DESCRIPTION

TITLE OF THE INVENTION:

COATING FILM REMOVING DEVICE AND COATING FILM REMOVING METHOD

Field

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

Background

[0002] While plastics are used in various fields, plastics are considered to be a cause of marine pollution such as microplastics, and reduction of environmental load by plastics is urgently needed.

In recent years, the evolution of the Internet of things (IoT), the number of electronic devices such as CPUs mounted on computers or smartphones has increased, and accordingly, the number of multilayer ceramic capacitors (MLCC) required to drive the electronic devices has also rapidly increased. A general manufacturing method of the MLCC includes: a step of forming a ceramic green sheet layer on a release film by using the release film obtained by forming a release layer on a plastic base film as a carrier sheet; and a step of removing the ceramic green sheet layer to obtain a ceramic green sheet. In this step, the release film from which the ceramic sheet has been removed is discarded as an unnecessary material.

[0003] That is, an increase of release films as a waste accompanying a rapid increase in the number of manufactured MLCCs in recent years has become an environmental problem, and efforts for reuse of the base films are becoming more active. Since the components of a release layer contained in a release film generally have a composition different

from the components contained in a base film from the viewpoint of releasability, in a case where a recycled film is formed by remelting the release film attached with the release layer as they are, the components of the release layer are present as foreign matters, and therefore stable film formation cannot be performed.

[0004] Patent Literature 1 discloses, as a method of removing a release layer containing water-soluble resin from a release film, a method in which a cleaning liquid in the form of droplets is applied to the release layer, the cleaning liquid is held in the form of droplets on the surface of the release layer, and then the release layer containing the cleaning liquid is removed.

[0005] Patent Literature 2 discloses, as a coating film removing device for a belt-shaped film provided with coating film, a coating film removing device including a plurality of rotary removing equipments in which an axis orthogonal to a conveyance direction of the belt-shaped film is set as the rotation axis, and blades for removing the coating film are circumferentially included on the outer peripheral portion at predetermined angular intervals.

Citation List

Patent Literature

[0006] Patent Literature 1: WO 2022/190713 A

Patent Literature 2: JP 2017-56675 A

Summary

Technical Problem

[0007] [First Problem]

In the method described in Patent Literature 1, it is necessary to apply high tension to the release film when the release layer is removed from the release film by a

removing equipment.

Embodiments of the present invention provide a coating film removing device and a coating film removing method capable of efficiently removing a coating film without applying high tension to a coated film.

[0008] [Second Problem]

In the coating film removing device of Patent Literature 2, since removed coating film is not immediately collected, there is a possibility that the removed coating film is deposited during continuous operation, which may result in poor removing.

Therefore, the embodiments of the present invention provide a coating film removing device and a coating film removing method capable of discharging removed coating film from a coating film removing member and maintaining high coating film removal performance even during continuous operation.

Solution to Problem

[0009] [First Coating film Removing Device and First Coating film Removing Method]

Disclosed herein is a coating film removing device that removes a coating film from a coated film including the coating film on at least one surface of a base film. The coating film removing device includes: a conveyance mechanism configured to convey the coated film; and a coating film removing member having an edge extending in a film width direction, the edge being configured to be in contact with a surface of the coating film of the coated film to remove the coating film. As viewed from a side in a conveyance direction of the coated film, an angle formed by a surface on an upstream side in the film conveyance

direction among surfaces forming the edge of the coating film removing member and the coated film conveyed toward the edge is greater than or equal to 90° and less than 180°.

[0010] The first coating film removing device of the above disclosure is preferably one of the following:

The coating film removing device of the above disclosure, in which a plurality of coating film removing members are arranged in the film conveyance direction.

The coating film removing device of the above disclosure, in which the coating film removing member includes a cylindrical main body and a plurality of edges arranged on a circumference of the main body in parallel to a central axis of the main body.

The coating film removing device of the above disclosure, in which the coating film removing member includes a cylindrical main body and a plurality of edges arranged spirally on a circumference of the main body.

