

Energy and utilities

ZA POLNA S.A.

Valve manufacturer uses Simcenter STAR-CCM+ to extend product portfolio and cover a wider group of customers

Product

Simcenter

Business challenges

Select and implement the most suitable flow simulation tool

Upgrade R&D department performance

Achieve better ROI

Keys to success

Apply Simcenter STAR-CCM+ to provide insight into valve flow phenomena

Perform advanced flow simulations to gain the comprehensive information

Use a variety of Simcenter STAR-CCM+ flow models to fulfil the most difficult projects

Encourage employees to expand their competence and scope

Results

Extended the product portfolio and covered a wider group of clients

Performed advanced flow simulations for valves

Conducted numerous simultaneous R&D projects

Siemens Digital Industries Software solution enables ZA POLNA S.A. to perform advanced flow simulations for valves

Located in Przemyśl, Poland, Zakłady Automatyki POLNA S.A. (ZA POLNA S.A.) employs about 200 people and delivers control valves to a variety of markets, including power generation (power and combined heat-power plants), food, chemical and oil refining.

The company produces a wide range of valves with inner channel dimensions from a few fractions of a millimeter (mm) up to 0.45 meters (m). Due to the complexity and diversity of projects, it is important for ZA POLNA S.A. to develop innovative solutions and improve the skills of its employees. Implementing Simcenter™ STAR–CCM+[™] software allowed the company to fulfill advanced flow simulations and collect in-depth information about flow phenomena in the valves they designed, thus enabling it to extend its product portfolio and cover a wider group of customers. It also enabled ZA POLNA S.A. to reach a new level in research and development (R&D) activity. Hence, expanding the R&D department's scope of activities and tooling capabilities will likely remain one of the company's key strategic considerations in the years ahead.



Figure 1: Valve type BR33-DN450 installation (main throttle valve for gas turbine power plant in Egypt).

A difficult task for engineers

The valves manufactured at ZA POLNA S.A. are used to control compressible and incompressible media, ensuring the proper parameters of various gases and liquid. It could be pure water, a highly aggressive chemical product, viscous food substance at a sugar factory or high-pressure steam at a power plant – there are many potential applications. All valves are precisely matched to specific operating conditions, including primarily temperature and pressure, and are specially adapted to the industry – gas transportation, power generation, petrochemistry, food processing, etc.

"We focus on manufacturing individual orders of control valves for every customer," notes Robert Busz, senior engineer in the

Results continued

Reduced product development costs significantly

Provided solutions that best fit customers' technical requirements



Figure 2: The vapor zones in the valve cage affected by cavitation phenomenon.

R&D department at ZA POLNA S.A. "In most target industries, main processing parameters are gradually intensified over time, which means increasing parameters requirements for valves, too."

It is well known physical phenomena associated with the flow of gases, vapors and liquids under high pressure drops and temperature constitute perhaps the biggest challenge for the engineers involved in designing control valves.

Cavitation, flashing, choked flow and other negative events seriously limit the possible area of reliable solutions, simultaneously causing vibration, instability, noise, damage to valve elements, etc.

For every such case it is vitally important to be able to answer questions such as: Will cavitation occur in the designed valve? Will the vaporized area block flow in case of a rising pressure drop? "It is clear to us that only an appropriate flow simulation tool, which takes into account a majority of substantial physical effects, could provide answers to those questions and fully reveal the R&D potential," emphasizes Bartosz Kochan, technical director at ZA POLNA S.A.

Figure 3: The distribution of velocity

vectors and the plot of the kv coeffi-

cient as a function of time.

"The Simcenter STAR-CCM+ implementation provides us with the ability to carefully analyze almost all the phenomena appearing in the valves without making it in metal."

