Bioplastics and Polymers for Sustainable Development: HRD and Toxicological Aspects

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Market Scenario & Challenges

Plastic market is extremely functional, versatile and significantly vital to our economy

- Role of ancillary materials- Covers a large group of products and play a vital role towards completeness of a package
- Safety Assessment of Packaging Materials- Overall Migration, Toxicological Safety Assurance
- Absence or inadequacy may impair performance functionally/ aesthetically/ statutorily
- Limited country-of-origin labeling hampers efforts to understand the link between where a food is grown and the chemical burden it carries.

Low per capita consumption levels of polymers in India which is ~11 kg vis-à-vis 38 kg in China, 65 kg in Europe and the global average of ~28 kg

Functions & Additives

Plastics ancillary equipment- material storage, conveying, blending, coloring, drying, magnetic tool clamping, parts conveying, separation and granulation of scrap.

Plastic additives- increasingly being utilized for varied functions which include property modifiers, extenders, stabilizers and processing aids in industrial applications.

Additives-antimicrobials, antioxidants, UV stabilizers, plasticizers, impact modifiers and others are largely used in compound formulations to improve chemical and physical properties

- ✓Adhesives for laminates- join parts
- ✓Printing Inks
- ✓Caps/Closures

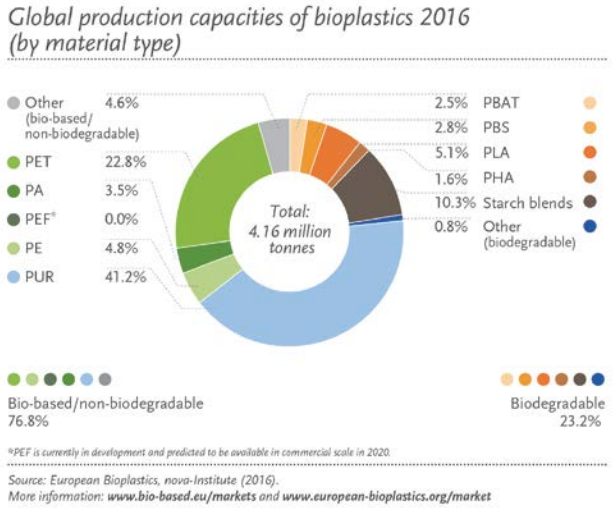
We need to promote sustainable development by investing in technologies that protects environment and stimulates growth while balancing economic needs and financial constraints.

Plastics wastes challenge has to be managed better with linkage of plastics waste management to prospects of recycling industry.

FDA / Codex Alimentarius/ BIS/ FSSAI,European Food Safety Authority [EFSA]

- Maintains educational information, databases and listings related to food allergens, ingredients, food additives, color additives and
- Generally Recognized As Safe [GRAS] substances.
- Packaging and Food Contact Substances
- Irradiation of Food Packaging
- Labelling, Nutrition, Environmental Decisions, Geographical conditions

Plastics processing in the Indian subcontinent is positive, the industry still faces challenges- Inadequate infrastructure & environmental myths.



Migration of Substances from Packaging Materials to Food

- Role of ancillary materials in food packaging complimenting packaging ensuring food safety and security
- Establish safety of ancillary materials in food packaging with focus on overall migration, toxicological safety
- Current Practices to prevent - Spoilage, contamination during transportation

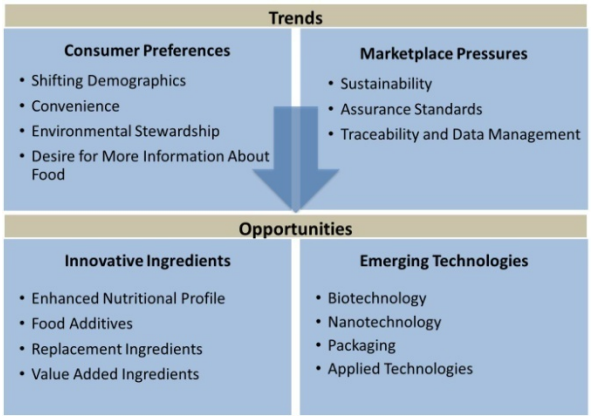
Scope for innovative products that will contribute to growth of the sector.
The packaging industry has witnessed a complete replacement of old age products with the new ones.

