SIEMENS

Krones

Major bottle designer uses NX CAE and NX Nastran to develop products faster

Product

NX

Business challenges

Reduce design validation time to achieve competitive advantage

Create accurate simulation models

Gain a deeper understanding of product performance in the consumer environment

Keys to success

Standardize on NX CAE and NX Nastran for top-load simulation

Leverage integrated CAD and CAE processes

Deploy simulation to the designer community

Results

Reduced overall top-load simulation time by 75 percent

Simplified simulation-modeling process

Solved FE models up to four times faster

Siemens PLM Software solutions enable Krones to reduce top-load simulation time by 75 percent

A valued partner

Krones AG (Krones) is a German-based filling and packaging company founded in 1951 that designs, engineers and manufactures bottles, cans and other specially shaped containers for soft drink companies, breweries and beverage producers as well as for other companies with distinct container needs for such products as perfumes, cosmetics, chemicals and pharmaceuticals. In addition to its container manufacturing business, Krones develops, produces and delivers machines that make up the entire bottling process. As a result, Krones has evolved from simply being a packaging supplier to a valued partner for mechanical engineering, line expertise, process engineering, and microbiology and information technology.

Unifying marketing, design and engineering

Krones' operating principle is that brilliant design concepts are the result of a unified marketing, design and engineering vision. For example, Krones' principle is evident when working with customers to develop a new polyethylene terephthalate (PET) beverage bottle. First, the Krones design team meets with its customer to understand what the customer wants to achieve with the new design, such as to reduce costs or create an aesthetically distinctive brand for the client that will stand out on the store shelf.

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Krones must also learn and understand the bottling line conditions and logistical or transportation conditions the bottle will undergo before reaching the end consumer. For example, pallets of bottles filled with liquid will be stacked on top of one another and transported by truck, so it is critical to know whether the bottles on the bottom of the pallet will be able to withstand the stress from all the weight at the top. This top-load condition is a critical influence that affects the bottle's final design.

The consumer product industry moves at a relentless pace, and Krones' customers want to introduce new bottles and packaging as quickly as possible. It currently takes about three to four weeks to go from concept to a validated design. Krones recognizes that to maintain a competitive advantage, it must

deliver what the customer wants faster than the competition. For this reason, Krones relies on simulation to validate new bottle design performance.

Simulating PET bottle performance
Krones has relied on numerous simulation tools for various aspects of PET bottle engineering in the past 20 years, including thermal and flow simulation for blow molding, motion simulation through the bottling line and structural simulation for top-load conditions. However, Krones felt that there was room to improve its top-load simulation process because, for each bottle design iteration, it would take four to eight hours just to create the analysis model, and then another eight to 24 hours to run the simulation using the company's legacy simulation tools.

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Arno Haner
Head of PET Packaging Design
Krones

One of the challenges in the simulation modeling phase of the process was that it was difficult to capture and edit geometry correctly using the finite element (FE) preprocessor, and simulation engineers had to frequently go back and forth with the computer-aided design (CAD) team to get something usable for FE analysis. Since Krones was using NX™ software for CAD, it decided to see if it could improve the simulation modeling process by using the computer-aided engineering (CAE) capabilities of NX instead of its existing FE preprocessor. Krones found that, by using NX CAE for simulation modeling, it immediately eliminated the geometry translation issues it had experienced when going from NX CAD to its FE preprocessor because NX CAD data seamlessly transfers into the NX CAE environment. The NX CAE analysis model also remains associated with the base design data, which means it is easy to update the analysis model to reflect any changes that occur to the design.

Additionally, tools available in NX CAE, such as synchronous technology, let engineers quickly and intuitively make the geometry edits necessary for meshing without having to go back to the design team. One of the critical challenges with creating a simulation model of innovative PET bottle designs is accurately capturing wall thickness. With the company's previous CAE tool, engineers often needed to define wall thickness by manually sectioning the geometry and mesh, which was an extremely tedious and time-consuming task because the wall thickness of a PET bottle varies throughout the bottle.

With NX CAE, Krones has automated the process and significantly reduced modeling time using the software's unique field-modeling concept. Ultimately, using NX CAE, Krones was able to reduce the four- to eight-hour simulation modeling process down to just one hour.
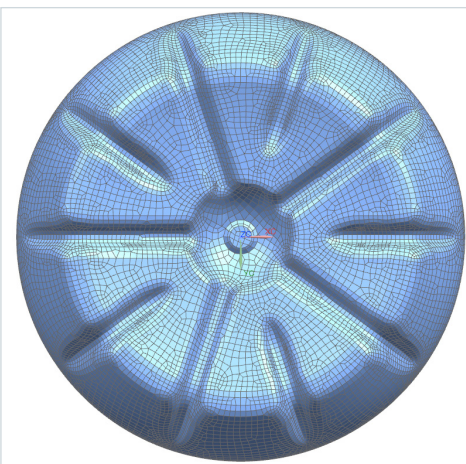
Next, Krones investigated how the simulation time could be improved. Krones' existing top-load simulation solution used an explicit, transient solver. This posed a challenge to Krones' simulation processes because explicit solution "time step size" depends on the length of the smallest element, and one excessively small element will reduce the stable time step for the entire model. So, Krones' engineers wanted to switch to an implicit solver because the computation step size of an implicit FE solver is largely independent of element size.

"The implicit NX Nastran solver with the feature of low-speed dynamics is well-suited for the top-load analysis we are doing at Krones," states Thomas Albrecht, a simulation expert at Krones. When Krones executed the top-load simulation in NX Nastran, they were able to achieve a solution time of between two to four hours, which was up to four times faster than their previous solution time, while achieving consistent results.

Driving design with simulation
Currently, simulation at Krones is performed by just a few expert analysts. This slows the validation process because the number of new projects and designers outpace the capacity that the analyst group can handle. It also means designers must then wait for feedback from the analyst group before refining its designs.

By having the ability to perform top-load simulation using the NX environment, Krones is starting to see additional opportunities to speed the performance validation of new bottle designs. Krones' vision is to have the CAE analysis team create automated wizards of the top-load simulation process using NX Open, the programming interface available within the NX environment for CAD and CAE. Because the top-load simulation process is essentially the same for each design, Krones' simulation engineers are automating the process and then packaging it into a wizard style interface that will allow designers using NX CAD to perform an initial top-load simulation to judge whether the design will pass or fail. The advantage is that designers will now be able to perform a basic level of analysis right away without having to wait days for the engineers' response.

According to Arno Haner, head of PET packaging design at Krones, "NX is the preferred and probably the only environment available on the market that scales simulation from expert analysts to the design community."

Krones has completed initial development of the top-load simulation wizard and is now beginning a pilot deployment of the wizard to a small subset of designers. Early results of the pilot project look promising, and Krones expects to deploy the wizard widely to the design community one year later.

"Our ultimate goal is to take a three- to four-week process down to just three- to four-days," states Haner. "The ability of designers to use simulation during design with NX will help us achieve that goal."

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Thomas Albrecht
Simulation Expert
Krones