

12

**EUROPEAN PATENT APPLICATION**

21 Application number: **89308547.2**

51 Int. Cl.<sup>5</sup>: **D 21 H 27/40**  
**B 31 F 1/28**

22 Date of filing: **23.08.89**

30 Priority: **23.08.88 AU 23/88**

43 Date of publication of application:  
**28.02.90 Bulletin 90/09**

84 Designated Contracting States:  
**BE DE ES FR GB IT**

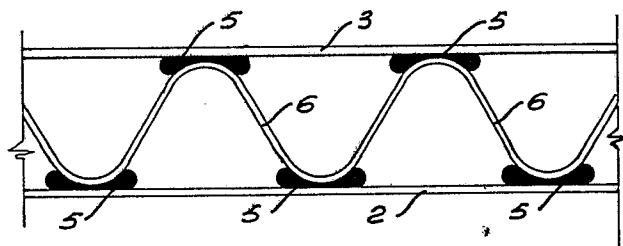
71 Applicant: **GEORGE WESTON FOODS LIMITED**  
**Braidwood Street**  
**Enfield, NSW 2136 (AU)**

72 Inventor: **Neale, Raymond Bede**  
**9 Eugenia Street**  
**Loftus New South Wales (AU)**

74 Representative: **Marshall, Monica Anne et al**  
**GALLAFENT & CO. 8 Staple Inn**  
**London WC1V 7QH (GB)**

54 **High compression strength corrugated board.**

57 A corrugated board consisting of a corrugated medium sandwiched between liners and having a high wet compression strength may be made by treating the medium with a level of adhesive substantially in excess of that required for adhesion of liners to the medium. The adhesive is desirably a starch based adhesive containing a polyphenolic/formaldehyde or a polyresorcinolic/formaldehyde in excess of 12.5g dry weight of adhesive per square meter glue line.



**FIG. 2**

## Description

## HIGH COMPRESSION STRENGTH CORRUGATED BOARD

This invention relates to corrugated board and a method of manufacture thereof.

Corrugated board is usually manufactured by passing a paper board between fluted rollers to form a corrugated medium. An adhesive is then applied to the crests of the corrugated medium by means of an adhesive coating roller. Liner paper board is then pressed into contact with the flute crests on one side of the medium. A similar procedure is conducted on the other side of the corrugated medium to produce a corrugated board in which a corrugated medium is sandwiched between two liner sheets and is bonded to the liners at glue lines extending along the crests of the corrugated flutes of the medium.

Modern corrugated board machinery operates at high speed. The adhesive is usually a starch based adhesive which often incorporates a waterproofing resin (e.g. a Ketone aldehyde adhesive or urea formaldehyde resin) the purpose of which is to prevent deterioration of the adhesive bond under conditions of high humidity or during moist storage. Such adhesives are applied at the minimum level required to extend along the flute crest and usually at 60g/square meter or less for a medium of 160g grade (i.e. 30 GSM for each side).

It has been practiced to impregnate the medium with hot wax prior to corrugating in order to increase the compression strength and water resistance of the finished product.

It has also been practiced to impregnate the medium with a resin prior to corrugating for this purpose. However, impregnation either with resin or wax adds to the materials cost, inventory cost and also requires additional application, equipment and raw materials.

The present invention stems from the surprising discovery that application of greater quantities of the herein described adhesive than are required for adhesion of the liner to the medium results in a board which, when subjected to high humidity conditions, having a compression strength (important for stacking) not only greatly in excess of that of normally treated board, but also in excess of normally treated board having a wax impregnated medium.

According to one aspect the present invention comprises a process for manufacture of a corrugated board characterized by the step of treating the medium with a level of adhesive substantially in excess of that required for adhesion of liners to the medium.

In preferred embodiments the adhesive is applied at in excess of 12 1/2g (dry weight) of adhesive/square meter per glue line. Also in preferred embodiments the adhesive is a starch based adhesive containing a polyphenolic/formaldehyde or polyresorcinolic/formaldehyde waterproofing resin.

An embodiment of the invention will now be described by way of example only with reference to the accompanying drawings wherein:

Figure 1 shows schematically a corrugated board according to prior art;

Figure 2 shows schematically a preferred embodiment of corrugated board according to the invention.

With reference to Figure 1 there is shown a prior art corrugated board comprising a corrugated medium 1 having a first liner 2 on one side and a second liner 3 on the other, the liners being bonded to the medium at flute tips by means of an adhesive 4.

In normal manufacture of such board, paper to form the medium is corrugated by means of steam heated fluted rollers.

Adhesive is applied to the corrugation flute tips on one (first glue line) and a paper liner is brought into contact with the adhesive coated flute tips to form a single-faced board. Sufficient heat and pressure are applied to bond the liner to the medium to form at the flute tips.

