

**SUMMER EXAMINATIONS 2020**

**EXAMINATION:**

**UNIT 4 Package Printing and Decorating & Packaging Machinery**

**COURSE:**

**CPD Diploma in Packaging Technology**

**DATE:**

**May 14th 2020**

**2pm to 4pm**

**EXAMINERS: Tony Duffy, David Little, Ron Gardiner**

**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.

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**Question 1 (25 marks)**

| a) | Explain the following terms used in colour printing | | | **(10 marks)** |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  |  | TERM | EXPLANATION |  |
|  |  | CMYK |  |  |
|  |  | Dot Gain |  |  |
|  |  | Special Colour |  |  |
|  |  | Density |  |  |
|  |  | Full Colour Half Tone |  |  |
|  |  | Spot Colour |  |  |
|  |  | L\*a\*b\* |  |  |
|  |  | Saturation |  |  |
|  |  | Pantone Colour |  |  |
|  |  | Hue |  |  |

1. What is the role of the anilox in the flexographic printing process? With the aid of an annotated print unit diagram, describe how the anilox works and the impact it has on the colour reproduction. Mention the impact, of a dirty anilox and of changing the anilox to a different screen or volume.

**(15 marks)**

**Question 2 (25 marks)**

1. Washed salad leaves are filled on a vertical form fill seal bagging machine. Describe the operation of this equipment and any specific considerations required for this

product. **(15 marks**)

1. Horizontal form fill seal (flow-wrapping) is a common packaging format which is similar to vertical form fill seal. Discuss the differences in product characteristics which would indicate a preference for one each of these techniques.

**(5 marks)**

c) Discuss the options for date / batch coded the salad leaf pack. **(5 marks)**

**Question 3 (25 marks)**

1. Describe the packing line for packaging individually wrapped cereal bars in a collation carton of six bars, from receipt of packaging materials to finished packed products ready for dispatch.



**(16 marks)**

1. Discuss three factors which contribute to overall equipment effectiveness of the line and provide an example how each could be improved.

**(3 x 3)**

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**Question 4 (25 marks)**

1. Discuss how the correct amount of individually frozen prawns could be metered.

**(5 marks)**

1. Discuss the mechanisms and merits of level and volume filling for correct amount of olive oil into a glass bottle.

**(10 marks)**

1. Describe a volumetric filling system suitable for the filling the correct amount talc into a tub.

**(3 marks)**

d) Discuss the difficulties of volume filling this type of product.

**(3 marks)**

1. Compare the use of fixed weight and variable weight approaches to retailing prepacked meat steaks.

**(4 marks)**

**Question 5 (25 marks)**

1. For the following printed packs, list the typical printing process used, for large scale production (i.e. not digital).

| **Full colour printed pack** | **Typical process used** |  |
| --- | --- | --- |
| Crisp bag |  |  |
| Folding carton |  |  |
| Corrugated case / Outer |  |  |
| Stand-up pouch (high quality) |  |  |
| Self-adhesive labels |  |  |
| Yogurt pot (direct printed) |  |  |
| Shelf-ready display pack |  |  |
| Carton for heavy valve |  |  |
| Beer bottle (direct printed) |  |  |
| Large TV screen outer |  |  |
|  | **(10 marks)** | |



1. Choose one of the above printing processes and describe the process fully with the aid of an annotated diagram. Include details on the plate type, ink type, drying method and typical substrates along with a brief description with of the transfer / application method for that process.

**(15 marks)**

Unit 4 Page 3 of 3

**Question 1 (25 marks)**

| **a)** | **Explain the following terms used in colour printing** | | | **(10 marks)** |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  |  | **TERM** | **EXPLANATION** |  |
|  |  | **CMYK** |  |  |
|  |  | **Dot Gain** |  |  |
|  |  | **Special Colour** |  |  |
|  |  | **Density** |  |  |
|  |  | **Full Colour Half Tone** |  |  |
|  |  | **Spot Colour** |  |  |
|  |  | **L\*a\*b\*** |  |  |
|  |  | **Saturation** |  |  |
|  |  | **Pantone Colour** |  |  |
|  |  | **Hue** |  |  |

Sure, here's an explanation of each term used in color printing:

1. \*\*CMYK:\*\*

- CMYK stands for Cyan, Magenta, Yellow, and Key (Black). It is a color model used in color printing to reproduce a wide range of colors by combining varying percentages of these four ink colors. CMYK is also known as the subtractive color model, as it subtracts light to create colors on a white background, such as paper.

2. \*\*Dot Gain:\*\*

- Dot gain refers to the phenomenon where halftone dots printed on a substrate appear larger than intended, leading to a darkening or muddying of printed colors. Dot gain occurs due to factors such as ink absorption, paper texture, and printing press conditions.

3. \*\*Special Colour:\*\*

- Special colors refer to specific ink colors used in printing that are outside the standard CMYK color gamut. These colors may include metallic inks, fluorescent inks, or custom-mixed spot colors. Special colors are often used to achieve specific visual effects or brand colors that cannot be accurately reproduced using CMYK inks alone.

