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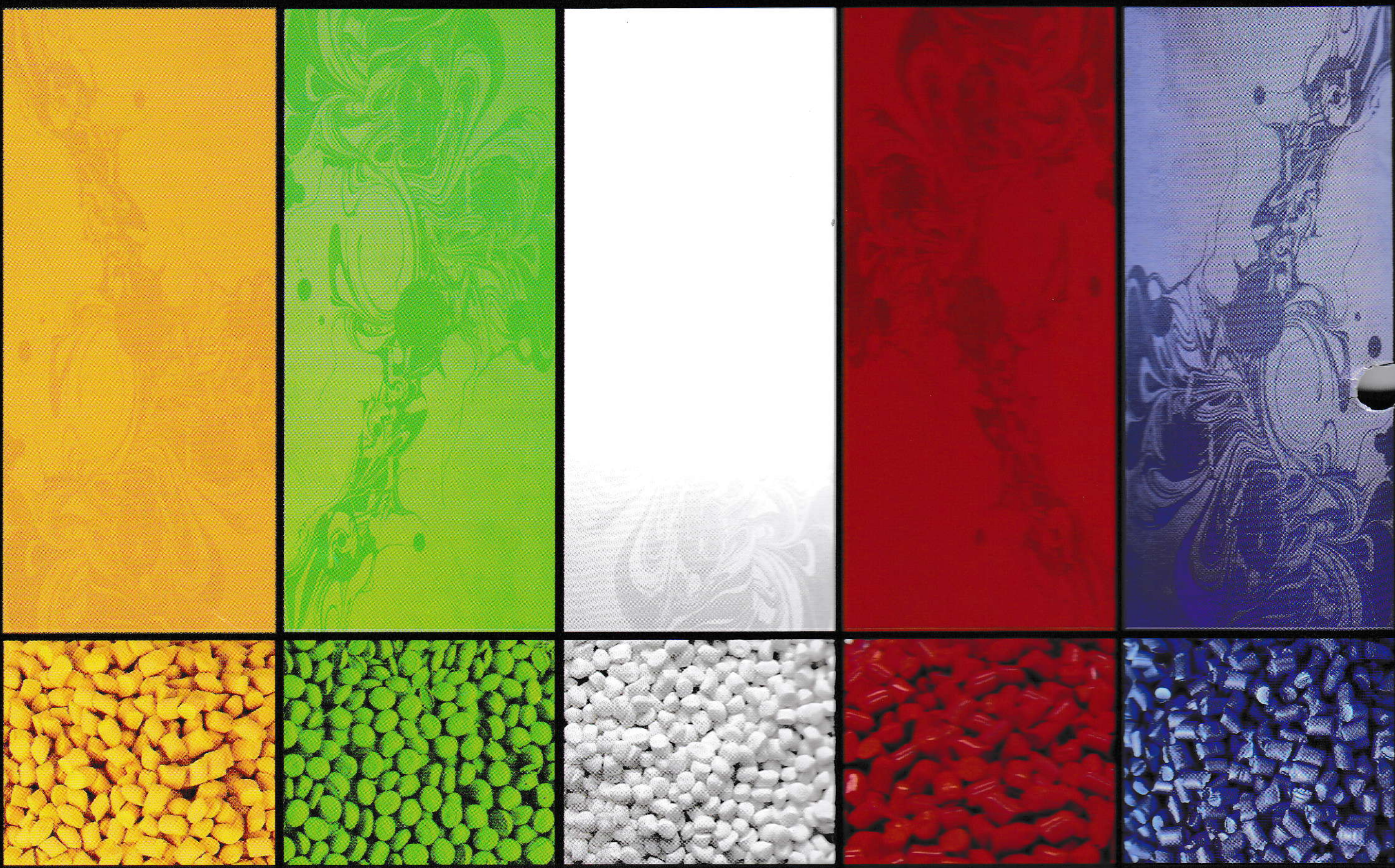

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8B, Royd Street, 1st Floor
Kolkata - 700 016 (INDIA),
Phone: 2217 5699 / 5700 / 6004
Telefax : 91-33-2217 6005
Email : ipf@cal2.vsnl.net.in
Web : www.theipf.in

Editor : Sri Pradip Nayyar

Editorial

Dear Members,

Good day!

Hope you are all now in possession of our October issue. I thank all of you and in particular to the advisors and Editorial Board for their valued contribution and support in bringing out the issue on time.

In this issue I would like to highlight the recent developments in domestic and international economic scenario and plastics industry. First let me say a few lines on domestic and international economic scenario.

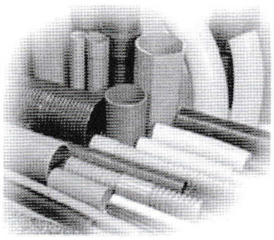
On account of the recent developments in domestic and international economic scenario, CRISIL has revised it outlook on India's GDP growth for 2011-12. Due to deteriorating global economic environment, lack of progress on domestic policy reforms and adverse impact of tighter monetary policy on investment and private consumption, GDP growth has been revised down to 7.6 per cent for 2011-12 from the earlier range of 7.7 to 8.0 per cent, with downward revisions of industry and services growth. In contrast, according to CRISIL, agriculture is expected to grow faster than anticipated earlier with timely and normal monsoon.

The average inflation forecast for 2011-12 has been revised upwards to 9.1 per cent. With the successive interest rate hikes by the RBI, the inflation rate is expected to come down by the second half of 2011-12, but a new risk to inflation in the form of depreciating rupee has emerged, which is expected to put upward pressure on inflation. The rupee according to CRISIL is expected to settle in the range 45-46 per US$ by March 2012, up from the current levels of 49.23.

As far as plastic industry is concerned, you are all aware that the processing industry is highly fragmented. Though the industry turnover is around Rs. 25,000.00 crore with over 12,000 players in the industry the processing capacity is very small compared on a global scale.

The industry has great growth potential but limited by many factors. Also the per capita plastic consumption in India is low at 3.4 kg per person per annum, which is less than many Asian countries like China, which has a per capita consumption of 14-15 kg per annum. The world average is around 22 kg. With this data you will all agree with me the importance of our industry, particularly in Eastern India as we are at the bottom, the leader being Northern and Western regions who account for 70 percent, followed by South and then the East.

Pradip Nayyar
Editor



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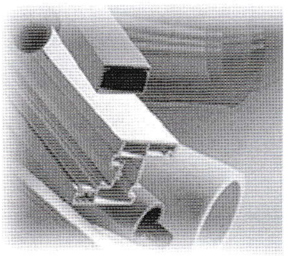

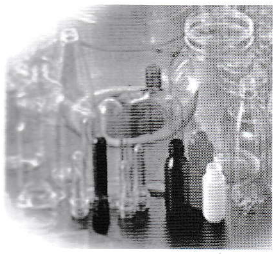

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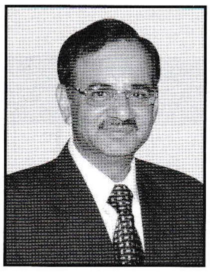


Dear Members

This is my second message to you as President of the Federation.

The festival season is over and members may attend to their usual business with new vigor. While there is much controversy over oil price rise and the unsuccessful efforts of the RBI to control inflation, I would like to write a few words on global market for machines used in plastics processing.

Global demand for plastics processing machinery is forecast to climb 4.7% pa through 2012 to US$ 24.9 bn. Product sales will be spurred by ongoing economic growth and rising personal income levels, resulting in increased plastics product consumption, processing activity and associated equipment demand. Market advances will be constrained to some extent by a moderation in fixed investment spending following a period of healthy gains, as well as by competition from used and rebuilt machinery. However, the large increases that have been recorded in energy and resin prices in recent years will provide some offsetting support, leading to the replacement of older plastics processing equipment by new machinery that is more productive and energy efficient. Product sales in developing parts of Asia, Eastern Europe, the Africa/Mideast region and Latin America will outpace demand in the US, Western Europe and Japan through 2012. Advances will be stimulated by healthy economic growth, ongoing industrialization efforts and rising per capita income in developing areas. China will post the largest gains of any national market in value terms. Plastics processing equipment demand in the country will rise by over US$ 1.6 bn from 2007 to 2012, when China will account for close to one-fourth of the total global market. Two of the other three BRIC nations — India and Russia - will also record strong advances, while machinery sales growth in Brazil will be more subdued, due in part to the double digit annual increases in demand that have been registered in recent years. Gains are expected to be healthy as well in lower-volume markets such as the Czech Republic, Iran, Malaysia, Saudi Arabia, Turkey and Vietnam. Plastics processing equipment demand in developed parts of the world will expand as well, although growth will be much less robust than in developing countries. Product sales will be driven by generally favorable economic conditions and further increases in plastics processing activity in developed areas; bolstering demand for plastics processing machinery as fixed investment activity climbs. Extrusion equipment will post the strongest gains of any major product type through 2012, benefiting from growth in global construction spending, which will fuel demand for extruded goods like pipe and siding, as well as by further advances in extrusion technology, resulting in increased sales of higher priced, more productive machinery. Demand for other miscellaneous equipment will also rise at an above-average rate, led by products like rapid prototyping and manufacturing, reaction injection molding and Rotomolding machines, which do not require the use of molds and can replace injection molding in some low-volume applications. However, injection molding equipment will continue to account for almost two-fifths of the 2012 plastics processing machinery market total, benefitting from the greater accuracy, energy efficiency, flexibility and output of newer generations of equipment.

I convey my Good wishes to all members and their family for the remaining part of 2011.

With Warm regards,

Rajesh Mohta
President

SECRETARIAL REPORT

Dear Members,

I am thankful to members for having elected me to serve the Federation as Hony. Secretary in the 52nd Annual General Meeting held on 20th September, 2011. For the first time I am honoured to act as Secretary of the Federation and Editor of our Journal 'Plastics India' simultaneously.

This being my first my message to you as Hony Secretary of our Federation, at the beginning itself, I seek your whole hearted support and co-operation to run the Federation smoothly without any hitch. This request, mainly considering the ensuing **'Indplas'12' – International Exhibition on Plastics to be held on 5th – 8th October 2012 at Kolkata**. You are all aware it's a herculian task, considering the amount and nature of work involved. But, I am sure with the experience and expertise of our organizing committee and induction of few young bloods in the Executive Committee this can be well done.

For the information of members, a brief overview of the activities of the Federation in the month of October/ November 2011 is given below: -

1) Our website www.indplas.in is online and the members, advertisers, participants can now have all the details with a few clicks of a mouse. Members are requested to visit this website and book their stalls.

2) As decided by the new Committee all those nominated as Co-opted, Special Invitees and Chairman to various Sub-Committees have been intimated of the Committees decision.

3) The Federation is in negotiation with CIPET to set up an Extension Centre at our upcoming Knowledge Centre. Their feedback is awaited.

4) Many members have paid an advance of Rs. 11,000/- towards stall booking. These members have been informed officially to select their stalls by logging on to our website. In case any member through oversight has not booked his stall we request you to kindly do the same at the earliest.

5) The all India launch of Indplas'12 exhibition has been fixed on 3rd February 2012 in the auditorium above Hall No. 8 at Pragati Maidan, New Delhi. Arrangements have also been made for site advertisement of Indplas'12 at Pragati Maidan during PI-2012. Members visiting PI-2012 to be held from February 1 – 6, 2012 are kindly requested to joint the all India launch function of Indplas'12..

6) A conference on "MSME Financing : Challenges & Opportunities" organized by FICCI on November 2, 2011 at Hotel Hindustan International, Kolkata under support of IPF was well attended by our members.

At last it is my earnest request to all our esteemed members to have their mail and correspondences checked regularly as I observed, often, very important communications from IPF office are not attended on time. Also please let the IPF office updated with the change of address and contact details of members as quite a lot of correspondences are returned regularly.

With best wishes,

Pradip Nayar
Hony. Secretary

Pravin G Kadam & Dr. ST Mhaske; Dept of Polymer Eng:, Inst of Chemical Technology (formerly UDCT), Mumbai-400019, pravinkadam1987@gmail.com

Application of Polymers in Flexible Solar Cells

Abstract
Solar cells are the most important means for conversion of solar energy into usable form of energy. Solar energy is readily and abundantly available. So conversion of this energy can be beneficial looking at the present days of energy scarcity. But one thing that is largely unknown is that polymers have an important application in solar cells. Polymers like poly(3-octylthiophene), poly(3-hexylthiophene), polyfluorene etc. are widely used in solar cells. In this review paper, efforts are taken to explain in detail the application of polymers in solar cells.

Keywords: solar cell, poly(3-octylthiophene), poly(3-hexylthiophene), polyfluorene.

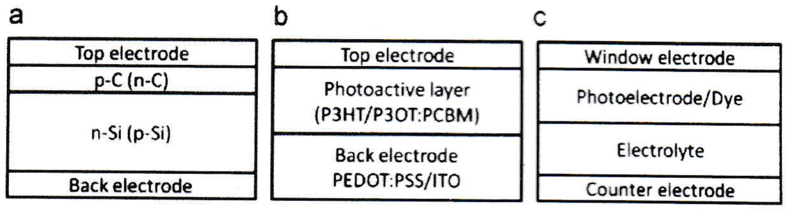
Solar Cells

The conversion of solar radiation occurs by photovoltaic effect which was first observed by Becquerel. It is quite generally defined as the emergence of an electric voltage between two electrodes attached to a solid or liquid system upon shining light onto the system. Practically, all photovoltaic devices incorporate a pn junction in a semiconductor across which the photovoltage is developed. Requirements for the ideal solar cell material are:

(1) Band gap between 1.1 and 1.7 eV;
(2) Direct band structure;
(3) Consisting of readily available, non-toxic materials;
(4) Easy, reproducible deposition technique, suitable for large area production;
(5) Good photovoltaic conversion efficiency;
(6) Long-term stability.

