NexantECA

Technology and Costs

Biorenewable Insights: Bio-polymers for Food Applications

Bio-polymers for Food Applications is one in a series of reports published as part of NexantECA's 2019 Biorenewable Insights program.

Overview

While there are many issues and drivers behind the development of biopolymers, the most important driver is the mitigation of a number of environmental problems (particularly end of life issues (e.g., plastic straws)) as well as climate change, which is seen as increasingly important to brand owners' consumers. There are many cost competitive options currently for increasing renewable content as concluded by the analyses in this study. These include drop-in replacements for current petrochemically derived polymers (e.g., propylene), as well as novel approaches (e.g., PLA). Additionally, commercial capacity exists and significant development is underway on additional capacities across the various polymer types—which is important as different polymers are useful in different applications. At once, the implications for food contact applications are large and small at the same time. The implications are large in that for almost any application, there are existing or emerging options for a renewable alternative to the incumbent petrochemical polymers. The implications are quite small, because the capacities of the biopolymers are significantly small compared to the conventional markets. Drop-in replacements such as ethylene, propylene, and PX, which use the existing petrochemical equipment and the existing value chain, stand the greatest chances of radical step-wise change.

Bioplastics are increasingly being sought as alternatives to conventional fossil fuel based plastics and are increasingly being used in food contact materials. Bio-based polymers are made from bio-based resources though in practice bio-based resource content may vary. Biomass used for the production of bioplastics may either be extracted directly from plants (starch, cellulose), produced by microorganisms in fermentative processes, or catalytic conversion of biomass or biomass fractions. Bio-based polymers are not necessarily biodegradable.

Technologies

Polymers of interest are divided into three basic categories:

- Natural polymers are polymers found naturally occurring. Natural polymers investigated for food packaging include cellulose, starch, and PHAs. While PHAs can be found naturally, significant work has gone into producing them via fermentation
- Novel bio-polymers are polyesters synthesized from bio-based monomers. Novel bio-polymers investigated for food packaging include polylactic acid (PLA), polyethylenefuranoate (PEF), and polybutylene succinate (PBS).
- Drop-in replacements are fungible substitutes for petrochemical polymers, produced from biofeedstocks. Drop-in replacements for food packaging currently investigated includes polyethylene, polypropylene, and polyethylene terephthalate (PET).

Process Economics

Cost of production models for USGC, Brazil, Western Europe and China are shown for:

- Starch Polymer Film
- PHA via fermentation of sugar
- Integrated Lactic Acid and PLA
- PEF
- PBS, integrated with succinic acid production
- Ethylene from Ethanol
- Ethylene via bio-naphtha cracking
- MEG from Ethanol
- Propylene via biopropane PDH
- Bio-PET via Origin Materials PX and Bio-MEG

Capacity

NexantECA has catalogued existing and planned biopolymer capacity for food applications.

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Technology and Costs comprises the Technoeconomics – Energy & Chemicals (TECH) program, the Biorenewable Insights program (BI), and the new Cost Curve Analysis. These programs provide comparative economics of different process routes and technologies in various geographic regions.

NexantECA serves its clients from over 10 offices located throughout the Americas, Europe, the Middle East, Africa, and Asia.

Americas
Tel: +1 914 609 0300
44 S Broadway,
5th Floor White Plains
NY 10601-4425
USA

Europe, Middle East & Africa
Tel: +44 20 7950 1600
110 Cannon Street
London EC4N 6EU
United Kingdom

Asia Pacific
Tel: +662 793 4600
22nd Floor, Rasa Tower I
555 Phahonyothin Road
Kwaeng Chatuchak
Khet Chatuchak
Bangkok 10900
Thailand

For more information. please contact
Technology@NexantECA.com or www.NexantECA.com