“Advances in Packaging Material Analysis”

Sreedath Tulamandi
Assistant Director
Indian Institute of Packaging
Bangalore
Packaging is the science, art, and technology of enclosing or protecting products for distribution, storage, sale, and use.

Packaging can be described as a *coordinated system* of preparing goods for transport, warehousing, logistics, sale, and end use.
Functions of Packaging

TO PRESERVE
- Foods are packaged to prevent them from going rotten.
- It also keeps them hygienic and allows them to be bought conveniently.

TO PROTECT
- The packaging protects the contents, allowing the contents to arrive at the shop or at home undamaged.

TO INFORM
- Labels provide information about the product to the customer or shop.
- They can be used as a marketing tool.
- They can make claims to a customer.
- They can carry information for shops in barcodes.

TO TRANSPORT
- Items are packed into boxes or trays called ‘Outers’ so that they can be moved, and stacked easily.
- Packaging usually tessellates to allow more to be transported in a smaller lorry, reducing costs.
• Primary package:
  – The first wrap or containment of the product that directly holds the product for sale.

• Secondary package:
  – A wrap or containment of the primary package.

• Distribution package (shipper):
  – A wrap or containment whose prime purpose is to protect the product during distribution and to provide for efficient handling.

• Unit load:
  – A number of distribution packages bound together and unitized into a single entity for purposes of mechanical handling, storage, and shipping.
Packaging can have many levels. All levels of the system must work together.

**Item** - A single unit for sale.

**Inner Pack** - A level of packaging inside a case that contains multiples of the single unit.

**Case** - A box, carton or bale that contains multiple items or multiple inner packs.

**Pallet** - A shipping platform upon which one or several cases are shipped.
Types of Packaging Materials

- Paper
- Board
- Plastic
- Metal
- Glass
- Wood
Why Plastics for Packaging?

- Light in weight
- Non Toxic
- Barrier Properties
- Resistant to Chemicals
- Can be Sterilized
- Process-ability
- Transparent & clear
- They do not corrode in humidity
- They do not promote any bacterial growth
Major Plastic Materials used in packaging

- **PVC**
  - Poly Vinyl Chloride
  - Blister Packaging & Inner Trays
- **HDPE**
  - High Density Polythene
  - Juice & Shampoo Bottles
  - Detergent Bottles
  - Milk Cartons
  - Bottle lids
Major Plastic Materials used in packaging

- **LDPE**
  - Low Density Polythene
  - Carrier Bags

- **PS**
  - Polystyrene
  - Squeezy Bottles
  - Yoghurt Pots & Food Trays

- Expanded PS: Egg & takeaway cartons, protective packaging
Major Plastic Materials used in Packaging

- Polypropylene (PP)
  - Packaging: activity pack cases
  - Sauce squeeze
  - Biscuit & crisp packets

- Polyester (PET)
  - Oven ready meal roasting bags
  - Oven Ready Rooster
  - Fizzy drink bottles
Flexible Packaging

- Non-rigid packaging structures used to package and protect various food and non-food products in the retail and industrial business forum.

- Covers a wide range of packaging that can be single and multi-layered.

- It can be paper/poly/foil or nylon or a combination of materials which are supplied either plain/printed/coated and/or laminated to provide long shelf life properties. End products packaged include confectionery, snack foods, frozen foods, soups and pharmaceuticals.
## Test methods & specifications for flexible packaging

