Biotechnology in Plastics

A bi-monthly newsletter monitoring developments in industrial biotechnology that impact the plastics industry.

Winter 2005

Introduction

This is the third issue and last free issue of the *Biotechnology in Polymers Newsletter*. Our objective is to offer our readers updates and commentary on what is happening in this emerging area of technology. To stimulate interest in this area of technology we have been involved in organizing programs with the Society of Plastics Engineers (SPE), a leading technical organization in Plastics.

GPEC 2005/ANTEC 2005

We have been instrumental in developing the Biorenewable material portion of the GPEC 2005 program. The Plastics Environmental Division of the SPE schedules a conference called the Global Plastics Environmental Conference (GPEC) once a year. Until recently the conference has been held in Detroit and had a large emphasis on recycling technology. This year the conference is being held February 23-25th at the Sheraton Gateway Hotel at Atlanta airport and has a large percentage of the program dedicated to biotechnology. The objective is to broaden the audience to consumer and consumer packaging companies in addition to the automotive industry which has been a significant portion of the attendance at past conferences. Presentations on bio-renewables materials and resources will be given by such notable organizations as: Cargill(see next article), DuPont, MBI, Metabolic Explorer and Michigan State University and Ford Motor Company. DuPont will be honored at the Environmental Awards luncheon on Friday, February 25th for its Sorona biobased polymer.
For more information about the conference and registration information go to http://www.4spe.org and click on the conference from the homepage.

Later in May, ANTEC (The Annual Technical Meeting of the Society of Plastics Engineers) is being held in Boston, Massachusetts May 1-5, 2005. The new technology committee of the SPE has scheduled a New Technology Forum on May 3, 2005 on Industrial Biotechnology in Polymers.

We have scheduled a session dedicated to Industrial Biotechnology in polymers and intermediates. The speakers scheduled for this session are also from notable companies. The session is scheduled for May 3, 2005- 1:30-6PM

This session is designed to give the attendee an overview of the field of biotechnology and how it applies to polymer technology. Each of the speakers is a leader in the field and the companies represented are state of the art in the technology.
At the end of the speaker's presentations we will have a panel discussion and a question and answer session allowing you to specifically address your questions.

List of speakers and topics scheduled:
1:30 –2:15 PM-Lawrence Drzal, Michigan State University-
Challenges and Opportunities for Structural Bio-based Materials

2:15-2:45- Ramani Nararyan-Michigan State University
Polymers based on Bio-renewable sources

2:45-3:15-Joseph Kurian, DuPont Company,
DuPont Sorona®Polymer: A New Sustainable Platform for Growth

3:15-3:45- Pat Gruber, Chris Ryan- Cargill Dow-
Developments in Polylactic Acid polymer (PLA)

3:45-4:15- Hans D.Scherzer, BASF Germany-
Plastics from Renewable Sources- PLA and PHA

4:15-4:45- Dietmar Heufel, BASF Germany-
Ecoflex: Performance Enhancer for Renewables

4:45- 5:15- Automotive OEM- TBD

A panel discussion will follow the session
If you plan to attend ANTEC 2005 please come to the New Technology Session! For more information go to http://www.4spe.org or contact Maggie Baumann, G.H. Associates at 908-832-2207 or mhbaumann@earthlink.net.

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World Congress on Industrial Biotechnology and Bioprocessing

The second annual Industrial Biotechnology Conference is scheduled for April 20-22, 2005 in Orlando, Florida. Larry Drumm (BioLarry Consulting) and Maggie Baumann (G.H. Associates) will be attending the conference again this year. The program is organized in tracks that deal with all aspects of industrial biotechnology including raw materials, process technologies and end markets. We will also be contributing to a CDMA (Commercial Development and Marketing Association-sponsored) workshop on Commercial Development in the Biotechnology Industry.

The Biotechnology Industry Organization (BIO), the American Chemical Society (ACS) and the National Agriculture Biotechnology Council (NABC) are the sponsors of the event.
The next issue of this Biotechnology newsletter will review the conference.
If you are interested in attending or want more information, please visit www.Bio.org/worldcongress.
Please let us know if you will be attending this year. We would like to meet with you. Contact us at mhbaumann@earthlink.net or biolarry@mindspring.com.

