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- **PATENT ABSTRACTS OF JAPAN vol. 13, no. 111**
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Description

The present invention relates to a curtain coating method by a slide hopper, and particularly to a coating method which eliminates unevenness of coating thickness produced in both edge portions of a coating film which is formed by causing a free falling coating film to collide with a web running continuously.

As conventional coating methods for eliminating unevenness of coating thickness produced in both edge portions of a coating film which is formed by causing a free falling coating film to collide with a web running continuously, it is provided that a method for eliminating the unevenness by means of supplying an auxiliary liquid between a coating film and guide plates for making even both edges of the coating film on a slide surface or between a coating film and edge guides for supporting both edge portions of a free falling coating film. For example, there are (1) a multiple layers coating method by free falling films, in which a film width of at least one layer is wider than the other layers (Japanese Patent Examined Publication No. Sho-62-47075); (2) a coating method pouring an auxiliary liquid having a lower surface tension than a coating film at both edge portions of a slide surface (Japanese Patent Unexamined Publication No. Sho-64-144378); and etc.

However, in a case where the free falling liquid film is formed by a slide hopper in the method (1), it is difficult to form an even film because of the surface tension difference between front and reverse sides of a free falling coating film contacting with the guide edge.

The reason is that the surface tension σ_2 of the reverse side is dynamic surface tension with high and the surface tension σ_1 of the front side is substantially static surface tension because of a time lapse difference of the surface under effect of a surface active agent in the coating liquid, instead it seems that an unbalance is occurred due to the surface tension difference between the front and reverse sides.

In a case where the free falling liquid film is formed in the method (2), because an auxiliary liquid being lower in surface tension than a coating liquid is poured, the liquid at the both edge portions near the edge guides is attracted to the center of a coating film because of the surface tension difference between the coating liquid and the auxiliary liquid, so that it is not able to form an even film. The above problems and such have been produced.

US-A-4830887 describes a coating method to coat liquids onto a running web, in which at least one layer of a coating liquid is poured as a coating film on a slide surface along guide plates supporting both edge portions of said coating film. The coating film is freely dropped together with an auxiliary liquid joined thereto along guide edges succeeding the guide plate and supporting both edges of the free dropping coating film which is joined with the auxiliary liquid. Finally, the free dropping coating film collides with the running web so as to coat said web.

It is therefore an object of the present invention to solve the foregoing problems and provide a coating method by which a stable film forming is performed and the both edge portions of the coating film is formed relatively uniformly and stably.

The foregoing object of the present invention is attained by a coating method in which coating liquids ejected from a die are coated onto a running web as a coating film, said coating method comprising the steps of; pouring at least one layer of said coating liquid as the coating film on a slide surface of said die along guide plates for supporting both edge portions of said coating film; pouring an auxiliary liquid being higher in surface tension and lower in viscosity than said coating liquid, onto upper surface of said guide plates; joining said auxiliary liquid to said both edges of said coating film flowing on said slide surface; free dropping said coating film joined together with said auxiliary liquid along edge guides which succeed said guide plates and support the both edges of said free dropping coating film joined with said auxiliary liquid; and colliding said free dropping coating film with said running web so as to coat said web with said coating film; wherein said auxiliary liquid in said pouring step is poured from a position on a distance of not more than 10 mm from a boundary line between said guide plates and edge guides in a direction of said guide plates.

According to the present invention, the surface tension of the auxiliary liquid is higher than that of the coating film, so that there is no case where the auxiliary liquid is attracted to the center of a coating film to thereby make film coating unstable. Furthermore, a relation among the surface tension σ_3 of the auxiliary liquid, the static surface tension σ_1 of the coating film and the dynamic surface tension σ_2 of the coating film is expressed by $\sigma_3 > \sigma_2, \sigma_1$, so that a stable film can be formed. The auxiliary liquid is joined to the coating liquid prior to the relieving the slide surface. This makes equalization of the velocity possible before the liquids leave the slide surface leading to a much more stable, free falling coating film without a disturbance. Moreover, in the present invention, the auxiliary liquid is poured to the upper surface of the guide plate 3 with separation of a distance of not more than 10 mm in the direction of the guide plate from a boundary line 7 between the guide plate 3 and an edge guide 6 as shown in Figure 2(A), so as to prevent that the uneven portions of the film broaden.

Further preferably, in the above coating method, a quantity of flow of said auxiliary liquid to be poured onto each of said guide plates is not more than 10cc/min.

