



Nissan Chemical Develops Faster, More Accurate Steam Reformer Model Using Aspen Hybrid Models™

First principles driven model embedded within Aspen Plus®

Twice as Fast

Build better models faster than conventional models

Up to 1%

Potential cost savings by optimizing amount of steam input

More Accurate, More Sustainable

AI-powered to improve predictive insights

CHALLENGE

Nissan Chemical was looking to optimize its ammonia manufacturing process and reduce operating costs. To do so, they needed to find a model that would enable them to simulate the behavior of a real plant.

Their existing reactor model was limited in its applications and they were having difficulty accurately estimating or measuring the temperature distribution in the furnace.¹

SOLUTION

Aspen Hybrid Models embedded in Aspen Plus

VALUE CREATED WITH ASPEN HYBRID MODELS

- Combines **first principles based simulation models and domain expertise with AI** and analytics algorithms, embedded in market-leading process simulator **Aspen Plus**
- **Reproduces real plant data faster and more accurately** than conventional reformer models
- **Automates model calibration** by incorporating machine learning
- **Reduces operational costs up to 1%** by optimizing amount of steam input

The top half of the slide features a blue gradient background with several 3D ball-and-stick molecular models of various chemical structures, including what appears to be ammonia and other hydrocarbons, rendered in shades of blue and white.

Finding the Right Solution to Model Ammonia Plant and Reduce Costs

Nissan Chemical Corporation was looking to model its ammonia plant and conduct a cost reduction study. They decided their first target would be: Steam Reforming. They were having difficulty modeling processes and assets accurately using their existing rigorous reactor simulation. It required a temperature profile of the process fluid and they were having difficulty accurately estimating or measuring the temperature distribution in the furnace. Because of the limitations of the conventional model, Nissan Chemical wanted to test different approaches.

In the end, they selected the First Principles Driven Aspen Hybrid Models with Aspen Plus. Working with AspenTech as its partner, Nissan Chemical identified key goals using this solution:

- Create a more accurate process simulation model
- Improve ammonia manufacturing efficiency to lower operating costs
- Start with steam reformer and expand simulation to other equipment
- Optimize the entire ammonia manufacturing process.

“Using the [AspenTech] hybrid model, we were able to create a model that can reproduce real plant data more accurately than the conventional reformer model. We were able to create a highly accurate model in a short period of time.”

—Mr. Takuto Nakai, Production Department, Nissan Chemical Corporation



Combining First Principles Model and AI

Nissan Chemical used First Principles Driven Aspen Hybrid Models to tune a reactor model in Aspen Plus with AI-enabled calibration. This approach combines first principles model knowledge and machine learning from plant data for unknown phenomena, using a neural network to perform the calculations.

As part of the process, and to overcome concerns about data reliability, the data had to be cleaned thoroughly before feeding it to the neural network for training. After cleaning the data, it was used inside the market-leading process simulator Aspen Plus to create a hybrid model. The model calculated the reaction rates using a neural network calculation method with temperature, pressure, feed rate and composition as input variables. Results demonstrated a higher correlation coefficient for the Aspen Hybrid Models compared to the conventional model.

Using Aspen Hybrid Models, Nissan Chemical was able to create a model that could reproduce real plant data more accurately—and twice as fast—as the conventional reformer model. To further optimize its ammonia production, Nissan Chemical is looking to use Aspen Hybrid Models in other processes.

Read more on [First Principles Driven Aspen Hybrid Models](#) and other [Performance Engineering](#) solutions.

Citations

¹Originally presented by the customer as part of the OPTIMIZE '21 conference, held in May 2021. Contact your AspenTech representative for more details.





About Aspen Technology

Aspen Technology (AspenTech) is a leading software supplier for optimizing asset performance. Our products thrive in complex, industrial environments where it is critical to optimize the asset design, operation and maintenance lifecycle. AspenTech uniquely combines decades of process modeling expertise with machine learning. Our purpose-built software platform automates knowledge work and builds sustainable competitive advantage by delivering high returns over the entire asset lifecycle. As a result, companies in capital-intensive industries can maximize uptime and push the limits of performance, running their assets safer, greener, longer and faster.

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