4. \*\*Density:\*\*

- Density in color printing refers to the darkness or lightness of a printed color. It is typically measured using a densitometer and expressed as a numerical value. Higher density values indicate darker colors, while lower density values indicate lighter colors.

5. \*\*Full-Color Halftone:\*\*

- Full-color halftone refers to the reproduction of continuous-tone color images using halftone dots of varying sizes and densities. Full-color halftones are created by breaking down the original image into four separate halftone screens (one each for Cyan, Magenta, Yellow, and Black) and combining them to produce a full-color print.

6. \*\*Spot Color:\*\*

- Spot color, also known as spot ink or Pantone color, refers to a pre-mixed ink color that is printed using a single ink plate, rather than being created through a combination of CMYK inks. Spot colors are commonly used for branding, logos, and specific color matching requirements.

7. \*\*L\*a\*b\*:\*\*

- L\*a\*b\* (CIELAB) is a color space used to quantify and describe colors based on human perception. It consists of three axes: L\* (lightness), a\* (green to red), and b\* (blue to yellow). L\*a\*b\* color values are device-independent and can accurately represent colors across different output devices and media.

8. \*\*Saturation:\*\*

- Saturation refers to the intensity or purity of a color. Highly saturated colors appear vivid and vibrant, while desaturated colors appear muted or washed out. Saturation is controlled by adjusting the amount of pigment or ink used to reproduce a color.

9. \*\*Pantone Color:\*\*

- Pantone color is a standardized color matching system used in the printing industry to ensure consistent and accurate color reproduction. Each Pantone color is assigned a unique identification number and can be reproduced using pre-mixed spot inks. Pantone colors are widely used for branding, graphic design, and packaging.

10. \*\*Hue:\*\*

- Hue refers to the attribute of color that distinguishes one color from another on the color wheel. It is the dominant wavelength of light reflected or emitted by an object and determines the basic color category (e.g., red, blue, green). Hue is one of the three dimensions of color perception, along with saturation and lightness.

1. **What is the role of the anilox in the flexographic printing process? With the aid of an annotated print unit diagram, describe how the anilox works and the impact it has on the colour reproduction. Mention the impact, of a dirty anilox and of changing the anilox to a different screen or volume.**

**(15 marks)**

## The Crucial Role of the Anilox in Flexographic Printing

The anilox is a critical component in flexographic printing, playing a vital role in achieving high-quality color reproduction. Here's a breakdown of its function, along with the impact it has on the process:

**Function:**

The anilox is a cylindrical roller with a precisely engraved surface. These engravings create millions of tiny cells that hold ink. The anilox functions as a meter and transfer unit:

1. **Metering:** During the printing process, the anilox rotates and comes into contact with the ink fountain. The engraved cells on the anilox's surface fill with ink.
2. **Transfer:** As the anilox continues to rotate, it presses against the printing plate. The raised areas of the printing plate (corresponding to the image) contact the anilox and pick up the ink from the cells. The ink is then transferred from the plate onto the printing substrate (paper, film, etc.) to create the printed image.

**Annotated Print Unit Diagram:**

Imagine a simplified flexographic printing unit with the following components:

1. **Ink Fountain:** Holds the ink supply.
2. **Anilox Roller:** The engraved cylinder discussed above.
3. **Doctor Blade:** A thin, metal blade that scrapes excess ink off the anilox, ensuring a consistent ink film thickness.
4. **Printing Plate:** A flexible plate with raised image areas that will transfer ink to the substrate.
5. **Impression Roller:** Presses the printing plate against the substrate during printing.
6. **Substrate:** The material being printed on (paper, film, etc.).

**Impact on Color Reproduction:**

* **Cell Volume and Screen Ruling:** The volume (depth) and screen ruling (number of cells per linear inch) of the anilox cells significantly impact color reproduction.
  + **Higher volume cells:** Hold more ink, resulting in a thicker ink laydown on the substrate. This can create more vibrant and saturated colors but might also lead to potential issues like ink mottle (uneven ink distribution) or bleeding (colors running into each other).
  + **Lower volume cells:** Hold less ink, resulting in a thinner ink laydown. This can produce sharper details and smoother color transitions but might also lead to weak or washed-out colors if not managed properly.
  + **Higher screen ruling:** Creates a finer pattern of ink dots, leading to smoother color gradients and finer details. However, it requires a more precise printing setup and can be more susceptible to ink filling the cells completely (blocking), reducing ink transfer.
* **Anilox Condition:** A dirty anilox with clogged cells will not transfer ink efficiently, resulting in weak, patchy color reproduction. Regular cleaning and maintenance of the anilox are crucial for consistent color quality.

**Impact of a Dirty Anilox:**

* **Uneven Ink Transfer:** Clogged cells in the anilox will not hold or release ink properly, leading to uneven ink laydown on the substrate. This results in patchy or mottled printing, affecting both color consistency and detail.
* **Weak Colors:** Blocked cells will limit the amount of ink transferred, resulting in weak and washed-out colors that lack vibrancy and saturation.

