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DECEMBER 2010

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AN OFFICIAL ORGAN OF INDIAN PLASTICS FEDERATION

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Editorial

Dear Members,

Public Relations is as old as human civilisation. It has existed in one form or the other. There are umpteen examples of its varied form, content and end use. An ancient clay tablet, found in Iraq, told the Sumerian farmers how to grow better crops. That was over 4000 years ago. The great religious teachers from Gautama Buddha and Sankaracharya to Nanak and Kabir were master communicators. They preached, in an idiom which the common people found easy to understand. The rock inscriptions of emperor Ashok were written in local dialects for easy communication. He also sent his own children to Sri Lanka to spread the message of Buddhism. From this angle, his daughter, Sanghamitra can be described as the first woman public relations executive in history. After all, what is Public Relations? It is to communicate to the public with a view to changing their mind set in a certain direction. Also, its purpose is to create goodwill for the communicating organisations, eventually leading to support from the public. This support is a sine qua non for the success of the given organisation. This is what great leaders, mentioned above, did.

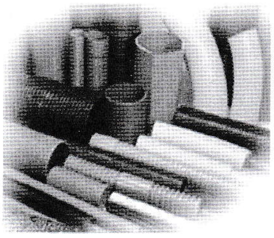
In the present century the outstanding example of a master communicator is that of Mahatma Gandhi. On 9th August 1942, he gave a call to the British rulers to quit India. This resulted in hundreds of thousands of citizens coming out for their exit once and for all. Within five years, i.e., 15th August, 1947, centuries of slavery ended and India became independent.

A systematic and organised practice of public relations in India began with the Indian Railways. The Great Indian Peninsular (GIP) Railways, for example, carried on a campaign in England in the 20s to attract tourists to India. Within the country, its Publicity Bureau introduced a travelling cinema which held open air shows at fairs, festivals and other places. This Bureau also undertook extensive advertising in newspapers and journals besides participating in exhibitions abroad to popularise the Indian Railways and tourist traffic.

The activities of the Ministry of Information and Broadcasting can be broadly divided into three sectors i.e., the Information Sector, the Broadcasting Sector and the Films Sector. The functions of these sectors are complementary to each other and cannot be strictly compartmentalised. Each of these sectors operate through specialised media units and their affiliated organisations. In a developing country like India, communication of Government programmes, achievements and expectations are, no doubt, important. But equally important is communication from and to the economic sector - public sector, NGOs, public utilities, academic bodies, etc. - seeking to inform, motivate, change the mind set and finally seek public support for achieving the objectives of these organisations.After Independence, multinational companies operating in India for several years, felt the need to communicate with the Indian people more meaningfully. In order to adjust their corporate policies to the democratic milieu, these companies increasingly turned to public relations. Among the Indian giants, the Tatas had already set up a Public Relations Department in Mumbai in 1943 headed by Shri Minoo Masani. The public sector has, however, made a significant contribution to the birth, nurturing, growth and professionalism in public relations. Public relations in its true sense started with PSUs like HMT, BHEL, Bhilai Steel Plant, followed by NTPC, Indian Oil, VSNL, NHPC, ONGC— to name a few. Bodies like Public Sector Public Relations Forum and SCOPE have played a notable role in professionalisation of PR discipline. At the apex level, there is Public Relations Society of India (PRSI) set up in 1958. It is the national association for professional development of Public Relations practitioners and communication specialists.

There are, however, certain areas where PR has yet to make a full dent. These include strengthening programmes for training in this field, publication of literature on PR by seasoned practitioners and academics, case studies on PR situations in Indian companies, equipping PR departments with professionally-trained personnel as well as latest communication equipment falling in the category of Information Technology and, above all, continuous trust and support by the management. All these are important for enabling the PR personnel to perform their role effectively, particularly in the present and future marked by fierce competition both nationally and internationally.

Pradip Nayyar
Editor



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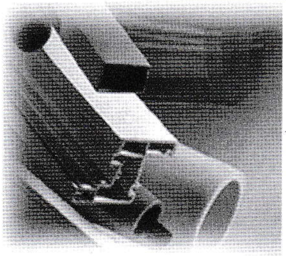

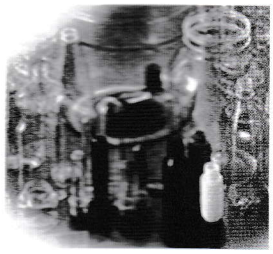

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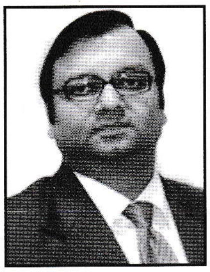


Dear Members,

This is my third message to you after taking over as President of the Federation for the second term.

Plastivision 2011 – an exhibition organised by All India Plastics Manufacturers Association, Mumbai will be held from January 20 – 24, 2011 and many of our members may be visiting Mumbai during this period either as exhibitors or visitors. IPF will make its presence felt in the exhibition as we have also taken a stall over there.

In this issue I would like to share some of my views on matters concerning **plastics waste disposal.**

There are several approaches to dealing with the problem of waste disposal, in particular waste generated by plastics. These approaches include **source reduction, recycling, incineration and landfills. Recycling is considered the best option** for reducing the volume of solid waste, second only to source reduction (which is accomplished by generating less packaging in the first place and/or reusing it in the same service). Recycling reduces landfill requirements and the consumption of virgin material resources. One of the most important factors in these energy-conscious times is the energy required to recycle many materials is substantially less than the energy consumed in producing them from virgin resources. The empty PET packaging discarded by the consumer after use, becomes PET waste. In the recycling industry, this is referred to as "post-consumer PET". Many local governments and waste collection agencies have started to collect post-consumer PET separately from other household waste. The collected post-consumer PET is taken to recycling centres known as **materials recovery facilities (MRF)** where it is sorted and separated from other materials such as metal, objects made out of other rigid plastics, flexible plastics such as those used for bags (generally low density polyethylene), drink cartons, glass, and anything which is not made out of PET. Post-consumer PET is often sorted into different color fractions, and into a mixed colors fraction. This sorted post-consumer PET waste is crushed, pressed into bales and offered for sale to recycling companies. Transparent post-consumer PET attracts higher sales prices compared to the blue and green fractions. The mixed colour fraction is the least valuable. The Further treatment process includes crushing, washing, separating and drying. Recycling companies further treat the post-consumer PET by shredding/down sizing the material into small fragments. These fragments still contain residues of the original content, shredded paper labels and plastic caps. These are removed by different processes, resulting in pure PET fragments or **PET flakes.**

PET flakes are used as the raw material for a range of products that would otherwise be made of polyester. Examples include polyester fibres (a base material for the production of clothing, pillows, carpets, etc.), polyester sheets, strapping, or PET bottles, etc. **Melt filtration** is typically used to remove contaminants from polymer melts during the extrusion process. There is a mechanical separation of the contaminants within a machine called a **'screen changer'**. A typical system will consist of a steel housing with the filtration media contained in moveable pistons or slide plates that enable the processor to remove the screens from the extruder flow without stopping production. The contaminants are usually collected on woven wire screens which are supported on a stainless steel plate called a 'breaker plate' a strong circular piece of steel drilled with large holes to allow the flow of the polymer melt. For the recycling of polyester it is typical to integrate a screen changer into the extrusion line. This can be in a pelletizing, sheet extrusion or strapping tape extrusion line.

Recycling of plastics bottles lends credence to the argument that the "feedstock" energy is not actually consumed but merely "borrowed", (available for use again). In particular, the rapid success of PET soft drink bottles created a great deal of controversy over the energy implications of bottle disposal. There are some more post consumer plastics recycling technologies that will be discussed in my next message.

After a wonderful Puja and a Happy Diwali the festivities continue into a Merry Christmas and A Happy New Year.

I wish all of you and your family **A MERRY CHRISTMAS AND VERY HAPPY NEW YEAR.**

The coming year will have some specialities viz. 1.1.11, 11.1.11, 1.11.11, ...11.11.11, 20.11.2011 which will occour ONCE IN OUR LIFE TIME.

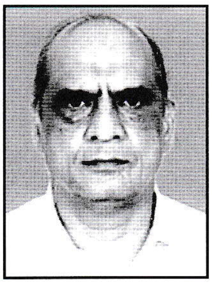
Cherish it and KEEP SHINING...!!!

Warmly,

Sourabh Khemani
President

From the Desk of

The Hony. Secretary



Dear Members,

In my last message we had informed you that IPF has taken up the matter with the Hon'ble Minister, Commerce & Industries who is also the Chairman, WBIDC, to inform us clearly whether they are willing to allot 1.02 acre land as promised to IPF for setting up a Training Centre at Poly Park that has been hanging for a few years. In response to our letter a delegation from IPF met the Hon'ble Minister on 1st December 2010. Members will be pleased to know that the Hon'be Minister has assured us that land will be allotted to IPF. The Hon'ble Minister has advised us to contact the MD, WBIDC in this regard.

The Federation had also written to WBIDC for expansion of the Poly Park. We had written to the MD, WBIDC to inform us clearly as to whether land will be allotted for expansion of the Poly Park. This information was required to enable IPF to take a final decision on refunding of earnest money paid by members for purchase of land in the Poly Park. In response to our letter WBIDC has informed IPF that they at present do not have any plan for expansion of the Poly Park at Sankrail but they are willing to offer land at Vidyasagar Ind. Park at Kharagpur. In case IPF members are interested they are willing to discuss this matter with us.

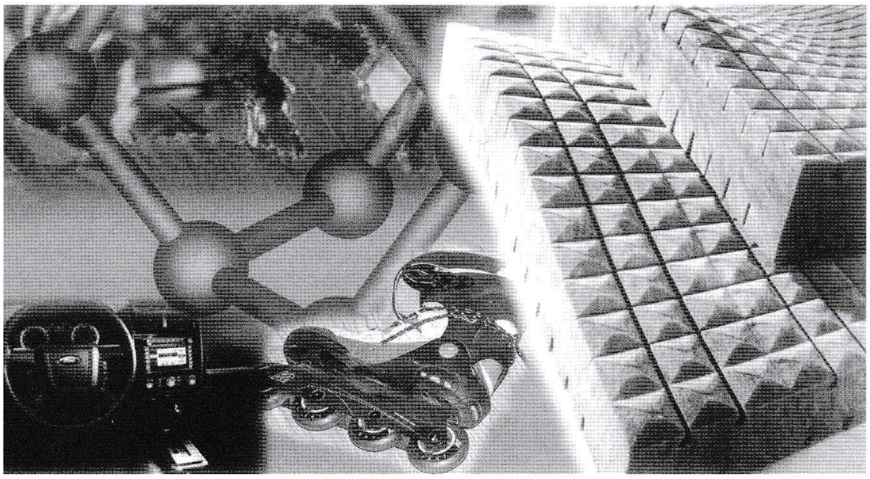
Efforts are being made to send the magazine 'Plastics India' at subsidised postal charges. For that registration process with the Office of the Registrar of Newspapers for India (RNI) is in progress. As a first step Title Verification of the magazine has been approved by the office of the Registrar of Newspapers vide their letter dated 8/11/2010. Further steps will now be taken in this regard.

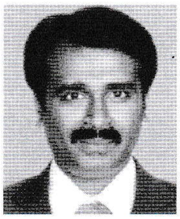
I wish all of you and your family a **MERRY CHRISTMAS & A PROSPEROUS NEW YEAR**.

With best wishes,

Ramawatar Poddar
Hony. Secretary

LIGNIN
Recent Developments and New Opportunities





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As an alternate, lignin has been used as an excellent low cost blending material in various polymers in the development of different polymeric products.

Abstract

It is predicted that the expanding cellulosic ethanol industries along with the existing paper and pulp industries would generate more than 250 billion kilos of *lignin* annually in North America. Currently *lignin* is undervalued. The value-added engineered biomaterials from the downstream co-products of biofuel industries pose a strong promise as new revenue streams for a sustainable bio-economy.

There remains wide opportunities in finding high value in *lignin* as chemical, plastic-based resins and biobased materials (biomaterials). The chemical nature of *lignin* has provided the opportunities to expand their applications into high value polymeric material as blends. *Lignin* as micro-particle on reinforcements with bioplastic creates novel value-added 'green' composites. Similarly, synthesis of carbon nanostructures from *lignin* as renewable feedstock is receiving great technological and industrial importance because of their unique physicochemical, electrical and mechanical properties.

There is a huge demand for polymer nanocomposites (with a polymer matrix and a filler with at least one dimension less than 100 nm) using carbon-based fillers because of its improved mechanical, thermal and electrical properties. Green nanocomposites; that are derived from bio-based polymers and bio-based nanoparticles tend to be viewed as the next generation of materials for innovative industrial uses.

The present article will focus on the improved utilisation of *lignin* and *lignin* based carbon nanostructures in new polymeric materials and their extensive uses in car parts, consumer goods and sustainable packaging.

Introduction

Lignin is the most abundant material next to cellulose in nature, which generally exists in the cell walls of plants. *Lignin* along with hemicellulose and polysaccharide act as the matrix reinforced with cellulose fibres to prevent the plants from compression, impact, bending and strengthen the tissues against micro-organisms. With respect to various biomasses, the amount of *lignin*[1] can vary from 15–30%. *Lignin* is formed by the polymerisation of three different basic units.

