The Innovation Fast Track: Saving Time and Money in New Product Development

aspentech | Case Study

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James Smith, Qenos

Optimized batch process recipe to save

$135,000

USD per year

CHALLENGE

- Supply custom-tailored products to the market faster than the competition.
- Optimize high-density polyethylene (HDPE) processes to meet customized specifications.
- Reduce side reactions in the batch processes that produce off-spec material.

SOLUTION

Used Aspen Polymers™ and process data from plant historian and final product molecular weight distribution to accurately predict outputs, including:

- Final product molecular weight
- Dynamic pressure profile inside the reactor
- Concentrations of reactants in vapor and liquid phases

BENEFITS

- Completed plant trials for a new product grade six months ahead of schedule
- Saved $135,000 USD per year

About the Company

Qenos Pty Ltd, a subsidiary of the China National Bluestar Corporation, is a manufacturer of high-density polyethylene (HDPE) with a production site located outside of Melbourne, Australia.

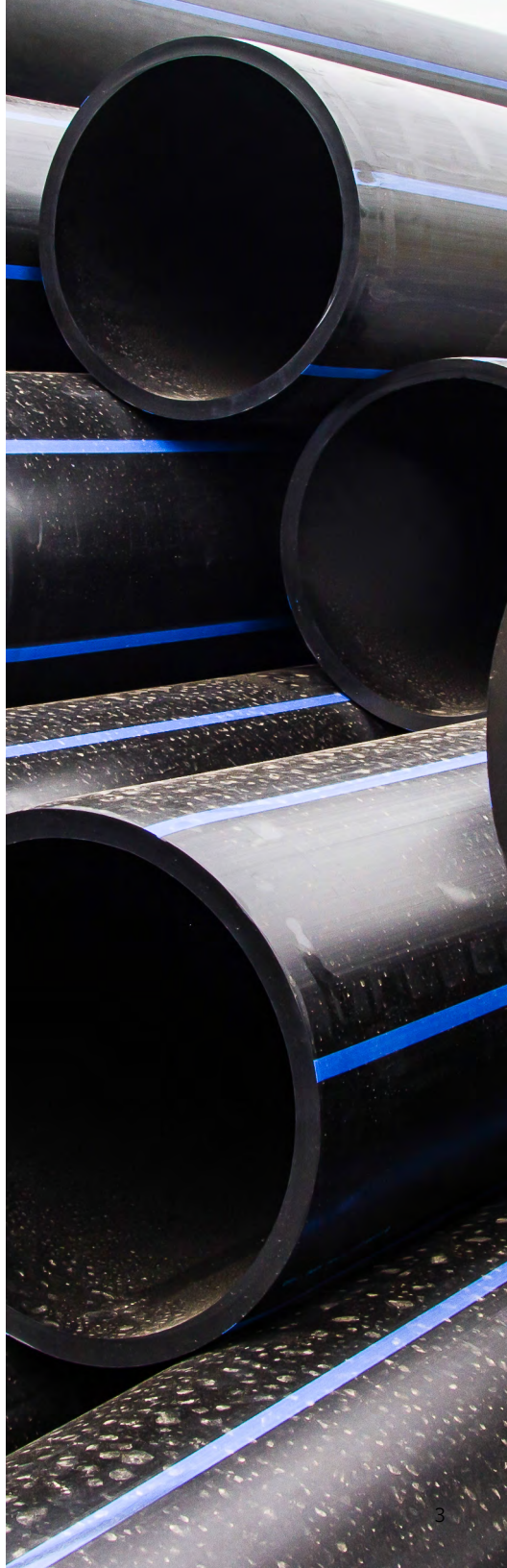
"One of the biggest competitive advantages we have is that we are the only local manufacturer of polyethylene in Australia," said James Smith, process engineer at Qenos. "We have technical support that works closely with the local market to define the grades of polyethylene needed for their application. Our ability to respond to customer requirements and bring new products to market makes Qenos the preferred polyethylene supplier in the region."

Qenos produces their material using batch processing, which is less common in the industry. This allows them to run short cycles through grades that are tailored to their customers' needs. Because Qenos has the capability to meet custom-tailored product specifications, their customers can produce higher-quality products more efficiently than they otherwise could.

Responding to Customer Needs With Greater Efficiency

One of the main challenges Qenos faces is responding to customer requirements and driving innovation for new product grades. Being a small site, there is no dedicated pilot plant for conducting trials. The same equipment used for commercial production must be allocated for development projects in a way that minimizes the impact on production targets.

"Our production equipment is our pilot plant," James said. "Sometimes the need to conduct plant trials gets in the way of meeting our production targets. By coming up with a better starting point through modeling as to where the recipe should be, we can significantly reduce the number of plant trials necessary to reach the final product. This allows us to innovate with minimal impact on commercial production."



Optimizing batch HDPE processes is particularly challenging. Consistent product quality is determined by introducing reactants into the reactor at the same time and controlling parameters including temperature and pressure. “We do not monitor what is happening inside the reactor as a function of time,” James added.

In one development project for a new HDPE grade, side reactions occurring in the batch processes produced off-spec material. To navigate this issue, the development team built a model inside the Aspen Polymers flowsheet. Historical batch data from the plant historian, along with final product molecular weight (MW) distributions, was used to fit kinetics for the model. The PC-SAFT equation of state was used to calculate the vapor–liquid equilibrium inside the reactor. Data from different grades running over various reaction conditions was used to fit the kinetic constraints for the reactions.

Accuracy of the model was evaluated based on its ability to predict outputs such as the final molecular weight of the polymer, the dynamic pressure profile inside the reactor and concentrations of reactants inside both the vapor and liquid phases. Samples were taken from both the vapor and liquid phases and tested to validate against the model outputs. The model developed could accurately predict the dynamics of the catalyst activation and the corresponding pressure profile inside the reactor.

“One of the great advantages of modeling batch processes is that we get an understanding of what is happening as the reactants are consumed and as the polymer is changing over time,” James said. “You are not making the same polymer in the beginning of the batch as you are in the middle or end of the batch. If you do not have a model to tell you what is happening, you are relying on trial and error and experience to determine the batch recipe. We cannot afford to operate this way, and this is the reason modeling batch processes is essential”

Based on the results of the model, Qenos found that instead of introducing the feed (a co-monomer) all at once to the reactor in the first reaction phase, gradual addition of feed resulted in a more efficient use of the co-monomer and a more even incorporation into the polymer. They could reduce co-monomer use, saving about $60,000 USD per year.

During the second phase of the reaction, low molecular weight polyethylene or "wax" is produced as a result of hydrogen introduction into the reactor. Modeling demonstrated that a gradual introduction of hydrogen reduces the amount of wax production, as opposed to the original operating condition where the hydrogen was added all at once. They reduced wax by-product, saving them about $75,000 USD per year.

Modeling the process allowed Qenos to hone in on the recipes needed before plant trials began.

"Within three batches, we reached the targets we wanted for the trial," James said. "We could use the leftover co-monomer to fast-track trials and finish development for two other grades six months ahead of schedule."

What's Next: Spreading the Value

On the horizon, James will begin to support the development of new batch injection-molding products that are analogs of the products already made in Qenos' plant in Sydney. Using his skills in process simulation, he will emulate the product made in Sydney and design the same process for the Melbourne site, adding flexibility to the organization to make the product where it is needed.

About the Engineer
James Smith is a plant process engineer for the Qenos resins plant in Melbourne, which utilizes the Hostalen HDPE technology. He is able to balance providing plant engineering support on major development activities with capital project support.

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