

**SUMMER EXAMINATIONS 2019**

**EXAMINATION:**

**UNIT 2 Packaging Materials and Containers I**

**COURSE:**

**CPD Diploma in Packaging Technology**

**DATE:**

**8th May 2019**

**2pm to 4pm**

**EXAMINERS: Colm Munnelly, David Little**

**TIME ALLOWED: 2 hours**

**INSTRUCTIONS: Please answer four questions. All questions carry equal marks**

**PLEASE DO NOT TURN OVER THIS PAGE UNTIL YOU ARE INSTRUCTED TO DO SO**

The use of programmable or text storing calculators, smart phones etc are expressly forbidden. Please note that where a candidate answers more than the required number of questions, the examiner will mark all questions attempted and then select the highest scoring ones.

Unit 2 Page 1 of 3

**Question 1 (25 marks)**

1. With the aid of a diagram describe the production of containers using the *Blow and Blow Process* from gob formation to the presentation of containers for annealing

**(13 marks)**

1. Why are surface coatings used on glass? Name where they are applied, their function and an example of each type

**(7 marks)**

1. When considering the design features of a glass container, briefly discuss which five areas merit special consideration

**(5 marks)**

**Question 2 (25 marks)**

1. Discuss the production of aluminium foil from ore extraction to the preparation of foil for despatch to the customer.

**(15 marks)**

1. Briefly discuss the reasons why aluminium foil is coated, listing as may reasons as possible.

**(10 marks)**

**Question 3 (25 marks)**

1. Describe the manufacturing process for a 2‐piece Drawn and Wall Ironed can suitable for packaging carbonated beer. Your description should start with a coil of metal and finish with cans ready for despatch to the packer/filler.
   * Why is aluminium a suitable material for this process?
   * Why is Drawing and Wall Ironing suitable for beverage cans?

**(15 marks)**

1. Describe some of the advantages and disadvantages of using impact extruded (collapsible) metal tubes?

**(5 marks)**

1. Describe how both retort packaging and aseptic packaging produce a shelf stable product and the difference between the two. What is a typical retort temperature?

**(5 marks)**

**Question 4 (25 marks)**

Unit 2 Page 2 of 3

1. List 5 different types of carton board packaging and describe in a few words their difference or use.

**(5 marks)**

1. Pick one of these types of carton board packaging, choose and describe a suitable product of your choice and briefly list the production steps in converting the carton board to your chosen type of packaging. Start from approved artwork and keyline, listing and describing the production stages / steps to up to a packed outer.

**(10 marks)**

1. List three (3) different types of board used to make cartons.

Describe the composition of two (2) of these types and the typical end‐use for that board type. Show in an annotated diagram the make‐up of the layers, in your chosen two board types.

**(2 X 5 marks)**

**Question 5 (25 marks)**

1. List and describe the three types of pulp used in the preparation and manufacture of paperboard and evaluate their differences / benefits and where they are typically used in packaging boards.

**(15 marks)**

1. List the production stages of manufacturing paperboard from forestry to packing the product for distribution.

**(10 marks)**

Unit 2 Page 3 of 3

**Question 1 (25 marks)**

1. **With the aid of a diagram describe the production of containers using the *Blow and Blow Process* from gob formation to the presentation of containers for annealing**

**(13 marks)**

To describe the production of containers using the Blow and Blow Process, from gob formation to the presentation of containers for annealing, a diagram is typically used to illustrate the step-by-step process. Unfortunately, as I am unable to draw diagrams, I will provide a detailed written explanation of the Blow and Blow Process:

1. \*\*Gob Formation\*\*: The process begins with the formation of gobs, which are small, molten glass masses. These gobs are formed by cutting a continuous stream of molten glass into individual pieces of the desired weight.

2. \*\*Gob Delivery\*\*: The gobs are then delivered to the forming machine, where they are positioned for the next stage of the process.