Adhesive is then applied to the exposed flute tips on the opposite side of the board (second glue line). A second liner is then brought into contact with the exposed coated flute tips. Sufficient heat and pressure are applied to bond the second liner to the medium (without deforming the corrugations) to form double backed board.

Starch based adhesives are typically applied at 25% solids and at an application rate of 20g (wet weight) of adhesive per square meter per glue line. This corresponds to 5g (dry weight) of adhesive per square meter per glue line.

The actual amount of adhesive may vary with weight of board and with manufacturing conditions and under some circumstances may be as high as 40g (wet weight) of adhesive per square meter per glue line corresponding to 10g (dry weight) of adhesive per square meter per glue line. It has hitherto been generally desired to use as little adhesive (on a dry weight basis) as is possible consistent with obtaining a bond between liner and medium.

According to the present invention more than 10g (dry weight) per square meter per glue line is applied, and preferably more than 12 1/2g (dry weight) of adhesive per square meter per glue line. In preferred embodiments of the invention the adhesive does not remain at the flute tips but forms bead lines 5 (Figure 2) extending adjacent to the flute tips and the liner on one or both sides of the flute tip.

If too much adhesive is applied, an excess amount of moisture migrates into the valley walls 6 of the fluted medium and causes weakness of the corrugations.

In practice for a weight of board such as 290g liner/160g medium then 20g (dry weight) of adhesive per square meter per flute line would be the maximum applicable, but a greater amount of adhesive might be usable for heavier weight boards.

Typical adhesive compositions for use in the

invention are

|                            |       |       |       |
|----------------------------|-------|-------|-------|
| Water (30° C)              | 590   | 590   | 590   |
| Wheat Starch               | 0     | 25    | 50    |
| Lotemp 20/47               | 50    | 25    | 0     |
| Caustic Soda (50%)         | 28    | 30    | 26    |
| Water (30° C)              | 1225  | 1225  | 1225  |
| Wheat Starch               | 625   | 625   | 625   |
| Boric Acid                 | 4     | 4     | 4     |
| Poly Resorcinol            | 30    | 60    | 23    |
| Resin (100% solids)        |       |       |       |
| Urea Formaldehyde          | 15    | 30    | 12    |
| Resin (62% Solids)         |       |       |       |
| Formalin                   | 13    | 25    | 10    |
| Ketone Aldehyde            | 25    | 35    | 20    |
| Resin (60% Solids)         |       |       |       |
| Total                      | 2605  | 2675  | 2585  |
| Solids Content (Dry Basis) | 24.0% | 24.5% | 23.9% |

By way of example of the benefit obtainable, a board was manufactured using 290g/square meter paper (KRAFT) for liners 2, 3 and using 160g/square meter paper (Recycled) for the "C" fluted medium 1.

A conventional starch based adhesive at 25% solids was applied at normal levels in "Case A" and "Case B" in accordance with prior art, that is to say at about 50g (wet basis) of adhesive per square meter overall, that is about 6.25g (dry weight) of adhesive /square meter/glue line. However, in "Case B" the medium was a hot waxed impregnated medium (parafin/hydrocarbon resin blend, weight 15GSM). In "Case C", according to the invention, applicator gaps were increased to apply 100g/square meter of adhesive overall, that is about 12.5g (dry weight) of adhesive per square meter per glue line. This is much more than is required for adhesion of liner to medium and in fact is sufficient to fill troughs of the valleys or build-up the shoulder of the crest.

The adhesive employed in case C was a conventional starch based adhesive containing waterproofing resins. The adhesive formulation consisted of 50 kgs of the following premix:

|                          |                  |
|--------------------------|------------------|
| Polyresorcinolic resin - | 500 parts by wt. |
| Acid modified Starch -   | 440 parts by wt. |
| Paraformaldehyde 91% -   | 60 parts by wt.  |
|                          | 1000             |

added to a 2000 litre batch of corrugating starch.

To the above batch was added 10kg of urea formaldehyde resin and 15kg of Ketone aldehyde resin waterproofing agents.

The properties of the resulting boards are shown in Table 1:

TABLE 1

| TESTS PERFORMED                  | CASE A | CASE B | CASE C |
|----------------------------------|--------|--------|--------|
| <u>A. Dry Conditions</u>         |        |        |        |
| Caliper (m)                      | 4352   | 4374   | 4318   |
| Edge Compression strength (kN/m) | 7.2    | 7.4    | 8.3    |
| Hardness (kPa)                   | 112    | 93     | 129    |
| Burst (kPa)                      | 2151   | 2266   | 2415   |
| Pin Adhesion (kN/m)              | 0.61   | 0.56   | 0.82   |
| Box Compression strength (N)     | 3860   | 3740   | 4300   |
| <u>B. 95% Relative Humidity</u>  |        |        |        |
| Edge Compression strength (kN/m) | 2.7    | 2.3    | 2.9    |
| Box Compression strength(N)      | 1500   | 1740   | 2080   |

It will be seen that the treatment in Case C according to the invention resulted in increase in burst strength, box compression under dry conditions, and a substantial increase in compression strength at high (95%) relative humidity in comparison with prior art wax treated lines.