- p-coumaryl alcohol
- coniferyl alcohol
- sinapyl alcohol[2], with very complicated

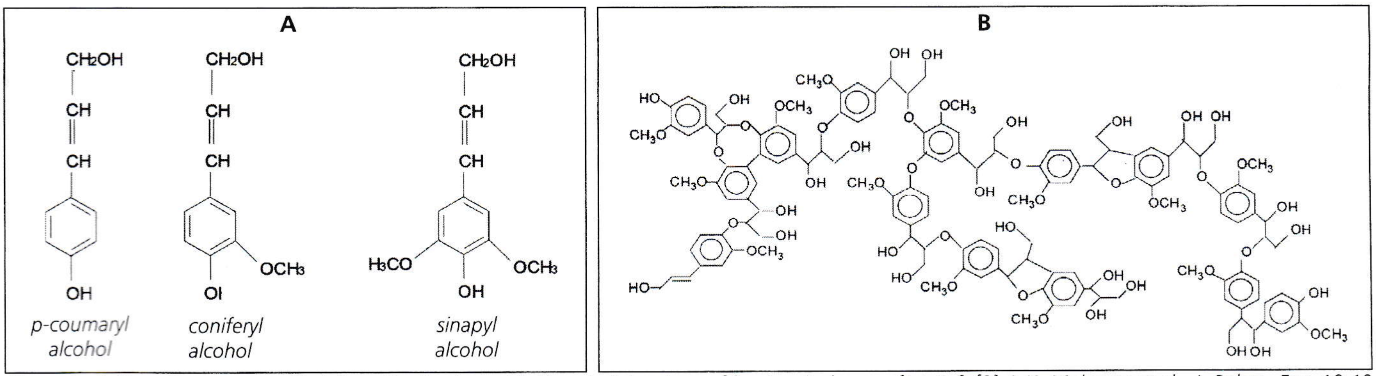

Figure 1: A Phenolic precursors that form the lignin and B Chemical structure of lignin. Redrawn after Ref. [2] A.K. Mohanty et al., J. Polym. Env. 10 19 (2002).

structure (Figure 1). This will vary with different plants.

Another important parameter that influences the structure of *lignin* is the extraction process. Hence, the structure of *lignin* existing in plants (called natural *lignin*) is not the same when isolated through various processes (called technical *lignin*). With respect to the structural combination, *lignins* are classified into three categories[1].

- Softwood *lignin*: Dominated with coniferyl structural units.
- Hardwood *lignin*: Combinations of equal quantities of coniferyl and sinapyl units.
- Grass *lignin*: Formulated with coniferyl, sinapyl and p-coumaryl alcohol units[2].

The isolation or separation of *lignin* plant materials is generally known as delignification. Kraft, Sulphite, and Soda pulping processes are the different delignification process in paper industries, like wise, organosolv, steam explosion, dilute acid as well as ammonia fibre explosion are performed in lignocellulosic ethanol industries. The *lignins* from pulp mills show higher polydispersity as well as sulphur contamination than the *lignin* from lignocellulosic bioethanol industries[1].

Lignin from Lignocellullosic, Pulp and Paper Industries

Lignocellulosic, pulp and paper industries are the major sources for *lignin*. The pulp and paper industries are the biggest consumers of natural resources such as wood and water with massive discharge of *lignin*, which is estimated to 70 million tonnes per year[1]. Food-versus-fuel concerns have stimulated greater interest on producing biofuels from non-food crops, such as switch grass, miscanthus and sugarcane baggage, commonly termed as second generation biofuels.

In cellulosic ethanol industries, roughly equal amounts of ethanol and *lignin* are produced on a quantum basis. Currently, *lignin* is undervalued and creates a serious issue in disposal. As the production of cellulosic bioethanol continues to grow, surplus production of *lignin* becomes a critical issue. Making lignocellulosic ethanol more affordable and economical, it is necessary to encourage the researchers from academic and industries to,

- Find value-added uses for the co-products of cellulose ethanol industries.
- Enhance the technology for efficient conversion of biomass into ethanol.

Current Status of *Lignin* and Need for Value Addition

The conversion of *lignin* to aromatic chemicals such as phenol, terephthalic acid, benzene, xylene, toluene, etc. imposes technical challenge in producing high volume aromatic chemicals.

> *Lignin* is found to be an efficient precursor for the synthesis of carbon nanostructures due to its high carbon rich chemical structure and its flexible chemical modification as compared to other biobased resources.

Other uses of *lignin* in fertilizer, wood adhesives, surfactants, UV stabiliser and colouring agents are under practice, but all the uses accounts for only 2% of the generated *lignin* and remaining are mostly burnt for energy[3]. However, the energy efficiency is very low and it is found to be one fourth of the energy from regular fossil fuels[1].

As an alternate, *lignin* has been used as an excellent low cost blending material in various polymers in the development of different polymeric products. Many researches have been motivated in the area of *lignin* based polymer blends with polyethylene oxide (PEO), polyethylene terephthalate (PET), polyvinyl alcohol (PVA) as well as polypropylene (PP) and their uses in structural composites[1,4]. In addition to that, *lignin* is found to be a suitable renewable carbon source for the synthesis of carbon materials.

Carbon nanostructures are of great technological and industrial importance because of their unique physicochemical, electrical and mechanical properties. Such carbon nanostructures can find application in materials, energy, electronics, environmental, as well as chemistry.

Also, *lignin* was successfully employed for the synthesis of carbon nanofibres using electrospinning techniques[5]. Recently, we have synthesised structure controlled carbon nanoparticles from chemically modified *lignin* at relatively lower temperature for the polymer nanocomposites applications.

With this scope, the present article is aimed at addressing the recent developments of *lignin* based polymeric materials and their composites for diversified applications.

Lignin Based Polymer Blends and Composites

Currently, the use of *lignin* in developing new class of plastics is highly motivated due to its abundance and advantageous properties like good adhesive properties, presence of reactive functional groups, moderate biodegradability, solution forming ability and great variety of modification options.

However, the molecular weight and chemical structure of *lignin* vary depending upon the source material and extraction methods that create difficulties in its use. The blending of *lignin* in elastomers, thermosetting and thermoplastic polymers seems promising for getting better economic, environmental and material performance benefits. The current value added material application of *lignin* are summarised here.

Lignin Based Petroleum Polymer Blends

The melt blending of polymers is a well known process that is extensively used in the plastic industries. Polymer blend materials often provide cost and performance benefit over the individual components. *Lignin* melt blends with various polymers in order to formulate low cost materials with enhanced properties. Various process technologies used for blending of polymers are solvent casting, melt extrusion, two roll milling, injection moulding and compression moulding.

Miscibility of blend is an important criterion for developing a material of superior properties. The miscibility of the blends containing *lignin* has been explained on the basis of hydrogen bonding between the hydroxyl groups in *lignin* and interacting site of the polar or semi polar polymers. It was found that *lignin*, polyethylene terpthalate (PET) and *lignin*, polyethylene oxide (PEO) form miscible blends whereas *lignin*, polypropylene (PP) and *lignin*, polyvinyl alcohol (PVA) form immiscible blends[1,6].

Further, hydrogen bonding with a particular polymer also differs for different wood *lignins* because of the presence of more biphenol units in sofwood *lignin* compared to the hardwood *lignin*[1,7,8]. The *lignin*, polymer ratio is very crucial in the blend and decides the overall performance of the material.

Blends of *lignin* with non polar polyolefins, such as low density polyethylene (LDPE), high-density polyethylene (HDPE) and polystyrene (PS) result in a blend of inferior strength[1] due to the difference in the solubility parameters. Hence, ethylene acrylic acid (EAA) copolymer and titanate are added as coupling agents to enhance the mechanical properties of the blends[9]. Diethylene glycol dibenzoate and indene are used as plasticisers in a blend containing 85% kraft *lignin* and polyvinyl acetate[10].

> *Lignin* PF resin formulation also exhibited equal or better performance than the PF resin alone.

Use of plasticiser helps in reducing the degree of association within the *lignin* molecules, maintaining homogeneity in the blend and improving the properties of the blend material. The efficiency of a plasticiser depends on its solubility parameter value and should be close to that of *lignin*.

Incorporation of ethylene vinyl acetate (EVA) into polyethylene (PE) allows 30% higher *lignin* loading while enhancing the strength and elongation properties compared to neat PE[11]. The flame retardant behaviour of *lignin* alone or in synergy with other flame retardants in PP and polyvinyl alcohol (PVA) has been investigated[12]. *Lignin* also forms blend with poly vinyl chloride (PVC), however, it gives better results when PVC is plasticised[1].

Lignin-Rubber Blends

Lignin acts as a reinforcing filler and stabiliser or antioxidant in rubber composites. The incorporation of sulphur free *lignin* improves the mechanical and thermal properties of rubber. *Lignin's* hindered phenolic hydroxyl groups act as a stabiliser of reactions induced by oxygen and its radical species[13].

Lignin exerts a stabilising effect in carbon black filled natural rubber. The antioxidant efficiency of *lignin* is compared with commercially used antioxidants in the rubber industry[14]. The addition of *lignin* also enhances the stabilising effect of commercial antioxidant.

Lignin-Biopolymer Blends and Composites

Limited research has been conducted on the *lignin* based biopolymer blends. *Lignin* blends with starch to make films by extrusion and solution casting. Extruded films show better properties compared to cast films. Blends have been made from *lignin* using hydroxypropyl cellulose (HPC) and cellulose acetate butyrate (CAB) polymers[15-16]. Ethylation and acetylation of *lignin* improves blend morphology in *lignin* HPC blends. Trials has been performed to incorporate *lignin* in polylactide (PLA) and polyhydroxy alkanoates (PHAs) blends, but not enough work has been done in this field.

Presently, a *lignin* based bioplastic blend has been developed in the Bioproduct Discovery and Development Centre (BDDC) at the University of Guelph, that has resulted in the significant improvement in the mechanical and thermal properties (Figure 2).

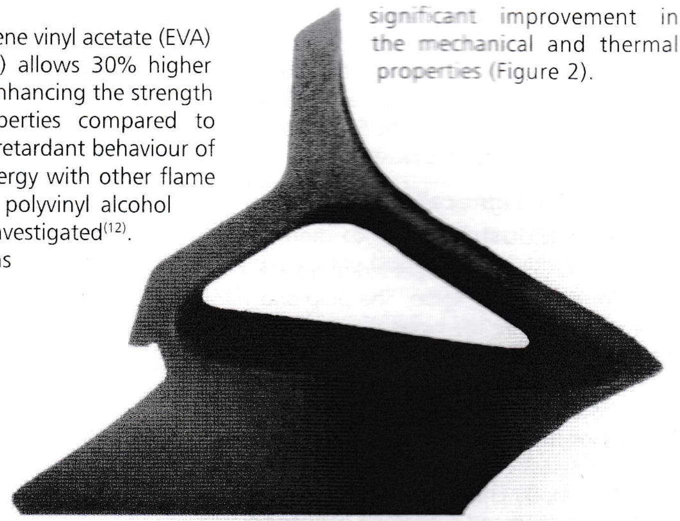

Figure 2: Prototype of car door panel made from lignin, switch grass and bioplastic (99% biobased) developed at BDDC

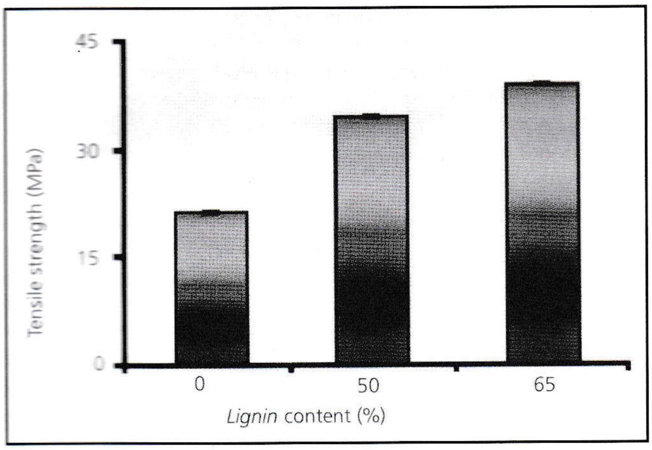

Figure 3: Effect of lignin content on the tensile strength of composites.

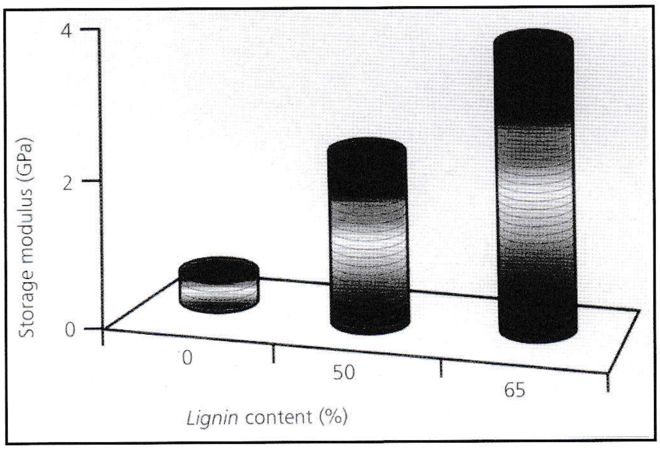

Figure 4: Effect of lignin content on the storage modulus of composites.

Addition of about 65% of *lignin* was achievable. About 13% increments in the tensile strength (Figure 3) and six fold increment in the modulus was achieved at 65% filler content. Such a huge fraction of filler incorporation presents a possibility of significant cost reduction of the material that could offer better economic stability to the plastic industry.

Storage modulus (Figure 4) increased quite significantly with increasing *lignin* content in the composites. The increase in the overall properties of the composites with increasing *lignin* content attributed to the matching of solubility parameters of the components.

Lignin in Adhesives

Structural similarity of *lignin* with phenol makes it a suitable material to substitute a part of phenol in the manufacturing of phenol-formaldehyde (PF) resin. *Lignin*-PF resin formulation also exhibited equal or better performance than the PF resin alone.

Chemicals such as methylene-diisocyanate (MDI), hexamethylene-tetra amine (HMTA) and polyethyleneimine (PEI), are used as curing agents for *lignin* based phenol-formaldehyde (PF) composites. *Lignin* can substitute 30-50% of phenol component in phenol-formaldehyde (PF) composites.

