



RAJOO ENGINEERING

MY COMPLIMENTS TO RAJOO ENGINEERS TEAM FOR EXCELLENT DEVELOPMENT OF EXTRUSION LINES FROM DESIGNING TO SHOP-FLOOR PERFORMANCE OF THE EQUIPMENTS SUPPLIED BY THEM AT HOME AND OVERSEAS. THEY HAVE ACHIEVED THIS SUCCESS THRU DEDICATION, CLOSER INTERACTION WITH CUSTOMERS TO IMPROVE ON THE PERFORMANCE AS AN ON GOING PROCESS AND KEEP A TRACK OF NEW DEVELOPMENTS GLOBALLY AND INCORPORATE THE SAME IN MACHINES DESIGNED AND BUILT BY THEM.

I WISH THEM MORE AND MORE SUCCESS IN THIS FIELD AND BE A FORCE TO REKON WITH GLOBALLY IN THE FIELD OF EXTRUSION.

ALL THE VERY BEST TO YOU, RAJOO FAMILY.



PACKAGING OVERVIEW

BY

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RAJOO ENGINEERS ENDOWMENT LECTURE

ORGANISED BY IPI, MUMBAI CHAPTER

ON

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AT

THE AIPMA CONFERENCE HALL, ANDHERI



MARKET SCENARIO – FLEXIBLES (POUCHES)

The Size of the Flexible Packing market is estimated to be 10% MMTPA out of which Polyolefins and PET take the major share – PE contributes 60% and PP 30%, PET 10%.

Not covered are PVC, NYLON, EVOH, PVDC etc. being a very small share.

The total size of the Retails Market is estimated USD EIGHT BILLION, which represents 2% of total flexible packaging market in India, which is estimated at USD 350 Billion and showing 40% growth per year.

The Retail sales from stores shall be in Flexible – films and laminates, Moulded Rigid Containers – Inj and Blow Moulded and Thermoformed Packagings.

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POUCHES ADVANTAGES

(Co-ex Films and Laminates)

Superior taste due to reduced retort time.

- Extended Shelf-Life.
- Reduced Storage Space
- Reduced transportation cost
- Easier, Safer Opening
- Deep Freeze Storage and Microwavable
- Product Windows possible

(OUTSIDE – INSIDE)

LAYER	MICRONS
=====	=====
RP-PET/BOPP FILM Adhesive	12
Aluminium Foil Adhesive	08 – 15
Nylon Film Adhesive	15
CPP Film	60 – 80

Advantages

- Higher quality product because of lower Retorting Temp
- Ecological and Economical advantage – lower Weight & Volume.

COSUMERS EXPECTATIONS OF A PACKAGE



1. Good grip for handling.
2. Ease of opening and closing (for Zip Lock)
3. Foods Ready – to – Eat Meals, Deep Freeze to Microwave for Hot Serving.
- Even dual ovenable
4. Tamper Evident, Pilferproof.
5. Manufacturing Date and Expiry date to ensure that the contents are safe.
6. Freshness of contents during the Specified (use before) time and as recommended by the Manufacturer.
7. Dispensing System
8. Ease of Disposal.



DEMAND IN PACKAGING DRIVEN BY

- Consumer Behavior
- Demographic developments
- Internationalization of Markets
- Handling Techniques
- Transportation
- Cost

WHAT CONSUMERS DO NOT LIKE ABOUT THE CURRENT PACKAGE



POUCHES / SACHETS

1. They do not look attractive on a Shelf in Stores – Particularly the Pillow Pouches, which loose the Shape and the Printed matter is distorted.
2. Most often, Very difficult to open, even with the provision of a notch.
3. The contents have an unpleasant odour.
4. They are not Microwavable (Foil / Met – PET / BOPP).
5. The Packed Product is not as fresh as it should be inspite of opening it within the prescribed period.
6. They are difficult to destroy before throwing to garbage and cause Water Clogging problem in Gutters.

