ICPE Envis Eco-Echoes

INDIAN CENTRE FOR PLASTICS IN THE ENVIRONMENT

Management of Plastics, Polymer wastes and Biopolymers and impact of Plastics on the Eco-system

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IN THIS ISSUE

Envis Eco-Echoes

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Editorial

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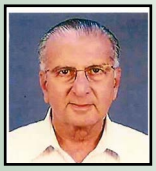

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Compostable Plastics

While Plastics offer multi facet benefits to modern world and the society at large due to its versatile properties, some applications of the material also create environmental issues when its waste* is not handled properly. Although plastics are 100% recyclable, however when the waste is not collected for its recycling and is left unattended, a critical waste management challenge crops up. With this background, polymer scientists developed, what was termed in those days of 1970's, biodegradable plastics, later most commonly known as 'compostable plastics'.

However, the new development did not meet the general expectations of masses who expected that biodegradable (compostable) plastics would vanish in the back yard or in the landfill of its own and would get mixed up with the soil system and thus avoiding the ill effect of the unattended plastics waste. The fact is that biodegradable (compostable) plastics require a specific environment, process and specific time frame for degradation into the soil. When these criteria are not fulfilled, biodegradable (compostable) plastics do not serve the intended purpose. This aspect is required to be understood before arriving at any policy decision on the matter of biodegradable (compostable) plastics. Emphasis is to be given on use of biodegradable (compostable) plastics for right types of applications.

Major manufacturers of plastics raw materials from natural gas have also set up plants for manufacturing compostable plastics albeit at a comparatively lower installed capacity. Despite the fact that the development of biodegradable (compostable) plastics took place in the 70's, its world production remained in the vicinity of one million tons per anum compared to about 300 million tons for conventional plastics materials in 2015. The major reason for the lower production and thus the low application base for biodegradable (compostable) plastics is that the material does not serve the purpose as efficiently as the conventional plastics does. Waste management, the prime mover of the development of this product, could not be achieved by using this material. Marine litter cannot be avoided by the use of biodegradable (compostable) plastics, as it is not degradable in water medium. Use of biodegradable (compostable) plastics is desired for some specific applications. The lead article discusses some critical points on biodegradable (compostable) plastics.

Comments from the readers are welcome.

** In true sense the terminology 'waste' in the industrial arena is a misnomer. It is to be understood that 'waste' is the output of one process and 'input' for another.*

Subscription Information:

ICPE ENVIS Newsletter is sent free of cost to all those interested in the information on Plastics and Environment.

Readers are welcome to send their suggestions, contributions, articles, case studies, and new developments for publication in the Newsletter to the ICPE-ENVIS address.

Editor : Mr. T. K. Bandopadhyay

Compostable Plastics

Introduction

Synthetic polymers have become versatile and useful material for the modern world. Since the discovery of manmade polymers, continuous and systematic efforts have been made to make polymers more stable, mechanically stronger and chemically resistant and safe for health and environment. The constituents of synthetic polymers include – Plastics, Manmade Fibres, Elastomers or more commonly known as Rubbers and Bio-polymers. This paper mostly deals with Plastics and Bio-polymers, though the basic chemistry applies to all polymers.

The attributes like light weight yet strong, least energy consumption and minimum emission of pollutants in the air and water during production including green house gases, inert characteristics, excellent water resistance and barrier properties, excellent insulation and dielectric characteristics, ease of fabrication into variety of shapes and structure – to name a few, have all made plastics not only a material of choice for an array of applications, use of plastics has become essential in every sphere of our modern life in the entire world. The long life of plastics products has added to the value. Plastics have replaced materials such as metal, glass, wood, paper, fibres, ceramics etc. in packaging, automobiles, building construction, biomedical applications, electronics, electrical equipments, appliances, furniture, pipes and heavy industrial equipments. In a nutshell, from agriculture to transport and from aerospace to food packaging, the use of plastics has become an integral part of our modern daily living.

