIG. 1 is a schematic view of a coating film removing device 101 according to an embodiment of the present invention. The coating film removing device 101
20 includes an unwinding device 4 that unwinds a coating film-attached base film 2 and a winding device 5 that winds a base film 3 from which a coating film has been removed. The coating film removing device 101 includes, between the unwinding device 4 and the winding device 5, a driving
25 device 9 for conveying the coating film-attached base film 2, a discharge head 6 as a cleaning liquid applying mechanism for applying a cleaning liquid 11 to a coating film of the coating film-attached base film 2, a removing member 7 for removing both the coating film of the coating
30 film-attached base film 2 and the cleaning liquid 11, and a driving device 10 for conveying the base film 3 from which the coating film has been removed. Note that the cleaning liquid applying mechanism includes, in addition to the

discharge head 6, a liquid feeding pump 12 for feeding the cleaning liquid 11 to the discharge head 6 and a tank (not illustrated) for storing the cleaning liquid.

[0036] The base film is conveyed by the driving devices 5 9 and 10, and the base film moves in a longitudinal direction thereof with respect to the removing member 7. In addition, the driving devices 9 and 10 can preferably cut a tension in order to stably convey the base film. When the tension is cut with a suction roll, a part of the 10 coating film of coating film-attached base film 2 may be sucked to cause a trouble, and thus the coating film-attached base film 2 is more suitably nipped with a metallic drive roll and a rubber roll. The driving devices 9 and 10 also function as tension applying mechanisms. 15 Furthermore, each of driving rolls of the driving devices 9 and 10 preferably includes a mechanism (tension control mechanism) capable of individually setting a rotation speed, and controlling the rotation speed to control a tension applied to the base film between the driving device 20 9 and the driving device 10 in a longitudinal direction of the base film. The mechanism is not limited thereto as long as a tension applied to the base film in a longitudinal direction of the base film can be controlled. In order to control a tension, preferably, a tensiometer 25 (not illustrated) is disposed between the driving device 9 and the removing member 7 and/or between the removing member 7 and the driving device 10, and an instruction value of the tensiometer is fed back to rotation speeds of the driving rolls of the driving devices 9 and 10 so as to 30 obtain a predetermined tension. In addition, an accumulator (not illustrated) may be disposed on a side closer to the unwinding device 4 than the removing member 7 such that a speed at which the coating film-attached base

film 2 is unwound from the unwinding device 4 may be variable, and the coating can be removed at a constant speed even when the coating film-attached base film 2 is intermittently conveyed due to replacement of the coating film-attached base film 2 wound in a roll shape to be set in the unwinding device 4, coping with a trouble during operation occurring in the coating film removing device 101, or inspection before removing the coating film. In addition, a dancer roll (not illustrated) for reducing a tension fluctuation generated when the conveyance speed is changed may be disposed between the driving device 9 and the driving device 10, but any means capable of making the conveyance speed variable and reducing the tension fluctuation can be used without being limited thereto.

[0037] Note that, in the present embodiment, since the base film is conveyed by the driving devices 9 and 10, the base film moves in a longitudinal direction thereof with respect to the removing member 7. However, as long as the base film can relatively move in a longitudinal direction thereof with respect to the removing member 7, there is no need to limit the present invention to the mechanism that conveys the base film by the driving devices 9 and 10. A mechanism for causing the removing member 7 to travel with respect to the stationary base film may be included.

Alternatively, a mechanism for causing both the removing member 7 and the base film to move, or a mechanism for causing the removing member 7 and the base film to move in the same direction or in different directions may be used.

[0038] The discharge head 6 which is a part of the cleaning liquid applying mechanism and the removing member 7 are surrounded by a booth 8. The discharge head 6 only needs to discharge the cleaning liquid 11 and apply the cleaning liquid 11 to a surface of the coating film of the

coating film-attached base film 2, and examples thereof include a slit nozzle and a spray nozzle, but are not limited thereto. The amount of the cleaning liquid 11 to be applied to the surface of the coating film of the coating film-attached base film 2 is preferably in a range of 3 to 650 ml/m² such that the cleaning liquid 11 can sufficiently dissolve the coating film containing a water-soluble resin. The specifications of the discharge head 6 and the liquid feeding pump 12 are preferably defined and adjusted such that the cleaning liquid 11 in an amount necessary for removing the coating film can be applied to a surface of the coating film of the coating film-attached base film 2. The application amount of the cleaning liquid 11 may be controlled by using a metering pump as the liquid feeding pump 12, or may be controlled by disposing a flow meter (not illustrated) between the liquid feeding pump 12 and the discharge nozzle 6 and feeding back an instruction value of the flow meter. Alternatively, the application amount may be controlled by collecting the discharged cleaning liquid 11, grasping the application amount from the mass of the collected cleaning liquid 11, and feeding back the application amount to the liquid feeding pump.

