

# ***PET IN PACKAGING : DISPELLING MYTHS AND MISCONCEPTIONS***

***Seminar on PET : Globally Accepted Pharma Packaging Solution  
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# ***POLYMER MATERIALS***

- Global production : > 250 million tons
- Employment : 60 million jobs
- Global consumption : 30 kg per capita
- Business value : US \$ 1200 billion per annum
- Consume less than 10% of fossil hydrocarbons
- India's production : 7 million tons
- India's consumption : 5-6 kg per capita

***Polymer materials offer great value proposition to consumers in terms of maximum functionality at lowest cost***

# SYNTHETIC POLYMERS

- **Plastics**

- Water bottles
- Packaging materials
- Tote bag / luggage
- Auto components



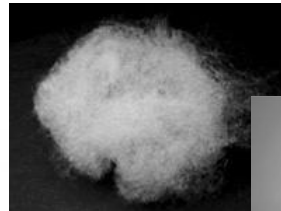
- **Rubbers (Elastomers)**

- Tires
- Latex Gloves
- Chewing gum



- **Fibers**

- Fillings in Pillows
- Apparels
- Stockings



## ***MANUFACTURE OF POLYMERS ARE GREAT EXAMPLES OF GREEN CHEMISTRY***

- Most polymers are manufactured in gas phase or melt phase where only the reactants are present ( Polyolefins, PET, Nylons, PC etc)
- Most frequently used medium : water for emulsion and suspension polymers (Polystyrene, PVC)
- Current catalytic processes have turn over frequencies approaching those of enzymatic catalysts with less than 1 % of the monomer vented as unreacted monomer and low residual metal impurities ((less than 3 ppm)
- Very little solid or liquid wastes
- High energy efficiency
- Exploit fully the economy of scale

***Polymers are truly miracles of chemistry and engineering***

# PACKAGING : WHY IS IT IMPORTANT ?

## ➤ Earlier View

Just to hold a material

## ➤ Current View

Protect the material

Ease of transportation and handling

Brand creation

Attract customers

*PET as a packaging material  
has been with us since 1977*



## WHY PET FOR PACKAGING ?

- Transparent
- Unbreakable
- Light weight
- Inert, pure and safe for food contact applications
- Safety: Pilfer-proof, user friendly
- Sustainable ; uses less than 0.15 % of the world's oil resources to meet the entire needs of mankind
- Can be recycled to fiber/resin
- Upon incineration generates only heat, CO<sub>2</sub> and water



***PET Is leaner, cleaner, greener and offers great value in packaging !***

  
plantbottle®  
up to 30% plant-based  
100% recyclable bottle  
redesigned plastic,  
recyclable as ever.



## ***ARE PET BOTTLES SAFE ?***

- ***General toxicity and genotoxicity of PET : No threat***

- Chemically inert
- PET does not produce dioxins when heated or microwaved
- Biologically inert if ingested
- Not hazardous if inhaled
- Dermatologically safe
- PET contains no known endocrine disruptor chemicals; In all the years of its use there is no evidence to prove that there has been any effect on reproductive cycles



***PET is “100% safe” and approved by global regulatory authorities***

# **PET CONFORMS TO ALL GLOBAL STANDARDS OF SAFETY**



**21 CFR 177.1630**



**2002/72/EC**



**IS : 12252-1987 (2005); IS 12229-1987; IS 12252-1987**

**Indian Pharmacopeia**

**IP 2010, General Chapter 6.2.3**

**Indian Drugs and  
Cosmetics Act**

**Schedule M, Section 16.10 (1940)  
Schedule M, para 11 (1945)**



## **PET : SOME MYTHS**

- **Do PET bottles contain Bisphenol-A?**

*BPA is not used in PET's manufacture. Factual errors or confusing statements occasionally appear which are totally wrong*

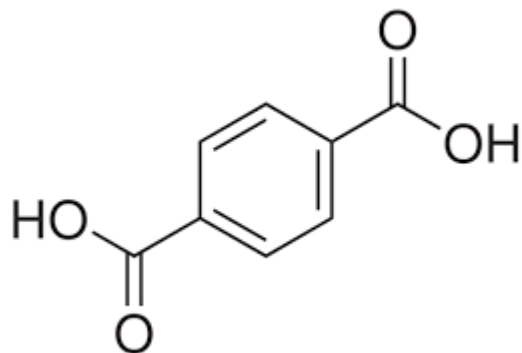
- **Some plastics contain plasticizers and stabilizers that can transfer to foods; does PET contain any similar additives?**

