NexantECA

Technology and Costs

Biorenewable Insights: Bio-Lubes

Bio-Lubes is one in a series of reports published as part of NexantECA's 2016 Biorenewable Insights program.

Overview

The fundamental function of a lubricant is to reduce the friction and wear between moving parts. Reflecting this, the single most important parameter in lubrication is oil viscosity. Oil viscosity is dependent on composition and varies significantly. In addition, oil viscosity changes with temperature, shear rate (velocities of operating surfaces) and pressure, and the thickness of the generated oil film is generally proportional to viscosity. For engineering applications, the oil viscosity is usually chosen to achieve optimum performance at design operating temperature or temperature range. Knowing the temperature at which the oil is expected to operate is critical as oil viscosity is extremely temperature dependent.

Other applications of lubricant-type liquids include hydraulic fluids, machining cooling oils, and drilling fluids.

Even though lubricant represents a very small amount of a crude oil barrel, the nature of its application provide a non-negligible impact on the environment. The global market for lubricants is about 40 million MT, and it was estimated that about one third each is lost in use or collected and burned as fuel, and the remainder split equally between illegal dumping and collection and re-refining.

The desire to find renewable feedstocks as alternatives to fossil-based feedstocks is touching nearly every chemical market, and the world of base stocks is no exception. The biolubricant ("bio-lubes") market is tiny today (less than 1 percent of the conventional market) but has experienced growth faster than the overall market.

Until now bio-lubes have been severely limited by performance, especially in applications with extreme temperatures. After years of development, quality have been improved and bio-derived base oils are now matching and even outperforming the highest quality conventional base oils.

Technologies

Bio-lubes can be produced from a variety of feedstock using various processes. Vegetable oils are among the most popular feedstocks.

However, vegetable oils are not generally used as-is and until recently have been severely limited by their poor cold performances. Issues of poor resistance to thermal oxidative stabilities due to the residual double bonds, high pour points, hydrolytic instability (rancidity) and relatively high price have been other major drawbacks.

Via chemical modifications, the properties of vegetable oils can be greatly improved. The three main chemical reactions to improve vegetable-derived base oils include:

- Esterification/Trans-Esterification
- Estolide Formation
- Epoxidation
- Other Novel Biotechnology Routes to Bio Base Oils

Process Economics

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

- Novvi
- Elevance
- Biosynthetic Technologies

Capacity

NexantECA catalogues existing and planned bio-lubes and base oil capacity and provides profiles of projects.

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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.

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