[0039] The discharge head 6 and the removing equipment 7 only need to be disposed so as to face a surface of the coating film of the coating film-attached base film 2. In FIG. 1, the coating film is laminated on a lower surface side of the base film 2, and the discharge head 6 and the removing equipment 7 are disposed so as to face the lower surface side of the base film 2 on which the coating film is laminated, but the place where the discharge head 6 and the removing equipment 7 are disposed is not limited to the lower surface side of the base film 2. In addition, the unwinding device more preferably can cope with both an

upward ejection and a downward ejection such that conveyance can be performed while a surface of the coating film of the coating film-attached base film 2 faces the discharge head 6 and the removing equipment 7 by switching
5 an unwinding direction of the coating film-attached base film 2 so as to be able to cope with both a case where the coating film of the base film 2 wound in a roll shape is located on an inner side of the roll and a case where the coating film of the base film 2 wound in a roll shape is
10 located on an outer side of the roll.

[0040] The discharge head 6 can preferably discharge the heated cleaning liquid 11 in order to dissolve the water-soluble resin contained in the coating film quickly. For heating the cleaning liquid 11, the discharge head 6 may
15 include a heat source such as a cartridge heater, or a tank (not illustrated) that stores the cleaning liquid may be heated. However, any means may be used as long as the cleaning liquid 11 can be heated, and the means is not limited thereto. In order to dissolve the water-soluble
20 resin contained in the coating film more quickly, the cleaning liquid 11 may be discharged in a state of steam from the discharge head 6. In general, since it is difficult to perform measurement for accurately grasping the discharge amount of steam, it is preferable to obtain
25 the application amount of the cleaning liquid 11 by measuring the amount of liquid decreased from the tank storing the cleaning liquid 11 in a certain period of time.

A material of the discharge head 6 preferably has heat resistance in order to discharge the heated cleaning liquid
30 11, and metal or a resin having heat resistance is suitably used.

[0041] FIG. 2 is a schematic cross-sectional view of the removing member 7 according to a first embodiment in the

coating film removing device 101. The removing member 7 is disposed such that the removing member 7 is in direct contact with a surface of the coating film of the coating film-attached base film 2, and an angle formed by the base films via the removing member 7, that is, an angle ($\theta_1 + \theta_2$) formed by the base film 3 from which the coating film has been removed and the base film 2 before the coating film is removed is in a range of 20 to 150°. When the angle is less than 20°, the removing member 7 may be bent or vibrated at the time of removing the coating film from the base film 2, or may be deformed or damaged in a case where a tension applied to the base film 2 is high, resulting in a problem in removing the coating film. When the angle is larger than 150°, a force of pressing the removing member 7 against the base film 2 is weakened. When the base film 2 is conveyed and the coating film is removed in this state, a force of pressing the removing member 7 against the base film 2 may become insufficient only by a slight fluctuation in a tension applied to the base film 2, and a part of the coating film may remain on the base film without being removed.

[0042] The tension (T_1 , T_2) to applied to the base film in a longitudinal direction of the base film is preferably controlled by the above-described tension control mechanism, and the tension is preferably adjustable in a range of 10 to 1000 N/m. It is only required to adjust a tension to be applied and an angle formed by the base films via the removing member 7 depending on properties of a coating film of the coating film-attached base film 2 to be removed. As the tension is higher and the angle between the base films is smaller, the coating film-attached base film 2 can be pressed more strongly against the removing member 7, and therefore the coating film can be more

reliably removed. However, when the pressing force is too strong, the pressing force exceeds a breaking strength of the base film, and the base film may be broken. When the base film is broken, removing of the coating film cannot be continuously performed, and operation efficiency of the coating film removing device 101 is significantly deteriorated. As a result of repeated studies by the inventors, it has been confirmed that by setting the tension to 1000 N/m or less, removing of the coating film can be continuously performed without breaking the base film even when the angle formed by the base films is small. When the tension exceeds 1000 N/m, it has also been confirmed that the base film is broken in rare cases with foreign substances attached to a distal end of the removing member 7 or a slight amount of burrs generated by machining when the removing member 7 is manufactured as a base point. On the other hand, as the tension is lower, the force of pressing the removing member 7 against the base film is smaller. Therefore, the coating film is less likely to be removed. However, the target coating film could be removed even with a slight tension as long as the coating film had properties in which removing was relatively easy. However, when the tension was lowered, a conveyance state of the base film was significantly deteriorated. When the base film was conveyed with a tension set to a low tension of less than 10 N/m, the base film meandered during conveyance or generated wrinkles, a portion that was not in direct contact with the removing member 7 was generated in a width direction of the base film, and removing of the coating film could not be performed. A lower limit of the tension is preferably 50 N/m or more, and more preferably 100 N/m or more.

