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SOFTWARE PROPOSAL FOR CUTTING CORRUGATED BOXES

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Abstract: the papers present a short history of corrugated cardboard and propose an software (made in Visual Basic media) to determine a loss of material through a cutting operation. The software allows viewing a disposal of results pieces on an initial carton plate.

1. INTRODUCTION

a. Some historical date of paper / boxes fabrication:

-A timeline of paper invention is the year 3000 BC.

-The first recorded historical reference to grocery paper bags was made in 1630. The use of sacks only really started to take off during the Industrial Revolution: between 1700 and 1800. Margaret (Mattie) Knight (1838-1914) - Knight was an employee in a paper bag factory when she invented a new machine part to make square bottoms for paper bags. Paper bags had been more like envelopes before. Knight can be considered the mother of the grocery bag; she founded the Eastern Paper Bag Company in 1870.

-1872, Luther Crowell also patented a machine that manufactured paper bags.

-The first commercial cardboard box was produced in England in 1817, more than two hundred years after the Chinese invented cardboard. Corrugated paper appeared in the 1850s; about 1900, shipping cartons of faced corrugated paperboard began to replace self-made wooden crates and boxes used for trade.

-The cardboard box emerged at the end of the 19th century, a simple yet revolutionary invention. An American, Robert Gair, had the bright idea of manufacturing in bulk a pre-cut cardboard panel which, once folded, would form a box in 1890.

-In 1856, Englishmen, Healey and Allen, received a patent for the first corrugated or pleated paper. The paper was used to line tall men's hats. However, this was not the corrugated cardboard (figure 1), we know today. On 1871, Albert Jones of New York patented a stronger corrugated paper (cardboard) used as a shipping material. This was the first cardboard and stronger than paperboard.

b. Containerboard or Corrugated Containers

The first use of corrugated paper for packaging came in 1871, when Albert Jones, introduced an idea of wrapping bottles and glass chimneys in it. However, it was the addition of a liner to one and then to the other side of corrugated paper that signaled the birth of cardboard as we know it. In 1874, G. Smyth built the first single sided corrugated board machine.

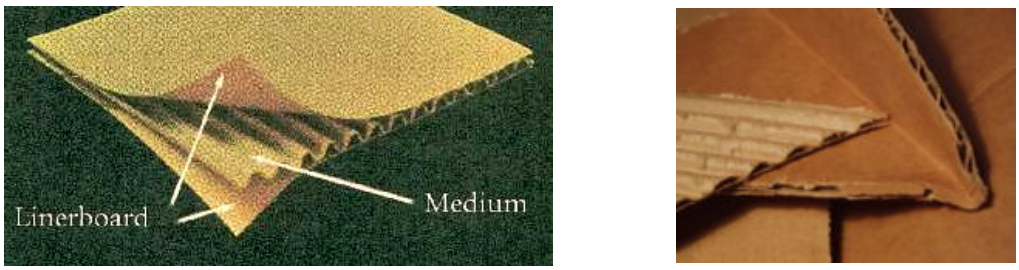


***Fig.1 Corrugated Fiberboard*.**

Also in 1874, Oliver Long improved upon the Jones patent and invented a lined corrugated material and this was modern cardboard as we know it today [1]

In the mid -19th century, an ingenious concept enabled flimsy sheets of paper to be transformed into a rigid, stackable and cushioning form of packaging for delicate goods in transit.

Corrugated (also called pleated) paper was patented in England in 1856, and used as a liner for tall hats, but corrugated boxboard would not be patented and used as a shipping material until 1871. The patent was issued to Albert Jones of New York for single-sided (single-face) corrugated board. The first machine for producing large quantities of corrugated board was built in 1874 by G. Smyth, and in the same year Oliver Long improved upon Jones' design by inventing corrugated board with liner sheets on both sides.