Food packaging-sensitive area and manufacturers must focus on the highest levels of manufacturing controls in line with the imperative of protecting the consumer, tamper resistant packaging/ closure and liners , shelf life, economics etc.

Responsibility of suppliers in the value chain-ensure that their contributions do not in any way endanger consumer health

Permeation

Leaching- May be identified by sensitive chemical analysis.



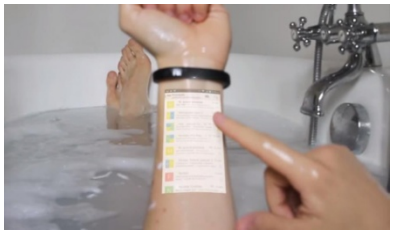
Prevention of leaching of extractable substances into the contents and of chemical interaction with the contents. . . .

- Risks of migration of toxic impurities, which is avoided using alcohol/acetate system;
- Multipurpose ink series/Universal ink concept/reverse printing of the films to be avoided unless there is functional barrier between ink and foodstuffs

Security Methods :

- Prevent tampering, prevent pilferage and theft from retail
- Anti-counterfeiting devices
- On-press label and online label verification
- Security of the product, promotional opportunities

Withstand processing, sterilizing, pasteurization, autoclaving – steps involved in life cycle



Labeling

Equipment , control, package, directions for use, maintenance manuals, Fragrance labels etc

- Increase in the production speed and the pressure for the ecological cleaner system has led to water based, radiation cure technology, digital flexoprinting processes in place of conventional system.
- Rigid plastics and glass are the major materials used for packaging beverages, accounting for 70% of the market.

Compliance to International guidelines of FDA/WHO/OECD/FSSAI/BIS/HACCP/ISO 22000/Codex Alimentarius etc

- The U.S. FDA has formulated the Federal Code of Regulations, Title 21, Part 177 to regulate the types of indirect additives used in food contact substances.

- These requirements are a set of guidelines established to regulate maximum permissible additive quantities used in food processing and packaging applications.

- The global industry is characterized by volatile raw material prices coupled with stringent environmental regulations for manufacturing plasticizers, UV stabilizers and other additives.

- Right packaging is highly essential to avoid spoilage and to maintain its quality and freshness before food products would reach to consumers.
- Varied types of packaging - norms set by the government
- For businesses, being able to adapt to the trends set by the new consumer typology is the key to success.
- Packaging industries are undergoing a process of constant innovation, seeking both to improve the performance of existing solutions and new ways to provide value without increasing the production costs

Polymers are the backbone of all ancillary materials used for packaging- thermoset/ thermoplastics depending upon the requirement

Contaminants at multiple steps along the supply chain, from the point where raw ingredients are raised to the final dishing up of a meal.

Residue level of specific Pesticides/ Phthalates depends on their usage, crop and the regional pests and packaging.

- Concerns about the harmful substances that plastics may contain- plasticizers, stabilizers, etc
- Non Intentionally added substances in foods are generally less well understood and regulated.
- Temperature
- Impart impurities, by-products, contaminants from recycling processes, and breakdown products from additives and plastic polymers.
- Affect the endocrine system in the long term and can also lead to fertility and thyroid problems, as well as diabetes.

Source: Volume 125 | number 1 | January 2017 Environmental Health Perspectives

- Contaminants from the post consumer material may appear in the final food-contact product made from the recycled material,
- Recycled post-consumer material not regulated for food-contact use may be incorporated into food-contact packaging, and
- Adjuvants in the recycled plastic may not comply with the regulations for food-contact use.

Contract packaging service to obtain the best quality packaging available.
A co-manufacturer may benefit by cost, speed, quality and innovation.

✓Improving the design of nutrition labels to promote healthier food choices and reasonable portion sizes
✓ Global Food Demand Scenarios

Innovations - interaction with the product, delivering information conditions like freshness, humidity, leakings, temperature, etc with data matrix system and the new RFID technologies.

Environment Protection -Sustainability, Recycling, composting, material lightness, PETs, bioplastics, etc.

Improvements– Size, family packs, microwaveable or bake able packs, and self-heating/cooling containers.

