

METHOD AND APPARATUS FOR PRODUCING LAMINATE SHEET

Technical field

The present invention relates to a manufacturing method for a laminate sheet and manufacturing apparatus therefore, and more particularly to a manufacturing method for a laminated sheet, in which a thermoplastic resin film is made to contact and pressed to a heated metal sheet, and a manufacturing apparatus for carrying out the manufacturing method.

Background technology

As shown in Figure 4, there is a well known laminating method in which metal sheet 101, heated in an oven, is then made to contact thermoplastic resin film 102, and metal sheet 101 and resin film 102 are both pressed by a couple of laminating rolls (nip rolls) 103 and 104 while film 102 is partially melted by the heat of metal sheet 101 to adhere to metal sheet 101 (see Laid-Open Japanese Patent Hei 4-201237, for example). In such a laminating method, thickness of the melted portion of film 102 (thickness of a melted layer), and adhering strength of film 102 to metal sheet 101 can be controlled to some extent by selecting conditions such as heating temperature of metal sheet 101, distance from the oven to laminating rolls 103 and 104, traveling speed of metal sheet 101, and melting temperature of film 102.

In the conventional method mentioned above, as shown

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in Figure 5, for example, in a case of laminating an oriented resin film when film 2 is pressed to metal sheet 101 by laminating rolls 103 and 104 (see Figure 4), a high temperature of metal sheet 101 is transferred to laminating roll 103 of a low temperature through film 102. while the high temperature causes film 102 to form a melted layer 5, the pressed metal sheet 101 and film 102 adhere to each other. After passing through between laminating rolls 103 and 104, metal sheet 101 is free from pressure, and the film surface is not more cooled, and then the temperature from the metal sheet is transferred to the whole film, which controls the orientation of oriented layer 106 of the film. Therefore, as the traveling speed of metal sheet 101 and film 102 increase, the temperature of the metal sheet should be lowered in order to control the orientation of the oriented layer because the cooling effect by the laminating rolls is not sufficient. For this reason, it is difficult to perform high speed lamination by the conventional laminating method.

On the other hand as a method to increase the melted layer by high speed lamination, heating metal sheet 101 to a higher temperature may be applied. But in this case, cooling by the laminating rolls does not fully effect so that the melted layer may be formed in the whole film, thus reducing the strength of the film.

In addition, in a case where such wholly melted film is located inside of a formed can, and when content is packed and stored in it. the film is easily cracked by outer impact, which often causes

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the packed content to be rotten.

It is the first object of the present invention to solve the problem in the conventional method and to provide a manufacturing method for a laminated sheet in which the laminated sheet has its adhesion increased, and the sufficiently increased adhesion can be obtained even by the high speed lamination. The second object of the present invention is to provide a manufacturing apparatus for such a manufacturing method.

Disclosure of the Invention

The manufacturing method for a laminate sheet of the present invention is characterized by the steps of : heating a continuous metal sheet ; making a thermoplastic resin film contact at least one surface of it ; and passing both the metal sheet and the thermoplastic resin film through between a couple of laminate rolls and pressing them, thus thermally bonding the thermoplastic resin film to the metal sheet. It is further characterized by pressing the laminate sheet which has passed through between the laminate rolls, in a traverse direction so as to deviate the traveling direction to either one of the laminate rolls, Furthermore, the method of the present invention is characterized by deviating the traveling direction of the laminate sheet to the one laminating roll which contacts the thermoplastic resin film.

The manufacturing apparatus for a laminate sheet of the present invention is characterized by a heating device for heating

a metal sheet, a supplying device for supplying a thermoplastic resin film to be laminated onto at least one side of the heated metal sheet, a couple of laminate rolls for pressing the metal sheet and the thermoplastic resin film, and a deflector roll for deviating traveling direction of the laminate sheet which has passed through between the couple of laminate rolls to a direction traverse to the original traveling direction by pushing it aside to one of the laminate rolls.

The apparatus of the present invention may further comprise a guide roll for making the travelling direction of laminate sheet, which is deviated by the deflector roll, back to the original travelling direction.

The apparatus may also comprise a deflector roll movably arranged in a direction traverse to the traveling direction of the laminate sheet.

Furthermore, the apparatus may effectively comprise a pressure roll for increasing the contact force of the laminate roll and the laminate sheet when the laminate sheet which has passed through between the laminate rolls is pushed aside to one of the laminate rolls.

When pushing the laminate sheet which has passed through between the laminate rolls aside to one of the laminate rolls, the laminate sheet winds round the one laminate roll by a certain angle.

