CFX Berlin's TwinMesh enables standardized design for new rotary lobe pumps

By Steffen Knabe
Vogelsang GmbH & Co. KG

CFD analysis improves performance, durability and service life of pumps for Vogelsang GmbH & Co. KG

Since the early 1970s, when rotary lobe pumps were invented mainly for agricultural purposes, their application has expanded from fertilizer distribution in agriculture to disposal and wastewater management in civil engineering and general industry. Rotary lobe pumps are the most reliable pumps in agriculture but, like all other technical equipment, they have to be optimized and constantly re-designed to continue competing in the market.

Traditionally, pump development involves intensive physical testing, but modern engineering offers much more; for example, computational fluid dynamics (CFD). Steffen Knabe, senior engineer at Vogelsang GmbH & Co. KG, one of Germany's leading rotary lobe pump manufacturers, uses TwinMesh for CFD analysis to improve the performance, durability, and service life of their rotary lobe pumps. Thanks to modern engineering, which uses state-of-the-art virtual product development tools, the newly developed IQ152 series weighs less, consumes less power, and has greater efficiency compared to previous models. This article describes the tools used by the engineering team at Vogelsang GmbH to make engineering easier. Finite Element Method (FEM) is a well-established engineering tool in the early development phases of rotary lobe pumps at Vogelsang GmbH. In contrast, CFD has mainly been used, until now, to optimize the inlet and outlet ports of their complex pumps. Due to the excessive man-hours required to ensure high quality CFD results, engineers often have to use reduced models with poor mesh quality to represent their machines. Thanks to the TwinMesh meshing tool from CFX Berlin, mechanical engineers now have a tool that allows them to analyze and optimize all their positive displacement (PD) machines without compromise. Axial and radial gaps, which have a serious influence on the prediction of machine performance, cannot be neglected in CFD analyses. Furthermore, the ability to use Structured grids and have reasonable resolution times for simulation are also essential. This is why
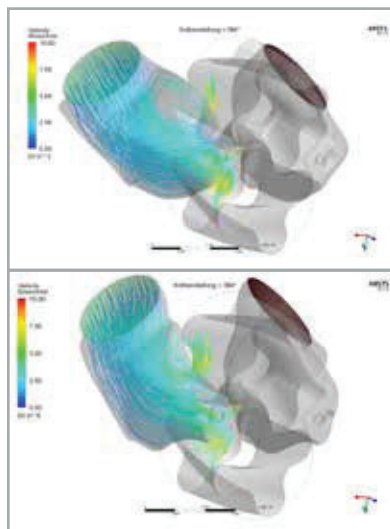
TwinMesh is a key tool for solid, reliable and accurate simulations and, in Vogelsang GmbH's case, for the development and optimization of rotary lobe pumps. For the newly developed IQ152 series, Vogelsang GmbH performed extensive physical experiments to validate their CFD results. In fact, during those experiments, the influence of the revolution speed on the torque was investigated and was found to be almost perfectly matched by the simulation data. In addition, the experimental data showed that changing the revolution speed also impacted leakage flows, which was also confirmed by post-processing the simulation data. The figure below shows the streamlines in the inlet area of the new IQ152. The simulation data revealed dead zones in that area as well as secondary vortices which resulted in a reduced coefficient of performance (CoP), higher energy consumption, and had a negative influence on cavitation behavior.

As a result, the engineering team was able to identify an inlet design to eliminate these dead zones and the undesirable vortices (see figure). Another advantage of the new design was the reduction in the material of the cast housing, which led to a lower pump weight and lower production costs for the new rotary lobe pump series. In addition, the simple TwinMesh and CFD setup made it possible to easily vary the rotor design to find a design with low cavitation behavior. All in all, the new design extends the service life of the pump, which reduces maintenance time and frequency, to the advantage of Vogelsang GmbH's customers. In summary, we can recommend TwinMesh to all manufacturers of PD machines and have decided to use CFD and TwinMesh for the development of the forthcoming Vogelsang GmbH rotary lobe pumps.

For more information
www.twinmesh.com or www.cfx-berlin.de
and contact Alessandro Arcidiacono - EnginSoft
a.arcidiacono@enginsoft.com