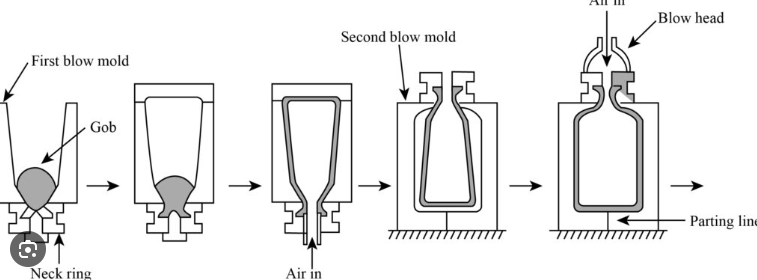
3. \*\*Initial Molding (Blank Mold)\*\*: In the initial stage, the gobs are dropped into the blank mold, which is the first part of the two-part mold used in the Blow and Blow Process. The blank mold shapes the glass into a parison, which is a hollow, elongated shape.

4. \*\*Transfer to the Blow Mold\*\*: The parison is then transferred to the blow mold, where it is further shaped and inflated to the final container shape using compressed air.

5. \*\*Blowing and Shaping\*\*: Compressed air is introduced into the parison, causing it to expand and take the shape of the mold cavity. The glass is blown and shaped to form the final container design.

6. \*\*Annealing\*\*: After the container is formed, it is gradually cooled in a controlled manner to relieve internal stresses and strengthen the glass. This process is known as annealing and is crucial for ensuring the durability and quality of the glass container.

The Blow and Blow Process is commonly used for producing glass containers like bottles and jars. It involves the initial formation of the parison in the blank mold, followed by transfer to the blow mold for final shaping and inflation. The containers are then annealed to ensure their structural integrity and quality.



1. **Why are surface coatings used on glass? Name where they are applied, their function and an example of each type**

**(7 marks)**

Glass surfaces are coated for a variety of reasons, often to improve upon the inherent properties of glass itself. Here are some key reasons for using surface coatings on glass, along with application areas, functionalities, and examples:

**1. Enhancing Functionality:**

* **Application:** Primarily used in architectural and automotive applications.
* **Function:** Improve thermal properties and energy efficiency.
* **Example:** Low-emissivity (Low-E) coatings: These microscopically thin coatings reflect long-wave infrared radiation (heat) back into the building in winter, while allowing visible light to pass through. This helps regulate indoor temperature and reduces energy consumption for heating and cooling.

**2. Improving Durability and Protection:**

* **Application:** Used on architectural glass, cookware, and other functional glass items.
* **Function:** Enhance scratch resistance, strengthen the glass, and repel dirt or water.
* **Example:** Hard coat: This type of coating creates a tougher outer layer on the glass, making it more resistant to scratches and abrasions. It's commonly used on eyeglasses or touchscreens for increased durability.

**3. Aesthetic and Decorative Purposes:**

* **Application:** Architectural glass, tableware, and decorative items.
* **Function:** Enhance aesthetics, provide color or reflectivity, or create a desired visual effect.
* **Example:** Reflective coatings: These coatings reflect light and create a mirrored appearance. They are used for architectural applications to control heat gain or for decorative purposes.

**4. Safety and Security:**

* **Application:** Architectural and automotive glass.
* **Function:** Enhance safety by preventing shattering upon impact and deterring break-ins.
* **Example:** Laminated glass: A layer of plastic is sandwiched between two glass panes. Upon impact, the plastic holds the glass fragments together, preventing them from scattering and creating a safer barrier.

These are just a few examples, and there are many other specialized coatings used for various applications. The type of coating chosen depends on the desired functionality and the specific use case for the glass product.

1. **When considering the design features of a glass container, briefly discuss which five areas merit special consideration**

**(5 marks)**

When designing glass containers, several key areas merit special consideration to ensure optimal functionality, performance, and appeal. Here are five areas that require careful attention:

1. \*\*Shape and Size:\*\*

- The shape and size of the glass container play a significant role in its functionality and aesthetics. Special consideration should be given to ergonomics, usability, and compatibility with filling, sealing, and dispensing equipment. Additionally, the container's dimensions should be optimized to accommodate the intended contents efficiently while minimizing wasted space and material usage.

2. \*\*Closure Compatibility:\*\*

- The design of the container's neck and finish should be compatible with the type of closure or cap intended for use. Factors to consider include thread size and pitch, sealing mechanisms, tamper-evident features, and compatibility with various closure materials (e.g., metal, plastic, cork). Ensuring proper closure compatibility is essential for maintaining product integrity, preventing leaks or contamination, and facilitating consumer convenience.