For the future of solar energy materials, three scenarios can be envisioned:

* Continued dominance of the present single crystal or cast polycrystal technology.
* New crystalline film Si materials of medium thickness either as ribbons or on foreign substrates.
* Breakthrough of true thin film materials like a-Si, CIS or CdTe.



Three basic types of solar cells: (a) silicon-based solar cell, (b) organic solar cell and (c) dye-sensitized solar cells.

Application of Polymers in Flexible Solar Cells

Polymer solar cells have attracted a lot of attention in recent years due to their potential use for new generation renewable energy sources [Brabec and Durrant, 2008; Gunes et al., 2007, Krebs, 2009; Krebs et al., 2010]. They have the advantages of low cost, light weight, flexibility, and easy manufacturing [Krebs et al., 2009; Krebs, 2009; Gevorgyan et al., 2009; Krebs, 2009]. The most commonly used polymer solar cell device structure is the bulk hetero-junction (BHJ) structure due to its high efficiency [Ingan et al., 2009; McNeill et al., 2008; Shaheen et al., 2001; Zhang et al., 2006; Cheyns et al., 2008; Beck et al., 2005]. In this structure, an electron donating conjugated polymer blends with an electron acceptor, such as PCBM (6,6-phenylC61-butyric acid methylester), as the active layer. After photo-excitation, electrons transfer from the excited conjugated polymer chains to the electron acceptor molecules (PCBM). The donoracceptor (DA) BHJ structure has been considered ideal for efficient and fast exciton dissociation, and charge transport can be enhanced due to the increase in interfacial area between the donor and acceptor [Mihailetchi et al., 2005; Gadisa et al., 2006; Jespersen et al., 2006]. The DA BHJ solar cells give power conversion efficiencies (PCE) in the range of 46% [Park et al., 2009; Shrotriya et al., 2005; Ma et al., 2005]. Compared to inorganic solar cells, the PCE of polymer solar cells is still too low for commercial application. For the conjugated polymer part, further improvement of PCE demands the development of new materials with high carrier mobility and broader absorption of the solar spectrum [Bundgaard and Krebs, 2007; Kroon et al., 2008; Zhao et al., 2008].

In the last few years, integration of photovoltaic modules in the facades and roofs of buildings has drawn considerable interest. Flexible solar cells give much more possibilities for integration in buildings and can also be applied in a variety of other applications such as smart electronic cards, consumer electronics, solar cars and boats, portable source of power for emergency and recreation, etc [Romeo et al., 2006].

Among donor acceptor-type organic solar cells, the most promising material combination is poly(3-octylthiophene) (P3OT), poly(3-hexylthiophene) (P3HT) and fullerene derivative (6,6)-phenylC61-butyricacidmethylester(PCBM) [Janssen et al., 2005]. However, it is expensive though PCBM can form film-like structures with high electron mobility. Investigation of carbon-based organic solar cells has been conducted towards developing alternative low-cost, light weight, flexible devices. Two typical carbon materials, fullerenes (C60) and CNTs, are always involved particularly by combining with p-conjugated polymers and severed as photoactive materials. It is well known that C60 is a stronger electron acceptor and is more efficient in charge separation [Hoppe et al., 2004; waldauf et al., 2004; Al-

Ibrahim et al., 2005; Hoppe and Sariciftei, 2006]. Semiconducting CNTs can be a suitable replacement for C60 by forming ideal hetero junctions. Work function (F) of CNTs is in the range of 4.55.1eV, which is close to the valence band of P3OT/P3HT. Therefore, CNTs can help to improve exciton dissociation by providing field at the CNTs/polymer interface and provide efficient hole or electron transportation. However, theoretical prediction indicated that in a photovoltaic hetero junction based on a mixed CNT distribution, the majority of interfaces are with metallic CNTs and inefficient [Kanai and Grossman, 2008]. Recent advances have shown that the conjugated polymer- C60/SWNTs composite represents an alternative class of organic semiconducting material. The cells with MEH-PPV [poly(2- methoxyl-5-2 (-ethylhexyoxyl-1,4-phenylenevinylene)] as the donor, HN-C60 as the acceptor exhibits a better η of 1.6% than that of PCBM [Yang et al., 2006]. In a hetero junction between P3HT-CNT composite and C60 layers [Pradhan et al., 2006], CNTs act as exciton dissociation sites and hopping centers for hole transport, providing increased mobility for carrier transport.

A C60-SWNT complex has been used as a component of the photoactive layer in bulk hetero junction photovoltaic cells [Mitraa, 2007] by taking advantage of the electron-accepting feature of C60 and the high electron transport capability of SWNTs. The cell based on C60 decorated MWNTs/P3OT [Kalita, 2008] shows a Jsc, Voc, FF and η of 1.68mA/cm^2, 0.245V, 27% and 0.11%, respectively. Here, C60 provides large surface area for photo excitons dissociation and efficient electron transportation, and MWNTs provide efficient hole transportation. As excellent electron transporters, SWNTs have been tested [Kymakis and Amaratunga, 2002; Kymakis et al., 2003] without the presence of C60. Diodes of Al/polymer-SWNT/ITO show a high Voc of 0.70.9V. Jsc is increased by two orders of magnitude. FF also increases from 0.3 to 0.4 due to the photo induced electron transfer at the polymer/SWNT interface. The cell constructed with P3OT/SWNTs shows a higher Voc of 0.98V [Landi et al., 2005]. CNTs can also be used to enhance carrier mobility for efficient removal of the charges in the cells consisting of P3OT blended with nitrogen-doped MWNTs [Reyes et al., 2007].

Polyfluorene (PF) copolymers are well known for their high charge carrier mobility [Scherf, 2002, Fong et al., 2006], good processability, and high absorption coefficients [Chiesa et al., 2005, Yohannes et al., 2004]. However, they have large band-gaps and blue shifted absorptions, which do not match the solar spectrum for solar cell applications. The bandgaps of polyfluorenes can be reduced through copolymerization of donoracceptor units. A regular alternation of donor and acceptor groups should lead to the broadening of the valence and conduction bands, and thus reduce the bandgaps [Gadisa et al., 2007; Roncali, 2007; Thompson and Frechet, 2008]. Intramolecular donor acceptor systems typically consist of electron donating groups (electron rich segments) and electron acceptors (electron deficient segments) [Handa et al., 2005, Yoshihara et al., 2004]. The incorporation of electron-withdrawing moieties as side chains of a conjugated polymer can widen the absorption spectrum. After photoexcitation, the charge separation occurs through transfer of electrons from the main chains to the side chains and then to [6,6]-phenyl-C61-butyric acid methyl ester (PCBM). Electrons can transfer at PCBM by hopping, and holes can transfer at the main chains of the polymer by hopping and delocalization. Therefore, conjugated polymers containing electron-withdrawing acceptors as side chains not only exhibit enhanced charge transfer ability, but also absorb light more effectively [Chang et al., 2008].

Lee et al. have synthesized a new low band-gap alternating polyfluorene copolymer (PFNAP) based on dioctylfluorene and a donoracceptor monomer with an electron-withdrawing moiety as a side chain (14H-benzo[4,5]isoquino[2,1-a]perimidin-14-one), via a Suzuki polymerization reaction (figure 1). The resulting copolymer has low optical and electrochemical bandgaps. The optical band gap and the electrochemical band gap of PFNAP are 1.82 and 1.89 eV, respectively. The bulk hetero-junction polymer solar cells were fabricated with the conjugated polymer as the electron donor and 6,6-phenylC_{61}-butyricacidmethylester (PCBM) as the electron acceptor. The power conversion efficiencies (PCE) of the solar cells based on PFNAP:PCBM (1:3) and PFNAP:PCBM (1:4) are 0.61% and 0.67%, respectively, under the illumination of AM1.5 G,100mW/cm^2 [Lee et al., 2010]

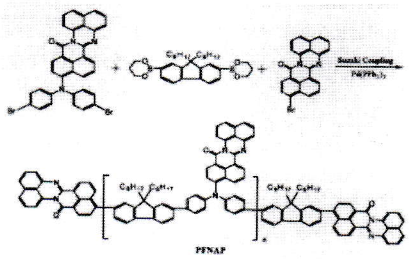


Figure1: Synthesis of copolymer (PFNAP).

Conjugated polymers are of great interest for the production of low-cost and flexible photovoltaic cells. The development of the interpenetrating electron donor acceptor conjugated polymer-based bulk hetero junction devices, such as polymer:fullerene, polymer:polymer, and polymer:nanocrystal, in the last decade, has made it possible to reach high photovoltaic conversion. The metal oxides offer high physical and chemical stability, and thus have been widely studied as a material for polymer photovoltaic conversion.

Zeng et al. conducted an extensive study on poly(3-hexylthiophene) (P3HT) in combination with titanium dioxide (TiO_2) nanorods hybrid material for polymer solar cell applications (figure2). The device performance critically depends on the morphology of the hybrid film that will be determined by the molecular weight of P3HT, the solvent type, the hybrid compositions, the surface ligand on the TiO_2 nanorods, film thickness, process conditions, and so on. The current-voltage characteristic of the device fabricated in air has shown a power conversion efficiency of 0.83% under airmass (AM) 1.5 illumination using high molecular weight (65,000D) P3HT, high boiling point solvent trichlorobenzene, and pyridine-modified TiO_2 nanorods with a film thickness of about 100nm [Zeng et al., 2009].

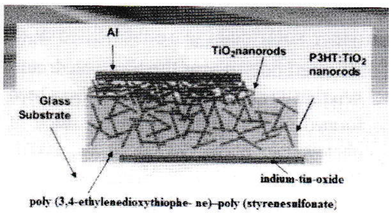


Figure2: Schematic structure of P3HT:TiO_2 nanorods hybrid solar cells.

The TiO_2 nanorod thin film serves as a hole-blocking electron-transporting layer in the photovoltaic devices [Zeng et al., 2006]. The devices reach their optimum performance at a layer thickness of 100150nm. A thicker film has greater photon absorption but the lower electric fields result in reduced charge separation efficiency and lower charge transport efficiency. The fill factor was found to have dropped significantly for a thicker layer (400 nm) [Petrella et al., 2005].

Hybrid solar cells based on conjugated polymers and colloidal inorganic semiconductor nanocrystals have been proposed as an alternative to the all-organic solar cells [Huynh et al., 2002]. The colloidal nanocrystals based on inorganic semiconductors such as CdSe [Sun and Greenham, 2006; Milliron et al., 2005] and ZnO [Moet et al, 2007; Olson et al., 2007] can be dispersed together with polymer in solvents and be solution-processed to form bulk heterojunctions. These inorganic semiconductors have much higher electron mobility than typical organic materials, which would provide more advantageous electron collection through the randomly formed bulk heterojunctions.

In addition to the possibility of complementing the organic phase in light absorption, the inorganic nanocrystals may also provide better environmental stability compared with their organic counterparts. Hybrid solar cells based on blends of CdSe nanocrystals and poly(3-hexylthiophene) (P3HT) have been widely explored in a simple structure of ITO/PEDOT:PSS/ P3HT:CdSe/Al, using CdSe nanocrystals synthesized in different shapes such as spherical, rod-like, or tetrapod structure [Milliron et al., 2005; Sun et el., 2003]. The CdSe nanorods or tetrapods have received the most attention with the perceived directional charge transport paths in these nanostructures, and power conversion efficiencies around 2% have been reported [Sun et al., 2005]. On the other hand, devices based on nano-spheres, which are the most easily synthesized nanocrystals, showed several times lower efficiencies compared to the nanorod- or tetrapod-based devices. The lower efficiency of CdSe nanosphere-based devices was attributed to inefficient electron transport by multiple hopping steps among the nano-spheres [Ganesan et al., 2008].

Yang et al. have studied hybrid solar cells based on the polymer poly(3-hexylthiophene) (P3HT) and colloidal CdSe nanocrystals (figure3). Using CdSe nanospheres with varying size, they found that the power conversion efficiency (η) of these devices increases monotonically with the CdSe nanocrystal size, from $\eta=(0.39\pm0.04)\%$ under AM 1.5G solar illumination for 4.0 ± 0.2nm size nano spheres to $\eta=(1.9\pm0.2)\%$ for 6.8 ± 0.5 nm size nanospheres.

The efficiency increase with nanocrystal size is mostly due to a significant increase in the short-circuit current, whereas the open-circuit voltage and fill factor of the solar cells are less affected. The devices also exhibit abnormal initial aging behaviour when exposed to air, as an increase in both the short-circuit current and open-circuit voltage [Yang et al., 2011].

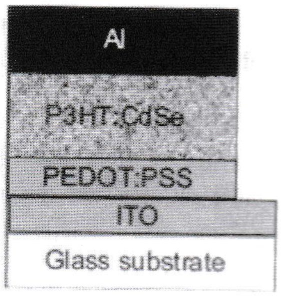


Figure3: Schematic device structure

$CuInSe_2$ (CIS) and related compounds containing Ga and S are important photovoltaic (PV) materials. If high efficency thin film CIS devices could be manufactured on light-weight and flexible substrates, they would be very attractive especially for many space applications [Flood, 1990; Landis and Hepp, 1991]. Recent efforts to develop light-weight flexible CIS solar cells on Mo and Ti foil substrates resulted in the fabrication of small area (~ 0.1 cm^2) devices with active area efficiencies of about 9% [Basol et al., 1993; Kapur et al., 1993].