BOTTLES

1. Difficulty in opening a threaded Closure with a break-strip.
2. The Threaded Closure do not fit perfectly to prevent leakage.
3. The inner wad of closure is not proper.
4. The closure is not Child Proof.
5. There is no Provision of ease of opening and dispensing for Elderly Folks.
6. The Beverage Bottles (PET) are too flimsy to handle even for Pouring.
- 6.1 They do not Preserve the Gas.even for a Short Time once opened.

BLISTERS FOR PHARMA



1. Printing is too small to read.
2. Particularly on Foil, because of the reflecting surface, its impossible to read.
3. Pushing out the tablet is not always easy.
4. Very difficult for Senior Citizens

QUESTION MARKS – IS THIS DONE

1. Is compatibility for expected Shelf LIFE Tested ?
 2. Is the Shelf Life Evaluation done for the Product in the Package at Varying ambient conditions.
 3. How confident protection towards Pilferage, Adultration. Etc.
 4. Is evaluation done periodically, on changing one of the components of the formulation even though Chemically it is equivalent to the substituted one.
 5. Are the Sizes of a Package are adequate for the quantity Specified.
 6. Are Printing Inks tested to ensure no migration through the Package Wall.s
 7. Is there any better way of dispensing the contents ?
- Particularly the Liquids in Bottles.

PACKAGING FOR RETAIL SALES



Organized Retail is comparatively a new development but over the last 2-3 Years has grown at a great speed and has spread so rapidly that its presence is now seen even at the smaller towns. The success of retail sales outlets has come to many as a surprise because of a very well established 'next door grocer' system prevalent over years and with a very personal touch and benefit of 'home delivery' and procuring for a customer a product, which may not be available with him.

With new organized Retail outlets, the role of packaging has become very important and has now to perform a role much beyond just containing a product to convenience, longest Shelf-life, attractive to catch attention and as well create a brand image for the product and the producer and with all these attributes, yet be eco-friendly. It has been said by experts that the purchase decision by a Housewife is done within 15 Seconds of looking at the package / product. Its, therefore, very important for the package to stand out among various other products.

One largest growing segment in Retail Sales is the Processed, Convenience, Ready-to-eat-meals and Snacks. With the correct use of polymers, the forms of package, use of packaging systems like Retorting, MAP etc, the desired shelf-life for a product is achievable.

Packaging is a very complex technology and the success is possible only with a very close coordination of the actual user, the package supplier and the supplier of the required Packaging Systems.

The very latest requirement, particularly the Overseas, is Biodegradable or from Renewable Resources Package, like that of PLA.

With the growth of the Retail outlets, the Package has become an important Marketing Tool.

Commonly Used Plastics in Packaging



Barrier Films
(Refer Table I)

PET
BOPP
NYLON
EVOH
PVDC COATED
Sio2 COATED
Metallized PET, BOPP
Aluminium Foil Laminate

Polymers For Films

LDPE, LLDPE, HDPE
PP
PET
PVC

Polymer for Bottles

LDPE / LLDPE
HDPE
PP
PVC
PET, PEN

Polymer for Soft Tubes

PE
PVC
Co-ex

Polymers for Thermoformed
Containers

PS, HIPS
PVC
PP
PET

Polymers For Woven Sacks,, FIBC HDPE

LLDPE
PP

Polymers For Closures – Snap-on, PF, UF
Thread

HIPS
HDPE
PP

Comparative Properties are given In Table I

TABLE I



Comparative Properties of Common Packaging(Plastics) MATERIALS

Property	HDPE	LDPE	PC	PET
Tensile strength, MPa (x 10 ³ psi)	22-31 (3.2-4.5)	19-44 (2.7-6.5)	66 (9.5)	48-72 (7.0-10.5)
Elongation, %	10-1200	600	110	50-300
Flexural Modulus, MPa (x 10 ³ psi)	1,000-1,600 (145-225)	280-410 (40-60)	2,350 (340)	2,420-3,100 (350-450)
Mold shrinkage, cm/cm	0.015-0.040		0.005-0.008	0.020-0.025
Clarity	poor	hazy	clear	clear
Impact strength	good	very good	excellent	poor
Oxygen barrier	poor	poor	poor	good
Water vapor barrier	excellent	good	poor	good
Heat distortion temp., 455 kPa, °C (°F)	62-91 (144-196)	40-44 (104-111)	138 (280)	38-129 (100-264)

