PLASTIC PACKAGING

Plastics are derived from natural organic materials such as cellulose, coal, natural gas, salt and crude oil.

There are two main processes used to produce plastics,

1. Polymerization

2. Polycondensation

In polymerization reactions monomers such as ethylene and propylene are linked together to form long polymers chains. Each polymer has its own properties, structure and size depending on the various types of basic monomers used.

The thermal and mechanical properties can be partially modified in order to manufacture plastics that have a high melting point, or thermosealable packages making.

Plastics with a low melting point are used to develop very flexible structures (sachets and wrappings), semi-rigid structures (trays and tubs) and rigid structures (bottles, closures and tanks).

Advantages of Plastic Packaging

1. Light weight
2. Reduced volume (warehousing & distribution cost reduction).
3. No corrosion problems.
4. Good resistance to mould & bacteria.
5. Generally inert chemically.
6. Usually have good impact strength; difficult to break, if breakage occurs fragments tend to be less dangerous than glass.
7. Wide design & decorative possibilities

Disadvantages of Plastic Packaging

1. No plastic is totally impermeable to moisture, gases etc.
2. Most plastics permit some passage of light. Even highly pigmented plastics & those with UV absorber are likely to let certain wavelengths through.
3. Many are difficult to clean or are liable to attract dust & dirt under unfavorable conditions.
4. May be permeable to, or subject to attack by, organic substances, particularly solvents.

5. Subject to adsorption or absorption according to formulation ingredient.
6. Light weight & thin wall section may require specific production line handling.
7. Fully effective closing systems are sometimes difficult to achieve.

Types of Plastics

1) **Thermoplastic Polymers**

   These are heat softening materials which can be repeatedly heated, made mobile & then reset to a solid state by cooling. They are easily molded and converted into films, fibers and packaging. Examples include polyethylene, polypropylene, polyvinyl chloride, nylon, and polyester.

2) **Thermosetting Polymer**

   These are polymers produced by a polymerization process involving a curing stage during which the material becomes 'set' to a permanent state by heat & pressure. Further heating leads to decomposition of the plastic. E.g. Phenolics, urea, polyesters and cross linked polymers.

PLASTICS USED FOR PACKAGING

1. High Density Polyethylene (HDPE)

a) Low-cost
b) Easy to process and easy to form
c) Moderately flexible
d) Stiffer and has better barrier properties-moisture
e) Chemical resistant\Not attack by most solvent
f) Odorless and tasteless
g) HDPE is a harder plastic and has a higher melting point than LDPE.

Disadvantages

a) Poor barrier for oxygen & other gases
b) Odors and flavors are sometimes lost
c) Perfume or flavoring oil can transpire rapidly
d) Poor clarity

Applications

a) Items made from this plastic include containers for milk, motor oil, shampoos and conditioners, soap bottles, detergents, and bleaches. It is NEVER safe to reuse.

b) Industrial and consumer bags and thermoformed trays

2. Low Density Polyethylene (LDPE)

a) Odorless and tasteless
b) Easily blended with copolymers
c) Highly resistant to most solvent
d) Poor barrier for gases
e) Softening temperature is around 210ºF
f) Easily pigmented
g) Good transparency

Advantages

a) Flexible
b) Moisture barrier
c) Tough
d) Chemical resistant
e) Light weight
f) Low cost
g) Heat sealable

Disadvantages

a) Problem in flavors and odors
b) Stress cracking
c) Not recommended for oily products

Applications

d) Use in squeezable tubes and bottles
e) Wrappers and bags for different products
f) Thermoformed into trays, frozen food containers
g) Coating material for bottle cartons, wrappers and paperboard milk containers

3. Linear Low Density Polyethylene (LLDPE)

a) Low-cost
b) Light weight
c) Superior toughness
d) Rigid

e) Flexible
f) Moisture barrier
g) Chemical and stress-crack resistant

Advantages

a) Good tensile strength
b) Puncture resistance
c) Good impact and tear properties
d) Stress cracking resistance

Application

a) For large-sized bagging and wrapping operations

4. Polypropylene (PP)

a) Heat and chemical resistance
b) Tough & rigid
c) Resist oil and greases
d) Stress-crack resistance
e) Fairly good barrier to moisture and gases
f) High melting point

Advantages

g) Light weight
h) Low-cost
i) Less shrinkage

Disadvantages

a) Low impact strength
b) Sharp melting point

Applications

a) It is used to make lunch boxes, margarine containers, yogurt pots, syrup bottles, prescription bottles.
b) Plastic bottle caps are often made from PP.
c) Suitable for some boil-in-bag packages and containers

5. Polyvinyl chloride (PVC)

a) Crystal clear

b) Low in impact strength
c) Tough and has good puncture resistance
d) Good barrier properties (moisture and gases)
e) Retains odors and flavors

Advantages

a) Relatively inexpensive
b) Tough
c) Clear

Disadvantages

a) Corrosive when overheated
b) Yellows when exposed to heat or UV light
c) Scratches easily seen

Applications

a) Blister packaging for pharmaceutical and capsules
b) Garment, box and pallet load wrapping applications
c) PVC is used for all kinds of pipes and tiles, but is most commonly found in plumbing pipes.
d) This kind of plastic should not come in contact with food items as it can be harmful if ingested.

6. Nylon

a. Structurally strong
b. Relatively low moisture absorption
c. Good dimensional stability
d. Heat sealability

Advantages

a) Clear
b) Good barrier properties to gases
c) Excellent stability at both high and low temperature

Disadvantages

a) Can be oxidized causing nylon to lose strength

Applications

a. Coating on paperboards, papers and foils

b. Extrusion-blow-molded containers for hard to-hold chemicals

7. Polyester (Polyethylene Tetraphthalate)

a) Excels in strength, toughness and clarity
b) Resistant to weak acids, bases and most solvents
c) Not good barrier for gases

Advantages

a) Fairly stiff material
b) Excellent transparency
c) Excellent heat, low temperature and water resistance
d) Excellent oil, chemical and solvent resistance
e) Excellent barrier to aroma and Flavor

Disadvantages

a) Poor seal property
b) High cost

8. Polystyrene (PS)

a) Crystal clear and very hard, brittle and rigid
b) Low melting point (190ºF)
c) Poor impact strength
d) Not good barrier for moisture or gases
e) Odorless and tasteless

Advantages

a) Clear and light weight
b) Low in cost
c) Easily molded, thermoformed and extruded into film
d) Accept printing, metallizing and hot-stamping

Disadvantages

a) Slight tendency to shrink
b) Discolor in strong sunlight
c) Can craze and become cloudy

Applications

a) Bottles for pharmaceutical tablets and capsules

b) In molded forms for close containment of fragile products

9. Polycarbonate

a) Good clarity, impact strength and low controllable mold shrinkage
b) Sterilizable and tolerates gamma radiation
c) High-priced material

Advantages

a) Great clarity, toughness and high softening temperature
b) Dimensionally stable and processable
c) Odorless and non-staining

Disadvantages

a) High- cost
b) High permeation of moisture and gases
c) Sensitive to oxygen and carbon dioxide