BHGE-ENOC system drills into the details
CST combines lubrication technology concepts for customized lube system

PLS uses principles from point-to-point, divider block systems

If operators want their lubricated reciprocating compressor to operate properly and reliably, then two issues should be avoided: poor lubrication and over lubrication. Poor lubrication leads to premature wear of piston rings and wear bands, while over lubrication creates process gas contamination, impaired machine performance and higher operating costs.

The two most commonly used lubrication systems currently on the market are the pump-to-point system and the divider block system, each of which has advantages and disadvantages. The pump-to-point system works with a pump unit for every injection point; each pump has its own dedicated rocker arm system with a screw for adjusting the stroke. The oil delivery is adjusted individually and manually, allow it to be approximate (often resulting in over-lubrication). This system also requires setup time and continuous and daily inspection by the operator. Additionally, the only way to check and adjust the oil drip is by a sight glass, the reliability of which often proves to be a critical point in the system.

In the divider block system, the lubricant is pumped into a single inlet of the "divider" and is spread volumetrically into a certain number of outlets through the progressive movement of the pistons in the elements arranged in sequence (see Fig.1). Each primary divider block outlet may lead to a secondary divider, usually one per cylinder, where the oil flow is further divided and pumped to all the points on the compressor for lubrication. The oil delivery is still adjusted by the pump; this system does not allow any adjustment of the lubricant flow either to the individual points or to the individual cylinders, unless one or more elements are replaced in a primary or secondary divider valve.

The precision of the divider valve lies in the dimensional tolerance with which each block is made, and reliability cannot be guaranteed without adequate control and maintenance of the quality of the oil and a system of properly designed alarms and trips. Moreover, blockage of only one of the lubrication points can cause the whole system to shut down.

To overcome the drawbacks of both these lubrication methods, Compression Service Technology (CST) has designed a customized lubrication system. CST’s system provides the intrinsic accuracy of the divider valves, dispensing with the approximate and inadequate adjustment of the drip rates. The system also makes it possible to reduce the risk of unexpected issues when new solutions are needed. The initial calibration of the system is always performed on a test bench prior to installing it on the machine.

CST has already developed, designed, tested and supplied this new concept lubrication system on six reciprocating compressors operating in different conditions.

**PLS lubrication system working principle**

The new system is based on a combination of the old pump-to-point concept – having more than one pump unit that makes it possible to adjust and optimize the oil flow to a single cylinder – and the divider block system, which can split the lubricating oil flow into precise fractions.
The oil pump is equipped with a minimum number of pumping elements (see Fig.2), generally one for each compressor cylinder. Each element is connected to a divider valve that distributes the oil in proportioned amounts to each lubrication point.

An accessory group, consisting of a thin mesh filter, a differential pressure gauge and a pressure relief valve, located between each pump element and the related divider block, protects the divider block from any impurities in the oil.

The hydraulic pump is a piston type; it can be designed for operating pressures up to 7977 psi (550 bar), is suitable for a wide range of viscosity oils (10 cSt to 460 cSt at 104°F [40°C]) and requires minimal maintenance.

The PLS lubrication unit is installed on an independent rack near the compressor (Fig.3) and is composed of the following main items:

- an overpressure pop-up indicator on every outlet, a visual flow indicator and a proximity switch to monitor the lubricant flow through the divider and to check that it is working correctly.
- pressure relief valves, suitably arranged to bypass the lubricant to the tank and to safeguard the system against overpressure.
- local control panel for remote monitoring of the oil flow and of any alarming situation.

**Test bench for calibration and performance analysis**

CST has designed and constructed a test bench to fine-tune the operation of the PLS lubrication system and to perform testing prior to installation. The test bench is built around the job unit and mimics operating conditions comparable to those in the field. The oil circuit is modified by means of bypass lines and other equipment to make the lubricant circulate in a closed loop, while the back pressure at the injection points is created using throttle valves.

The instrumentation provided with the PLS supply is included in the test. An electronic recording system detects the frequency of the flowmeter, which is installed on the divider valve. The flow rate of the latter can be checked with precision and adjusted by regulating the stroke of the pumping element. At the same time, pressures, flow rates and other parameters are also measured and checked to verify the correct operation of the whole system.

Testing takes 80 hours and includes checks of the tubing connections and the tank for lubricant leaks. If an issue arises, measures are taken to solve them until the operating and design parameters are aligned. When testing is successful, the lubrication system is completed with a test certificate.

Fig. 4 shows the trends of measurements acquired on the CST PLS, which replaced an old point-to-point system on a 250 kW
single-stage reciprocating compressor operating in Africa.

**Reduction of oil consumption and investment recovery**
Through controlled and precise lubricant injections, cost savings are immediate and return on investment can occur quickly. In the case of the compressor installed in Africa, CST PLS cost was recovered in 20 months. This result did not include the additional savings of operator time required to run daily checks and adjustments of the old system.

Point-to-point systems often experience problems due to malfunctioning sight glasses: these devices randomly lose vacuum, resulting in the pumping elements being unable to draw oil from the tank, resulting in the compressor running partially dry. In many cases, an operator spends time every day manually intervening and forcing the relevant pumping element back to its proper operating function.

With bigger compressors, the return on investment can be as quick as one year. Based on CST’s experience, the PLS reduces lubricant consumption up to 70% compared with a point-to-point system. Further economic advantage is gained through the efficiency of operation and increased availability of the machines. The PLS has also garnered positive feedback due to its superior functionality, flexibility and reliability compared with classic divider block systems.

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