Use of glyoxal modified *lignin* replaces formaldehyde for adhesives. Adhesive developed by glyoxylated *lignin* contains about 80% renewable content[17]. A small amount of kraft *lignin* improves the adhesion properties of poly (dimethyl siloxane) and PVC based sealant adhesive[18]. Adhesives can also be prepared from furfuryl alcohol and *lignin* using zinc chloride based catalyst[19]. Adhesives made from dialkylated kraft *lignin* and polyethyleneimine are highly resistant to water[20].

Lignin in Polyurethane

Lignin and modified *lignins* are used as polyol precursor in developing polyurethanes by solution casting techniques[1]. Polyethylene glycol (PEG) was generally used for making polyurethane foam. Now *lignin* is used for making the same due to the presence of large number of hydroxyl groups in it that react with isocyanates (-NCO) to make polyurethane. *Lignin*-polyurethane films having 5 to <10% *lignin* have shown improved mechanical properties compared to neat PU[21].

> Lignocellulosic, pulp and paper industries are the major sources for *lignin*.

Molecular weight of polyol plays an important role in polyurethane manufacturing. Polyols with lower molecular weight result in brittle polyurethane film unlike the polyols with high molecular weight. The low cost PU could be made by the polycondensation of polyol, *lignin* sulfonic acid and polyisocyanate[22]. Natural polyol from liquefied wheat straw obtained from steam explosion is used to prepare PU foams. Properties of the developed foam are almost comparable with that of petrochemical based polyol, except a higher biodegradation occurs in polyurethanes obtained from liquefied straw based polyol[23].

Various forms of isocynates such as hexamethylene diisocyanate (HDI), toluene diisocyanate (TDI), dimethylene diisocyantae (DMI) are used as isocynates (-NCO) functionalities. Hydroxypropyl *lignin*, nitrolignin, caprolactone polymerised *lignin* are modified *lignins* that are used as polyol precursors. The polyols are also prepared by reacting *lignin* with maleic anhydride (to obtain carboxylated maleic anhydride copolymer intermediates) followed by oxyalkylation and then used in polyurethane production[24].

Lignin-Epoxy Resin

Various forms of *lignin*, such as kraft *lignin* and allcell *lignin*, hardwood and softwood *lignin* at about 20-40 wt%, are used to develop *lignin*-epoxy resin. Bisphenol-A based epoxy resin was used traditionally as resin precursor. Currently, ester-epoxy resin synthesised from *lignin* or *lignin* derivatives are used for the same while various anhydrides and benzyldimethyl amine are used as curing agents and catalysts respectively[1].

The ozonised *lignin*, hydroxyalkyl *lignin* and *lignin*-amine complex are *lignin* derivatives that are used in adhesive or *lignin* based epoxy applications. Both, liquid and solid type *lignin* epoxy resin are prepared by the reaction of pheonlated *lignin* with epichlorohydrin using 20% sodium hydroxide as the catalyst[25] Methylhexahydrophthalic anhydride, maleic anhydride and 2-methyl-4-methylimidazole are used as curing agent for making liquid *lignin* based epoxy resins[26].

Polyamine also used as a curing agent in kraft *lignin*-epoxy system when curing takes place at elevated temperatures[27]. A

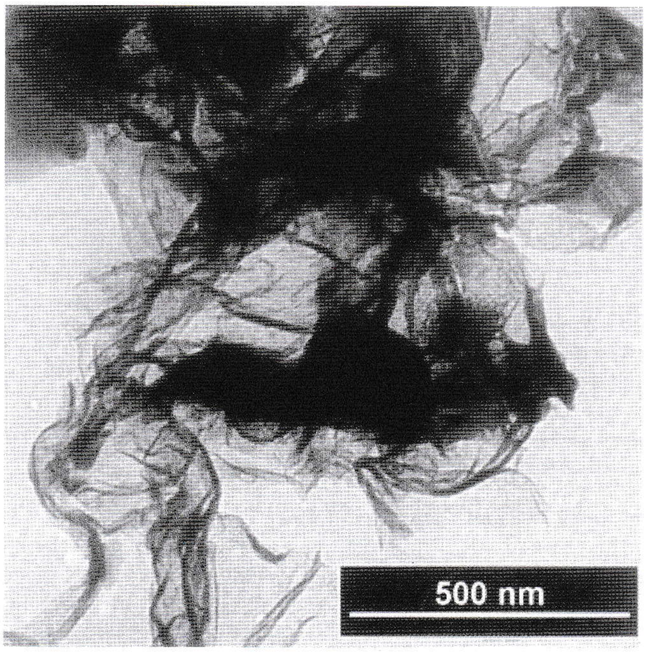

Figure 5: Lignin based carbon nanostructure.

mouldable *lignin*-epoxy composition can be prepared from *lignin*, polyisocyanate and aromatic epoxy resin[28]. It is believed that *lignin*-epoxy resin system results in properties that are either comparable or superior than the conventional bisphenol-A based epoxy resins[29].

Lignin Based Carbon Nanostructures for Polymeric Composites

Carbon nanostructures, including carbon nanotubes, carbon nanofibres as well as carbon nanoparticles are receiving more scientific and technological attention due to their unique physiochemical, electrical and mechanical properties.

They find extensive application in diversified areas like polymeric composites, sensors, energy storage as well as conversion, catalysis and biology[30]. Especially, in the carbon based nanocomposites, it results in improved thermal and mechanical properties with the minimum reinforcement[31] between ~0.1% and 5%. Also, it enhances the various functional properties such as flame retardancy, moisture resistance, barrier properties and linear thermal coefficient.

The conventional syntheses (vapour grown techniques) of these carbon nanostructures are not cost effective that limits its commercial applications, which lead the scope for cost effective novel process for the structure controlled synthesis of carbon nanostructures[32]. Thermal carbonising, hydrothermal and electro arc methods (which integrates material chemistry and process engineering) have been developed for the purpose for the cost-effective conversion of carbon rich precursors into carbon nanostructures.

Renewable Resources for Carbon

Precursors for carbon nanostructures play an important role in both, structure as well as in the yield. Petroleum based oil, gaseous hydrocarbons (methane and acetylene), toluene as well as benzene and carbon rich polymers (polyacrylonitrile-PAN) are the well knows precursors for the development of carbon nanostructures[32].

The ever growing demand for carbon nanomaterials as well as the depleting petroleum resources induced the researches to investigate alternate renewable resources for the development of carbon nanostructures. Hence, a wide range of renewable biomasses such as seed, oil, dried fibres as well as stem have been extensively used as the profitable source of carbon nanostructures with the compliment of reduced production cost[32,33].

The different morphology as well as chemical structure of this renewable resources results in the formation of diversified carbon nanostructures[32,33]. The recent addition to those renewable precursors is *lignin* and the following section describes the novelty of *lignin* based nanostructures and their extensive applications.

Carbon Nanostructures from *Lignin*

Lignin is found to be an efficient precursor for the synthesis of carbon nanostructures due to its high carbon rich chemical structure and its flexible chemical modification as compared to other biobased resources. Synthesis of carbon materials from *lignin* was reported earlier[34], however, synthesis of nanostructured carbon materials has not been explored to a great extent.

The recent accomplishment by our research team at the University of Guelph was the synthesis of carbon nanostructures from *lignin* at a relatively low temperature (Figure 5). Structural control of the carbon nanoparticles is quite possible by manipulating the chemical modification as well as carbonising temperature. Addition of metal and metal oxide catalysis further reduces the energy input during the carbonising process and enhance the controllability of carbon nanostructures.

The newly developed carbon nanoparticles find diversified applications such as polymer nanocomposites, energy storage (lithium battery technology), advanced electronics (nano enhanced conducting polymers) and hybrid vehicles (carbon based hydrogen storage) (Figure 6). The initial studies on the exploration of this carbon nanoparticles in the fabrication of polymer nanocomposites show a promising improvement in the thermal and mechanical properties, especially on heat deflection temperature (HDT).

Electrospun Carbon Nanofibres from *Lignin*

In nanofabrication, electrospinning has been widely investigated as an efficient technique

> There is a huge demand for polymer nanocomposites (with a polymer matrix and a filler with at least one dimension less than 100 nm) using carbon-based fillers because of its improved mechanical, thermal and electrical properties.

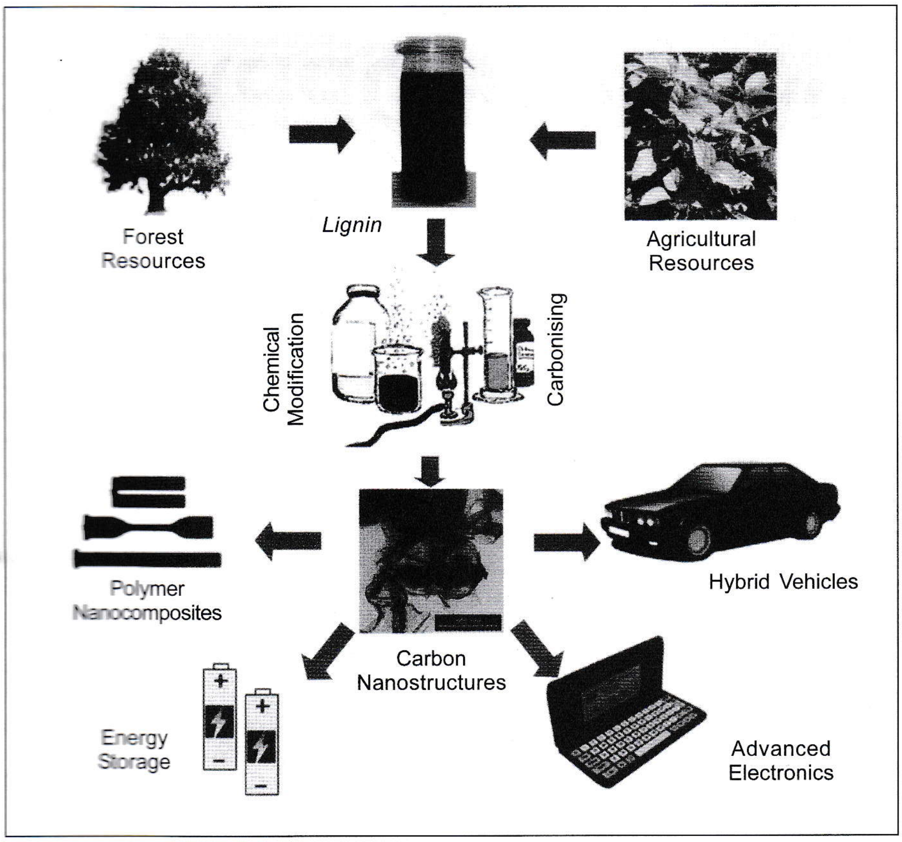

Figure 6: Schematic representation of lignin based carbon nanoparticles and their diversified applications.

for the synthesis of fibre nanostructures using polymeric solutions. The applied electrical potential (considerably very high DC voltage ~5-30 KV) between a metal capillary (where the polymer droplet is normally generated) and a grounded collector will produce a continuous fibrous structure[5]. The challenging issue in the electrospinning of *lignin* is its spinnability.

In order to convert the *lignin* into a spinnable material, researchers adopted various techniques such as:

- Suitable separation method from wood.
- Design of blends that contain *lignin* and synthetic polymers, which would help produce continuous fibres[35].

Furthermore, the obtained *lignin* fibre underwent thermal stabilisation.

Carbon nanofibres were obtained by carbonising the stabilised *lignin* fibres at elevated temperatures under inert atmosphere. The morphology of carbon nanofibres can be altered by employing various experimental parameters such as viscosity of the *lignin*, applied DC potential and distance between the spinnerete and collector.

Summary

- Novel innovative research ideas are imminent for value-added high end uses of *lignin* from bioethanol and paper pulp industries. A more value-addition can be drawn from the development of *lignin* based green composites for the automotive, packaging and structural applications.
- Matching of solubility parameter of *lignin* and polymers is an important factor to improve the miscibility of the components that improves the material performance of the composites.
- Also, the development of structure controlled carbon nanoparticles from chemically modified *lignin* relatively at lower temperatures will be a break through in the field of carbon based nanotechnology.
- In addition to the major composite applications, the newly developed carbon nanoparticles and their related materials will cater to diversified applications in many fields including lithium battery technology, hydrogen storage and also flexible electronics.

> **Carbon nanostructures are of great technological and industrial importance because of their unique physicochemical, electrical and mechanical properties.**

Acknowledgements

Authors are thankful to the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) 2009, New Directions & Alternative Renewable Fuels Research Programme Project number SR9225, the Ontario BioCar Initiative, Ministry of Research and Innovation and the 2009 OMAFRA-University of Guelph, Bioeconomy-Industrial Uses Research programme for the financial support to carry out this research.

Global Biaxially Oriented Polypropylene (BOPP) Film Market Update

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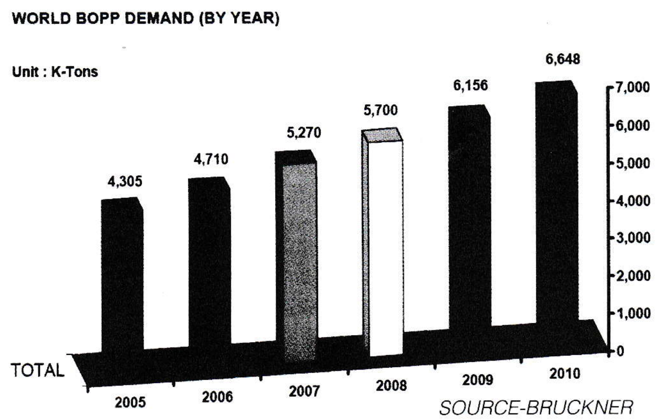
The world market of BOPP Films has reached to a capacity of 61.56 Lac tons by 2009 and 66.48 Lac tons by 2010. As per market research companies like AMI there are more than 291 producers BOPP in the world. The top 20 (Actually 30 due to same capacity) producers account almost 49% of the total capacity. The last 15 years witnessed a steady growth in both BOPP film production and global demand expect a few years when capacity outstripped the demand.