**Impact of Changing the Anilox:**

* **Switching to a Different Screen Ruling:** This alters the fineness of the ink dots laid down. A higher screen ruling might require adjustments to ink viscosity or pressure to ensure proper ink transfer and prevent blocking.
* **Switching to a Different Cell Volume:** This changes the amount of ink transferred. Switching to a higher volume anilox might require reducing printing pressure to avoid excessive ink laydown, while a lower volume might necessitate adjustments to ink viscosity for optimal color strength.

In conclusion, the anilox plays a critical role in flexographic printing by accurately metering and transferring ink for color reproduction. Its cell volume, screen ruling, and condition all significantly impact the final print quality. Maintaining a clean anilox and selecting the appropriate anilox for the desired ink density and detail are essential for achieving consistent and high-quality prints.

**Question 2 (25 marks)**

1. **Washed salad leaves are filled on a vertical form fill seal bagging machine. Describe the operation of this equipment and any specific considerations required for this**

**product. (15 marks)**

A vertical form fill seal (VFFS) bagging machine is commonly used for packaging washed salad leaves. Here's how the operation of this equipment typically works, along with specific considerations for packaging washed salad leaves:

1. \*\*Film Unwind:\*\* The packaging film, typically a roll of flexible plastic film such as polyethylene or polypropylene, is unwound from a roll and fed into the machine.

2. \*\*Forming Tube:\*\* The film passes through a forming tube or collar, which shapes it into a tube. The bottom of the tube is sealed to create a bag.

3. \*\*Product Filling:\*\* Washed salad leaves are dispensed into the forming tube from a hopper or feeder. The filling process is typically controlled to ensure accurate portioning of the salad leaves into each bag.

4. \*\*Sealing:\*\* Once the desired amount of salad leaves is filled into the bag, the top of the bag is sealed to enclose the product. The sealing process may involve heat sealing, where heat is applied to the film to create a secure seal, or other sealing methods such as ultrasonic sealing or impulse sealing.

5. \*\*Cutting:\*\* After sealing, the sealed portion of the film is cut to separate the filled bag from the continuous film. The cutting process may involve a rotary knife or other cutting mechanism to achieve a clean and precise cut.

6. \*\*Final Product Discharge:\*\* The filled and sealed bags of washed salad leaves are discharged from the machine onto a conveyor belt or packaging line for further processing, labeling, and packaging.

Specific considerations for packaging washed salad leaves on a VFFS bagging machine include:

- \*\*Product Sensitivity:\*\* Washed salad leaves are delicate and can be easily damaged during handling and packaging. Special care must be taken to handle the leaves gently to prevent bruising or wilting.

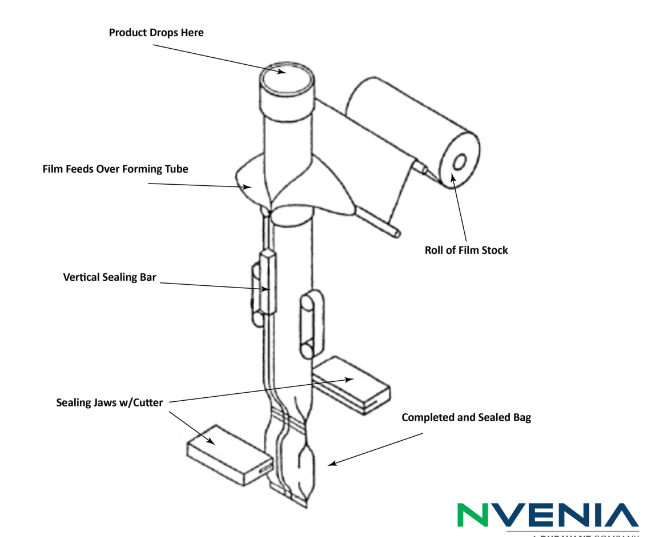
- \*\*Hygiene and Sanitation:\*\* Since salad leaves are a perishable food product, it's essential to maintain high standards of hygiene and sanitation throughout the packaging process to ensure food safety and prevent contamination.

- \*\*Product Integrity:\*\* The packaging film used for salad leaves should be durable and provide adequate protection to maintain the freshness and quality of the product. Considerations such as film thickness, barrier properties, and packaging design should be taken into account to preserve product integrity.

- \*\*Packaging Size and Shape:\*\* The VFFS machine should be capable of producing bags with the appropriate size and shape to accommodate the volume and presentation requirements of washed salad leaves. Adjustments may be needed to optimize bag dimensions and filling parameters for the specific product.

- \*\*Ventilation:\*\* To prevent the accumulation of moisture inside the bag, which can lead to condensation and spoilage of the salad leaves, some VFFS machines may incorporate ventilation or gas flushing systems to maintain product freshness and extend shelf life.

Overall, packaging washed salad leaves on a VFFS bagging machine requires careful attention to product sensitivity, hygiene, packaging integrity, and packaging design to ensure that the final product meets quality and safety standards.