Plastics, despite of possessing environmentally beneficial positive attributes like energy saving, least emission of greenhouse gases, nil / least emission of VOC's etc, compared to the alternative materials, do create environmental issues when the waste generated by certain types of plastics applications especially in the packaging sector remain unattended and dumped in landfills or find its way to the drains and water bodies. Marine litter caused by plastics waste has become a serious issue in the recent time.

In an attempt to overcome the waste management and related issues, scientists had developed what they called at that time in the early 1970's, biodegradable plastics which, in an appropriate environmental condition would disintegrate in the soil leaving CO2, water vapour and biomass. However the major emphasis for the development of biodegradable plastics was for natural degradation of some kind of plastic products after its intended use, which otherwise created environmental issues due to being unattended /not recycled. One example is 'mulch film' for agricultural use. After the production of the crop, it is not easy to wrap up the film from the entire field in a clean condition.

The soil contamination with the film makes recycling a difficult proposition. Earlier farmers used to burn the film after use. This was a cause of concern for the authorities (Japan). Although burning of agricultural film was banned, still there was a tendency among the farmers for disposing of the film by burning for many years. Hence, the farmers welcomed the development of biodegradable (later termed as compostable) agricultural film. This type of mulch film used to get converted into manure and gets mixed with the soil – biodegraded / composted, after the yield of the crop. This gives triple benefit to the farmer - saving on water during the cultivation (the basic purpose of mulching), avoiding the effort to remove the film after use and increasing the fertility of the soil by composting the film with the soil. This was a great achievement by polymer scientists. Another most important desired application of 'biodegradable' polymer is in the medical field like suture, which becomes a part of the human body after healing the wound.

However there are some misconceptions on the applications and benefits of biodegradable / compostable plastics.

Main Issues related to biodegradable (compostable) plastics:

1. Definition
2. Do compostable plastics disappear/degrade in the environment/in the landfill on its own?
3. Are biodegradable / compostable plastics really environment friendly?
4. Recycling or Degradation / Composting - which should be given more priority?

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5. Which application areas should be developed / encouraged for using biodegradable (compostable) plastics?
6. How to identify in the market place – whether a plastic product is really biodegradable (compostable) or not?
7. Technology status and availability at reasonable cost.
8. Role of Government – which should be encouraged: Recycling or biodegradation?

To find out the real position, ICPE made a study on the subject. Following points were considered for coming out with a Position Paper on the subject:

Claims

Some of the world leaders in the field of polymer manufacture have started developing and manufacturing compostable plastics. However total production of compostable plastics in the world reached a figure of around one million tons compared to a figure of around 300 million tons for non-biodegradable / compostable plastics. Compostable plastics require appropriate environment for degradation, this does not automatically get composted unless it is turned in the soil regularly in the presence of moisture / water. In such positive environment it would take approximately six months for compostable plastics to get itself mixed up with the soil. This implies that compostable plastics would remain in the road side or in the landfills if it is not processed appropriately. Hence the product did not attract attention for general purpose applications like carry bags/packaging films.

There is one type of product called "Oxo-degradable Plastics", which is claimed to be disintegrated by itself in the presence of sunlight. It is claimed that the product will automatically Oxo-degrade in the backyard or in the field and vanish in the presence of oxygen / sunlight, relieving the civic authorities and the citizens of the plastics waste littering problem. The traditional manufacturers of compostable plastics, which include the large companies of USA, Europe and Japan, through their respective associations, have raised their concern on such claims.

International Biodegradable Polymers Association & Working Groups (IBAW) expressed their concern on such claims attracting the attention of the authorities and general users that whenever a packaging product is placed on the market as "degradable", conformance with the requirements of approved Standards is essential. IBWA declares that no PE additive product, like the "Oxo-degradable" plastics, has yet been shown to comply with such Standards. It adds that so called "Oxo-biodegradable" additives pose several concerns regarding safety and eco-toxicity.

These additives are based on ionic metals that trigger PE fragmentation. Some metal compounds used in these products are classified and labelled under the EU Directive as Dangerous Substances causing adverse effects on humans and the environment.