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Cargill buys Dow's stake in NatureWorks PLA.

On February 1, 2005, the company that manufactures the corn-based plastic resins marketed under the NatureWorks ®PLA and Ingeo® fiber brand names will be known as NatureWorks LLC. The name change follows Cargill's decision to acquire the Dow Chemical Company's interest in Cargill Dow LLC, a 50:50 joint venture formed in 1997 to commercialize polylactic acid biopolymers. Beyond the name change, no immediate changes are expected at NatureWorks. The continued development and commercialization of NatureWorks and Ingeo underscores Cargill's commitment to create innovative, transformational products that address critical global needs.
NatureWorks PLA applications include rigid packaging and films including containers for bakery, dairy, deli, meat, produce, disposable serviceware, cold drink cups and cutlery, water, milk and juice bottles. Ingeo fibers are used in fiberfil applications including pillows, comforters, mattress pads, blankets and apparel sold in North America, Asia and Europe.

Kathleen Bader, President and CEO of NatureWorks stated that it will continue to expand the applications of this new polymer platform in the marketplace. They claim that customers continue to recognize the benefits of a polymer made from annually renewable resources that is competitive with fossil fuel-based materials on cost and performance.
Cargill claims that with the increased cost of conventional polymers due to increased energy costs the pricing of PLA is becoming more and more competitive.

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The First Compostable Logo for Cutlery goes on NAT-UR® Utensils

The NAT-UR® biodegradable plastic cutlery recently received another international honor. The Biodegradable Products Institute (BPI) this week granted its first "Compostable Logo" to NAT-UR, Inc. for compostable utensils. NAT-UR® utensils are made of NAT-UR resin which incorporates NatureWorks PLA™. The BPI's symbol demonstrates that NAT-UR's cutlery meets ASTM D6400 "Specifications for Compostable Plastics".

NAT-UR utensils offer a convenient, durable and responsible alternative for everyday use by consumers," said Frederic Scheer, President and CEO, NAT-UR, Inc. "The cutlery provides more than just the performance and durability desired in flatware, it competes on price and will not deplete the earth's limited resources like traditional, petroleum-based disposable serviceware." The combination of higher costs for fossil fuels and the use of natural components makes NAT-UR® utensils competitive to conventional disposable plastic cutlery.

The BPI symbol will be used on all NAT-UR's utensils made including its forks, spoons, knives, and sporks of various sizes. NAT-UR utensils can be used like traditional plastic food service items but offer the benefit of being made of renewable resources and are compostable. NAT-UR's newest entries complement the company's already extensive line of BPI approved food service containers and compostable bags.

The utensils were tested by a third party laboratory for its biobased content using radiocarbon dating. The results confirmed that the products are biobased with content in excess of 95% and NAT-UR, Inc. is an active member of the Biobased Manufacturer Association.

The Compostable Logo is a joint effort between the U.S. Composting Council and the Biodegradable Products Institute (BPI) to identify plastic products which are designed to biodegrade satisfactorily in municipal and commercial composting systems, as do leaves, grass and food scraps. Before a manufacturer can receive the BPI symbol, it must provide data from an approved, independent laboratory that their products meet the specifications in ASTM D6400. This assures that the products will disintegrate and biodegrade quickly during composting and not leave behind any toxic residues or plastic fragments. Further, the data must be reviewed by knowledgable third party scientists to assure conformance.

NAT-UR is a leading provider of biodegradable packaging designed to meet the highest needs for sustainability. NAT-UR's innovative manufacturing process combines natural starch with other biodegradable materials to produce packaging that are 100% biodegradable and compostable. When composted, NAT-UR packaging biodegrade completely into carbon dioxide, water and biomass in 30-60 days, just like food scraps and yard trimmings.

NAT-UR products can be disposed along with leftover food in biodegradable trash bags that can be taken directly to a composting facility without expensive sorting.

In addition to cutlery, NAT-UR's products include lawn and leaf bags, bin liners, and food serviceware such as cups, straws, lids and plates. NAT-UR products are sold by large national chain such as Whole Foods Market. NAT-UR is based in Los Angeles, California. More information is available at its website.