1. **Horizontal form fill seal (flow-wrapping) is a common packaging format which is similar to vertical form fill seal. Discuss the differences in product characteristics which would indicate a preference for one each of these techniques.**

**(5 marks)**

Horizontal form fill seal (flow-wrapping) and vertical form fill seal (VFFS) are both popular packaging formats used in various industries. While they serve similar purposes of packaging products efficiently and securely, they have distinct characteristics that may make one more suitable than the other depending on the product and specific packaging requirements. Here are some differences in product characteristics that would indicate a preference for each technique:

\*\*Horizontal Form Fill Seal (Flow-Wrapping):\*\*

1. \*\*Product Shape:\*\*

- Flow-wrapping is ideal for packaging products with irregular shapes or varying dimensions, such as bakery items (e.g., bread, cakes, cookies), confectionery (e.g., chocolate bars, candies), and non-rigid products (e.g., diapers, towels). The horizontal flow-wrapping process allows for flexibility in accommodating different product sizes and shapes.

2. \*\*High-Speed Packaging:\*\*

- Flow-wrapping machines are capable of high-speed packaging, making them suitable for applications requiring rapid production and packaging throughput. Products can be continuously fed into the machine on a conveyor belt, allowing for efficient mass production.

3. \*\*Flexible Film Usage:\*\*

- Flow-wrapping typically uses flexible packaging films such as polyethylene (PE) or polypropylene (PP), which are well-suited for wrapping products with irregular shapes and sizes. These films offer good conformability and seal integrity, ensuring that the product is securely wrapped and protected.

4. \*\*Visible Product Presentation:\*\*

- Flow-wrapping provides a clear, uninterrupted view of the product, making it suitable for retail packaging where product visibility and presentation are important for consumer appeal. The transparent film allows customers to see the product inside the package, enhancing its marketability and attractiveness on store shelves.

\*\*Vertical Form Fill Seal (VFFS):\*\*

1. \*\*Granular or Powdered Products:\*\*

- VFFS is commonly used for packaging granular or powdered products such as coffee, snacks, grains, and powders. The vertical filling process allows for precise measurement and filling of these types of products into bags, pouches, or sachets, ensuring accurate portion control and consistency.

2. \*\*Space-Efficient Packaging:\*\*

- VFFS machines are compact and space-efficient, making them suitable for packaging operations with limited floor space or where vertical integration is preferred. The vertical packaging format allows for efficient use of vertical space, maximizing production capacity within a smaller footprint.

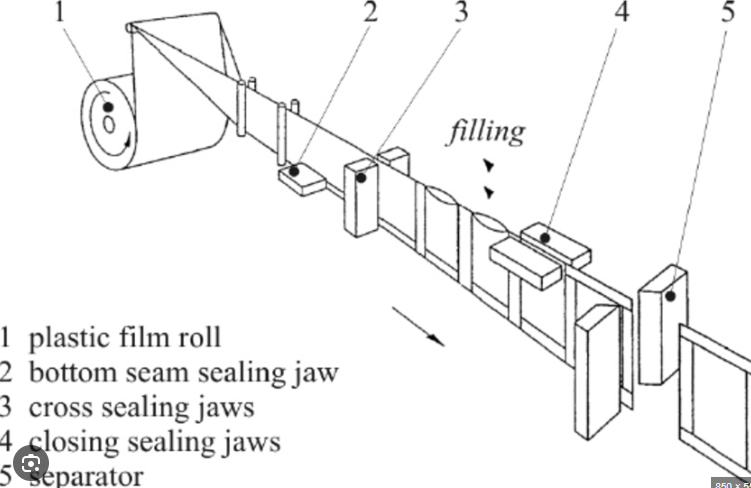
3. \*\*Ease of Handling and Transportation:\*\*

- VFFS packages are typically compact and stackable, making them easy to handle, store, and transport. The vertical orientation of the packages facilitates efficient palletization and storage, reducing storage space requirements and logistics costs.

4. \*\*Longitudinal Sealing Strength:\*\*

- VFFS machines provide strong longitudinal seals along the length of the package, ensuring product integrity and preventing leakage or spillage during handling and transportation. This makes VFFS suitable for packaging products that require robust sealing, such as liquids, powders, or granular products.

In summary, the preference for horizontal form fill seal (flow-wrapping) or vertical form fill seal (VFFS) depends on various factors such as product shape, speed of packaging, packaging material, visibility, and handling requirements. Each technique offers unique advantages and is best suited for specific product characteristics and packaging needs.



**c) Discuss the options for date / batch coded the salad leaf pack. (5 marks)**

When it comes to date and batch coding for salad leaf packs, several options are available to ensure traceability, compliance with regulations, and consumer safety. Here are some common options for date and batch coding salad leaf packs:

1. \*\*Inkjet Printing:\*\*

- Inkjet printing is a popular method for date and batch coding on flexible packaging such as salad leaf packs. It involves the use of specialized inkjet printers equipped with food-grade inks to print alphanumeric codes directly onto the packaging film. Inkjet printing offers high-speed operation, high-resolution printing, and flexibility in coding various information such as expiration dates, production dates, batch numbers, and barcodes.