For instance, it is claimed that Cobalt Co (II) has been found in concentrations higher than 4,000 mg/kg in "Oxo-biodegradable" additives. At such high concentrations these materials are considered harmful if released into the environment, and are regulated at the workplace of plastic manufacturers and converters, since metal fumes might be released through dust or under heating. During the fragmentation process however, regulated metals may be liberated into the environment with the consequence of adding (eco) toxic persistent and bio accumulative CMR substances (Carcinogenic, Mutagenic, toxic to Reproduction).
"Oxo-biodegradable" PE products have been described as a solution to littering problems, as after trashing they supposedly decompose in the natural environment. De facto such a concept promotes littering and endangers organic recovery schemes which are built up to promote sustainability.
The manufacturer of Oxo-degradable plastics material rejects such allegations and justifies that such product degrades by a two-stage process. The first phase is abiotic oxidation in which the formulation breaks the molecular chains within the polymer. When the molecular weight has reduced to 40,000 Daltons or less, the material is no longer a plastic, but a material which can be bio-assimilated by naturally-occurring micro-organisms in the same way as nature's wastes. At the end of the process there is only water, CO_2, biomass and trace-elements.

However the manufacturer does not give specific time frame for its degradation but assures that the product

would degrade quicker than the natural materials like leaves or straw and more quickly than ordinary plastics.

IBWA however points out that it has not been certified in line with widely-used EU standard for "packaging recoverable through composting and biodegradation" (which closely resembles a U.S. standard on compostable plastics).
The Oxo-biodegradable Plastics Association, an industry group, doesn't believe in the said EU Standard, particularly the requirement of compostability, and has pushed for a review.

Biodegradable Plastics – ICPE Position

On - Definition

Bureau of Indian Standard (BIS) has accepted the concept and definition of Compostable Plastics as provided in ISO: 17088:2008, as Biodegradable Plastics. ICPE accepts this.

On - environment friendliness of biodegradable plastics (compostable plastics) and
On - whether compostable plastics disappear or degrade in the environment or in the landfill of its own?

It is evident that the degradation / composting process releases carbon dioxide in aerobic condition and methane and carbon dioxide in anaerobic condition. Both the situations are not desirable as both carbon dioxide and methane are greenhouse gases. Plastics recycling do not create such situation.

The Oxo-degradable plastics release more harmful agents during disintegration. Moreover, a molecular-weight range of 40, 000, after disintegration, is quite high and is well within the category of High Polymer. The disintegrated polymer powder remains in the soil.
However, after considering overall assessment of specific application / s, when it is absolutely necessary that a product has to be designed with biodegradable (compostable) plastic material, it is reasonable to agree that the compostable plastics, as defined in ISO 17088: 2008 could be used in principle for such applications.
It is important here that appropriate facility for composting should be available in working condition and the disposal sites / landfill sites should be processing the waste as per laid down norm. In the Indian context municipality landfill sites are generally not equipped with this infrastructure of mechanical composting. For Agricultural Mulch film or Plant seeding bags (nursery bags) – which are supposed to get mixed with the soil at the site of use, this criterion is not necessary.

This is important because even if a plastic product is certified as 'Compostable' as per designated ISO / BIS specifications, the same would not get composted in the disposal site of its own. It is required to be appropriately processed. Food waste wrapped in compostable plastic bags dumped in landfills and left unattended / unprocessed would remain inside such bags for months and would not get degraded. It is also argued that even if the food waste which is wrapped in compostable plastics is processed as per composting protocol, the food waste would get composted within 45 days to 60 days. However, the compostable plastics would still remain 'un composted' in the otherwise converted biomass of the food waste, as compostable plastics would require 180 days to be converted in to biomass even in the test condition.

Compostable Plastics do not degrade or disappear in to the soil of its own. It will remain in the open environment until it is processed as per 'Standard Procedure'.

On - Recycling or composting - which should be given more priority?