The demand of BOPP has been much higher in the Asian region over the last few years(almost 34% of the total consumption is from Asia).The major growth of BOPP is expected to be in India, China and Middle East for the coming 5 years. China has become a great force in BOPP with more than 9% of average growth rate. It is expected that China account for more than 6 Lac tons consumtion of BOPP by 2010. North America and Western Europe will almost 42-43% share of global market are not likely to grow beyond 5%.



SOURCE-BRUCKNER

It is very clear that over the last few years the various regions have reacted in different ways and indeed, individual countries within this regions have often displayed different reactions. In particular Middle East and Asian regions and India continue to play a more significant role in both production and market terms. In the current variable market conditions,

In the last 30 years BOPP films has been one of the success stories of the global plastics and packaging industry.

Strong Demand from customer industries combined with a real competitive advantage against other plastic and traditional materials has resulted in accelerated market demand. From an original position where it was perceived as a replacement for cellulose film it has now developed its own market niches, especially in coextruded areas where paper and other traditional materials are being replaced. Indeed over the last few years we have seen BOPP film developed to the extent that it can be considered a truly global business where the developments in one region can have major consequences in others.

As an illustration of the success of the BOPP film industry the following graph charts growth of BOPP and the contraction of cellulose film over the last 50 years.

Biaxially oriented polypropylene (BOPP) film is a high-barrier plastic film that is one of the most important substrates used in flexible packaging. Ever since it's introduction, it has been one of the fastest growing products in the flexible packaging business. Today, it is the most widely used high-barrier substrate and it's dominance is underscored by the fact that its world-wide usage is almost four times that of it's nearest competitor – biaxially oriented polyester (BOPET) film.

The film derives its special properties from the biaxial orientation process that substantially enhances its strength, stiffness, transparency and barrier properties. The increase in strength and stiffness make it possible to "downgauge", i.e. use very low thicknesses for most applications; this makes it possibly the most cost-effective and sustainable material available for high-barrier packaging.

Biaxial orientation

Biaxial orientation means the orientation or alignment of molecules in a special way along two axes, viz. along its length and across its width. This is achieved by stretching the film along its length (called machine direction orientation) and across its width (called transverse direction orientation) and then cooling the film to retain the molecules in the oriented configuration. The stretching can be done simultaneously or sequentially depending on the manufacturing technology employed.

Manufacturing technology

The first technology developed for the manufacture BOPP film - the blown film process – was pioneered in the late

1960's. It is similar to the conventional blown film process for producing thermoplastic films except that the film is blown into a "bubble" from a circular die and is accelerated by drawing it through nip rollers at the top of the bubble causing it to be stretched biaxially while still in the melt state. The first lines produced only a monolayer film made from homopolymer PP. As many packaging applications required the film to be heat-sealable, this had to be achieved either by blending it with polyterpene or by coating it off-line with a heat-sealable lacquer that had a much lower melting point than the base homopolymer PP. (All oriented films have to be heatsealed at temperatures lower than their recrystallisation temperatures since they tend to shrink and lose their orientation once this threshold is exceeded.) Both these options had limitations – polyterpene was not suitable for direct food contact and the off-line coating was expensive in both the additional process involved and in the formulations that had to be used. Therefore, it was not very successful in totally replacing cellophane, which was then the most widely used high-barrier flexible packaging substrate.

The real success of BOPP film was possible only with the development of coextruded BOPP film where the film was actually a multilayered structure produced by the simultaneous extrusion of three melt layers that were combined in the melt state itself into a single film. This enabled the film to be heat-sealable as produced without any additional processing by using surface layers of PP-PE copolymers that had a relatively low melting point and a core homopolymer PP layer. This film was also suitable for direct food contact.

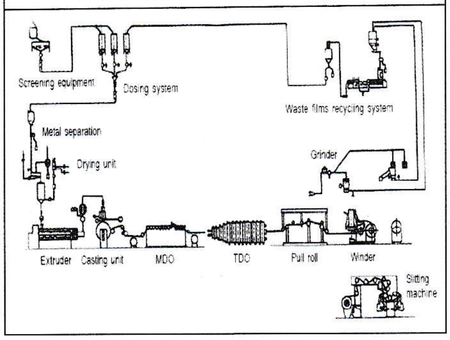
At the same time, the stenter process was developed for biaxially oriented films where the film was first stretched in the machine direction and subsequently stretched across its width in-line on a stenter frame. This process was much more capital intensive although it did provide much better controls on film gauge and was capable of running at much higher speeds and operating widths. It also needed relatively larger production runs for individual film grades and thicknesses to make it economically viable as change-overs were comparatively complicated and more time-consuming than the blown film process.

For quite some time, both processes co-existed and manufacturers used both options. However, as film lines gradually required higher rates of output that were best achieved by going wider and faster, the sheer bubble sizes required in terms of width as well as height became so unwieldy that the blown film process died out. In any case, it could never compete with the stenter process on line speeds and gauge control.

Today, all large manufacturers use only the stenter process and the number of layers has also gone up to four or five for some film grades.

Another manufacturing technology that has been responsible for explosive growth in BOPP film usage has been that of high-barrier metallising. This is primarily the vacuum deposition of a very thin aluminium layer on the film surface which gives it a metallic appearance and substantially enhances both the moisture barrier and gas barrier of the film. It also cuts light transmission to almost zero levels – a very useful requirement for many packaging operations. Apart from aluminium foils, metallised BOPP films are probably the most efficacious high-barrier flexible packaging options available today.

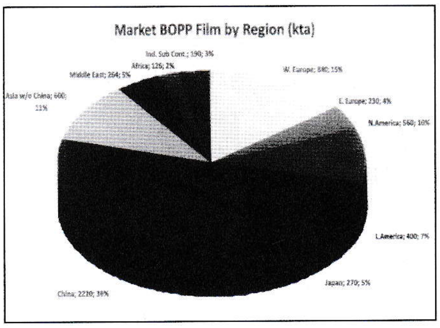
BOPP Film Production Process



Market & Application

The major end-user industries are estimated to be as follows:

Base film for adhesive tapes -	20%
Biscuits and bakery products -	15%s
Pasta and noodles -	11%
Other dried foods -	20%
Other foods -	20%
Confectionery -	6%
Tobacco -	4%
Others -	4%



Asia has emerged as the largest market for BOPP films with China being far ahead of any of the other countries. The major consumption areas for BOPP films in 2009 are estimated to have been as follows:

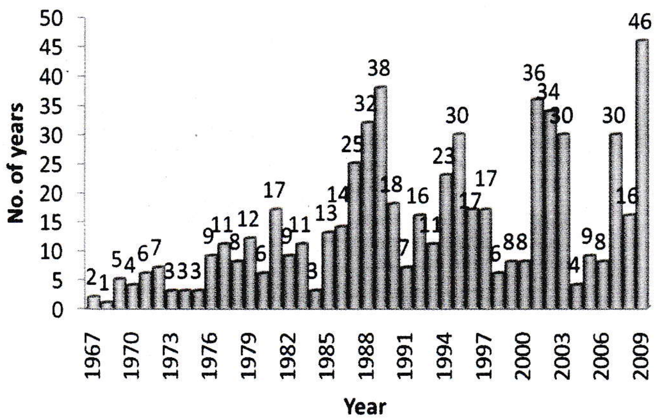
China -	2,220,000 MT
Western Europe -	840,000 MT
North America -	560,000 MT
Latin America -	400,000 MT
Japan -	270,000 MT
Middle East -	264,000 MT
Indian Subcontinent -	2,16,000 MT
Rest of Asia -	600,000 MT
Africa -	126,000 MT

The highest rates of growth are in China, India, the Middle East and Latin America which are still in the high-growth stage. The mature markets like Western Europe, North America and Japan are growing at less than 5% per year. China also dominates in terms of production capacities with over 20% of global capacity located there.

Capacities and major players

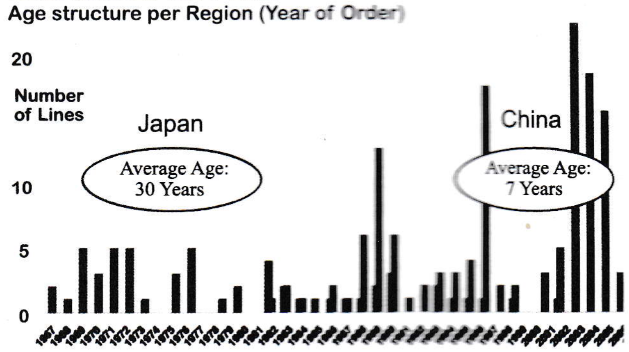
The installed global capacity for BOPP films is approximately 6.7 million MT per year. At 85% utilisation, this is just about sufficient to meet the global demand. As the demand is expected to grow @ 8% per year, a lot of capacity is expected to be added over the next 3 or 4 years. We ourselves are setting up a new 8.7 meter wide plant in Egypt (one of the world's largest lines) that will be operative early next year. The confirmed additions to capacity over the next 2 years total about 1.5 million MT per year. Most of this additional capacity is coming up in Asia and the Middle East, which are also the fastest growing markets. Indian companies are adding a little over 200,000 MT per year to existing capacities. China is expected to add 650,000 MT per year over the next 2 years.

GLOBAL BOPP LINES ORDERED FROM 1967-2009



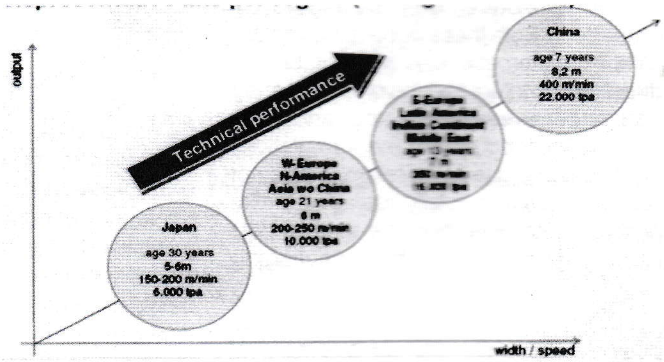
Competitiveness of BOPP Lines per Region

Performance of BOPP Lines
Age structure per Region (Year of Order)



Competitiveness of BOPP Lines per Region

Representative line per region (average of all lines)



There are almost 300 manufacturers of BOPP films. The top 20 ıanufacturers presently account for almost 49% of the world's apacity. The largest player is the Formosa Plastics Group (that ıcludes Nanya) with a projected total annual capacity of some 00,000 MT located in the USA, Taiwan, China and Vietnam. Most f the top 20 manufacturers, except for 4 large Chinese companies, have plants located in several countries. Only two Indian ıanufacturers (Jindal Polyfilms at number 10 and Cosmo Films at umber 17 presently figure in the top 20).

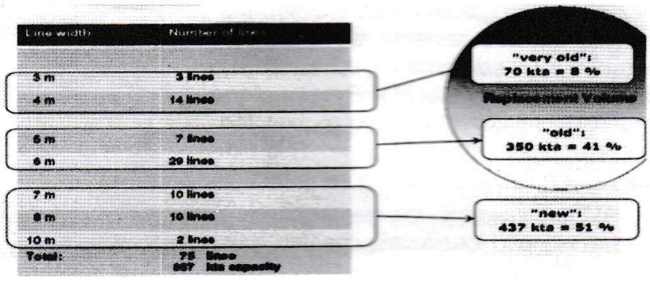
BOPP Film Producers World

BOPP Producers World
Capacities on seliable film, end of 2008

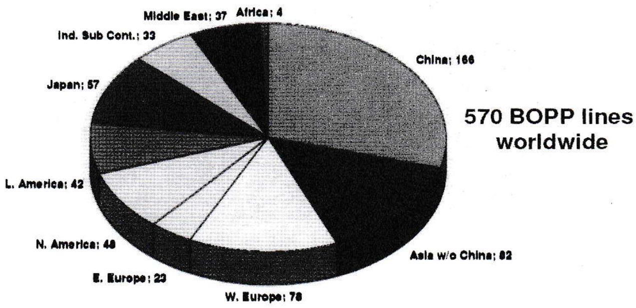
Region	kta	Number of Ordered Lines	kta
Western Europe	857	1	16
Eastern Europe	223	2	39
North America	550		
Latin Americas (incl. Mexioo)	466	8	172
China	1,580	29	695
Asia without China	717	3	74
Japan	304	1	
Middle East	334	5	130
Indian Sub Continent	216	3	25
Africa	40	2	50
Total	**5,287**	**46**	**1201**

BOPP Film Lines Ready for Replacement

BOPP Line Segmentation (running lines)
Western Europe 2008

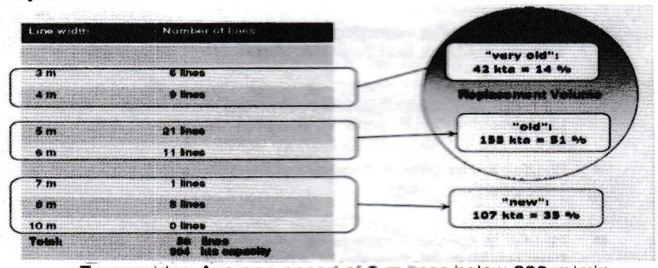


Performance of BOPP Lines
Number of BOPP lines per region (running and ordered)



BOPP Film Lines Ready for Replacement

BOPP Line Segmentation (running lines)
Japan 2008



To consider: Average speed of 6 m lines below 200 m/min

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Workshop on "Trouble Shooting in Plastic Processing"

Indian Plastics Federation and Indian Plastics Institute – Kolkata Chapter jointly organised a Workshop on "Trouble Shooting in Plastics Processing" on 15th December 2010 at Rotary Sadan, Kolkata from 2.00 pm to 5.30 pm.

