

**INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH
TECHNOLOGY****STUDY OF CORRUGATION PROCESS FOR OPTIMUM UTILIZATION OF FIBRE
BOARD****Arohit Goyat^{*1}, Nishan Singh² & Vinay Arya³**^{*1}Assistant Professor, Department of Printing Technology, GJUS&T, Hisar (Haryana)²Assistant Professor, Department of Printing Technology, SITM, Rewari (Haryana)³M. Tech. (Print & Graphics Communication), SITM, Rewari (Haryana)

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ABSTRACT

Corrugated Paper boxes are extensively used in the packaging of industrial as well as consumer goods. In some of products like crockery, electronic items, automobile components, glass and cigarettes, pharmaceuticals, soaps & cosmetics, biscuits, hosiery, toys, rubber & rubber products, refrigerator, cooler & fans, proper type of packaging becomes very important. Corrugated box is a container most extensively applied in goods packaging and transporting. It is made from paper, and machine-shaped from corrugated box board with hollow structure. Since 1903 when corrugated box was first accepted by legal freight classification organizations as the containers for freight transportation, the application history of corrugated box has been over more than 100 years. Because of its light weight, low cost, ease of assembly and disassembly, good sealing performance, certain cushioning and anti-vibration ability and easy recovery and waste treatment, corrugated box is widely applied in various fields.

I. INTRODUCTION

In the dynamic competitive market the needs and expectations are always changing. It is very difficult to maintain and execute actions against other organizations. The process of an industry such as corrugated boxes production has to focus on ways to make more efficient processes in order to deliver high quality product while at the same time reducing costs. The organizational perspective is examined by focus on “who” performs the different tasks and how operators are related. Process manufacturing aims at extracting process knowledge from event logs, which may originate from all kinds of information systems. The event logs contain information about the start and completion of activities with reference to related context data (e.g. workers and resources). Process manufacturing is a very broad area both in terms of applications and techniques. The process mining methodology is also called as workflow mining methodology. This is been developed for filtering a structured process description from a set of real executions. This research paper provides an insight about corrugated boxes manufacturing industry, since not much work is done in this regard. Current research paper focuses on the applicability of process mining in the corrugated boxes manufacturing unit.

II. MARKET POTENTIAL

With the steady rise in the industrial production, the demand for corrugated paper boxes increasing every year. These boxes have got distinct advantages such as light in weight, easy to fabricate as per required specifications. The corrugated papers and boards may also find market in the rural areas for packing of fruits, vegetables & eggs.

III. CORRUGATED BOXES MANUFACTURING PROCESS

Overwhelming demand of the customer forces the manufacturer to manufacture very strong corrugated boxes in order to stand out in the competitive world. The boxes are made up of corrugated paperboard that is different from the rigid paper called as cardboard. The boxes are used to hold things to protect it from damaging and keeping it from leaking. Boxes are printed with important information on them about what is inside or how to carry or move them. It is carefully designed to insert, hold items in place so they won't spill or be damaged. Steps in Box Building Corrugating machine is designed to do continuous process which brings together three, five or seven sheets of paper to form single, double or triple wall corrugated board. Strong boxes can be made from different layers like 3 layers or 5 layers of flutes. The first work is to mix dry corn starch with water and

other chemicals and push it into the corrugators to spread on the corrugated medium as the layers of liner are added. A box can be made by the corrugated board on a sequence of connected machines called a corrugating line.

1. Corrugation

The corrugators are fed with reels of paper as shown in figure. The paper is hardened with heat and steam which is passed between corrugating rolls. This process gives the paper a flute shape (wavy layer) in the single facer. The roll of paper is pulled between a pair of gear like cylinders called corrugating rolls as shown in figure. This forms the paper into a series of particular waves. Glue is applied to the tips of the flutes on one side at the right places and the flute tips are pressed against a flat liner. This creates a corrugated board, i.e., a continuous sheet of flat paper with fluted paper glued to it. The corrugated board is so stiff that it cannot be rolled up; this is cut into flat sheets as per the required size to make the boxes which has been ordered. The corrugated board are then arranged and set aside so the glue can dry properly and after that it is sent to the next process.