Source: *NAT-UR*

Metabolix and ADM Enter Strategic Alliance to Commercialize PHA Natural Polymers

On November 4, 2004 Metabolix, Inc. and Archer Daniels Midland Company (ADM) announced that they entered a strategic alliance with the purpose of commercializing a new generation of high-performance natural plastics that are eco-friendly and based on sustainable, renewable resources. Through the alliance, the two companies are planning to establish a state-of-the-art 50,000-ton production facility and a 50/50 joint venture to manufacture and market natural PHA polymers for a wide variety of applications, including coated paper, film, and molded goods. Natural PHA polymers are produced using a fully biological fermentation process that converts agricultural raw materials such as corn sugar into a versatile range of biodegradable and compostable plastics.

Under the agreement, ADM will obtain exclusive manufacturing rights and certain co-exclusive marketing rights to Metabolix proprietary PHA technology, which is protected by over 130 issued and pending US patents. The agreement provides that Metabolix will receive upfront and milestone payments for transfer and scale up of the technology. The agreement also provides for royalty payments and profit sharing by the joint venture partners.

"This agreement is a major advance toward our goal of making an array of renewable, eco-friendly alternatives to traditional petrochemical plastics widely available to the global marketplace," said Jim Barber, Metabolix's President and CEO. "ADM is a world leader in industrial fermentation, and we are delighted to combine Metabolix's groundbreaking technology with ADM's global strengths in agricultural products processing, fermentation, and logistical networking."

PHAs are a broad and versatile family of natural plastics that range in properties from rigid to highly elastic, making them suitable for films, fibers, adhesives, coatings, molded goods, and a variety of other applications. While stable to even hot water, they will biodegrade in aquatic, soil and composting environments, and even under anaerobic conditions, once their use is over. They are made using a proprietary process developed by Metabolix that converts renewable and sustainable agricultural raw materials through a fully biological fermentation process.

Founded in 1992,Metabolix is a world leader in applying the advanced tools of metabolic engineering and molecular biology to efficiently produce PHA biobased plastics in microbial systems and directly in non-food plant crops. For more information, please visit www.metabolix.com. Or contact Marcia Miller at 617-492-0505 X227

Additional information can be found on ADM's Web site at www.admworld.com.
Move over Dupont and Dow---Looks like we can add the names Cargill and ADM to the list of global polymer producers for the future.

DuPont™ Sorona® Recognized as Environmentally Sustainable Innovation
(Feb 8, 2005)

DuPont's newest polymer innovation - DuPont™ Sorona® - the first DuPont polymer derived from a biological source, has been recognized by the China State Intellectual Property Office and China Central Television (CCTV) as "Most Visionary Innovation" at a recent award ceremony.

Also, on February 25, DuPont™ Sorona® will receive the 2005 "New Technologies in Renewable Materials and Processes" award at the Global Plastics and Environmental Conference, sponsored by the Society of Plastics Engineers (SPE). Founded in 1942, SPE has membership of more than 20,000 plastics professionals in the United States and more than 70 countries around

the world. Conference Chairman Tim Kettering said, "The story of Sorona® is unique because it demonstrates that the use of renewable materials and processes can create new performance technologies and products."

At the January 2005 Innovative Design Night, sponsored by the China State Intellectual Property Office and state-run CCTV, Sorona® was selected as the "Most Visionary Innovation" in the sports and health category. Fabrics made with Sorona® for active wear, apparel and sportswear are commercially available through Chinese fiber and fabric manufacturers. More than 1,000 products from multinational and local companies were considered for this recognition.

Sorona® brings to fabrics the following properties: exceptional softness, easy care, and UV- and chlorine-resistance. Mills and manufacturers appreciate its easy dyeability and handling. In addition, products made with Sorona® are naturally stain resistant, requiring no additional chemical treatment to prevent stains. Sorona® can be used in a variety of applications including soft floor covering, textiles for apparel and interiors, engineering resins and packaging.

