Searching for Speed and Flexibility in Chemical Product Prototyping

Finding Flexibility in Chemical Product Prototyping

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

‘It was not feasible to interrupt production to produce small quantities of additional prototypes.’ 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 professional 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: &#149 Accurate identification of a problem and its market &#149 Conceptualization of alternative ideas and approaches &#149 Integration of rapid prototyping and multidisciplinary teams &#149 Evaluation of prototypes &#149 Qualification of the test prototype relative to marketing demands A recent project involving the development of a new generation of high-quality DVD 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 the various 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 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 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 &#151 continuous review, multidisciplinary teams, the iterative process and the expansion of options &#151 can all be credited for defining and achieving the desired DVD polymer and process in a fraction of the time anticipated. *Larry Rosen is chairman and CEO of Pressure Chemical Co., a chemical pilot plant, 3419 Smallman St., Pittsburgh, PA 15201. He was awarded the American Chemical Society’s first Eugene B. Humphrey Small Chemical Business Entrepreneur of the Year award in 1998. He has served as co-chairman and a board member of the Pennsylvania Chemical Industry Council as well as a board member of the Synthetic Organic Chemical Manufacturers Association and chairman of its Small Chemical Business Committee. Readers can request a free copy of the “Guide to Chemical Product Development” by visiting www.pressurechemical.com. Additional information is available by contacting Rosen at lrosen@presschem.com or calling 800-722-5247.* mo l to meet these demands, a

new power model was required. This demand has been met by the high power trunk (HPT) approach. HPT technology offers a unique power solution for general purpose as well as hazardous location chemical process applications. It takes the energy limitation away from the control room and embeds it deeper into the physical layer in the field. This gives the end user access to higher power, without losing the ability to run long trunk distances. Traditional fieldbus power supply architecture requires a separate power supply (and corresponding cabinet spacing) for each fieldbus H1 segment as well as connection of the field devices to the trunk by means of junction boxes. With the inherent power limitations of traditional power supply options and the current draw of field devices, most segments can only support up to six devices. Since most DSC H1 cards are limited to a maximum of four ports, splitting devices into different segments isn\rquote t a cost-effective solution. As a result, traditional power supplies equal fewer devices on each segment, short cable distances and ultimately higher cost to incorporate all the field devices needed. Prior to the HPT approach, FISCO and FNICO (fieldbus intrinsic safe concept for Division 1 and fieldbus non-incendive concept for Division 2) were marketed as a way to achieve additional power on the fieldbus. However, their limitations on cable length, low power and lack of redundancy render these concepts ineffective in ultimately achieving end-user goals.

HPT users enjoy the same benefits in terms of power, cable length and number of devices per segment in hazardous location applications as they do in general purpose applications. To meet the demands of the chemical processing industry, modular power supply systems have been designed to work in conjunction with field barriers and segment protectors. Depending on the application, the energy limitation when using HPT is done in the field using segment protectors and/or field barriers. Field barriers are distribution modules that allow spurs to branch into Zone 1/Division 1 areas. They can be installed in Zone 2/Division 2 areas. Field barriers combine three functions into a single unit: short circuit protection, distribution of the fieldbus trunk for easy device connection and connection of IS devices to standard power supplies. Segment protectors offer short circuit and overload protection. This protection prevents all other devices on a segment against short circuit or overload in the event of a failure. Additional benefits of the HPT concept are listed below. &#149 Live maintenance on the spur in the field can be done when non-incendive wiring practices are followed. &#149 Modular solutions allow for a range of power modules. &#149 Each segment can now handle 32 devices. &#149 Highly reliable fieldbus power is achieved. &#149 There is power redundancy. &#149 Physical layer diagnostics are available. Modular power supply systems allow choices in power supplies and power conditioners to meet the varied power requirements for field devices and fieldbus host systems. Modular fieldbus power supply systems have been designed specifically for the fieldbus H1 segments and in accordance to IEC 61158-2. These systems have been designed for installation in Zone 2 or Class 1/Division 2 hazardous areas. The modular \ldblquote motherboard\rdblquote systems differ in the number of modules and type of electronic modules. Some have the ability to \ldblquote hot swap\rdblquote without interrupting communication on the fieldbus segments.

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