During traveling the distance corresponding to that angle, the laminate sheet contacts that laminate roll with some holding

strength due to its own tension and meantime the laminate sheet is cooled. Therefore, the metal sheet can have its initial temperature higher selected, which permits a melted layer to be thicker during that traveling period. Thus, the thermoplastic resin film and the metal sheet can be more reliably adhered to each other by the pressing force also during that traveling period.

Since the manufacturing apparatus is provided with a deflector roll to deviate the traveling direction of the laminate sheet which has passed through between the couple of laminate rolls, it is possible to deviate the traveling direction without causing any resistance to the traveling of the laminate sheet. The manufacturing apparatus provided with the guide roll to make the deviated travelling direction back to the original direction can easily be combined with a conventional manufacturing line for a laminate sheet. Further, the apparatus provided with the deflector roll movably arranged in a direction traverse to the original traveling direction of the laminate sheet, it is possible to obtain the most preferable thickness of the melted layer of the film depending on the kind of raw material and the traveling speed of the laminate sheet so that the adhesive strength of the film can be improved to thereby prevent the peeling-off of it.

Brief explanation of the drawings

Figure 1 is a schematic front view showing one example of the manufacturing apparatus for a laminate sheet of the present

invention.

Figure 2 is a partial cross section of Figure 1.

Figure 3(a) is a graph showing the relationship between the period of time during which the film contacts the laminate roll according to the present invention and the thickness of its melted layer, and Figure 3(b) is a graph showing the relationship between the thickness of the melted layer and the adhesive strength of the film.

Figure 4 is a schematic front view showing one example of the conventional manufacturing apparatus.

Figure 5 is a partial cross section of Figure 4.

Figure 6 is a schematic front view showing another example of the manufacturing apparatus of the present invention.

The best mode for carrying out the invention

Next, the manufacturing method and the manufacturing apparatus for a laminate sheet of the present invention will be explained more in detail referring to each Figure.

Figure 1 is a schematic front view showing one example of the manufacturing apparatus of the present invention. Figure 2 is a partial cross section of Figure 1. Figure 3(a) is a graph showing the relationship between the period of time during which the film contacts the laminate roll according to the present invention and the thickness of its melted layer, and Figure 3(b) is a graph showing the relationship between the thickness of the melted layer

and the adhesive strength of the film (after forming). Figure 6 is a schematic front view showing another example of the manufacturing apparatus of the present invention.

In manufacturing apparatus A for a laminate sheet shown in Figure 1, the denoted figure 1 is an oven in which metal sheet 2 passes and is heated continuously, and a couple of laminate rolls 4 and 5 arranged below oven 1 to press and adhere film 3 to metal sheet 2 coming out from oven 2. At a short distance below laminate rolls 4 and 5 is arranged deflector roll 6 rotatably and movably in a directions as shown by arrows P1 and P2. Further below deflector roll 6 is arranged guide roll 7 rotatably. The rotation axes of laminate rolls 4 and 5, deflector roll 6 and guiding roll 7 are parallel to each other. Quenching tank 8 containing a quenching liquid is arranged below guide roll 7.

Manufacturing apparatus A' is the one provided with hold down roll 9 for pressing laminate sheet 10 against laminate roll 4 additionally to manufacturing apparatus A. Pressure roll 8 is rotatable and arranged parallel to laminate roll 4.

As oven 1, conventionally known one such as dielectric heating oven can be applied. Another heating device such as a heating roll or an induction heating coil can also be applied instead of oven 1. A couple of laminate rolls 4 and 5 are prior known ones that acts as nip rolls for pinching and pressing metal sheet 2 and film 3 running through between them. Normally, laminate rolls 4 and 5 are each synchronously rotated in the opposite



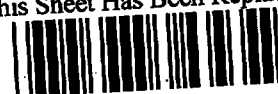
direction (arrow S1 and S2) so as to move laminate sheet 10 downward. The distance between both laminate rolls is adjustable and rotation speed can also be controlled.

Deflector roll 6 has its both ends rotatably supported by bearings (not shown), and the bearings are each synchronously movable in the directions of arrow P1 and P2 using a control cylinder or the like. The positions of the bearings are normally adjusted according to a predetermined laminating condition, but they may be adjustable during the laminating operation. The bearings are arranged to move straight and reciprocatively in a direction perpendicular to the surface of the laminate sheet. They can also be arranged to rotate about an axis Q which is positioned below (or above) their axes and parallel to them. that is, the bearings may be circularly movable as shown by the imaginary line.

Guide roll 7 has its both ends supported by bearings (not shown), and the bearings are each fixed to a frame or the like.