3. \*\*Surface Treatment and Labeling:\*\*

- Surface treatment options such as embossing, debossing, frosting, or labeling can significantly impact the visual appeal and branding of the glass container. Special consideration should be given to the design and placement of labels, graphics, and text to ensure clarity, legibility, and adherence to regulatory requirements. Surface treatments should also enhance grip, handling, and user experience while complementing the overall aesthetic of the packaging.

4. \*\*Thickness and Strength:\*\*

- The thickness and strength of the glass container walls should be carefully optimized to meet the structural requirements of the intended application while minimizing material usage and weight. Special consideration should be given to areas prone to stress concentrations, such as corners, edges, and transitions between thick and thin sections. Design features such as reinforcement ribs, grooves, or chamfers may be incorporated to enhance structural integrity and resistance to breakage.

5. \*\*Functional Features and Innovation:\*\*

- Innovative design features can differentiate glass containers in the market and enhance their functionality and user experience. Special consideration should be given to features such as ergonomic grips, pour spouts, handles, stacking or nesting capabilities, and compatibility with dispensing systems. Additionally, incorporating sustainability attributes such as refillable designs, recyclability, or reusable packaging options can further enhance the appeal and marketability of the glass container.

By carefully considering these five areas during the design process, glass container manufacturers can develop products that meet the needs and preferences of consumers, brand owners, and other stakeholders while maximizing performance, efficiency, and aesthetic appeal.

**Question 2 (25 marks)**

1. **Discuss the production of aluminium foil from ore extraction to the preparation of foil for despatch to the customer.**

**(15 marks)**

## Aluminium Foil Production: From Ore to Customer

Here's a breakdown of the aluminium foil production process, from extracting the raw material to preparing the finished product for dispatch:

**1. Bauxite Ore Extraction:**

* The journey begins with mining bauxite, the primary aluminium ore. This reddish clay-like rock contains aluminium oxide (Al2O3) along with various impurities like silica and iron oxide.

**2. Bayer Process:**

* The extracted bauxite undergoes the Bayer process to extract aluminium oxide (alumina) from the ore. This process involves:
  + Crushing and grinding the bauxite.
  + Dissolving the alumina in a hot, caustic soda (sodium hydroxide) solution. Impurities remain undissolved.
  + Separating the alumina solution from the residue using a series of filtration and precipitation steps.
  + Seeding the solution with aluminium hydroxide crystals to encourage further precipitation of pure alumina.

**3. Hall-Héroult Electrolysis:**

* The purified alumina is then subjected to the Hall-Héroult electrolytic process to extract metallic aluminium. This involves:
  + Dissolving the alumina in a molten cryolite bath within a large electrolytic cell.
  + Passing a strong electric current through the solution. The current separates the oxygen from the aluminium oxide, allowing molten aluminium to collect at the bottom of the cell.

**4. Casting and Shaping:**

* The molten aluminium is tapped from the electrolytic cells and cast into large ingots.
* These ingots may be further processed into slabs or sheets depending on the desired final product form.

**5. Hot Rolling:**

* The aluminium slabs or sheets are hot rolled. This involves passing them through a series of rollers at high temperatures, progressively reducing their thickness and increasing their length.

**6. Cold Rolling:**

* Further reduction in thickness is achieved through cold rolling. This process takes place at room temperature and imparts a smoother finish and improved mechanical properties to the aluminium sheet.

**7. Annealing:**

* After rolling, the aluminium sheet undergoes annealing, a heat treatment process that softens the metal and improves its workability for further processing.

**8. Slitting and Foiling:**

* The large aluminium sheets are then fed into slitters to cut them into narrower coils with the desired width for foil production.
* These coils are further rolled in specialized rolling mills to achieve the final thin gauge required for aluminium foil.

**9. Surface Treatment (Optional):**

* Depending on the intended use, the aluminium foil may undergo additional surface treatments like washing or applying a thin layer of lubricant to improve performance and prevent sticking.

**10. Quality Control and Inspection:**

* Throughout the production process, the aluminium foil undergoes rigorous quality control checks to ensure it meets the desired thickness, strength, and surface quality specifications.