*PET used for food/ medical applications is in a very pure form, free from any added stabilizers/additives, which can migrate into or affect the packaged material. Dioctyl phthalate, a low molecular weight liquid, called plasticizer, is never used in PET. This is normally found in flexible PVC.*

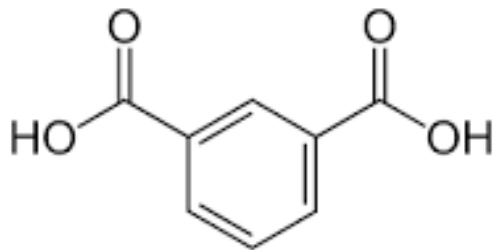
- **Can PET release any other harmful chemicals ?**

*No harmful chemical has been detected in any measureable amounts from PET containers under any condition of use*

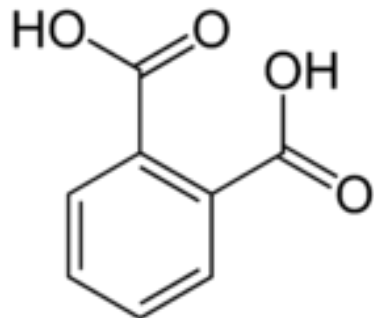
## ***PHTHALIC ACIDS : ISOMERS***



1,4- Benzene dicarboxylic acid  
Terephthalic acid

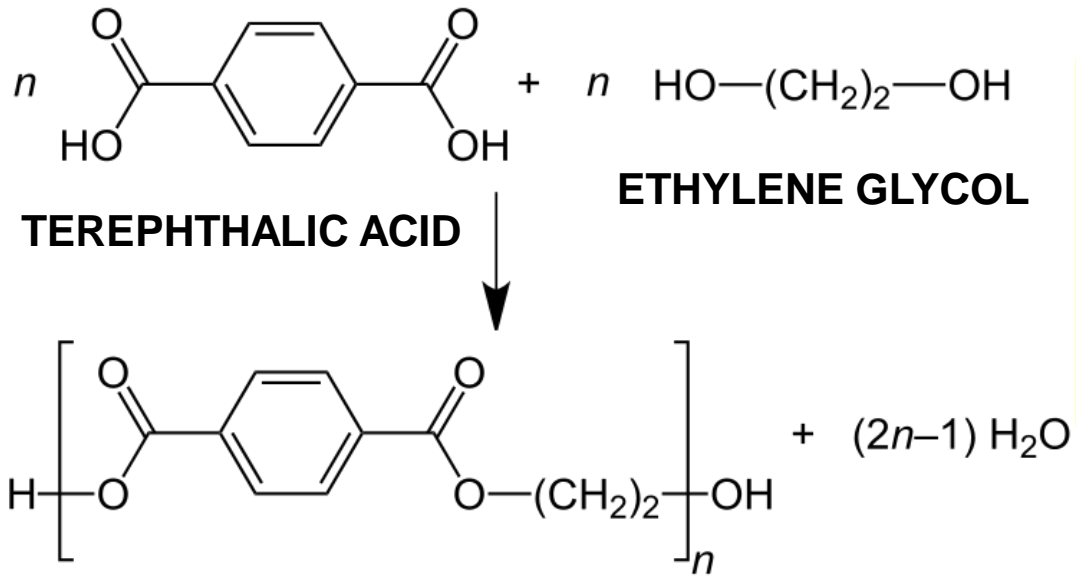


1,3 – Benzene dicarboxylic acid  
Isophthalic acid

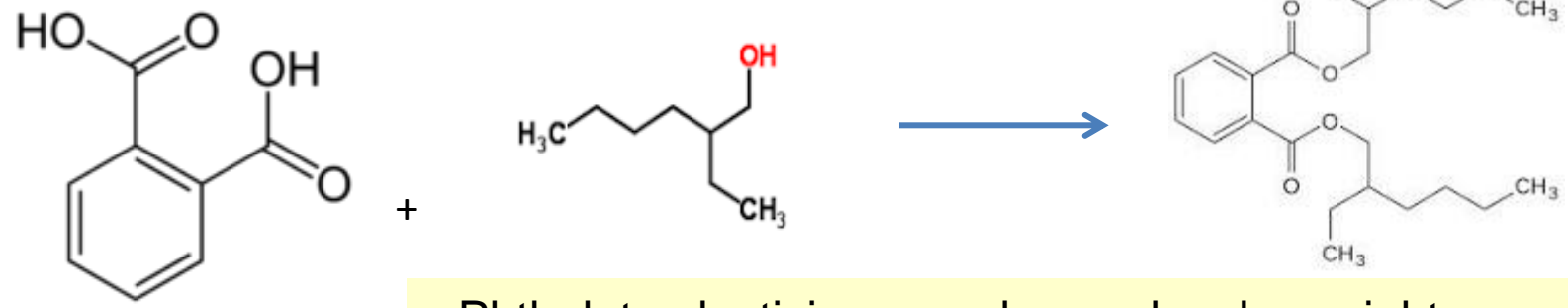


1,2 – Benzene dicarboxylic acid  
Phthalic acid

# WHAT IS THE DIFFERENCE BETWEEN A POLYESTER AND PHTHALATE PLASTICIZER ?



Polyesters are prepared from terephthalic acids by condensing with ethylene glycol. Polyesters are high molecular weight materials, typically in the range of **20,000 to 35,000**



