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(54) **Manufacturing process for the manufacture of thermoformed trays and the trays obtained by said method**

(57) The manufacturing process for trays based on sheets of corrugated cardboard including the steps of manufacturing the corrugated cardboard, where the features of the channel and the moisture at the outlet of the corrugator are controlled and a first surface treatment and a second treatment are performed respectively on the side that will remain on the inside and the outside of the tray, which can be performed in the corrugator or when printing, and the process is followed by printing, which can be flexographic pre-printing, flexo post-printing, offset...; it is then die-cut and thermoformed within certain moisture levels. This procedure allows improving both the manufacture of the trays without compromising their final strength and the properties derived from the surface treatments applied.

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Description

OBJECT OF THE INVENTION

[0001] The object of this invention is a manufacturing process for thermoformed trays made from corrugated cardboard, characterised in that both the obtaining of the corrugated cardboard for its subsequent thermoforming, and the thermoforming process itself respond to a series of specific conditions in order to achieve optimal conditions for configuration.

[0002] This invention is characterised by the special conditions of moisture that the entire manufacturing process is subject to, as well as the control of times and the application of protection layers, which leads to improving the manufacturing process, sine it ensures an easy and simple thermoforming without compromising the structural resistance of the tray obtained.

[0003] Therefore, this invention falls within the scope of corrugated cardboard, and in particular to that of manufacturing processes for products based on sheets of corrugated cardboard that use thermoforming.

BACKGROUND OF THE INVENTION

[0004] Different manufacturing processes are known for the manufacture of trays with corrugated cardboard, such as that described in patent EP 1017354 A1, which describes a series of known steps or actions for in the manufacturing process of a tray obtained from a sheet of corrugated cardboard that is die-cut and subsequently moulded in moulds.

[0005] Although it makes a broad description both for the process and for the product obtained, there are several aspects that are not mentioned in said patents that can be improved, as well as replaced.

[0006] In the process described in said patent it is necessary to use wedges or sheets arranged on the inside of the moulds, which must also have their larger axis parallel to the main axis of the waves of the corrugated layer.

[0007] Moreover, no mention is made of moisture control either for the corrugated cardboard at the outlet of the corrugator or at the inlet of the thermoforming, which are key factors that, without weakening the cardboard structure, allow it to be die-cut and then thermoformed.

[0008] On the other hand, no mention is made either to the protection layers, either anti-moisture or of other kinds, applied both on the inside and on the outside in order to protect the tray obtained.

[0009] It is therefore an object of this invention to overcome the drawbacks described, as well as improving the manufacturing process and qualities of the final product obtained by the process described.

DESCRIPTION OF THE INVENTION

[0010] The object of the invention is a manufacturing process for thermoformed trays made in corrugated cardboard, where both the manufacturing process of the corrugated cardboard and the thermoforming process take place under specific and special conditions of moisture and temperature in order to favour the forming process of the tray, and where the tray obtained has sufficient structural strength as well as protection from external agents, especially moisture, since it would reduce its strength.

[0011] The process starts with the manufacture of the corrugated cardboard, which can be

- Single face. A flexible structure formed by a corrugated element (fluting) glued to a flat element (liner).
- Single wall. A rigid structure formed by a corrugated element (fluting) glued on both sides to flat elements (liners).
- Double wall. A rigid structure formed by three flat elements (liners) glued to two interposed corrugated elements (fluting).
- Triple wall. A rigid structure formed by four flat elements (liners) glued to three interposed corrugated elements (fluting).

[0012] In one possible non-limiting embodiment, the corrugated cardboard is formed by a first sheet or coating, a second corrugated sheet, and a third sheet or coating, the second corrugated sheet being lodged and glued between the first and the third sheets forming the coating.

[0013] The key features when forming the corrugated cardboard that best adapts to the purpose of obtaining trays by thermoforming within an established range of structural strength are the channel features and the moisture of the corrugated sheet at the outlet of the corrugator.