However, monolithic integration of these devices for module fabrication was not possible because of the difficulties associated with the deposition of a totally pinhole-free insulator layer over the conductive metallic foil substrate before the fabrication of the CIS cells. **Basol et al.** fabricated for the first time thin film flexible $CuInSe_2$ (CIS) solar cells on light-weight polymeric substrates (figure4). Evaporated Cu-In alloy precursors were selenized in H_2Se atmosphere at around 400°C to grow the CIS absorber layers.

Low temperature techniques which are compatible with the polymeric substrates (polyimide) were used to deposit the window layers of CdS and ZnO. The demonstrated active area conversion efficiency of 9.3% makes this light-weight device very attractive for many terrestrial and space power generation applications where high specific power and mechanical flexibility are needed.

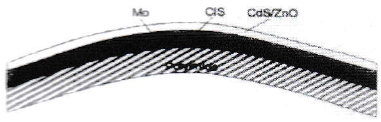


Figure4: The structure of a flexible CIS solar cell

The substrate of the device was a 50μm thick polyimide sheet. Back contact to the CIS absorber film was a 1.5 μm thick Mo layer. The junction was formed on the CIS surface by a composite window layer consisting of a thin CdS film (0.15 Izm) and a boron-doped transparent conductive ZnO layer (2.0 μm) [Basol et al., 1991; Nair and Nair, 1987]. Adhesion of CIS films to Mo-coated flexibles substrates is of prime concern. These films should display a degree of flexibility without cracking or peeling. The most important source of poor adhesion between a CIS film prepared by the two-stage technique and its Mo coated substrate is the stress generated in the CIS layer during the selenization process due to the expected three-fold volume increase in the Cu-In film. This expansion results from the inclusion of Se into the lattice and formation of the ternary compound. One can affect the "volume expansion factor" by controlling the density of the Cu-In layer. The density of the precursors grown by the method of this study was measured to be about 3 gm/cm^3 and therefore the volume expansion factor was less than 1.5. As a result, adhesion of the CIS layers to the Mo contact layers was much improved [Biilent et al., 1996].

Flexible substrate solar cells were directly grown on commercially available ~10 mm thin polyimide (UpilexTM) foils by Romeo et al. A process for the deposition of ITO (Indium doped Titanium Oxide, front contact) has been developed to have a stable front contact on the UpilexTM foil.

Post-deposition annealing treatments of the ITO/polyimide stacks bring a significant stability to the front contact, having almost the same sheet resistance at the beginning and at the end of the cell fabrication process. Solar cells with efficiency of 11.4% have been developed. It has been shown that CdTe has the highest stability under proton and electron irradiation [Batzner et al., 2002; Romeo et al., 2001] compared to the other photovoltaic devices, which makes CdTe cells very interesting for space applications. High specific power is an important issue for space solar cells: if satellites are lighter they are easier and cheaper to launch in orbit. Flexible CdTe solar cells are immensely interesting for terrestrial and space applications [Romeo et al., 2006].

Meillaud et al., in order to get high efficiency micromorph solar cells in the nip configuration (figure5), advanced light scattering strategies are also applied by implementing different length scales, either in the same interface by over-coating a large structure with smaller features or by varying the texture between the individual interfaces. nip Cells are typically grown on a flexible polyethylene substrate and the surface morphology of the substrate is textured with a periodic sinusoidal structure that is embossed into the surface by a roll-to-roll process. The substrate is then covered with sputtered silver and zinc oxide layers with typical thicknesses of 80 and 60 nm, respectively. Front contact typically consists of LPCVD-ZnO. Polyethylene plastic foils with imprinted gratings gave 11.2% initial and 9.8% stable efficiency [Meillaud et al., 2011].

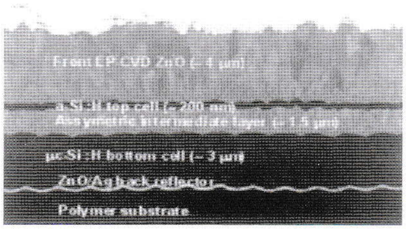


Figure5: Cross section image through a micromorph tandem cell with LPCVD-ZnO assymetric intermediate layer on periodically textured polymer substrate.

The interest in flexible solar cells is steadily increasing, since high altitude platforms, satellites for telecommunications, and deep-space missions would benefit from rollable or foldable solar generators. Cars, aircraft, and various electric appliances could also cover part of their power demand from ambient illumination of their free-form cases. The integration of photovoltaics with textiles is not only interesting for powering portable devices, which we address here, but also opens a wealth of opportunities for the integration of electronic features with architectural fabrics.

The US company United Solar Ovonic manufactures flexible triple junction a-Si-based modules on steel foil for building integration [Yang et al., 1997] with a total power output above 45 MW per year [Guha, 2005]. Since these modules are designed for long-term outdoor stability, the final laminates are comparatively rigid and not suitable for large-area clothing integration.

Werner et al. prepared thin-film solar cells consisting of a layer stack that is continuous in two dimensions and very thin in the third. Because of their planar substrates, these cells bend but do not crinkle. Solar cells have been formed on Cu wires for fabrics made of photovoltaic fibers [Rojahn et al., 2001]. Without a continuous planar substrate, however, the fibers arbitrarily move against each other which gives rise to many problems like moving interconnects, shadowing, and cancellation of the electric output of single fibers.

Considering all the unsolved problems of manufacture and interconnection of such photovoltaics fibers, 'woven solar modules' do not seem to be technically feasible in the foreseeable future. Finding a compromise between the minimum total thickness and, hence, maximum conformal flexibility of ipv modules on the one hand, and washability, mechanical resilience, and durability on the other, is an important task that has not yet been solved for most of the flexible cell technologies.

Clothing-integrated photovoltaics are an interesting option for powering mobile electronic devices (figure6). Among various technologies for flexible solar modules, Si thin films currently offer the most promising combination of flexibility and performance, especially under typical low-light conditions.

Ultrathin pc-Si cells are ready for direct lamination with textiles, while high-efficiency c-Si transfer cells are suitable for add-on accessories or pocket integration. Low-loss charge controllers, textile wiring, and specialized know-how on integration with garment production will pave the road to the first ipv products.

Development in solar cells to comply with the textile feeling of regular clothes like shirts, jackets, etc., we need to reduce the substrate thickness further, and also therefore the substrate temperature during deposition. It is only in a deposition temperature range of Td = 100-130°C, that ultrathin PET or polyethylene naphthalate (PEN) foils with a thickness of d = 10-20 μm retain enough mechanical stability for solar cells and module processing.

A brief description of the steps essential for forming flexible c-Si cells starts with the electrochemical formation of a porous double layer over a 6" wafer surface. A subsequent annealing step restructures the porous layer structure into a separation layer and a so-called 'quasi-monocrystalline Si' (QMS) layer on top [Rinke et al., 1999; Bergmann et al., 2002]. This step also closes the top QMS surface to provide a perfect template for high temperature Si epitaxy.

All solar cell front-side processing then proceeds at high temperature on the device grade epitaxial layer. The separation layer still fixes the half-processed, thin-film solar cell to the original host wafer. By laminating a transparent superstrate like glass or appropriate plastic foils onto the front of the cell, the separation layer finally releases the thin-film cell from the host wafer. Completion of the cell back side must now proceed at low temperature, since either the flexible foil or a transparent adhesive on the front side limit the process temperature to $T < 200°C$ [Brendle et al., 2005; Rostan et al., 2005; Bergmann and Werner, 2002].

Recently, Masuda et al. reported solution-processed polymer solar cells by a combination of spin-coating and layer-by-layer (LbL) deposition techniques. The LbL technique is not only simple and versatile but also useful for fabricating multilayered ultra thin films with nanometer-scale precision; thereby the thickness of a light-harvesting layer was precisely controlled to be comparable to the exciton diffusion length. Owing to the careful design of the thickness and interfacial structures, the internal quantum efficiency of the LbL-based solar cell was as high as 50% [Masuda et al., 2009].

Conclusion

Plastics which are looked at negatively most of the time, have a great role to play in increasing efficiency by reducing weight of the systems thus helping recover energy from renewable sources. Plastics, rather polymers, are used in systems of energy recovery from natural resources like solar cells to trap solar energy in the form of flexible solar cells.

Intelligent packages that satisfy many criteria in addition to supplying the necessary consumer information are on the advance – and not only where foods are concerned. The plastic film industry has therefore been hit much less hard by the 2009 economic crisis than other branches of the plastics industry.

It's flexible packages, ie. film packages, that are in particularly strong demand because of the low cost of materials and production, and their broad range of applications. Because of their low weight, they help to conserve resources and also offer good scope for recycling. The use of flexible packages in the food and beverages industry and in the pharmaceutical industry is encouraged by the materials' hygienic qualities and long shelf life. Further development with breathable films, microwave- and freezer-safe films, and biodegradable films is also spurring their growing use. Even today, plastic films meet about three quarters of global demand for flexible packages. According to a study by the US Freedonia Group, global demand for flexible packages will rise by an average of about 3.5% per annum in the coming years from a good 16 million tonnes in 2008 to ultimately almost 19.5 million tonnes in 2013.

Market researchers expect the fastest growth in the developing regions of Asia, Latin America, Eastern Europe and Africa as well as in the Middle East.

Industrial films usually 3 layer

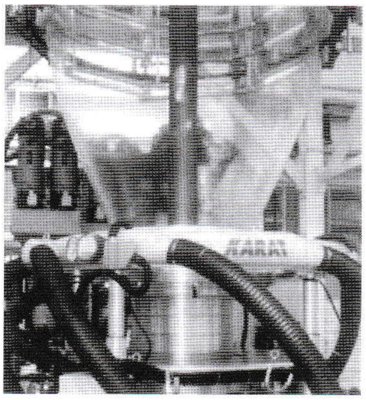
Industrial film is the term usually given to those films that are employed, for example, as shrink film hoods, stretch films or as packaging for industrial goods; and films sold by the film producer to industry as raw stock for converting.

Polyolefins are mainly used for the production of industrial films and principally grades of PE. The market today is dominated by 3-layer film composites. By combining two or three different types of polymer, it is often possible to save on material while entrancing functionality at the same time – an important factor for a production line's cost-effectiveness.

Thinner Films and more Functional Packages

Consumer packages defy the crisis

In the industrialised nations, the reasons for the increasing use of flexible food packages made of plastic can also be found above all in changing consumer habits. There is constant growth in the consumption of ready-to-serve meals, the range of foods is fast-expanding and, finally, the growing desire for an appealing package exterior is becoming increasingly important. Film composites have become established for consumer packages and particularly food packages. 5-layer films are standard, and 7- and 9-layer composites are by no means rare today.



Extrusion line manufacturers are giving the processor extra flexibility by enabling him to produce as many different products as possible on a single line without retooling, e.g. 3- and 5-layer films. With the latest die technologies, cast films with strong barrier properties can be produced in up to 27 layers.

In both cast and blown film lined, virtually all machine makers today use energy-saving and maintenance-free AC motors or, in some cases for reasons for space, direct drives instead of conventional motor-gearbox versions. Always a crucial element in the production of blown films is the blow head. Together with suitable film cooling and gauge control, it ensures a high extruder rate and film extruder rate and film quality.

Most recently, considerable advances have been made in film cooling with a variety of approaches. At K 2010 from 27 October to 3 November in Dusseldorf, the no.1 for

Bio - and recycled materials conquer food packages

While grades of polyolefin combined with barrier materials such as polyamides and EVOH are usually employed on a blown film line for the production of food films, PET has long established itself as the 'mass plastic' for cast films. The endeavours of many companies to efficiently recycle PET have come to fruition. One obstacle, however, continues to be the approval of grades of so-called rPET (recycled PET) for repeat use in direct contact with foods.

Already established are many processes for the production of multi-layered film composites in which rPET is employed as the middle layer. Thanks to ongoing improvements in machine technology, rPET made of processed post-consumer PET wastes and ground bottles is now in use for food packages and for the packaging of deep-frozen ready-to-serve meals. Across the board, biomaterials have been on the advance for some time now, but only recently in connection with food packages. For instance, carbon-neutral film products made of PE and from renewable resources have been attracting attention. The main reasons for the expanding use of biomaterials can be found above all in resource conservation, compostability and sustainability. However, a biodegradable material or a material based on biological raw materials is not necessarily greener and more sustainable than a conventional plastic. All the same, growing environmental awareness and the discussion of the pros and cons of various categories of materials have initiated a multitude of innovations to conserve resources.

Long Fiber Thermoplastic (LFT) Based Solutions for Metal Replacement

Long Fiber Thermoplastics Polypropylene (LFTPP) are the next generation engineering plastic compounds which result in tough, strong, yet lightweight molded parts for Automotive, Appliance and other Engineering Industries. Glass fibers that run continuously through the length of pellets help these compounds exhibit much better mechanical properties than short fiber reinforced thermoplastics resulting in much lower part weights. The magnificent combination of strength, stiffness & impact resistance makes them an ideal choice for applications including the pump industry. Substitution of metals by LFTPP is mainly driven by the need to reduce component or system cost and weight. Cost reduction is typically obtained through part consolidation and elimination of secondary operations like machining, welding or painting.

