PACKAGING DESIGN FOR
YOGHURT

SE2127 Packaging Materials

GROUP MEMBERS

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1 MOTIVATION
The objective of this project is to design a modified version of the existing yoghurt packaging which is commonly available in the market. Our aim is to design a package which can minimize the loss or wastage of the product. As we feel that there is significant loss of product in case of yoghurt packages which are currently being used. This package can only be used for yoghurt and other similar viscous products like cream, but it will not be a good idea to use this packaging for some kind of drink e.g. milk.

![Figure 1](image)

There are various types of yoghurt packaging available in the market and we have focused our attention towards maximum utilization of the product by minimizing the loss of the product as we feel that this area needs some improvement as it is neglected in the packaging currently available in the market.

2 PROTECTION OF PRODUCT
2.1 PACKAGING MATERIAL
The most common types of material used for packaging are paper, fiberboard, plastic, glass, steel and aluminum. Great packaging begins with the right material - one that can deliver
performance, quality and reliability for the product it houses. So in order to design efficient packaging selection of proper materials is the first and most important step. Materials which we have used are mentioned below.

1. Paper board.
2. Polymers.
3. Aluminum.

2.1.1 PAPER BOARD
Paperboard packaging comes in several different grades that possess unique characteristics making each grade suitable for different packaging requirements and needs. Strength and durability of primary packaging largely depends upon the proper selection of paperboard. Paperboard is eco-friendly as it is based on wood, the only naturally renewable packaging raw material. We have used KÖRSNAS OPTIPACK to calculate the box compression resistivity.
Required BCR = 346

Recommended materials for our packaging are

<table>
<thead>
<tr>
<th>Material</th>
<th>BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>KÖRSNAS LIGHT 330</td>
<td>350</td>
</tr>
<tr>
<td>KÖRSNAS WHITE 345</td>
<td>378</td>
</tr>
<tr>
<td>KÖRSNAS CARRY 350</td>
<td>397</td>
</tr>
</tbody>
</table>

As we intend to add 1500 grams of yoghurt in our primary packaging so the good choice will be Korsnäs 350 for our yoghurt packaging. Tower stacking of products during shipment will create excessive load on the bottom products so we needed some strong paperboard and Korsnäs 350 is an excellent choice for heavier products.

Packaging design report generated using OPTIPACK is in APPENDIX.

2.1.2 Polymers
In order to preserve the product and to enhance the storage life we have used various layers of different polymers. Our paperboard is laminated from externally and internally with suitable type of polymers.

Lamination of paperboard with polymers serves following purpose.
• Provide protection to the food and to the paperboard against hazardous environmental effects like sunshine, moisture, air, dust, oxygen.
• These layers give extra strength and stiffness to the packaging.
• Lamination is also done for aesthetic reason.

Factors which become the basis of polymer selection are

• Percentage of water present in the product
• Moisture in the atmosphere.
• Oxygen.
• Effective sealing, preservation and safety of the product.
• Surface finish, gloss and printing of the packaging.
• Barrier properties.
• Cost.

**Inner layer**

There are a lot of barrier materials available in the market for inner layer of food packaging. We have selected two layers of HDPE (15+25 g/m²) because of its properties and price. Polypropylene is a common and least expensive plastic to produce, it is still being used in food cans like yoghurt, margarine but its recycling is less efficient so high density polyethylene was selected; it is being widely used in packaging industry now a days although it is little more expensive but it can be recycled mores easily as compared to polypropylene. With the increase in the use of HDPE recycling industry is also focussing and trying to refine the recycling process to make it less expensive and to increase its use in packaging industry. Salient features of HDPE are mentioned below.