**11. Spooling and Packaging:**

* The finished aluminium foil is wound onto large spools or cores for industrial applications.
* For consumer use, the foil is cut into smaller sheets and packaged in rolls or boxes with labels and branding information.

**12. Despatch to Customer:**

* The packaged aluminium foil is palletized and shipped to distributors, retailers, or directly to customers (depending on the order size).

**Additional Notes:**

* Recycling aluminium scrap generated throughout the process and using recycled aluminium content in production are becoming increasingly important aspects of sustainable aluminium foil production.
* The specific details and equipment used in each stage may vary depending on the manufacturer and the desired final foil properties.

This process transforms bauxite ore into the thin and versatile aluminium foil used in various applications, from food packaging to thermal insulation.

1. **Briefly discuss the reasons why aluminium foil is coated, listing as may reasons as possible.**

**(10 marks)**

Aluminium foil is sometimes coated with various materials to enhance its properties and functionality for specific applications. Here are some reasons why aluminium foil might be coated:

1. **Improved Food Release:** A light coating of oil or a non-stick polymer can be applied to prevent sticking, particularly for cooking applications. This allows food to slide off the foil easily, reducing waste and simplifying cleanup.
2. **Corrosion Resistance:** For applications where the foil might be exposed to moisture or corrosive substances, a lacquer coating can be applied to create a protective barrier. This helps prevent the aluminium from reacting and potentially contaminating the contents or deteriorating the foil itself.
3. **Enhanced Heat Distribution:** In some cases, a thin layer of a heat-conductive material might be used to improve heat distribution during cooking. This can be beneficial for achieving even browning or baking results.
4. **Gas Barrier Properties:** Certain coatings can improve the foil's gas barrier properties. This can be useful for packaging applications where it's crucial to maintain freshness or extend shelf life by limiting oxygen or moisture ingress.
5. **Antimicrobial Properties:** In specific applications, a coating with antimicrobial properties might be used. This can be beneficial for food packaging to potentially inhibit the growth of bacteria or mold on the foil's surface.
6. **Color and Printability:** For decorative or branding purposes, a thin layer of colored lacquer or a printable coating might be applied. This allows for customization and visual appeal in certain applications.
7. **Sealing and Tamper Evidence:** Some coatings can enhance the foil's ability to form a strong seal when wrapped around containers. This can be important for tamper-evident packaging or to ensure secure closure.
8. **Induction Heating:** A specific type of coating might be used to make the foil compatible with induction heating technology. This allows the foil to be directly heated by an electromagnetic field for certain applications.

It's important to note that not all aluminium foil is coated. The choice of coating, if any, depends on the intended use and desired functionalities of the final product.

**Question 3 (25 marks)**

1. **Describe the manufacturing process for a 2‐piece Drawn and Wall Ironed can suitable for packaging carbonated beer. Your description should start with a coil of metal and finish with cans ready for despatch to the packer/filler.#**

The manufacturing process for a 2-piece Drawn and Wall Ironed (DWI) can suitable for packaging carbonated beer involves several steps, starting with a coil of metal and ending with cans ready for dispatch to the packer/filler. Here's a detailed description of the process:

1. \*\*Metal Coil Preparation:\*\*

- The process begins with a coil of aluminum or steel sheet metal. The metal coil undergoes surface treatment, such as cleaning and coating, to remove impurities and improve adhesion.

2. \*\*Sheet Metal Cutting:\*\*

- The metal coil is fed into a cutting machine, where it is sheared or slit into individual sheets of the desired width and length.

3. \*\*Blanking:\*\*

- The metal sheets are then passed through a blanking press, which cuts out circular blanks of the appropriate size for the cans.

4. \*\*Drawing:\*\*

- The blanked metal discs are transferred to a drawing press, where they are formed into cup-shaped shells or "cans" through a process known as drawing. In this step, the blank is progressively stretched and elongated to form the cylindrical body of the can.

5. \*\*Trimming:\*\*

- After drawing, excess metal or flash around the top edge of the cans is trimmed off using a trimming press, leaving a clean and smooth rim.

6. \*\*Necking and Flanging:\*\*

- The top portion of the drawn cans is then necked to reduce the diameter, creating the can's neck and opening. Subsequently, a flange is formed at the can's opening to provide stability and a surface for attaching the lid.