Opportunities exist to replace die-cast metals which require extensive machining or have corrosion and/or weight problems. Similarly, steel stamping having complex assemblies, deep draws or corrosion problems are also potential candidates. Replacement of metal with LFTPP also provides following benefits: Corrosion and chemical resistance, thermal insulation, sound dampening, improved surface finish and design freedom (complex 3D shapes). The technical presentation elaborates on the various functional advantages LFTPPs offer over metals and short fiber compounds. Highlights typical applications in automotive /fluid engineering and appliance industries.

Composite Thermoplastics

Superior combination of mechanical, thermal, electrical and other properties offers better product possibilities in engineering applications compared to conventional materials.

- Design flexibility
- Eliminates many primary & secondary operations over metal and wood
- Total system cost reduction
- Unmatched strength to weight ratio
- Cost effective only when engineers & designers *"think"*

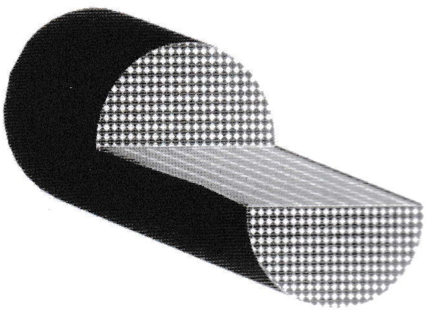
- Lightest commodity plastics-density of 0.90 and high strength to weight ratio
- Excellent chemical and fungal resistance
- Easily molded / extruded in any fiber / filament form
- Low cost, Easily available & recyclable

Typical Short Fiber pellets

- Random fibers, <3 mm fiber length
- Fiber length after injection molding - 0.4 mm

Typical Long Fiber pellets

- Aligned fibers, 11-12 mm fiber length
- Fiber Length after injection molding 4-6 mm



The Long Fiber Advantage

- Greater design freedom
- Potential for parts consolidation
- Weight reduction
- Extreme toughness & durability
- Dimensional stability
- Corrosion and chemical resistance
- Elimination of secondary operations (painting, welding, etc.)
- Lower total system cost

Long Glass vs. Short Glass Functional Advantage

- Surface finish using long fiber thermoplastic is much better due to aligned fibers and lower fiber ends
- Lower warpage & shrinkage (0.1-0.3%) compared to short glass compounds with same resin & glass content
- Better flow properties due to aligned fibers, hence lower injection pressures
- Possible to design parts with much lower thickness using LFT which results in lower overall weight & cost

LFT Special Molding Requirements

For optimum properties, the following is recommended.

- General purpose screw with an L/D ratio of 18:1 to 20:1
- Compression ratio of 2:1 to 2.5:1
- General purpose nozzle with a minimum orifice diameter of 5.5mm
- Screw speed between 20 and 50 rpm
- Back pressure less than 3.75 kg/cm2

Long Glass vs Short Glass Mechanical Properties - Summary

	Test Method	Unit	PP HP	PPSFT 30%	PPLFT 30%	PA-6	PA-6SFT 30%	PA-6LFT 30%
Density	ISO-1183	gm/cm3	0.9	1.12	1.12	1.13	1.37	1.37
Tensile Strength	ISO 527	Mpa	40	80	103	79	165	170
Tensile Elongation	ISO 527	%	2	3	2.3	3	3	2.2
Flexural Strength	ISO 178	Mpa	48	105	146	103	230	245
Flexural Modulus	ISO 178	Mpa	1600	5700	5950	2826	6200	8200
Notched Izod Impact	ISO 180	KJ/M2	3	12.5	19	7	13	28
HDT @ 1.820 MPa load	ISO 75	0C	140	145	159	190	210	210

Property	Unit	Aluminum	Steel	Nylon-6 LG40	PP LG40
Tensile Strength	Mpa	255	640	200	115
Specific Tensile Strength	Mpa cc/gm	94	82	138	95
Tensile Modulus	Mpa	68,948	201,000	12,500	9,555
Tensile Elongation	%	10	21	2	1.95
Flexural Modulus	Mpa	26,518	-	11,500	8,450
Coefficient of Thermal Expansion	in/inF * 10E-5	1.3	0.75	-	1.17
Density	gm / cc	2.7	7.85	1.45	1.21

Specific tensile strength of LFT is higher than steel and aluminum leading to parts with much lower weight

LFTPP Typical Applications in Auto

INTERIOR	EXTERIOR	SEMI-STRUCTURAL	SYSTEMS	E&E/COMPONENTS
Instrument panels Spare Wheel trays Spare wheel covers Seat shells Pedal systems Rear shelves Headliners Load floors	Sun roofs Door handles	Front end carriers Splash shields Bumper beams Door modules Rear seat backs Hatchback structures	Inlet manifolds Fan shrouds Radiator Fans	Pulley covers Engine covers Rocker valve covers

PUMPS- Property Benefits with LFT versus Metal

- Excellent impact strength
- Excellent corrosion resistance compared to metals
- Good surface finish due to lower molding defects
- Lower warpage and good dimensional stability
- Lower cost per volume & greater design freedom
- Option of precolored material as per requirements

MonoBlock Pump parts identified for replacement with LFTPP

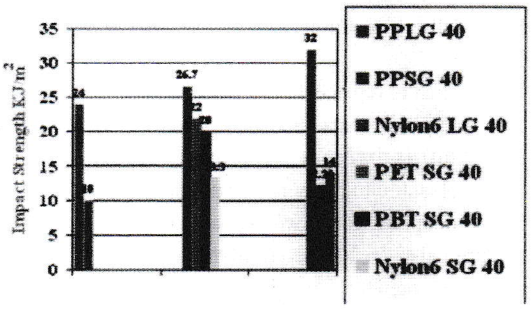
Part Name	Existing Material of Construction	Suggested Material	Est. Wt. Saving in LFTPP(%)	Est. Cost Saving in LFTPP (%)	Important Criteria
Delivery Casing	Cast Iron	LFTPP	60 to 75	30 to 40	1.Dimensinal stability 2.Good hygroscopic properties 3.High impact strength 4.Corrosion resistance 5.Good wt/performance ratio 6.Good weatherability 7.Chemical resistance
Mounting Casing	Cast Iron	LFTPP	60 to 75	30 to 40	Same
End Cap	Cast Iron	LFTPP	60 to 75	30 to 40	Same
Motor Housing	Al /Cast Iron	LFTPP	40 to 75	30 to 40	Good wear resistance

Case Studies

Critical parameters - The part should have high impact strength, be anti corrosive, withstand load & damp conditions, have excellent electrical insulation, good hydrolytic stability & wear resistance.

Part Name	Previous		LFT-Material		Cost		Cost Saving (%)
	Material	Wt. (gm)	Material	Wt. (gm)	Prev	LFTPP	
Upper Housing	Cast Iron	2090	LFT PP	300	141	54	60
Lower Housing	Cast Iron	1610	LFT PP	230	112	44	60
Motor Base	Cast Iron	2530	LFT PP	360	168	65	60
Suction	Cast Iron	2510	LFT PP	360	166	65	60
NRV	Cast Iron	1850	LFT PP	260	127	50	60

Impact Strength - LFT vs SFT



Revolutionizing New Application through Composites

- Avg. mid-sized car in US contains $2219 of Chemistry (including both chemical products & processing)
  - > Total amount of Chemistry in Automobiles US$ 31.5 bln
  - > Chemical products make up ~ US$ 800 of total value of car
  - > On an avg. contains 150 kg of Plastics (8% of total wt)
- Enhancing Efficiency (West Europe case)
  - > Each 4.5 kg of plastics substituted improves fuel efficiency by 0.11 to 0.14%
  - > Annual fuel savings of over 2.3m t-equivalent to 9.2 m t CO2 emissions

Conclusion

- LGFPP can be used to replace metal / high cost engg plastics & thermosets
- LGFPP improves temperature resistance
- LFTPP Improved impact / Energy absorption
- Part consolidation & weight savings
- Lower weight-improved pump performance and efficiency
- Sound damping characteristics & very low warpage
- Easy handling and transportations & ease of assembly

Specific Chemical Handling Application Areas for PVDF and PVDF Copolymers

Since the construction of the first Kynar® Polyvinylidene Fluoride (PVDF) commercial plant in 1965, in Calvert City, KY, USA, this product has been used in many types of chemical industries. The first applications for PVDF centered around the excellent chemical resistance to chlorine & chlorinated solvents, bromine, hot acids and combinations of chemicals for waste handling. Users in these chemical areas soon discovered PVDF had other special properties not universally associated with all plastics. PVDF was found to offer high abrasion resistance similar to UHMW and Nylon, high tensile strength at elevated temperatures which set it apart from commodity plastics and other fluoropolymers,[1] ability to withstand high doses of radiation in service which made it superior to almost any known polymer,[2] excellent flame resistance, and superior sunlight resistance (UV) and overall weathering durability.

The article is intended to help equipment designers and engineers that would prefer a thermoplastic material over metal components for chemical related applications, but have not found a material that meets all their needs in an economical fashion. PVDF simply put, is a high-end plastic and a problem solver. It is often not always the first product looked at as a solution, but once it is chosen, the end user is often pleased and continues to scan their facility to find more areas where they desire long life and trouble free performance. In an effort to make it easy to understand why and where PVDF or PVDF copolymers could be used in a specific chemical industry, the information has been broken down into small concise chapters.

PVDF Properties & Characteristics

Polyvinylidene fluoride is a tough engineering thermoplastic that offers a unique balance of performance properties:

- Resistant to most chemicals and solvents
- Resistant to ultraviolet and nuclear radiation
- Resistant to weathering
- Low permeability to most gases and liquids
- Low flame and smoke characteristics
- Mechanical strength and toughness
- High abrasion resistance
- High thermal stability
- High purity
- Readily melt processible
- Rigid and Flexible versions of PVDF are available.

General physical properties of PVDF are shown in table 1.

Property of the Material	Unit for Property	PVDF Homopolymer	PVDF Copolymer
Melt Point	Deg C	168	158
Specific Gravity		1.77	1.78
Tensile Strength @ Yield*	psig	7500	5000
Tensile Strength @ Break*	psig	7000	5000
Elongation @ Break*	%	50	200
Flexural Modulus*	psig	280,000	170,000
Notched Izod Impact Strength*	Ft lb / in	3	6
Hardness	Shore D	78	74
***Values indicated above are only for reference. One must consult material manufacturer, while selecting the grade for specific application. ** There are ranges of performance of homopolymer and copolymer; the table only reflects data for one particular grade of PVDF.**			

Table 1 General Physical Properties PVDF

Pulp & Paper Bleaching

The pulp & paper industry commonly utilizes chlorine-based technology for bleaching operations. Chlorine is very aggressive to metals and quickly rusts and corrodes equipment. Additionally, chlorine and chlorinated compounds are aggressive to many polymers, ultimately leading to corrosion induced stress cracking. PVDF is not appreciably attacked by chlorine and is often used for long term handling of chlorinated chemicals. In bleach applications where the chlorinated compound is also blended with a caustic solution that increases pH level, PVDF copolymers are preferred because the softer and more flexible nature of this technology has greater overall resistance to any potential cracking over time.

Metals Preparation and Mining

In the metals industry a variety of acids are used to clean, treat/prepare or separate the final product. Strong Acids like hydrofluoric, hydrochloric, sulfuric, nitric, chromic are all common to this industry. The concentrations of these chemicals can vary throughout the

Contd. to Page - 21

GLIMPSES

CONFERENCE ON MSME FINANCING : CHALLENGES & OPPORTUNITIES

FICCI organized a Conference on MSME Financing : Challenges & Opportunities on November 02, 2011 at Hotel Hindustan International, Kolkata. The programme was supported by Indian Plastics Federation.

The conference was well attended by various industry associations and its members.

Zonal Head and GM, Bank of Baroda, Dr. A.K. Chanda, Addl. Chief Secretary, Dept. of Micro & Small Scale Enterprises and Textiles GoWB, Hon'ble Minister of Micro & Small Scale Enterprises and Textiles, GoWB Dr. Manas Ranjan Bhunia, Ms. Nayantara Palchoudhuri, Member of FICCI MSME Task Force along with representatives of Banks and Financial Institutions and National Stock Exchange were on the dais.

Mr. Gaurav Swarup, Chairman, FICCI ERC welcomed the audience. Mr. Athinathan, Zonal Head and General Manager, Bank of Baroda spoke in detail about the financing aspects. Hon'ble Minister Dr. Manas Ranjan Bhunia in his speech requested the banks and financial institutions to come forward and extend their full cooperation and support to the industry as lack of availability of institutional credit was a major deterrent to the industry's growth.

On behalf of Indian Plastics Federation Mr. Sourabh Khemani, immediate Past President addressed the audience. Mr. Yogesh Dixit, Head - SME Rating CRISIL spoke on the different aspects of credit rating for the industry and how the rating process benefits both lenders and rated borrowers.

The Conference was attended by over 150 representatives from banks, financial institutions and well covered by media.

process, temperatures can tend to be elevated, and mixtures of acids are common. This combination of variables makes it difficult to find one material to meet the needs for handling the process and waste chemicals. PVDF and PVDF copolymers extend the temperature limits of equipment and allow for protection from upset conditions encountered should the blending of chemicals create aggressive by-products that would present problems for other potential material choices.