- continued -

Property	PP	PS	PVC	SAN
Tensile strength, MPa (x 10 ³ psi)	31-38 (3.6-4.5)	45-83 (6.5-12.0)	41-69 (6.0-10.0)	69-82 (10.0-11.9)
Elongation, %	100-600	1-4	5-135	2-3
Flexural Modulus, MPa (x 10 ³ psi)	1,170-1,730 (170-250)	2,620-3,380 (380-490)	2,620-3,588 (380-520)	3,450-4,000 (500-580)
Mold shrinkage, cm/cm	0.015-0.025	0.004-0.007	0.002-0.006	0.003-0.005
Clarity	poor/good	clear	clear	clear
Impact strength	fair	poor	good	poor
Oxygen barrier	poor	poor	good	good
Water vapor barrier	excellent	poor	fair	fair
Heat distortion temp., 455 kPa, °C (°F)	107-121 (225-250)	68-96 (155-204)	57-82 (135-180)	104-107 (220-224)

PAKAGING AS A SYSTEM – TOTAL SYSTEM



This Covers

The entire cycle from the point of production to the point of consumption and a little Beyond viz. the disposal of the package.

- It is constrained by the System of production, type of package, Systems of transportation, environmental conditions influencing product life, methods of merchandising, consumer preference, the relevant laws governing the package, etc.

Package Design :

A good package design necessarily involves a total systems approach with due consideration to every element of the system, such as :

- Cost effective
- Meet Product requirements such as compatibility, filling temps, Shelf-life, etc.
- Enhanced sales appeal
- Satisfy needs of the customer

Packaging Model : Packaging should provide maximum efficiency at all states.

Purpose : It should be designed so that :

- It is suitable for the contents
- In fulfills the logistic requirements for production, distribution, storage
- The best possible sales promotion effect is obtained
- It is in the best interest of the consumer and informs him sufficiently and honestly about the product.

Ecology :

The package should be designed so that the environment damage caused by the production, use and disposal is as little as possible.

SMART PACKAGING SYSTEMS :



- Oxygen Scavenging
- Anti-microbial
- Odour and Flavour Absorbing
- Moisture Absorbing
- Microbial Growth Indicators
- Leakage Indicating
- Light Protection
- On-line Testing of Oxygen and Moisture in Head Space
- On-line Testing of Seal Integrity



MARKET PERCEPTION

Vast increase in Global Volume, both co-ex films upto 17 Layers and laminates (mainly Extrusion and Solventless).

1. Convenience
2. Long (extended) Shelf-Life
3. Microwovable
4. Products visibility (may be even an Window)
5. Superior graphics – a very good marketing tool.
6. Processors familiar with modified processes and the Polymers choice – Retorting, Gas Flushing, MAP, etc.
7. Easy for re-use or disposal.

PLASTICS CONTAINERS FOR FOODS PACKAGING



The Indian Packaging Industry is estimated at USD 14 Billion and ranks 8th in the World in Plastics Consumption and by 2010, India is expected to be the third largest consumer of Polymers after the USA and China with Polymer demand estimated at 12.4 Million Tones.

the Packaging constitute estimated 50% of the total Polymers consumed and, today, is perhaps the fastest growing segment.

The major forms of package currently consumed are : Films, both monolayer and multilayer barrier films with NYLON or EVOH as a Barrier Layer, HDPE, PP, LLDPE, Woven Sacks, Blow Moulded (HDPE, LDPE, PVC) and Stretched Blow Moulded (PET, PP) Containers, Thermoformed Packages of HIPS, PVC, PP, PET, Injection Moulded (PS, PE, PP) Containers and closures, Box Strappings of PP and PET, protective packaging in the form of Foamed PS and PE, Air Bubble Films and Inflated Film Bags of LD and LLDPE, Stretched and Cling Films and LD and PVC Shrink Labels, Dry Bond Adhesive and Solventless and Extrusion Coated Laminates and Pouches – these form the **WORLD OF POLYMERS IN PACKAGING SEGMENT.**

