Polyolefins originated with the invention of low density polyethylene (LDPE) in 1933, and its subsequent commercialization in 1938 using the ICI autoclave process. In the mid 1950’s, the first catalytic low pressure polyolefins were produced following the award winning work of Karl Ziegler and Giulio Natta. The step change in commercial low pressure polyethylene technology came with the development of the chromium catalyzed Phillips loop process in the mid-1960s which led the production of HDPE. The commercialization of the gas phase process by Union Carbide Corporation heralded a decade of new technology developments throughout the 1970s, which saw the introduction of a number solution, slurry and gas phase processes. In this period of rapid new developments, there were new bimodal technologies introductions, which resulted in improvement of existing technologies such as Basell’s HOSTALEN and Mitsui’s CX, high density processes and in the 1990’s, the introduction of competing new 6 bimodal technologies including Borealis’ BORSTAR and Basell’s SPHERILENE and Mitsui’s EVOLUE processes as well as metallocene/single-site catalysts (for LLDPE production). There are currently numerous technologies are available for license, several of which are capable of producing LLDPE and HDPE. Each process has its strengths and weakness relative to the balance of cost competitiveness and product range/capabilities.

For HDPE, five leading technologies accounting for 78 percent of all the installed capacity, of almost 15 million tons per year (see figure). The five dominant technologies are the slurry loop of Chevron Phillips, the stirred-reactor bimodal slurry processes, Basell’s HOSTALEN and Mitsui’s CX process, and the gas phase swing technologies, Univation’s UNIPOL and BP Chemical’s (BP) INNOVENE.

Global polyethylene demand continues to grow vigorously, fuelled by both economic growth and continued substitution of traditional materials such as paper, glass and wood, as well as gains within the polymers sector at the expense of PVC and some of the higher cost polymers. As demand grows, the experience curve effect continues to lower the relative price to fund further polyethylene, which in turn reinforces the growth. The increasing demand for polyethylene will assure the need for new build in the industry and with it demand for technology licenses.
Since the early 1990s, metallocene/single site catalyst developments have dominated advances in polyethylene technology. In the medium term, the impact of these metallocene/single-site developments will be felt largely in the LLDPE market where improved mechanical strength plus excellent optical performance are significant performance benefits. While traditional HDPE applications are not expected to see significant metallocene penetration in the short term there are metallocene-based advances in HDPE. The introduction of dual site catalysts for the production of single reactor bimodal HDPE may become a significant metallocene application. Dual site catalyst research has typically focused upon at least one metallocene component in the catalyst system.

A small number of technology developers continue to explore the potential of producing bimodal polymer from a single reactor system. The attraction of this approach for the producer is a significant reduction in capital outlay for the single reactor system, however questions remain over the ability of the single reactor systems to replicate the molecular structures of twin reactor systems. Nexant/ChemSystems takes the view that it is unlikely that a single reactor system will ever match the flexibility of a twin reactor system. However, it is likely that the single reactor performance will be capable of producing single reactor bimodal material with a balance of properties, which exceed the performance of current unimodal products, and consequently take market share from unimodal product. The single reactor route is expected to offer significant capital cost savings, yet is less likely to offer the degree of process operating flexibility afforded by the twin reactor approach. The
single reactor approach uses mixed or dual site catalyst, often comprising one or more metallocene components as discussed above.

The most advanced developer in single reactor bimodal technology is Univation, which states that its new catalyst system produces polymer with a distinct bimodal polymer structure and performance properties equal to the cascade slurry technologies. In October 2002, Univation completed a six-day commercial (single) 160 thousand metric ton per year reactor run that produced 3 thousand metric tons of bimodal film grade HDPE.

Cost of production estimates for 300 thousand metric ton (661 million pound) per year plants for a variety of conventional HDPE technologies have been developed. This capacity was chosen in order to make a direct comparison of the processes. Representative economics are presented in this report for an HDPE injection molding grade of resin. Cost of production estimates for 200 thousand metric ton (441 million pound) per year for a variety of HDPE bimodal technologies have also been developed.

In addition to production economics, this report contains Nexant’s ChemSystems market outlook and supply/demand forecasts for HDPE out to 2010.

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