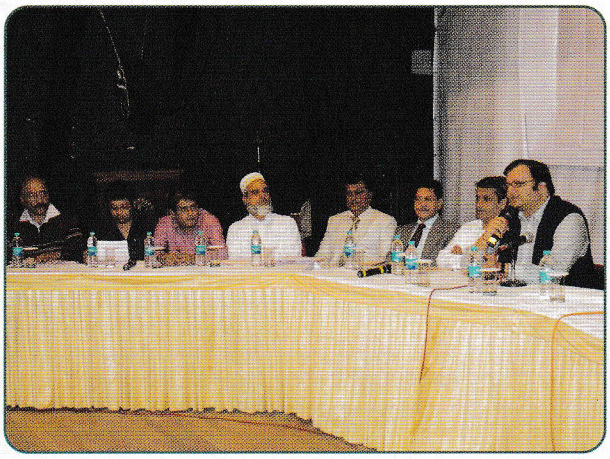
The workshop Chairman was Mr. Amar Seth and the Co-ordinator was Mr. Aloke Ghosh. The following Panel Members answered various technical questions from the participants regarding different segments of plastics industry.

Injection Moulding	**Extrusion**	**Compression Moulding**
Mr. Ranajit Guha,	Mr.Satish Bhaia	Dr. N. R. Bose
Mr. T. K. Banerjee,	Mr. S. Roy	**Raw Materials**
Mr. Shyamal Kr. Baksi	Mr. R. M. Maheshwari	Mr. Anindya Pal
Electrical & Electronics	Mr. Madanlal Agarwal	Mr. Subhomoy Ganguly
Mr. Koushik Dhara	Mr. Subash Ch, Mohanty	**Hydraulics**
Mr. Rohon Ghosh	Dr P. R. Mukherjee	Mr. Hunaid
Mr. Dilip Ganatra	**Blow Moulding**	
	Mr. Tarun Datta	

The programme was co-sponsored by:

Conhyde (India) Pvt. Ltd., Dee Bee Polymers Pvt. Ltd., Eastland Machines & Tools Pvt. Ltd., Fortune Polymers, Joharilal Agarwala Sales (Pvt.) Ltd., Kalpena Industries Ltd., K. M. Enterprises, Kushal Polysacks Pvt. Ltd., Maraica Industries, Rajami Barter Pvt. Ltd., Rajda Group, Rateria Laminators Pvt. Ltd., Sashibhai Suklal Pvt. Ltd., Swastik Polymers Pvt. Ltd., Uma Plastics Ltd.

The workshop was an all-round success and it was attended by 102 participants. The programme was followed by high tea.



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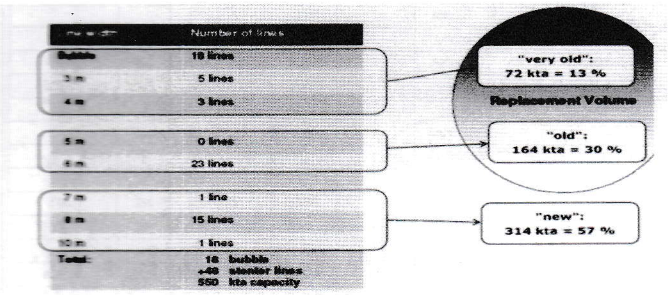
BOPP Film Lines Ready for Replacement

BOPP Line Segmentation (running lines)
USA / Canada 2008



Competitiveness of BOPP Lines per Region

Performance of BOPP Lines

Region	Average Age
China	7 years
Eastern Europe Latin America Indian Continent Middle East	13 years
Western Europe North America Asia without China	21 years
Japan	30 years

BOPP Film Lines Ready for Replacement

Lines ready for replacement

	Number of Lines	Capacity (tpa
W. Europe	53	420.000
N. America	31	240.000
Japan	47	200.000
Total	131	860.000

In established countries (W. Europe / N. America Japan) about 130 lines with a capacity of [illegible] are ready for replacement.

Competitiveness of BOPP Lines per Region

Conclusion

- **Existing lines in 10 regions have different performance. Leader is China, last position: Japan**
- **All regions have a different cost structure. Leader is M. East. Last position: W. Europe, N. America, Japan.**
- **Leader in competitiveness of existing lines is China. Last position: Japan**
- **Leader in competitiveness of new, 8m lines is S. Arabia. Last position: W. Europe, N. America, Japan**

Conclusion

Future of the BOPP business / future of the BOPP companies

- **Total change in the commodity business in the next 5-10 years**
- **Production locations of commodities will move more and more from established BOPP markets (W-Europe /N-America/Japan) to low cost regions**
- **Established BOPP producers will only survive and be successful if they accept and follow these changes in the market**
- **Specialities will not be affected as much as commodities by this trend**

WORLD TOP 20 BOPP FILM MANUFACTURERS INCLUDING (EXISTING LINES & INCLUDING ORDERED LINES)

No.	Company	Country	Capacity (no. of lines)
1	FORMOSA PLASTICS GROUP(FPG) –AmTopp –Nanya plastic corporation	Lotita,USA (Amtopp)	120000MT
		Vietnam(Formosa)	64800MT
		Taiwan(Nanya)	151000MT
		China(Nanya)	64800MT
			TotaL-400600MT
2	Exxon Mobil	Belleville, Canada	270000MT
		Stanford,	
		Connecticut	
		La Grange, Georgia (NA)	
		Shawnee, Oklahoma(NA)	
		Kerkada, Netherland	
		Virtan, Begium	
		Brindisl, Italy	
3	Taghleef Industries	Dubai	260000MT
		Oman	
		Egypt	
		Italy	
		Hungry	
		Australia	
4	Treofan	South Africa	220000MT
		Mexico	
		Belgium	
		Germany	
		Italy	
5.	Jiangsu Zhongda New Materials International Trade Co. Ltd	china	185000MT
6.	Vifan	Laquila, Italy	175000MT
		Pontenza, Italy	
		Montreal, Canada	
		Morristown, USA	
7.	Jiangsu shenlong chuangye group co ltd	china	170000MT
8	Shenda Group Co Ltd	China	160000MT
9	W &G (WANG & GRACE)	CHINA	140000MT
10	JINDAL POLYFILMS LTD	INDIA	127000MT
10A	ZHEJIANG WENZHOU GETTLE PLASTIC INDUSTRY CO LTD	CHINA	127000MT
10B	VITOPEL DO BRAZIL	BRAZIL/ & ARGENTINA	127000MT
11	JIANGSU SHUKANG PACKING MATERIALS CO LTD	CHINA	120000MT
11A	MANULI FILM SpA	ITALY	120000MT
11B	Innovia Films	Brazil	120000MT
11C	JIANGSU SHUANGLIANG	CHINA	120000MT
11D	JIANGSU SANITY MACHINERY CORP LTD	CHINA	120000MT

12.	AET films	USA CANADA	115000MT
13	ANHUI GUOFENG GROUP	CHINA	109000MT
14	BIOFILM	COLOMBIA & MEXICO	103000MT
15	POLINAS PLASTIK FILM	MANISA,TURKEY	100000MT
15A	ZHEJIANG YIMEI FILM INDUATRY CO	CHINA	100000MT
16	POLIBAK PLASTIC FILM	IZMIR	90000MT
16B	Davelim Industries	KOREA	90000MT
16C	Thai Film Industries Public Comp Ltd	BANGLADESH & THAILAND	90000MT
17	COSMO FILMS LIMITED	INDIA	86000MT
18	SUN TOX (TOKUAMA)	JAPAN	83000MT
19	BIMO ITALIA SpA	ITALY	73000MT
20	TORAY	USA/FRANCE/JAPAN/AUSTRALIA	70000MT
20A	TOHCELLA	JAPAN	70000MT
20B	SUPER FILM	GAZIANTEP, TURKEY	70000MT
			TOTAL - 37,29,000MT

Source : AMI & Bruckner

Note: Taghleef Industries of Dubai are also aiming big and they have recently bought over Radici and Shorko Films, who are both large manufacturers to take their total present capacity to 260,000 MT per year that is just behind ExxonMobil at 270,000 MT per year, who were for many years the world's biggest producer of BOPP films.

Indian BOPP scenario

Indian capacity in 2009 is reported at about 289,000 TPA and Domestic Demand is about 204,000 TPA. In the next 3 years, it is expected that, additional capacity of 222,000 TPA will be added to India i.e. 452,000 TPA. The total domestic capacity in India is expected to hit almost 650,000 MT per year in the next 3 to 4 years making it possibly the largest global player after China. 21% BOPP is exported from India.

Domestic Demand growth, mainly driven by flexible packaging applications, will absorb almost all of this additional capacity. India will continue to be a low cost production base for manufacturing and converting oriented films and Indian producers will continue to be long term competitors in export market.

Indian producers have a proven track record in supply & their domestic market offers significant opportunity for profitable growth.

Indian BOPP capacity / production

	2003	2008	2009	2013
Capacity	87	230	289	450
Production	70	170	204	375
Exports	15	34	40	35
Import				
	55	204	244	410

Indian BOPP Manufacturers

UFLEX LIMITED, NOIDA

Formerly known as Flex Industries has grown very fast, having two BOPP lines with capacity 36,000 TPA in Noida and growing continuously. UFLEX is selling about 75% in domestic market and balance to its Inter unit converting plants. The company is growing very fast under the **dynamic Legendary leadership of Mr. Ashok Chhhaturvedi (CMD) & Mr. Pradeep Tyle (CEO).** For the financial year 2009-10 Uflex Limited reported consolidated sales of INR 24.2billion (USD519million) for its flexible packaging business, an increase of 12% on the previous year. The EBIT margin was slightly improved at 14.2% compared to 13.8%.

Uflex decided to enhance further their Indian operation with additional PET & BOPP line during 2012.After successful operation in Dubai & Mexico, Uflex is going to start their Egypt BOPP operation during July 2010.CPP film line with metalizer will start November2010 & PET film line in September/October 2011.

BOPP Film Capacity in India 2010 and Expected Volume by 2011

Sr. No	Nam of the compony	Location	No. of Lines	Capacity	DOM	IUT	Export	Total Cap. Utilized
1	Jindal Polyfilms Ltd.	Nashik	5	127000	30000	NIL	18000	108000
2	Cosmo Films Ltd.	Waluj	5	60000	48000	NIL	30000	78000
		Baroda	2	36000		NIL		
3	Uflex Ltd.	Naida (U.P)	2	36000	18000	8400	3600	30000
4	Max Speciality Film	Toansa	3	32400	30000	NIL	600	306000
5	Kabra Plastics	Daman	1	3600	300	NIL	NIL	306000
6	Xpro India	Durgapur	1	8000	8000	NIL	NIL	8000
		Pithampur	1	3000		NIL	NIL	
7	Abhedaya Industries	Hyderabad	1	12000	3000	NIL	NIL	3000
8	Raha Madhav Corp.	Daman	1	12000		2400	NIL	2400
9	Pollyplex Corporation Ltd.	Bajpur	1	34000	12000	NIL	NIL	12000
10	Nahar Polyfilms Ltd.	Mandideep	1	34000	8400	NIL	NIL	8400
11	Hindustan Adhesive	Ghaziabad	1	1500	1000	NIL	NIL	1000
			25	399500	218700	10800	52200	285000
		Monthly Average		33292	17767	900	4350	2375000
								Nahar-12000
								Polyplex-12000

when polyplex & nahar will be in full capacity from Dec 2010 to Mar - 2011

Total = 309000MT

Cosmo Films Limited, Aurangabad & Baroda

Cosmo films has 6 BOPP film lines producing 96,000 TPA. Product mix- 42% Tape and Textiles, 36% Packaging and 18% Print Lamination. Cosmo Films records 74% jump in the 3rd quarter 2009-2010. The company has planned increase its capacities about 30% by fiscal 2011-12.

Jindal Polyfilms Ltd, Nasik

Jindal Polyfilms is believed to have increase BOPP production capacity from 57000 MT to 127000MT with the addition of two35000 MT 8.2M Dornier Lines.

Their major business almost two-third capacity is for tape and textile and at present they are the largest Nasik based BOPP film manufacturer in India.

Their tentative planning for another BOPP line with 25000MT capacity for this film below 15 micron during 2011

They are also having 6 metalizers and two coating machines.

Max Speciality Products, Toansa

Max Specialty Products has started a new BOPP Line of 20000 MT/Year capacity from 2007. They are already having 7000 capacity before the above plant started manufacturing BOPP film.

Nahar Polyfilm Limited, Mandideep

Nahar Polyfilm Limited will be inaugurating their BOPP line during May 2010 of 8.7M Bruckner Line 34000MT capacity. The Nahar Group is a diversified organization having 15000 employees including spinning, knitting fabrics, hosiery, sugar and infrastructure development.

They are planning for one BOPA (Nylon)line during 2011-12.

The future of rigid packaging (or Beam me up, Scotty!)

Did you get caught out when the recession hit, or were you prepared for the downturn? In either case, you can fortify your operations and proceed with a plan.—Paul Sturgeon

Where is the rigid packaging market headed? There are studies that show the packaging market is set to increase at this or that percentage over the next few years, and specifically that rigid plastic packaging is projected to grow slightly more or less. The exact numbers are subject to guesstimates on the overall global economy, resin prices, currency exchange rates, environmental pressures, and consumer trends.