[0014] In one possible embodiment the degree of moisture there must be at the outlet of the corrugator must range between 11.5% and 12.5%. This moisture content is to be used as a guideline, since what is truly critical is the moisture content of the sheet when it is to be thermoformed; It is not important, therefore whether the moisture required for thermoforming is reached in the corrugator, during printing or in the subsequent storage. That is, the sheet could be achieved in normal moisture conditions, 7%-8% relative humidity of coal, and subsequently increased to the 10% moisture required for thermoforming.

[0015] The combination of the final moisture, ambient humidity and the times until input in the thermoforming machine are limiting factors that allow achieving the intended purpose.

[0016] During the manufacturing phase of the corrugated cardboard, at least a surface treatment on one of the sides of the sheet could be applied in the corrugator. In one possible embodiment it could have a first surface treatment, a treatment that is performed on the side of

the corrugated cardboard that will remain inside the tray, that is, in contact with the products it will contain. A second surface treatment may also be applied on the surface of the corrugated cardboard facing outwards.

[0017] The first and second surface treatment to be applied on the outer and inner surfaces of the corrugated cardboard may take place once the cardboard is obtained during printing. That is, the surface treatments of any of the faces can take place in the corrugator or during printing.

[0018] The possible treatments to be applied can be fire-proof, bactericidal, water-repellent, dyes using active thermochromatic inks, anti-moisture treatments or any combination of these. In the event of applying an anti-moisture treatment, this would increase tray resistance to the perspiration of the products to be carried

[0019] The first surface treatment or treatment of the inner part of the tray, if it is an anti-moisture treatment, will allow maintaining tray resistance to the perspiration of the fruit to be carried.

[0020] The second treatment, if it is an anti-moisture treatment, also implies an additional advantage, since it prevents the tray from sticking to the thermoforming moulds.

[0021] In the event of applying both a water-repellent and an anti-moisture treatment, the extraction of steam during the thermoforming process will be facilitated, avoiding the occurrence of bubbles, which is a key factor in order to work at certain temperatures and moisture.

[0022] Having obtained the corrugated cardboard it is then printed on the side of the corrugated cardboard facing outward.

[0023] The printing can be flexographic, flexo preprints, offset printing; printing that can be mass-printing or limited to an area if necessary.

[0024] Flexography is a direct rotating printing method that uses sheets made in resilient rubber substrates or photopolymers. The Sheets are glued to metal cylinders of different lengths that are supplied ink by a roller formed by cells, with or without an inverted dosing blade that has fluid ink that dries quickly on the sheet, in order to print on virtually any absorbent or non-absorbent substrate.

[0025] The sheets of corrugated cardboard are then die-cut using pertinax or the like.

[0026] The following step is the thermoforming, where the die-cut sheet must arrive at the thermoforming step within a certain range of moisture,
ranging from between 9.5% a 10.5%, regardless of where this moisture content is achieved, either in the corrugator, during printing or during the subsequent storage.

[0027] Another important aspect to be controlled in the thermoforming process is the temperature of the moulds, where both moulds are not required to have the same temperature and must exceed 100°C.

[0028] An essential aspect during the entire thermoforming process is moisture, so that the tray obtained can be thermoformed without losing its final strength. To do this it is necessary for the corrugated cardboard to be manufactured with an abnormally high moisture and to manage the logistic time taken from the production of the corrugated cardboard until it reaches the cutting die, and from the cutting die to the thermoforming machine. As well as maintaining the moisture even after having thermoformed the tray.

[0029] In either case, controlling the times would be secondary if the entire manufacturing process took place in a controlled moisture environment.

DESCRIPTION OF THE DRAWINGS

[0030] To complete the description made below and to aid a better understanding of its characteristics, the present descriptive memory is accompanied by a set of drawings, the figures of which represent the most significant details of the invention for purposes of illustration only and in a non-limiting sense.

Figure 1 shows a representation of a die-cut sheet of corrugated cardboard that is ready for thermoforming.