Conformance to applicable regulations is mandatory

US Food and Drug Administration;

Department of Agriculture;

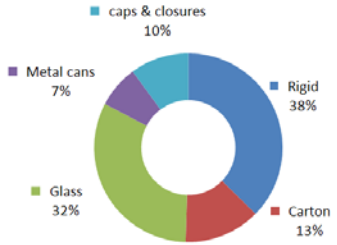
European Food Safety Authority.

Certification programs - Global Food Safety Initiative

Food packaging considerations - Hazard analysis and critical control points, Verification and validation protocols, Good Manufacturing Practices with use of an effective Quality management system, Track and trace systems, Requirements for label content etc.

- Food packaging testing-Measurement of a characteristic or property involved with packaging : primary packages, shipping containers, unit loads.
- The quality and safety of food - consumers, businesses, and governments across the global supply chain.
- Food safety testing measures- qualitative or quantitative procedure.
- Package testing is Physico, Chemical, Mechanical and Toxicological evaluation: determine suitability of food contact materials.

Narrowing of the gap between basic and applied research - create natural bridge to translational research, communication between the applied research arenas.



Source: http://foodpackaging.conferenceseries.com

Effectively balancing innovation with cost-efficiency keeps the consumer's needs at the forefront while still remaining effective in demonstrating the product and its benefits.

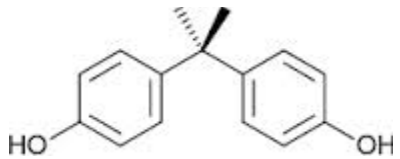
Growing concerns clustered around the fundamental fear that the world faces a daunting waste management problem

Sustainable packaging may be as effective, efficient, cyclic and safe.

Changing lifestyles, which will all influence market growth in the foreseeable future.

- Efforts are needed to prevent the accumulation of microplastics in the sea.
- Developments in aspects: laminated specifications, security, Time–temperature, Sleeveless, barcodes, watermarks, decorative gravure printing, holography.
- Packaging logistics- multidisciplinary approach, integrating the packaging system and logistic system to enhance the efficiency and effectiveness of the entire supply chain.

Nanotechnology-enabled food packaging may be categorized- improved packaging, active packaging, intelligent or smart packaging.

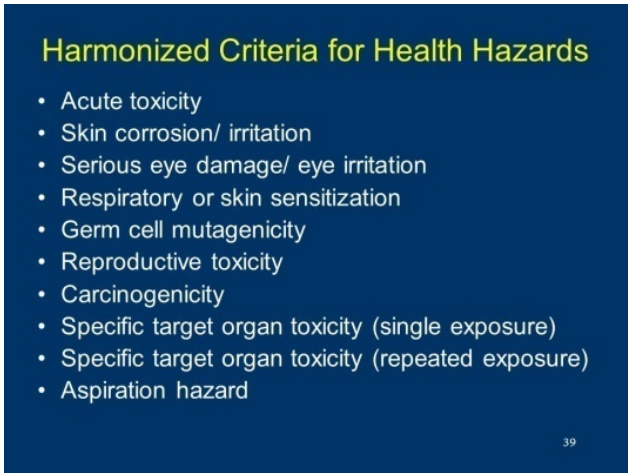


Major Health Hazards of Phthalates

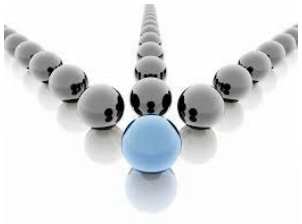
- Premature birth
- Birth defects of male sex organs
- Reduced fertility
- Prostate and testicular cancer
- Learning disabilities
- Behavior problems
- Asthma and allergies
- Early puberty in girls
- Breast growth in boys
- Obesity and diabetes

- Protect against all adverse external influences that may alter the properties of the product [moisture, light, oxygen and temperature variations]
- Protect against biological contamination;
- Protect against physical damage;
- Carry the correct information and identification of the product.

Design concepts of active, intelligent and sustainable food packaging materials. The objective is to fit the functional, cost, safety and environmental impact requirements of the targeted food by developing bio-molecules based solutions.



What is Needed.....