7. \*\*Washing and Coating:\*\*

- The drawn and flanged cans undergo washing and coating processes to remove any contaminants and apply protective coatings to the interior and exterior surfaces. These coatings enhance the cans' corrosion resistance and prevent interaction with the packaged beverage.

8. \*\*Wall Ironing:\*\*

- In the Wall Ironing (WI) process, the cans are placed upside down on a mandrel and passed through a series of dies that progressively reduce the diameter of the can walls while increasing their height. This results in thinner walls and a taller can body, which is ideal for carbonated beverages like beer that require high internal pressure resistance.

9. \*\*Base Reforming:\*\*

- After wall ironing, the cans undergo base reforming to shape and reinforce the can's bottom. This step involves reshaping the can's base to create a convex profile and improve stability.

10. \*\*Lid and Tab Application:\*\*

- Once the cans are formed and shaped, lids and tabs are applied to seal the can's opening. The lids are typically attached using a seaming machine, which crimps and seals the lid to the flange, while tabs are attached to provide a pull-tab for easy opening.

11. \*\*Inspection and Quality Control:\*\*

- Throughout the manufacturing process, the cans undergo rigorous inspection and quality control measures to ensure dimensional accuracy, integrity, and compliance with industry standards and customer specifications.

12. \*\*Packaging and Dispatch:\*\*

- Finally, the finished cans are packaged into crates, trays, or pallets and prepared for dispatch to the packer/filler. The cans are carefully stacked and secured to prevent damage during transportation to beverage filling facilities where they will be filled with carbonated beer, sealed, and labeled for distribution to consumers.

By following these steps, manufacturers can produce high-quality DWI cans suitable for packaging carbonated beer, ensuring product integrity, performance, and consumer satisfaction.

* + **Why is aluminium a suitable material for this process?**

Aluminium is a suitable material for the process of manufacturing 2-piece Drawn and Wall Ironed (DWI) cans for packaging carbonated beer due to several key reasons:

1. \*\*Lightweight\*\*: Aluminium is lightweight, making it ideal for producing cans that are easy to handle, transport, and store, especially in large quantities.

2. \*\*Corrosion Resistance\*\*: Aluminium has natural corrosion resistance properties, ensuring that the cans maintain their integrity and protect the contents, such as carbonated beer, from external elements.

3. \*\*Recyclability\*\*: Aluminium is highly recyclable, allowing used cans to be recycled and reused, contributing to sustainability and environmental benefits.

4. \*\*Malleability\*\*: Aluminium is malleable, allowing it to be easily formed into intricate shapes like the 2-piece DWI cans, providing flexibility in design and manufacturing.

5. \*\*Barrier Properties\*\*: Aluminium offers excellent barrier properties, protecting the carbonated beer from light, oxygen, and moisture, ensuring product freshness and quality.

Overall, the unique properties of aluminium, including its lightweight nature, corrosion resistance, recyclability, malleability, and barrier properties, make it a suitable material for manufacturing 2-piece DWI cans for packaging carbonated beer.

* + **Why is Drawing and Wall Ironing suitable for beverage cans?**

**(15 marks)**

Based on the information provided in the search results, the Drawn and Wall Ironed (DWI) can design is suitable for packaging carbonated beverages, such as beer, for the following reasons:

1. Strength and Durability:

- The DWI process allows the can body to be formed into a strong, durable structure that can withstand the internal pressure of carbonated beverages.

- The wall ironing step progressively reduces the thickness of the can wall, increasing the height and strength of the can body.

2. Lightweight:

- Aluminium, which is a common material used for DWI cans, is a lightweight metal, making the cans easy to handle, transport, and store in large quantities.

3. Barrier Properties:

- Aluminium provides excellent barrier properties, protecting the carbonated beverage from light, oxygen, and moisture, helping to maintain the product's freshness and quality.

4. Compatibility with Carbonation:

- The DWI can design is well-suited for carbonated beverages, as it can withstand the internal pressure without deformation or leakage.

5. Manufacturing Efficiency:

- The DWI process allows for high-speed manufacturing and efficient production of cans, which is important for the large-scale production of carbonated beverage packaging.

