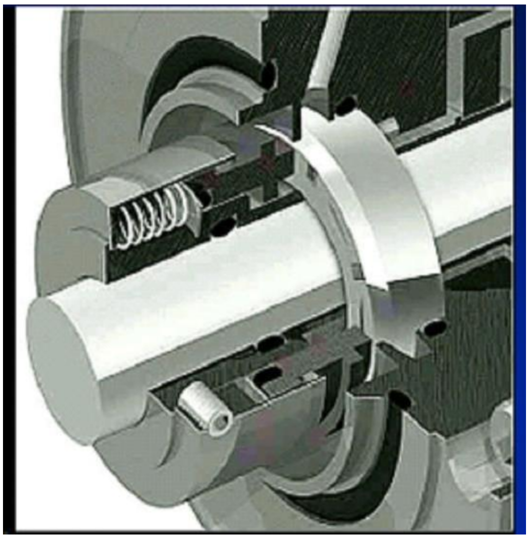
POLAR PARS OL & Wall Rotation features of PHOENIC S applied to Pumping Ring Flow Analyses for Mechanical Seals.

Pumping Rings are cooling devices widely used in the sealing systems of rotary machines. They use water circulation to extract heat caused by seal friction. A major concern of engineers is how much heat the cooling system can take, which mainly depends on the flow rate.

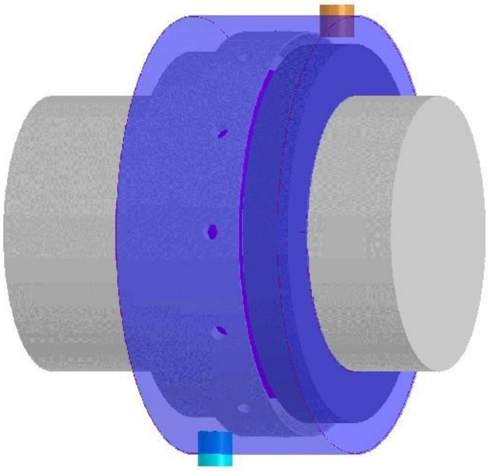
The pumped process fluid (liquid or fluid with vapor bubbles or solids) is sealed at the radial face gap between the rotating primary seal ring and stationary mounted mating ring. Frictional heat occurs at the sealing interface.



Picture courtesy of John Crane Inc

In this example, the rotation of the device is treated as a “slip wall” on the rotating parts with angular velocity, which forms part of a new feature of PHOENIC S -3.6.2 – “POLA R PA RS OL”.

The Pumping Ring with a seal system on the axis is shown in Figure 1. The yellow cylinder above the device is an inlet and the blue one below the device is the outlet. The rotating Pumping Ring and mating ring are shown in Figure 2.



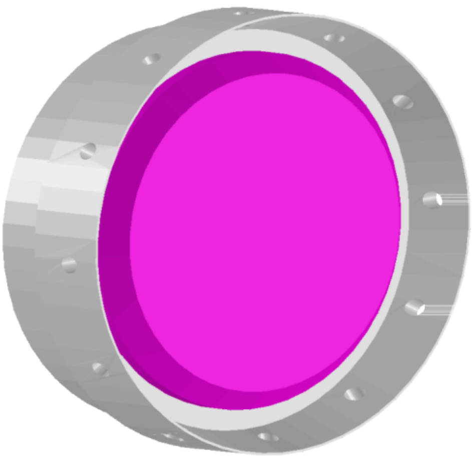


Figure 1. Pumping Ring with seal system Figure 2. Geometry of Pumping and Mating Rings

S even simulations were carried out which produced the pressure and flow rate curve shown in Figure 3.