• Chemical resistance is superior as well as resistance to oil and grease.
• HDPE has 90% crystallinity which increases its stiffness.
• The opaque HDPE film offer excellent moisture protection and significantly decreases gas permeability.
• It has also good heat sealing properties so no adhesives is required

Some basic properties of polyethylene films are shown in the table below:
<table>
<thead>
<tr>
<th>Type of Polyethylene</th>
<th>Moisture Vapour Transmission</th>
<th>Gas Transmission</th>
<th>Tensile Strength (MPa)</th>
<th>Softening Point (°C)</th>
<th>CH₃ Groups per 1000 Cs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low density (920 kgm⁻³)</td>
<td>1.4</td>
<td>500</td>
<td>1350</td>
<td>9-15</td>
<td>120-180</td>
</tr>
<tr>
<td>Medium density (940 kgm⁻³)</td>
<td>0.6</td>
<td>225</td>
<td>500</td>
<td>21</td>
<td>120-180</td>
</tr>
<tr>
<td>High density (960 kgm⁻³)</td>
<td>0.3</td>
<td>125</td>
<td>350</td>
<td>28</td>
<td>135-180</td>
</tr>
</tbody>
</table>

Sequence of layers

- 2 layers of HDPE (15+25 g/m²).
- Paperboard in MD (Korsnäss carry 350).
- Aluminium layer: 7 micrometre (It acts as barrier for oxygen and light. The content of the package remains fresh longer)
- EVA: 20 g/m² (It has excellent sticking or gluing properties, it is used between the aluminium and paperboard for better tightening. EVA is a copolymer, EVA film is tough and tacky so we have used it with HDPE as a tie-layer, stress resistance and flex cracking resistance.)
- The outer layer of the package is also from HDPE (20 g/m²) but not so thick like the inner one. It protects package from external environment.
- Plastic seal and top cap are made up of polyethylene (HDPE).

2.1.3 ALUMINIUM
Aluminium foil acts as a complete barrier to light and oxygen (which cause fats to oxidise or become rancid), odours and flavours, moisture, and bacteria. Aluminium foils are good choice for dairy products; it also helps in preservation of dairy products for some time without refrigeration.
3  PRODUCT FLOW
It includes handling, transportation and storage of the product. We have divided our packaging design into three phases which includes primary packaging, secondary packaging and the load carrier.

3.1  PRIMARY PACKAGING

3.1.1  Handling
Primary packaging is tray made up of paperboard with laminate layers of various polymers. Product inside the package is divided into two parts, both parts contains yoghurt of different flavors, two parts of the packaging can also be filled with yoghurt of different fat composition.

While designing the yoghurt packaging we kept certain things in our mind i.e.

1. Protection of the product.
2. Easy handling.
3. Aesthetic appeal.
4. Minimizing the loss of the product
5. Compact and sleek design, effective utilization of the space in the store shelf and warehouses.

Salient features of primary packaging are mentioned below.

Product weight = 1500g
Shelf Life = 30 days
3.1.2 Transportation
Primary packaging will be transported in a group of 6 packs.

3.1.3 STORAGE
Storage of primary packaging is important for the end user; end users are people who will purchase this product from the retailers so storage for end user is usually not a big problem as majority of the end users do not purchase such perishable items in bulk quantities. While designing this package for the end user we have focused more towards effective and maximum utilization of product inside the packaging, appearance of the packaging and how it can communicate with its purchaser in a better way.

3.2 SECONDARY PACKAGING

3.2.1 Handling
Our secondary packaging consists of a tray which contains six packs of yoghurt. Six pack packaging is intended towards retailers, it has been designed in a way to provide ease of handling to those working in stores. Tray of six yoghurt packaging can easily be handled by the personnel working in the shop, it is easy to carry and it can easily be stack at a dedicated place inside the store. Weight of the tray is around 9.5 kg and an average adult person can easily carry this load.
3.2.2 Transportation
While designing secondary packaging we have ensured safe and easy transportation from the warehouses to the shelf.

3.2.3 Storage
Storage of secondary packaging is particularly aimed at retailers; it has been designed in a way to provide ease of storage to the retailers. A secondary packaging of six items can easily be stored at a dedicated area in a refrigerator, wide base of primary packaging will nullify the chances of falling and its less thickness will ensure that it will occupy less space in the shelf.

3.3 LOAD CARRIER
Standardized pallet has been selected, cube efficiency is 81 % and area utilization is 82 %. Dimension of load on the pallet is 800x606x984.
3.3.1 Handling
Load carrier design primarily focuses the ease of those people involved in the transportation, loading, unloading and those working in the warehouses.