[0043] As illustrated in FIG. 2, the removing member 7

in the removing device 101 of the present invention is disposed so as to be in direct contact with a surface of the coating film of the coating film-attached base film 2, and is adjusted such that the angle ($\theta_1 + \theta_2$) formed by the base films via the removing member 7 is in a range of 20 to 150°. In this state, the removing member 7 preferably has a contact length L of 1×10^{-5} to 1×10^{-3} m in a longitudinal direction of the base film in a range in which the removing member 7 is in contact with a surface of the coating film. At this time, in order to further strengthen the force of pressing the removing member 7 against the base film, the shorter the contact length L, the better. Therefore, the inventors tried to make a portion where the removing member 7 was in contact with a surface of the coating film as sharp as possible, and as a result, a limitation of the contact length L that could be achieved without generating warpage or burrs during machining was 5×10^{-6} m. When the contact length L was set to 5×10^{-6} m, a strong force was locally applied under a condition where the force of pressing the removing member 7 against the base film was strong, and therefore a distal end of the removing member 7 was deformed in some cases. Therefore, it has been found that the contact length L is more preferably 1×10^{-5} m or more in order to prevent the distal end of the removing member 7 from being deformed even under various conditions. When the contact length L is long, the force of pressing the removing member 7 against the base film is dispersed in a wide area by the contact length L, and therefore the coating film is hardly removed. As a result of intensive studies by the inventors, by setting the contact length L to 1×10^{-3} m or less, even when the properties of the target coating film changed, the coating film could be removed by adjusting the

application amount of the cleaning liquid 11, the tension applied to the base film, and the angle formed by the base films via the removing member 7. When the contact length L exceeded 1×10^{-3} m, the force of pressing the removing member 7 against the base film was dispersed and decreased, and therefore it was difficult to stably remove the coating film, and the coating film partially remained.

[0044] FIG. 3 is a schematic view of a second removing member 13 in the coating film removing device 101 of the present invention. As illustrated in FIG. 3, the contact length L of the removing member 13 in a longitudinal direction of the base film in a range where the removing member 13 is in contact with a surface of the coating film includes a case where a distal end of the removing member 13 is an arc. FIG. 4 is a schematic view of a third removing member 14 in the coating film removing device 101 of the present invention. As illustrated in FIG. 4, when a range of the removing member 14 in contact with a surface of the coating film extends over a plurality of surfaces, the contact length L corresponds to a sum of L_1 , L_2 , and L_3 . In the removing member 14, the sum of L_1 , L_2 , and L_3 , which is the contact length L, is preferably in a range of 1×10^{-5} to 1×10^{-3} m.

[0045] The booth 8 of the removing device 101 is disposed so as to surround the discharge head 6 to the removing equipment 7 in order to prevent the cleaning liquid 11 from scattering around and to prevent the temperature of the cleaning liquid 11 from lowering when the cleaning liquid 11 is heated. A material of the booth 8 preferably has heat resistance because the temperature inside the booth 8 becomes high, and metal, glass, or the like is suitably used.

[0046] It is more preferable to completely remove

moisture from the base film 3 which has been wound by the winding device 5 in order to stably form a film as a regenerated film after remelting the base film 3, and a drying device (not illustrated) may be disposed between the removing device 7 and the winding device 5. The drying device only needs to be disposed before winding, and may be disposed either before or after the driving device 10.

[0047] In addition, in order to check the quality of the base film 3 from which the coating film has been removed, an inspection machine (not illustrated) that detects residues of the coating film and environmental foreign substances attached in the process may be disposed before the winding device 5. The inspection machine only needs to be selected according to properties of the base film 3, and an inspection machine using transmitted light or reflected light is suitably used. In addition, a marking device (not illustrated) for recording the positions of residues of the coating film or environmental foreign substances attached in the process, detected by the inspection machine may be disposed between the inspection machine and the winding device 5. A marking method by the marking device may be any method as long as the position of a detection target can be marked, such as a pen, a seal, or a laser. By marking residues of the coating film or environmental foreign substances attached in the process, the marked place can be removed before remelting. Therefore, a regenerated film can be more stably formed, and deterioration in quality of the regenerated film can be prevented.