Recycling should be given priority as a part of resource management. Material Recycling means replenishment of the resource. Plastics products, which can be mechanically recycled for producing products for non-food contact applications, save use of virgin raw materials thus saving resources. Composting generates greenhouse gases – carbon dioxide and methane, mechanical recycling does not.

Although compostable plastics are generally made from renewable natural resources, still it is a debatable issue whether the farming activity should be principally reserved for human (and animal) food requirement or it could be diverted for producing products for industrial use. This debate is on for manufacturing biodiesel also. Moreover, while making products from biodegradable or

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non-biodegradable plastics, lot of energy is consumed. In case of non-biodegradable products, the waste is recycled to augment the material (virgin) requirement and hence lot of energy and resource is saved. In case of biodegradable plastics, the products are degraded / composted necessitating fresh input for new product manufacture. Thus energy and resource utilised for the manufacture of the original product is lost.

Biodegradable plastics also creates problem of mixing up with non-biodegradable plastics waste and normal recycling process chain is disturbed. Multilayer plastics waste, which are generally difficult for mechanical recycling except manufacturing compressed boards etc, can also be treated for recovery of energy like co-processing in the cement kiln, replacing fossil fuel. Industrial fuel also can be generated from all plastics waste through feed back recycling process.

In case of biodegradable plastics, such retrieval of recycled product or energy is not possible. Hence, biodegradable plastics may be developed and used only for applications, which cannot be recycled or recovered. A Life Cycle Analysis, which computes the overall impact of a product on the environment, helps in taking any final decision on this issue.

On - Which application areas should be developed / encouraged for using biodegradable plastics?

Plastics products, which are difficult for **mechanical recycling or from which energy cannot be recovered,** could be encouraged to be manufactured with compostable plastics. Following are the recommended products, which may be made out of compostable / biodegradable plastics:

Agricultural Mulch Film, Nursery Bags, Special Food Wraps, Coating on Paper/Jute/Textile, specialised fishery items, plastic water bottles to be carried during expedition in mountains, cutlery to be carried in boats / ships / trains, foam packaging products etc. Applications for use in medical sector should be encouraged.

On - How to judge in the market place – whether a plastic product is really biodegradable or not?

This is an issue on use of Biodegradable (compostable) Plastics for any mass application. Unless there is any system of traceability and / or accountability, any biodegradable (compostable) plastics application should not be recommended for a mass application.

On - Technology status and availability at reasonable cost

Technologies have been developed by many reputed and large companies of the world to manufacture compostable plastics / polymers for various applications. Adequate availability is however a constraint. World production of biodegradable (compostable) plastics is estimated at less than one million tons compared to more than 300 million tons for non-biodegradable plastics. This is the current position despite the product being available for over 40 years after being developed in the 1970's. Cost is also very high.

On - Role of Government – should it encourage Recycling or biodegradation?

Various developed countries have opted for encouraging recycling over degradation. French Government, which had a proposal to introduce biodegradable plastic carry bags in the entire country by banning normal plastic carry bags, had dropped such plan on the suggestion of the European Union Parliament, which stated that a nation cannot ban a particular product so long it fulfils specific requirements. In other words, plastics recycling are desired.
Government of India also encourages plastics recycling. Government of India has come out with Plastics Waste Management Rules, 2016 wherein plastics recycling has been given specific emphasis with responsibility for the collection of waste by the stake holders. Government of India's position should be a facilitator for developing and implementing the use of truly biodegradable plastics (compostable) for recommended applications, ensuring that it does not create additional burden on the environment – air, soil or water, visible to naked eyes or not. It should also ensure that appropriate testing facilities are installed in different parts of the country.

Before making a recommendation for a possible application in biodegradable (compostable) plastics, an LCA study should be conducted to scientifically establish the environmental benefit of such an action over the alternative.

US Expert Ramani Questions 'Biodegradability' at SPE Conf. Oct10

US Expert Ramani Questions 'Biodegradability' at SPE Conf. Oct10

At SPE's thermoforming conference, a voice questions 'Biodegradability'

Narayan argued that the industry should focus more of its energy on recycling and waste-to-energy conversion, saying these are "the best use of plastics."