It consists of standard EURO pallet type, a top cap is provided which ensures safe handling and transportation of load carrier, a shrink wrap is also provided around the load carrier and straps are added for protection.

3.3.2 Transportation
Standard pallet has been used for ease of transportation from the production facility to the wholesalers and retailers. Excessive care has been taken while designing the tertiary packaging to ensure the safe and easy transportation.

3.3.3 STORAGE
Tertiary packaging is aimed at Warehouse storage. Tertiary packaging has been designed using standard pallet size, stacking of pallet at top each other is not recommended.

4 RUNNABILITY
Runnability of packaging material in packaging line is of great importance for the manufacturer. Materials which does not have good Runnability properties do not compete in the market. Runnability is a combination of characteristics in a paper that provides a trouble-free process, leading to high productivity.

4.1 STIFFNESS
Stiffness is one of the most important properties of paperboard as it affects the ability of cartons to run smoothly through the machine that erects, fills and closes them. Stiffness also gives strength and reduces the propensity of a carton to bulge under the weight of settling flowable contents such as cereals. Other factors which affect board stiffness include thickness, coatings, moisture content, grammage and density.

Korsnäs carry 350 has a bending stiffness of 805 MN and 350 MN in machine direction and cross direction respectively which will ensure the safety of the packaging and product under adverse conditions.
4.2 STRENGTH
It includes compression strength, tear strength and surface strength.

When packaging is stacked on top of each other, the bottom layer bears the greatest load. To avoid collapsing, the most important property is good compression strength. Korsnäs carry 350 has the compression strength of 10 KN/m and 7.3 KN/m in machine direction and cross direction respectively.

Tear strength is the force required to tear the paperboard sheet from an existing incision. Tearing resistance for Korsnäs carry 350 is 7200 MN.

4.3 LAMINATION
The printed sheet is coated with a protective layer of plastic or metal foil - the laminate. There are gloss and matt laminates. They are applied by a special lamination machine

The laminate provides excellent protection against dirt, moisture and wear, hazardous environmental effects etc.

We have used plastic based and metal based laminate layers for various reasons. This has been discussed earlier.

4.4 CREASIBILITY
To facilitate folding a well-defined folding line or crease is made. A perfect crease can be compared to a hinge and its aim is to produce the desired shape

Creasibility is an important property in paper making; we have used multiple layer paper board for our packaging which will provide better Creasibility and folding properties.

4.5 FLATNESS
Flatness means the ability of carton board to remain flat during printing and other process, flatness is greatly affected by the moisture contents, in order to ensure the flatness of the paper board its contact with the moisture should be minimal. Our product has high moisture content so to make our packaging moisture resistant we have used various polymer layers to keep the quality of product and packaging intact.
4.6 ROUGHNESS AND BRIGHTNESS
Smoothness is particularly important when being used for printing, the smoother the paperboard, the better the ink coverage. It is measured using air leak methods – the greater the rate of air leakage, at a specific air pressure, from under a cylindrical knife placed on the surface, the rougher the surface.

Roughness and brightness of Korsnäs carry 350 is 2 and 80 respectively, this improves the whiteness, smoothness and gloss of paperboard and helps in achieving the desired printing and vanishing properties. With reference to paper packaging brightness means percentage of light which is reflected from paperboard surface at a wavelength of 457 nm. Along with this we have also used aluminum which provides good resistance against the adverse effects of light.

4.7 ENVIRONMENT
Packaging should be design in a manner so that it is easy to reuse and recycle, and it should minimize the amount of packaging waste which is needed to be disposed. This can bring business benefits such as reduced costs across the business, a better relationship with stakeholders and new sales and marketing opportunities.

Purpose of modern day packaging is not only to design attractive and efficient packaging but it should be made up of materials which are environment friendly and recyclable. In our design we have used paperboard which is environment friendly and it is recyclable. Majority of the paperboard being utilized in the developed countries is recycled. Major raw material of paper is wood and good thing about wood is that it is renewable.