In summary, the Drawn and Wall Ironed can design, often made from lightweight and corrosion-resistant aluminium, provides the necessary strength, durability, and barrier properties to effectively package and protect carbonated beverages, such as beer, making it a suitable choice for this application.

1. **Describe some of the advantages and disadvantages of using impact extruded (collapsible) metal tubes?**

**(5 marks)**

Based on the information provided in the search results, here are some of the key advantages and disadvantages of using impact extruded (collapsible) metal tubes:

Advantages:

1. Barrier Properties:

- Metal tubes, such as aluminum tubes, provide excellent barrier properties against oxygen, moisture, and light, helping to protect the packaged product.

2. Collapsibility and Dispensing:

- The impact extruded design allows the metal tubes to be collapsible, enabling easy and controlled dispensing of the product.

- This collapsible nature also reduces the amount of product left in the tube after use.

3. Durability and Protection:

- Metal tubes are durable and can withstand physical abuse during handling, transportation, and storage, providing good protection for the packaged product.

4. Resealability:

- Metal tubes often come with screw-on or snap-on closures, allowing the package to be resealed after initial use.

Disadvantages:

1. Weight:

- Metal tubes are generally heavier than other packaging materials, such as plastic tubes, which can impact transportation and handling costs.

2. Cost:

- The manufacturing process for impact extruded metal tubes can be more expensive compared to other tube packaging options.

3. Recycling Challenges:

- Recycling metal tubes can be more complex than recycling some other packaging materials, as the tubes may contain multiple components (e.g., metal, plastic, or other materials).

4. Limited Decoration Options:

- The impact extruded manufacturing process can limit the range of decoration options available on the metal tubes, compared to other packaging formats.

5. Potential for Denting or Deformation:

- While metal tubes are durable, they can be susceptible to denting or deformation if not handled carefully, which can affect the overall appearance and functionality of the package.

Overall, the advantages of impact extruded metal tubes, such as their barrier properties, collapsibility, and durability, need to be weighed against the potential drawbacks, such as weight, cost, and recycling challenges, when considering this packaging format.

1. **Describe how both retort packaging and aseptic packaging produce a shelf stable product and the difference between the two. What is a typical retort temperature?**

**(5 marks)**

Both retort packaging and aseptic packaging are methods used to produce shelf-stable products, but they differ in their processes and the level of heat treatment applied:

1. \*\*Retort Packaging\*\*:

- Retort packaging involves heating the packaged food in a retort (a large pressure vessel) to high temperatures for a specific period to achieve sterilization.

- The food is sealed in a container, such as a metal can or pouch, and then heated in the retort to kill harmful microorganisms and enzymes that could cause spoilage.

- The high heat treatment in retort packaging ensures the product is commercially sterile and shelf-stable for an extended period, often measured in years.

- Retort temperatures typically range from 121°C to 135°C, depending on the specific food product and processing requirements.

2. \*\*Aseptic Packaging\*\*:

- Aseptic packaging involves sterilizing the food product separately from the packaging material and then filling and sealing the product in a sterile environment.

- The food is pasteurized or sterilized using heat exchangers, and the packaging material is sterilized using methods like hydrogen peroxide or UV light.

- The sterilized food is filled into the sterilized packaging material in a sterile environment, ensuring the product remains free from contamination.

- Aseptic packaging allows for the filling of the product at lower temperatures than retort processing, preserving the quality and nutritional value of the food.

- Shelf stability in aseptic packaging is achieved through the combination of sterilization, aseptic filling, and hermetic sealing, resulting in a product with a shelf life measured in weeks or months.

In summary, both retort packaging and aseptic packaging are used to produce shelf-stable products by applying heat treatment to sterilize the food. The key difference lies in the process: retort packaging sterilizes the food and package together, while aseptic packaging sterilizes them separately before filling and sealing in a sterile environment.

**Question 4 (25 marks)**

1. **List 5 different types of carton board packaging and describe in a few words their difference or use.**

**(5 marks)**

Based on the provided information, here are five different types of carton board packaging along with a brief description of their differences or uses:

1. \*\*Solid Bleached Board (SBB)\*\*:

- Description: High-quality board with a bright white surface, often used for premium packaging.

2. \*\*Solid Unbleached Board (SUB)\*\*:

- Description: Unbleached board with a natural brown appearance, suitable for eco-friendly packaging or products where a natural look is desired.