**PHTHALIC ACID**

Phthalate plasticizers are low molecular weight organic liquids and are not classified as polymers. The molecular weight of dioctyl phthalate is **390**

# **MOLECULAR WEIGHT (LENGTH) + FLEXIBILITY MAKE IT HAPPEN...**

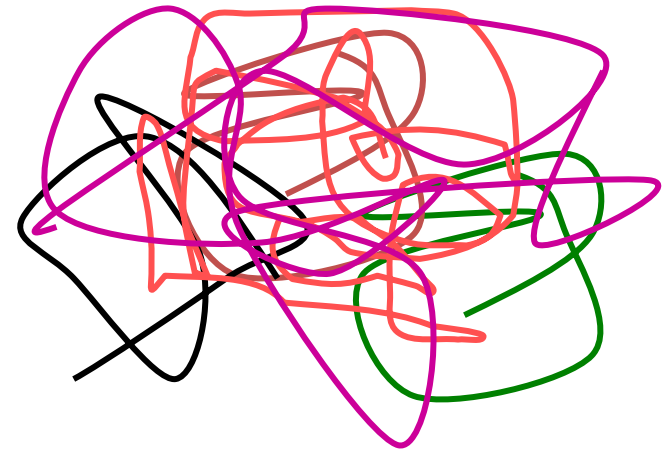
## **Short Molecules**



- **Can separate easily**
- **Too short to entangle**
- **Behave independently**

***Bowl of Rice***

## **Long Molecules**



- **Completely entangled**
- **Molecules do not easily move independently**

***Bowl of Spaghetti***

## ***PET'S UNIQUE SOLID STATE PROPERTIES MAKE MIGRATION OF A SMALL MOLECULE FROM THE POLYMER VERY DIFFICULT***

- PET has a glass transition temperature ( $T_g$ ) of about  $70^\circ\text{C}$ ; Significant mobility of polymer chains can be expected only above this temperature
- However, the melting temperature ( $T_m$ ) of PET is  $260^\circ\text{C}$ . PET is highly crystalline in nature and these crystallites melt at high temperatures. The polymer can be melt processed only above its  $T_m$ .
- The polymer chain are literally frozen till about  $70^\circ\text{C}$ ; even thereafter, the chain mobility is less because of the highly crystalline nature of PET.

***Any small molecule including catalyst residues will find it difficult to extricate itself from the polymer even at high temperatures, in view of the unique solid state structure of PET***

# ***MIGRATION STANDARD OF PET COMPONENTS***

European Union food contact materials and articles legislation directive 82/711/EEC prescribes following SML for the monomers commonly used in making PET

Monomer	Specific migration limit
Terephthalic acid (PTA)	7.5 mg/kg
Dimethyl terephthalate (DMT)	No SML
Isophthalic acid (IPA)	5mg/mL
Ethylene glycol (EG)	30 mg/kg
Diethylene glycol (DEG)	30 mg/kg

***Migration results are well below above standards***

# **ARE THE CATALYSTS USED IN MANUFACTURE OF PET HAZARDOUS?**

- Antimony trioxide is used as catalyst in PET manufacture and are present at very low levels, typically less than 300 ppm in a bottle
- Repeated extraction tests with simulants show that the extracted amount is well below any FDA/EC legal limits. Recent studies have shown that less than 1 ng of Sb per mL leaches out after three years of storage of water in a PET bottle. This is one part in a trillion !
- Moreover, the extracted materials are neither toxic nor hazardous

