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ASSEMBLY AND PACKAGING IN CORRUGATED BOXES TO ENHANCE PRODUCTIVITY

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Abstract: This project investigates productivity linked assembly in the paper industry, with a focus on the production of corrugated cardboard boxes. The research encompasses the entire production process, from the sourcing of raw materials to the manufacturing and quality testing of the final product. The primary raw material for this industry is wood, which is currently facing a shortage due to environmental concerns. The study aims to understand how industries are managing the shortage of high–quality, cost–effective products. It delves into packaging issues, discussing them with manufacturers, and subsequently develops constraint models to address these issues. In the production process, boxes of varying sizes are made to accommodate different packaging needs. These boxes undergo rigorous testing for tear strength and compression resistance to ensure their durability. Modifications are made during the manufacturing process, such as altering flute sizes and layering panels both vertically and horizontally, to enhance the box's strength. Once produced, the boxes are tested for their suitability within the industry. The study concludes by proposing measures to alleviate constraints faced by entrepreneurs and the food industry, such as the implementation of digitalization and the establishment of supplier agreements.
Keywords: paper packaging, sourcing, constraints, testing, cost

INTRODUCTION

In the current scenario, paper is required due to its easy use in the manufacturing process and helps in paper packaging of various products and solves the problem of unemployment. The leading role of paper in mass communication and education is positive. On the one hand, it is the basic raw material of the paper packaging industry; On the other hand, the printed press needs it for advertising purposes and the industry invests heavily in advertising to attract the attention of customers and also increase product sales easily. Greater awareness is needed from consumers and the industry to fully appreciate this type of revolution. There is another segment in this paper industry.

One of them is raw material manufacturers like paper mills that use pure bamboo which is mainly available in South India and some industries like Orient Paper Mills, Sandeep Paper Mill, Andhra Paper Mills and Star Paper Mills. In the production of the boxes, raw materials such as silicates, adhesives to attach the paper and threads to sew the boxes are used. These industries are more of a small sector covering 60–70% of the demand in the MSME sector and agencies are conducting research in this area as new packages are introduced for adaptation. Due to the advanced techniques available in the manufacturing sector for mass production, the high demand is mainly in the food processing industry to save money and extend the shelf life of canned products.

PROBLEM STATEMENT

When packing materials in boxes, the tear strength of the paper is not tested and papers of different weights are used, for example from 80 to 140 grams. The use of heavier paper weights affects the cost of corrugated boxes because the boxes can support this weight. No advanced techniques are used during the manufacturing process to increase strength, which can be achieved by using narrow flutes in vertical and horizontal gluing in smaller layers such as 3–layer, 5–layer and 7–layer. During the corrugation process, flutes of different sizes need to be made, saving paper costs.

By procuring the raw material in the right quantity, in the right quality, at the right price and at the right time, sales and marketing strategies can be planned through the use of production, packaging and transportation capacities, which is not done correctly. A case study of fruit packaging is carried out to reduce not only the product cost but also the cost of paper raw materials. If a corrugated box is of inferior quality, it may be damaged and the entire product stored in the box may not meet company standards.

ADDITIONAL CHALLENGES IN PAPER INDUSTRY

- Increase in raw material costs. In the area of flexible packaging, the prices for these raw materials have recently risen significantly. Due to tight supplies, prices for polypropylene, used in resins, bottles and packaging films, are also rising.

- Perishability of the contents. Flexible packaging companies are not only under pressure to innovate their offerings, but at the same time must ensure that their products are designed to protect the contents of the packaging from the external environment.
- The industry's problems are mainly due to the shortage of raw materials in the country. With the increase in population, the use of all types of wood is constantly increasing.
- Most industrial facilities are located in remote locations that rarely attract the attention of the younger generation. This leads to a labor shortage, which further impacts the industry's production.
- The Indian paper industry is facing one of the most difficult phases in history due to the novel coronavirus (Covid–19) pandemic that has impacted supplies, hampered by unavailability of shipping containers and import of huge quantities of handicrafts is exacerbated by China importing paper from India.

OBJECTIVE OF THESIS

Given the size of the paper packaging industry in India, constraints on inputs, processing and marketing need to be removed for rapid development.

