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Technology and Costs

TECH 2019S7: Ultra High Molecular Weight Polyethylene

Ultra High Molecular Weight Polyethylene (UHMWPE) is one in a series of reports published as part of Nexant's 2019 Technoeconomics – Energy & Chemicals (TECH) program.

Overview

UHMWPE is a thermoplastic polyolefin with a molecular mass usually between two to six million. Its impact resistance, abrasion resistance, performance at low temperatures, weatherability, lubricity, and chemical resistance makes it suitable for a variety of applications from medical to automotive to textiles.

This TECH report provides an updated overview of the technological, economic, and market aspects of UHMWPE. The following issues are addressed in the report:

- How is UHMWPE produced? What technology is used in production?
- How do the process economics compare across processes and different geographic regions, for UHMWPE resin, rods and yarn?
- Who are the top producers of HDPE? How will this change over the next five years?
- What is the current market environment for HDPE? What applications will drive growth?

Commercial Technologies

The polymerization of UHMWPE was commercialized by Ruhrchemie AG (Ticona, and now Celanese Corporation), based in northern Germany, during the 1950s.

UHMWPE is synthesized by a slurry process using a heterogeneous Ziegler-Natta catalyst with a hydrocarbon as diluent. Since the active sites in such catalyst systems are relatively close together, the chains grow in close proximity to each other. As a result of the relatively high polymerization temperature, crystallization of the polymer chains is relatively slow and the resulting polymer has a very high degree of entanglements. Due to the high molecular weight and high degree of entanglements, the mobility of these chains is very limited and complete fusion of these polymer particles during processing is difficult to achieve. Thus, the structure created during synthesis of the polymer affects the final properties of the polymer.

Technologies for UHMWPE resin production are not licensed. It is believed that Sinopec has licensed the technology in China.

Process Economics

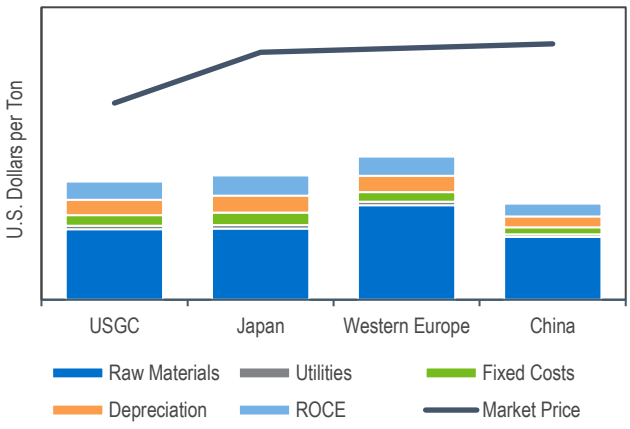
Detailed cost of production estimates for technologies are presented for USGC, coastal China, Western Europe and Japan. Estimates are developed for UHMWPE resin, rods and yarn.

Commercial Overview

In 2019, global UHMWPE consumption is estimated at more than 266 000 tons while capacity at about 313 000 tons, implying an operating rate close to 85 percent. China and North America are the largest consumers of UHMWPE, accounting for about 75 percent of the global consumption of the resin.

Celanese and Braskem account for about 50 percent of the global capacity for UHMWPE. By 2025, the global capacity is expected to reach over 400 000 tons, with capacity expansions driven mainly by China.

Regional Cost of Production Comparison for UHMWPE Resin



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- Trends in chemical technology
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Technology and Costs comprises the Technoeconomics – Energy & Chemicals (TECH) program (formerly known as PERP), the Biorenewable Insights program (BI), the Sector Technology Analysis, 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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