2. \*\*Thermal Transfer Printing:\*\*

- Thermal transfer printing involves the use of a thermal printhead to transfer ink from a ribbon onto the packaging material. It is suitable for printing durable, high-quality codes on flexible packaging films. Thermal transfer printers can be used to print date codes, batch numbers, and other variable data directly onto salad leaf packs. This method offers excellent print quality, durability, and resistance to fading or smudging.

3. \*\*Hot Foil Stamping:\*\*

- Hot foil stamping is a printing method that uses heat and pressure to transfer metallic foil onto the packaging material. It is commonly used for adding decorative or promotional elements to packaging, but it can also be used for date and batch coding. Hot foil stamping provides a permanent, high-contrast marking that is visible on various packaging substrates, including plastic films used for salad leaf packs.

4. \*\*Labeling:\*\*

- Labeling involves applying pre-printed labels or stickers onto the salad leaf packs to display date and batch information. Labeling offers flexibility in terms of design, format, and placement of the information. It can be done manually or using automated labeling machines. Labels can include additional information such as product branding, nutritional information, and barcodes.

5. \*\*Laser Marking:\*\*

- Laser marking is a non-contact printing method that uses a laser beam to create permanent marks on the packaging material. It is suitable for high-speed production environments and can be used to print alphanumeric codes, logos, and graphics directly onto salad leaf packs. Laser marking offers high-resolution printing, excellent durability, and resistance to fading or smudging.

6. \*\*Embossing or Debossing:\*\*

- Embossing or debossing involves creating raised or recessed impressions on the packaging material without the use of ink or foil. It can be used to imprint date codes, batch numbers, or other information onto salad leaf packs. Embossing or debossing offers a tactile, permanent marking solution that enhances the packaging's visual appeal and brand identity.

Each of these options for date and batch coding salad leaf packs has its advantages and considerations in terms of cost, speed, print quality, durability, and regulatory compliance. The choice depends on factors such as production volume, packaging material, coding requirements, and budget constraints.

**Question 3 (25 marks)**

1. **Describe the packing line for packaging individually wrapped cereal bars in a collation carton of six bars, from receipt of packaging materials to finished packed products ready for dispatch.**



**(16 marks)**

## Packing Line for Individually Wrapped Cereal Bars (Carton of Six)

This line takes individually wrapped cereal bars and packs them into collation cartons containing six bars each. Here's the breakdown of the process, from receiving materials to dispatch:

**1. Inbound Materials:**

* **Individually Wrapped Cereal Bars:** Delivered on pallets, typically in pre-printed flow wraps with product information and branding.
* **Collation Cartons:** Delivered flat-packed on pallets, pre-printed with branding and handling information.
* **Pallet Handling Equipment:** Forklifts or pallet jacks are used to maneuver pallets of incoming materials.

**2. De-palletizing and Wrapper Separation (Optional):**

* Depending on the setup, a de-palletizer might automatically unload pallets of cereal bars.
* If the cereal bars are wrapped together in a larger plastic wrap for transport, a wrapper separator might be used to separate individual bars onto a conveyor belt.

**3. Cereal Bar Conveyor:**

* A conveyor belt transports the individual cereal bars to the next stage. This conveyor might have infeed lanes to ensure proper spacing between bars.

**4. Vibratory Feeder (Optional):**

* In some cases, a vibratory feeder might be used to orient or separate the cereal bars before entering the cartoning system.

**5. Cartoning Machine:**

* This automated machine forms the flat-packed cartons into 3D boxes and fills them with the desired number of cereal bars. Here's a simplified breakdown of the cartoning process:
  + A vacuum or mechanical arm picks up a flat carton from a magazine.
  + The carton is folded and glued or heat-sealed to form a 3D box.
  + A counting system accurately dispenses six cereal bars (using volumetric cups, auger feeders, or vision systems) into the open carton.
  + The top flaps of the carton are folded and sealed shut using glue or heat sealing.

**6. Outfeed Conveyor:**

* The filled and sealed cartons exit the cartoning machine onto an outfeed conveyor.

**7. Case Packing (Optional):**

* Depending on the production volume and distribution needs, the cartons might be further packed into corrugated cardboard cases for bulk shipment. This would involve a separate case packing machine and a supply of pre-formed cases.

**8. Case Sealer (Optional):**

* If case packing is utilized, a case sealer automatically closes and seals the corrugated cases with tape or glue.

**9. Product Inspection (Optional):**

* In-line vision systems might be employed to inspect the filled cartons for missing bars, damaged packaging, or sealing issues. Rejected cartons can be automatically diverted for rework.

**10. Palletizing:**

* A palletizer, either robotic or automated, stacks the filled cartons (or sealed cases) onto pallets according to a pre-defined pattern for efficient stacking and transport.

**11. Stretch Wrapping:**

* A stretch wrapper applies a layer of plastic film around the completed pallet(s) to secure the load during transport.

**12. Labeling (Optional):**

* Depending on specific shipping or warehouse requirements, additional labeling with shipping information or barcodes might be applied at this stage.

**13. Dispatch:**

* The wrapped pallets are loaded onto trucks or other transport vehicles for final dispatch to warehouses or distribution centers.