Considering the above perspective, the objectives of the study were set as follows:

- A study on the limitations of the Indian paper packaging industry in terms of input, processing and marketing.
- Propose measures to eliminate constraints and promote industrial development.
- Develop models for a potential packaging entrepreneur considering factory size, demand forecasts, cost structure, investments, product range and supplier relationships/contracts.

Generally, flutes A and B are used (Figure 1). The performance of the plate depends on the type and direction of the flute, which depends on the type and weight of the item packaged.

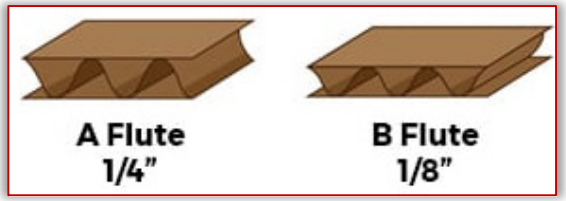

Figure 1: Flutes A and B

Generally, the flutes (Figure 2) in the box are vertically oriented to ensure maximum resistance to insertion. A–flute is used when top–down compressive strength is important, such as for non–load–bearing products stacked high in a warehouse. Fragile items are also packed in Type A corrugated boxes. High–density products are best packaged in B–fluted boxes. The C–flute design is a compromise between A and B–flutes with pretty good stacking resistance and notable rigidity for the E–flute is used for special purposes and is not as common as A and C flutes. Double–layer and multi–layer corrugated cardboard (Figure 3) can combine two or more groove types to achieve better properties and performance.

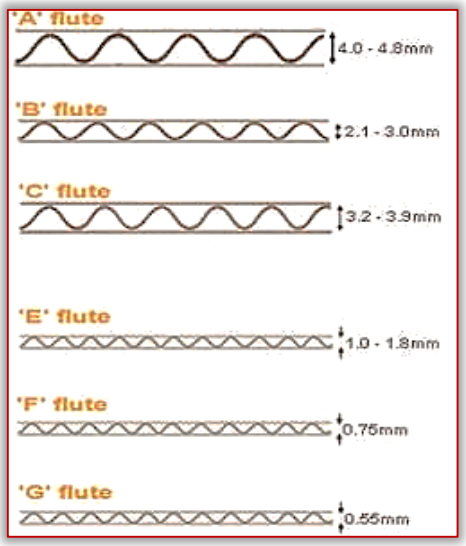

Figure 2: Types of Flute

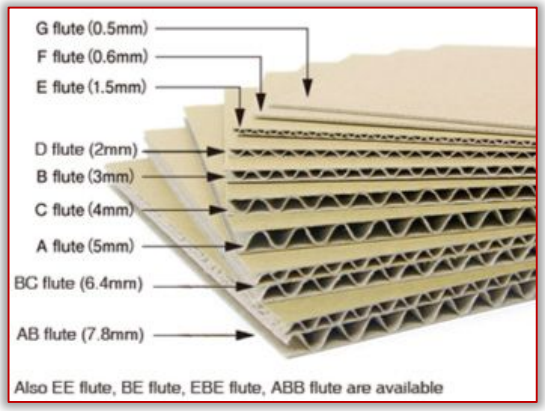

Figure 3: Flutes in corrugated cardboard

METHODOLOGY

In this method, paper is used as a raw material along with glue in a machine to make corrugated boxes (Figure 4). In the previous cases, the box produced was designed to have only horizontal flutes. Therefore, the resistance of the box was not technically increased by using the flutes vertically and horizontally, increasing the resistance by 5 or 7 layers and using different sizes and types for this purpose. (Figure 5).

Applying the flute in the manufacture of the box not only saves cost, but also conserves the food product stored in the box, as the search includes

the guava fruit in the search and finds it in different patterns (Figure 6) with different weights, resulting in a cost–effectiveness ratio. Also, height of flutes and number of flutes per linear meter was noted (Figure 7). Various testing machines were used, such as burst strength testers, vibration machines and other machines.