- * Compatability
- * Safe in Contact
- * Do not impart undesirable odour
- * Barrier Properties to achieve the required Shelf Life
- * Ease of forming – filling and sealing



- * Convenience in use
- * Pilfer proof Tamper proof
- * Withstand the prescribed Drop Test
- * Sterilizable, Retortable
- * Aseptic
- * Ease of handling
- * Eco-friendly
- * Tailor-made structure and form
- * Closures of various types of simple snap-on, threaded to Child Proof, convenience to Senior citizens, ease of measured dispensing etc.
- * Attractive to look on Shelf in stores

All the above requirement can be fully made by using properly selected Polymers the greatest advantage being that a package structure can be developed by using combination of materials with varied properties each to meet even the exacting requirements of the material to be packed with respect to compatability, filling temperatures, storage by Refrigeration (that is even the sub zero or below zero temperatures), Aseptic Packaging, Barrier to Oxygen, moisture and gases and retention of flavours and fragrances, duel ovenable, micro-ovenable for products such as ready-to-eat meals and even the use of Oxygen scavengers and microbial protection additives.

Plastics packaging forms range from a very tiny package in the form a sachet used for portion packs of shampoo, zarda etc. to large Flexible Bulk Containers, FIBCs, of a few tones fro transport and storage of products such as Fertilizers, Agricultural Chemicals, Polymer Pallets, Food Grains and even Water.

Damaging Factors and Effects



In addition to the Barrier Properties for the desired Shelf Life, there are several other factors, damaging factors and their effects as given below :