The coating film removing device of the above disclosure, further comprising a cleaning liquid applying mechanism provided on the upstream side in the film conveyance direction with respect to the coating film removing member, the cleaning liquid applying mechanism being configured to discharge a cleaning liquid toward the surface of the coating film of the coated film.

[0011]Disclosed herein is a coating film removing method for removing a coating film from a coated film including the coating film on at least one surface of a base film using any one of the above coating film removing devices. The method includes: removing the coating film from the coated film by bringing the edge of the coating film removing member into contact with the surface of the coating film while conveying the coated film by the

conveyance mechanism.

The first coating film removing method of the above disclosure is preferably any one of the following:

The coating film removing method of the above disclosure, in which the cleaning liquid is applied to the surface of the coating film, and then the coating film containing the cleaning liquid is removed by the coating film removing member.

The coating film removing method of the above disclosure, in which the coating film contains a water-soluble resin.

The coating film removing method of the above disclosure, in which the coating film contains a curable silicone.

[0012] [Second Coating film Removing Device and Second Coating film Removing Method]

According to a first aspect of the present invention, there is provided a coating film removing device that removes a coating film from a coated film including the coating film on at least one surface of a base film. The coating film removing device includes: a conveyance mechanism configured to convey the coated film; and a rotary removing member including: a main body having a rotation axis extending in a width direction of the coated film; a plurality of edges configured to remove the coating film, the plurality of the edges being arranged to extend in the width direction on a circumference of the main body; and a discharge portion that is a space between the plurality of edges. The coating film is removed from the coated film conveyed by the conveyance mechanism by rotation of the rotary removing member, and the coating film removed is removed from an end of the discharge portion in the width direction.

[0013] The coating film removing device of the first aspect of present invention preferably comprises any one of the following embodiments.

In an embodiment of the coating film removing device according the first aspect, the edges and the discharge portion are arranged on the circumference of the main body in parallel to the rotation axis.

In an embodiment of the coating film removing device according to the first aspect, the edges and the discharge portion are spirally arranged on the circumference of the main body around the rotation axis.

In an embodiment of the coating film removing device according to the first aspect, a suction mechanism is connected to the discharge portion.

In an embodiment of the coating film removing device according to the first aspect, an air jetting mechanism is connected to the discharge portion.

An embodiment of the coating film removing device according to the first aspect, further include a cleaning liquid applying mechanism configured to discharge a cleaning liquid toward a surface of the coating film of the coated film.

In an embodiment of the coating film removing device according to the first aspect, an angle formed by a surface on an upstream side in a conveyance direction of the film among surfaces forming an edge of the coating film removing member and the coated film conveyed toward the edge is greater than or equal to 90° and less than 180° as viewed from a side in the conveyance direction of the coated film.

[0014] According to a second aspect of the present invention, there is provided a method for removing a coating film from a coated film including the coating film on at least one surface of a base film using any one of the

above coating film removing devices. The method includes: conveying the coated film by the conveyance mechanism; bringing the rotary removing member into contact with a surface of the coating film while rotating the rotary removing member; removing the coating film from the coated film; and removing the coating film removed from an end of the discharge portion in a width direction.

The second aspect of the coating film removing method of the present invention preferably comprises any one of the following embodiments.

In an embodiment of the coating film removing method according to the second aspect, a cleaning liquid is applied to the surface of the coating film, and then the coating film containing the cleaning liquid is removed by the rotary removing member.

In an embodiment of the coating film removing method according to the second aspect, the coating film contains a water-soluble resin.

In an embodiment of the coating film removing method according to the second aspect, the coating film contains a curable silicone.

Advantageous Effects of Invention

[0015] [First Effect]

According to embodiments of the coating film removing method of the present invention, coating film can be efficiently removed from a coated film including the coating film on at least one surface of a base film without applying high tension.