**Additional Considerations:**

* **Line speeds:** The speed of the packing line will depend on the capabilities of the cartoning machine and the desired production output.
* **Sanitation:** Regular cleaning and sanitation protocols are crucial to maintain a hygienic environment, especially when handling food products.
* **Safety:** Safety measures like machine guards and proper operator training are essential to prevent accidents on the packing line.
* **Waste Management:** A system for collecting and disposing of any packaging waste generated during the process should be implemented.

By automating most of the steps, this packing line ensures efficient and consistent production of cereal bars packaged in collation cartons.

1. **Discuss three factors which contribute to overall equipment effectiveness of the line and provide an example how each could be improved.**

**(3 x 3)**

Based on the information provided in the search results, three key factors that contribute to the overall equipment effectiveness of a packaging line are:

1. Machine Efficiency and Productivity:

- Example: The introduction of new packaging materials or design changes may require machine modifications, leading to downtime, longer changeover times, and additional training costs for operators.

- Improvement: Carefully managing the introduction of new materials and designs, conducting thorough machine trials, and ensuring compatibility with existing equipment can help maintain high machine efficiency and productivity.

2. Packaging Material Selection:

- Example: The packaging material selected must be compatible with the packaging machinery, as even minor changes in the material can lead to problems with machine performance.

- Improvement: Selecting packaging materials after conducting comprehensive machine trials to ensure the required machine efficiency and productivity can be achieved. Closely coordinating between packaging development and production teams.

3. Logistics and Distribution Considerations:

- Example: Changes in primary packaging can have a knock-on effect on secondary packaging, impacting volume (cube) efficiencies during distribution and storage.

- Improvement: Considering the entire packaging system, including primary, secondary, and tertiary packaging, during the design and development process to ensure compatibility and optimization across the supply chain.

By addressing these factors and continuously improving them, the overall equipment effectiveness of the packaging line can be enhanced, leading to increased productivity, reduced downtime, and better integration with the broader supply chain and distribution requirements.

**Question 4 (25 marks)**

1. **Discuss how the correct amount of individually frozen prawns could be metered.**

**(5 marks)**

Metering the correct amount of individually frozen prawns is crucial to ensure accurate portioning, minimize product waste, and maintain product consistency. Here are several methods that can be used to meter the correct amount of individually frozen prawns:

1. \*\*Weight-based Metering:\*\*

- One common method is to use weight-based metering systems. In this approach, prawns are weighed using precision scales or load cells to measure the exact weight of each portion. This method ensures precise portioning and can be adjusted to meet specific weight requirements.

2. \*\*Volume-based Metering:\*\*

- Another method is volume-based metering, where prawns are portioned based on their volume or size. This approach is often used when weight-based metering is not feasible or when product consistency is more important than precise weight measurements.

3. \*\*Count-based Metering:\*\*

- Count-based metering involves portioning prawns based on the number of pieces rather than their weight or volume. This method is suitable for products with consistent sizes and shapes, such as individually frozen prawns, where each piece is expected to have a similar weight.

4. \*\*Automated Metering Systems:\*\*

- Automated metering systems utilize specialized equipment such as augers, vibratory feeders, or belt feeders to accurately meter prawns based on predetermined settings. These systems can be integrated into production lines for high-speed portioning and packaging operations.

5. \*\*Manual Metering:\*\*

- In some cases, manual metering may be used, particularly in small-scale operations or artisanal production settings. Skilled operators can portion prawns by hand based on visual inspection and experience, although this method may be less precise than automated metering systems.

6. \*\*Computer Vision and Image Processing:\*\*

- Advanced technologies such as computer vision and image processing can also be employed to meter prawns accurately. Cameras and sensors can analyze the size, shape, and orientation of individual prawns and adjust portioning parameters accordingly.

7. \*\*Combination Methods:\*\*

- In practice, a combination of metering methods may be used to achieve the desired level of accuracy and efficiency. For example, weight-based metering may be supplemented with visual inspections or count-based verification to ensure consistent portioning.

Overall, the correct amount of individually frozen prawns can be metered using a variety of methods, depending on factors such as production volume, product characteristics, and processing requirements. By selecting the most suitable metering method and implementing appropriate equipment and controls, manufacturers can ensure consistent and accurate portioning of prawns for packaging and distribution.

1. **Discuss the mechanisms and merits of level and volume filling for correct amount of olive oil into a glass bottle.**

**(10 marks)**

Level and volume filling are two common methods used to fill glass bottles with olive oil, each with its own mechanisms and merits:

1. \*\*Level Filling:\*\*

- \*\*Mechanism:\*\* Level filling, also known as gravimetric filling, relies on the principle of filling the bottle to a predetermined level. The bottle is positioned under a filling nozzle, and olive oil is dispensed until it reaches a specified height or level in the bottle. This is typically achieved by controlling the flow rate of the olive oil and monitoring the level using sensors or visual inspection.

- \*\*Merits:\*\*

- Accuracy: Level filling can provide precise and consistent filling levels, ensuring that each bottle contains the correct amount of olive oil.