Fuel

In recent years, fuels are getting very complicated in formulation. Gasoline at one time was simple, but now there is diesel fuel, alcohol blends, ether additives for octane adjustment, and biodiesel. In underground transport and holding systems it is expected that the installations will last for years without need for replacement or repair. While these versions of fuel can usually be handled by relatively cheap materials, each different fuel variation poses a potential disaster should the line be required to switch fuel type at some point.

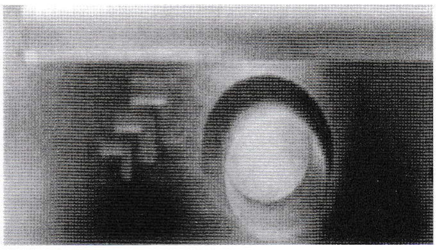


FIG 2. PVDF PIPES & FITTINGS

PVDF gives the designer the very unusual combination of resistance to alcohol, hydrocarbon resistance (aromatic and aliphatic), and resistance to oxidants commonly associated with the newer biodiesel technology.

In the related area of production of ethanol, it is common to have low levels of sulfuric acid generated in the process. Many processing plants began constructing with stainless steel, but have now turned to PVDF lined process equipment to avoid corrosion problems caused by low percentage acid concentrations.

Pharmaceutical and Biotech

The life sciences field uses a multitude of chemical combinations - Bromine, Iodine, Chlorine, Acids, and Alcohols just to name a few. Just reading the ingredients on a medicine box gives you the feeling of the process challenges this industry faces. This is coupled with FDA regulations, USP Class 6 requirements, and process water purification targets. PVDF meets all of these requirements and has the added advantage over common plastics that it can be repeatedly steam cleaned at up to 30 psi steam. Plastics are gaining increased use in the Pharmaceutical industry due to the fact that they do not rust when exposed to cleaning agents and do not rouge over time in water exposure.

PVDF and PVDF copolymers are listed in the ASME Bioprocessing Equipment (ASME-BPE) standards as a common material selected by designers for Biotech system design. Piping, flexible tubing, tanks, membranes and pumps are all common applications for PVDF in this industry.

Semiconductor Processing

Perhaps the biggest industrial use for PVDF is in the Semiconductor Industry. PVDF has many properties desired for this industry that are not always a requirement in general chemical applications. Flame and smoke resistant compliance outlined by Factory Mutual (FM) 4910 plus Underwriters Laboratories (UL 2360), and SEMI F57 high purity standards are special requirements in the manufacture of high purity piping systems and acid etching equipment used in the process of preparing silicone wafers. The combination of chemical resistance, high purity and superior strength of PVDF compared to other high quality materials has made it a standard material of construction in areas of a semiconductor facility.[3]

Nuclear Industry

The nuclear reclamation industry has interesting challenges. First, a series of harsh chemicals are used in the glove boxes manufactured to purify the radioactive ores. While many materials handle the chemicals like Hydrochloric Acid and Nitric Acid used to purify plutonium and uranium, the contact surfaces of the glove box must also handle the radioactivity associated with this process. After several years of testing and years of field experience, PVDF has been found to be the most radiation resistant polymer capable of long life in nuclear glove box design and waste holding equipment.[4]

Potable Water and Wastewater

Certain grades of PVDF are listed by the National Sanitation Foundation (NSF) for use in potable water (NSF 61). While water is not commonly considered highly corrosive, there is an increasing desire for water systems to last nearly indefinitely. With the concern for bacteria, bioterrorism, chlorine content of water, and UV exposure for many years of service life, a material like PVDF offers a greater opportunity for long system life even if the system parameters change over time.

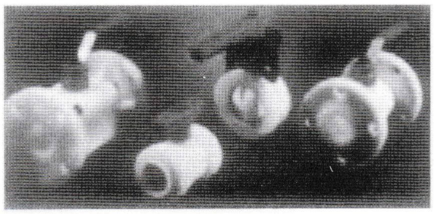


FIG 3. PVDF VALVES

In wastewater applications there is a general concern that chemical compatibility could be unpredictable. A product like PVDF offers improved safety factor should unexpected or unplanned chemical combination occur. It is unlikely that any combination of chemicals at 140°C or below over a short period of time would attack PVDF in a castastrophic manner like it could occur with metals or lower performing polymers.

Clarified Polypropylene for Packaging of Food & Beverages

Introduction :

Clarified PP is the specialized additivated Polypropylene which has glass like clarity, excellent moisture barrier properties, hot filling capacity & low cost making it the ideal packaging material for food, beverages, optical media, housewares and medical products etc. 'Clarified PP' offers excellent solutions to diverse packaging needs for a wide range of consumer products. Infusion of new technologies like injection stretch blow moulding (ISBM), thin wall injection moulding (TWIM) & thermoforming are key to fuel growth. Indian food, pharma & dairy industry which are focused for very high growth have great potential for the use of "Clarified PP".

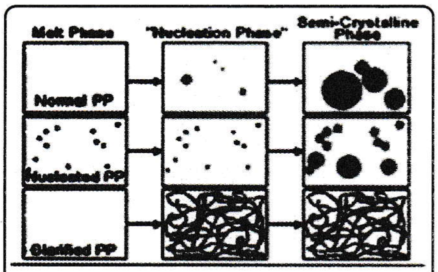
Impending organized retailing boom coupled with thrust on food processing sector in India will create huge market for 'clarified PP' applications in packaging and houseware. The demand for clarified PP in India from the present 100 KT is estimated to reach 250 KT in the next 5 years. There is a vital need for capacity creation in downstream processing industry to leverage this opportunity and assure all support for market development with technical innovations.

This paper describes the structural properties and attributes of Clarified Polypropylene with opportunities in food, milk beverages and pharmaceutical sector.

Why Clarified PP?

Clarity in Polypropylene is achieved by incorporation of a small quantity of Ethylene during polymerization. This product is called PP Random Copolymer. In PP Random copolymer chain, regularity is disturbed with decrease in crystallinity and rate of crystallization which restrict the size of crystalline aggregates resulting in better clarity. Use of a clarifier/nucleating agent further enhances the clarity.

In Clarified PP, a large number of crystallites have size less than the wavelength of light. Nucleation gives better clarity and high stiffness.



(Fig 1: Mechanism of Clarified PP; courtesy Milliken Chemicals)

Attributes of Clarified PP

Products manufactured from Clarified PP possess

- Glass like transparency
- Excellent moisture barrier & chemical resistance
- Higher continuous use ambient temperature
- Hot fillability (up to 98° C)
- Retortability & microwavability
- Excellent balance of stiffness, flexibility and hinge property coupled with excellent environment stress cracking resistance (ESCR) property
- Cost effective value proposition

Versatility of Clarified PP

Clarified PP has excellent process friendliness. It can be processed with equal ease for standard injection moulding, thin wall injection moulding (TWIM) and injection stretch blow moulding (ISBM) applications. The chart below gives an insight in technology drives for Clarified PP.

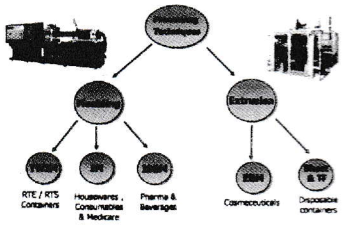


Fig: 2 Processing Technologies of Clarified PP

Regionwise demand for Clarified PP

Clarified PP contributing to a 7.5 % share is the highest amongst all types of PP. With a present global consumption of about 3.5 MMT/ annum, the demand is likely to grow further. Presently Asia Pacific, Western Europe and North America are the major Clarified PP users. Asia Pacific region will be witnessing the highest growth in demand of Clarified PP (1.3 MMT in 2010). In the coming years, India has to ramp up its Clarified PP consumption from its current 4 % share to 7.5 %.

Growing Technology base for PP

At present in India, injection stretch blow moulding (ISBM) and thin wall moulding (TWIM) are in the early stages of development. Injection moulding and thermoforming sectors are in a mature stage and growing at the rate of 10-20% per annum. ISBM & TWIM are technologies which will experience high growth in future and become the technologies for the coming years due to their capability for mass production with accurate and precision products.

Property comparison of Clarified PP with other polymers

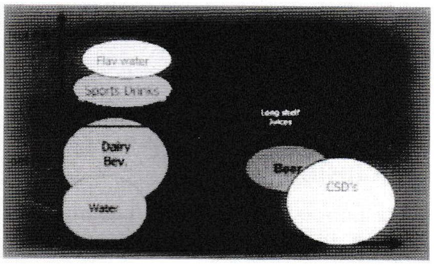
Compared to other materials used in packaging containers or bottles, PP has many advantages including light weight, moisture barrier, toughness, strength, cost effectiveness and recyclability. Table I provides a comparison of Clarified PP with other Polymers.

Table 1: Property comparison of Clarified PP with other Polymers

Desired Property	PET	PS	PVC	HDPE	PC	Glass
See Through Transparency and Glass	0	0	0	++	0	0
Cost/ Unit Volume	++	+	+	0	++	+
Hot Filling Capacity	++	++	++	++	0	0
Moisture/ Vapour Barrier	+	++	+	0	++	-
Lower Density	++	+	++	0	++	++
Taste & Odor Transfer Property	+	0	+	+	0	-
Drop Impact Strength	+	++	-	-	-	++
Flexibility	0	++	0	0	0	++
Stiffness	-	-	-	+	-	-
Chemical Resistance	+	+	++	0	0	0
Oxygen Barrier	-	0	-	-	0	-
Microwavability	++	++	++	++	++	-
Much Better (++), Better (+) , Comparable (0), Worse(-)						

Classification of Beverages

As can be seen from Table 1, Clarified PP has excellent clarity and hot fillability but poor oxygen barrier. Therefore, it can be safely used for dairy beverages and low concentration fruit juice but not for carbonated drinks, beer and soft drinks.



(Fig 4: Classification of Beverages based on fillability & O2 sensitivity; courtesy Milliken Chemical)

Flavoured milk in Clarified Polypropylene

Processed food in India is a sun rise industry. With the backup from union & local governments combined with the demand created by the organized retail industry and changing food habits of middle class families, this sector is experiencing unprecedented growth. This in turn is creating a lot of opportunities in the packaging of these products.

In milk beverage industry, flavored milk is one such value added product growing annually at 20%. It comprises of skimmed or semi-skimmed milk and contains less than 3% fat.

Flavoured Milk Industry snapshots

- Market Value: Rs. 250 Cr.
- Over 80 dairies across India with capacity of 300 Kl/day; growing @25 %
- Amul - leader in the market with 72% market share
- Other players in the market: Mother Dairy, Aavin, Nestle, Cavin Care
- Products are available in glass bottles, cartons, sachets
- Pack size: 100/200 ml

Major Flavoured Milk brands

Amul

Mother Dairy

Britannia

Packaging Technology for Flavoured Milk

Flavored milk is available in crown cork glass bottles, glass bottles with aluminum foil lid or snapon plastic lid, plastic sachets and aseptic packs (tetra bricks).

Flavoured milk is subjected to sterilization / retorting which effectively kills or eliminates transmissible agents (such as fungi, bacteria, viruses and spore forms etc.). The sterilized product has a shelf life of more than 6 months at ambient temperature.

Conventionally, glass bottles are used for sterilized products such as flavoured milk. The autoclaves used for sterilization of glass bottles are very simple needing no process automation.

These are typically steam sterilizers where the required sterilization temperature (121°C) is achieved by pressurizing the steam up to 30 psi (2.2 Bar). The temperature is maintained by maintaining the steam pressure.

However the same sterilization conditions cannot be used for plastic bottles. For Clarified PP, constant temperature pressure relationship in these systems results in containers collapsing or bursting during the process.

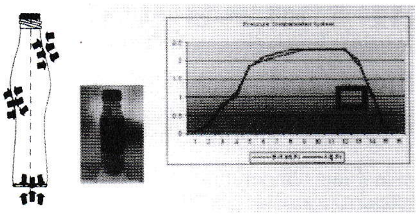
This problem is overcome by the use of super heated water spray sterilizers (SWHS).

Working Principle

Heating and cooling is done by circulating water in a closed system. The water gets heated by passing through the exchanger, which is then sprayed on the product through nozzles from the upper part of the chamber. High water flow rates also ensures that uniform temperature distribution is maintained throughout the chamber during the sterilization phase.

During the cooling phase, the heat exchanger is fed with cooling medium and the circulating water gets cooled which in turn is sprayed onto the product, thus reducing its temperature to the desired level. A sterile air overpressure is maintained during all the phases to compensate the internal pressure build up within bottle / container, thus no bottle deformation takes place.

Schematic Representation of working of SWHS



(Fig 5: Effect of pressure compensation on plastic bottles (internal pressure vs ambient))
Internal bottle pressure = External pressure on bottle in sterilizer
Result: No deformation during sterilization.

Clarified PP can withstand sterilization temperature (under proper conditions and container design) & hot fillability (up to 98°C) in addition to contact clarity. This makes Clarified PP the most preferred plastic material over other plastics.

Result of Replacing Glass with Clarified PP (200 ml bottle weighing 14 gm)

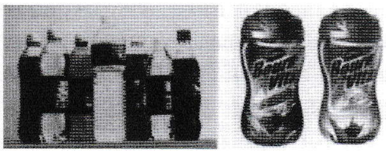
Bottles made of Clarified PP using injection stretch blow moulding and caps by injection moulding process.