<table>
<thead>
<tr>
<th>Standard Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS : 2508 - 1984</td>
<td>• Low Density Polyethylene Films</td>
</tr>
<tr>
<td>IS : 7903 - 2011</td>
<td>• Textiles - Tarpaulins Made From High Density Polyethylene Woven Fabric</td>
</tr>
<tr>
<td>IS : 12265 - 1987</td>
<td>• Flexible packs for the packing of edible oils</td>
</tr>
<tr>
<td>IS : 11652 - 2000</td>
<td>• Textiles - Woven Sacks for Packing Cement - High Density Polyethylene (HDPE)/Polypropylene (PP)</td>
</tr>
<tr>
<td>IS : 11352 - 1998</td>
<td>• Flexible pouches for the packing of vanaspati up to 5 kg or 5 liters</td>
</tr>
<tr>
<td>IS : 9845 - 1998</td>
<td>• Determination of Overall Migration of Constituents of Plastics Materials and Articles Intended to Come in Contact with Foodstuffs - Method of Analysis</td>
</tr>
<tr>
<td>IS : 6899 - 1997</td>
<td>• Textiles - High density polyethylene (HDPE) woven fabrics</td>
</tr>
<tr>
<td>IS : 11198 - 1985</td>
<td>• Polypropylene (PP) woven sacks for packing fertilizers</td>
</tr>
<tr>
<td>IS : 9755 - 2003</td>
<td>• Textiles - High Density Polyethylene (HDPE) / Polypropylene (pp) Woven Sacks for Packing Fertilizers</td>
</tr>
<tr>
<td>IS : 2076 - 1981</td>
<td>• Unsupported Flexible Polyvinyl Chloride Sheeting</td>
</tr>
<tr>
<td>IS : 11805 - 2007</td>
<td>• Polyethylene Pouches for Packaging Liquid Milk</td>
</tr>
<tr>
<td>IS : 8069 - 1989</td>
<td>• High density polyethylene (HDPE) woven sacks for packing pesticides</td>
</tr>
<tr>
<td>TEST</td>
<td>EQUIPMENT</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Density</td>
<td>Electronic Balance</td>
</tr>
<tr>
<td>Melt Flow Index</td>
<td>Melt Flow Index Tester</td>
</tr>
<tr>
<td>Thickness</td>
<td>Thickness Tester</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>UTM</td>
</tr>
<tr>
<td>Elongation at break</td>
<td>UTM</td>
</tr>
<tr>
<td>Impact Resistance</td>
<td>Dart Impact Tester</td>
</tr>
<tr>
<td>Carbon Black</td>
<td>Carbon Black Tester</td>
</tr>
<tr>
<td>Appearance</td>
<td>Observation</td>
</tr>
</tbody>
</table>

**IS : 2508 (1984) - Low Density Polyethylene Films**
## IS : 2508 (1984) - Low Density Polyethylene Films

<table>
<thead>
<tr>
<th>TEST</th>
<th>EQUIPMENT</th>
<th>RANGE &amp; UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>Scale</td>
<td>mm</td>
</tr>
<tr>
<td>Haze</td>
<td>Haze Meter</td>
<td>%</td>
</tr>
<tr>
<td>Yield</td>
<td>calculation</td>
<td>%</td>
</tr>
<tr>
<td>Co efficient of Friction</td>
<td>Co efficient of Friction tester</td>
<td>-</td>
</tr>
<tr>
<td>Gloss</td>
<td>Gloss meter</td>
<td>%</td>
</tr>
<tr>
<td>Carbon black dispersion</td>
<td>Micro scope</td>
<td>%</td>
</tr>
</tbody>
</table>
### IS : 7903 (2011) Textiles - Tarpaulines Made From High Density Polyethylene

**Woven Fabric**

<table>
<thead>
<tr>
<th>TEST</th>
<th>EQUIPMENT</th>
<th>RANGE &amp; UNIT</th>
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</thead>
<tbody>
<tr>
<td>Identification of the Major Component</td>
<td>DSC</td>
<td>HDPE</td>
</tr>
<tr>
<td>Carbon Black Content</td>
<td>Carbon black content tester</td>
<td>Min: 2.5%</td>
</tr>
<tr>
<td>Dimensions (L X W)</td>
<td>Measuring Tape</td>
<td>mm</td>
</tr>
<tr>
<td>Mass</td>
<td>Electronic Balance</td>
<td>Min: 200 g/m²</td>
</tr>
<tr>
<td>Breaking Strength &amp; Elongation</td>
<td>UTM</td>
<td>Min: 981 N</td>
</tr>
<tr>
<td>Welded Seam Strength</td>
<td>UTM</td>
<td>Min 65% of the breaking load</td>
</tr>
<tr>
<td>TEST</td>
<td>EQUIPMENT</td>
<td>RANGE &amp; UNIT</td>
</tr>
<tr>
<td>---------------------------</td>
<td>--------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Tongue Tear Strength</td>
<td>UTM</td>
<td>Min: 120 N</td>
</tr>
<tr>
<td>Puncture Resistance</td>
<td>UTM - TINIUS</td>
<td>Min: 200 N</td>
</tr>
<tr>
<td>Color Fastness to Light</td>
<td>Blue wool and Grey scale standards</td>
<td>-</td>
</tr>
</tbody>
</table>
Testing and Evaluation of Plastic Films, Laminates & Pouches