The Scottish - born Robert Gair invented the corrugated box in 1842, consisting of pre-cut flat pieces manufactured in bulk that folded into boxes. Gair's invention, as with so many other great innovations, came about as a result of an accident: he was a Brooklyn printer and paper-bag maker during the 1870s, and while he was printing, an order of seed bags a metal ruler normally used to crease bags shifted in position and cut the bag. Gair discovered that by cutting and creasing board in one operation he could make prefabricated cartons. Extending this to corrugated boxboard was a straightforward development when the material became available. By the start of the 20th century, corrugated boxes began replacing the custom-made wooden crates and boxes previously used for trade.

Corrugated fiberboard is a paper-based construction material consisting of a fluted corrugated sheet (medium) and one or two flat linerboards. It is widely used in the manufacture of corrugated boxes and shipping containers. When only one facing is glued to a medium the resulting product is called single face board. Corrugated board can be imparted with various characteristics. This is achieved through varying the type and thickness of paper used in making the board (figure 1).

The corrugated medium and linerboard are made of paperboard, a paper-like material usually over 0.25 mm thick. Paperboard and corrugated fiberboard are sometimes called *cardboard* by non-specialists; although cardboard might be any heavy paper-pulp based board.

c. Manufacture of Corrugated Board

Corrugated board is manufactured on large high-precision machinery lines called Corrugators.

The corrugated medium is usually 127 g/m^2 paperboard; higher grades are also available. It arrives to the corrugator's on large rolls. At the single-facer, it is heated, moistened, and formed into a fluted pattern on geared wheels. This is joined to a flat linerboard with a starch based adhesive to form single face board. At the double-backer, a second flat linerboard is adhered to the other side of the fluted medium to form single wall corrugated board. Linerboards are often kraft paperboard (of various grades) but may be bleached white, mottled white, colored, or preprinted.

Flutes come in five basic heights and shapes - the most common are sizes are "A", "B", "C", "E" and "F" or microflute (figure 2). A-flute was the first to be developed and is the largest common flute profile. B-flute was next and is much smaller. C-flute followed and is between A and B in size. E-flute is smaller than B and F-flute is smaller yet.

The letter designation relates to the order that the flutes were invented, not the relative sizes. Flute size refers to the number of flutes per lineal foot. For example, "B" flute is approximately 1/4 inch from the top of one flute to the next (or 50 flutes per foot

(12in)). "C" Flute is 5/16 inch from flute to flute (or 42 flutes per lineal foot (12in)). "E" flute is 1/8 inch flute to flute (or 90 flutes per lineal foot (12in)). Board thickness is an unreliable metric, due to various manufacturing conditions. However, a rough guide is: "C" flute=5/32 inch thick, "B" flute=1/8 inch thick, "E" flute=1/16 inch thick. The most common flute size in corrugated boxes is "C" flute."

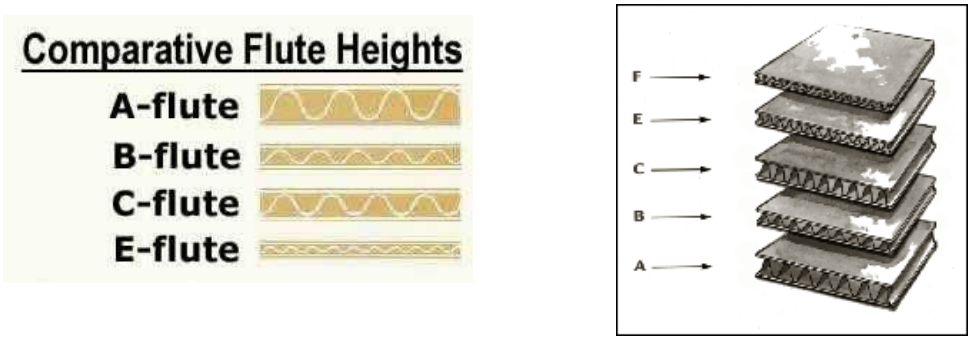


Fig. 2 The basic type of flutes

Corrugated board is often graded by the basis weights of the linerboards, burst or mullen strength, edge crush test, or flat crush test. TAPPI and ASTM test methods for these are standardized.

The choice of corrugated medium, flute size, combining adhesive, and linerboards can be varied to engineer a corrugated board with specific properties to match a wide variety of potential uses. Double and triple-wall corrugated board is also produced for high stacking strength and puncture resistance.