- Material conservation
  - Proposed Clarified PP - 200ml bottles are 85% lesser in weight than glass
- Reduction in transportation: Lighter packaging means lighter loads or fewer trucks to ship the same amount of product, thus helping to reduce transportation energy and saving fuel.
- Waste reduction: Weight-reduced packaging will result in reduced amount of waste generated.

Shift to Clarified Polypropylene bottles can result in substantial saving to Dairies across the country.

Other Clarified PP applications

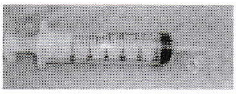
Food & Health Drink Sector : India is the world's second largest producer of food next to China. The Indian Food Industry is US $75 billion, out of which almost 65% is in the unorganized sector. Considering the economic growth and changing lifestyle, the market for branded items will grow and so also the trend of new variants in existing range with stylish packaging. Beverages can be classified as Dairy products as water is the main ingredient where cold filling is generally required. Hot filling beverages include flavoured water, Sports drinks etc. Oxygen sensitive beverages comprise of CSD drinks, beer and long shelf-life juices as mentioned in the graph above.



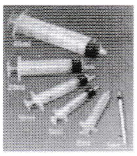
(Fig 6: Beverages)

The market for water, fruit juices and beverages is growing and the Government of India is giving incentives to boost investment in Food Processing Industry.

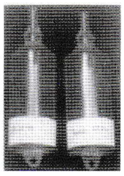
Healthcare Sector : Presently, the Indian Pharma Industry is a US $4 billion industry with a capital investment of US $0.5 billion and growing more than 20% per annum. India is one of the top 5 manufacturers of bulk drugs & amongst the top 20 exporters of pharmaceutical products. India is becoming a global sourcing base and contract manufacturing with focus on innovative packaging/disposable medical devices. Indian companies are tapping the international generic market by setting up subsidiaries.



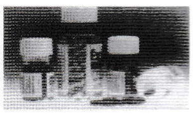
(Fig 7: Single use Disposable Syringe)



(Fig 8: Disposable Syringes)



(Fig 9: I V Fluids bottles)

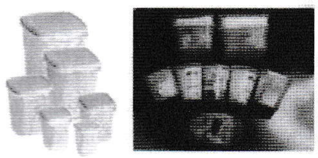


(Fig 10: Cough syrup & Pharmaceutical products)

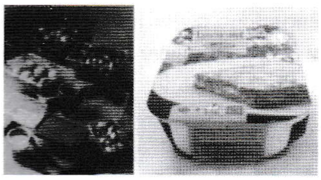
Medical Disposables: Medical disposables are single use products, mainly PP non woven based, used for applications like masks, caps, gowns & bedsheets etc.

IV Fluid Bottles: These are mostly blow moulded PP bottles made by EBM/ISBM process sterilized at 120° C for 20 minutes.

Thin Wall Injection Moulded Containers: A variety of injection moulded and thin wall containers are employed for numerous household applications like containers for dairy products, snacks packaging, disposable cups for soft beverages & drinks, microwave containers for RTE food, confectionery boxes, storage boxes etc. Some of the key products are given as under.



(Fig 11: Thin Wall Injection Moulding with In mould label)



(Fig 12: Thermoforming Application in Food Packaging)

Conclusion

Clarified PP is a versatile polymer with excellent combination of clarity and hot fillability that has immense growth potential for packaging of food beverages. It can revolutionize the packaging of dairy, food & health drinks, and medical products. Growth can be captured by employing proper strategy and partnership/ associations with the entire value chain. Broadly it should cover :

a) Facilitate capacity creation by downstream development
b) Introduction of state-of-art machines for high volumes
c) Partnership with key end users and nodal agencies (GCMMF, Coke, CFTRI)
d) Creating awareness for Clarified PP penetration through customer relationship programs (CRMs).

Product Update

GEC Delivers Two Industrial Accumulator Head Blow Molding Machines To TrafFix Devices Inc

TrafFix Devices Incorporated (TDI), of San Clemente, California, recently accepted delivery of the second of two Graham Engineering Corporation (GEC) accumulator machines ordered late last year. TDI manufactures and distributes highway safety products for the traffic control and transportation industry.Based upon growing business, TrafFix converted to in-house molding of their products in a newly constructed plant in Fairfield, Iowa.

The cornerstone of this effort is the purchase of two new Graham Model GEC-7460 dual head blow molding machines <http://www.grahamengineering.com/products/Accumulator-Head/accumulator-head.htm> . Each machine included a 6 inch smooth bore extruder with a 300 HP AC drive, dual 20-lb. series heads, XBM Navigator PC controls and a 74x60 inch press with 190 tons of clamping force. TrafFix started in-house production on the first machine in May 2010, with the second machine entering production in October. Each of these machines runs both HDPE and LLDPE.

According to Jack Kulp, President and Founder of TrafFix, "We chose Graham over others because of their innovative and technical advantages in machine design. We felt that Graham would provide the best support in training, service, processing and on line support. We received excellent references from other peer companies on their equipment's efficiency and service support and Graham delivered as advertised."

GEC industrial machines are known for their fast color change capabilities. Color changes, which can require as much as 8-12 hours on many competitive machines, can be accomplished in less than one hour on Graham machines, due to their unique flowhead design. During the TrafFix machinery acceptance, Graham demonstrated both a liquid color and color concentrate color change from natural HDPE to orange in four shots.

David Yenor, Vice President of Global Business Development at Graham, adds, "We were very pleased to support the incredible growth and competitiveness of TrafFix with the installation of these two machines. TrafFix fits the profile of many of our customers for industrial machines – growing companies, with exciting product lines, who benefit from the reliability and capabilities of our single and dual head equipment. We look forward to working with them on an ongoing basis."

Mr. Kulp continued, "The new GEC equipment allows TrafFix to run all of our products on the same machine size, yielding a higher efficiency on an annual production basis. The GEC spiral heads also provide a much quicker color or material change compared to others. The entire process, from order to installation, training and commissioning, exceeded our expectations

."About Graham Engineering Corporation:
Graham Engineering offers a complete line of monolayer and multilayer extrusion blow molding equipment, including: shuttle machines up to 10 L capacity; reciprocating screw and shot pot machinery for lightweight HDPE containers; multi-cavity, single and dual parison rotary wheel blow molders for up to 30 L packaging applications; and single and dual head accumulator machinery from 5 to 50 lbs (3 to 30 liters) capacity.

About TrafFix Devices Inc.: TrafFix currently produce over 100 traffic control and safety road devices, making them one of the largest producers of road safety products in the world. They have plants in San Clemente CA, Fairfield, IA, Adelanto, CA and Tijuana, Mexico. Their products include Channelizer© barrier drums, portable sign stands, roll-up signs, plastic barricades, and traffic cones.

For more details:
www.traffixdevices.com
www.grahamengineering.com

Special Article

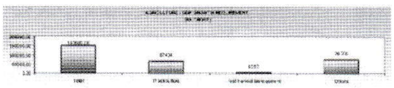
Ms Poorvi C. Desai, Sr. Manager, Business Development – Polymers, Reliance Industries Limited

"New Innovations Needed In Polyethylene Greenhouses In India"

Importance of Agriculture in Indian Economy in India & Percentage of Population Dependent on Agriculture

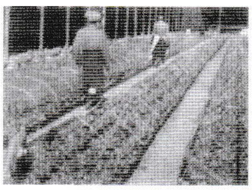
Is an agriculture-based economy, where 43% of its people remain employed in agricultural and allied activities. Agriculture along with other related fields like forestry and logging provides employment to 60% of India's population. Agriculture accounts for almost 19% of the Gross Domestic Product and 9% of the total exports. India's agro-climatic conditions and rich natural resource base sets prelude for doing very good on agriculture front. Today, India has become the world's largest producer across a range of commodities, like coconut, mango, banana, milk & dairy products, cashew nuts, pulses, ginger, turmeric and black pepper. It is also the second largest producer of rice, wheat, sugar, cotton, fruits and vegetables.

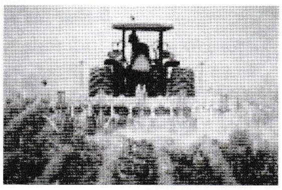
Agriculture is Indian economy's mainstay & it comprises 18.5% of the gross domestic product (GDP). In the last two years agriculture growth rate was 4% against growth rate of 2.5% during the



10thFive Year Plan.

(Source : Reserve Bank of India,

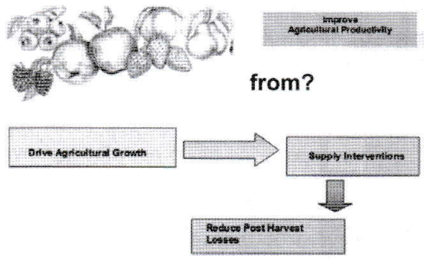




4.1% growth implies a Rs 1,50,000 crore increase In Agriculture GDP

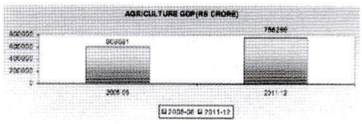
Planning Commission Targets)

Where will this growth come from?



Driving agriculture growth requires concurrent demand and supply side interventions

Plastics in Agribusiness



Rapid adoption of plastic applications alone can provide 50% of the intended targets in Agriculture...

(Source : Reserve Bank of India, Planning Commission Targets)

New Products in Plasticulture

.HDPE Eyeleted Tarpaulins as sacks for fruits & vegetables

.LDPE Reverse Printed Extrusion Coating on 2 sides of HDPE Woven Sacks

Plastics in Agribusiness

Plastic pipes open up flow of water into the agricultural fields contributing to the growth of fruits & vegetables. Barren land without water would lead to a failure of crops. Plastic products related to

agriculture include LLDPE Mulch film, PVC Pipes, HDPE Pipes, LLDPE Drip Irrigation Pipes, HDPE Nets, PE Greenhouse etc would lead to higher productivity(yield).

Plastics which was initially perceived as films have grown from films to agrishade nets, from tapes to agrishade net and from monofilament to monofilament agrishade nets.

A growing phenomenon, this plastic product has been an indirect contributor to the food of a common man. Food, meaning fruits and vegetables, for survival of each human being. Plastics in Agribusiness have been a contributor for a higher productivity(yield) of fruits and vegetables.

India being No.2 producer of fruits (50 million tonnes) & No.3 producer of vegetables (90 million tonnes) in the world, high potential exists for plastic products related to agriculture

Polyethylene Greenhouse

Polyethylene Greenhouse is a plastic product made up of a polyethylene film of upto 10 mts wide & upto 200 microns. Polyethylene monolayer, three layer & five layer films are used. Three layer polyethylene film extruders of 1200 kg/hr upto 10 metre wide are available in the country. PE Greenhouses are available in widths of 4.5 mts, 5.5 mts, 7 mts & 9 mts (mainly used upto 200 microns).

A greenhouse is a framed or inflated structure covered with a transparent or translucent material in which crops could be grown under the conditions of at least partially controlled environment and which is large enough to permit a person to work within it to carry out cultural operations.

Specific Benefits of Polyhouses

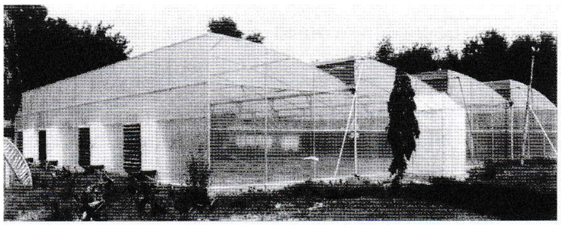
1. Crop cultivation under inclement climatic conditions
2. Control of growing conditions for plants to obtain desired results
3. Certain crops cultivated year round to meet the market demands
4. High value and high quality, even organic, crops grown for export markets
5. Small land holdings increased several fold
6. Successful nurseries from seeds or by vegetative propagation prepared as and when necessary
7. More Self-employment opportunities for educated youth on farm
8. Manipulation of microclimate and insect proof feature of the greenhouse for plant breeding and, thus, the evolution of new varieties and production of seeds
9. Protection from birds and animals
10 .Facility in controlling pests and diseases
11.Possibility of widening the variety of plants for general gardening purposes
12. Possibility of reducing gardening costs because the owner or gardener grows his own plants

(Source : http://www.homegardenguides.com/wiki/Greenhouse)

Benefits of Plastic Greenhouses

1. Construction cost per square foot is much lower than a glass greenhouse
2. Plastic greenhouses can be heated as satisfactorily as glass greenhouses
3. Plants grown under plastic have the same quality as those grown under glass
4 .Polyethylene tend to scatter light. Scatter or diffused light tends to benefit plants by reducing excess light on upper leaves and increasing reflected light to lower leaves
5. Plastic is adapted to various greenhouse designs, generally resistant to breakage, light weight and relatively east to apply

(Source : Oklahoma Cooperative Extension Service http://nmwater.nmsu.edu/pubs/_circulars/circ556.html)



Low density polyethylene uv stabilised film of 200 micron thickness

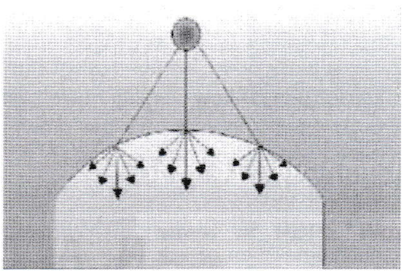
Types of PE Greenhouses

Classification based on material

1. Frames are made of wood, galvanized steel or aluminium
2. Covering can be :
- Glass
- Fibreglass
- Double wall plastic
- Film plastic

(Source : NCPAH)

High cost structure with iron/Aluminium frame need to be replaced by bamboo and timber



Crop	Yield (tonne/ha)		% increase	Type of Green House
	Greenhouse	Open field		
Onion	15.6	11.10	41%	Naturally ventilated greenhouse
Cauliflower	15.2	8.00	90%	Naturally ventilated greenhouse
Raddish	55.3	20.00	177%	Naturally ventilated greenhouse
Tomato	98.9	80.00	24%	Multispan greenhouse

Green Houses & Large Tunnels

• Benefits
• Cultivation possible in hostile climates • Yield increase (more than 100%)
• Better quality of produce
• Reduced infestation of plant diseases and pests
• Rain-shelter in heavy precipitation areas • Status in India
• 2000 Ha under Green House cultivation

Status in India

• 2000 Ha under Green House cultivation..