[Second Effect]

According to embodiments of the coating film removing method of the present invention, it is possible to maintain high removal

hot air generator or the like (not illustrated) can be used. By setting the temperature of the coated film 1 to higher than or equal to 40°C by hot air, the cleaning liquid applied to the surface of the coating film quickly dissolves at least some components of the coating film, whereby the coating film can be more efficiently removed. The means for heating the coated film 1 may be any means. For example, the coated film 1 may be brought into direct contact with a heating roll, or the cleaning liquid applying mechanism 60 and the coating film removing member 40 may be surrounded by a booth, and an infrared heater may be installed inside the booth for heating, yet it is not limited thereto. In addition, installing the booth makes it possible to prevent a decrease in the temperature of the heated cleaning liquid and/or the coated film 1, and it is possible to prevent scattering to the surroundings even in a case where the cleaning liquid is applied in the form of droplets. Since the inside of the booth has a high temperature, the booth preferably has heat resistance, and thus metal, glass, or the like is suitably used.

[0036] In the coating film removing device 100E, it is more preferable to completely remove the cleaning liquid in order to stably form a film as a regenerated film after remelting the base film 2 obtained after removing the coating film 3 and wound by the winding device 20, and a drying device (not illustrated) may be provided between the coating film removing member 40 and the winding device 20. The drying device only needs to be provided as a preceding stage to winding and may be either preceding or subsequent to the driving device 30-2.

[0037] As described above, the coating film removing device and the coating film removing method according to

the first embodiment of the present invention can efficiently remove the coating film from the coated film including the coating film on at least one surface of the base film without applying high tension.

[0038] (Second Embodiment)

FIG. 10 is a schematic diagram of a coating film removing device 100 according to a second embodiment of the present invention. The coating film removing device 100F includes an unwinding device 10 that unwinds a film 1 including coating film 3 on one surface of a base film 2 (hereinafter, referred to as a coated film in some cases), a winding device 20 that winds the base film 2 after removing the coating film 3 on a surface of the coated film 1, and driving devices 30-1 and 30-2 that convey the film in a direction of an arrow X in a state where tension is applied to the film. In the coating film removing device 100F, a rotary removing member 40F that removes the coating film 3 from the coated film 1, a roller 50 disposed on the downstream side of the rotary removing member 40F, and a suction mechanism 70 that sucks the coating film 3, which is a removed matter removed by the rotary removing member 40F, are arranged between the driving devices 30-1 and 30-2. Hereinafter, the coating film removing device according to the second embodiment will be described.

[0039] [Coated Film]

In the coating film removing device 100F according to the second embodiment of the present invention, the target coated film 1 has the coating film 3 on at least one surface of the base film 2, which is the same as the target coated film 1 of the first embodiment. A cleaning liquid may be applied to the coating film before the coating film 3 is removed by the rotary removing member 40G in a coating film removing device 100K described later so that

the rotary removing member 40F is disposed in such a manner as to bring the plurality of edges 41 into contact with the coated film 1. As a result, the removing efficiency of the coating film 3 by the rotary removing member 40F can be improved.

[0045] The suction mechanism 70 includes a tank 72 that stores the sucked coating film 3 and a suction device 74 that sucks the removed coating film 3 from the discharge portions. As the suction device, a vacuum pump or the like can be used. The discharge portions 44 and the tank 72 are connected by a pipe 71, and the tank 72 and the suction device 74 are connected by a pipe 73. Since the removing of the coating film 3 from the coated film 1 by the edge 41 F is performed only at a portion where the coated film 1 and the edge 41 F are in contact with each other, the suction mechanism 70 may have a configuration such that the removed coating film 3 is sucked from the discharge portion 44 constituted by the surface 411 on the upstream side in the film conveyance direction of the edge 41 F in contact with the coated film 1.

[0046] Note that, in order to check the quality of the base film 2 from which the coating film 3 has been removed by the rotary removing member 40F, the coating film removing device 100F may include an inspection machine (not illustrated), for detecting residues of the coating film 3 or environmental foreign matters attached in a step, as a preceding stage to the winding device 20. The inspection machine may be selected depending on the properties of the base film 2, and an inspection machine using transmitted light or reflected light is suitably used. A marking device (not illustrated) for recording the position of the residues of the coating film detected by the inspection machine or the environmental foreign matter attached in the

hours of use.