Regardless of the exact numbers, rigid plastic packaging will continue to take space from glass and paperboard, and from flexible packaging in some cases. Flexible will replace rigid in other areas.

So what does the future hold? It is what we make it, and I talked with some of the people who are doing just that in the rigid packaging field.

To set the stage, let's look at the past 15 months or so for the rigid packaging industry. Picture an old Star Trek episode. A few of the federation starships are zipping around the galaxy, when suddenly they are attacked by unseen forces (Romulans). There are a lot of explosions, alarms, panic, and people running around trying to figure out how to do their jobs in the face of impending doom.

After the commercial, we discover that, fortunately, most of the spaceships survived and are slowly assessing their damage, either drifting along or moving ahead on impulse power. But one ship and its crew seem to be different from the others. They have escaped serious damage, recovered quickly, and are planning to go on the offensive. Of course, loyal viewers recognize the Starship Enterprise with its fearless crew. What is it in the rigid packaging world that will allow some companies to be leaders while others struggle to maintain market share?

Deflector shields

One of the keys to sustainable growth is being able to survive the downturns without a big decrease in revenue. That means having some diversification in the product line, product mix, or end user markets. For example, companies with a significant healthcare or medical exposure performed relatively better during the past recession. Alpha Packaging (St. Louis, MO) is a good illustration. Alpha is a $125 million manufacturer of stock and custom PET, HDPE, and PLA bottles and jars for the pharmaceutical, nutritional, personal care, and niche food and beverage markets. It maintained its record 2008 sales levels throughout the downturn, ended 2009 strong, and is poised for continued growth at 10% per year or better.

Dave Spence, president and CEO of Alpha, attributes its continued success in part to being diversified within its niche. "We know our customers very well, and we ask them what they need. That might be a new product, or perhaps a different size within an existing product line. We are also adding capacity where it makes sense. Our plant in Roosendaal, Netherlands, will open in May 2010 and will be our seventh manufacturing facility."

Alpha has grown through selective acquisitions, four in all, although Spence notes that as a percentage of sales, it has actually had more organic growth. Today, Alpha produces about 2.5 million bottles per day and employs 550 people, shipping to more than 30 countries and to every state. "I like to tell people it took us 25 years to become an overnight sensation," Spence laughs.

Photon torpedoes (made of 50% recycled photons)

Boulder, CO-based Eco-Products is targeting 40% growth in 2010 by converting existing markets to its line of environmentally friendly food service disposable products. While the food service disposables market is expected to see up to a 3% gain this year and next, the green segment of that market is projected to grow 17%-20%. Bob King, CEO, says that legislation is currently providing a tailwind as well, as America's desire to be a better steward of the environment raises awareness of such products.

"There is still a lot of misinformation out there on green products," says King, "so even though we are still a small company, when we see the opportunity to provide thought leadership, we try to do that." King anticipates adding sales and marketing staff in the coming year to support Eco-Products' growth. When evaluating potential new employees, the company wants to ensure that everyone shares the company's values. "We like our people to be environmental patriots," says King.

CM Packaging, a Lake Zurich, IL company that provides packaging for the bakery, produce, deli, supermarket, pizza, restaurant, packer, processor, distribution, and food service industries, is also responding to increasing customer demand for greener products. CM's president and CEO Mark Faber says that the company plans to introduce a line of produce and bakery clamshells made from recycled water bottles in the middle of this year. It also makes a line of products from PLA.

"We were actually green long before it was cool," notes Faber. "Our company roots go back to aluminum foil, which is fully recyclable forever. I think we will get to that same level of environmental stewardship with plastic, but it takes a conscious effort."

Warp drive

Innovation is the engine that propels the market leaders faster and higher than the industry as a whole. Constar International (Philadelphia, PA) is one of the world's major suppliers of PET containers, going head-to-head with larger competitors. It is the only major competitor that develops its own barrier material technology internally, however, which has led to a family of proprietary barrier technologies that protect sensitive food and beverage products from degradation induced by oxygen ingress. They extend the shelf life of products such as beer, juices, teas, enhanced waters, wine, flavored alcoholic beverages, ketchup, and other food products, according to Alex Fioravanti, VP of material sales for Constar.

"Food companies will increasingly be switching from glass containers to PET alternatives in the next one to two years, particularly for foods like pasta sauces, salsa, jams, and jellies," predicts Fioravanti. "Thanks to our new DiamondClear oxygen scavenging technology, we can showcase the package and the product much more clearly than before in a PET container that is recycled and recyclable, has a lighter weight, and helps to reduce carbon footprint and transportation costs."

Fioravanti is currently working to extend the DiamondClear value proposition to the thermoforming side of the house, where the innovations offered by this technology are also apparent. "We are looking at food applications where shelf life is important, such as packaged and fresh meat, puddings, and other segments where barrier is used today. These are areas where we can offer more environmentally friendly DiamondClear PET cups and trays that are also much clearer than other alternatives." Working with brand owners and converters, Constar is hopeful that new markets will continue to open up.

To seek out strange new worlds

Every great starship has a strong leadership team that sets the course and enables the crew to do its job. What these leaders have in common is a vision for the future, and the ability to share that vision throughout the organization. At Alpha, that vision means aggressively reinvesting in equipment and technology. "We are constantly looking forward," says Spence, "always asking ourselves how we can get faster and better."

Faber agrees, and is looking to add to CM Packaging's existing product development and marketing staff in the coming year to support his aggressive growth plans. "Our goal is to continue to develop excellent new products that meet the needs of the consumer," says Faber.

So if you want to know how to survive economic downturns and resume double-digit growth in the rigid packaging business, we've laid out the easy recipe. First, diversify your products and/or markets, then be innovative, recognize that sustainability is a very real priority, and have great team leadership. On behalf of Captain Kirk, Mr. Spock, and the rest of the crew, let us boldly go forward; warp factor three . . .

BPA remains in regulatory cross hairs

In coming months, legislatures at all levels of government will weigh greater restrictions and regulation of polycarbonate (PC) precursor bisphenol A (BPA), but even before their verdict is rendered, the court of consumer and retailer opinion appears to have already found PC guilty by association and moved to eliminate it from packaging.—Tony Deligio

In the U.S., the states of Washington, Minnesota, Connecticut, and Wisconsin all have BPA bans in place. In May 2009, Chicago became the first city to ban BPA, and the Illinois state legislature is currently weighing two bills that would prohibit the sale or distribution of certain BPA-containing products and require product labeling. Massachusetts is also considering a ban.

The Canadian federal government formally declared the chemical a hazardous substance in October 2008, placing it on a list of toxic substances. In May 2009, the Danish parliament passed a resolution to ban the use of BPA in baby bottles, with the law enacted in March 2010. On the retail side, Wal-Mart, Toys"R"Us, Babies"R"Us, and others have moved to phase out BPA baby bottles, allowed consumers to exchange them for BPA-free ones, or done both.

In March, the U.S. Environmental Protection Agency (EPA) said it would add BPA to its chemicals-of-concern list and require testing related to environmental effects as part of a new action plan, saying that more than 1 million lb of the chemical are released into the environment every year. The EPA said it would not examine BPA within food packaging, leaving that to the U.S. Food & Drug Administration (FDA), which in January stated that it had "concerns" about the potential human health impacts of BPA. Those concerns have led the FDA to study the potential effects and ways to reduce exposure to BPA in food packaging.

Cal Dooley, president and CEO of the American Chemistry Council (ACC), stressed in a statement released the same day as the EPA announcement that he believes the EPA is not proposing regulatory action regarding human health. Dooley also said that the ACC would cooperate with the EPA, and modernize the agency's Toxic Substances Control Act (TSCA).

In response to questions, the ACC said a key aspect of the action plan is to conduct research that will help answer key scientific questions and address uncertainties, with many of the studies occurring over the next 18-24 months. "For the same reasons, [ACC] also has an ongoing program to sponsor research and testing on BPA," an ACC spokesperson said. "Although the FDA did not announce a timeline, further updates and decisions will presumably be based on the research they and others are conducting."

Enesta Jones of the EPA press office said its action plan could have an effect on BPA and PC manufacturers and converters. "EPA's focus is predominantly on the presence and concentration of BPA in the environment and its potential effects on environmental organisms," Jones said. "Accordingly, EPA is considering proposing environmental sampling and monitoring in the vicinity of known or potential releases of BPA to the environment, including manufacturing plants, major industrial processors, and landfills, to determine whether environmental concentrations may be of potential concern."

The Nathan Performance Gear Flip Straw Pure Bottle from Penguin Brands Inc. uses Eastman's Tritan copolyester in an application that might previously have sourced polycarbonate.

Jones also stated that with respect to BPA, the EPA will start implementing the moves identified in its action plan this spring, including the Design for the Environment (DfE) projects that seek to reduce unnecessary exposures. It will also draft and publish the proposed rules this fall for listing BPA as a chemical of concern and for conducting further studies.

Adrian Beale, global engineering thermoplastics (ETP) director at Chemical Market Assoc. Inc. (Houston, TX), says CMAI estimates that only about 3% of all PC is used in packaging, so the BPA controversy, if it stays confined to packaging, does not affect PC suppliers too much.

Products already affected include thermal and carbonless paper coatings used in receipts where BPA alternatives may be readily available. Plus, the EPA intends to examine alternatives for BPA used in foundry castings, as well as BPA-based materials lining water and waste water pipes. And although plastics are getting the bad press, deliberations on BPA's use are much more critical to metal can makers, who use the material as a liner.

A higher EPA profile

EPA administrator Lisa Jackson has launched what she calls a comprehensive effort to bolster the agency's chemical management program and ensure the safety of chemicals. On March 10, the Senate Environment & Public Works Subcommittee on Superfund, Toxics & Environmental Health held a hearing on modernizing the TSCA, with testimony provided by DuPont and Dow Chemical, among others. This spring, Senator Frank Lautenberg (D-NJ) and Representative Bobby Rush (D-IL) are expected to introduce a TSCA reform bill. Of the 62,000 chemicals on the market at the time the original law passed in 1976, environmental groups say the EPA has required testing on about 200, while regulating just four (asbestos, radon, lead, and PCBs).

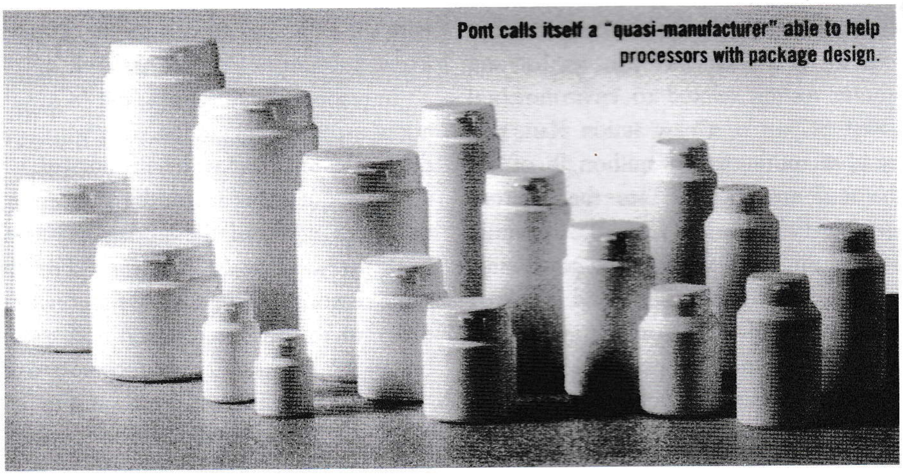
On March 30, ACC's Dooley spoke on a TSCA Modernization panel at GlobalChem Conference & Expo in Baltimore, MD, saying, "[The ACC] is committed to developing a new, comprehensive chemical management law that puts the safety of the American consumer first, while ensuring the innovation that will lead to the development of essential new consumer products and high-paying American jobs."

Outside the same event, a coalition of 200 environmental and public health groups called on the chemical industry within the conference to deliver what they called "a substantive platform to reform our federal toxic chemicals policy." That coalition, Safer Chemicals, Healthy Families (SCHF), released a document outlining three differences they've discerned between how the chemical industry and public health groups are defining TSCA reform.

In particular, SCHF wants health and safety information released on all chemicals as a condition for entering or remaining on the market. The SCHF has also called for the EPA quickly to reduce the impact of chemicals "already known to be dangerous," saying that complete risk assessments called for by the chemical industry would leave the EPA "wasting precious resources to reinvent the wheel." SCHF also believes that the EPA should investigate cumulative exposure to chemicals, such as they are experienced in the real world, not on an individual basis.

Secret to impressing your distributor? No big secret: Flexibility, reliability, and quality

Some packaging processors make product for a brand owner or end user, but often the packages find their way to buyers via a distributor. Is the distributor your partner, or just another link in the chain grabbing a cut of your margin?—Matt Defosse

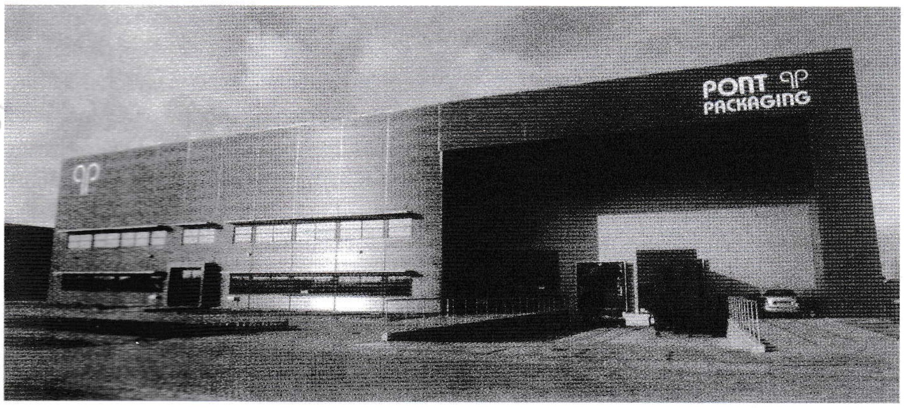

Pont calls itself a "quasi-manufacturer" able to help processors with package design.