By Clare Goldsberry
Published: October 4th, 2010

After materials pricing and the challenge of globalization, it would be hard to find a hotter topic in the plastics industry than sustainability. But the terminology used in that realm is often too "fast and loose" for some experts' tastes, including those of Ramani Narayan, a professor of chemical engineering at Michigan State University. During the recent Society of Plastics Engineers' thermoforming conference in Milwaukee, he railed against the improper use of "biodegradable," and his words found firm footing with many of the attendees.

"The problem is that people are claiming that all you do is put in an additive into the plastics and the material will magically disappear," said Narayan. "Biodegradable is a misused and abused term. What we need is an end-of-life strategy."

Still, he acknowledged that the pubic relations' strength of the word biodegradability carries a lot of weight. "All of this biodegradable stuff sounds good. The public loves it! But, I ask, in what environment will this degrade? Define environment. The word 'biodegradable' means nothing."

According to Narayan, too much flagrant "green washing" is occurring, with companies announcing eco-claims for the products that cannot be backed up with facts. "There are so many misleading biodegradable claims in the marketplace. In high school you'd be failed for creating a chart like this," he said as he held up a chart listing some of what he called the so-called facts of biodegradability.

Narayan argued that the industry should focus more of its energy on recycling and waste-to-energy conversion, saying these are "the best use of plastics." He continued, "Why is replacing petro-carbon with bio-carbon better? Carbon is carbon. There is organic carbon and inorganic carbon. It takes 10 years to turn an inorganic carbon into an organic carbon through biodegradability." —Clare Goldsberry

Nursery Bags

Agricultural Mulch Film

Awareness Campaign by ICPE ENVIS Centre on 3rd Feburary, 2017 at Air Force Bal Bharati School, Lodhi Road, New Delhi

An Awareness program was conducted at Air Force Bal Bharati School, Lodhi Road, New Delhi for 250 students of 8th Standard. Apart from students, teachers from Eco-club had also attended the program. The program was conducted by the ICPE team comprising of Shri. (Dr.) A.N. Bhat, Shri Pankaj Srivastava, Sr. Manager (Mktg-PC-TS), GAIL and self.. The program commenced with a welcome address by Ms Gurvinder Kang, In charge-Eco Club of the school followed by Dr. A. N. Bhat's brief introduction speech about ICPE & ICPE Envis Cebtre and ICPE mission.

ICPE's awareness films "Living in the Age of Plastics" & "Listen Plastic have something to Say" in English were shown. The Vice Principal requested for copy of the films for showing to all other students, who were unable to participate in the event. ICPE's presentation on "Plastics & Environment And the Waste Management" was elaborated by Dr.A.N. Bhat followed by an interactive session with students. During this session, majority of the students wanted to know about the negative aspect of plastic in view of news in the social media highlighting 'Ban on Plastics'.. However, at the end of the interactive session ICPE team could convince the students as to how plastic is useful on our day-to-day life and how to manage plastic waste issues. Mr. Pankaj Kumar Srivastava, gave a brief speech on Plastics & its benefits, and how best to manage Plastic Waste disposal problems.

In the meantime, students were requested to spread awareness for a proper disposal of waste especially Plastic waste. The School management appreciated ICPE's Awareness Programs and its benefits for society. ICPE's booklets, Its' My World Imagination for a Cleaner Environment (in English) were distributed to all students, who participated in the program. ICPE's booklets, Point-counterpoint & Frequently Asked Questions and the recent two editions of Eco Echoes/ENVIS Newsletter (10 copies each) were also handed over to the School library. The presentation and the films were well received,. These publications helped to clear their misconceptions about plastics. The Vice Principal and the Head Teacher-Eco-club also showed interest in visiting the Recycling Project in New Motibagh along with some students.

10 New Waste Processing Plants to Provide RDF to Cement Plants in Karnataka

India: According to the Economic Times, the waste from city kitchens will soon be recycled into refuse-derived fuel (RDF) at waste processing plants in Kalaburagi City, Karnataka. The RDF from the 10 upcoming waste processing plants in Kalaburagi will be given to cement companies for use as fuel and the biodegradable waste will be used as manure by farmers.