INDUSTRILIST & MANUFACTURES

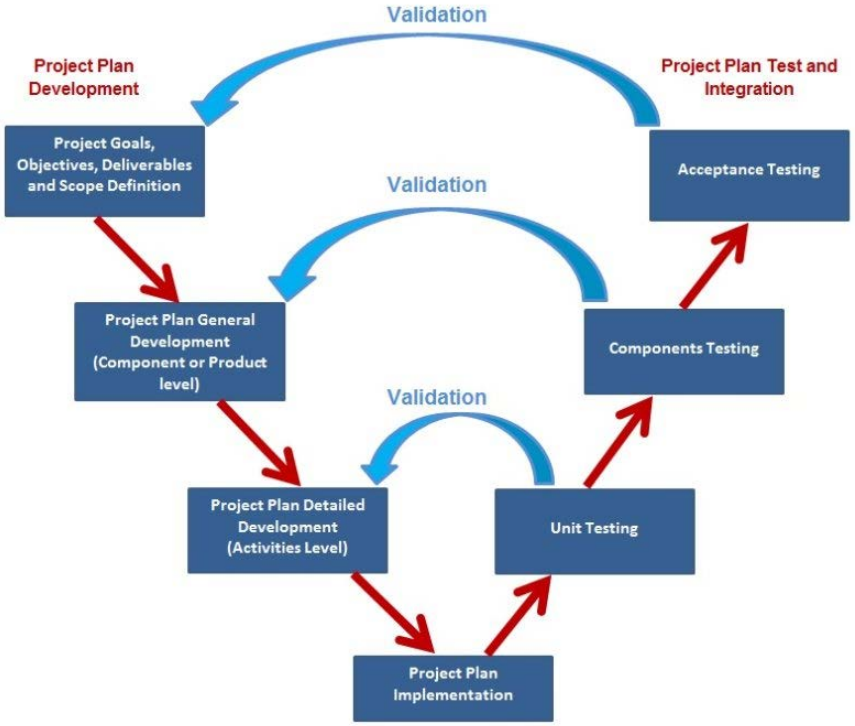
COMMUNITY

JUDICIARY

REGULATORY AGENCIES

R & D ORGANISATIONS

ENFORCING AGENCIES



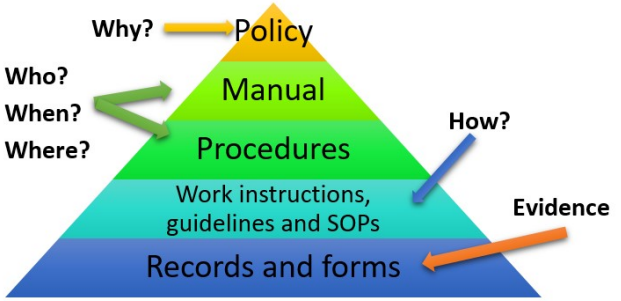
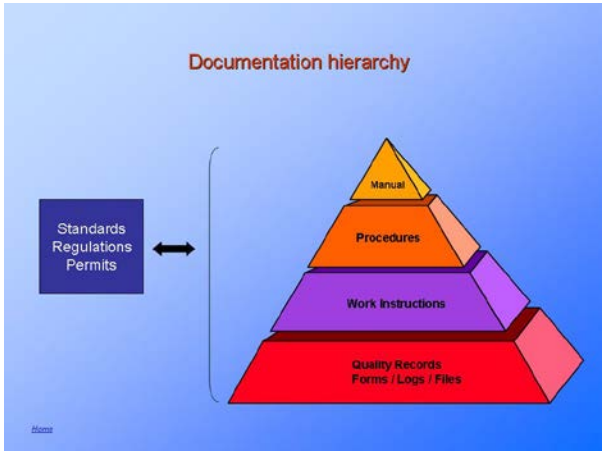


Figure 1 – Documentation hierarchy

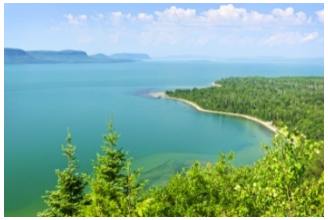


Approx 1.1 billion tons of waste, more than 40 percent of the world's garbage, is burned in open piles, contributing more emissions than is shown in regional and global inventories.