Potential: 400, 000 Ha area can be brought under Green House.

Plastics opens up into multiple enduses leading to closed structures such as polyethylene greenhouses.These greenhouses in the greenfields have made plastics the most sought product for increasing the productivity(yield) of fruits & vegetables.

The machinery used to manufacture Three Layer & Five Layer Polyethylene Greenhouse are three layer & five layer blown film extruders.

Manufacturing Process

Blown film extrusion is a technology that is the most common method to make plastic films. The process involves extruding a tube of molten polymer through a die and inflating to several times its initial diameter to form a thin film bubble. This bubble is then collapsed and used as a lay-flat film.

The Film Blowing Process –

1.The polymer material starts in a pellet form, which are successively compacted and melted to form a continuous viscous liquid

2.This molten plastic is then forced or extruded, through an annular die. Air is injected through a hole in the centre of the die and the pressure causes the extruded melt to expand into a bubble. The air entering the bubble replaces air leaving it, so that even and constant pressure is maintained to ensure uniform thickness of the film

3.The bubble is pulled continually upwards from the die and a cooling ring blows air onto the film. The film can also be cooled from the inside using internal bubble cooling. This reduces the temperature inside the bubble, while maintaining the bubble diameter

4.After solidification at the frost line, the film moves into a set of nip rollers which collapse the bubble and flatten it into two flat film layers. The puller rolls pull the film onto windup rollers. The film passes through idler rolls during this process to ensure that there is uniform tension in the film. Between the nip rollers and the windup rollers, the film may pass through a treatment centre. During this stage, the film may be slit to form one or two films or surface treated.

Three layer blown film extrusion (also known as blow film co-extrusion) is a process of simultaneously extruding in molten stage three polymers which adhere to each other through a common die to form an integral film of unique strength and barrier properties. This process saves time because it extrudes two or more layers at the same time. Coextrusion is the least expensive means of producing layered films.

(Source : http://www.appropedia.orgBlown_film_extrusion)

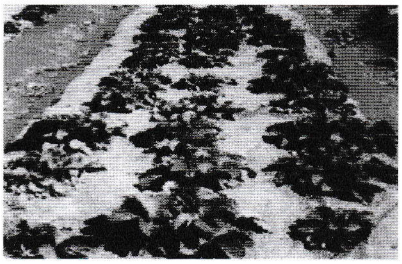
* The size of a PE Greenhouse could be reduced for plants which need a growth with lower heights upto a height of 6 feet. Dimensions of 6 ft * 6 ft. Small greenhouses offer lower initial investment and flexibility of operation.

* A combination of LLDPE Mulch film & PE Greenhouse could be used in case of a greenhouse in summer where more sunlight is not needed such as summer, when a reduction in light is desirable & when cooling is a problem in summer. Mulches will also help conserve moisture This could serve as a dual purpose of LLDPE Mulch film & PE Greenhouse saving one investment of LLDPE Mulch film

The example of strawberries wherein Linear Low Density Polyethylene Mulch film is used in high quantities also exists for other fruits and vegetables.

Water is needed for survival of human beings, Linear Low Density Polyethylene Mulch film is needed for the growth of plants. Retaining moisture levels in soil thus becomes a need for achieving a higher productivity of plants for both fruits and vegetables.

Black colour mulch film with addition of carbon black is amongst the most common film used which prevents the film from ultra violet degradation. Achieving higher quality film with a longer shelf life with virgin material offers a quality product to the farmers helping in creating a brand for each farmer.



UV stabilised mulch film with addition of carbon black is used for the growth of plants.

Distribution Pattern of PE Greenhouses

Apportioning high percentage of Selling & Distribution Expense i.e. 10% of Sales would lead to a market penetration. Shelling out high commission to commission agents would lead to a faster market penetration without affecting the desired payback period.

1. 5 Nos commission agents from APMC's etc in 5 regions where use of PE Greenhouse is maximum

2.Shelling out good commissions to these commission agents by apportioning high selling & distribution expenses in the project

3.Involve persons qualified in the field of agriculture who would be able to communicate the advantages of use of Polyethylene greenhouse to each commission agent who would be able to communicate to each farmer

4.Initiate this exercise with one place/city/region and replicate the same in other places/cities/regions

For achieving a higher market

penetration of PE Greenhouses

- Achieve higher market penetration parallely via
1. Commission Agents
2. Qualified persons from field of Agriculture
3. Dealers of plastic products related to agriculture

- Commission agents who know the local language would communicate more effectively with farmers

- Farmers would have more faith and believe local persons from their village

- Qualified persons from field of Agriculture would be able to brief the farmers on higher productivity (yield) and benefits of PE Greenhouses

- Dealers who display the plastic products related to agriculture such as pipes, mulch film to add one more product in their shops
- Promote PE Greenhouses amongst existing multilayer film processors

- Distribution pattern – Commission Agents, Marketing persons qualified in field of Agriculture, Dealers of plastic products related to agriculture leading in achieving a higher market penetration

- **Business leading to :**
  - Net profitability to the farmers
  - Net profitability to the entrepreneurs
- Tieups between the two bringing in more business leading to an economic growth of our country

- One farmer, a leader uses these plastic products, followers too would use these products

- Initiate the business with one farmer, one village would result in achieving a higher market penetration

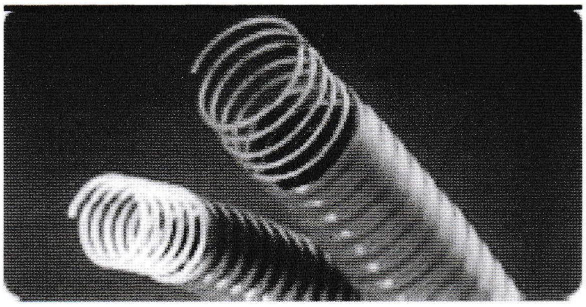
Conclusion
Plastics for Entrepreneurs
Multilayer polyethylene film manufacturers can produce LLDPE Garbage bags/PE Multilayer film for flexible packaging laminates/PE Multilayer film for milk, edible oil/LLDPE Stretch & Cling film/LLDPE Mulch film on the same film extruder. PE Greenhouse can be manufactured on a 3 layer PE film extruder upto 10 metre wide. Monolayer polyethylene film manufacturers can produce LLDPE Carry bags/LLDPE Nursery bags/LD/LLDPE Liners/LLDPE Perforated film for fruits and

Plastics Products And Parts or Food Processing Industry

Bekaert flexible duct
Bekaert flexible duct is a plastic coated (PU) low carbon wire to reinforce large flexible ducts used to transport gases, food and other material.

Bekaert Removable Mesh Pack
One of the options Bekaert offers for its filter candle range is the removable Mesh Pack®. This original patented design can be dismantled which means you can easily remove the filtering part of the candle to have it cleaned and to reuse the part several times again. When the filtering element can not be cleaned anymore you only need to replace this specific part of thecartridge. That way you significantly reduce your incineration or landfill costs which can help you save up to 30% on total filtration costs. The separate parts of the Mesh PackR are ensured by a metal sealing that provides 100% security down to 5 m.

Polymer filtration
Looking for an upgrade for your polymer filtration application? With more than 30 years experience in designing and producing fiber media and metallic filtration systems Bekaert has the know-how and technology to provide an appropriate solution for any filtration application from polymerization to spinning. Our service includes our full support; from investigating the



possibilities of improving the filter process to the design, development and production of a filter solution that matches your quality, productivity, handling and maintenance requirements.

For more details:
www.emeraldgroupe.in

Anxillary Update

Tank For Plastic Tubing Includes Vacuum Sizing For Material Savings Quality

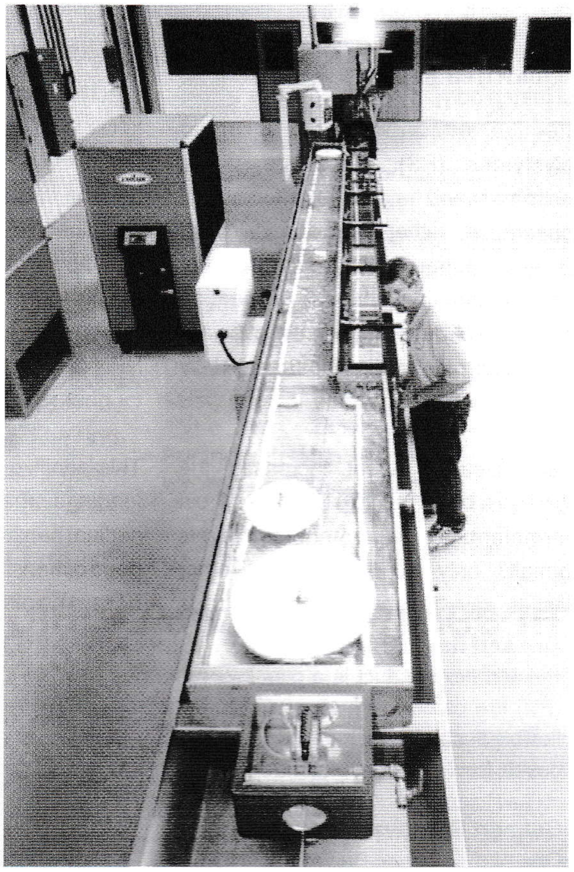
A new multipass cooling tank and related technologies from Conair now make it possible for producers of plastic tubing to reduce wall-thickness tolerances and cut material use dramatically while increasing productivity and reducing floor-space requirements. Systems are available for extrusion of medical tubing and also for non-medical products like aquarium tubing, small-gauge irrigation tubing and pneumatic airway tubing.

With new and innovative OD, ID, and wall-control algorithms, new tension-control devices, and precision puller technology, this new combination vacuum/multi-pass tank technology is reducing commodity tubing tolerances to levels never seen before.

"Like any multipass tank, this new unit cuts floor space requirements by sending the tubing along a back-and-forth path through the cooling water, but that's where the similarity ends" explains Bob Bessemer, Medical Downstream Extrusion Sales Manager for Conair. "The first thing you notice is that part of the tank is taken up with a vacuum-sizing chamber. Because vacuum sizing is inherently more controllable than air-pressure sizing, Conair has advocated this technology for over 15 years and we've demonstrated success in extrusion of flexible PVC, TPE, TPU and PE tubing. By reducing tolerances from 0.005 inch (0.127 mm) down to 0.003 inch (0.076 mm), for instance, processors can save tens of thousands of pounds of material while increasing the amount of product produced.

As the industry migrates from PVC to more expensive materials, savings of even a few percent in material use becomes very important."

Besides using vacuum-sizing, the new MedLine™ Multipass tank has several other advanced features, each of which contributes further to improved process stability, tighter control of wall thickness, ovality and cut-to-length tolerances.



•An oversized, driven roller at the end of the tank reverses the direction of the tube as it exits the vacuum chamber and begins a second pass through the tank. The large diameter and precision design minimizes the potential for tube distortionor flattening, and because this roller is actually driven by a closed-loop vector drive or digital servo, it acts as the primary puller in the line. Located close to the beginning of line, it minimizes the stretching that can occur when the primary puller is a hundred feet or more down the extrusion line.

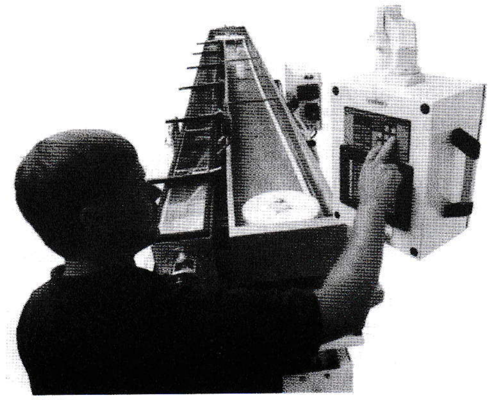
•Precision glass bearings on non-driven rollers reduce drag and stretching as the tubing makes subsequent passes through the tank at line speeds that now sometimes approach 800 feet/minute.

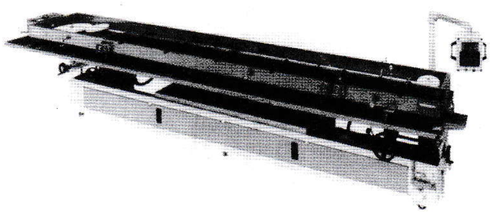
•A load cell measures tension on the tubing. This device sends a signal to the secondary puller outside the tank to automatically adjust speed to maintain a consistent and repeatable tension and prevent shrinkage issues.

•Two gauging units – an ultrasonic gauge upstream and a laser gage at the downstream end – are linked to the pullers to automatically control wall thickness, concentricity and ovality of the tubing.