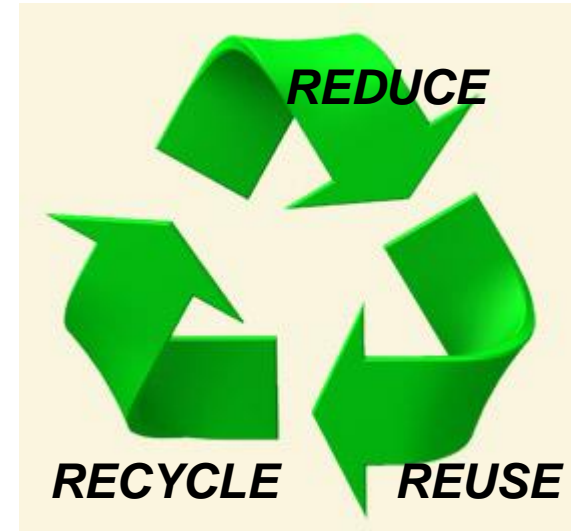
## ***Recommended for antimony levels in drinking water***

a	World Health Organization (WHO)	:	20 micrograms/liter
b	Environmental Protection Agency, USA	:	6 micro grams/liter
c	Health Canada and the Ontario Ministry of Environment	:	6 micro grams/liter
d	German Federal Ministry of Environment	:	5 micro grams/liter
e	Japan	:	15 micro grams/liter

***Antimony leaching levels far below accepted global standards of safety***

## ***PET : AN EPITOME OF A RECYCLABLE MATERIAL***

- PET bottles/jars/trays are 100% recyclable
- PET when burnt generates only heat, CO<sub>2</sub> and water
- The identification code for PET is 1. This is a numerical code and has no relation to how many times a PET bottles may be used.
- For packing equivalent volume of material, one needs lesser amount of PET compared to glass leading to resource conservation. For example for packing 350 mL of a liquid, one needs 24 g of PET , whereas, if it is glass, one will need 200 g !





## **EMERGING NEW SCIENCE WILL LEAD TO EVEN BETTER FUTURE SOLUTIONS**

- No material. However successful, is perfect. Although proven recycling options exist, collection and transportation of used products still require care and incentives
- Science continuously strives to seek new solutions
- Is it possible to have a packaging material which decomposes into carbon dioxide and water simply by burying under the soil ?
- Chemistry has shown glimpses of such an environmentally benign material. With further advances in technology, costs are expected to come down leading to more wide spread deployment

***The new polyester is derived from Lactic acid, a naturally occurring organic acid and as a material even more sustainable than PET***

# POLY (LACTIC ACID )S : A COMPOSTABLE POLYESTER DERIVED FROM CORN OR SUGAR



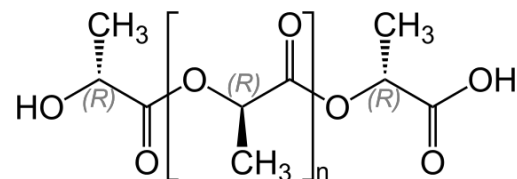
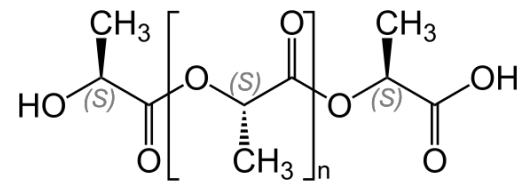
*Insoluble in water, moisture and grease resistant*

*Biodegradable and compostable*

*Clarity and glossiness similar to PET*

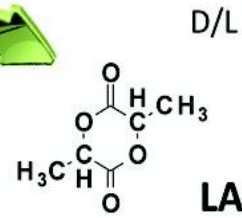
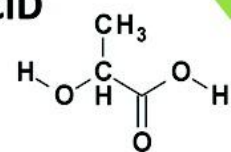
*Requires 20 to 50% less fossil fuels to produce than PET*

*CO2 emissions down by 60% (0.75 kg of CO2 per kg vs 3.4 for PET)*



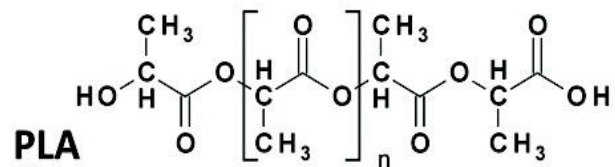
## LACTIC ACID

Conc.  
D/L  
Impurities  
Residual components



D/L  
H<sub>2</sub>O  
Metals  
Free acids  
**LACTIDE**

## FROM LACTIC ACID TO PLA



**PLA**

Structure-property relationships  
Residual components, degradation products



## ***IN SUMMARY***

- PET is 100% recyclable
- PET is non toxic and inert
- PET bottles meet all statutory national and international approval
- PET bottles are 100% safe and pose no threat to human physiology whatsoever
- For equivalent volume of storage, only 10% in weight of PET is needed compared to glass; thus use of PET helps in reducing transportation energy and reduction in GHG

***PET is safe, sustainable, recyclable and contributes to resource as well as energy conservation. The value proposition offered by PET is unbeatable by any competitive material***



***THANK YOU***

