Bio based chemicals industry: Transitions, prospects and challenges

A KnowGenix presentation
Industrial Green Chemistry World 2011, 4-6 Dec 2011, Mumbai, India

R. Rajagopal
raj@knowgenix.com

Since 2000, the nascent bio based chemical industry has been steadily gathering momentum driven by developments in biomass feedstocks generation, innovations in bioprocess conversions, and emergence of new platform chemicals.

The global bio based chemicals market is projected to reach about US$56.9 billion by the year 2015. It is influenced by several factors: a strong pipeline of novel bio products, government policies, and growing consumer preference for renewable based greener products. In particular, it is influenced by narrowing cost differential between petroleum based polymers and renewable polymers. Many established chemical and biotechnology companies are actively investing in the development and commercialization of bio based platform chemicals from a host of renewable feedstocks such as sugars, oil & fats and lignin.

Competitive development of platform chemicals holds the key to bio based chemical business. The multiple functional groups in the platform chemicals present high potential for conversion to value added specialties.

The focal platform chemicals are:

**Sugar based:** Glycerol, 3-Hydroxy Propionic Acid etc., (C3); Succinic Acid, Fumaric and Malic Acids, Aspartic Acid (C4); Xylitol, Glutamic Acid, Levulinic Acid, Itaconic Acid etc., (C5); and Sorbitol, Glucaric Acid (C6)

**Oil & fats based:** Fatty acids, Fatty Acid Methyl Esters (FAME), Fatty Alcohols, Fatty Amines and Glycerols

**Lignin based:** Methanol, Dimethylether, Olefins and Mixed Alcohols

Markets for bio based products picked up with the commercialisation of first generation products derived by thermo chemical conversion (Propane Diol, Poly Lactic Acid etc.). The second generation products through metabolic engineering and bio processing technologies are still at
a pilot stage (Glycerine, Alcohols, Esters, Caprolactam, Hydroxy Alkanoates, Succinic Acid, 1,4 Butanediol, etc.). The third generation products based on plant expression are in the early discovery phase and far removed from the market place (High Oleic oils, Ricinoleic Acid, etc.).

Commercialisation of bio based products faces several barriers such as sub optimal technology, complexities in market development, lack of financing options, high cost supply chain infrastructure and sustainability challenges. Shifts in feedstocks generation practices, regional markets, regulatory frameworks and consumer preferences are related issues needing innovative strategies.

Development of a bio based chemical economy is at an early and high risk stage. A change in feedstock from hydrocarbons to biological molecules is bound to alter the technological basis of the chemical industry in profound ways.

This discussion will focus on the present trends in the fast evolving bio based chemicals industry and the diverse strategies of key players. It will explore the prospects and challenges of using sugars, oil & fats and lignin to develop platform chemicals and value added specialty products thereof. It will touch upon the market, technology and sustainability challenges facing the industry.