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*An independent chemical pilot plant fosters product development by offering multidisciplinary expertise and expansive equipment capabilities. Specially designed prototype systems are sometimes assembled as skid-mounted pilot units.*

# Finding Flexibility in Chemical Product Prototyping

**The 'concept to commercialization' process gets this manufacturer the polymer needed in a fraction of the time**

*By Larry Rosen*

Companies have historically looked to chemical pilot plants to scale up products, but that traditionally limited role is expanding. In an era of outsourcing, when capital investment has lost ground as a key determinant of competitive advantage, many U.S. companies are now focusing on the changing role of product and process innovation to create a differentiated market position and growth. And they are increasingly turning to external chemical pilot plants to outsource their product and process development in order to reduce lead times, costs and associated risks.

Successful companies interested in developing new products and processes in less time have learned that innovation requires flexibility in process options, diversity of profes-

sional backgrounds within the development team and "hands off" management control over the process. For example, verifying the efficacy of a variety of processes in a short time frame usually requires a considerable diversity of equipment and flexibility of configurations. Much like a custom woodworking shop or a test kitchen, where many tools are available but relatively few are employed at a given time, an environment designed for product development requires a workspace devoted entirely to concept prototyping and verification.

Those companies with highly efficient manufacturing capability simply do not have the flexibility or variety of options to conduct innovative development. Many companies that have been successful in developing new chemical products and processes followed one or more of the following principles:

- Accurate identification of a problem and its market
- Conceptualization of alternative ideas and approaches
- Integration of rapid prototyping and multidisciplinary teams
- Evaluation of prototypes
- Qualification of the test prototype relative to marketing demands

A recent project involving the development of a new generation of high-quality DVDs illustrates some of the major principles for rapid prototyping in a pilot plant. The challenge was to arrive at a prototype that could be produced efficiently to gain improved performance and meet the economic demands of the product marketplace in a short time frame. The client had identified the product need and had a specific polymer in mind but did not have the capability in-house to produce samples rapidly or test process parameters.

The prototype development involved a number of novel issues, not the least of which were the following:

1. The base polymer the client supplied to the pilot plant was a modification of a commercial polymer produced by the client in large continuous systems. It was not feasible to interrupt production to produce small quantities of additional prototypes for testing and product enhancement.

2. No commercial catalyst existed to transform the base polymer into the desired end product. Novel catalysts were prepared for evaluation by major catalyst manufacturers but were as yet untested under practical conditions. The challenge was to find economical conditions under which the combination of the polymer precursor and catalyst would produce a product with all the desired properties.

Unlike the typical "gated" innovation process, a "concept to commercialization" process integrates rapid prototyping and multidisciplinary teams to create multiple prototypes that are refined through numerous and, sometimes, nearly simultaneous iterations. In this instance, the teams included catalyst, polymer and hydrogenation experts as well as marketing and manufacturing professionals.

One of the multidisciplinary team's greatest challenges was to overcome the limitations posed by the customer's large-scale production of the base polymer. Most companies are

**'It was not feasible to interrupt production to produce small quantities of additional prototypes.'**

limited when they want to enhance their base capabilities by modifying their commercial facilities for output on a small-quantity basis for pilot trials. Most times, it's simply too costly to interrupt commercial production. After exhausting the range of client-supplied precursor polymers, a pilot manufacturing process train was built at the pilot plant and commissioned to supply alternate base polymers.

The development process also employed a number of process parameters to achieve a product exceeding the stated specifications. Since testing was nearly simultaneous with the process development, the improved properties that were exhibited in earlier samples would alter



*During product development and scale-up, it's important to verify that results obtained in the laboratory will be comparable at production scale.*

the specifications for later trials. A matrix of products was ultimately produced and sample quantities supplied to the company's own laboratory people, as well as to others, to confirm that the ultimate improved product performance would meet all market expectations.

There were several rounds of testing. Feedback from laboratory and market experts informed later iterations. While the precursor polymer was developed and tweaked, process conditions were modified to deal with the changes in order to ensure complete hydrogenation of the precursor polymer with each iteration. Through a process of successive approximation, each iteration created additional data that informed the next phase.

Processing, engineering, material science and market knowledge were constantly re-examined, refined and estimated for cost. Several critical factors — continuous review, multidisciplinary teams, the iterative process and the expansion of options — can all be credited for defining and achieving the desired DVD polymer and process in a fraction of the time anticipated. ●

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## Just the Facts

### About Pilot Plants

- U.S. companies are turning to external chemical pilot plants to outsource their product and process development in order to reduce lead times, costs and associated risks.
- An environment designed for product development requires a workspace devoted entirely to concept prototyping and verification.
- Unlike the typical "gated" innovation process, a "concept to commercialization" process integrates rapid prototyping and multidisciplinary teams to create multiple prototypes that are refined through numerous and, sometimes, nearly simultaneous iterations.

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