

Philippe Dupont: “Good pump design reduces costs.”



Philippe Dupont leads the Global Core Technology team in the Pumps Equipment division. Speaking to the *Sulzer Technical Review*, he explained how Sulzer meets the high requirements of the oil and gas industry with innovative pump designs.

What requirements does the oil and gas industry place on pump technology?

Pumps are critical operating components in all processes in the oil and gas industry, which means that the failure of a pump will stop the entire operation and result in enormous costs. Customers therefore demand the highest possible reliability. One area this particularly applies to, for example, is offshore oil production. Carrying out repair work on a remote oil platform is much more difficult and expensive than on land. Platforms also don't have the same options for storing spare parts or installing several pumps in parallel. Therefore, the customer relies on the pumps functioning perfectly.

For many applications, efficiency is of prime importance—especially when power consumption is a relevant cost factor. For example, when you are looking at the overall balance sheet of a pipeline, the operating costs of the pumps are critical factors for economic efficiency.

And the operating conditions are also demanding.

The pumps have to move difficult media and often are subject to extreme environmental conditions. Examples of this are water injection pumps, which increase the reservoir pressure in offshore oil production. The seawater that these

pumps transport is aggressive, and it attacks the pump material. The transport of sand-bearing oil also places great demands on the pumps—on the one hand, due to the viscosity, and on the other, due to the abrasive solids.

How does Sulzer meet these challenges?

Our many years of experience enable us to find the best solutions for our customers through innovative designs. A good design not only ensures the reliability and efficiency of a pump, but also lowers the costs. We have made remarkable progress in reducing pump size over the last few years. The goal is

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to achieve the same performance with less material. We are dealing with two physical limits. One limit is the maximum speed, because an increase in speed makes it possible to reduce the size of the pump. However, cavitation will occur once a certain speed is reached. The vapor bubbles produced then implode immediately and lead to high-pressure waves that cause heavy wear on the pump material. The more accurately we can predict cavitation, the closer we can bring the pump speed to this limit without any risks. The second limit is the load on the components of the pump, from a material stress and a hydrodynamics point of view. Static and dynamic stress limits of the material have to be considered in order to avoid plastic deformation or fatigue rupture

of these components. Hydrodynamic loads above a certain level can impair the efficiency and the smooth operation of the pumps. We can find the optimum using our high-precision modeling.

How complicated is this search for the optimum?

There's a great deal of expertise involved in the design process, and a lot has been calculated manually up to now. Our approach is to standardize and automate the design process more and more, and thereby accelerate it. We develop our own software tools to integrate all the steps of the design into an automated process. These steps include modeling

and validating the hydraulic contours and then designing the shape of the

pump, as well as calculating the material loadings that will arise. Because all these factors influence one another, optimization loops are usually necessary. Automation simplifies these cycles. This improved system benefits the customer because it increases the accuracy and reliability of the results.

Why are tests important?

We validate our CFD simulations with trials on smaller pump models milled from aluminum. In addition, it's crucial to be able to use real operating conditions to test the pumps that have been produced. That's why we have various test beds in our manufacturing centers around the world—even for very large pumps. For example, we can test our subsea multiphase booster pumps or

injection pumps under real conditions in Leeds, Great Britain. Unlike many other companies, we can test the full load conditions on most of our test beds. This is crucial because some phenomena that can jeopardize the pump reliability—like vibrations—can only be detected under real operating conditions. Thanks

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to these tests, our customers can be certain the pumps will run with the correct operating data and with high reliability.

What are Sulzer's latest innovations for the oil and gas industry?

We have brought various new or improved products for the upstream and downstream oil industry onto the market in the last few years, such as an updated series of pumps for refineries, the BBS process pumps. These are lighter and smaller than their predecessors and are also more efficient. For oil production, we offer new high-pressure injection pumps up to 1000 bar or 14 500 psi (see article p.4). We have also invested a great deal in the last few years in the subsea pump area. We develop innovative multiphase pumps, i.e., pumps for the complete bandwidth of transported media—from 100% gas to 100% liquid. We have been building multiphase pumps for more than 30 years and are continually improving them.

And what are you doing in the field of oil pumps?

The effect of viscosity on performance is an important subject in oil pumps. There are standard methods that consider this in the design, but these methods are based on statistics and are not very accurate, especially for high viscosities. On our development test stand, we are testing a certain number of pump types with real viscous products. Based on these results, we have developed new models that enable us to make better predictions. In addition, we are working on improving the efficiency of pumps for high-viscosity media with innovative designs.

How important are partnerships?

We rely heavily on partnerships, for example, for seals. Standard seals cannot be used in high-performance pumps such as our 1000 bar injection pumps. With these kinds of products, it is important to develop new seals by working directly with the seal manufacturer. In addition to the cooperation with seal manufacturers, we also have partnerships with motor companies, for example, for subsea pumps. We can develop complete systems thanks to these cooperations.

What goals do you and your team have?

Together with my team, I would like to optimize the development processes further. We are continually improving our calculation methods to raise accuracy and to approach the limits of physics in the core competencies that are relevant for product development, like materials science, hydraulics, design methodology, mechanical integrity, and mechatronics. In addition, we want to standardize the

pump components further. It would be a great advantage for our customers if we could reduce the variation in spare parts. This would simplify procurement and reduce storage space, particularly in refineries, where there are very many different pumps. More coordinated product development among our development centers will make it possible to reduce production costs and to offer our products at even more attractive prices without compromising on the quality of the pump.

Interview: Tünde Kirstein

Philippe Dupont

studied mechanical engineering at the Swiss Federal Institute of Technology in Lausanne (EPFL), where he received his PhD. He then worked for more than seven years as Head of the Cavitation Research Group at the Hydraulic Machines Laboratory of EPFL. He joined Sulzer in 1998 and took over the responsibility of the hydraulics department of Sulzer Pumps divisional headquarters in 2001. He worked in that position for around 13 years, with subsidiary responsibilities as Manager of Core Technology Projects and of Product Development for the Water & Wastewater segment. He started as Global Head Core Technology at the Pumps Equipment division at the end of 2013.

For refineries, Sulzer has developed new BBS process pumps that are smaller and more efficient than their predecessors.

