TECHNICAL BULLETIN

PROGRESSING CAVITY PUMPS | LS-TB-007

LIFTING SOLUTIONS

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LS-TB-007 D1	PC PUMP SLIPPAGE AS A FUNCTION OF PRESSURE	MARCH 9 2020	ENGINEERING

BACKGROUND

In a progressing cavity pump (PCP), the slippage is a function of discharge pressure and is independent of speed. Slippage occurs when liquids or gasses move backwards across the seal line created between the rotor and stator. There is a large pressure differential between the intake of a PCP and the discharge (as a function of the application lift requirements). This pressure differential is distributed across the cavities between the top (high pressure discharge) and bottom (lower pressure intake) of the pump by slippage. The primary mechanism for the distribution of pressure is compression of the elastomer itself under high pressure and in some cases deformation of the lobes depending on the geometry. Both result in a reduction in sealing efficiency.

GEOMETRIC FACTORS AFFECTING SLIPPAGE

There are several geometric factors that affect slippage rates in a PCP. Most importantly is the structure of the seal lines themselves. The width of a seal line is primarily bound to the pitch of a given geometry. It is also affected by the compression or depth of interference between the rotor and the stator.

Long Pitch	Wide Seal Lines Low Compression (Shallow Interference)	Better sealability
Short Pitch	Narrow Seal Lines High Compression (Deep Interference)	Harder to seal

The number of sealing lines or the lift provision in a PCP also affects sealability. The more seal lines that are added result in a higher maximum discharge pressure or alternatively a lower pressure differential across each seal line (depending on the application lift requirements).

ELASTOMER CONSIDERATION

The hardness or stiffness of the elastomer affects sealability. The harder the elastomer the better the sealability as more force is required to compress or deform the lobes of a stator. The opposite is true for a soft elastomer.

APPLICATION FACTORS

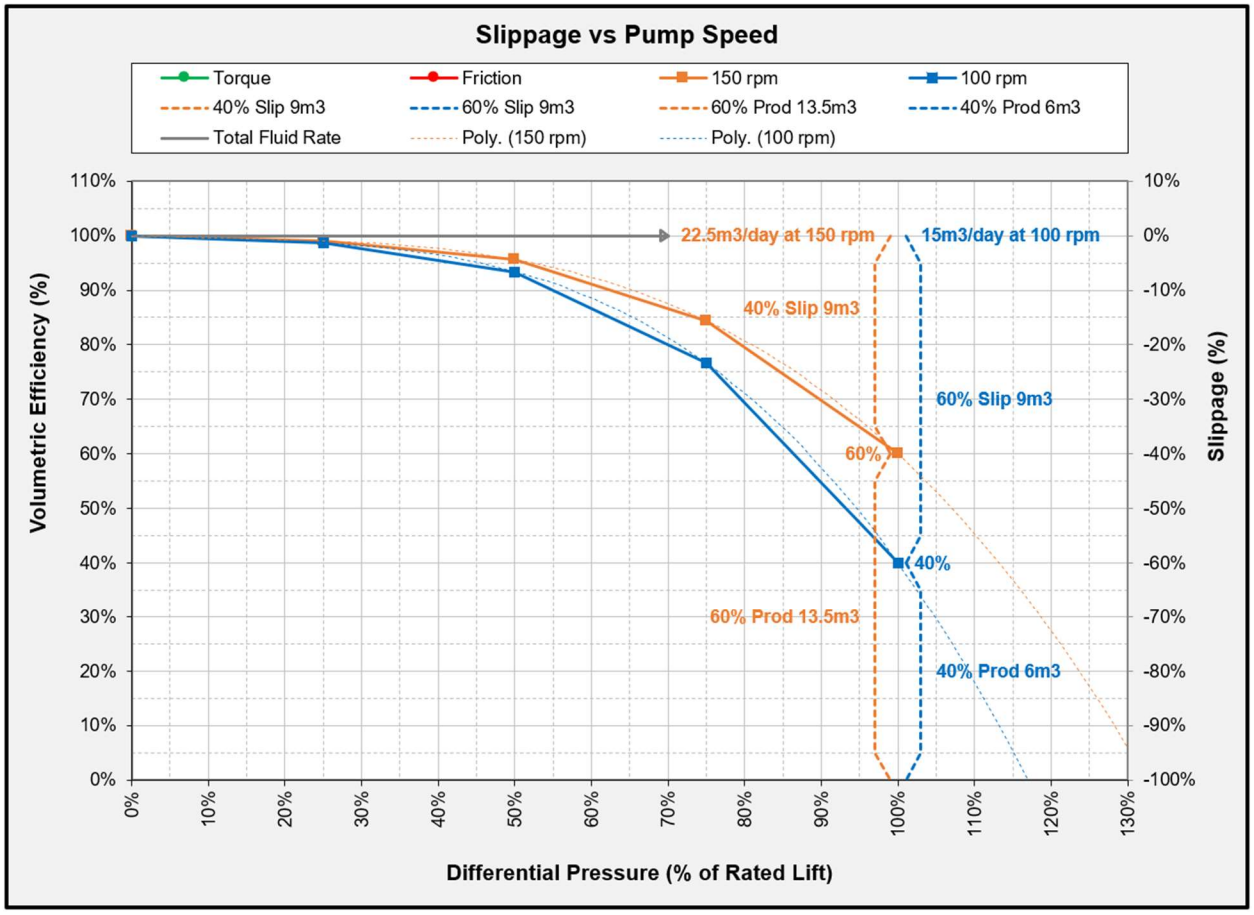
There are several application related factors the affect the sealability of a PCP. Seal ability increases with the viscosity of the produced fluid emulsion because the fluid is more resistant to flow. Thermal or aromatic swell of the elastomer will increase compression between the rotor and stator resulting in deeper interference and better sealability. In the case of thermal swell, there is a slight softening of the elastomer with increased temperature which partially counteracts the increased compression.

CALCULATING EFFICIENCY AT DIFFERENT SPEEDS

Because slippage is independent of speed you can easily calculate theoretical pump efficiency at any speed and pressure when the slippage is known for a single speed at the same pressure.

Chart 1 below shows the effects between 150rpm test speed and 100rpm. As you can see, the total fluid rate drops with the decrease in speed. Because the differential pressure remains at 100% of rated lift, the

slippage rates stay the same at 9m3/day. When subtracted from the total fluid rate at speed, the resulting volumetric efficiency is lower for the blue curve at 100rpm



CONCLUSION

Slippage rate is a loss in flow rate measured in m3/day. It is a function of differential pressure and does not change with operating speed. Once a pump test curve has been established at a given speed, you can easily predict the resulting curve at a different pump speed. It is extremely important to understand the application pump speed requirements as differences in the target speed will have a significant effect on pump performance as it relates to speed.