Figure 2 shows a perspective view of a tray that has been obtained.

PREFERRED EMBODIMENT OF THE INVENTION

[0031] The object of the invention is a manufacturing process for thermoformed trays in corrugated cardboard, where both the manufacturing process for the corrugated cardboard and the thermoforming process take place under specific conditions of moisture and temperature in order to favour the tray forming operations.

[0032] The process starts with the manufacture of the corrugated cardboard, which is preferably but not limited to being formed by a first sheet or coating, a second corrugated sheet and a third sheet or coating, the second corrugated sheet being housed and glued between the first and third coating sheets.

[0033] The key features when forming the corrugated cardboard that best adapts to the purpose of obtaining trays by thermoforming within an established range of structural strength are the channel features and the moisture of the corrugated sheet at the outlet of the corrugator.

[0034] Regarding the geometric features of the channel, it is defined by the height of the wave and the step or distance between two consecutive valleys or crowns. Therefore, in one possible embodiment the preferred channels are channels of the E, F or N type, ore even the equivalent of a B wave, wherein:

- the E type channels have a wave height of 1.1 to 1.4 mm, a step of 3 to 4.2 mm and a number of waves per metre of 333 to 238.
- The F type channels have a wave height of about 0.75 mm, a step of 2.4 to 2.7 mm, and a number of waves per metre of 555.

- The N type channels have a wave height of 0.42 mm, a step of 1.8 mm, and a number of waves per metre of 555.

[0035] The moisture it must have at the outlet of the corrugator must range between 11.5% to 12.5%. This moisture content is to be used as a guideline, since what is truly critical is the moisture content of the sheet when it is to be thermoformed; It is not important, therefore whether the moisture required for thermoforming is reached in the corrugator, during printing or in the subsequent storage.

[0036] The combination of the final moisture, ambient humidity and the times until input in the thermoforming machine and the ambient moisture after thermoforming are limiting factors that allow achieving the intended purpose.

[0037] The sheet will have a surface treatment applied on at least one of its sides. The application of the surface treatments, both the first treatment on the side of the sheet that remains inside tray and the second treatment, if there is one, on the outer side of the tray, can be performed indistinctly in the corrugator machine during the manufacture of the corrugated cardboard, or once manufactured. Any combination is possible for applying the surface treatments in the corrugator or afterwards. The treatments do not have to be applied in mass, and they can be limited to a certain area if necessary.

[0038] The two types of surface treatment for any of the sides, the inner or the outer side of the tray, may be any of the following or combinations thereof; fire-proof, bactericidal, water-repellent, dyes, with thermochromatic active inks, anti-moisture treatments, etc.

[0039] In the event of applying both a water-repellent and an anti-moisture treatment, the extraction of steam during the thermoforming process will be facilitated, avoiding the occurrence of bubbles, which is a key factor in order to work at certain temperatures and moisture.

[0040] Having obtained the corrugated cardboard it is then printed on the side of the corrugated cardboard facing outward. The surface treatments, as indicated above, are applied either in the corrugator or during printing. The printing can be a flexographic post-printing, a flexo preprint, offset printing, etc.

[0041] The sheets of corrugated cardboard are then die-cut using pertinax or arrangement sheets in order to facilitate slitting on the four corners of the tray, necessary to facilitate the subsequent thermoforming and to improve the final appearance of the tray.

[0042] The next step is the thermoforming, wherein the die-cut sheet has to reach the thermoforming step within an interval of moisture, which in a possible embodiment could be in a range of 9.5% to 10.5%.

[0043] The range of moisture necessary at the outlet of the corrugator and the inlet of the thermoforming are indicative and should never be understood in a limiting sense.

[0044] Another important aspect to be controlled in the thermoforming process is the temperature of the moulds.

[0045] An essential aspect during the entire thermoforming process is moisture, so that the tray obtained can be thermoformed without losing its final strength. To do this it is necessary for the corrugated cardboard to be manufactured with an abnormally high moisture and to manage the logistic time taken from the production of the corrugated cardboard until it reaches the cutting die, and from the cutting die to the thermoforming machine.