[0048] In the coating film removing device of the present invention, the form of the coating film-attached base film may be a cut sheet shape, but is particularly preferably a coating film-attached base film wound in a

roll shape. By unwinding the coating film-attached base film wound in a roll shape, removing the coating film by the coating film removing device of the present invention, and winding the base film from which the coating film has
5 been removed, the coating film removing treatment can be continuously and efficiently performed.

[0049] In order to more efficiently dissolve and swell the coating film by the cleaning liquid 11 applied to a surface of the coating film of the coating film-attached
10 base film, equipment for exposing a layer containing a large amount of water-soluble resin in the coating film of the coating film-attached base film 2 may be disposed between the unwinding device 4 and the driving device 9. In particular, when the coating film of the coating film-
15 attached base film is a thermosetting silicone resin compound having dimethylsiloxane as a main skeleton, the coating film-attached base film is suitably used as a release film for a process from characteristics of surface free energy thereof. Specifically, the coating film-
20 attached base film is used as a release film for extracting a release object in a desired shape after the release object is disposed on the coating film of the coating film-attached base film. In the coating film-attached base film after being used as such a release film for a process, a
25 release object may remain on a surface of the coating film. Therefore, equipment for exposing the surface of the coating film of the coating film-attached base film is preferably disposed between the unwinding device 4 and the driving device 9 to expose the surface of the coating film
30 of the coating film-attached base film. The equipment for exposing the surface of the coating film may be a contact type or a non-contact type, and is appropriately selected depending on a remaining state of the release object.

[0050] The release object is appropriately selected depending on characteristics of the coating film, and examples thereof include an inorganic substance such as a metal disposed by vapor deposition, a pressure-sensitive adhesive made of an organic substance such as an acryl disposed by coating, and a ceramic green sheet containing barium titanate as a main component.

[0051] As described above, by using the coating film removing method and the coating film removing device of the present invention, a coating film can be efficiently and reliably removed from a surface of a coating film-attached film by dissolving a water-soluble resin using a small amount of cleaning liquid. In addition, according to the coating film removing method and the coating film removing device of the present invention, it is possible to obtain a high-purity resin chip free from foreign substances at low cost without significantly increasing an environmental load, and thus it is possible to stably form a regenerated film.

[Examples]

[0052] Hereinafter, the present invention will be described with reference to Examples, but the present invention is not necessarily limited thereto.

<Coating film-attached base film>

A coating film-attached film described below was prepared.

<Coating film-attached film>

On one surface of a polyethylene terephthalate base film having a thickness of 30 μm and a width of 100 mm, a polyvinyl alcohol resin coating film having a thickness of 0.1 μm was formed as a water-soluble resin.

Furthermore, a coating film of a curable silicone resin as a release component was formed thereon with

reference to a coating material described in JP 2015-189226
A so as to have a film thickness of 0.1 μm as follows.

The release component was prepared by dissolving

• 100 parts by mass of thermosetting silicone,
5 manufactured by Shin-Etsu Chemical Co., Ltd., trade name
"KS-847T", and

• 3 parts by mass of platinum catalyst, manufactured
by Shin-Etsu Chemical Co., Ltd., trade name "CAT-PL-50T

in a mixed solution of toluene and MEK (A mass ratio
10 of toluene : MEK was 1 : 1) as a solvent such that a solid
content was 1.8% by mass. Next, the release component was
applied onto the coating film of the polyvinyl alcohol
resin using a bar coater, and dried in an oven at 90°C for
20 seconds to form a coating film of the release component,
15 thereby obtaining a coating film-attached film.

[0053] <Method for evaluating removing>

(1) Removing property of coating film

Evaluation of removing was measured by the following
method using a commercially available dyne pen (surface
20 energy: 30 or 70 mN/m). When a pattern was drawn on a
sample surface with a dyne pen in an environment of a room
temperature of 23°C and the state was retained for four
seconds or more, it was determined that surface energy of
the sample surface was higher than surface energy of the
25 dyne pen. When the coating film of the release component
of the coating film-attached film remains on the surface,
surface energy thereof is less than 30 mN/m. Therefore, a
reagent of any dyne pen is repelled on the sample surface,
and the drawn pattern cannot be retained. On the other
30 hand, when the coating film of the release component is
removed and the water-soluble polyvinyl alcohol resin is
exposed, the surface energy is 70 mN/m or more. Therefore,
any dyne pen can retain the drawn pattern. When both the

coating film of the release component and the coating film of the water-soluble polyvinyl alcohol resin are removed and polyethylene terephthalate is exposed, the surface energy is 43.8 mN/m. Therefore, the drawn pattern of the 5 30 mN/m dyne pen is retained, but the drawn pattern of the 70 mN/m dyne pen cannot be retained. Whether or not the coating film of the coating film-attached film could be removed was determined by the above evaluation method.