[0054] FIG. 15 is a schematic diagram of a coating film removing device 100H according to a second modification of the second embodiment of the present invention. The coating film removing device 100H includes the rotary removing member 40G of the first modification, and an air jetting mechanism 80 is disposed.

[0055] The air jetting mechanism 80 ejects air into the discharge portion 44G of the rotary removing member 40G to remove the coating film deposited in the discharge portions 44G. The air jetting mechanism 80 is connected to the discharge portion 44G by a pipe 81. Since the removing of the coating film 3 from the coated film 1 by the edges 41G is performed only at locations where the coated film 1 and the edges 41G are in contact with each other, it suffices to implement a structure in which air is ejected into a discharge portion 44G formed by the surface on the upstream side in the film conveyance direction of an edge 41G that is in contact with the coated film 1.

[0056] In the coating film removing device 100H according to the second modification of the second embodiment, since the coating film 3 in the discharge portions 44G of the rotary removing member 40G can be forcibly discharged by air, the coating film can be removed from the rotary removing member 40G, and thus the removing performance can be maintained even in long hours of use.

[0057] Note that, instead of the air jetting mechanism 80, the suction mechanism 70 may be connected to the rotary removing member 40G to suck the removed coating film 3. Alternatively, the air jetting mechanism 80 may be connected to the rotary removing member 40F instead of the rotary removing member 40G.

[0058] FIG. 16 includes (A) a front view of a rotary

air jetting mechanism is supplied to the discharge portions 44I by the first connection member 46, the coating film discharged together with the air supplied to the discharge portions 44I is collected by the groove 47b of the second connection member 47, and the coating film in the groove 47b is sucked by the suction mechanism via the connection portion 47a.

[0060] In the rotary removing member 40I according to the third modification of the second embodiment, air is supplied to the discharge portions 44I, where the coating film is deposited, by the first connection member 46 and the second connection member 47, and the coating film is sucked together with the supplied air, and thus the coating film can be quickly removed from the rotary removing member 40I.

[0061] Furthermore, by making the width of the coated film 1 substantially the same as the width of the rotary removing member 40I to cover the discharge portions 44I with the coated film 1, scattering of the removed coating film can be suppressed, and the airtightness of the spaces of the discharge portions 44I is enhanced, whereby the coating film can be removed more quickly. Furthermore, releasability may be improved by applying fluorine coating or silicone coating to the surfaces on which the discharge portions 44I are formed, whereby deposits of the coating film in the discharge portions 44I may be suppressed.

[0062] Alternatively, instead of the second connection member 47, the rotary removing member 40I is structured to have a hollow structure continuing to the shaft end, and holes for communicating the hollow portion and the discharge portions 44I are formed. Furthermore, by connecting to the suction mechanism from the shaft end of the rotary removing member 40I via a rotary joint, the

in the film conveyance direction with respect to the rotary removing member 40G. As the cleaning liquid applying mechanism 60, a similar one to the cleaning liquid applying mechanism 60 used in the coating film removing device 100E according to the fifth modification of the first embodiment of the present invention can be used. The coating film removing device 100K is suitably used to facilitate removing of the coating film 3.

[0066] As for the amount of the cleaning liquid to be applied to the surface of the coating film of the coated film 1, the type of the cleaning liquid, and the type of a discharge nozzle, similar ones to those of the cleaning liquid applying mechanism 60 used in the coating film removing device 100E according to the fifth modification of the first embodiment of the present invention can be used.

The cleaning liquid applying mechanism 60 is only required to be able to apply the cleaning liquid to the surface of the coating film of the coated film 1 and may have a liquid tank storing the cleaning liquid and apply the cleaning liquid to the surface of the coating film by immersing the coated film 1 in the liquid tank.