[0046] Management of the times between one step and the next will depend on the moisture / dryness of the environment, and the loss of moisture will not be the same in some seasons as in others. Therefore, the time elapsing from the corrugator to the die-cutting machine must be be between 10 hours to one day, whereas the time elapsing between the die-cutting and the thermoforming must be between one hour and three hours. Whereas storage times can be very variable and longer than one day.

[0047] In either case, controlling the times would be secondary if the entire manufacturing process took place in a controlled moisture environment.

[0048] Regarding the trays obtained by the procedure described, Figure 1 shows a die-cut sheet of corrugated cardboard (1) on which the surface treatments have already been applied, both on the inner side and on the outer side. Of the different treatments that can be applied the most usual are anti-moisture treatments.

[0049] On this sheet, as well as the die-cutting there is a series of slits (2) and (3) performed on each of its four corners, and as can be seen some slit lines (2) are shorter than others (3) in order to ensure the forming of the corners.

[0050] The figure shows a rectangular tray, but its shape is not limited to any specific shape or geometry. The specific shape of the tray is not object of the invention.

[0051] The distribution of the slit lines (2) and (3) on the corners exceeds the arch defined by the outer edge of the die-cut sheets (1).

[0052] Figure 2 shows the thermoformed tray, showing a base or bottom (4), a perimetral area (5) arranged on an inclined plane with respect to the base plane and separated from the base plane (4) by a transition area (7).

[0053] The tray shows on its corners the overlap of the material of the die-cut sheet (1), an overlap that is favoured by the slits (2) and (3) performed before the thermoforming.

[0054] Finally, the upper edge (8) of the perimetral area (5) can be sealed in order to prevent the moisture from entering the sheet of cardboard.

[0055] The shape of the tray represented in Figure 2 is rectangular, but it can adopt any other shape designed, without the principles object of the invention being affected.

[0056] Finally, we shall indicate that the fibres used to manufacture the sheet of corrugated cardboard, in one possible embodiment are recycled fibres.

[0057] The essence of this invention is not affected by variations in the materials, shape, size and arrangement of its component elements, described in a non-limiting manner that will allow its reproduction by an expert.

Claims

1. A manufacturing process for trays manufactured from sheets of corrugated cardboard having at least one corrugated sheet, **characterised in that** it includes the following steps:

   - manufacture of the corrugated cardboard, controlling the moisture of the sheet of cardboard at the outlet of the corrugator,
   - applying a surface treatment on at least one of the sides of the corrugated cardboard.
   - printing, which shall be performed on the outward-facing side of the corrugated cardboard,
   - the sheets of corrugated cardboard are then dye-cut using pertinax or the like
   - thermoforming, wherein the die-cut sheet has a moisture within a certain range, and the moulds have a certain temperature.

2. A manufacturing process for trays according to claim 2, **characterised in that** the surface treatment on at least one of the sides includes a first surface treatment performed on the side of the corrugated cardboard that will remain inside the tray, as well as a second surface treatment on the side facing outwards.

3. A manufacturing process for trays according to claim 1, **characterised in that** the sheet of corrugated cardboard used is a simple cardboard with a single sheet of cardboard or a double cardboard with two sheets of corrugated cardboard or a triple cardboard with three sheets of corrugated cardboard, all of which are coated and separated from one another by planar sheets

4. A manufacturing process for trays according to claim 1, **characterised in that** the first surface treatment, the treatment performed on the side of the corrugated cardboard that will remain inside the tray, is performed in the corrugator or when printing.

5. A manufacturing process for trays according to claim 1, **characterised in that** the second surface treatment, the treatment performed on the side of the corrugated cardboard that will remain on the outside of the tray, is performed in the corrugator or when printing.