The strength of a corrugated box starts with its material. A corrugated sheet consists of two major components - linerboard and medium. Linerboard is the flat paper that covers both sides of the sheet and the medium is the "fluted" or arched paper found between both liners. The flute, when anchored to the linerboards with a starched-based adhesive, resists bending and pressure from all directions. When placed vertically on its ends, the flutes form vertical columns, capable of supporting considerable amounts of weight.

d. Box Manufacture

The obtaining stages for the boxes are presented in figure 3.

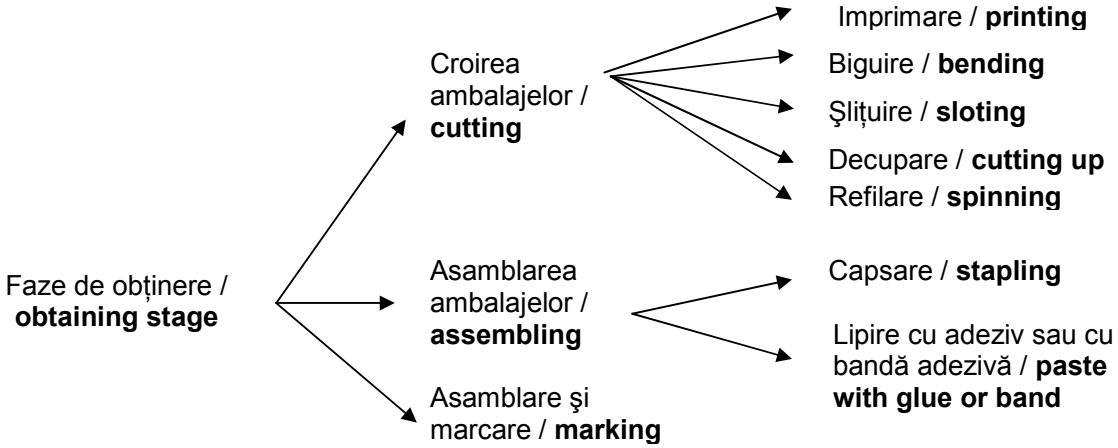


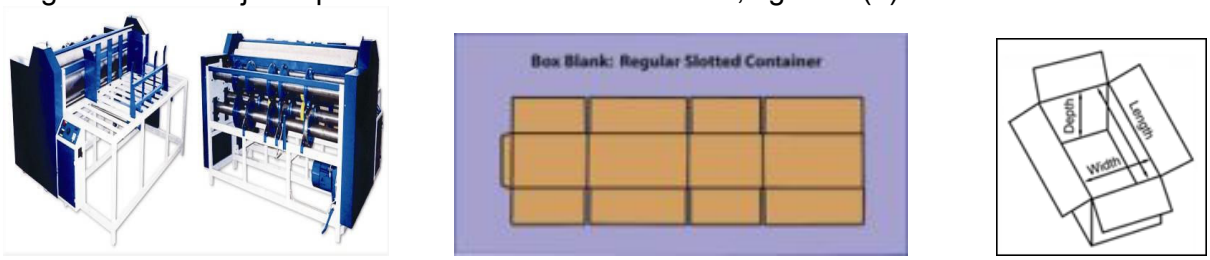
Fig.3 Obtaining stage for the most common box style

This stage can made on different devices or on slitter, figure 4 –a.

Box sizes are measured by using inner dimensions unless otherwise specified. The size of your contents actually determines the inner box dimensions. Usual, in USA, those dimensions are listed in the following sequence: Length (L) x Width (W) x Depth (D). Internationally, the dimensions are stated as Length (L) x Breadth (B) x Height (H).

The corrugated board is creased or scored to provide controlled bending of the board. Most often, slots are cut to provide flaps on the box. Scoring and slotting can also be accomplished by die-cutting.