As a guide plate used in the present invention, in order to pour an auxiliary liquid 2 to the side of the coating film 1 on a slide surface, preferably an upper surface 4 of the guide plate 3 has an inclination of an angle $\theta = 10^\circ$ to 80° with respect to a slide plane 5 as shown in Figure 2(B). In addition, an edge portion of the guide plate 3 on the slide surface

side is provided with a wall of height h 0.5 to 5 mm perpendicular to the slide surface. The height h and inclination angle θ may be set free within thus ranges.

Further, preferably portions where the guide plate 3 and an edge guide 6 are in contact with the coating film have a same shape each other in order to prevent a disturbance from being produced in the flow of the coating film in the boundary portion thereof.

Examples of material for the guide plate and the edge guide used in the present invention include stainless steel, vinyl chloride, acrylic resin, Teflon, or the like.

Furthermore, the present invention preferably sets the supplied quantity of the auxiliary liquid to be not more than 10 cc/min., so as to prevent that the uneven coating portion broadens and to perform a uniform coating.

The auxiliary liquid is continuously supplied from a pump to the upper surface of a guide plate 3 by means of a small tube, which end being in contact with the surface of the guide plate 3.

Figure 1 is a side view of a slide hopper type curtain coating apparatus of an embodiment for realizing the present invention.

Figure 2(A) and Figure 2(B) are plan and sectional views, respectively, of the periphery portion of a boundary between a guide plate and an edge guide of the embodiment for realizing the present invention.

Figure 3 is a front sectional view for explaining a method for calculating the width w_i of an uneven portion at an edge portion of a coating composition film relating to the present invention.

The present invention will be described in accordance with the following examples.

(Example 1)

An alkali-treated gelatin solution (10% by weight) containing sodium dodecylbenzene-sulfonate (0.15% by weight) was thickened with sodium polystyrene-sulfonate so as to provide a viscosity of 55 cp and a surface tension of 32 dyne/cm. The solution thus prepared was used as a coating liquid.

As a coating method as shown in Figure 1, a method of ejecting the coating liquid at the rate of 0.6 cc/cm · s from each of slits 9a, 9b, and 9c of a slide hopper 8 for applying three layers simultaneously was used.

As an auxiliary liquid 2, a liquid having 2 cp viscosity, 37 dyne/cm surface tension and 4 cc/min. Supplied quantity was used. As a guide plate and an edge guide, a plate having an edge portion height h of 0.5 mm on a side of a slide surface and a guide having the angle θ of 45° between the upper surface of the guide plate and the slide surface were used respectively.

The position of a comparative example from which the auxiliary liquid was to be poured to the upper surface of the guide plate was set to the position B of Fig. 1 which was upper than the slot for the uppermost layer of the three layers to be coated simultaneously. The position, as an auxiliary liquid injection point in the present invention, from which the auxiliary liquid was to be poured to the upper surface of the guide plate was set to the position A which was at a distance of not more than 10 mm in the direction of the guide plate from a boundary line 7 between the guide plate and the edge guide. The regions of uneven coating in the above two cases of the comparative embodiment and the present invention were compared each other by each of the three layers. Results were shown in Fig. 3 and Table 1. Width w_i of an uneven portion represents the width from a coating edge portion to a position corresponding to the thickness difference $|\Delta d_i| > 0.03 d_i$ ($i=1,2,3, \dots$) of a measured layer. Here d_i represents film thickness at the even portion of the measured layer.

Table 1

auxiliary liquid injection point	width of an uneven portion		
	lowermost layer	intermediate layer	uppermost layer
A	5	7	10
B	5	19	27

As shown in Fig. 3 and Table 1, in the case where the auxiliary liquid is poured at the position A according to the present invention, the uneven coating portion in the three layers could be limited to a range of not more than 10 mm from the coating edge portion. However, in the case where the auxiliary liquid was poured at the position B, the uneven coating portion in the three layers was broadened to a range of 27 mm from the coating edge portion.

(Example 2)

An alkali-treated gelatin solution (10 % by weight) containing sodium dodecylbenzene-sulfonate (0.15 % by weight) was thickened with sodium polystyrene-sulfonate so as to provide a liquid having viscosity of 60 cp and surface tension of 32 dyne/cm. The liquid thus thickened was used as a coating liquid.

As a coating method, a method of ejecting the coating liquid from each of three slits at the rate of 1.3 cc/cm · s by using a slide hopper for applying three layers simultaneously was used.