When the coating film of the release component of the 10 film-attached film remains on the surface, the release component is mixed into a regenerated resin chip. Therefore, the regenerated resin chip is colored (yellowing) or foreign substances are also generated. Therefore, the quality of the regenerated resin chip is 15 deteriorated, and the regenerated resin chip cannot withstand practical use. When the coating film of the release component is removed but a part of the coating film of the water-soluble polyvinyl alcohol resin remains, a regenerated resin chip is slightly colored (yellowing), and 20 the quality thereof is slightly inferior to the quality of the raw material, but is within a practical range. When both the coating film of the release component and the coating film of the water-soluble polyvinyl alcohol resin are removed, a regenerated resin chip has a favorable 25 quality.

[0054] (2) Quality of regenerated resin chip

(i) Melt film forming property

After the coating film is removed from the coating film-attached film, the base film is collected. 30 Regenerated resin chips obtained by pulverizing the collected base film by a crusher and then granulating the pulverized film by a granulator are dried at 180°C for two hours, then put into an extruder, melt-extruded at 280°C,

and formed into a sheet shape on a cast drum cooled to 25°C. It is confirmed whether or not a polyethylene terephthalate film can be prepared without any problem.

(ii) Intrinsic viscosity

5 Intrinsic viscosity IV (R) of the sheet obtained in the above (i) is measured. The intrinsic viscosity IV (R) is obtained as follows. That is, a polyethylene terephthalate film is dissolved in 100 ml of orthochlorophenol (solution concentration $C = 1.2$ g/dl),
10 and the viscosity of the solution at 25°C is measured using an Ostwald viscometer. Similarly, the viscosity of the solvent is measured. Using the obtained solution viscosity and solvent viscosity, $[\eta]$ (dl/g) is calculated by the following formula (a), and the obtained value is taken as
15 the intrinsic viscosity.

$$(a) \eta_{sp}/C = [\eta] + K[\eta]^2 \cdot C$$

(Here, $\eta_{sp} = (\text{solution viscosity (dl/g)}/\text{solvent viscosity (dl/g)}) - 1$, and K is a Huggins constant (0.343).).

20 Next, before a coating film-attached film is prepared, the intrinsic viscosity IV (I) of the base film sampled in advance before formation of the coating is measured similarly.

25 Since deterioration in quality of a resin chip caused by mixing of foreign substance and the like appears as a difference between IV (R) and IV (I), ΔIV is calculated by the following formula (b), and the following determination is made using the obtained value.

$$(b) \Delta IV = IV(R) - IV(I)$$

30 • The difference in intrinsic viscosity is 0.05 or less: there is no problem in the quality of the regenerated resin chip.

• The difference in intrinsic viscosity is more than 0.05 and less than 0.2: the quality of the regenerated resin chip is slightly poor, but it is within a practical range.

5 • The difference in intrinsic viscosity exceeds 0.2: The regenerated resin chip cannot withstand practical use in terms of quality.

[0055] <Example 1>

The coating film-attached film was set in the
10 unwinding device 4 of the removing device 101 illustrated in FIG. 1.

A spray nozzle (two-fluid type) was used as the discharge head 6 that discharged the cleaning liquid 11. The cleaning liquid was hot water at 60°C, the discharge
15 amount thereof was adjusted to 3 to 650 ml per 1 m² of a surface area of the coating film using a diaphragm pump, and the cleaning liquid was directly applied to the coating film.

A stainless steel plate having a distal end shape as
20 illustrated in FIG. 2 was used as the removing member 7, and the width of the distal end portion in a base conveyance direction was 1.0×10^{-5} m. The removing member 7 was disposed such that an angle ($\theta_1 + \theta_2$) formed by the base films via the removing member 7 was 90° (θ_1 : 45°, θ_2 :
25 45°). As a result, it was confirmed that the length L where the base film and a distal end portion of the plate were in direct contact with each other in the conveyance direction was 1.0×10^{-5} m. The discharge head 6 and the removing member 7 were disposed such that the base film
30 reached the removing member 7 one second after warm water was applied to the base film by the discharge head 6.

The coating film was removed by conveying the base film while applying a tension of 10 N/m from both

directions in a longitudinal direction of the base film.

In a similar device structure, the coating film was removed with a tension set to 500 N/m or 1000 N/m.

