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Review 2013-03
Cerenol™—DuPont Polyether Glycol
Made from 1,3-Propanediol (PDO)

By Anthony Pavone
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Abstract

Cerenol™ is a trademarked family [1] of polyether polyl liquid glycols (PEGs) invented, manufactured, and marketed by DuPont since 2008 using bio-based 1,3-propanediol (PDO, CAS 504-63-2) as the basic feedstock. PDO, in turn, is produced by DuPont entirely via corn sugar fermentation [2] using genetically modified E. coli bacteria developed by DuPont in partnership with Tate & Lyle. Cerenol grades include both homopolymers of PDO and copolymers using other conventional polyol feedstocks. Cerenol has found commercial applications in automotive coatings, personal care products, thermoplastic elastomers, as a functional heat transfer fluid, and as an impact-resistant engineering plastic. Cerenol commercial products include solid Hytrel® thermoplastic elastomers and liquid performance coatings [3]. Marketing data indicate that both DuPont and Shell Oil developed PDO originally as a co-feed with purified terephthalic acid (PTA) to produce polytrimethylene terephthalate (PTT), which could be spun into a fiber having functional properties similar to nylon used in rug and clothing textile applications. DuPont remains in the PTT business with its Sorona® product line, while Shell Oil subsequently exited the businesses for both PDO and PTT (Corterra®) fiber. Shell produced PDO via the hydroformylation of ethylene oxide. PDO can also be made via the hydration of acrolein, followed by hydrogenation (Degussa technology), but this route has not been commercialized. By producing feedstock PDO from low-cost corn sugar via a malonic acid intermediate, DuPont believes that its total manufacturing cost is well below that of crude oil-derived feedstocks required to make comparable-performing products.

Due to its production from low-cost biomass, rather than conventional petrochemical feedstocks, Cerenol provides DuPont the opportunity to market a polyurethane feedstock that claims to be produced entirely from renewable resources, while affording the opportunity for DuPont to improve process and product technology resulting in producing Cerenol at a cost that is substantially below the cost to produce competing PEGs that depend upon conventional feedstocks (propylene) and conventional process technology. The polyols are made by via mild polycondensation (USPA 20120277478 A1, 1-Nov-2012) using an acid catalyst (usually sulfuric acid) at between 120–180°C under an inert nitrogen reactor blanket. The reaction products are distilled to remove unreacted monomer feedstock, oligomers, water, and acid. Molecular weight ranges between 500 and 3,000 for commercial-grade products.

DuPont’s commercial PDO plant with Tate & Lyle started up in 2006 and is located in Loudon, Tennessee, USA. Nameplate PDO capacity is 140 kty. The PDO is shipped to DuPont’s First Mississippi subsidiary (Pascagoula, Mississippi, USA) and to Ontario, Canada, for polymerization to Cerenol. Cerenol competes with other polyether glycols produced by Dow Chemical, Bayer, BASF, Huntsman, and Shell Chemicals. The conventional polyether polyol business has an annual global consumption of approximately 6 million metric tons, with demand increasing by 5% per year. We have prepared in this review a Class-3 process design and the corresponding production economics based on our understanding of the DuPont process for a world-class (160 kty) Cerenol homopolymer manufacturing facility.
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