Customer Success Story:
Lube oil filtration in hydrogen production

Market segment:
Oil and gas

Reliable filtration in the Siberian winter

Location:
Siberia, Russia

Challenge:
Filtering lube oil at temperatures as low as -58 °F

Solution:
Adapted EDA filters with a duplex design made by Eaton specially designed to withstand the demanding environmental conditions in Siberia

Result:
Thanks to the modified EDA filters and Eaton's high level of flexibility, the client was able to start their hydrogen production on time and to place the facility into regular operation

"The filtration of the lube oil using the EDA filter works just as smoothly as planned and that despite the extreme temperatures."

Nico Juch,
technical sales engineer at Eaton's Filtration Division

Background

Hydrogen is currently the key in a wide variety of aspects for a sustainable economy since it is environmentally friendly, a mobile energy source that can be stored, and carbon neutral when used in manufacturing. This is especially true, when it is used as a fuel, its only combustion product is water. Many energy intensive industries, such as the steel industry, can also benefit from a combustion process free of carbon-containing pollutants.

Hydrogen is also being used in other areas as well. Traditionally, it plays an important role in fertilizer production for farming. In the Haber-Bosch process, hydrogen and nitrogen form ammonia, which in turn is the basis for a number of different fertilizers.

Challenge

This is why hydrogen is needed and produced worldwide – including in regions like Siberia, where exceptionally cold winters are especially challenging for the industry. Russian companies are among the largest fertilizer manufacturers in the world. Due to the increasing demand, one of them decided to build a new hydrogen production facility in western Siberia.

To make sure that hydrogen production would be safe and reliable even at the local temperatures, which can be as low as -58 °F, all components of the production plant must be designed for these conditions. The compressors of the facility have to meet a special challenge. They have to manage the staged compression of hydrogen and other gases in production as high as 5,075 psi.

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Uncompromising reliability is indispensable under these circumstances – because the entire production would quickly come to a halt if a compressor ever failed. When the facility was planned, a decision was soon made to use a renowned European manufacturer with years of experience in building large-scale piston compressors, using engines delivering up to 1,000 kilowatts, as is required in hydrogen production.

However, these higher requirements not only affect the machine as a whole; they also affect each individual component and all consumables. The lube oil is especially important. It has to perform and keep the danger of failure as small as possible. As in other critical areas, hydrogen production operators therefore rely upon both high-quality oils and the filters used to remove dirt particles – such as the ASME certified stainless-steel changeover filters from Eaton's EDA range. Thanks to their duplex configuration, these filters can be used in continuous operation in compliance with the API 614 standard and are thus ideal at providing durable protection for the system components.

Solution

The filters of the EDA range work as pressure changeover solutions in numerous compressors, turbines, and large pumps. They all work the same way. The medium enters the filter housing and is filtered by the filter element in one of two filter compartments. A pressure gauge displays the status of the filter element inside the active filter compartment. If the element is very dirty, or even blocked, the center-mounted changeover ball valve can then permit redirection of the flow to the second filter compartment. The contaminated filter element can then be flushed or replaced without interrupting the filtration process.

Are all components of the EDA duplex filter suitable for use at extreme subzero temperatures? "To make the filters suitable for use in Siberia was no easy task," Nico Juch remembers. As a technical sales engineer at Eaton, he was familiar with all the properties of the tried and tested EDA filters. He was the best person for the task of making them work for winter conditions. Eaton's engineers checked the filter, component by component, testing and modifying it to meet the plant designer's requirements. A decision was made to use size 633 (L x W x H: 29 in, 7.9 in, 25.7 in) as the basis to reliably filter the required flow volume, as well as two NL filter elements made of glass fiber, with a 10 micron filter unit. "Due to the specific challenges of that environment, we obviously had to make some modifications. And the problem wasn't the filter housing, which is made of AISI 316 standard stainless steel," Juch said.

The gaskets of the filter presented a much greater challenge. The seals have to provide maximum performance because, in addition to the chemical stress placed upon the elastomers by the lubrication medium, they are also subjected to vibration and mechanical stresses – all in addition to the ambient temperature. "There are a wide variety of materials for this type of gasket, but only a few which are fundamentally compatible with extreme subzero temperatures," Juch explained. As a result, finding the right combination of temperature and chemical durability has not been easy – especially with the client insisting upon a safety buffer being designed into the facility: "We had to ensure that the EDA filter would withstand temperatures even as low as -58 °F," Juch emphasized.

This is where the long years of partnering with leading gasket manufacturers paid off. "The extreme subzero temperatures were a tough challenge even for our suppliers. But, in the end, they were able to provide a material that is up to the job," Juch said with a smile. Eaton's team also proved their flexibility. "Even before we finished adapting our design, we were able to provide a prototype of our filter to our compressor manufacturer. Although it wasn't functional, the dimensions and connections were exactly as in the final filter," Juch went on to explain. "After all, we had already established all of the dimensional details." The manufacturer gratefully accepted the offer, because it meant a chance to actually install the compressor in Siberia during the summer by using the prototype, and to finish welding all of the pipelines while the engineers were still making final adaptations. "In the end, the prototype was simply replaced by the final EDA filter on-site," Juch said. Eaton's team thus helped by significantly reducing the time needed to build the facility.

Result

A little less than two months passed between the RFQ and the plant being put into initial operation. "We managed to deliver a filter in a very short time which not only meets the customer's specifications and the necessary technical ASME certification requirements, but whose components can also reliably withstand these extremely low temperatures," Juch pointed out. The hydrogen plant with its complicated production process now benefits from a continuous, uninterrupted filtration with simple and quick maintenance as well as a long service life.

The construction of the plant was significantly accelerated by providing a prototype during the construction phase because work was still able to continue while the filter was still being tested in the lab.

Trial operation soon demonstrated that the compressors were capable of operating at an optimum level of lubrication. "The filtration of the lube oil using the EDA filter works just as smoothly as planned," said Juch, "and that despite the extreme temperatures." In the meantime, the plant has remained in routine operation while supplying hydrogen on a daily basis – as a basic element for the fertilizers that contribute to providing food supplies for millions of people.

The duplex configuration of the ASME certified stainless steel pressure filter from the **EDA range** can be used for continuous operation: If a filter element has to undergo maintenance, or the element must be replaced, the operator can redirect the flow through the filter from one side to the other.

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