Do answer that question we visited Pont Europe, one of Europe's leading distributors of plastics and glass packaging (closures and containers), and spoke to CEO Stephen Compson. He led the company to become one of the first, and still one of the very few, packaging distributors in Europe to which overseas packaging suppliers can turn for pan-European coverage; most distributors are still national in nature. "It's a tough business, but if you can learn how to blend the best of the different cultures, the synergies are great," notes Compson. "The complexity of the European market is amazing, but it's a fun challenge."

In 2001 his became one of the first companies to distribute imported polyethylene terephthalate (PET) packaging in Europe, with bottles from U.S. processors Paradigm and Alpha Plastics for vitamin packaging. "It was a very lucrative period for us" and allowed for investment in the business, he recalls. Between 2001 and 2005 the company, which until then had been essentially a collection of national business units in France, the Netherlands, and Germany, was able to focus some energy internally, adding personnel, separating sales and procurement, and investing in a new IT system.

The changes helped. "By 2007/2008, we had a pretty good pan-European platform," says Compson, with sales offices and warehouses added in the UK and Poland. All of these changes helped Pont's bottom line, but the question remains: Why should a plastics processor use a distributor? "Many packaging processors just don't have the sales force to deal with a myriad of small to midsized accounts. Locally, in the same language, in the same time zone . . . offering service; it's not easy and it's costly."

With Pont, a plastics processor is promised a distributor who will actively court its end customers, says Compson. "You need a love of customers," he says. "It's a core belief in our company . . . we want our customers to want to do business with us, because of our products and our service." Great employees are the key to reaching that goal, he says. "You have to understand your customers' needs and priorities. Maybe it's price, maybe it's good credit terms, maybe speed of delivery. You need to know what it is and offer it."



Pont's HQ in Almere, the Netherlands; expansion throughout Europe is under way.

Dealing with processor as partners

For the plastics processors it represents, Pont takes an active role. Increasingly the company places its molds, typically two to four per project, in different processors' facilities. Placing molds at processors in different countries helps both to limit risk and to ensure availability of supply should one source have problems. It reinforces the company's pan-European footprint as well; most distributors limit themselves to working with plastics processors in their domestic market.

"Generally I expect my suppliers to take the risk for raw material prices," he adds. "When we find high-quality manufacturers, we put molds in there, but to give a customer steady pricing, I often have to take out hedging terms to cover the currency risk." The relationship between processor and distributor needs to be "adult and balanced," he says. "At our major suppliers, we are in their top three in terms of customer ranking. This is a very important strength," he says, noting a processor rarely will go behind the back of such a large customer.

Building such loyalty with its processing suppliers takes effort, Compson admits. To that end Pont has invested in package design capability so that it is able to help processors with that; he even refers to his company as "a quasi-manufacturer" and insists, "We're different [from a standard distributor]." Pont was heavily involved with plastics processor RPC (London) to develop a mailbox-friendly blowmolded container project that at first ran into trouble as the end customer was primarily UK-focused. But Compson and Pont helped bring it to fruition: "We bought the molds [for this package] because we knew we could market this package internationally, which made the project commercially viable."

Despite the broader economic slowdown, Compson says, "My biggest issue right now isn't selling, it's finding the right suppliers. Many just aren't flexible enough to jump when a project comes along."

By year's end the company plans to add distribution warehouses in Spain, Italy, the UK, and likely Poland, with its objective to offer local service throughout the continent. "We're starting to sell more internationally, especially as we develop our own products, but our focus remains pan-European, with local service in every market," he adds. About 80% of Pont's suppliers are European.

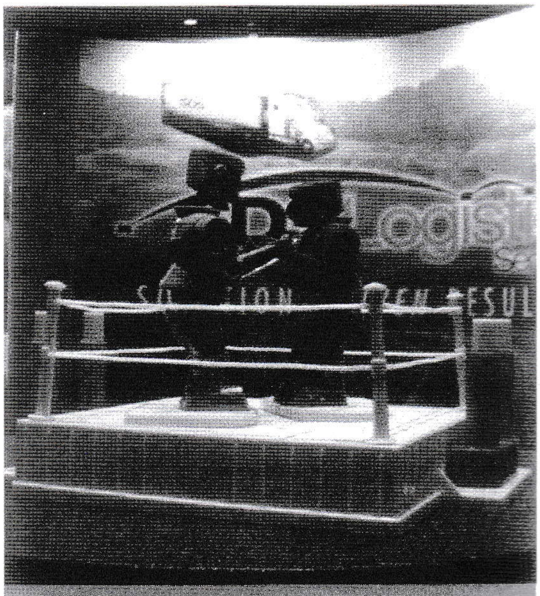
The company also has made an internal change so that Pont Europe is now the name of the group; previously there was Pont Packaging in Northern Europe and Pont Emballage in France. In another change, it also is increasingly having its molds made so that its own name appears on a package's base.

The company's growth path is clear. "In 2001 we had revenue of €12 million, and we're now triple that. My goal is to double it again in the next five years," he says. By that time, Compson (55) also intends to have his successor in place. Processors can rest assured that the successor, too, will work for win/win situations.

Plastics recycling: Sleeping giant's time has come?

If Rip Van Winkle were a packaging processor who dozed off in 2000 and woke this year, his greatest shock, after material costs, likely would be the much greater significance placed on sustainability in all product development discussions. Plastics recycling stands to benefit from these discussions, and indeed already has, but obstacles remain.—Matt Defosse

Many obstacles remain: That was the essence of two days of presentations and meetings during Plastics Recycling 2010, an annual conference held this year in Austin, TX in early March. In attendance were many representatives of brand owners and OEMs, and their interest is a good indication that resource recovery and recycling are issues that plastics processors will be facing even more in the coming years.



Deposit legislation, non-bottle recycling, better sorting, and more: There is no lack of issues to argue about in plastics recycling.

Recovery is a huge issue for plastics recyclers, all of whom said their main problem is finding a suitable supply to meet the demand. Many blame consumer ignorance. Georgina Sikorski, director of CARE (Carpet America Recovery Effort), spoke for them when she said, "The biggest challenge for us is educating consumers, educating consumers, and educating consumers," leaving no doubt where she thinks emphasis needs to be placed.

John Challinar, director of corporate affairs at Nestlé Waters Canada, agreed, and also argued that a bottle deposit law is not necessary to prompt successful recovery and recycling of postconsumer recyclate (PCR).

But according to an annual survey conducted by e-newsletter Plastics Recycling Update, in 2009, 86% of PET recyclers surveyed said they would support container deposit legislation, and 60% of PE recyclers did, said Henry Leinweber, associate editor of the newsletter. In 2009, according to respondents, 54% of PET and PE recyclers increased their volume, but margins fell. Although recyclers say finding bales of PCR material is easier than before, quality is way down. "The quality has dropped in every year of this survey," now in its fourth iteration, he said. As a result, respondents said their top move is investing in more efficient cleaning/sorting/recycling equipment.

Coca-Cola late last year introduced its PlantBottle, using PCR-PET and PET with its precursors derived from renewable resources, but it capped PCR-PET content at 30% in North America, also due to lack of supply. Working to counter that will be Leon Farahnik. As reported in last month's **MPW** "Notable Processors" feature, Farahnik, former owner of processors including PWP Industries and Hilex-Poly, plans to install a massive 100 million-lb/year PET recycling facility in California, and within the next six years to have three plants of this size across the United States. Currently much of the PCR-PET in California is exported to China, but Farahnik reckons he can compete for enough of it to keep his recycling plant fed.

He'll face competition aplenty, based on a presentation made by Stephanie Lam, business development manager at UNM International, a global recycling firm based in Hong Kong. In 2009 she purchased more than 140 million lb of recovered plastics from North America and the Middle East. Lam said a Chinese regulation implemented in November 2009 requires the registration of foreign recyclate suppliers and domestic assignees, a move made to limit the amount of unusable plastics waste imported into the country.

"A crackdown by customs officials in 2009 eliminated a significant percentage of illegal imports," she said. Despite that, Chinese recyclers' biggest problem remains trying to find enough quality recyclate, she said, just like their peers in North America and elsewhere. Domestically, she said, there remains little PCR resin available, as the culture of reuse among consumers doesn't allow for much waste creation.

Plastics recyclers have a tough lot but at least they generally have no concerns on the demand side of the equation; quite the opposite, in fact, noted Mike Shedler, director of technology at Napcor (National Assn. for PET Container Resources).

"There is a phenomenal pent-up demand for this recyclate," he said. "The problem now is getting it." Napcor (Sonoma, CA), first formed with the mission to serve PET bottle processors and their customers, in 2007 opened its membership to processors of thermoformed PET containers.

Non-bottle PET in the spotlight

In the U.S., there is tremendous interest in increasing the available supply of PCR from thermoformed PET packaging. According to Shedler, in 2008 about 1.4 billion lb of this packaging was produced in North America, not counting imported material, which also is a significant amount (think PET clamshell packaging of electronic devices).

The need for greater collection is huge, he said. "By 2011, [thermoformed PET packaging] could be half the size of the PET bottle market [based on total material consumption], as growth is about 15% per annum, driven by conversion from polystyrene and PVC to PET."

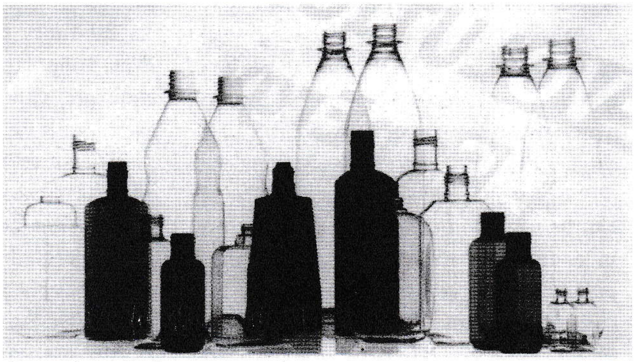
However, demand for recyclate from PET bottles is "going through the roof," said Shedler, which means many recyclers are hesitant to start recycling non-bottle PCR-PET, for which there may not be a customer base. Also hindering greater recycling of non-bottle PET packaging, he said, are look-alike materials (especially OPS, PVC, and PLA), which spoil the recyclate pool. In addition, the wide variety of intrinsic viscosities (IV) for PET sheet makes it difficult for a processor to get the type of material he needs.

In comparison, PCR-PET bottles are relatively homogenous. Napcor sees an IV range for thermoformed PET packaging extending from 0.64-0.80. Other issues hurtful to greater recycling rates of these packs are the many shapes, use of direct printing, and use of different adhesives and additives.

Plenty of questions remain and there are tough issues to debate. Clear from the event, which was attended by more than 900 from around the world, is that plastics recycling is on the cusp of a number of big breakthroughs: better sorting technology, increased collection of materials beyond PET and PE, and the tremendous focus on collecting more non-bottle PCR-PET. Next year's event in March in New Orleans no doubt will continue this story.

Better measurement of barrier performance; PP and PLA barrier bottles coming?

The need for an effective gas barrier in blowmolded packaging is increasing in importance for food and beverage processors with their customers' desire to extend shelf life and cut down on product loss, says Klaus Hartwig, director of the product technology center at Nestlé Waters (Vittel, France).—Robert Colvin



IKV studies reveal that plasma-coated PP and PLA could eventually compete with stretch blowmolded PET bottles.

Hartwig, formerly with stretch blowmolding equipment manufacturer KHS Corpoplast (Hamburg, Germany), emphasized the need to reduce the development time of improvements in introductory remarks during a session on barrier packaging at this year's biennial plastics technology colloquium conducted by Germany's Institute of Plastics Processing (IKV; Aachen). He says product development today takes between two and three years before new technology is marketable. This needs to be much shorter, he says.

Yet, as he points out, food packagers are only willing to accept developments that offer them more cost-effective solutions than they now use, processes that are compatible with today's recycling laws and collection means as well as offering improvements in overall shelf-life expectancy.

IKV researchers working together with industry partners presented two new processes for beverage packaging in this area. Thorsten Leopold, an IKV engineer, showed developments he and his team have made in an integrative modeling system to determine the oxygen barrier of stretch blowmolded polyethylene terephthlate (PET) bottles, depending on the biaxial stretch of the material during molding.

"Continuing downgauging and lightweighting of bottles [to save money] has led to problems of loss of barrier," Leopold says. He points to commercial 0.5-liter carbonated soft drink (CSD) bottles that have dropped in overall weight from 30g to just 12 g/bottle in a 10-year period starting from 1997.

Leopold presented a means of calculating the permeation of gas through the walls of PET bottles by a simulation method that analyzes the influence of the area stretch ratio and the temperature on the permeation coefficient. The calculation distribution of the wall thickness and the local-area stretch ratio of the shaped bottle are included in the calculation of the temperature-dependent oxygen transmission rate (OTR). "This allows [bottlers] an evaluation method of barrier properties as a way to support development of new packaging materials," he says.

A new take on plasma coatings

In a second presentation dealing with beer and CSD bottles by IKV engineer Karim Bahroun, a system to improve passive barrier was explained using a plasma coating for stretch blowmolded containers, rather than multiple layered preforms. Plasma-enhanced barrier coating of PET beverage bottles is an established process—for example, with Sidel's (Le Havre, France) Actis (amorphous carbon treatment on internal surface), which uses a license of an IKV patent.