[0056] The base film 3 which had been wound by the
5 winding device 5 and from which the coating film had been removed was collected, and a removing state of the coating film was confirmed with a dyne pen. As a result, it was confirmed that under a condition of a tension of 1000 N/m, when the amount of water to be applied was adjusted to be
10 in a range of 3 to 650 ml/m², both the coating film of the curable silicone resin as the release component and the coating film of the water-soluble polyvinyl alcohol resin could be removed. Under a condition of a tension of 500 N/m, when the amount of water to be applied was adjusted to
15 be in a range of 10 to 650 ml/m², both the coating film of the curable silicone resin as the release component and the coating film of the water-soluble polyvinyl alcohol resin could be removed. On the other hand, under a condition of a tension of 10 N/m, it was confirmed that both the coating
20 film of the curable silicone resin as the release component and the coating film of the water-soluble polyvinyl alcohol resin could be removed by setting the amount of water to be applied to 100 ml/m² or more.

Then, the base film 3 in which removing of the coating
25 film could be confirmed was collected. Thereafter, a sheet was formed by the method described in (2) (i) above, and a polyethylene terephthalate film was formed. A polyethylene terephthalate film could be obtained without confirming bubbles, gel, and the like in a molten polymer, and without
30 causing an abnormality such as an increase in pressure. The difference in intrinsic viscosity at each level is illustrated in FIG. 5. At each of the levels, the difference in intrinsic viscosity was 0.2 or less, and

there was no problem in practical use. It was confirmed that as the amount of water to be applied was larger and as the tension to be applied was higher, the difference in intrinsic viscosity was smaller, that is, the regenerated resin chip was more favorable in terms of quality.

[0057] <Example 2>

The coating film-attached film was set in the unwinding device 4 of the removing device 101 illustrated in FIG. 1.

The amount of water to be applied to the coating film was 100 ml/m². Furthermore, an angle ($\theta_1 + \theta_2$) formed by the base films via the removing member 7 was 20°, and a tension was 500 N/m. The coating film was removed in a similar manner to Example 1 except for the above. In addition, a similar device structure equipment was modified such that the angle ($\theta_1 + \theta_2$) was variable, and the coating film was removed similarly by changing the angle ($\theta_1 + \theta_2$) to 45° (θ_1 : 22.5°, θ_2 : 22.5°), 60° (θ_1 : 30°, θ_2 : 30°), 90° (θ_1 : 45°, θ_2 : 45°), 120° (θ_1 : 60°, θ_2 : 60°), 150° (θ_1 : 75°, θ_2 : 75°), or 170° (θ_1 : 45°, θ_2 : 45°), and changing the tension from both directions to 10 N/m, 50 N/m, 100 N/m, 250 N/m, 500 N/m, 750 N/m, or 1000 N/m. A distance between the discharge head 6 and the removing member 7 was adjusted such that the base film reached the removing member 7 one second after warm water was applied to the base film.

The base film 3 which had been wound by the winding device 5 and from which the coating film had been removed was collected, and a removing state of the coating film was confirmed with a dyne pen. FIG. 6 illustrates possibility of a coating film at each level. "O" in FIG. 6 indicates a condition under which it was confirmed that both the coating film of the curable silicone resin as the release

component and the coating film of the water-soluble polyvinyl alcohol resin could be removed. " Δ " in FIG. 6 indicates a condition under which the curable silicone resin could be removed, but a part of the polyvinyl alcohol resin remained on the surface of the base film. "x" in FIG. 6 indicates a condition under which both the curable silicone resin and the polyvinyl alcohol resin partially remained on the surface of the base film. From this result, it was confirmed that as the angle formed by the base films for coating film removing was more obtuse and as the applied tension was lower, there was more amount of removing residue of the coating film.

[0058] Then, the base film 3 was collected. Thereafter, the base film 3 was pulverized by a crusher and formed into resin chips by a granulator. Thereafter, the resin chips were put into an extruder, melt-extruded at 280°C, and molded into a sheet shape on a cast drum cooled to 25°C to prepare a polyethylene terephthalate film. In the resin chips collected under the condition of "x" in FIG. 6, a gel was generated in a molten polymer, and a device abnormality was caused by an increase in pressure. Therefore, a polyethylene terephthalate film could not be obtained. On the other hand, in the resin chips collected under the condition of " Δ ", a polyethylene terephthalate film could be obtained without confirming bubbles, gel, and the like in a molten polymer, and without causing an abnormality such as an increase in pressure. Thereafter, the difference in intrinsic viscosity was confirmed to be in a range of more than 0.05 and less than 0.2 under each of the conditions, and it was confirmed that the quality of the regenerated resin chip was slightly poor, but was within a practical range. In the resin chips collected under the condition of "O", a polyethylene terephthalate

film could be stably obtained, the difference in intrinsic viscosity was 0.05 or less, and it was confirmed that the quality of the regenerated resin chips was within a range having no problem.