Because the MedLine MultiPass tank uses vacuum sizing instead of air-pressure in free extrusion, Bessemer also reports that is less affected by automated downstream functions like cutting to length and coil winding. "Where processors might have avoided using these techniques because of their impact on overall tube tolerances," he says "they can now confidently institute these labor saving techniques and cut costs further while increasing productivity."

The Conair Group (www.conairgroup.com) is the world's leading supplier of auxiliary equipment for plastics processors, including resin drying systems, blenders, feeders and material-conveying systems, temperature-control equipment and granulators. Extrusion solutions include line-control systems, film and sheet scrap-reclaim systems and downstream equipment for pipe and profile extrusion. Over 450 individual products solve problems, save energy, cut waste and are easy to use. With long-standing operations in Europe, Asia and South America, Conair is also an international company. More than 300 employees worldwide bring together 50 years of manufacturing experience and youthful creativity to break down barriers to innovation and harness new technology to give customers meaningful, bottom line benefits. The industry's most complete product line, top-flight engineering and unbeatable service, all combine to give processors the confidence they need to succeed in today's competitive global marketplace.





For more details:
www.conairgroup.com

Bayer Passes First REACH Milestone Registration Of Large-Volume Chemicals Completed On Time

Bayer has successfully completed the registration of 125 large-volume chemicals under the European Union's REACH Regulation by the specified deadline of December 1, 2010. According to European law, this is an essential requirement for the continued production and marketing of these products. More than 50 highly qualified experts devoted three years of their time exclusively to this task. "We have shown great commitment in meeting the requirements of the REACH Regulation. We consider it important to again document the high safety standards maintained in our chemical production facilities by this means too," said Dr. Wolfgang Grosse Entrup, Head of Environment & Sustainability in Bayer's Corporate Center. REACH (Regulation on the Registration, Evaluation and Authorization of Chemicals) came into force on June 1, 2007 and has completely overhauled European chemicals policy. Its goal is to improve protection of people and the environment through the compilation of more comprehensive data. For this purpose, project groups in the Bayer subgroups compiled detailed and specially dedicated dossiers for each substance subject to registration. This information then had to be submitted to the European Chemicals Agency (ECHA) in Helsinki, an organization especially set up to deal with REACH. Many of Bayer's 125 registration dossiers are more than 100 pages long.

"The subgroups began early with this complex task, establishing a well functioning organization and cooperating highly effectively," said Dr. Andrea Paetz, Groupwide REACH Coordinator, explaining the basis for this successful achievement. One of the major challenges was to coordinate with competitors within consortia. "To avoid more animal studies being carried out, the legislator stipulated the exchange of existing studies on substances used by several companies," continued Paetz. Parts of the dossiers are put on the Internet and are thus publicly accessible.

The next important deadline is June 1, 2013, by which time all substances produced or imported in volumes of between 100 and 1,000 metric tons per annum have to be registered. This concerns many chemicals that are important to the subgroups Bayer CropScience and Bayer HealthCare. The final registration deadline for substances that were already being produced when REACH was enacted is June 1, 2018. This is the date by which smaller-volume substances (1 to 100 metric tons per annum) have to be registered. REACH will thus continue to pose a major challenge to Bayer - not least because plans are afoot to fundamentally revise the REACH Regulation in 2012. "This is something we will have to devote a lot of attention to," concluded Paetz.

Forward-Looking Statements This release may contain forward-looking statements based on current assumptions and forecasts made by Bayer Group or subgroup management. Various known and unknown risks, uncertainties and other factors could lead to material differences between the actual future results, financial situation, development or performance of the company and the estimates given here.

For more details:
www.bayer.com

Material News

Investment And Innovation Focus Boost Success For Borealis' And Borouge's Wire And Cable Customers

Pioneering power transmission and distribution projects around the world are benefitting from Borealis' and Borouge's continued investment in delivering consistent, high quality, cutting-edge innovations for the wire and cable market.

Recent ventures featuring Superclean™ XLPE insulation and Supersmooth™ XLPE semiconductive materials from the world's leading providers of innovative, value creating plastics solutions for the wire and cable industry, include the first major construction project in China involving the laying of 220 kV cables under a 10km long bridge; part of the largest tunnel-bridge project in the world to date. The first ever installation of a 135km Extra High Voltage (EHV) cable beneath a densely populated city in India is another example of their use in ground-breaking cabling initiatives.Borealis and Borouge offer a broad portfolio for the most challenging EHV and High Voltage (HV) cable applications, as well as in Medium Voltage(MV) and Low Voltage (LV) energy distribution cables, building wire and communication cables.

Borealis has implemented many research and production technology initiatives to support cable development as XLPE cables have advanced to EHV (>220 kV) applications. Working in partnership with a global customer base to respond to their needs, Borealis has established technology for the production and supply of compounds to manufacture high-stressed XLPE cables and thus has become the leading supplier of compounds to the largest EHV projects in the world

Superclean XLPE insulation compounds offer the highest level of material cleanliness essential to insulation performance in elevated electrical stress conditions.

Supersmooth XLPE semiconductive compounds give very smooth and,even surfaces when extruded as the semiconductive screen in conjunction with Superclean XLPE insulation. Supersmooth compounds help eliminate small contaminants and surface pips, reduce electrical stresses and minimise the risk of power failure to help ensure a long cable service life.

Fujikura Shanghai Cable project

The Shanghai Changjiang Tunnel-Bridge project is a world-class 25.5km cross-river project at the estuary of the Changjiang River and an integral part of China's highway construction plan. When finalised, it will play a significant role in meeting transportation demand in the area and in improving accessibility around Shanghai.

A 220 kV cable network using more than 400km of cables was incorporated into the project, covering bridges, tunnels, pipes and shafts. The vast extent of the distribution network, which was completed in 2009, made high reliability and long life span a priority.

Cable manufacturer Fujikura Shanghai Cable Ltd selected insulation material Superclean LE4201S and shielding material Supersmooth LE0500 from Borouge and Borealis to produce EHV cables meeting the high specifications and service life demands of this pioneering project. The minimum impurity and smooth interface between the cable conductor and insulator will ensure long-term, reliable operation under strong field intensity conditions.

Cable Corporation of India (CCI)

When the city of Chennai, with a population of over 8.5 million people, required a new power supply line, the Tamil Nadu Electricity Board turned to Cable Corporation of India (CCI) for production and installation support. CCI is the first company in Asia, outside of Japan, to be licensed by Mitsubishi Cable Industries to make EHV cables using its patented MDCV process technology. It is India's leading EHV cable manufacturer.To ensure the most effective distribution system in this busy city during both, installation and operation, project criteria included ensuring clean power delivery through an underground installation, with supply unaffected by environmental conditions over a long service lifetime.

Based on its extensive experience with Borealis' and Borouge's high purity cable solutions and the need for reliable performance, CCI selected Superclean LE4244EHV and Supersmooth LE0592S XLPE materials with an additional LE7710 semiconductive screen compound for the 135.3km cable. The cable was based around a 1200mm Milliken conductor

This was the first prestigious project in India with this conductor size, type and voltage grade over a long cable length," Senior Executive Vice President, Marketing CCI. "After some initial trials, it was clear that only with Superclean materials could we achieve the reliability and stability of consistent quality for this type of cable."

"Borealis and Borouge are truly committed to the wire and cable industry worldwide," says Marc Hubert, Borealis Vice President for Wire & Cable. "Customers can count on us for global supplies and for continuous development of new solutions way into the future."

Michael Björn, Borouge Vice President for Wire & Cable adds, "Borealis and Borouge are undertaking major investments in capacity to meet marketdemand for wire and cable compounds. This includes the construction of a 350,000 tonnes per year LDPE plant inaugurated in June 2010 in Stenungsund, Sweden and an identical new plant to be built as part of the Borouge 3 expansion project in the Ruwais, Abu Dhabi by the end of 2013."

Business Unit Wire & Cable

Borealis and Borouge are the world's leading providers of innovative, value creating plastics solutions for the wire and cable industry. Our solutions are customer-driven and designed to satisfy the industry's continuously evolving demands for higher technical performance. They can be found in the most challenging extra-high voltage (EHV) and high voltage (HV) cable applications, as well as medium voltage (MV) and low voltage (LV) energy transmission and distribution cables, building wires, and communications cables. In answer to the need for production, installation and cable-system lifetime enhancements, we create the innovation links that secure world-class, step-changing solutions and benefit the whole wire and cable value chain.

About Borealis and Borouge

Borealis is a leading provider of chemical and innovative plastics solutions that create value for society. With sales of EU4.7 billion in 2009, customers in over 120 countries, and 5,200 employees worldwide,Borealis is owned 64% by the International Petroleum Investment Company (IPIC) of Abu Dhabi and 36% by OMV, the leading energy group in the European growth belt. Borealis is headquartered in Vienna, Austria, and has production locations, innovation centres and customer service centres acrossEurope and the Americas.

Through Borouge, a joint venture between Borealis and the Abu Dhabi National Oil Company (ADNOC), one of the world's major oil and gas companies, the company's footprint reaches out to the Middle East, Asia Pacific, the Indian sub-continent and Africa.. Established in 1998, Borouge employs approximately 1,600 people, has customers in more than 50 countries and its headquarters are in Abu Dhabi in the UAE and Singapore.

Building on Borealis' unique Borstar® technology and their experience in polyolefins of more than 50 years, Borealis and Borouge provide innovative, value creating plastics solutions for the infrastructure (pipe systems and power and communication cables), automotive and advanced packaging markets. In addition, Borealis offers a wide range of base chemicals from melamine and plant nutrients to phenol and acetone.

Today, Borealis and Borouge have a manufacturing capacity of over 5.4 million tonnes of polyolefins (polyethylene and polypropylene) per year of which 26% are the result of a recently completed capacity expansion in Abu Dhabi. An additional 2.5 million tonnes per year is scheduled for completion by the end of 2013, creating the world's largest integrated polyolefins plant. The companies continue to invest to ensure that their customers throughout the value chain, around the world, can always rely on superior products and security of supply.Borouge and Borealis are committed to the principles of Responsible Care® and proactively contribute to addressing the world's water and sanitation challenges through their Water for the World™ initiative.

For more details:
www.borealisgroup.com
www.borouge.com
www.waterfortheworld.net

PRESS CLIPPINGS

আনন্দবাজার পত্রিকা

১১ কার্তিক ১৪১৮ শনিবার ২৯ অক্টোবর ২০১১

নতুন নিয়োগ

রাজেশ মোহতা ইন্ডিয়ান প্লাস্টিক্স ফেডারেশনের নতুন প্রেসিডেন্ট হিসেবে নির্বাচিত হয়েছেন।

The Telegraph – 30.10.2011

ON THE MOVE

RAJESH MOHTA *has taken over as president of Indian Plastics Federation.*

MONTHLY CIRCULAR OF THE FEDERATION

CIRCULAR NO. 52/2011 :

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. BHATTASALI PRINT & SERVICES PVT. LTD.**
   Block 'A', Number-1, New Alipore
   Kolkata - 700 053
   b) Class of membership : **Manufacturer Member**
   c) Proposed by : M/s. National Moulding Co. Ltd.
   d) Seconded by : M/s. Plastic Engineers
   e) Name of representatives : 1) Mr. Arunabha Bhattasali
   2) Ms. Shikha Bhattasali
   f) Items of manufacture : Manufacturer of Plastic Containers.

2. a) Name & Address of the Applicant Firm : **M/S. CREATIVE TRADE & EXPORT PVT. LTD.**
   3, Karbala Mohammad Street
   Kolkata - 700 001
   b) Class of membership : **Life Dealer Member**
   c) Proposed by : M/s. Plastic Engineers
   d) Seconded by : M/s. Ever Bright Plastic Works
   e) Name of representatives : 1) Mr. Om Prakash Kochar
   2) Mr. Amit Kochar
   f) Items dealt in : Deals in Writing Instrument, Writing Pen ink, Tip, Cartridge and Plastic Granules etc.

3. a) Name & Address of the Applicant Firm : **M/S. UNEKAR POLYMER AGENCY**
   P-498, Keyatala Road
   Kolkata - 700 029
   b) Class of membership : **Life Dealer Member**
   c) Proposed by : M/s. National Moulding Co. Ltd.
   d) Seconded by : M/s. Lily India Pvt. Ltd.
   e) Name of representative : Mr. Ravindra Dewan
   f) Items dealt in : Deals in Casting Polyurethans of DOW Hyperlast UK

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

MALSON™

MALSONS POLYMERS PVT. LTD.

MFRS. OF : MASTERBATCHES AND COMPOUNDS.

56E, Hemanta Basu Sarani, 4, B. B. D. Bag (East), Stephen House
4th Floor, Suite No. 57 ABC, Kolkata - 700 001 (West Bengal), India
Ph. No. +91-33-22623124 / 3125, 22429745, +91 98303 36400, Fax No. +91-33-22433091
E-mail : malson@karanpolymers.com, Website : www.karanpolymers.com

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- Calcium / Talc filled PE Compounds
- Black, White and Colour Masterbatches
- UV, Optical Brightner, Anti-block, Masterbatches.
- Consumers specific Masterbatches.

USER INDUSTRIES

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- Films/ Tarpaulins
- Containers
- Non Woven Fabrics
- Carry Bags
- Moulded Goods
- PP/PE Pipes

RNI No. : WBENG/2011/37860 Postal Registration No. KOL RMS / 431 / 2011-2013