



Advanced Biofuels USA, a nonprofit educational organization, advocates for the adoption of advanced biofuels as an energy security, economic development, military flexibility and climate change solution.



Selected bio based polymer producers

Part of a series of informational summaries related to co-products, precursors, intermediates and biochemicals important to the understanding, development and use of advanced biofuels.

By Milsa Vijayadharan

Global commodity polymer demand grew from 2000–2007. After a slight dip in recent years due to the economic downturn, consumption is expected to continue to grow for the next ten years.

1. **PET** (Polyethylene terephthalate) – PET is a thermoplastic polymer resin of the polyester family and is used in synthetic fibers; beverage, food and other liquid containers; thermoforming applications; and engineering resins often in combination with glass fiber. PET is used in beverage and food packaging and other applications such as custom-care and cosmetics packaging, pharmaceutical uses, household products, and industrial packaging applications.

- **Indorama**- Indorama Ventures PET division is a leading global manufacturer of Polyethylene Terephthalate (PET). PET is produced from 2 different monomers, PTA (Terephthalic Acid) and MEG (mono-Ethylene Glycol). The plant-based MEG is produced from fermented and dehydrated sugarcane or sugarcane waste. It is a first step to produce PET from renewable raw materials. Indorama Ventures PCL, headquartered in Bangkok, Thailand the world's largest PET producer, reported in a presentation in August 2011, that it makes 30% bio content PET for Coke. Indorama can make a bio version of any PET grade. Indorama now produces bio content PET in Asia, Europe and North America.

Indorama ventures-RAMAPET 12822 is a high IV type PET resin with ItV of 0.95. It is designed for applications which require very good temperature performance, good impact resistance and strength. RAMAPET 12822 is especially suitable for small containers that require a high resistance against creep, combined with high resistance at elevated temperatures, such as for example Aerosol Containers. Indorama Polymers (IRP) Workington PET facility is located in the industrial town of Workington, in the county of Cumbria, North-west England. The facility was acquired by Indorama Ventures in 2008 from Eastman Chemical Company. The facility has an annual production capacity of 168,000 tonnes. The site produces PET resin made with MEG from plant-based ethanol.

2. **PLA (Polylactide)** - New materials, derived from renewable raw materials, are the new trends of today's materials. These materials have excellent biodegradable properties. After disposal, they can be degraded into carbon dioxide and water by microorganisms in the soil, and do no harm to our environment. They are new biodegradable materials, and the most widely used one is polylactide (PLA). PLA takes annually renewable resources (corn, cassava and other plants) as raw material. These feedstock are first fermented and distilled to produce lactic acid. Through a process of refining, dehydration polymerization high-temp de-polymerization and finally polymerization, lactic acid is then transformed into PLA. Under general conditions, PLA products can be degraded in soil within one year after disposal, or about 70 days under the condition of composting. PLA is considered to be the most promising biodegradable plastics in the 21st century. PLA is widely used in fields of packing, textile coating, medical, agriculture, etc.
 - **Zhejiang Hisun Biomaterials-** Zhejiang Hisun Biomaterials Co., Ltd is located in Taizhou, a port city in southeastern China. It is a high-tech enterprise engaged in research and development, manufacturing and distribution of biomaterials. Hisun Biomaterials focuses on developing the new material industry- polylactide (PLA). Hisun Biomaterial now has become model enterprise of industrialization of PLA resin and its derivative products.
3. **PE (Polyethylene)-Biobased polyethylene** in all its variations has properties identical to those of traditional polyethylene, however, since it is derived from renewable materials, it has decisive advantages, such as reducing greenhouse gas emissions by sequestering carbon dioxide from the atmosphere. Typical end-use applications of bio-PE are films (storage bags, pouches, packaging films), blow molded hollow parts such as beverage containers, automotive fuel tanks, and injection molded parts, tubes and other applications where bio-PE could be an environmentally friendly drop-in replacement.
 - **Braskem-** Braskem's industrial units are located in Brazil, United States and Germany. Braskem's green ethylene plant was commissioned in September 2010. This marked the beginning of I'm green™ Polyethylene production on a commercial scale. The plant has received an investment of \$290 million and has annual production capacity of 200,000 tons of I'm green™ Polyethylene. I'm green™ Polyethylene is a plastic produced from ethanol sugarcane. Currently, Braskem provides I'm green™ Polyethylene to various partners in Brazil and in the world, operating in various industry segments. There are currently available in the product portfolio the following families of I'm green™ Polyethylene: high density polyethylene (HDPE) and linear low density polyethylene (LLDPE) covering rigid packaging applications, flexible, caps and closures, bags, among others. From January 2014, the family of low density polyethylene (LDPE) is also part of the product portfolio, covering additional applications of packaging and films.

4. **PHA** (Polyhydroxyalkanoates) - The applications for use of PHA are food service implements and utensils, single-use cups and takeout containers, containers for liquid products such as bottles, personal care items, plastic film for goods packaging, and nonwoven fabrics for personal care diapers and hygiene applications.
- **Meredian-** Meredian, Inc., a privately held biopolymer manufacturer with a range of Fortune 500 clients anticipating their products, expects to be operating at full capacity by the second quarter of 2014. The company's innovative and ground-breaking product, Polyhydroxyalkanoates (PHAs), is a polymer derived naturally through fermentation of sustainably produced, fully renewable plant derived oils which creates completely biodegradable bioplastics.

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Advanced Biofuels USA advocates for the adoption of advanced biofuels as an energy security, economic development, military flexibility and climate change mitigation solution. Technology neutral and feedstock agnostic, the organization helps clarify details of controversial issues, provides information about job opportunities, helps teachers and students prepare educational materials in science, math and social lessons related to energy security, economic development and environmental sustainability challenges. The website serves a world-wide audience as a free library of information helping investors, researchers, producers, legislators, opinion-leaders and consumers understand "from seed to wheel" the options they have when it comes to biofuels.

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