Guide roll is arranged at such a position as to contact a tangential line N of laminate rolls 4 and 5. Not shown, but laminate sheet 10 taken out from quenching tank 8 is driven downward by another nip roll. Therefore, there causes tension on laminate sheet 10, and thus a proper tension works on laminate sheet 10 located between laminate rolls 4 and 5 and guide roll 7.

The manufacturing apparatus constructed as mentioned above is used as follows. At first, two film 3 and 3 taken out from a supplying device which is not shown are made to contact both sides of



the metal sheet that has passed through oven 1, and then the three members are passed through between laminate rolls 4 and 5. Subsequently, thus laminate sheet 10 is passed on the left side of deflector roll 6 which is deviated to the left side from tangential line N shown in Figure 1, and then it is passed on the right side of guide roll 7, to thereby make the travelling direction back to the original travelling direction. The deviation distance of deflector roll is suitably adjusted according to forming conditions and so on. Further, laminate sheet 10 is guided downward into quenching tank 8.

As mentioned above, since laminate sheet 10 coming out from laminate rolls 4 and 5 travels in a zigzag line, laminate sheet 10 winds round one laminate roll 4 by a predetermined winding angle (contacting angle) θ . Contacting angle θ becomes larger when deflector roll 6 is deviated to the left side in Figure 1, while it becomes smaller when deflector roll 6 is deviated to the right side. When the deviation becomes "0", the laminate sheet is guided downward straight as conventional, and winding angle becomes 0.

Thus, a pressing force due to the tension of laminate sheet 10 is worked between film 3 and metal sheet 2 by making laminate sheet 10 contact one laminate roll 4 by a predetermined winding angle to thereby increase a period for cooling the laminate sheet. Further in the case where the presser roll shown in Figure 6 is provided, a greater pressing force can be worked, which can improve cooling effect.

Since the increase of the cooling period is due to the increase of the pressing force worked between film 3 and metal sheet 2, it affects not only film 3 which contacts one laminate roll 4 but also film 3a contacting the other side of metal sheet 2 shown by the imaginary line in Figure 2. The greater the pressing force and the longer the period for contacting the laminate roll, the more the total mass of thermal conduction increases. Therefore, an initial temperature of metal sheet 2 can be raised due to the increase of the cooling period, and thickness W of melted layer 11 on the side contacting metal sheet 2 can be increased. The relationship between the contacting period "t" of film 3 to laminate roll 4 and thickness W of melted layer 11 is substantially in direct proportion as shown in Figure 3a.

As melted layer 11 increases, adhesion of film 3 to metal sheet 2 during forming increases after being cooled. The relationship between them is also substantially in direct proportion as shown in Figure 3b. In addition to the increase of the melted layer, the increase of the period during which film 3 is pressed to metal sheet 2 multiplicably affects film 3 and its adhesion is more improved.

In the above-mentioned example, the increase of adhesion of film during forming is explained on condition that the laminating speed is same as that applied in the conventional method. Conversely speaking, if the adhesion is as fair enough as that obtained by the conventional manufacturing method, the

laminating can be carried out at a higher speed than conventional. Furthermore, winding the film round the laminate roll makes the contacting period of laminate sheet 10 to laminate roll 4 longer immediately after the lamination, and the cooling effect by the laminate roll can be fully obtained. Therefore, film 3 does not wholly melt even when metal sheet 2 coming out from the oven is heated to a higher temperature, and the unmelted layer can reliably remain outside. Accordingly, even when the laminating is carried out at a high speed, melted layer 11 having thickness can be obtained, thus increasing the film adhesion during forming. In this case, the orientation of the film in the unmelted layer is reduced. Between melted layer 11 and slightly oriented layer 12, the layer whose orientation gradually decreases is intervened.

Next, concrete examples and comparison examples are given and the effect of the manufacturing method of the present invention is explained.

(Examples 1 to 3)

A biaxially oriented polyester thermoplastic resin film having thickness of 25 μ m was heat laminated on one side of a strip of electrolytically chlorinated steel (TFS) having thickness of 0.2 mm used for can stock using the manufacturing apparatus as shown in Figure 1. The temperature of the steel strip just before coming into a couple of laminate rolls was about 225 ° C, and that of the laminate roll spontaneously cooled was about 150 ° C. The traveling speed of the laminate sheet were 100, 200 and 400m/min in



Example 1, 2 and 3, respectively. Winding angle for the laminate sheet round the laminate roll was 20° in all the examples.

When the laminates thus obtained were formed into a cup having a diameter of 65 mm and a height of 100 mm using a drawability taster, no film crack was caused in all the examples and 4.0 to 5.6 N/10 mm of stripping force of the film (adhering strength during forming) was required to strip the film in each example. The original orientation of the film measured by birefringence rate was about 0.09, while in the laminated film, the melted layer had the birefringence rate of 0.01 and the thickness of about 5 to 15 μ m, slightly oriented layer had the birefringence rate of about 0.058 and the thickness of about 10 to 20 μ m, and the intervening layer had the birefringence rate of 0.01 to 0.05 and the thickness of about 3 μ m.