Source: *Dupont*

BASF

Combining the right polymers

Two polymer classes are particularly promising candidates as components for biodegradable polymers. Both however have weaknesses: aliphatic polyesters like polycaprolactone (PCL) or polybutylene adipate (PBA) are readily biodegradable, but because of their melting points of 60 °C are unsuitable for many applications. On the other hand, aromatic polyesters like polyethylene terephthalate (PET) or polybutylene terephthalate (PBT) have high melting points above 200 °C and very good material properties but are not biodegradable. The proposed solution: combinate aliphatic polyesters and aromatic polyesters.

Translating this idea into reality involved modifying/disrupting the crystalline structure of PBT by incorporating aliphatic monomer (such as adipic acid) in the polymer chain in such a way that the material properties of the polymer would remain acceptable (e.g. melting point of the crystalline range still around 100 °C), but the polymer would also be readily compostable / biodegradable. Pursuing this strategy it was possible to combine the degradability of aliphatic polyesters with the outstanding properties of aromatic polyesters.

Ecoflex is a copolyester based on conventional monomers available on a large industrial scale and is produced in an existing plant using available polymerization technology. Ecoflex is certified as a compostable material according to DIN V 54900.The material is fully compostable and has no adverse ecotoxicological effects.

In a large number of applications, Ecoflex combines improved benefits with ecological advantages. For example, Ecoflex can be used to make plastic bags for biological refuse. Carrier bags made from Ecoflex or Ecoflex starch blend become bifunctional and thus especially consumer-friendly: first they can be used several times for shopping, and then can be composted as a garbage bag together with organic waste.

Interesting applications were also found for Ecoflex in packaging. A coating of Ecoflex makes paper, cardboard or starch-based foam tougher and protects against fat, moisture and temperature variations. These are ideal properties for hamburger boxes, coffee cups, packaging for meat, fish, poultry, fruit or vegetables, food dishes and fast-food boxes.

Film made from Ecoflex also has many uses in agriculture: after being used as cover sheeting, it can be ploughed into the field and is degraded in the soil. Not least, this results in cost savings since labor-intensive clearing of fields and expensive disposal are unnecessary.

For more information on Ecoflex go to http://www.BASF.com

Novamont Buys Eastman's *Eastar Bio* Technology

In September 2004, Novamont S.p.A. and Eastman Chemical Company announced the sale of Eastman's *Eastar Bio* copolyester business and technology platform to Novamont, a producer of biodegradable materials.

"The acquisition of Eastman's *Eastar Bio* copolyester technology, including the excellent manufacturing skills and an extensive patent portfolio, represents an important strategic breakthrough for Novamont," said Catia Bastioli, managing director of Novamont S.p.A. "The acquisition will permit us to widen the range of Novamont's proprietary products and speed up the internal development of polyesters from renewable resources. The patent portfolio related to *Eastar Bio* technology will further strengthen Novamont's position in the sector of polyesters and starch/polyester systems."

Novamont S.p.A. started its activity as a research center in 1989 and today is a market leader in the sector of bioplastics. Under the *Mater-Bi* trademark, Novamont offers a family of competitive materials based on renewable agricultural origin. Industrial applications covered by *Mater-Bi* are very broad ranging from separate collection of organic waste and composting to agriculture, hygiene, packaging, food service ware and additives for rubber.

"The emerging biodegradable industry is experiencing exciting market development activities; however, only limited synergies exist with markets currently served by Eastman," said Phil Griswold, vice president and general manager for Eastman's specialty plastics business. "As such, we believe that Novamont is a better natural owner of this innovative technology. We're pleased that Novamont, a recognized world leader in producing biodegradable polymers, will be using the technology and manufacturing skills that Eastman has developed to further this very important market."

Eastar Bio copolyester is used commercially in food service ware markets for cutlery and single-use disposable packaging, protective packaging, compost bags and organic waste bin liners. Eastman also had biodegradable development efforts in agricultural plastics, packaging and sporting goods. Eastman's specialty plastics business is part of the company's Eastman Division. Both companies are working closely to promote a smooth transition of the business and technology.

.For more information about Novamont and *Mater-Bi* products, visit http://www.novamont.com.

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References: The stories in *Biotechnology in Plastics* come from a variety of sources including Company/Organization Press Releases, Interviews, and trade publications, e.g. *Plastics News, Industry Week* and newswires.

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