2. Printing

A printing machine is used to print with bright color ink. Use graphic designs for self-supporting display feature like company name, logo, product information, etc.

3. Die-Cutting

Die cutting is used to cut or punch out the size and shape of corrugated paper desired

4. Stitching

Stitching is used to connect the lap and the end of the sheet of a corrugated container with a metal wire.

5. Gluing

Gluing is like stitching but resin adhesive is used instead of metal wire. Finally the packed or bundled boxes are ready for dispatch.

IV. CORRUGATED BOARD

Corrugated fiber board consists of a flat layer of paper sheet (liner) glued on one or both sides of a corrugated paper (medium). The corrugated board is made by passing two layers of paper (usually kraft) through corrugating machine. One layer of paper becomes corrugated after being passed through the heated rolls and other is brought into contact with it after the former having glued at tips. The corrugating 'medium' is generally made from a 0.009" thick (9 caliper) or 0.23 mm. The glue frequently used is starch or silicate of soda adhesive. When only one liner is used, the product is known as "Single face" or "two ply" board. This board is flexible in one direction. When the corrugated medium is combined on both sides with flat sheets, it is known as double faced or "3-ply board".

V. THE STUDY IS FOCUSED ON THE DISCOVERY PART OF PROCESS MANUFACTURING

Simple Random Sampling Methodology: In a simple random sample ('SRS') of a given size, all such subsets of the frame are given an equal probability. Each element of the frame thus has an equal probability of selection: the frame is not subdivided or partitioned. Moreover, any given pair of elements has the same chance of selection as any other such pair (and similarly for triples, and so on). This minimizes the biased chance of sampling error and simplifies analysis of results. More than 95% surety is achieved in this method.

Systematic Sampling: In this method, the first object of a sample is taken randomly and then a systematic pattern is followed to draw a sample from the lot. Though a bias is created but as the first object is random, it can serve the purpose.

Stratified Sampling: Where the lot embraces a number of distinct categories, the frame can be organized by these categories into separate "strata." Each stratum is then sampled as an independent sub-lot; out of which individual sample can be randomly selected. There are several potential benefits to stratified sampling. A stratified sampling approach is most effective when three conditions are met

- Variability within strata are minimized
- Variability between strata are maximized
- The variables upon which the population is stratified are strongly correlated with the desired dependent variable



VI. ADVANTAGES OF CORRUGATED FIBRE BOARD BOXES

Corrugated fiberboard boxes have replaced the wooden and tin containers due to their several advantages for safe transportation of the goods. These are discussed here under :

- 1) Light in weight (freight advantage)
- 2) Cellular structure with high compressive strength, resiliency & shock resistance. Assured safety to delicate articles.
- 3) Can be stored conveniently in folded condition when not in use, thus saving storage space.
- 4) Can be attractively printed, thus advertising advantage.
- 5) By lining, lamination or coating, they can be made water resistant and resistant to other adverse conditions.
- 6) Easy to fabricate.
- 7) Contents packed in these boxes remain dust free.
- 8) Available throughout the year
- 9) Expedites production due to one line conveyor packing.
- 10) Re-usable
- 11) No strapping necessary
- 12) Desired in export market
- 13) Eliminated dependency on natural wood.

VII. APPLICATIONS

Corrugated fiber board boxes are being used for the packing of industrial as well as consumer goods. They are used for packing of chemicals, drugs, tobacco, engineering goods, canned and bottled goods, food, electrical appliances, confectionary, textiles, fruits, vegetables, potteries, footwear, glassware's and other fragile items, medical instruments, photographic equipments and a number of other products.

VIII. OPTIMIZATION OF OVERALL DESIGN OF CORRUGATED BOX

Design optimization refers to the optimization made by designers according to the theory of meeting specific properties, so that different configuration complying with new standards will be obtained.

1. **Forming process:** The forming process of corrugated boxes has significant impact on the quality of corrugated box. Groove, slotting, printing, and gluing all need to be optimized in actual operation. First, the strength of corrugated box is associated with the width and depth of press mark line of cardboard. Excessive width and depth of press mark will lead to the rupture of inner paper; while insufficient width and depth lead to the non-fold ability of the corrugated box.