6. A manufacturing process for trays according to claim 5 or 6, **characterised in that** the first surface treatment or the second surface treatment is one or a combination of some of the following: a fire-proof, bactericidal, water-repellent, treatment with active thermochromatic inks, or anti-moisture treatment.

7. A manufacturing process for trays according to claim 5 or 6, **characterised in that** the application of the surface treatments can be in mass or limited to a specific area.

8. A manufacturing process for trays according to claim 3, **characterised in that** the preferred channels are channels of the E type, F type or N type or even the equivalent of a B wave, wherein:

   - the E type channels have a wave height of 1.1 to 1.4 mm, a step of 3 to 4.2 mm and a number of waves per metre of 333 to 238.
   - The F type channels have a wave height of about 0.75 mm, a step of 2.4 to 2.7 mm, and a number of waves per metre of 555.
   - The N type channels have a wave height of 0.42 mm, a step of 1.8 mm, and a number of waves per metre of 555.

9. A manufacturing process for trays according to claim 1, **characterised in that** the moisture there must be at the outlet of the corrugator must range from 11.5% to 12.5%.

10. A manufacturing process for trays according to claim 1, **characterised in that** the inlet moisture for thermoforming must be comprised between 9.5% and 10.5%.

11. A manufacturing process for trays according to claim 1, **characterised in that** the entire manufacturing process takes place in an environment with controlled moisture.

12. A manufacturing process for trays according to claim 1, **characterised in that** the printing is a flexographic pre-print, flexo post-print, etc.

13. A manufacturing process for trays according to claim 1, **characterised in that** the time elapsing from the corrugator to the die-cutting must be from 10 hours to one day, whereas the time elapsing from the die-cutting and the thermoforming must last from one hour to three hours.

14. A thermoformed tray obtained by the previously claimed procedure, **characterised in that** it has a base or bottom (4), a perimetral area (5) arranged in a plane that is inclined with respect to the base plane and that is separated from the base plane (4) by a transition area (7), having on its corners (6) overlapping cardboard thanks to slits (2) and (3).

15. A thermoformed tray according to claim 12, **characterised in that** the upper edge (8) of the perimetral area (5) is sealed in order to prevent moisture from entering the sheet of cardboard.

