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Polypropylene

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Report Abstract
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Nexant

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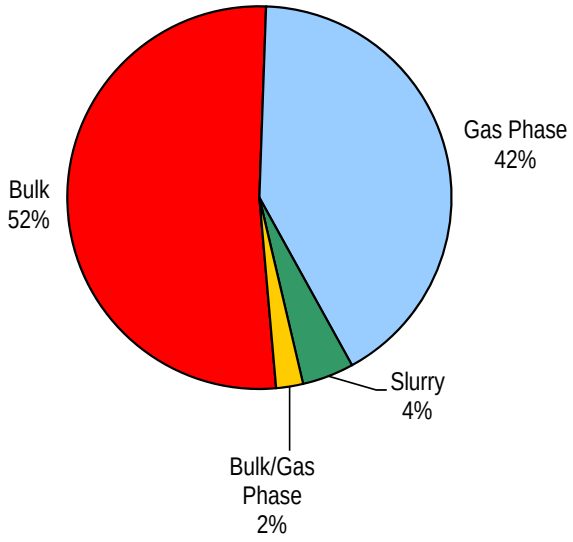
INTRODUCTION

Polypropylene (PP) is a versatile polymer used in a variety of applications, including injection molding (automotive parts, housewares, appliances), fiber (carpet, clothing, non-wovens), film (plastic bags, food packaging) and extrusion (toys, pipes).

The polypropylene technology market is one of the most competitive, with the number of technologies available in double figures. The high performance of the leading technologies makes it very difficult to separate the technologies on a performance basis, particularly in the less differentiated homopolymer market. The once dominant slurry technology is now a minor contributor, with the bulk and gas phase processes now controlling the market.

Installed Polypropylene Capacity by Process



2012_00101.0011.4105_Figures.xls\Capacity by Process

Over the next decade, feedstock issues will continue to influence the shape and direction of the polypropylene business. With polypropylene growing somewhat faster than polyethylene, the demand for propylene is rising ahead of that of ethylene, yet since much of the propylene supply is linked to ethylene production in steam crackers, propylene supply is not expected to keep pace with polypropylene growth, unless on-purpose plants are constructed. The trend of using lighter feedstocks in some regions will intensify this need. The location of future polypropylene plants is likely to be influenced as much by feedstock availability as market demand for product.

Much of polypropylene's rapid growth has been due to its excellent price/performance balance, which is often superior to HDPE in injection molding applications. A shift in relative prices will move the balance more to polyethylene's favor and in the longer-term cause some demand to swing between the two polymers. These changes could have some impact on technology sales, with a modest slackening of polypropylene demand and corresponding firming of injection molding polyethylene demand.

CURRENT TECHNOLOGY

All state-of-the-art processes employ a gas phase or bulk reactor system for the polymerization of homopolymer and random copolymer, followed by a gas phase reactor system for the sequential production of impact copolymer. Several of these processes are now capable of producing second-generation metallocene-based resins.

In terms of product development, incremental improvements are being successfully achieved by producers on a wide range of fronts, based largely on catalyst improvements, both Ziegler-Natta and metallocene, and to a lesser extent on process developments. For homopolymers, one of the areas seeing a greater level of development effort is fiber applications where the influence of metallocenes is allowing products with higher processing speeds and better operating continuity. For copolymers, improved clarity remains one of the key goals for a number of applications focused on the packaging market through thin wall injection molded, blow molded, and thermoformed containers. Improved property balance is also a key area of development for copolymers, with developers seeking higher stiffness without compromising impact resistance.

For technology licensors, cost reduction and product enhancement of their technologies are critical, with numerous technologies competing for each new plant. In an effort to reduce unit operating costs, technology licensors have continued to increase reactor capacity, with most licensors offering single-line capacities of at least 400 thousand tons (882 million pounds) per year. The largest single-line licensed has a capacity of 500 thousand tons (1.1 billion pounds) per year.