Other than paperboard, our packaging consist of aluminum which is a metal, it can be separated and processed for future use. Plastic top cap can also be recycled and reused. HDPE is recyclable but it requires extra processing for future use as compare to metal, glass or paperboard.

4.8 COMMUNICATION
Packaging of any product should communicate with its customer and persons involved in its handling and transportation. It should educate its buyers about the products, its pros and cons. One idea behind the design of our packaging is that it should help in improving the quality of life and properly design packaging serves that purpose through effective communication with its buyer.
In our packaging design major information for the customer includes

- Ingredients and energy contents.
- Date of manufacturing and expiration dates.
- Packaging material and information for the user about dumping of packaging after use.
- Secondary and tertiary packaging will have special handling and storage instruction.

5 REFERENCE

- Hand book of food sciences, technology and engineering volume 3 Yiu.H.Hiu
- Association of European carton board and carton manufacturer.
- IDES The plastic web
- Lecture notes and class notes (KTH)
- www.wikepedia.com
6 APPENDIX:

Cape Pak

Billerud

Optipack

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Arrange Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>Cartons/Bag/ovals</td>
</tr>
<tr>
<td>Description</td>
<td>pdf (3/8/2010)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Load Ref.</th>
<th>Case Used</th>
<th>Area Used</th>
<th>Pallet Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>G2</td>
<td>80.7 %</td>
<td>82.9 %</td>
<td>Euro441</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Arrange Group</th>
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</thead>
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</tr>
<tr>
<td>Description</td>
<td>pdf (3/8/2010)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Box (OD)</th>
<th>220.0</th>
<th>100.0</th>
<th>75.0 mm</th>
<th>4.000</th>
<th>2.000 Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case (OD)</td>
<td>250.0</td>
<td>200.0</td>
<td>210.0 mm</td>
<td>12.000</td>
<td>12.000 Kg</td>
</tr>
<tr>
<td>Pallet</td>
<td>666.0</td>
<td>606.0</td>
<td>590.0 mm</td>
<td>452.000</td>
<td>452.000 Kg</td>
</tr>
<tr>
<td>Load</td>
<td>500.0</td>
<td>500.0</td>
<td>451.0 mm</td>
<td>452.000</td>
<td>444.000 Kg</td>
</tr>
</tbody>
</table>

Tuesday, March 09, 2010

1. This is an example for the cape pack User Guide
2. Issued on 1/4/02
3. Issued by QC Department
4. Approved by IT Manager
5. Issue from 1/4/02
6. Valid until 5/12/2008
1: Secondary packaging for shallow box of yogurt

Board: Billerud White Top 140, Billerud Flute 127, Billerud White Liner P+ 135 (CCT)
Box 0433 (220*100*70 mm) Warning: Shallow box
ECT = 6923 N/m, BCT = 2162 N, Load = 28 kg (with safety factor 8)
## Material

<table>
<thead>
<tr>
<th>Material</th>
<th>Result BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>KORSNÄS LIGHT 330</td>
<td>350</td>
</tr>
<tr>
<td>KORSNÄS WHITE 345</td>
<td>378</td>
</tr>
<tr>
<td>KORSNÄS CARRY 350</td>
<td>397</td>
</tr>
</tbody>
</table>

## Demand

<table>
<thead>
<tr>
<th>Demand</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight of the content</td>
<td>1500 gram</td>
</tr>
<tr>
<td>Stack height</td>
<td>12</td>
</tr>
<tr>
<td>Number of pallets</td>
<td>1</td>
</tr>
<tr>
<td>Transport &amp; Environment</td>
<td>Normal/Normal</td>
</tr>
<tr>
<td>Stacking</td>
<td>Tower stacking</td>
</tr>
<tr>
<td>Demand</td>
<td>346 N</td>
</tr>
</tbody>
</table>

## Properties

- **Design**: A6040
- **Loading direction**: H
- **Fibre direction**: Direction 2

## Dimensions

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dim A</td>
<td>220 mm</td>
</tr>
<tr>
<td>Dim B</td>
<td>100 mm</td>
</tr>
<tr>
<td>Dim H</td>
<td>70 mm</td>
</tr>
</tbody>
</table>