Flame retardants are a key component in reducing the devastating impact of fires on people, property and the environment. They are added to or treat potentially flammable materials, including textiles and plastics. The term "flame retardant" refers to a function, not a family of chemicals.

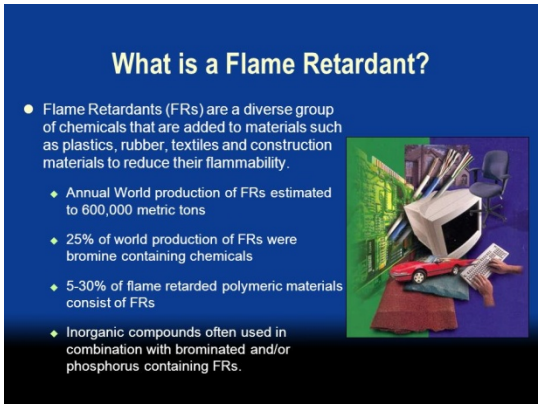
PBDEs, a class of chemicals used primarily as flame retardants in furniture and plastics, are structurally similar to the known human toxicants PBBs, PCBs, dioxins, and furans. Having similar mechanisms of toxicity in animal studies, they also bio-accumulate in both humans and animals and persist in the environment.

Bioaccumulative
Persistent
Toxic
Long Range Transport

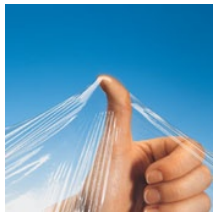


Researcher to study effects of flame retardants on Great Lakes

Need for Halogen Free Flame Retardant & Natural Plasticizers



Melamine Cyanurate MCA Flame Retardant
Chemical CAS 37640-57-6




DEHP


BPA

Pollutants, which accounted for far bigger percentages of global emissions.

29 % of global anthropogenic emissions of small particulate matter (tiny solid particles and liquid droplets from dust to metals that can penetrate deep into the lungs) come from trash fires.

About 10 percent of mercury emissions come from open burning, as well as 40 percent of PAHs.

Such pollution may cause lung and neurological diseases, and have been linked to heart attacks and some cancers.

Potential health effects from BPA exposure include breast and prostate cancer, attention deficit hyperactivity disorder and a wide range of developmental problems.

BPA in urine, lead traces in blood may be found

The environmental and health impacts of unregulated plastic recycling business are immense: the cleaning process pollutes waterways, melting and burning the scraps released toxic pollutants into the air, and leftover pieces unfit for recycling are dumped directly into riverbeds.

Type of flame retardants

Many flame retardants are made with bromine or chlorine, which slow fire's combustive reaction by taking the place of oxygen. However, tests have cast doubt on whether adding chemicals to furniture is effective, and concerns over health risks have forced some products off the market.

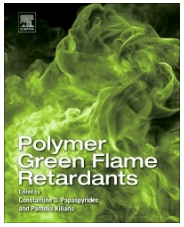
CHEMICALS			
Penta and octa Polybrominated diphenyl ethers, or PBDEs	**Deca** Also a PBDE	**Chlorinated tris** TDCCP	**Firemaster 550** Brand name
HAZARDS			
Build up rapidly in breast milk and human blood; hormone disruption, developmental problems, neurological damage, reproductive problems	Persists in the environment and creates penta as it breaks down; potential carcinogen, neurological damage	Probable carcinogen, neurological damage	Chemical's brominated components found in wildlife; levels increasing in air around the Great Lakes; developmental problems at high doses
STATUS			
Not in use After the European Union voted in 2003 to ban the chemicals, U.S. makers pulled them from the market; penta is still present in older furniture, other products containing foam and recycled carpet padding	**Being phased out** Manufacturers voluntarily agreed to end production by Dec. 2013; it is still present in casing of older electronics and in wire insulation, textiles, automobiles, airplanes	**Still in use** Voluntarily removed from children's sleepwear in late 1970s but still widely used in furniture foam; also has been found in baby products containing polyurethane foam	**Still in use** Introduced in 2003 as a replacement for penta; identified for "high priority" review by U.S. Environmental Protection Agency

Source: U.S. Environmental Protection Agency, Consumer Product Safety Commission, National Research Council, peer-reviewed research
Graphic: Chicago Tribune


15 हिन्दुस्तान

बेंगलुरु में भी प्लास्टिक बन रहा सिरदर्द

Plastic Era: Boon or Bane

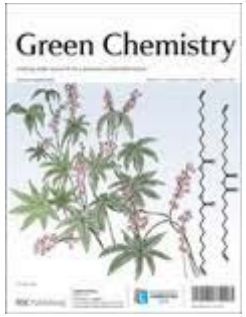


How Long Does It Take……?