As an auxiliary liquid, a liquid having viscosity of 1 to 2 cp was used and injected from the above-mentioned position A while changing its surface tension into three cases.

In the case where the surface tension of the auxiliary liquid was 30 dyne/cm which was lower than the surface tension of the coating film of 32 dyne/cm, a free falling coating film was instable. However, in the cases where the surface tension of the auxiliary liquid was changed to 37 and 70 dyne/cm, a free falling coating film could be applied stably. Consequently, a stable free falling film could be formed by setting the surface tension of the auxiliary liquid to be higher than the surface tension of the coating film.

(Example 3)

The same conditions for the coating liquid and the coating method as in Example 2 were used. As an auxiliary liquid, a liquid having viscosity of 2 cp and surface tension of 37 dyne/cm higher than the surface tension of the coating liquid was poured from the above-mentioned position A as an auxiliary liquid injection point while the quantity of flow of the auxiliary liquid was changed successively to 5 cc/min and 20 cc/min. In the case of 5 cc/min, the width w_3 of the uneven portion was 5 mm, but in the case of 20 cc/min, the width w_3 was broadened to be 10 mm. It is to be understood from the above results that preferably the quantity of flow of the auxiliary liquid is set to be lower than 10 cc/min.

As is apparent from the above examples, the uneven coating portion at the edge portion of the coating film can be reduced due to the auxiliary liquid injection point, surface tension and pouring amount of the auxiliary liquid according to the present invention. It is possible to construct and coat a stable free falling film.

Claims

1. A coating method in which coating liquids ejected from a die are coated onto a running web (10) as a coating film, said coating method comprising the steps of:

pouring at least one layer of said coating liquid as the coating film (1) on a slide surface (5) of said die along guide plates (3) for supporting both edge portions of said coating film (1);

pouring an auxiliary liquid (2) being higher in surface tension and lower in viscosity than said coating liquid, onto upper surfaces (4) of said guide plates (3);

joining said auxiliary liquid (2) to said both edges of said coating film (1) flowing on said slide surface (5);

free dropping said coating film (1) joined together with said auxiliary liquid (2) along edge guides (6) which succeed said guide plates (3) and support the both edges of said free dropping coating film (1) joined with said auxiliary liquid (2); and

colliding said free dropping coating film (1) with said running web (10) so as to coat said web with said coating film;

wherein said auxiliary liquid (2) in said pouring step is poured from a position (A) on a distance of not more than 10 mm from a boundary line (7) between said guide plates (3) and edge guides (6) in a direction of said guide plates (3).

2. A coating method according to claim 1, wherein a quantity of flow of said auxiliary liquid (2) to be poured onto each of said guide plates (3) is not more than 10cc/min.

Patentansprüche

1. Ein Beschichtungsverfahren, bei dem Beschichtungsflüssigkeiten, die von einem Abgabekopf abgegeben werden, als Beschichtungsfilm auf ein sich bewegendes Gewebe (10) aufgebracht werden, wobei das Beschichtungsverfahren die folgenden Schritte umfaßt:

Aufbringen von zumindest einer Schicht einer Beschichtungsflüssigkeit als Beschichtungsfilm (1) auf eine Abgleitoberfläche (5) des Abgabekopfes entlang Führungsplatten (3) zum Stützen der beiden Randbereiche des Beschichtungsfilmes (1);

Aufbringen einer Hilfsflüssigkeit (2), die eine höhere Oberflächenspannung und eine niedrigere Viskosität als die Beschichtungsflüssigkeit hat, auf die oberen Oberflächen (4) der Führungsplatten (3);

Verbinden der Hilfsflüssigkeit (2) mit den beiden Rändern des Beschichtungsfilmes (1), der auf der Abgleitoberfläche (5) fließt;

frei Fallenlassen des Beschichtungsfilmes (1), der mit der Hilfsflüssigkeit (2) verbunden ist, entlang von Randführungen (6), welche den Führungsplatten (3) folgen und die beiden Ränder des frei fallenden Beschichtungsfilmes (1), die mit der Hilfsflüssigkeit (2) verbunden sind, stützen; und

Zusammentreffenlassen des frei fallenden Beschichtungsfilmes (1) mit dem sich bewegenden Gewebe (10), um das Gewebe mit dem Beschichtungsfilm zu beschichten;
wobei die Hilfsflüssigkeit (2) in dem Aufbringsschritt von einem Ort (A) zugeführt wird, der einen Abstand von nicht mehr als 10 mm in Richtung der Führungsplatten (3) von einer Grenzlinie (7) hat, die zwischen den Führungsplatten (3) und den Randführungen (6) liegt.