3. \*\*Folding Boxboard (FBB)\*\*:

- Description: Lightweight board with good folding properties, commonly used for packaging applications like folding cartons and boxes.

4. \*\*White Lined Chipboard (WLC)\*\*:

- Description: Chipboard lined with white paper on one or both sides, providing a smooth surface for printing and suitable for various packaging applications.

5. \*\*Sack Kraft\*\*:

- Description: Strong, unbleached paperboard used for heavy-duty packaging like multiwall sacks, ideal for products that require robust and durable packaging.

Each type of carton board packaging has specific characteristics and is suitable for different applications based on factors like appearance, strength, printing capabilities, and environmental considerations.

1. **Pick one of these types of carton board packaging, choose and describe a suitable product of your choice and briefly list the production steps in converting the carton board to your chosen type of packaging. Start from approved artwork and keyline, listing and describing the production stages / steps to up to a packed outer.**

**(10 marks)**

## Folding Carton (Cardboard Box) for Breakfast Cereal

**Product:** A brand new, whole-grain breakfast cereal targeting health-conscious consumers.

**Production Steps:**

1. **Printing:** The approved artwork and keyline are used to create printing plates. The carton board is fed through a high-speed printing press where the design is printed onto both sides of the board. This might involve multiple passes for different colors and potentially a clear coat for added protection.
2. **Die Cutting:** A large steel die, shaped exactly like the unfolded cereal box, is used to precisely cut out the individual boxes from the printed carton board sheet.
3. **Scoring and Creasing:** Sharp metal blades or rollers score and crease the carton board along the fold lines. This process weakens these specific areas, allowing for clean and defined folding later.
4. **Slotting:** Special cutting blades create slots on designated areas of the die-cut shape. These slots will be used for interlocking tabs during box assembly.
5. **Stacking and Stripping:** The die-cut and creased blanks are automatically stacked and then separated using a stripping mechanism. This separates the individual blanks for easier handling in the next stage.
6. **Folding and Gluing:** The separated blanks are fed into a folding and gluing machine. The machine folds the blank along the pre-scored lines, applies glue to designated tabs or flaps, and presses them together to form the basic box shape.
7. **Inspection and Packing:** The finished cereal boxes are inspected for quality and consistency. Approved boxes are then packed into larger cardboard boxes for transport to the cereal filling facility.

**Additional Notes:**

* Depending on the complexity of the box design, additional processes like hot foil stamping or embossing might be incorporated.
* The entire production process is typically automated and high-speed, allowing for efficient and cost-effective production of large quantities of folding cartons.

1. **List three (3) different types of board used to make cartons.**

**Describe the composition of two (2) of these types and the typical end‐use for that board type. Show in an annotated diagram the make‐up of the layers, in your chosen two board types.**

**(2 X 5 marks)**

Here are three different types of boards used to make cartons:

1. **Solid Bleached Sulfate (SBS):** This is a premium grade board known for its bright white surface and smooth finish.
2. **Folding Boxboard (FBB):** This is a widely used board with good strength and printability, available in various thicknesses and grades.
3. **Chipboard:** This is a thick, rigid board often used for the body of set-up boxes, offering good structural support.

**1. Solid Bleached Sulfate (SBS):**

* **Composition:** SBS is typically made from virgin wood pulp, primarily bleached softwood fibers. The bleaching process removes lignin, a natural component of wood, resulting in a bright white color and smooth surface. SBS might also have a thin clay coating for enhanced printability and a more luxurious feel.
* **Typical End-Use:** Due to its premium aesthetics and printability, SBS is often used for high-end packaging, such as:  
  + Cosmetic boxes (e.g., for perfumes, makeup)
  + Pharmaceutical packaging
  + Food packaging for luxury chocolates or gourmet products

**Annotated Diagram - SBS:**

+---------------------+

| Clay Coating (optional) | (For enhanced printability)

+---------------------+

| Bleached Softwood Pulp | (Primary layer)