The joint initiative taken up by the Karnataka State Pollution Control Board (KSPCB) and Karnataka Urban Infrastructure Development & Finance Corporation (KUIDFC) has had agreements with cement manufacturers such as ACC, Vicat Sagar and UltraTech in Kalaburagi.

"Plastic-like material is a good alternative for fossil fuel as it can replace up to 20% of fossil fuel in terms of energy," said KSPCB chairman Vaman Acharya. The pact is yet to be signed and talks between the stakeholders is in the final stages. Transport costs for the RDF are estimated to be less than US$0.016/kg.

The idea to use RDF instead of fossil fuel in Kalaburagi cement plants was first conceived by Hasiru Dala, a Bengaluru-based non profit organisation working on waste management. It has provided 100t of combustible waste to Zuari Cements' plant in Andhra Pradesh in the past two months. Nalini Shekar, founder of Hasiru Dala, said that the material was not sold to the cement plant for a price, but Zuari paid for packaging and transportation. Households have been asked to segregate waste and hand it to BBMP garbage collectors to make the process easier.

Source : http://www.globalcement.com/news/item/3690-10-new-waste-processing-plants-to-provide-rdf-to-cement-plants-in-karnataka

Collection Counter For Recyclables

THIRUVANANTHAPURAM: The city corporation is set to resume collection of non-biodegradable articles. Ten collection counters will function on Saturday at various places in the city from 8am to 12pm. Three types of non-biodegradables will be collected at the counters; cleaned plastic waste, glass bottles, broken glass and tubelights.

Plastic bottles, covers, vessels, sheets, pens, containers, buckets, mugs, ropes and toys will be collected under plastic waste category. The residents have been asked not to mix perishable waste with the bags containing recyclable items during the collection drive. Separate counters will function for each kind of recyclable waste.
The counters will be opened at Jagathy ground, near Vattiyoorkavu ward committee office, near Journalist colony, Kudappanakkunnu, near Kazhakoottam ward committee office, near Sreekaryam market, near Kadakampally zonal office, Vanchiyur junction, Putharikandam ground, near Chackai HI office, near Pipinmoodu junction and near Kallumoodu junction, Muttathara.

The first collection drive of glass bottles following Onam week in September had seen a phenomenal turn out in all collection centres of the city corporation. The health wing recorded 60 tons of glass bottles, the biggest collection so far on a day. The corporation authorities will also organize collection drives for footwear, bags and e-waste in the next few weeks.

Source : http://timesofindia.indiatimes.com/city/thiruvananthapuram/collection-counter-for-recyclables/articleshow/57638449.cms

Major Manufacturers of Biodegradable Plastics

USA

Cargill Dow – Bags for compost, Garden refuse, Agricultural Mulch Film, Coated Paper, Flavour and Aroma barriers – replacing Nylon- in multilayer structure.

Products are based on PLA and other lactic acid derivatives. Trade name – Nature Works™.

Bioplastics Inc – Compost bags, Mulch Films, Paper Coatings and other applications including one having the properties of Polystyrene and still completely biodegradable.

Products are based on Reactive blends of Starch and Polycaprolactone, cellulose esters, Zein – a Corn Protein, Modified lesuerella and soy bin oils. Trade names – ENVAR, Evercorn, SPOL, SPARKA.

Du Pont – Domestic wipes, yard waste bags, top and back sheets of disposable diapers, disposable eating utensils, disposable cutlery, dispensable water bottles - like PET bottles, agricultural films, seed mats, plant bags that covers ripening fruits, coated paper etc.

Products are based on modified polyethylene terephthalate. Trade name – Biomax

Chronopol Inc (ACX Technologies Inc) - Food and Fast Food Packaging, Medical and Agricultural applications.

Products are based on PLA.

Novon (Churchill Technologies Inc) – Compost Bags, Trash Bags, Bin Liners and Agricultural Mulch Film.