The most common box style is the Regular Slotted Container. All flaps are the same length and the major flaps meet in the center of the box, figure 4 (b).



a ***b***

Fig. 4 The most common box style (a – slitter, b – box style)

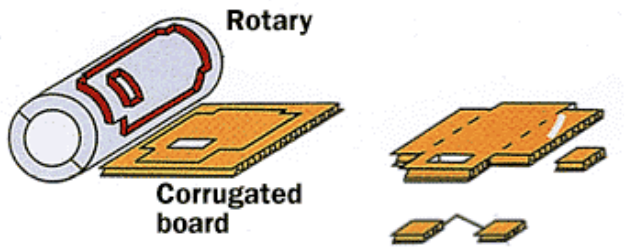


Fig.5 Rotary Die-cutting

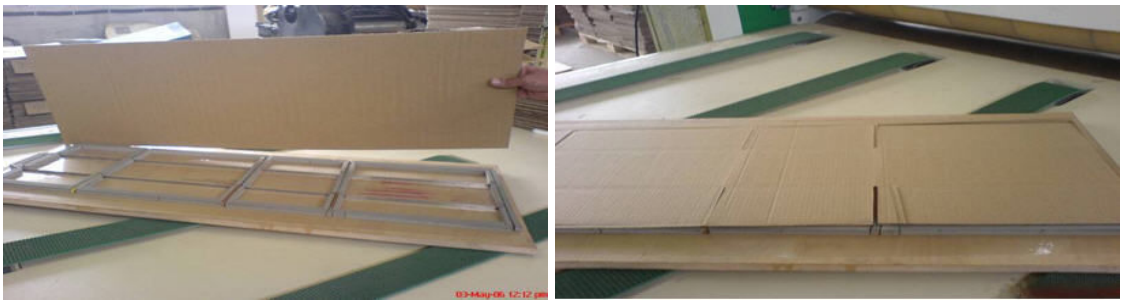


Fig. 6 Flatbed die cutter

The die-cut containers are manufactured on a die-cutter that cuts and creases the board. It is usually reserved for a more sophisticated pack style.

This process requires a « form » that can be mounted around a cylinder, in which case the machine is called a rotary die-cutter (figure 5), the other variant is called a flatbed die-cutter. As indicated by its name its form is flat.

Once the converting process is over, the corrugated packaging is put on a pallet and can be delivered to the customer. [3]

In figure, 6 are shown a flatbed die cutter.

2. Proposal Software [2]

Proposal software was created in Visual Basic media. The main reason for what it was made is to reduce a material (carton) loss. These losses are determinate by cutter positioning.

The start window (figure 7) allows introducing a carton dimension ("Dimensiuni placa"), the representation scale ("Scara") and a cutters dimension ("Stanta 1"…). Each punch / cutter is represented by different color (same with a background color of text box). In figure 8 is shown an example. By pushing a command button "Executa", are calculated a number of pieces result for each punches and a surface what is occupied (figure 9).

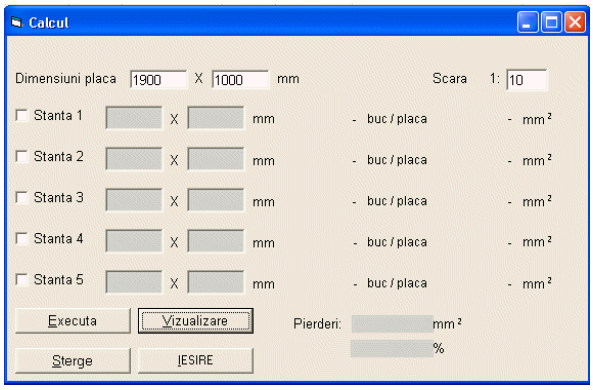


Fig. 7 Start window

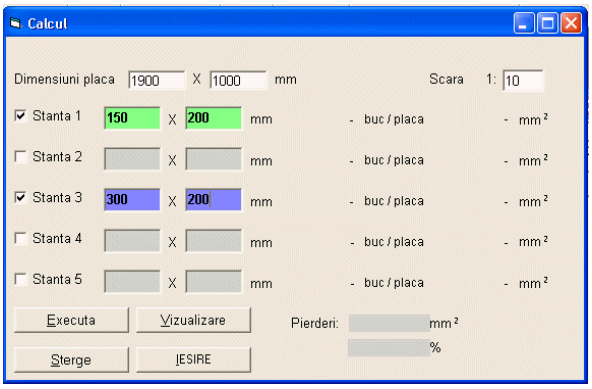


Fig. 8 Example on running software

Also, in figure 9 is shown a loss of material – "pierderi", like an mm^2 and percentages. The user has a possibility to view an arrangement of pieces, by pushing a command button: "Vizualizare", figure 10.