Figure 4: Corrugated cardboard roll

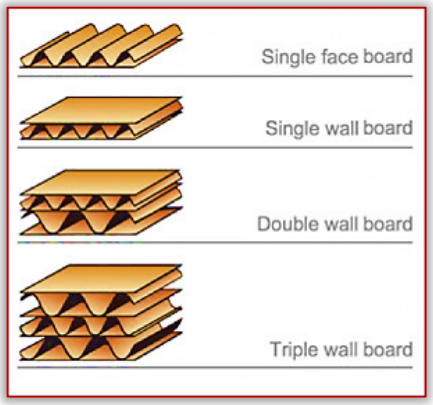

Figure 5: Types of corrugated board

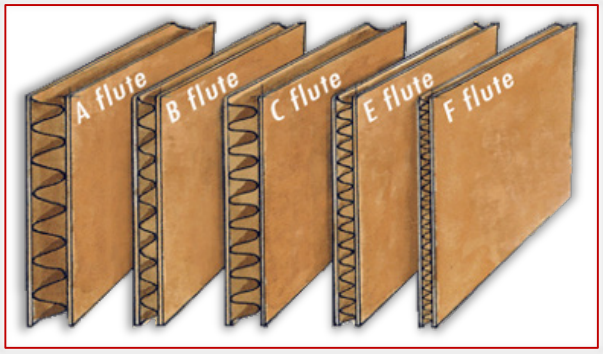

Figure 6: Different patterns of corrugated box

Flute Type	Height of Flute In mm	Number of Flutes per linear meter
A-flute	0.187	36+3
B-flute	0.098	51+3
C-flute	0.130	42+3
E-flute	0.036	96+3

Figure 7: Flute Type details

RESULT ANALYSIS

The researcher visited 30 industries, including 10 large industries, which were asked to complete the questionnaire. Responses were received from only three sectors. The data collected from the completed survey is presented in the table. It is observed that capacity utilization is different across the three sectors due to delay in procurement of raw materials and unavailability of quality packages on time. The boxes were damaged during distribution/physical transportation and adequate testing was not performed. The corners of the boxes were damaged and the boxes were open due to the poor quality of the sewing thread used. This shows that technical issues are not taken into account. Appropriate testing machines should be used.

RESEARCH FINDINGS & LIMITATIONS

This study prioritized the main issues related to the objective, taking into account all factors affecting cost, distribution, quality and technical measures. Test results show that for guava packaging, a vertical flute height of 0.273 resulted in a 98% improvement in breakage rate. This shows that packaging quality can help reduce guava packaging losses during transportation. The study suggests quality and improvement.

The packaging industry in India is far behind that of developed countries. There is a great need for rapid development of the packaging industry in India. The need for industrial development in India can be fully understood if one considers that almost 20–25% of fresh fruits and vegetables, 30% of animal products including dairy and meat products, 10–11% of cereals and 7% of the food produced, 10% of cement, chemical and industrial products are lost due to inadequate packaging.

Our economy is still largely based on agriculture. Recognition of the need to modernize the agricultural industry and give further impetus to the agricultural sector. It is estimated that a strong food processing sector would help accelerate agricultural activities as well as diversification and marketing of agricultural products, channeling them towards increasing exports on the one hand and creating more opportunities to improve nutrition, employment and income generation in rural areas.

A diverse agricultural sector with different soils and climates provides an increasingly broad raw material base suitable for the production of a rapidly expanding range of processed foods.

Rapid urbanization, increasing numbers of working women and increasing per capita income have contributed to rapid growth and changing demand patterns. India offers huge investment and growth opportunities in the processed food sector.

CONCLUSION & RECOMMENDATION

After passing the tests, you need to pay special attention to the technical aspects and use the right raw material, such as: when sewing, if the thread is not of required quality, it will destroy the item packed in the box. During packaging and testing, it was found that the corners of the packed boxes were damaged by non–technical activities. It is therefore recommended to carry out proper planning before starting production. It has been observed that the entire process is carried out on mechanically operated machines. Therefore, efficiency is interrelated during the production process in the paper industry.

Further analysis of paper availability is needed as it impacts costs and destroying more trees creates problems for the paper industry. The availability of raw materials is currently at risk. Therefore, it is necessary to protect the environment in order to increase the production of food and reduce the cost of the production process. Therefore, more research is needed to save the country revenue. Because currently this sector plays an important role in creating jobs for people and, according to literature analysis, can generate good incomes.

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