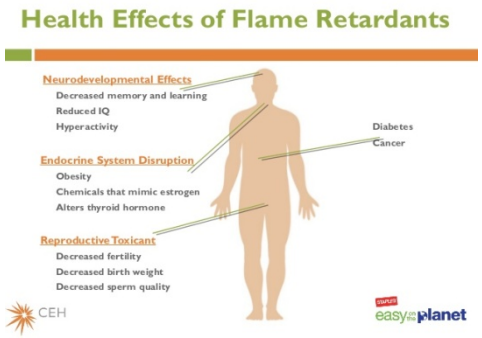
Cotton rags	1-5 months
Paper	2-5 months
Wool socks	1 to 5 years
Cigarette butts	1 to 12 years
Plastic coated paper milk cartons	5 years
Plastic bags	10 to 20 years
Nylon fabric	30 to 40 years
Aluminum cans	80 to 100 years
Plastic 6-pack holder rings	450 years
Glass bottles	1 million years
Plastic bottles	May be never
Orange peels	6 months
Bioplastics	Within 6 months

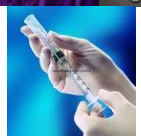
Efforts are being made for polymer flame retardancy, with emerging, effective, and applicable strategies for commercially viable, green fire-proof materials.

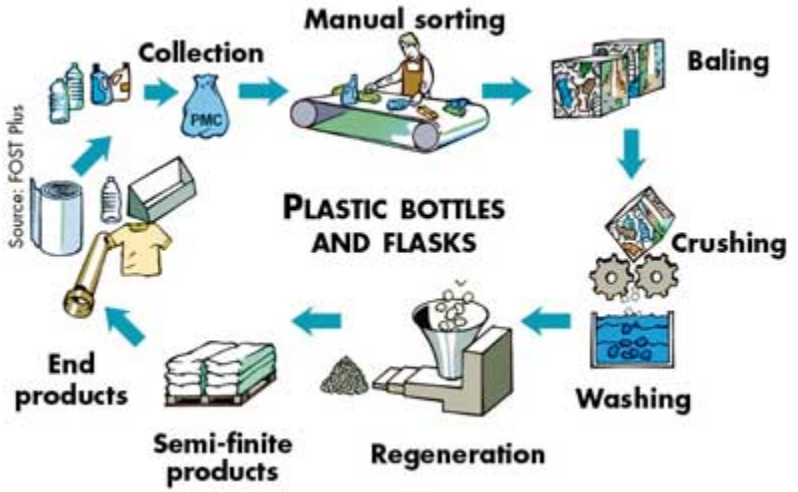
- Management is required to provide resources to carry out managerial and technical duties with efficiency, appoint suitable personnel with authority for varied activities within the scope. The management and the quality assurance team have direct responsibility for the implementation of quality assurance system.



- Food Industry
- Medical Fields
- Industries
- Pharmaceuticals Household Items
- Packaging