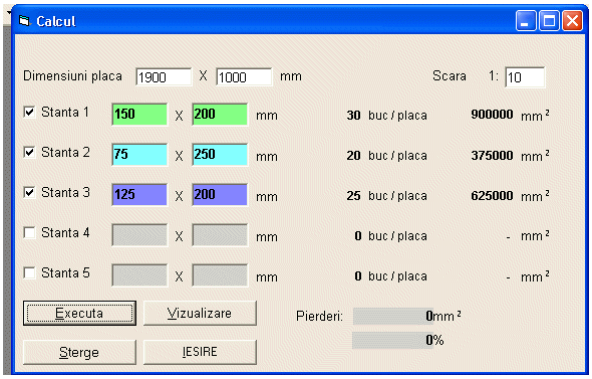


Fig. 9 Example on running software

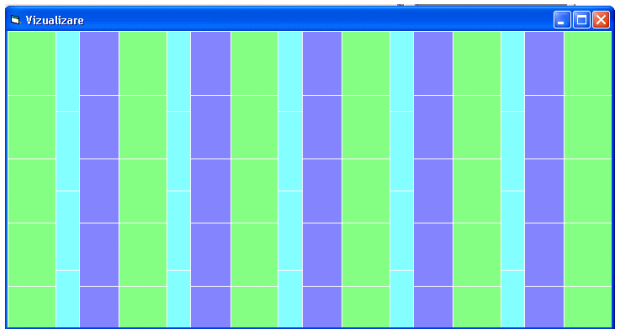


Fig. 10 Disposal of cutters on carton plate

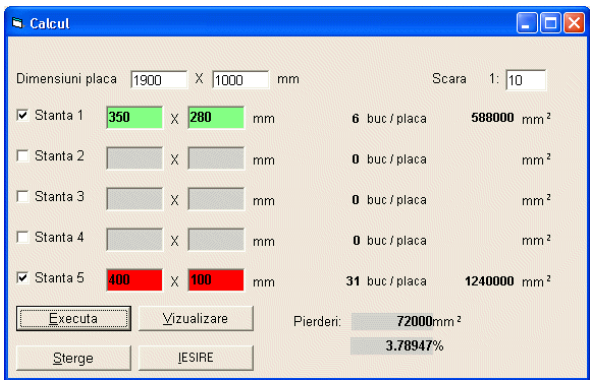


Fig. 11 Example on running software

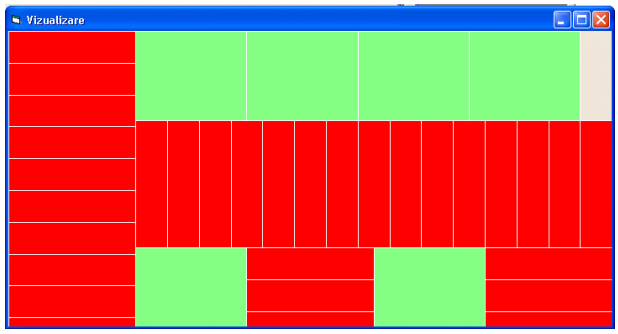


Fig. 12 Disposal of cutters on carton plate

The software allows selecting different punches, not in order. This is shown in figure 11, where are selected punches 1 and 5. For it, are calculated a surface and also a loss of carton. The new representation of arrangement is viewed in figure 12. It can also view a lost surface.

3. Conclusion

A paper is a brief presentation of manufacture stage for corrugated boxes. Proposed software allows calculating very quickly a carton loss on cutting stage and provides a possibility to visualize a disposal of carton pieces.

The software can be developing according with request or beneficiary's machinery.

4. References

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