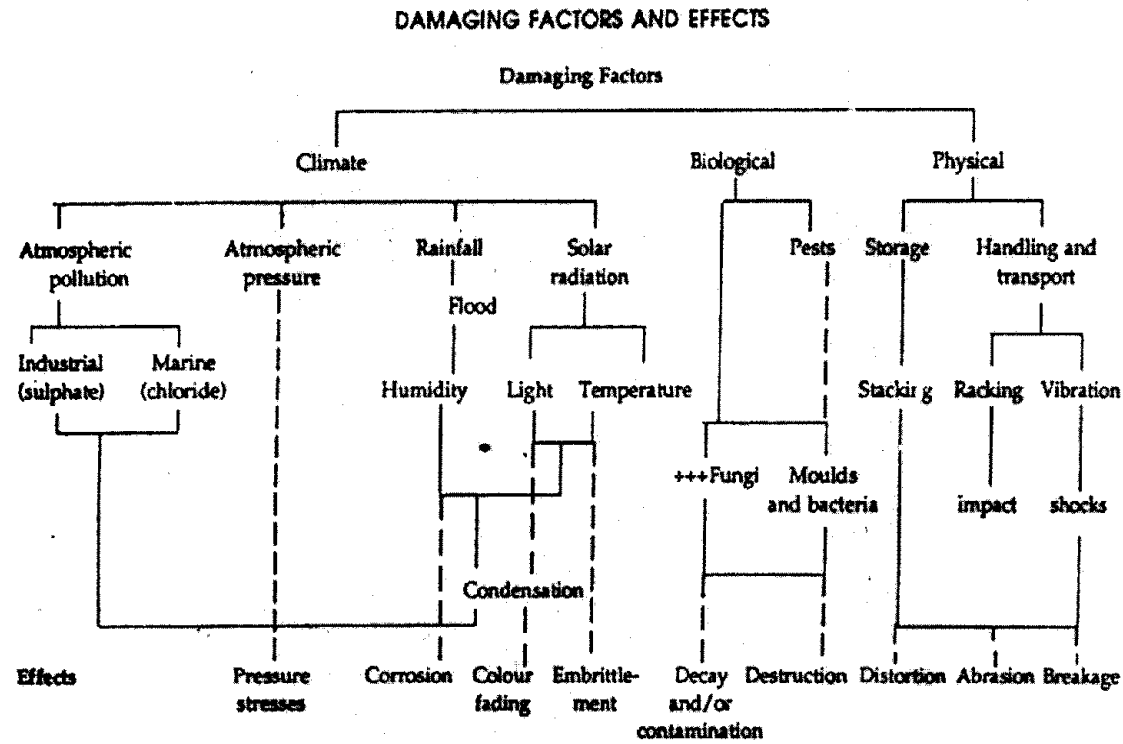


TABLE 2

CURRENT TRENDS IN FOOD PACKAGING



The sure to come

- Single serve Portions
- Flat dish shape
- Microwave heating
- Biodegradable, Renewable Resources like PLA
- Use of Nano Molecules for upgrading Barrier Properties as a replacement of Barrier Resins such as EVOH and that too at a fraction of the cost.
- ALL THIS HAS ALREADY STARTED MAKING INROADS

Shelf Life

- 3 to 6 Weeks
- 3 to 6 Months
- 12 Months or more
- AT AMBIENT TEMP OR COLD STORAGE FACILITY

Processing and Keeping Process

Sterilization, one year, ambient temperature
Freezing, one year, negative cold
Aseptic, UHT, 3-6 Months, ambient temperature
Pasteurization, vacuum, CAP/CAM, 3-6 Weeks, positive cold
Other Processes, marginal

Which Packaging Material

Dual Ovenable Barriers, Engineering / Barrier
Microwavable Barriers, PP/Barrier
Simple hot fill microwavable, PP
Microwavable Metals ? NANO MOLECULES ?
Pouches, BAG-IN-BOX ? SACHETS ?

How fast developing in competition with

Canned Foods
Frozen Foods
Basic ready-to-eat foods

HOW THE SHELF – LIFE IS EXTENDED



1. Selection of Polymers to meet the Barrier Properties Requirements of the Product to be Packed.
2. Hot filling for the Products like Juices.
3. Nitrogen Flushing to remove Oxygen, Moisture, etc.
4. Retorting of a Package on line.
5. Use of additives like Oxygen Scavengers to protect product from Oxidation.
6. Use of anti-microbial additive to prevent growth of fungus, etc.
7. Ensuring that there are no Pinholes and that Sealing is perfect so as to prevent effect of environmental pollutants.
8. For Sensitive Products, Clean Room Noms are adapted in Manufacturing.
9. To Protect from Light (UV from Sunlight / Fluorescents Lights etc) Pigmented opaque Films are used.
10. Often Seal is the biggest culprit. There are inline Equipments available to test the Seal integrity and Seal being a very important parameter for success of the package, selection of proper Polymer as a sealant layer is very important.

Different Terminologies used in 'Modified Atmosphere Packagings' Techniques



Termonilogies

Modified Atmosphere Packaging (MAP)	Replacement of air with a single gas or mixture of gases. No further control over initial composition.
Controlled Atmosphere Packaging (CAP) / Controlled Atmosphere Storage (CAS)	Proportion and type of gas mixture is controlled over the whole period of storage
Equilibrium Modified Atmosphere Packaging (EMAP)	Used for fresh fruits and vegetables. Pack is flushed with gas or sealed without modification. Permeability of packaging and respiration of product results in an equilibrium modified atmosphere.
Vacuum Packaging (VP)	Product sealed in low gas permeability pack, after part evacuation of pack results in changes in atmosphere during storage due to altered metabolism of product and microbial flora and gas permeation.
Vacuum Skin Packaging	Used for delicate products. Softened film placed over product and vacuum applied.

HOW TO IMPROVE PROTECTION OF PACKED PRODUCTS BY USING ADDITIVE MASTERBATCHES



PACKING

A CRUCIAL TOOL
FOR YOUR PRODUCT

{
{
{
{
{
{

PROTECTION

PROTECTION
CONVENIENCE
VISUAL APPEAL
ENVIRONMENTAL CONSIDERATION
REGULATIONS SAFETY
MANUFACTURING

THE ADDITIVES THAT ENHANCE PRODUCTS PERFORMANCE

(COURTESY : CIBA)

OXYGEN

- Leads to Product deterioration
- Oxygen is a threat to freshness and Shelf-life
- Oxygen imposes limits on Packaging options and product innovation

USE OF OXYGEN SCAVENGERS

- Enhances passive barrier performance
- Reduce / Eliminate Oxygen within the Package
- Help maintain the original quality of product packed
- Potentially extends Shelf-Life



FOG

- Condensation / droplets on films
- Negatively impact the image
- Contents are then not visible
- Quality of the content is aesthetically reduced

Use of anti-fog agents help to prevent the above and enhance the product.