+---------------------+

**2. Folding Boxboard (FBB):**

* **Composition:** FBB is typically made from recycled paper fibers, a blend of both bleached and unbleached softwood and hardwood pulp. This gives it a natural brown color and a less smooth surface compared to SBS. FBB comes in various thicknesses and grades, offering a balance between strength, printability, and cost.
* **Typical End-Use:** FBB is a versatile board used for a wide range of applications due to its affordability and good functionality. Examples include:  
  + Cereal boxes
  + Food packaging (e.g., pasta boxes, snack boxes)
  + Clothing boxes
  + General merchandise packaging

**Annotated Diagram - FBB:**

+--------------------+

| Top Layer (optional) | (Bleached or unbleached pulp)

+--------------------+

| Recycled Paper Pulp | (Blend of softwood & hardwood)

+--------------------+

| Back Layer (optional) | (Bleached or unbleached pulp)

+--------------------+

**Note:** The top and back layers in FBB might be made from a single layer of bleached or unbleached pulp, or they might be absent depending on the desired thickness and strength of the final board.

**Question 5 (25 marks)**

1. **List and describe the three types of pulp used in the preparation and manufacture of paperboard and evaluate their differences / benefits and where they are typically used in packaging boards.**

**(15 marks)**

Based on the information provided in the search results, the three main types of pulp used in the preparation and manufacture of paperboard are:

1. Chemical Pulp:

- Description: Chemical pulp is produced by chemically treating wood chips to dissolve the lignin and separate the cellulose fibers.

- Benefits: Chemical pulp provides high strength, brightness, and purity, making it suitable for high-quality paperboard applications.

- Typical Use: Chemical pulp is commonly used for the outer layers of solid bleached board (SBB) and folding boxboard (FBB) to provide a smooth, printable surface.

2. Mechanical Pulp:

- Description: Mechanical pulp is produced by physically grinding or refining wood chips to separate the cellulose fibers.

- Benefits: Mechanical pulp is less expensive to produce and provides bulk and stiffness to the paperboard.

- Typical Use: Mechanical pulp is often used for the middle layers of folding boxboard (FBB) to provide body and rigidity.

3. Recycled Pulp:

- Description: Recycled pulp is produced by processing recovered paper and paperboard waste.

- Benefits: Recycled pulp is a more sustainable and cost-effective option, helping to reduce the consumption of virgin fiber.

- Typical Use: Recycled pulp is commonly used in the core or middle layers of solid unbleached board (SUB) and white-lined chipboard (WLC) to provide a cost-effective base.

The differences between these pulp types lie in their production methods, properties, and typical applications in packaging boards:

- Chemical pulp provides superior strength, brightness, and purity, making it suitable for the outer layers of high-quality boards like SBB and FBB.

- Mechanical pulp is less expensive and contributes to the bulk and stiffness of the middle layers in boards like FBB.

- Recycled pulp is a more sustainable and cost-effective option, often used in the core or middle layers of boards like SUB and WLC.

By combining these different pulp types, manufacturers can create paperboard with the desired properties, performance, and cost-effectiveness for various packaging applications.

1. **List the production stages of manufacturing paperboard from forestry to packing the product for distribution.**

**(10 marks)**

The production stages of manufacturing paperboard from forestry to packing the product for distribution are:

1. \*\*Forestry\*\*: Harvesting and processing wood chips from sustainable forests.

2. \*\*Pulping\*\*: Chemical or mechanical processing of wood chips to create pulp.

3. \*\*Screening\*\*: Removing impurities and contaminants from the pulp.

4. \*\*Refining\*\*: Refining the pulp to improve its strength and quality.

5. \*\*Bleaching\*\*: Bleaching the pulp to achieve the desired color and brightness.

6. \*\*Forming\*\*: Forming the pulp into a sheet using a fourdrinier machine.

7. \*\*Pressing\*\*: Pressing the sheet to remove excess water and flatten it.

8. \*\*Drying\*\*: Drying the sheet using heat from a series of hot rollers.

9. \*\*Cutting\*\*: Cutting the dried sheet into the desired size and shape.

10. \*\*Finishing\*\*: Applying coatings, laminations, or other treatments to enhance the paperboard's properties.

11. \*\*Packaging\*\*: Packing the finished paperboard into boxes, bags, or other containers for distribution.

These stages are crucial in ensuring the quality and performance of the final paperboard product, which can be used for various applications such as packaging, printing, and construction.