2. Ein Beschichtungsverfahren nach Anspruch 1, worin die Flüssigkeitsrate der Hilfsflüssigkeit (2), die auf jede der Führungsplatten (3) aufgebracht wird, nicht größer als $10 \text{ cm}^3/\text{min}$ ist.

Revendications

1. Procédé d'enduction dans lequel des liquides d'enduction éjectés d'une filière sont enduits sur une toile en mouvement (10) comme une couche d'enduction, ledit procédé d'enduction comprend les étapes de :

coulage d'au moins une couche dudit liquide d'enduction comme couche d'enduction (1) sur une surface de glissement (5) de ladite filière le long de plaques de guidage (3) pour supporter les deux parties de bord de ladite couche d'enduction (1) ;

coulage d'un liquide auxiliaire (2) ayant une tension de surface plus élevée et une viscosité plus petite que ledit liquide d'enduction, sur des surfaces supérieures (4) desdites plaques de guidage (3) ;

jonction dudit liquide auxiliaire (2) audits deux bords de ladite couche d'enduction (1) passant sur ladite surface de glissement (5) ;

chute libre de ladite couche d'enduction (1) jointe audit liquide auxiliaire (2) le long des guides latéraux (6) qui succèdent auxdites plaques de guidage (3) et qui supportent les deux bords de ladite couche d'enduction à chute libre (1) jointe audit liquide auxiliaire (2) ; et

collision de ladite couche d'enduction à chute libre (1) avec ladite toile de défilement (10) afin d'enduire ladite toile avec ladite couche d'enduction ;

dans lequel ledit liquide auxiliaire (2) dans ladite étape de coulage est versé à partir d'une position (A) sur une distance non supérieure à 10 mm d'une ligne de limite (7) entre lesdites plaques de guidage (3) et les guides de bord (6) dans une direction desdites plaques de guidage (3).

2. Procédé d'enduction selon la revendication 1, dans lequel une quantité d'écoulement dudit liquide auxiliaire (2) à verser sur chacune desdites plaques de guidage (3) n'est pas supérieure à 10 cc/minute .

FIG. 1

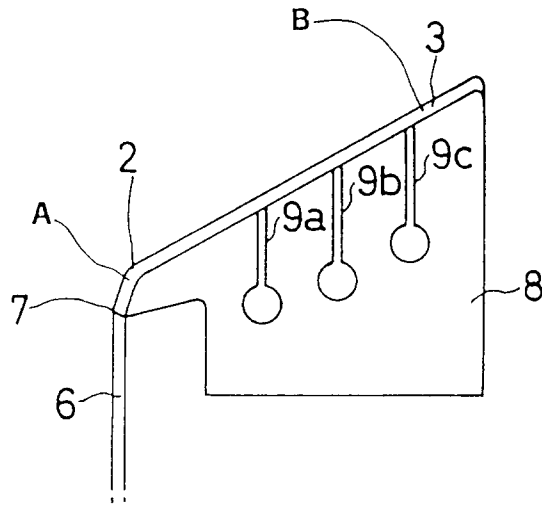


FIG. 2(A)

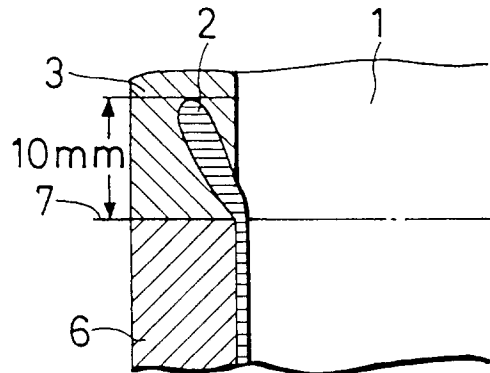


FIG. 2(B)

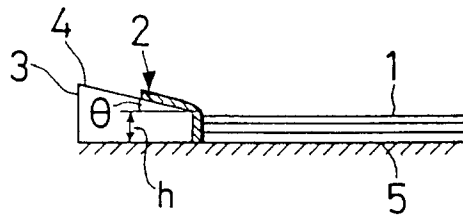


FIG. 3