- Visual Appeal: Level filling results in uniform fill levels across all bottles, enhancing the visual appeal of the product on store shelves.

- Control: The process can be easily controlled and adjusted to accommodate different bottle sizes and fill levels, allowing for flexibility in production.

- Minimal Product Loss: Level filling minimizes product loss or spillage since the fill level is precisely controlled, reducing waste and maximizing efficiency.

2. \*\*Volume Filling:\*\*

- \*\*Mechanism:\*\* Volume filling, also known as volumetric filling, involves dispensing a predetermined volume of olive oil into each bottle. This is typically achieved using a piston filler or rotary filler equipped with volumetric cylinders or pistons that measure and dispense a fixed volume of liquid.

- \*\*Merits:\*\*

- Speed: Volume filling can be faster than level filling, especially in high-speed production environments, as it does not rely on monitoring fill levels.

- Consistency: Volumetric filling ensures consistent fill volumes across all bottles, regardless of variations in bottle shape or size.

- Efficiency: The process can be highly automated, requiring minimal operator intervention and allowing for continuous production without frequent adjustments.

- Reduced Foaming: Volumetric filling can help reduce foaming of the olive oil, particularly when filling at high speeds, resulting in cleaner fill levels and reduced product waste.

In summary, both level and volume filling methods have their own mechanisms and merits for filling glass bottles with olive oil. Level filling offers precise control over fill levels and enhanced visual appeal, while volume filling provides speed, consistency, and efficiency, particularly in high-speed production environments. The choice between the two methods depends on factors such as production volume, accuracy requirements, and equipment capabilities.

1. **Describe a volumetric filling system suitable for the filling the correct amount talc into a tub.**

**(3 marks)**

A volumetric filling system for filling talc into a tub typically involves a specialized machine or equipment designed to accurately dispense a predetermined volume of talc powder into each container. Here's a description of a volumetric filling system suitable for filling talc into a tub:

1. \*\*Hopper or Supply Bin:\*\*

- The process begins with a hopper or supply bin that holds the talc powder. The hopper is equipped with mechanisms to ensure consistent flow of talc powder to the filling station.

2. \*\*Volumetric Filling Mechanism:\*\*

- The volumetric filling mechanism consists of one or more volumetric cylinders or pistons that measure and dispense a fixed volume of talc powder into each tub. The size of the volumetric cylinders or pistons can be adjusted to control the volume of talc dispensed.

3. \*\*Filling Nozzles or Chutes:\*\*

- Below the volumetric filling mechanism, there are filling nozzles or chutes that direct the talc powder into the tubs. These filling nozzles are positioned directly above the tubs to ensure accurate and precise filling.

4. \*\*Control System:\*\*

- The filling system is equipped with a control system that regulates the operation of the volumetric filling mechanism. The control system may include sensors, actuators, and programmable logic controllers (PLCs) to monitor and adjust the filling process based on parameters such as fill volume, speed, and accuracy.

5. \*\*Tub Conveyor or Indexing System:\*\*

- A conveyor belt or indexing system transports the tubs to the filling station and positions them beneath the filling nozzles. The conveyor or indexing system ensures smooth and continuous movement of the tubs throughout the filling process.

6. \*\*Optional Features:\*\*

- Depending on the specific requirements of the application, the volumetric filling system may include additional features such as dust collection systems to minimize powder spillage, anti-static devices to prevent powder clumping, and level sensors to detect when tubs are full.

7. \*\*Integration with Packaging Line:\*\*

- The volumetric filling system is typically integrated into a larger packaging line that includes additional equipment such as tub denesters, lid applicators, and labeling machines. This integration allows for seamless automation and optimization of the packaging process.

Overall, a volumetric filling system for filling talc into a tub provides accurate and efficient dispensing of talc powder, ensuring that each tub receives the correct amount of powder for the intended application. The system can be customized to meet specific production requirements and can be integrated into existing packaging lines for maximum efficiency.

**d) Discuss the difficulties of volume filling this type of product.**

**(3 marks)**

1. **Compare the use of fixed weight and variable weight approaches to retailing prepacked meat steaks.**

**(4 marks)**

**Question 5 (25 marks)**

1. **For the following printed packs, list the typical printing process used, for large scale production (i.e. not digital).**

| **Full colour printed pack** | **Typical process used** |  |
| --- | --- | --- |
| **Crisp bag** |  |  |
| **Folding carton** |  |  |
| **Corrugated case / Outer** |  |  |
| **Stand-up pouch (high quality)** |  |  |
| **Self-adhesive labels** |  |  |
| **Yogurt pot (direct printed)** |  |  |
| **Shelf-ready display pack** |  |  |
| **Carton for heavy valve** |  |  |
| **Beer bottle (direct printed)** |  |  |
| **Large TV screen outer** |  |  |
|  | **(10 marks)** | |

Here are the typical printing processes used for large-scale production of the listed printed packs:

Printed Pack | Typical Printing Process

--- | ---

Crisp bag | Flexographic printing

Folding carton | Offset lithographic printing

Corrugated case / Outer | Flexographic printing

Stand-up pouch (high quality) | Gravure printing

Self-adhesive labels | Flexographic printing or Offset lithographic printing

Yogurt pot (direct printed) | Rotary screen printing

Shelf-ready display pack | Flexographic printing

Carton for heavy valve | Offset lithographic printing

Beer bottle (direct printed) | Rotary screen printing

Large TV screen outer | Offset lithographic printing

Explanation:

1. Crisp bag: Flexographic printing is commonly used for flexible packaging like crisp bags due to its ability to print on a wide range of substrates, including plastic films.

