

PETRO VS. BIOBASED PLASTICS

P. J. Lemstra*, R. M. Fifield

*Faculty of Chemistry and Chemical Technology, Eindhoven University of Technology,
PO. Box 513, 5600 MB Eindhoven, the Netherlands
Email: p.j.lemstra@tue.nl.*

Synthetic polymers (plastics) have shown an almost exponential growth during the past decades and currently over 200 million tonnes/annum are produced world-wide, viz. about 35 kg per capita in the world! In view of the very uneven distribution of the plastic production and consumption e.g. appr. 150 kg/capita in Western-Europe and the USA vs. 25 kg/capita in China and 6 kg/capita in India, the forecast is that the world production of plastics could grow to > 1000 million tonnes/annum at the end of this Century. The feedstock for producing synthetic polymers (plastics) is almost exclusively oil and currently appr. 5% of oil is used for making plastics. In view of the strong projected growth we need 25% or more of the current oil production at the end of this Century for making plastics which is not sustainable in view of the predicted depletion of oil reserves. Alternative technologies have been developed already, e.g. to use coal and/or gas as feedstock for producing plastics, e.g. Sasol (SA), converting gas/coal into syngas and via Fischer-Tropsch catalysis converting syngas into low molar mass polyethylene wax and via hydroprocessing converting the wax into diesel, fuel and/or monomers to make polymers. The economics of these so-called GTL (Gas-to-Liquid) and CTL (Coal-to-Liquid) processes will depend on the (rising) oil price in this Century.

A different approach regarding future feedstock for plastics is using biomass. In this respect we have to distinguish between:

(1)The use of polymers made by Nature, viz. biopolymers, with the prime examples of (thermoplastic starch) (TPS) and polyhydroxyalkanoates (PHAs), notably polyhydroxybutyrate (PHB) copolymers;

(2)The use of monomers derived from biomass, e.g. lactic acid to produce a whole family of polylactic acid (co)polymers, the use of diols and dicarboxylic acids obtained via fermentation to make partly “green” polyesters and polyamides (nylons) and last but not least the recent trend to make in the future ethylene from bio-ethanol and subsequently bio-polyethylene as announced a.o. by Braskem (Br).

Currently approximately 500 kilotons of bio-based polymers (of which 85% is only partly based on renewable feedstock) are produced annually compared with 250,000 kilotons of oil-based plastics. In the lecture some bottlenecks will be discussed for introducing bio-based plastics including realistic predictions.