Products are based on starch and starch blends biodegradable plastics.

Europe

Novamont - Agricultural Mulch Film, Paper lamination, Diaper back sheets, Wrapping film, Garbage bags, Shopping bags, Cutlery, Seedling planter trays, Golf Tees, vending cups etc.

Products are based on blends of thermoplastic starch and synthetic components like poly-G-caprolactone, Cellulose derivatives and polyvinyl alcohol copolymer. Trade name – Mater-Bi: Not compostable / Master-Bi: Compostable.

BASF – Bags, Coating for paper board, Agricultural Mulch Film. **Trade name – Ecoflex**

Monsanto – (ICI-Zeneca's BIOPOL)- Coated paper bags, coated board for frozen foods, Agricultural Mulch Film, Disposable Cutlery.

Products are based on polyhydroxyalkanoic acid (PHA) produced by fermenting natural resources such as wheat as sugar with microorganisms. Trade name – BIOPOL

Biotech – Refuge bags, sacks, shopping bags, agricultural film, foam products for packaging purpose etc.

Products are based on starch. Trade name – Bioplast, Biopur, Bioflex.

Bayer – Yard waste bags

Products are based on polyesteramide. Trade name - BAK

Japan

Showa Highpolymer – Compostable rubbish bags, shopping bags, food packaging, wrapping film, paper lamination, cups, containers, disposable nappies, napkins, Agricultural Mulch Film, Compostable Garbage bags, packaging material for electrical and audio-visual equipment parts etc.

Products are based on thermoplastic aliphatic polyester produced by chemical reaction and polycondensation glycol with dicarboxylic acids and others. Products are polybutylene succinate homopolymers and polybutylene succinate adipate homopolymers. Trade name – Bionolle

Mitsui Chemicals – Packaging and containers, agricultural, forestry and civil engineering area and composting and waste treatment. Compostable bags, Disposable nappies.

Products based on PLA. The company has also invented a unique technology of manufacturing polylactic acid via a direct condensation polymerisation reaction of lactic acid instead of usual two-step reaction. Trade name – Lacea

Daicel Chemical Industries – Mulching film, loose fill packaging and also developing foam products.

Products based on polycaprolactone and acetyle cellulose resin. Trade name – Celgreen

Shimadzu – Fibres for clothing textile, Long Fibres or Short Fibres for soil stabilisation and blending with other compostable grades manufactured by other companies.

Products based on polylactic acid. Trade name – Lacty for plastics / Lactron – for fibre

Mitsubishi Gas Chemical - Actively associated with Showa Highpolymer and Shimadzu of Japan and Cargill Dow of USA for its Asia market. Pre-paid cards and various compostable plastics. Even Natural Latex Gloves have been manufactured.

Products based on polylactic acid, blend of polyhydroxy butyrate (PHB) and polycaprolactone, polyester carbonate resin. Trade name - Biogreen

Dainippon Ink & Chemical (with subsidiary in North America and Europe under the name of Reichhold Group)- Compost bags, cushioning material, packaging applications, agricultural and fishing materials and sanitary products.

Products based on lactic acid copolymerised with aliphatic polyester and a catalyst.

Aicello Chemical - Pharmaceutical capsules, Fishing and Agricultural products

Products based on Chitosan, cellulose and starch. Trade name – Doron CC

An Appeal

From

ICPE ENVIS Centre

Reduce Green House Gas Emission – Save the Planet

Encourage Energy Efficient Products

Do not Allow Open Burning of Any Waste

Do not Litter – Use Waste Bins

Segregate Wet & Dry Waste at Source

Encourage Composting Green Waste of Your Kitchen in Your House / Society

Send Dry Waste for Recycling / Energy Recovery

Carry Your Own Bag for Shopping, Cut Down on Waste

Save Water / Save Energy / Save Trees – Save Environment

Encourage Water Harvesting

And Nurture It

Picture Source: https://pbs.twimg.com/media/CkIJ5NQWUAAi8Ha.jpg