2. Folding carton: Offset lithographic printing is the typical process for folding cartons as it provides high-quality, full-color printing suitable for premium packaging.

3. Corrugated case / Outer: Flexographic printing is the preferred method for corrugated cases and outer packaging due to its cost-effectiveness and suitability for printing on coarser substrates.

4. Stand-up pouch (high quality): Gravure printing is often used for high-quality stand-up pouches as it offers excellent print quality, especially for photographic images and gradients.

5. Self-adhesive labels: Both flexographic and offset lithographic printing are common for self-adhesive labels, depending on the specific requirements and quality needs.

6. Yogurt pot (direct printed): Rotary screen printing is typically used for direct printing on yogurt pots and other rigid plastic containers.

7. Shelf-ready display pack: Flexographic printing is the go-to process for shelf-ready display packs, as it can handle the corrugated and coated substrates used.

8. Carton for heavy valve: Offset lithographic printing is preferred for high-quality cartons, such as those used for heavy valves, due to its superior print quality.

9. Beer bottle (direct printed): Rotary screen printing is the typical process for direct printing on glass bottles, including beer bottles.

10. Large TV screen outer: Offset lithographic printing is commonly used for large, high-quality outer packaging, such as those for TV screens, due to its versatility and print quality.

1. **Choose one of the above printing processes and describe the process fully with the aid of an annotated diagram. Include details on the plate type, ink type, drying method and typical substrates along with a brief description with of the transfer / application method for that process.**

**(15 marks)**

## Flexographic Printing Process Breakdown with Diagram

Flexography (Flexo) is a widely used printing process for large-scale production of various packaging materials. Here's a detailed breakdown of the process with an annotated diagram:

**Process:**

1. **Prepress:** The design is created digitally and prepared for printing. This involves separating the image into individual colors and creating printing plates.
2. **Plate Making:** Flexible photopolymer plates are used. These plates are imaged using a laser that hardens the desired printing areas while leaving the non-printing areas soft. The plates are then washed to remove the uncured resin, creating a raised image relief on the plate.

**Annotated Diagram:**

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

| Artwork | (1)

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

|

v

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

| Plate Making | (2)

| (Photopolymer Plate) |

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

|

v

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

| Printing Unit | (3)

| (One per Color) |

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

|

v

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

| Substrate | (4)

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

|

v

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

| Finished Print | (5)

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

**Explanation:**

(1) **Artwork:** The design is created using graphic design software and separated into individual colors (CMYK or spot colors) for plate creation.

(2) **Plate Making:** A photosensitive resin is applied to a flexible photopolymer plate. The separated color artwork is then used to create a laser image on the plate. The laser light hardens the resin in the image areas, while the non-image areas remain uncured. The plate is then washed to remove the uncured resin, leaving a raised image relief that corresponds to the design.

(3) **Printing Unit:** The printing press consists of multiple printing units (one for each color). Each unit has: \* **Anilox Roller:** A cylinder with a precisely engraved surface holding ink. \* **Doctor Blade:** A thin metal blade that scrapes excess ink off the anilox, ensuring a consistent ink film thickness. \* **Printing Plate:** The photopolymer plate with the raised image. \* **Impression Cylinder:** Presses the substrate against the plate during printing.

(4) **Substrate:** The material being printed on, such as plastic film, paperboard, or foil.

(5) **Transfer/Application Method:** \* The anilox roller comes into contact with the ink fountain, filling the engraved cells with ink. \* The doctor blade scrapes the anilox, leaving a thin layer of ink on the raised image areas of the printing plate. \* The substrate is pressed against the printing plate by the impression cylinder. As the substrate makes contact with the raised image areas, the ink is transferred from the plate to the substrate, creating the printed image.

**Ink Type:** Flexo typically uses solvent-based inks, water-based inks, or UV-curable inks depending on the substrate and desired properties.

**Drying Method:** The ink drying method varies depending on the ink type: \* Solvent-based inks: Dry through evaporation of the solvent. \* Water-based inks: Drying is often assisted by heated air dryers within the printing press. \* UV-curable inks: Dry instantly when exposed to UV light lamps integrated into the press.

**Typical Substrates:** Flexography can handle a wide range of flexible and semi-flexible substrates, including:

* Plastic films (e.g., polyethylene, polypropylene)
* Paperboard (e.g., for folding cartons)
* Metal foils
* Non-woven fabrics
* Labels

Flexography is a versatile and cost-effective process ideal for high-volume printing on various packaging materials. Its ability to handle flexible substrates and a wide range of inks make it a popular choice for the production of a variety of printed packs.