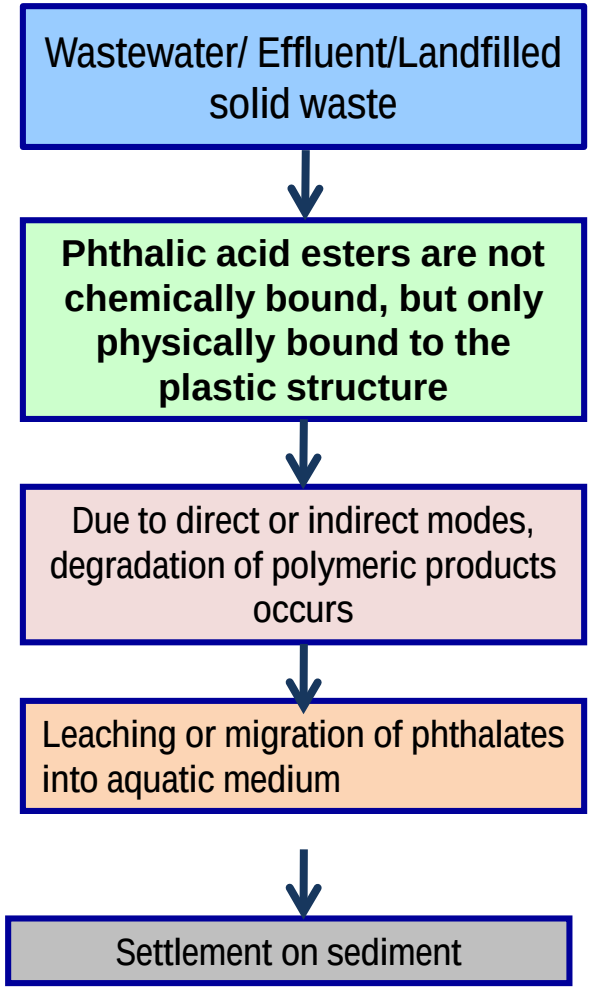
GREEN CHEMISTRY

Worldwide the law/ Legislations exist for use of biodegradable plastics in short lived applications particularly in food/ perishable goods packaging etc.

The high cost of biodegradable plastics, which are meeting criteria of compostable specifications as per ASTMD-6400 or IS/ISO 17088:2008

Phthalates: Environmental Concern

- Man-made chemicals
- Used to soften hard plastics into soft rubber and jelly
- Exhibit hormone-like behavior by acting as Endocrine Disruptors in humans and animals
- Enters environment from wastewater effluents during the production phase.
- Via leaching and volatilization from plastic products during their use and after disposal.
- Due to biotic and abiotic degradation of landfilled wastes.



Bisphenol A : Chemical of Environment Concern

- A chemical used during the manufacturing of certain hard, clear plastics; Found in polycarbonate, baby bottles, cups, reusable plastic
- Capable of altering normal functioning of genes
- It mimics the **hormone estrogen** and disrupts reproductive
- Decline in semen quality
- Miscarriage
- Birth defects
- Urogenital abnormalities in male babies
- Early onset of puberty in girls
- Obesity
- Prostate and breast cancer
- Neurobehavioral defects

Biological Mechanism involves

- Damage to DNA
- Endocrine Disruptor

Polyvinyl Chloride & Polystyrene Health Implications

- Found in pipes packaging, wraps for meat, building products

- Manufacture
  Fumes
  Leaching of chemicals
- Disposal
  Very difficult to recycle
  Dioxin emissions
  Major source of Lead & Cadmium

- Found in food containers
- May leach Styrene –possible Human Carcinogen

What May Happen From Common Synthetic Plastic…..?

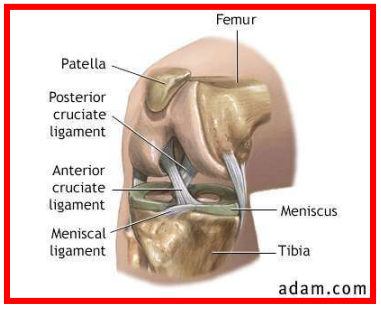
Animal Testing Revealed

- Reduced numbers of offspring
- Increased rate of malformations
- Reduced estrogen and testosterone
- Reduced numbers of sperms
- Increased cancer rates
- Can possibly impair reproduction
- Can possibly cause harm to babies via breast feeding
- Can possibly harm unborn children via contamination of the mother
- DEHP supposed to have endocrine disruptive properties.

Smart Polymers: Bio-organic Nanoprobes

Are they Science-Fiction or Science-Fact?

Recently developed polymer matrices which have the amazing property of swelling to many times their original size when hydrated with water have been designed. Such materials have wide ranging applications, from biological purifications to novelty confectionary.




Safe, Versatile and Biodegradable
Alternatives for Our Future
Back to Nature


Profit
Sales
Performance
Innovation
Goals
Customer
Idea
Business plan
Competitors
Management
Strategy
Project
Team
Opportunities
Market

Thanks.....!!!