DUST

Dust build-up on the package during storage and display on the shelf is due to accumulation of electrostatic charges.

Use of antistatic agents.

- Preserve the original appearance of a package
- Prevent dust pick-up

FRICTION

Friction is an issue during processing and handling particularly on FFS Machines reducing the packaging speeds

BRIEFLY

The additives that help to enhance your package and product's overall performance are:

- UV Filters
- Oxygen Absorbers / Scavengers
- Antistatic Agents
- Antifog Agents
- Clarifying Agents
- Antioxidants
- Slip Agents
- Recycling Agents
- NANO PARTICLES

ALL THESE ADDITIVE MASTERBATCHES EXCEPT THE NANO ARE INDIGENEOUSLY AVAILABLE

WHAT IS RFID ?



Radio Frequency Identification (RFID) is a means of storing and retrieving data through electro-magnetic transmission to an RF Compatible integrated circuit. This system enables a complete visibility and tracking of the Supply Chain and Prevent other loss of inventory from pilferage and theft and this is particularly very beneficial to large retailers and for expensive products.

RFID Involves the use of electronic tags with integrated circuit Chips that can store data. The tags affixed to the assets, transmit their data via low power radio waves to reading systems which are tuned to the same frequency enabling transmissions to be recorded and tracked.

RFID is being adopted mainly in manufacturing and Processing, transmission and distribution and securities.

ENVIRONMENTAL OBJECTIVES



(FOR IMMEDIATE FUTURE)

1. Source raw material from renewable feedstock.
2. Reduce fossil or Non-renewable energy use.
3. Reduce Green-house gas emissions, which is leading to global climate change.
4. Minimize Water use and recycle the Water after the required treatment.
5. Eliminate by-products and Waste.
6. In a vision of zero Waste, provide the greatest number of end-of-life options.

(Courtesy : Nature Works LLC)

Plastics are Environmentally Friendly



Almost every gramme of Plastics waste can be use by recycling and / or incinerating.

All the in-house plant waste is as good as a virgin material and can most often be used for home production by blending with the virgin material.

The commingled plastics waste can be converted by extrusion to useful sheets for use in place of particle boards.

The recycled plastics waste can be used as a sandwich layer in multilayer products.

The municipal plastics waste can be blended with Tar to build / repair roads as is already being done in Bangalore and being experimented in Mumbai.

The latest in Australia is the use of plastics waste in the manufacture of steel. The waste plastics are fed into electrical steel making furnaces as an alternate source of carbon and heated to super hot temperatures of 160° C.

RECYCLING OF PLASTICS PACKAGES WASTE



The Package Waste is in the Form of

- Films, Co-ex Multilayer Films, Oriented Films.
- Laminates – Adhesive / Solventless.
- PET Bottles.
- Blow – Moulded PE, HDPE, PP Containers.
- Extruded / Laminated Tubes.
- Injection Moulded.
- Rotational Moulded.
- Thermoformed, Blisters.
- HDPE / LLDPE / PP Woven Fabrics and Products thereof.
- Closures.
- Box Strappings.
- Protective Packaging such as PE / PS Foams, Air – Bubble Films, PP Corrugated Board, Shrink and Stretch Wraps, etc.

The most common Polymers are Polyolefins, PVC, PET.

The possible and commonly used methods are :

- Wash, Clean and re-use.
- Use as a Sandwich Layer in Co-extrusion.
- Use of Blending with Virgin.