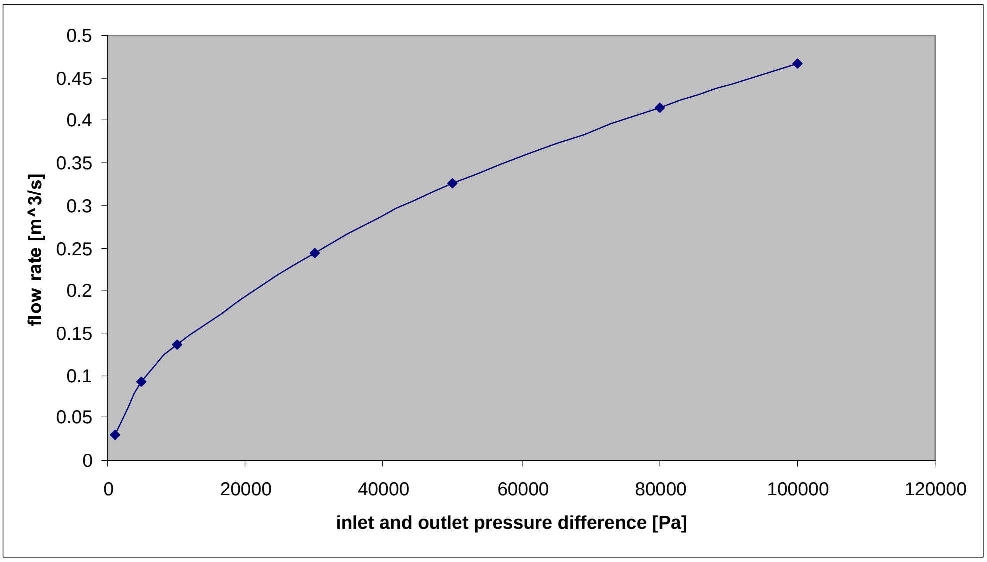
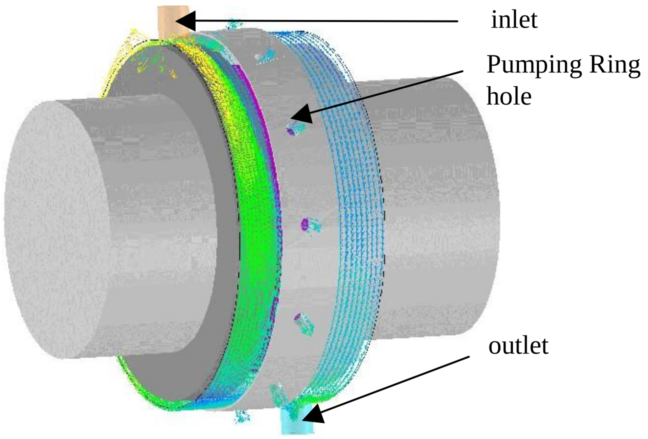


Figure 3. The relation of Pumping Ring flow rate with pressure

The results below (inlet pressure 1.0E05 [Pa]) are velocity vectors clearly showing the coolant coming from the inlet along the stationary surface of the primary ring into the passage between the mating ring and the Pumping Ring, and then



flowing through the hole on the Pumping Ring to the outlet.

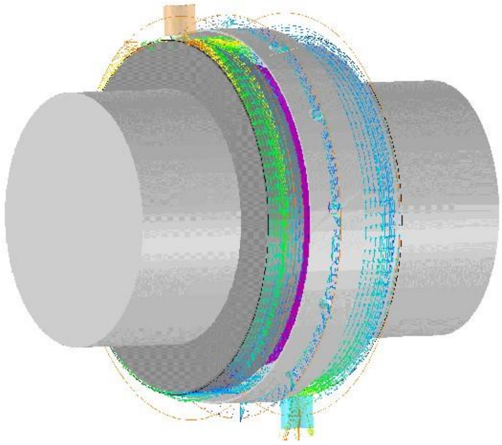


Figure 4. Velocity vectors on Y -plane near inner surface of Pumping Ring (left) and X -plane along the Pumping Ring hole (right)

Pressure contours on the Pumping Ring surface in Figure 5 indicate high- pressure areas on the inside surface of the Pumping Ring. Figure 6 shows streamlines of the flow path coloured by residence time.

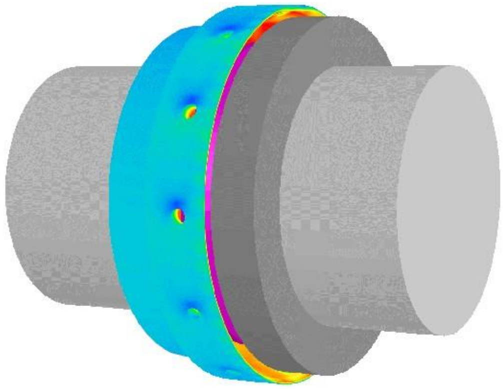


Figure 5. S urface pressure of Pumping Ring

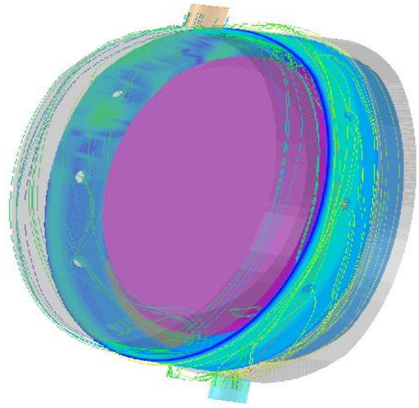


Figure 6. S treamlines of residence time

The case demonstrates how the wall rotation feature in POLA R PA RS OL simulates rotary machines. For most steady rotation cases, wall rotation can be over ten times faster than running transient MOFOR. A dditionally, the automatic POLA R PA RS OL grid generation makes the analysis work as easy as pressing a button.

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