[0067] In order to dissolve at least some components of the coating film quickly, it is preferable to apply a heated cleaning liquid to the surface of the coating film of the coated film 1. In a case where a discharge head is used, the discharge head may be provided with a heat source such as a cartridge heater, or a tank for storing the cleaning liquid may be heated. In a case where a liquid tank is used, the liquid tank may be heated, or a throw-in heater may be installed inside the liquid tank. Any means may be used as long as the cleaning liquid can be heated, and it is not limited to the above means.

[0068] Since the coating film removed as described above

contains a component dissolved by the cleaning liquid and thus has high viscosity and poor fluidity, which is likely to cause deposits. However, when the rotary removing member 40F of the present invention is used, the removed coating film is forcibly discharged from the ends of the discharge portions 44G on the downstream side in the film conveyance direction as the rotary removing member 40G rotates, and thus the removing performance can be maintained without deposits even in long hours of use.

[0069] In addition, in the coating film removing device 100K, instead of the rotary removing member 40G, the rotary removing member 40I according to the third modification may be used together with the air jetting mechanism and the suction mechanism. Since the coating film is sucked together with the supplied air, the removed coating film is forcibly discharged, and thus the removing performance can be maintained without deposits even in long hours of use.

[0070] In addition, the coated film 1 to which the cleaning liquid has been applied may be heated in the coating film removing device 100K. As the heating means, a hot air generator or the like (not illustrated) can be used. By setting the temperature of the coated film 1 to higher than or equal to 40°C by hot air, the cleaning liquid applied to the surface of the coating film quickly dissolves at least some components of the coating film, whereby the coating film can be more efficiently removed. The means for heating the coated film 1 may be any means. For example, the coated film 1 may be brought into direct contact with a heating roll, or the cleaning liquid applying mechanism 60 and the coating film removing member 40G may be surrounded by a booth, and an infrared heater may be installed inside the booth for heating, yet it is not limited thereto. In addition, installing the

CLAIMS

1. A coating film removing device that removes a coating film from a coated film including the coating film on at least one surface of a base film, the coating film removing device comprising:

a conveyance mechanism configured to convey the coated film; and

a rotary removing member including: a main body having a rotation axis extending in a width direction of the coated film; a plurality of edges configured to remove the coating film, the plurality of the edges being arranged to extend in the width direction on a circumference of the main body; and a discharge portion that is a space between the plurality of edges,

wherein the coating film is removed from the coated film conveyed by the conveyance mechanism by rotation of the rotary removing member, and the coating film removed is removed from an end of the discharge portion in the width direction.

2. The coating film removing device according to claim 1, wherein the edges and the discharge portion are arranged on the circumference of the main body in parallel to the rotation axis.

3. The coating film removing device according to claim 1, wherein the edges and the discharge portion are spirally arranged on the circumference of the main body around the rotation axis.

4. The coating film removing device according to claim 1, wherein a suction mechanism is connected to the discharge portion.

5. The coating film removing device according to claim 1, wherein an air jetting mechanism is connected to the discharge portion.

6. The coating film removing device according to claim 1, further comprising a cleaning liquid applying mechanism configured to discharge a cleaning liquid toward a surface of the coating film of the coated film.

7. The coating film removing device according to claim 1, wherein an angle formed by a surface on an upstream side in a conveyance direction of the film among surfaces forming an edge of the coating film removing member and the coated film conveyed toward the edge is greater than or equal to 90° and less than 180° as viewed from a side in the conveyance direction of the coated film.

8. A coating film removing method for removing a coating film from a coated film including the coating film on at least one surface of a base film using the coating film removing device according to any one of claims 1 to 7, the method comprising:

conveying the coated film by the conveyance mechanism; bringing the rotary removing member into contact with a surface of the coating film while rotating the rotary removing member; removing the coating film from the coated film; and removing the coating film removed from an end of the discharge portion in the width direction.

9. The coating film removing method according to claim 8, wherein the cleaning liquid is applied to the surface of the coating film, and then the coating film containing the cleaning liquid is removed by the rotary removing member.

10. The coating film removing method according to claim 9, wherein the coating film contains a water-soluble resin.

11. The coating film removing method according to claim 10, wherein the coating film contains a curable silicone.