(Comparative examples 1 to 3)

The laminating operation for Comparative examples 1, 2 and 3 were performed on the same conditions (the traveling speed of the laminate sheet were 100, 200 and 400 m/min, respectively) as in Examples except that the laminate sheet was not made to wind round the laminate roll but traveled downward straight. When the laminate sheet of Comparative example 3 was formed into a cup substantially the same as Example, film crack was partially caused.

In case of Comparative examples 2 and 3, no film crack was caused, but stripping force of the film (adhering strength during forming) were 4.0 and 2.9 N/10 mm, respectively. The melted layer had the



birefringence rate of 0.01 and the thickness of about 0 to 5 μ m, the slightly oriented layer had the birefringence rate of about 0.058 and the thickness of about 20 to 25 μ m, and the intervening layer had the birefringence rate of 0.01 to 0.05 and the thickness of about 3 μ m. The results are shown in Tables 1 and 2.

Table 1

Example

No	traveling speed	thickness of melted layer	thickness of oriented layer	adhering strength
1	100 m/min	15 μ m	10 μ m	5.6 N/10 mm
2	200 m/min	9 μ m	16 μ m	4.8 N/10 mm
3	400 m/min	5 μ m	20 μ m	4.0 N/10 mm

Table 2

Comparative example

No	traveling speed	thickness of melted layer	thickness of oriented layer	adhering strength
1	100 m/min	5 μ m	20 μ m	4.0 N/10 mm
2	200 m/min	2.5 μ m	22.5 μ m	2.9 N/10 mm
3	400 m/min	0 μ m	25 μ m	0.5 N/10 mm

From the results shown above, it is apparent that according to the manufacturing method of the present invention, a laminate sheet having excellent adhering strength of the film to a matallic sheet and hardly to be peeled off during forming can be obtained, even when the laminate sheet is manufactured at a high speed of 100 ~ 400m/min.

Industrial utility

As mentioned above, according to the manufacturing method of the present invention, the adhering strength of the film to a matallic sheet can be improved and it is not reduced even when the laminating oparation is performed at a high speed. According to the manufacturing apparatus of the present invention, the above-mentioned manufacturing method can easily be carried out.

Summary

A method of producing a laminate sheet (10) comprises the steps of heating a continuous belt-like metal sheet (2) by a heating furnace (1), laminating a thermoplastic resin film (3) on at least one of the surfaces of the metal sheet, pressing and passing both of them between a pair of laminate rolls (4 and 5), and thermally bonding the film (3) to the metal sheet (2), wherein the laminate sheet (10) coming out from between the pair of laminate rolls (4 and 5) is pushed by a deflector roll (6) in a transverse direction so as to bias the traveling direction towards the laminate roll (4) which



contacts the film (3). The invention also discloses an apparatus

(A) used for this method.

Claims

1. A manufacturing method for a laminate sheet comprising the steps of:

heating a continuous metal sheet;

laminating a thermoplastic resin film at least on one of the surfaces of the metal sheet; and

passing both of them through between a couple of laminate rolls, pressing them, and thermally bonding said film to said metal sheet,

wherein said laminate sheet coming out from between said couple of laminate rolls is pushed aside in a traverse direction so as to bias its traveling direction to either one of said laminate rolls.

2. A manufacturing method according to claim 1,

wherein said laminate sheet is pushed aside to one of said laminate roll that contacts said film.

3. A manufacturing apparatus comprising :

means for heating a metal sheet ;

means for supplying a thermoplastic resin film to be laminated at least on one surface of said heated metal sheet;

a couple of laminate rolls for pressing said metal sheet and said thermoplastic resin film ; and

a deflector roll for pushing a laminate sheet, which has come out through the couple of laminate rolls, in a traverse direction so as to bias the traveling direction of the laminate



sheet to one of the laminate rolls.

4. The manufacturing apparatus according to claim 3

further comprising a guide roll for making said travelling direction of said laminate sheet which is biased by said deflector roll back to the original travelling direction of said laminate sheet.

5. The manufacturing apparatus according to claims 3 or 4, wherein said deflector roll is movably arranged in a direction traverse to said original traveling direction of said laminate sheet.

6. The manufacturing apparatus according to any of claims 3 to 5,

comprising a pressure roll for increasing contacting force of said laminate roll and said laminate sheet when said laminate sheet which has come out through said laminate rolls is pushed aside to one of said laminate rolls.

