Interview with an Expert:

Improving Operational Performance and Safety with Dynamic Process Simulation

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Erika Belmont has over a decade of experience in the software industry, backed by a strong foundation in chemical engineering. She seamlessly transitioned into customer support and training roles, where she cultivated a deep understanding of user needs and was able to translate technical intricacies into user-friendly experiences. Her passion for empowering users led her to roles in professional services and subsequently, product management.

As Product Manager, Erika actively contributes to strategy and product technology, and ensures the development of products that resonate with end users. She is currently steering AspenTech's solutions for HYSYS Dynamics, Operator Training and safety products.

In this interview, Erika Belmont explains the advantages of using dynamic process simulation to gain insight into the transient behavior of systems and understand how processes respond to changes. These help operators address risks, predict possible equipment failures ahead of time and optimize the use of resources. She is currently steering solutions for Aspen HYSYS Dynamics™, operator training and safety products.

What are the significant industry challenges addressed by dynamic simulation?

Dynamic simulation is a powerful tool that can benefit many industries, including energy and chemicals. Companies in these market sectors are faced with multiple challenges, including cost and emissions reduction, process safety assurance, and the need for effective operator training:

- **Cost reduction:** In order to reduce production costs, companies need better visibility into the KPIs affecting plant operations, including the ability to forecast operational changes while considering all possible scenarios.

- **Emission reduction:** To meet sustainability targets, plant managers need to ensure their emissions meet the targets set by the company. Key to this is the ability to accurately predict emissions, especially under transient operating conditions.

- **Safety:** Companies need to know which variations can occur in their plant operations that might endanger both personnel and equipment. They need to put in place process safety systems, such as protection from overpressure, that ensure safety across the plant's operations while avoiding unnecessary expenditure from over-engineering such systems.

- **Training:** Operators must have a good understanding of the process, to enable them to respond to unexpected changes and various operating conditions.

What is dynamic simulation and how is it different from steady state simulation?

Steady state simulation, used by most of the process industry today, simulates a condition where the system is at a constant operating point and no major changes are expected. It is a useful tool for identifying opportunities to improve efficiency and troubleshoot operational issues. On the other hand,

dynamic simulation takes into account operational changes with respect to time. This type of simulation is particularly useful for studying dynamic processes where variables change continuously, and the system's behavior is influenced by time-varying factors.

Why is dynamic process simulation important?

Dynamic process simulation allows the accurate modeling of real-world processes, to help companies gain insights into the transient behavior of systems and understand how processes respond to changes, disturbances or events. This is vital for predicting and mitigating issues related to startups, shutdowns and process disruptions. Dynamic simulation enables operators to address risks, predict possible equipment failures ahead of time, and optimize the use of resources, such as raw materials, energy, human resources, etc. It is also useful for testing and validating the process itself, guaranteeing that different requirements are met, and helping to avoid cost overruns.

AspenTech customer China Petroleum Engineering reported **savings of up to $20M** by helping its E&P client reduce startup time by four days using Aspen HYSYS Dynamics.

As I mentioned above, plant startups and shutdowns are particularly sensitive. For example, process units may need to be shut down for yearly maintenance, which can take a few weeks. When restarting operations, dynamic simulation can help reduce the startup time and enable the plant to reach full production more quickly, saving the company millions of dollars.

Another advantage of dynamic simulation is in the construction of safety systems. Companies that do not have accurate insights into flow conditions will have to over-engineer/over-design/over-spend on safety systems to ensure all possible safety scenarios are covered. Dynamic simulation can accurately analyze a number of operational scenarios, including the worst case, enabling companies to design safety systems exactly to their needs and no more than that.

How does Aspen HYSYS® perform dynamic simulation?

Dynamic simulation is considered more difficult to set up than steady state. AspenTech has solved this problem by enabling dynamic and steady state simulation to be done in the same Aspen HYSYS environment. There is no need to build a separate model for dynamic simulation from scratch, as users can simply move their model from steady state to dynamic simulation with the click of a button – it's that easy. It's fully integrated, and no additional software is needed.

You can begin with a simple existing steady state model. The integrated environment makes it pretty straightforward—depending on the size of the model and the scope of the simulation, conversion from a steady state to a dynamic model can take from a couple of days to a few weeks.