5 [0059] <Example 3>

The coating film-attached film was set in the unwinding device 4 of the removing device 101 illustrated in FIG. 1.

A plurality of types of stainless steel plates having
10 a distal end shape as illustrated in FIG. 2 were prepared for the removing member 7, and the length L where a distal end portion of each of the plates and the base film were in direct contact with each other in the conveyance direction was changed. Specifically, the plates were prepared so as
15 to have L of 1.0×10^{-5} , 2.5×10^{-5} , 5.0×10^{-5} , 1.0×10^{-4} , 2.0×10^{-4} , 5.0×10^{-4} , 7.5×10^{-4} , and 1.0×10^{-3} m, respectively. An angle ($\theta_1 + \theta_2$) formed by the base films via the removing member 7 was changed in a range of 20° to 150° , and a tension was changed in a range of 10 to 1000
20 N/m. A distance between the discharge head 6 and the removing member 7 was adjusted each time such that the base film reached the removing member 7 one second after warm water was applied to the base film. The coating film was removed in a similar manner to Example 1 except for the
25 above.

[0060] The base film 3 which had been wound by the winding device 5 and from which the coating film had been removed was collected, and a removing state of the coating film was confirmed with a dyne pen. FIG. 7 illustrates a
30 correlation between possibility of the coating film and $\{T_1 \times \cos(\theta_1) + T_2 \times \cos(\theta_2)\}/L$ at each level. Note that meanings indicated by the symbols in FIG. 7 are similar to those in Example 2. It was confirmed that the coating film

could be removed under a condition under which Formula (1):
 $1.0 \times 10^6 \leq \{T_1 \times \cos(\theta_1) + T_2 \times \cos(\theta_2)\} / L \leq 2.4 \times 10^8$ is
 satisfied in a range where the contact length L is 1×10^{-5}
 to 1×10^{-3} m. In particular, it was confirmed that the
 5 smaller the contact length L was, the more the coating film
 could be removed.

Then, the base film 3 was collected. Thereafter, the
 base film 3 was pulverized by a crusher and formed into
 resin chips by a granulator. Thereafter, the resin chips
 10 were put into an extruder, melt-extruded at 280°C, and
 molded into a sheet shape on a cast drum cooled to 25°C to
 prepare a polyethylene terephthalate film. As for a level
 at which the polyethylene terephthalate film could be
 prepared, a difference in intrinsic viscosity was
 15 confirmed. As a result, similar results to Example 2 were
 obtained at both of the levels of "Δ" and "O" in FIG. 7.
 [0061] <Comparative Example 1>

The coating film-attached film was set in the
 unwinding device 4 of the removing device 101 illustrated
 20 in FIG. 1. The coating film was removed in a similar
 manner to Example 1 except that the discharge amount of
 the cleaning liquid 11 was adjusted to 2 ml per 1 m² of the
 surface area of the coating film.

The base film 3 which had been wound by the winding
 25 device 5 and from which the coating film had been removed
 was collected, and a removing state of the coating film was
 confirmed with a dyne pen. As a result, it was confirmed
 that both the coating film of the curable silicone resin as
 the release component and the coating film of the water-
 30 soluble polyvinyl alcohol resin remained. Since it was
 confirmed that both the coating films remained, no further
 evaluation was performed.

[0062] <Comparative Example 2>

The coating film-attached film was set in the unwinding device 4 of the removing device 101 illustrated in FIG. 1. In a longitudinal direction of the base film, a tension of 1100 N/m was applied from both directions. The coating film was removed in a similar manner to Example 1 except for the above. Since the high tension was applied, tetanic wrinkles were generated in the base film in the conveyance direction. Since the generated wrinkles passed through the removing member 7 as they were, it was possible to visually confirm that the coating film remained at the same position as the position where the wrinkles were generated in the film width direction.

The base film 3 which had been wound by the winding device 5 and from which the coating film had been removed was collected, and a removing state of the coating film was confirmed with a dyne pen. As a result, it was confirmed that both the coating film of the curable silicone resin as the release component and the coating film of the water-soluble polyvinyl alcohol resin remained at the same position as the position where the wrinkles were generated in the film width direction. On the other hand, at the position where no wrinkle was generated, it was confirmed that both the coating film of the curable silicone resin as the release component and the coating film of the water-soluble polyvinyl alcohol resin could be removed. Since it was difficult to extract only the portion where both the coating films could be removed from the collected base film 3, no further evaluation was performed.