Therefore, investigation has to be made into the groove process of corrugated cardboard, so as to determine the optimal operational parameters. Second, the printing process is another factor affecting the load bearing strength of corrugated box. Research shows that with the increase of printing pressure, the contraction and deformation will occur to corrugated cardboard; its compressive strength declines until the crush of the corrugated box. It is thus necessary to adopt the smallest printing pressure possible while ensuring good printing appearance. Third, the slotting and gluing process optimization also need exploration, since the compressive strength of corrugated box dramatically decreases with the deepening of the slotting; inadequate dosage of adhesive leads to the weak cohesion.

As a result, adhesive failure is very likely to happen under pressure, leading to crushing and the decline of compressive strength. On the other hand, excessive dosage will bring about glue overflow, which affects the appearance of the products; or, it will result in cohesion between corrugated boxes, with a waste of production cost.

2. **Optimization of size and proportion:** To ensure moderate packaging, the arrangement number and arrangement orientation of the packaged commodities, as well as the internal and external size of the corrugated box can be optimized during the transportation. In actual practice, various kinds of cushioning pads are placed inside the corrugated box to prevent the packaged commodity from being damaged. By this means, the volume of commodity after packaging is usually larger than that of the commodity itself, sometimes by 5-10 times. In this case, prodigious waste is incurred with a several-fold increase in consumption quantity of corrugated cardboard. Therefore, much can be done in reducing the size of corrugated box in accordance with the reducing principle of corrugated box.
3. **Palletized corrugated packaging:** The use of pallets in logistics has already reached maturity, including wooden pallets, plastic pallets, and metal pallets. The application of pallets makes the handling, loading and unloading, stacking and classification much more convenient. Over the recent

years, the emergence of paper pallet has facilitated the seamless linkage of logistics packaging and retail packaging.

The use of corrugated pallets, by protecting the bottom and facades of the commodity, makes the packaged commodities easier to be stacked. The remaining part is wrapped by plastic thin films or other packing methods. By this means, the consumption quantity of corrugated cardboard can be reduced by 60% or more. With its visibility and air permeability, pallets are extensively applied in the integrated packaging of carbonated soft drinks, mineral water, beer and other kinds of soft drinks.

IX. RESEARCH OBJECTIVE

The main objective of this research is study of corrugation process for optimum utilization of board in “**B.K Print & Pack**” Haridwar. The packaging industry and their customers seek to reduce costs and environmental impact of packaging. A general trend for packaging is that the amount of material is being reduced. The dominating material for transport packaging is corrugated board of various qualities and grammages. Therefore, if optimum utilization of corrugated board is done for corrugation process then overall cost will be reduced and quality will also be improved. The present study objective is thus, focused on the optimization of corrugation process for optimum utilization of board in “**B.K Print & Pack**” Haridwar.

X. RESEARCH METHODOLOGY

The whole study focuses on study of corrugation process for optimum utilization of board by using different techniques. The following methodology will be adopted during the study:

1. Study of corrugation process in a printing press. Record readings like print reading, total wastage in terms of money and power and paper wastage.
2. Some jobs of the “**B.K Print & Pack**” Haridwar. During project work will be selected in which Paper & Board wastage is more & the readings will be recorded on each selected job.
3. Generate checklist during project work and then reading will be recorded so as to optimize the utilization of board.
4. Data Related to optimum utilization of corrugated board Will be Collected during the study.

XI. FUTURE & SCOPE

This research focuses on optimum utilization of board & waste reduction in corrugation printing in “**B.K Print & Pack**” Haridwar. The suggestions made during the study will be incorporated in a checklist which will be in the form of table to check the different factors related to optimum utilization of board & waste reduction before all jobs to be handled on particular machine on daily printing. Various points in this check List will help to reduce the wastage of paper & board and hence will improve the quality of corrugation process. The study may be concluded in a manner that if all suggestions were implemented for optimum utilization of board & waste reduction then a positive result will achieved and quality of corrugation process will be improved. The present study will be focused on the optimization of Corrugation Process for Optimum Utilization of Board.

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