- Thickness
- Tensile Strength & Elongation
- Stripping Strength
- Heat Seal Strength
- Dart Impact Test
- Gloss & Haze
- WVTR & OTR
- Co-efficient of Friction
- Flex Crack Resistance (Gelbo)
- ESCR (Environmental Stress Crack Resistance)
- Migration Test
**Thickness**

**Standard:** IS 2508 – 1984
Low Density Polyethylene Films

**Unit:** mm / Gauge / Microns

**Equipment:** Dial Gauge Micrometer

**Affects:**
- Mechanical properties
- Barrier properties
- Seal-ability and
- Product protection.
• The maximum stress that a material can withstand while being stretched or pulled apart

• Depends on the fiber strength, mostly on degree of bonding between fibers

**Standard**: As per ASTM D 882

**Unit**: Kg/cm²

**Equipment**: Shimadzu UTM

**Strain / Elongation** – change in length / original length and given as percentage
Density

The weight per unit volume of Material

**Equipment**: Density Meter

**Unit**: g/cc

**Standard**: IS:2508, ASTM D1895

**Significance**: Criteria for identification of material
HAZE

Standard : ASTM D 1003

Equipment : Haze Meter

Unit : Percentage
**Standard**: ASTM D-2457

**Equipment**: Gloss meter

**Unit**: Percentage Measurement Of Shining Appearance Of Film

**Significance**: Comparative study of surface property and aesthetic appearance
HEAT SEAL STRENGTH

- **Standard Used**: ASTM F 88
- **Equipment**: Shimadzu UTM
- **Unit**: Kgf/25mm
- **Depends On**: Dwell Time, Temperature, Pressure, Seal Contamination, Thickness Variation, MFI, Type Of Sealant Layer, Type Of Sealing Process (Impulse / High Frequency / Ultrasonic).
**PEEL or STRIPPING STRENGTH**

**Standard**: ASTM D 903

**Equipment**: Tensile Tester.

**Unit**: gf/25mm.

Reliability of continuing adhesion during packaging, sealing and storage.

**The Degree Of Bond Varies** :-

- The Adhesive Used.
- The Quantity Of Adhesive.
- Affinity To Moisture.
- Excess Solvent Retention.
- Climatic Conditions.
DART IMPACT TEST

- **Standard**: IS 2508 – 1984
- **Equipment**: Dart Impact Tester
- **Unit**: gf at 50% failure

<table>
<thead>
<tr>
<th>Films</th>
<th>Drop Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Impact Film</td>
<td>220 mm</td>
</tr>
<tr>
<td>Normal Impact</td>
<td>660 mm</td>
</tr>
<tr>
<td>High Impact</td>
<td>1524 mm</td>
</tr>
</tbody>
</table>
COEFFICIENT OF FRICTION

Standard: ASTM D-1894

Equipment: Mecmesin Friction Tester

Unit: unit-less

Two types: static & dynamic

Related to slip properties of films.

It can be film to film or film to metal COF
Standards: ASTM F 392

Equipment: United States Testing Co. Inc. (5000 ES)

- Gelbo-flex tester is used to determine the flex crack resistance for the materials or products including
  - Flexible plastic films
  - Coextruded structures
  - Coated films and paper
**WATER VAPOUR TRANSMISSION RATE**

- **Standard**: IS 1060 –II & ASTM F - 1249
- **Equipment**: Mocon WVTR tester/ Dish method
- **Unit**: (g/m²/24 hrs.) At 38 ± 1 °C & 90 ± 2% RH.
- Most important barrier property for moisture sensitive products
- Decides shelf life of the products
- Directly proportional to thickness
- Varies from polymer to polymer
Standard: ASTM D 1434

Equipment: Mocon OTR Tester

UNIT: cc / m²/ 24 hrs. At 23°C and 1 atm pressure

Most important property for oxygen sensitive products

Used to test vacuum packaging / gas packaging materials
Standard: IS 9845

The phenomenon of transfer of substances from the package to the product.

Unit: ppm, mg / (dm)$^2$, mg / L

The constituents which are transferred are known as migrants.

Types of migration: Specific migration & Overall migration.
THANK YOU

iipbangalore@iip-in.com