Oil & gas

System upgrade's sealless solution

When a carbon dioxide recovery plant in Oklahoma, USA, needed a pumping system upgrade, the senior process engineer soon realised that the reflux stream from the Propane Recovery Column (PRC) needed to be entirely re-designed.

The plant uses the Ryan-Holmes Process for the efficient extraction of Natural Gas Liquids (NGL) from a carbon dioxide stream. Prior to the upgrade, the process used two in-line vertical pumps to achieve the required differential head with a further pump on duty stand-by.

All three pumps were fitted with dual mechanical seals which were located at the base of the PRC. At the pump inlet, the process liquid was at high temperature and near to its bubble point. As a result, the sealed pumps in use suffered frequent mechanical seal failures, which resulted in loss of productivity, process emissions and extra cost.

Magnetic drive pump

A process re-design relocated the pumping position to a lower temperature location further downstream in the PRC reflux line. The dual in-line vertical sealed pumps were replaced by a one-off 3-stage sealless magnetic drive pump, the HMD Kontro GSPX, which meets the requirements of the API-685 standard.

The decision to switch from double mechanically sealed pumps to sealless magnetic drive technology was an easy one according to the senior process engineer. He recognised the increased process efficiency and savings of the sealless pumps, as well as the environmental, health and safety compliance benefits from the elimination of escaping emissions.

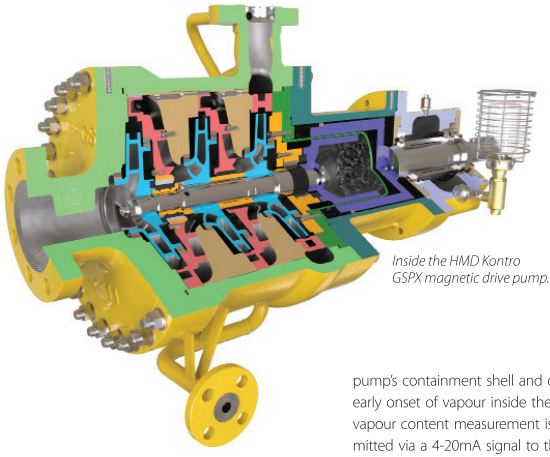
Whilst the plant re-design has made the pumping application less troublesome, the nature of the process liquid (as a light hydrocarbon) means that the application is still potentially volatile. The robust nature of the magnetic drive multi-stage pump has been further improved by several new technologies:

Yellow HMD Kontro GSPX Sealless Pump in application.

1. Non-metallic containment shell

In typical magnetic drive pumps, the containment shell is metallic. Heat is generated in the metallic containment shell as a result of the eddy currents produced by the rotating magnetic flux, as it passes through the static, electrically conductive shell. This eddy current heating effect reduces the operational margin to vapour pressure and can lead to bearing failures (loss of liquid separation film) in process upset conditions.

By using a chemically inert and tough PEEK composite shell, these eddy currents and the associated heat are eliminated, giving both increased margin to vapour pressure and greater robustness in the event that a severe process upset causes dry running of the pump. This makes a non-metallic shell an excellent choice for potentially volatile applications. Here the process re-design has facilitated the use of the optimum containment shell solution.



Inside the HMD Kontro GSPX magnetic drive pump.

The VapourView Gas in Liquid Detector.

2. Matrix Composite (CMC) thrust pad

This has improved strength under marginal lubrication conditions and provides a more benign ultimate failure mode (in case of a severe process upset) than conventional Silicon Carbide (SiC) on SiC bearings.

3. Non-intrusive ultrasonic condition monitoring instrument

The VapourView instrument provides real-time condition monitoring inside the pump's containment shell and detects the early onset of vapour inside the pump. The vapour content measurement is transmitted via a 4-20mA signal to the site distributed control system and provides alarm and shutdown signals. The VapourView instrument is proving more useful than the company originally realised. For example, when the process is coming back on stream, the liquid entering the pump is unstable for a period of time. By having visibility of conditions inside the pump, the user can avoid premature start-up (which could damage the pump) and can also ensure that the pump is brought on line as quickly as possible.

The VapourView instrument has also revealed issues upstream in the process. This includes, the unexpected detection of vapour during 'normal' operating conditions which was the primary indicator allowing the user to detect a leak in an upstream heat exchanger. The plant's process controllers pay close attention to this 4-20mA signal because it allows them to tune upstream processes to further improve plant efficiency and robustness.

The HMD Kontro GSPX Pump.

4. In-line filter basket

This is located in the discharge branch of the pump and prevents the ingress of any solid particulate, suspended in the process liquid, into the bearing system of the magnetic drive pump, where it could cause wearing damage and increase the risk of failure.

The HMD Kontro GSPX

The multi-stage pump used produces 1200ft (360m) of head at 180 USGPM (40m^3/hr) at 3500 rpm and is controlled by a variable speed drive controller (VSD) for process flexibility. The pump was selected for this application to ensure the highest level of health and safety and as an investment in sealless' magnetic drive pumps, compliant with the American Petroleum Institute (API) standard 685, yet also featuring the latest technologies.

The GSPX pump is a multi-stage derivative of the HMD Kontro GSP range. The GSPX is a combination of OH2 (first stage) and between bearings design (BB5) for the second and third stage impellers. The GSPX pump range is based on the HMD Kontro magnetic drive and is available in 2 or 3 stage configurations with two diffuser-based hydraulic options. These multi-stage pumps produce higher differential pressures than single stage sealless pump models.

According to the company, the intelligent process design and sealless technologies which are integral to the GSPX multi-stage pump, offer a lower lifetime cost, lower maintenance and lower emissions than a mechanically sealed pumping solution. ●

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