Material	Oxygen, 23°C (DIN standard 53380)	Carbon dioxide, 23°C (DIN standard 53380)	Moisture vapor, 23°C (DIN standard 53122)
	$\frac{cm^3 \times \mu m}{m^2 \times day \times bar}$	$\frac{cm^3 \times \mu m}{m^2 \times day \times bar}$	$\frac{g \times \mu m}{m^2 \times day}$
PET	1000-2500	5000-10,000	100-200
PP	40,000-60,000	132,000-212,000	30-50
PLA	6250-15,000	25,000-80,000	6000-45,000

Source: IKV (Aachen, Germany)

Typical permeation coefficients of nonbarrier, oriented PET, PP, and PLA.

Induced by microwave energy, a plasma coating as thin as 0.1 µm on the inside of CSD and beer PET bottles is sufficient to provide good barrier protection. This method also has the advantage, says Bahroun, that it doesn't adversely affect the recycling chain.

Bahroun wanted to see if the chemical vapor deposition (CVD) of a thin plasma barrier layer can also be applied to two materials seeing greater use in the beverage packaging market, polypropylene (PP) and polylactic acid (PLA). "A trend can be seen [within the packaging sector] in a desire to move toward alternative polymers for ecological reasons, in the case of PLA, and for economic reasons with PP," he says. He points to prognoses that growth rates in such applications could reach up to 25% in coming years for polymers produced from renewable resources. PP's advantage compared to PET is, he notes, its lower density, and therefore lower weight, even with higher wall thickness. Its heat stability, enabling hotter filling temperatures, is another PP plus point compared to PET, he adds.

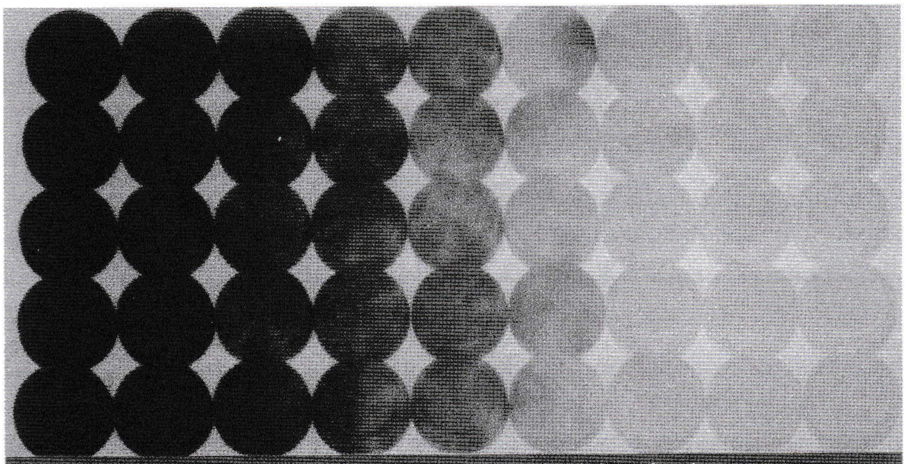
Where PET shines is its natural gas barrier, even in an untreated form, compared to the other materials. PLA typically allows five times higher oxygen penetration and 10 times higher CO_2 permeation of container walls than PET. In both categories, nonbarrier PP exhibits 30 times higher penetration. However, nonpolar PP does offer a significant moisture vapor advantage when compared with PET.

The study showed that both PP and PLA have the potential to compete with PET on gas barrier performance if they are pretreated to maintain a proper plasma adhesion to the wall surface prior to the CVD. For plasma treatment of PP, bottle interiors require a precoating of an acetylene precursor or hexamethyldisiloxan in combination with oxygen and acetylene; for PLA bottles, these also helped provide the necessary grip prior to CVD.

Once plasma is applied to 0.5-liter bottles, a 12 times better oxygen barrier, compared to untreated PP bottles, results. Barrier improvement of PLA bottles showed an 8.8 jump in CO_2 protection and 3.8 times better oxygen barrier. This, says Bahroun, allows both PP and PLA bottles to offer potential in future blowmolded packaging solutions.

Closure molding clash: Compression vs. injection

Huge volumes of resin are used to form plastic bottle closures, and there remains huge disagreement about the best way to mold those closures. Injection mold? Compression mold? Tough choice. We asked experts at two leading machinery suppliers to make the case for their process, and they eagerly picked up the gauntlet. Let the clash begin.



Color changes in the injection molding process can be accomplished in just a few shots.

Compression: Sacmi makes its case

In compression molding, everything depends on a lower plastic extrusion temperature, 30-40 deg C less than injection, which gives these advantages:

- **Shorter cycle time = higher productivity.** The lower extrusion temperature allows the cap to be cooled in the mold more quickly. This has reduced cycle times, which have, in the case of lightweight caps, been cut to less than 2 seconds.
- **Less energy consumption.** Lower extrusion temperatures mean less energy is needed to bring the plastic to extrusion temperature and, since the plastic is colder, less energy to cool it. Overall energy savings per cap produced can be up to 45%.
- **High specific density.** Molding pressure being equal, lower temperatures allow attainment of a higher specific density; moreover, the injection point, which puts added strain on the molten plastic, is absent. This technological condition provides good mechanical properties and a consistency that would be unattainable with injection.
- **Maintenance-free molds that last decades.** Unlike the injection mold, which is burdened by its own weight, the vertical and axial movement of the compression mold ensures the molds are protected from all kinds of wear.
- **Quick color changeovers.** These can be completed quickly without having to clean a hot chamber, which is absent in the compression process.
- **Less waste = lower costs.** In a scenario where the major retail multinationals demand both high standards and lower final product costs as necessary conditions for any increase in volumes, even the plastic cap is beginning to play a key role in decision-making.
- **Online video inspection.** Since compression operates with continuously rotating turrets, orientation and alignment of outgoing caps allows for the simple insertion of video cameras, feedback-connected to the machine itself at a practically negligible cost.

Injection: Netstal responds

Compression has enjoyed a perceived "king of the hill" position with respect to productivity for a long time, particularly for certain types of closures. That picture has changed dramatically in recent years, as injection molding solutions have surpassed the capability of compression molding, particularly for single-piece closures. This is particularly evident in the lightweight water closure segment.

Many of the old arguments are no longer valid. The historical claims in favor of compression are related to higher productivity, lower capital investments, faster color changes, lower energy consumption, greater process consistency, and lower production costs. These are all compelling reasons to choose a technology, but make sure you look into all of the claims.

- **Higher productivity.** A modern injection system will be able to produce in excess of 2000 caps/min on a medium-platform machine and in excess of 2750 caps/min on a large-platform system. The smaller and lighter parts allow for reduced cycle times and so the output of one system will win in terms of output. If you combine the better efficiency with the small footprint, the output per square foot is staggering.

Measurement in terms of instantaneous output is also often misleading. It's actually quite easy to have small buffers, even on an inline process of an injection system, without significant impact on floor space. Without buffers, an interruption anywhere in the process means a loss in efficiency. In both the output and efficiency, injection is the winner.

- **Lower capital investment.** A high-output injection molding system has become very efficient and cost competitive. The fact is that for the popular super-lightweight closures, the volume demands are high and so allow for the use of high-output systems. In a single-piece closure, if the demand is sufficiently high, the capital investment per million parts will favor the high-capacity injection molding system. Each application has its own requirements, but when you compare the cost of the total solution, injection is the winner.
- **Faster color changes.** Common claims are that a compression system can change colors in about 20 minutes. The photograph on the opposite page shows a blue to natural color change that was done on the fly in a matter of a few shots.

In addition to fast color changes, IM has a process advantage. There are a number of parameters that can be implemented in injection molding to compensate for the different shrinkage inherent with colors. More importantly, these parameters can normally be done without a negative impact on the cycle time.

- **Lower energy costs.** The real measure of energy efficiency must be done with respect to productivity. It is commonly accepted that the best measure is in kWh per kg of raw material throughput. Since the output (actual usable output) is higher, the consumption per kg would be lower. Be careful, though, since as the part weight goes down, the consumption per kg can go up. In terms of the energy consumption per kilogram, injection is the winner.
- **Greater process consistency.** The common claim is that the compression system has far fewer variables and therefore greater consistency. On the surface, it makes some sense. However, if you look into the practical side, you'll find a different picture. If the machine is capable, you will have control parameters, and not variables. If the system is in control and you have the flexibility of using a number of process setpoints, you will be able to establish an optimum and, more importantly, a robust process.

Often in compression molding, only one parameter is available to compensate for shrinkage: process speed. Injection molding has the flexibility of process parameters such as backpressure, hold pressure, and fill time to achieve the same dimensions without taking on cycle time penalties.

MONTHLY CIRCULAR OF THE FEDERATION

Circular No. 32/2010

IMPORTANT TAXATION MATTERS

Salient Features of Issue of Way Bill in Dematerialized form

1) A new electronic system of issuance of Way bill is being introduced from 1.12.2010
2) The way bill in **Form 50A** has to be generated and printed from the Directorate's Web site www.wbcomtax.gov.in by the importing registered dealer.
3) The new electronically generated way bill will not require endorsement from check post or charge office.
4) The transporter shall have to carry the waybill and produce it if intercepted by any officer of Commercial Tax Directorate.
5) The existing system of issue of Press Printed Waybills in **Form 50** either on electronic or manual application would continue side by side till **14.12.2010**
6) **The waybills in Form 50 in hands of the dealer may be utilised till 28.2.2011. After the date unutilised Waybill in Form 50 has to be surrendered with Central Return Receiving Unit (CRRU) at ground floor Beliaghata Commercial Tax Office within 10.3.2011**
7) **After 28.2.2011 use of Press printed waybill in form 50 shall be discontinued.**

Guidelines for generation of Waybill in Dematerialised Form (Form 50A)

- Access 'Login for Dematerialised Waybill' link under 'Log in for E Services' on Directorate's Website www.wbcomtax.gov.in
- **Part – I of Way Bill** shall be generated by **Consignee** by entering same User ID and password as used for uploading return and clicking on 'Generate Way bill Part – I'
- A dealer can generate bulk Waybill Part –I by entering VAT/CST TIN No. Name and address of the Consignor and PAN No. Of the consignor.
- After taking the print in Duplicate, one copy duly signed and stamped by the dealer should be sent to Consignor or authorised agent.
- This shall facilitate sending bulk waybill to Consignor in advance.
- **Waybill Part- II** shall have to be generated by **Consignor or authorised agent** by clicking on 'Dematerialised Waybill Consignor/Consignee Agent' under 'Log in for E Services' on www.wbcomtax.gov.in and entering Consignee's Tin no. And Waybill Key No.
- Details like Transporter's name Consignment note no. Date, Vehicle No. Total no. of invoices, Total value of goods etc. Have to be entered by Consignor/Consignee's Agent.
- Details like Commodity, Invoice No., Date, Quantity, unit, value of goods are to be uploaded by way of XML file created by Java Application Provided in the form.
- Waybill Part –II so generated along with Part – I and Annexure for Invoice shall Constitute Waybill in Form 50A and shall be valid for one month from the date of generation of Waybill Part –II.
- The waybill so generated has to be carried by transporter and produce if intercepted anywhere in West Bengal.
- Waybill Utilisation has to be submitted online by Consignor by clicking Waybill Utilisation Part – II under the link 'Login for Dematerialised Waybill' within 7 days from the date of entry of material in West Bengal.

The procedure for generation of Waybill has been elaborately given on Department of Commercial Taxes' website www.wbcomtax.gov.in with screenshots. All the members are requested to carefully read the user manual before generating the waybill.

CIRCULAR NO. 33/2010 :

Sub: Membership of the Federation

The Federation has received the following applications for membership of the Federation :

1. a) Name & Address of the Applicant Firm : **M/S LINC PEN & PLASTICS LTD.**
"Satyam Towers",
3, Alipore Road
Kolkata - 700 027
b) Class of membership : **Life Manufacturer member**
c) Proposed by : M/s Tib Creations Pvt. Ltd.
d) Seconded by : M/s National Moulding Co. Ltd.
e) Name of representative : Mr. Deepak Jalan
f) Items of manufacture : Manufacturer of Writing Instrments – Their Accessories and Parts, Packing Materials etc.

2. a) Name & Address of the Applicant Firm : **M/S. KAMAKHYA PLASTICS PVT. LTD.**
Birkuchi, Bonda
Guwahati - 781 026
b) Class of membership : **Manufacturer member**
c) Proposed by : M/s Rajda Sales (Cal) Pvt. Ltd.
d) Seconded by : M/s Stretch Plast
e) Name of Representative : Mr. Surya Kant Adukia
f) Items of manufacture : Manufacturer of Tusker Brand PVC Pipes & Fittings and Plastic Water Tank.

(Circulated in terms of Article 15 of the Articles of Association of the Federation)

CIRCULAR NO. 34/2010 :

Sub: Consumer Price Index Number for Industrial Workers for Kolkata for the months of January to September 2010

Month	Consumer Price Index	
	Base (1982 = 100)	Base (1960 = 100)
January, 2010	855	4053
February, 2010	850	4029
March, 2010	850	4029
April, 2010	860	4076
May, 2010	870	4124
June, 2010	881	4176
July, 2010	896	4247
August, 2010	896	4247
September, 2010	901	4271

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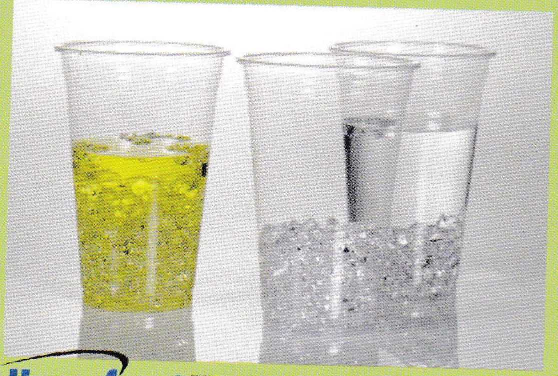

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