Tool that support work

"Before we chose Simcenter STAR-CCM+, we performed a detailed market analysis," declares Busz. "We were looking for a stable software that would fit well in our CAD and CAM applications, which we had been using for many years. Additionally, using a bunch of tools from one supplier gave us reason to assume they would work smoothly together. Finally, the financial

"The Simcenter STAR-CCM+ implementation provides us with the ability to carefully analyze almost all the phenomena appearing in the valves without making it in metal."

Bartosz Kochan Technical Director Zakłady Automatyki POLNA S.A.



Figure 4: Overset mesh for two objects – liquid valve casing domain and solid valve plug domain.

aspect was extremely important, especially considering not only the software purchase, but also maintenance costs compared to other offers on the market."

In the autumn of 2017, ZA POLNA S.A. chose Simcenter Star-CCM+ because it most thoroughly addressed the company's criteria, such as price and compatibility. It was purchased, along with HP[™] workstations, with funds largely provided by a European Union (EU) subsidy.

"At present all that technology is used by three analysts that are involved in several middle- and long-term projects" says Busz. "With such powerful tools at our disposal, we had the ability to organize R&D processes in a completely new and systematic way. All projects were prioritized and conditionally divided into groups based on time considerations: urgent, near term, distant prospect, etc. The urgent project might be associated with, for example, guick reaction to a customer's order with some specific working conditions. Frequently, these requests were unique and could not be realized without a simulation tool, as in the case of a biodiesel plant valve working on fatty acids mixture (11 components with different properties) under high pressure and temperature.

"Short- or near-time projects are mostly related to improving and modifying the existing valve product line, with the aim of becoming a market leader in terms of durability, noise parameters, etc. "Obviously, this requires deep insight into the phenomena in the valves and would likely not be achieved without performing simulation. But probably the greatest impact simulation has had on the company is on long-term prospective projects, such as testing new concepts, ideas and design solutions, which are presently too risky to use in a conventional valve. It requires performing advanced flow study and collecting in-depth information about phenomena features, which is provided in full measure by Simcenter STAR-CCM+. Now all these projects are running in parallel, giving ZA POLNA S.A. the ability to enhance its R&D department performance."

Flow simulation

The typical task for valve simulation in Simcenter Star-CCM+ is determining the flow coefficient (Kv), which is used to characterize the flow capacity of the valve in specified conditions and is a basic parameter of critical importance. This value expresses the volumetric flow in cubic meters per hour (m3/h) of water with a temperature of 5 to 40 Celsius (°C) through a valve in case of 1 bar pressure drop for specified plug travel. It allows the customer to determine both the valve size, expressed as nominal diameter (DN), and pipeline diameter. "Due to the Simcenter STAR-CCM+ implementation, we are now able to organize R&D processes in a new and systematic way: carry out more projects simultaneously, fulfill advanced flow simulations and collect in-depth information about flow phenomena, etc."

Robert Busz Senior Engineer, R&D Department Zakłady Automatyki POLNA S.A.

Figure 5: Velocity streamlines distribution and Kv coefficient plot as a function of time.

"It requires performing advanced flow study and collecting in-depth information about phenomena features, which is provided in full measure by Simcenter STAR-CCM+."

Robert Busz Senior Engineer, R&D Department Zakłady Automatyki POLNA S.A.

Figure 8: Overset mesh for valve acoustic analysis with approximately 16 million polyhedral elements.

A remarkable feature of Simcenter STAR-CCM+ is that it can be used to determine Kv in real time for a set of specified plug travels, which is possible with transient analysis. The plug displacement is simulated with the help of overset mesh (figure 4), which changes its position in time according to previously chosen criteria.

"The time intervals are very short, which results in dealing with extremely dynamic processes," says Busz. "The possibility of simulating them is unquestionably one of the significant advantages of this software."