The improvement of the invention (Case C) over waxed medium (Case B) is as follows:

|                               |         |
|-------------------------------|---------|
| Dry edge compression          | + 12.1% |
| Dry burst                     | + 6.6%  |
| Pin adhesion                  | + 46.6% |
| Dry box compression strength  | + 15.0% |
| Wet edge compression strength | + 26.0% |
| Wet box compression strength  | + 19.5% |

It is believed that other similar starch based adhesives and waterproofing resins may be used without departing from the scope of the invention hereby disclosed.

In other embodiments of the invention the adhesive or could be applied after corrugating but before adhering the liners.

## Claims

1. A process for manufacture of a corrugated board of high wet compression strength characterized by the step of treating the medium with a level of adhesive substantially in excess of that required for adhesion of liners to the medium.

2. A process according to Claim 1 wherein the adhesive is a starch-based adhesive containing a polyphenolic/formaldehyde or a polyresorcinolic/formaldehyde waterproofing resin.

3. A process according to Claim 1 or Claim 2 wherein the adhesive is applied at in excess of

12.5g dry weight of adhesive per square meter per glue line.

4. A claim according to any one of the preceeding claim wherein the adhesive is applied at a solids content of from 20% to 30% by weight.

5

5. A process according to any one of claims 2 to 4 wherein the resin of the adhesive is in the range of from 2% to 15% by weight of the weight of starch (dry basis) of the adhesive.

10

6. A process according to Claim 5 wherein the resin is in the range of from 4% to 10% of the weight of the starch (dry basis) of the adhesive.

7. A process according to any one of the

15

20

25

30

35

40

45

50

55

60

65

4

preceeding claims wherein the adhesive is a starch based adhesive incorporating an acid or oxidized modified starch.

8. A process according to any one of the preceeding claims wherein the water proofing resin is a polyresorcinol compound.

9. A process according to any one of the preceeding claims wherein the adhesive forms a bead line at the junction of the medium and liner adjacent the flute tip.

10. A corrugated board manufactured according to any one of the preceeding claims and having a high compression strength at 95% relative humidity.

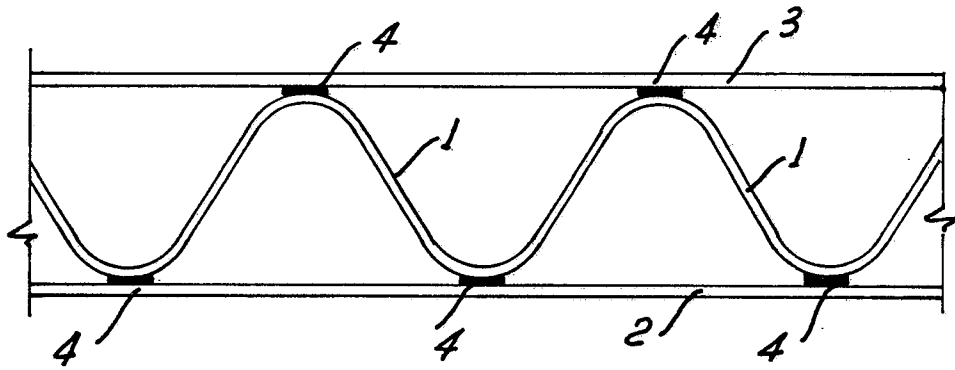


FIG. 1

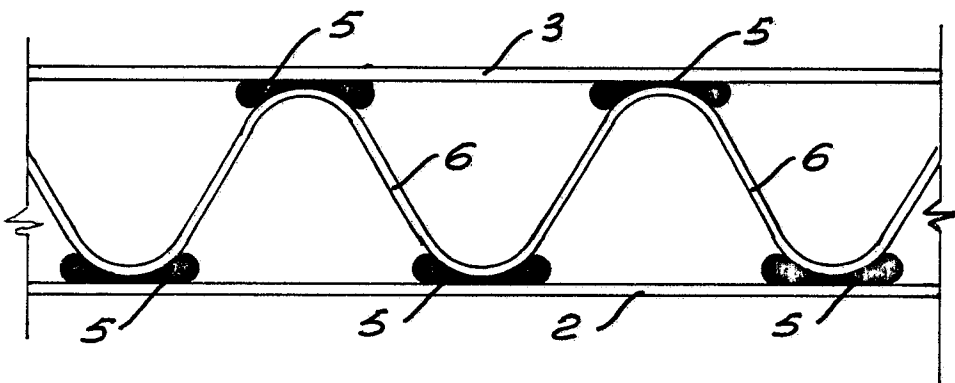


FIG. 2