Industrial Applicability

[0063] The coating film-attached base film applicable to the method and device for removing a coating film from a coating film-attached base film of the present invention is not limited to a film having a coating film containing a

water-soluble resin on one surface of the base film, and only needs to be a renewable resin film, paper film, or metal film having a coating film containing an easily soluble resin layer.

5 Reference Signs List

- [0064] 2 COATING FILM-ATTACHED BASE FILM
 - 3 BASE FILM
 - 4 UNWINDING DEVICE
 - 5 WINDING DEVICE
 - 10 6 DISCHARGE HEAD
 - 7, 13, 14 REMOVING EQUIPMENT
 - 8 BOOTH
 - 9, 10 DRIVING DEVICE
 - 11 CLEANING LIQUID
 - 15 12 LIQUID FEEDING PUMP

CLAIMS

1. A coating film removing method for removing a coating film containing a water-soluble resin from a base film having the coating film on at least one surface of the base film, the method comprising:

applying a cleaning liquid containing water as a main component to the coating film in an amount in a range of 3 to 650 ml per 1 m² of a surface area of the coating film; and

bringing a removing member into contact with a surface of the coating film to which the cleaning liquid is applied, and removing the coating film from the base film by relatively moving the base film with respect to the removing member in a longitudinal direction of the base film while setting an angle formed by the base films via the removing member to a range of 20 to 150° and applying a tension in a range of 10 to 1000 N/m in at least one longitudinal direction of the base film.

2. The coating film removing method according to claim 1, wherein

in a range in which the removing member is in contact with a surface of the coating film, when a length of the base film in a longitudinal direction is represented by a contact length L, a surface passing through a center position of the contact length and vertical to a surface of the removing member is referred to as a vertical surface, a side on which the base film relatively approaches the removing member is referred to as an upstream side, and a side on which the base film relatively separates from the removing member is referred to as a downstream side,

the contact length L [m] is in a range of 1×10^{-5} to 1×10^{-3} m, and

an angle (acute angle) θ_1 [°] formed by the vertical surface and the base film on the upstream side of the vertical surface, an angle (acute angle) θ_2 [°] formed by the vertical surface and the base film on the downstream side of the vertical surface, a tension T_1 [N/m] applied to the base film on the upstream side of the vertical surface, and a tension T_2 [N/m] applied to the base film on the downstream side of the vertical surface satisfy the following formula (1).

10 Formula (1): $1.0 \times 10^6 \leq \{T_1 \times \cos(\theta_1) + T_2 \times \cos(\theta_2)\} / L \leq 2.4 \times 10^8$

3. The coating film removing method according to claim 1, wherein an angle formed by one surface among two surfaces constituting the removing member and the base film before being in contact with the ridgeline is set to 5° or more, the ridgeline being a ridgeline of the removing member where the removing member starts to be in contact with a surface of the coating film and being sandwiched between the two surfaces of the removing member, the one surface of the removing member being on a side facing the base film before being in contact with the ridgeline.

4. The coating film removing method according to any one of claims 1 to 3, wherein the coating film contains a curable silicone resin.

5. A coating film removing device for removing a coating film containing a water-soluble resin from a base film having the coating film on at least one surface of the base film, the device comprising:

 a cleaning liquid applying mechanism for applying a

cleaning liquid to the coating film;

a removing member for removing the coating film to which the cleaning liquid is applied from the base film;

a driving device for relatively moving the base film
5 with respect to the removing member in a longitudinal direction of the base film; and

a tension applying mechanism for applying a tension in at least one longitudinal direction of the base film, wherein

10 the cleaning liquid applying mechanism is set to apply the cleaning liquid in an amount in a range of 3 to 650 ml per 1 m² of a surface area of the coating film,

the removing member is disposed such that the removing member is in contact with a surface of the coating film to
15 which the cleaning liquid is applied, and an angle formed by the base films via the removing member is in a range of 20 to 150°, and

the tension applying mechanism is set to apply a tension in a range of 10 to 1000 N/m.

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6. The coating film removing device according to claim 5, wherein the removing member has a length of 1×10^{-5} to 1×10^{-3} m in a longitudinal direction of the base film in a range in which the removing member is in contact with a
25 surface of the coating film.

7. The coating film removing device according to claim 5 or 6, further comprising:

an unwinding device for unwinding the coating film-
30 attached base film wound in a roll shape; and

a winding device for winding the base film from which the coating film has been removed.