- PET Bottles are generally converted to Textile Fibers for Synthetic Carpets and Industrial Fabrics.
- * Non-Critical Components,
- Sheets upto 35 mm Thick for Industrial end-uses.
- Sheets of comingled Plastics Waste .
- Blend with Bitumin in Road Construction.



AND

Generate Energy.

POLYMERS WASTE IS EASY TO USE AS SUCH OR BY BLENDING WITH ADDITIVES ETC BY IDENTIFYING THE END-USES BASED ON THE QUALITY.

AND

POLYMER WASTE IS NOT EVEN A FRACTION AS HAZARDOUS AS THE ELECTRONICS WASTE.



AN EFFECTIVE ENERGY SOURCE

A Considerable proportion of energy locked in the Plastics can be recovered in the form of heat, through the process of incineration. Most Plastics have a Calorific value which is similar to that of heating oil, well in excess of the equivalent potential of wood or coal. Heat recovered in this way can be used in a variety of ways – for example local community hot water networks, interior heating, small scale electricity generation, or for industrial processes.

ROLE OF NANO MOLECULES IN PACKAGING



This is the latest development that is changing the total concept of Polymers Properties and their end-uses.

The use of Nanos improves barrier properties outstandingly. Not only this, but they help to improve clarity and overall Mechanical Properties.

And all this at a Fraction of cost of Barrier and Properties Enhancing Additives such as EVOH for Barrier.

Nanoclays such as Monotomorillonite are found in nature as platelets and by dispersing these in a Plastics Matrix so that they are intercalated, that is Separated into individual Platelets and Exfoliated with a continuous Polymer Phase between a tortuous path for the passage of gaseous molecules such as Oxygen, Water Vapour, Carbon Dioxide and Aromas may be created.

With this in place, a relatively small addition of Nanoclay, less than 5% of the total, can be an effective barrier with reduction, say for Oxygen and Carbon Dioxide Penetration reducing by 80 / 90 %.

Another Nanoclay Property established is the obviation of Flavour Scalping.

Tremendous Work is on all over the World and in the coming Months, the positive role of these as Properties Enhancers and Barrier Properties are expected to be established.

INTERESTING ?



1. **New Anti-Theft Tag for Food Packaging** : New anti-theft tag can be inserted into the packaging of moist such as cheese and meat to reduce the percentage of stolen produce in retail outlets, according to Cryovac and Checkpoint systems.

Checkpoint's SmartPak tags radio frequency (RF) electronic article surveillance (EAS) and are certified for food contact. Cryovac integrates the tag into its vacuum shrink bags at the manufacturing stage, thus making it impossible as the tag cannot be removed without destroying the entire pack, claim the developers.

2. **Advances in Easy Opening Technology** : One of the standard methods of providing customers an access to containers has been narrow width tear stripe tapes. These have been good solutions for most corrugated and film packages. Special constructions of some wider tapes now expand the capabilities to controlled tear of tough plastic films that previously could not be opened easily.

3. **Active and Intelligent Packaging Concepts**

Active : Scavenger for Oxygen, Carbon dioxide, moisture, odour

Scavenger : Antimicrobial – CO₂release

Intelligent : Time temp indicators

Package leak indicators

Product Freshness Indicators

4. **PET LIGHT WEIGHT BOTTLES**

PET ENGINEERING AND HUSKY have jointly developed bottles using about 30% less material than the currently used preforms.

5. **HEAT TRANSFER PRINTING**

TECHNO PRINTS offer this with advantages such as superior brightness and brilliance, very high resolution printing image, photo quality image, holographic effect with colour print and is suitable for all plastics commonly used for packaging.

A WRAP - UP



I have recently written on Flexible Packaging a Series of 12 write-ups in Modern Plastics and packaging and as such I opted to say all that I sincerely feel in my mind and am sure that many of my colleges have similar thoughts.

All the modes of Packaging will continue side-by-side, the choice being the product requirement, the consumer's preference and the cost.

I would like to stress one point that we can no more ignore the facts related to the environmental problems and continuous rise in the Polymer Prices.

We must start immediately working on Biodegradable Materials as well as those based on renewable resources like PLA.

Thank You.



THANK YOU.