Making flow as silent as possible

Today customer requirements increasingly concern not only common valve operation parameters, such as pressure or temperature, but also additional parameters that might be decisive. One of them is the generated noise level, which for example, is crucial for gas transfer stations in residential areas. According to commonly used standards, the generated noise level must not exceed 85 weighted decibels dB(A), which is guite a strict limitation, especially for large valves under high pressure drops. Using Simcenter STAR-CCM+ allows ZA POLNA S.A. engineers to find new solutions, simultaneously considering mechanical, aerodynamic and hydrodynamic noise sources. For instance, a larger number of throttling devices with special structures reduce the acoustic pressure and, consequently, the generated noise level to recommended values. "Thanks to Simcenter STAR-CCM+, it became possible to check and compare the acoustic pressure levels on selected throttling devices of any control valve; for example, with two and four cages," says Busz.

In general, acoustic simulations are quite time consuming as high resolution of fluid domain is required. However, using Simcenter STAR-CCM+ allows ZA POLNA S.A. to shorten solution time significantly. It is all due to the polyhedral mesh

Figure 6: Acoustic sound pressure distribution inside a two-cage valve.

Figure 7: Acoustic sound pressure distribution inside a four-cage valve.

elements application (figure 8), which reduces three times as many overset mesh cells as tetra type elements.

As a result, time needed to obtain the first satisfactory solution or complete overall calculations decreases sharply, too.

There are no two identical designs

"We are constantly developing new solutions," says Busz. "The equipment specifications for individual customers often may differ from each other, even for valves within identical technological processes in the same industry sector.

"Simcenter STAR-CCM+ is well adapted to automation for repeating simulation processes, which allows analysts to save significant time, especially when the workload is heavy, so we can achieve high performance."

"The widespread use of macros, batch files processing and specialized products such as HEEDS MDO and Design Manager allows us to reduce the amount of manual labor significantly.

"Due to the Simcenter STAR-CCM+ implementation, we are now able to organize R&D processes in a new and systematic way: carry out more projects simultaneously, fulfill advanced flow simulations and

Solution/Service

Simcenter STAR-CCM+ siemens.com/simcenter

Customer's primary business

ZA POLNA S.A. specializes in the design and manufacture of control valve solutions, and is located in Przemyśl, Poland. It employs about 200 people. ZA POLNA S.A. also machines parts with computer numerical control (CNC) and conventional machine tools, performs stamping, punching, welding, surface hardening, paint coating, repair and regeneration. polna.com.pl/en

Customer location

Przemyśl Poland collect in-depth information about flow phenomena, etc. The product development time and costs are reduced significantly, and solutions are developed, which fit the best for customers' technical requirements. As a result, we manage to extend the product portfolio and cover a wider group of clients."

Future considerations

"Our company seeks to be innovative all the time and we strive for excellence in our engineering solutions," says Busz. "So the next step for R&D activity development is going to be creating the valve test station for high pressure drops. Simcenter STAR-CCM+ simulation results will be compared with real measurements carried out during the tests. Within the experiment procedure we are going to follow the behavior of a given valve or its separate structure, so we can understand how well Simcenter STAR-CCM+ simulations agree with reality. Having the reliable test data set of specific valve objects and structures, we will be able to make improvements to the simulation model's parameters to reach maximum accordance.

"Additionally, soon we plan to increase the productivity of simulations by uniting the existing individual workstations into computing clusters.

"We also clearly understand that software and hardware is worth nothing without qualified personnel. Therefore, we encourage our people to expand their competence and scope, systematically directing them to training. In 2018 two analysts were trained in Paris, France and this year one in Leuven, Belgium. We intend to follow the same policy in the future, too."

"Simcenter STAR-CCM+ is well adapted to automation for repeating simulation processes, which allows analysts to save significant time, especially when the workload is heavy, so we can achieve high performance."

Robert Busz Senior Engineer, R&D Department Zakłady Automatyki POLNA S.A.

Siemens Digital Industries Software

Americas+1 314 264 8499Europe+44 (0) 1276 413200Asia-Pacific+852 2230 3333

© 2019 Siemens. A list of relevant Siemens trademarks can be found <u>here</u>. Other trademarks belong to their respective owners. 75701-C6 7/19 M