

Hazards from packaging material to food

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Introduction

- Most of the packaging related regulatory initiatives are concerned to the Product quality, Public Health and Hygiene, Safety, Export Promotion, Transportation and Consumer protection.
- Packaging needs to communicate clearly all the mandatory information about the product to the consumer.
- This helps in protecting the consumers from accidents that could occur while opening the pack or during disposal, as in the case of glass bottles.
- To ensure product quality and provide safety to the consumer, it is important to regulate manufacturing, distribution, marketing and retailing of packaged products.
- Due to the sensitive nature of food, stringent rules and regulations have been mandated to address specific issues that could arise due to faulty packaging.

Negative Effects of Plastics as Packaging Material

Negative health effects

- PVC (polyvinyl chloride) contains numerous toxic chemicals called **adipates and Phthalates ("plasticizers")**. Chemical used to make PVC, vinyl chloride, as a **known human carcinogen**.
- **Plasticizers** used to make soft PVC for toys can leach out into the mouths of the children chewing on the toys. In 2006, the EU placed a ban on six types of phthalate softeners, including DEHP (diethylhexyl phthalate), used in toys. An alternative plasticizer, DINP (diisononyl phthalate) is also found to be risky.
- **Vinyl chloride monomer:** Vinyl chloride is a known human carcinogen that causes a rare cancer of the liver.
- **Dioxins:** The dioxin is produced as a byproduct of vinyl chloride manufacture and from incineration of waste PVC in domestic garbage
- Dioxins are a global health threat because they persist in the environment and can travel long distances

- At very low levels, dioxins have been linked to immune system suppression, reproductive disorders, a variety of cancers, and endometriosis.
- Toxic compounds from PS (polystyrene) is a possible human carcinogen.
- Primary building block of polycarbon is bisphenol A (BPA), a hormone disrupter that releases into food and liquid and acts like estrogen.
- Leached from the lining of tin cans, dental sealants and polycarbonate bottles
- Low-level exposure to BPA results in insulin resistance, which can lead to inflammation and heart disease.

Negative effects on environment

- Plastics are durable and **degrade very slowly**.
- In some cases, burning plastic can release **toxic fumes**.
- The manufacturing of plastics often creates **large quantities of chemical pollutants**.
- Thermoplastics can be remelted and reused, and thermoset plastics can be ground up and used as filler, though the purity of the material tends to degrade with each reuse cycle.
- To assist recycling of disposable items, the Plastic Bottle Institute of the Society of the Plastics Industry devised a now-familiar scheme to mark plastic bottles by plastic type.

A recyclable plastic container using this scheme is marked with a triangle of three "chasing arrows", which encloses a number giving the plastic type i.e. Resin identification code.

Unfortunately, recycling plastics has proven difficult. The biggest problem with plastic recycling is that it is difficult to automate the sorting of plastic waste, and so it is labor intensive.

Recycling certain types of plastics can be unprofitable, as well, e.g. polystyrene is rarely recycled because it is usually not cost effective.

These unrecyclable wastes can be disposed of in landfills, incinerated or used to produce electricity at waste-to-energy plants.

Residual Toxic Components Present in Plastics

- Great number of substances are extracted by food such as plasticizers, pigments, catalyst, adhesives and monomers or low molecular weight, polymer/oligomers and these are hazardous and toxic for human health.
- Even leaching of plasticizers by liquid product from packaging material results into embrittlement of the packaging material itself.
- The preservatives in food/pharmaceutical are absorbed into plastic and therefore the resulting unprotected product leads to spoilage.
- In case of PE bottles, the milk fat gets into plastic by absorption and it results into rancidity of the product and therefore such bottles can't be reused.

Food grade plastics, two types of limits are fixed:

- **1. Global/overall migration:** Includes all substances (from plastics) transferred to food i.e. sum of all mobile packaging components transferred to food. They may be toxic/non-toxic, even substances physiologically harmless and even unknown also.
- **2. Specific migration:** Includes one or two individual, identifiable components only. For these reasons Toxicological substances and Labeled components are used.
- Global migration limits of 60 mg/kg of food stuff or 10 mg/cm² is been suggested by EEC
- In India, BIS and CCFS (Central committee on Food Standards) has prepared the Guide lines.
- PVC: The VC monomer content limit:1 ppm (max).
- PS: Styrene monomer limit: 0.2% by mass of polymer.

Residual toxic compounds likely to be transferred to food through plastics

- **Monomers and oligomers:** Polymers have very high molecular weight and hence not assimilated by the body. Monomers being small may be assimilated by the body and therefore may pose health problems.
- **Polymerization residues:** There may be presence of catalysts, solvents, emulsifiers and wetting agents having low molecular weight. During film container manufacturing a variety of processing aids are added which are:
 - **Antioxidants:** To prevent fading of colour and prevent cracking, viz. BHA/BHT etc.
 - **Antiblock agents:** To avoid blocking of film i.e. when it is drawn rolled the film surfaces should not adhere to each other.

➤ **Antistatic agents:**

- They are important in packaging industries, when two materials/surfaces are in contact,
- the electrons on the surface atoms intermingle and may move from one material to another.
- The nature of plastic will determine the degree to which this takes place e.g. PS is most active followed by Acrylic and PE.
- Friction between the materials increases movement of electrons when they are separated.

Absence of antistatic agents may lead to:

- 1. Fire/spark hazard
- 2. Dust attraction and
- 3. Difficulty in Derolling

Presence of moisture in air causes ionization resulting into neutralized electrons. The antistatic agents absorb moisture from air.

➤ **Plasticizers:**

- At lower processing temperature they avoid decomposition of polymer and modify processing characteristics like flexibility. Acting as lubricant.
- They allow the molecules of plastic to slide over one another freely or by acting as a partial solvent for the resin.
- Plasticizers tend to ooze out during long contact or high temp and they may migrate from one plastic to another (e.g. from vinyl to PS if they are in contact).
- They may also leach out by solvents or by liquid product.
- Even some plastic becomes stiff and brittle when cold.
- Greatest use of plasticizers is in PVC – PVA. For e.g. Dioctyl phthalate (DOP), therefore PVC has poor resistance to oil. About 33% of DOP migrate into oil products.

➤ **Lubricants:**

- Internal lubricants such as Fatty acid glycerides reduce friction between plastic molecules
- External lubricants like Montanic acid reduce friction with processing equipments.

➤ **Slip agents:**

- Silicon components helps in easy rolling/derolling of film

Many additives used, may migrate to food. Therefore **limit has to be specified** along with list of safe components.

However, **in case of recycled materials**, it is almost impossible to have migration within the prescribed unit, hence **should never be used for food materials.**

Methods of reducing migration from packaging material to food

- Use of new migration resistant plasticizers.
- Improvement in formulation to reduce greatly their use.
- Surface treatment of finished plastic products to reduce plasticizer migration (U.V. light, laser radiation treatments given).
- Plasticizers related to cancer by International Agency for Research on Cancer are:
 1. DEHA- BIS-2-Ethyl Hexyl Adipate BBP: Butyl Phenyl Methyl or Butyl Benzyl Phthalate
 2. DEHP- Bis-2- Ethyl Myxyl or Di-Ethyl Hexyl Phthalate

Factors involved in migration

- Composition and properties of packaging materials
- Composition and properties of food stuffs
- Surface (plastic) to volume (food) ratio
- Temperature conditions
- Duration of contact
- Influence of light

THANK YOU