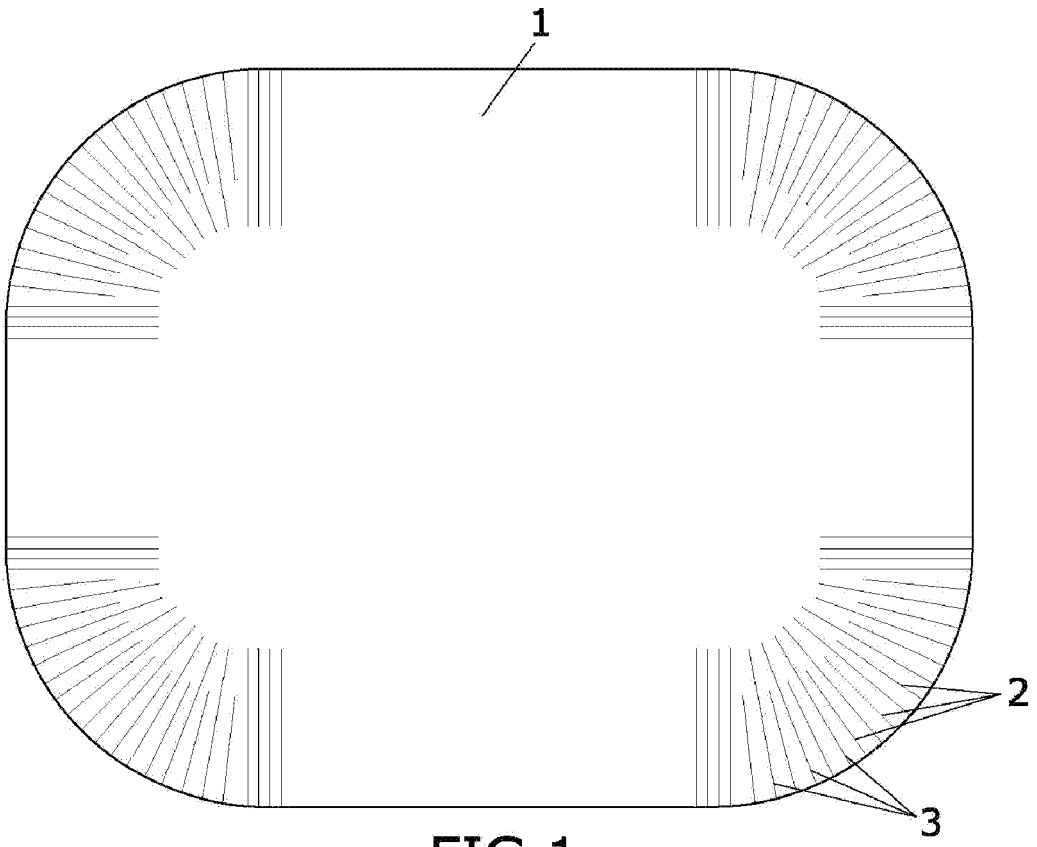

FIG.1

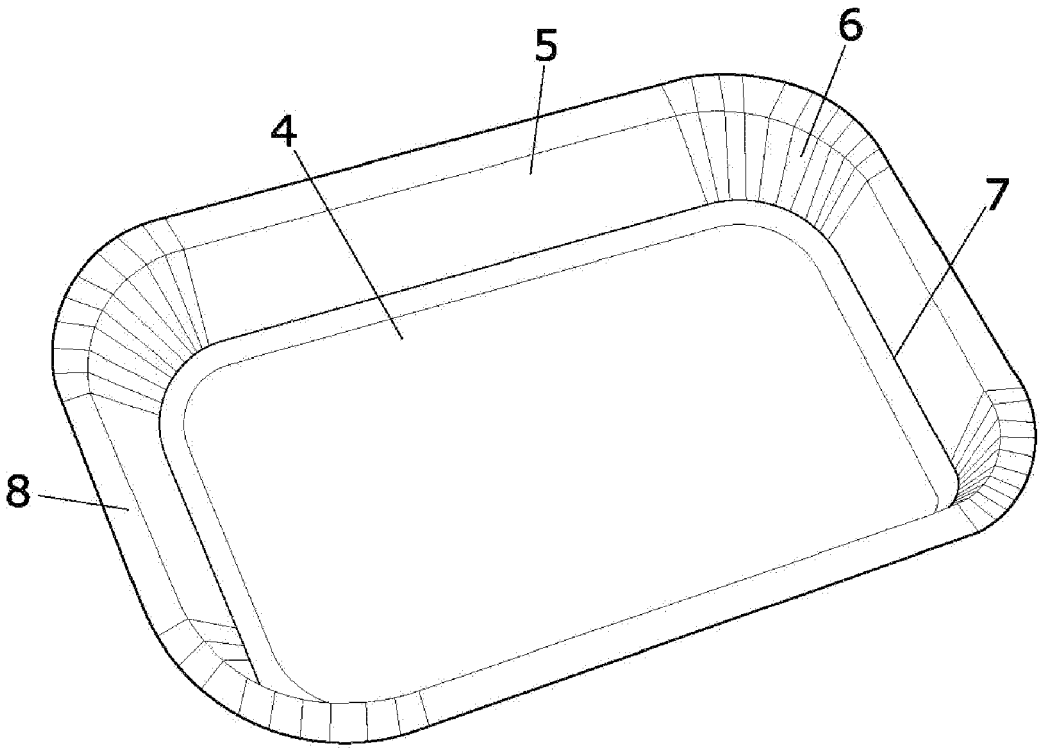

FIG.2

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EUROPEAN SEARCH REPORT

Application Number
EP 10 38 2130

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	5 May 2011	Bevilacqua, Vincenzo

CATEGORY OF CITED DOCUMENTS

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