Nexant evaluated various gas phase, bulk, and slurry processes that are well-established, commercially practiced technologies for the production of polypropylene resin, and are generally available for license. The evaluation provides recent developments, highlighting key developments relating to each process technology; background, including general product capabilities and a list of licensees; and a process description with simplified flow sheets, for each technology covered.

PROCESS ECONOMICS

Nexant developed and compared cost of production estimates for the major commercial polypropylene processes using the U.S. Gulf Coast (USGC) as the basis. Since major capacity additions are planned in China and the Middle East, Nexant also developed economics for these locations.

Cost estimates for homopolymer and impact copolymer polypropylene were evaluated for the following processes:

- Gas Phase Processes
  - UNIPOL™ from Dow
  - INNOVENE™ PP from INEOS Technologies
  - HORIZONE from Japan Polypropylene
  - NOVOLEN® from Lummus Novolen Technology
  - SPHERIZONE from LyondellBasell
  - Sumitomo

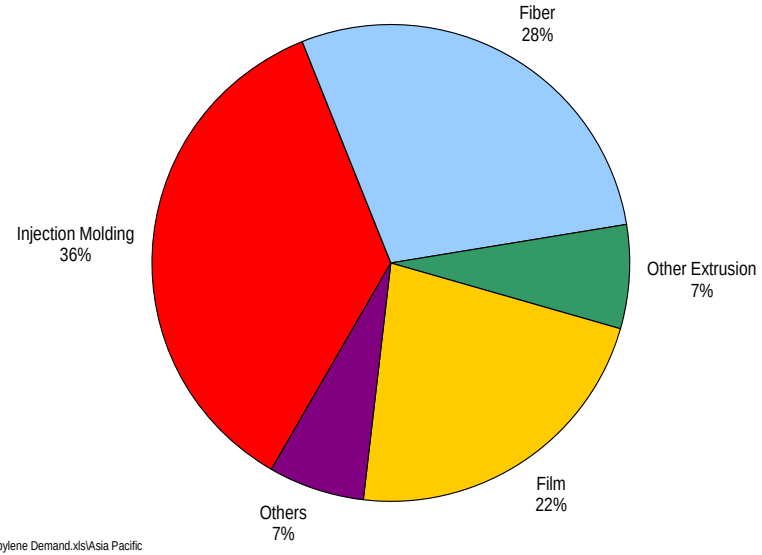
- Bulk Processes
  - BORSTAR® PP from Borealis
  - ExxonMobil
  - SPHERIPOL from LyondellBasell
  - HYPOL II from Mitsui
- Improved Slurry Process (impact copolymer only)

Detailed cost tables are presented for the USGC, while summary tables are included for the other locations. All detailed cost tables given in this report include a breakdown of the cost of production in terms of raw materials, utilities, and direct and allocated fixed costs. These categories are presented by unit consumption, per metric ton, and annually. The contribution of depreciation and a simple nominal return on capital are also included to arrive at a cost estimate.

COMMERCIAL MARKET REVIEW

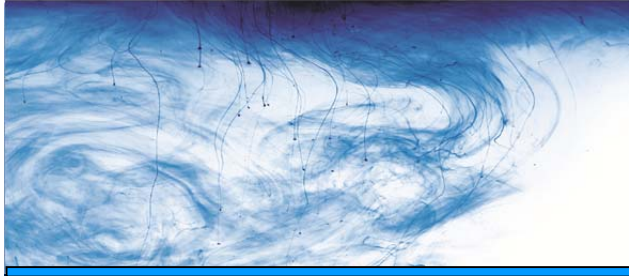
Polypropylene is used in many end use segments such as injection molding, fiber, film, and extrusion. For Asia Pacific, the demand pattern is more balanced than in the developed economies of the United States and Western Europe, where injection molding accounts for at least 50 percent of demand.

Asia Pacific Polypropylene Demand by End-Use



Polypropylene Demand.xls\Asia Pacific

- Commercial applications are outlined in the report
- United States, Western Europe, and Asia Pacific demand, supply, and net trade data are given and discussed.
- A list of plants in each of these regions is given showing company, location, current plant capacity, and technology employed.



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