While little additional data is needed to develop a dynamic simulation model, some additional information will be required from users who already have a steady state model, such as equipment size, pressure flow specs, and how they want to set up the controller strategy (controllers are not used in steady state simulation).

Where do you see dynamic simulation as being particularly useful?

Dynamic simulation is particularly valuable in compressor applications, where many changes can take place. Dynamic simulation can help us understand the performance curve of the compressor, to analyze time-dependent behavior under different operating conditions. These include predicting parameters like temperature, pressure and flow rate at variable speeds, which are liable to fluctuate under changing conditions over time. Compressor conditions change quickly, and compressor failure can affect the entire process. Dynamic simulation can help predict when operational issues such as compressor surge might occur and improve the compressor control strategy to ensure a smooth and efficient transition between different operating conditions and mitigate any risks involved. Especially during startup and shut down when compressors most often experience transient conditions, it's important to model how changes will occur under different loads and feeds per demand in the plant.

Compressor surge is a common problem, and the Compressor Surge Analysis tool in Aspen HYSYS offers pre-built templates for users to model their compressor systems for single or multiple stages. That way they can quickly set up and evaluate different scenarios, with no need to spend time creating models from scratch. The tool also offers predefined scenarios that help simulate what's happening with the compressor. Both of these capabilities streamline the process and make it easier for both experienced and newer users.

What other areas can benefit from dynamic simulation?

Operator Training Simulation (OTS) can definitely benefit from dynamic simulation. Dynamic simulation can help operators analyze individual processes and identify specific areas for improvement and test configurations without having to perform these activities in the plant itself. The training helps them understand the transient behavior of processes, allowing them to anticipate and respond effectively to dynamic changes in the system at no risk to the actual operations.

Training includes simulating normal operations, startups, shutdowns and various abnormal or emergency situations. Operators are allowed to make mistakes and learn from them in a controlled, risk-free environment, reducing the likelihood of errors and accidents when transitioning to actual operations. They can use simulation to optimize control strategies and learn how to operate processes more efficiently, leading to improved overall plant performance and huge cost reductions.

Using Aspen Operator Training (AOT) software, it is possible to connect with an existing Aspen HYSYS dynamic simulation to create a custom user interface that mirrors the company's actual control room panels and shows how the system is behaving. AOT can simulate multiple scenarios and enable the operators to interact with them. You can use existing Aspen HYSYS models to develop an OTS solution, they do not need to be developed from scratch.

As mentioned above, it's easy to develop dynamic simulation systems from steady state models due to the seamless transition between the two simulation types. Note that OTS is done only in dynamic simulation mode, not steady state.

Dynamic simulation can also help ensure process safety by allowing users to evaluate what will happen under certain fluctuations or disturbances and learn how to respond in order to prevent damage. This is particularly critical when assessing the risk of a blowdown, in which too much pressure builds up and the operator needs to release it by opening a valve. If the overpressure protection systems are not properly designed, blowdowns can fracture the equipment. Dynamic simulation alerts to the specific conditions at which blowdown will occur and helps guarantee safety by ensuring the equipment is designed to handle those conditions, including under very low temperatures.

What kind of training courses does AspenTech offer to operators who want to learn more about performing dynamic simulation?

AspenTech offers comprehensive eLearning courses. Many of our software solutions, such as Aspen HYSYS, offer built-in in-context guidance to help users. Dynamic simulation courses, training on how to start using HYSYS dynamics, and knowledge-based articles can be accessed from within the Aspen HYSYS software.

What's unique about our in-context guidance is that the software understands which information you're looking for by seeing which screen you're on, and tailors the content to your specific task, without you having to search for it. Esupport is also available, and every AspenTech customer has full, free-of-charge access to the customer support site. In addition, AspenTech offers instructor-led classroom courses to help you learn more about using our software for dynamic simulation. Solution consultants are another great resource. These are technical experts who can offer personal, one-to-one guidance.

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About Aspen Technology

Aspen Technology, Inc. (NASDAQ: AZPN) is a global software leader helping industries at the forefront of the world's dual challenge meet the increasing demand for resources from a rapidly growing population in a profitable and sustainable manner. AspenTech solutions address complex environments where it is critical to optimize the asset design, operation and maintenance lifecycle. Through our unique combination of deep domain expertise and innovation, customers in asset-intensive industries can run their assets safer, greener, longer and faster to improve their operational excellence.

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