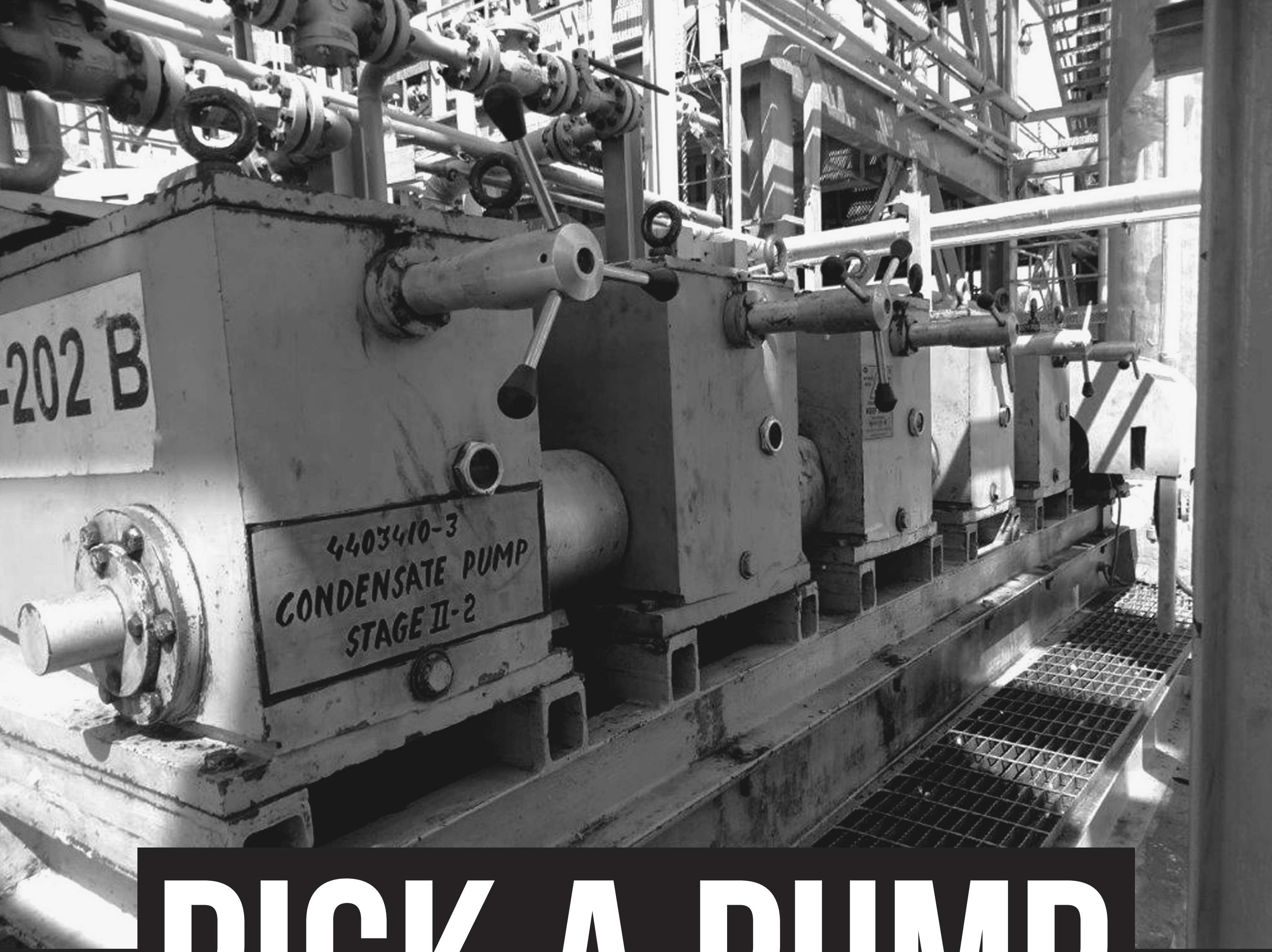

PICK A PUMP

Paul Davis, Wanner International Ltd, UK, explains why pump selection should not be an automatic process.

Transferring, compressing, mixing and processing hydrocarbons for many different uses is a highly complex procedure, and one in which pumps play a prominent role.

The liquids that pumps handle are diverse, and the flows, pressures and temperatures at which they must operate, equally so. Many of the liquids that are pumped are not straightforward. They may carry impurities of all kinds or may present special problems in themselves. For example, they might be corrosive, sensitive to shear, contain fine suspended solids, have high vapour pressures, or vary widely in viscosity – all creating a challenge to pump.

Pump selection, whether for a replacement or a new project, should not be an automatic process. System planners, buyers, plant engineers and others involved are alerted to possibilities, and benefit from experience drawn from both outside and within their own organisation. This article looks at some of the salient points that may be overlooked and cites case examples. It will particularly focus on the topics of metering, dosing and injection – all of which are becoming progressively more important year by year.

Energy costs

One issue that is not easily overlooked is energy. Energy costs have risen rapidly in recent years, and they are now responsible for an unprecedented share of pump life cycle costs worldwide.

Figure 1. Pumps replaced: a battery of five linked traditional metering pumps on a condensate application (one diaphragm/head).

Figure 2. The replacement pump: a single Hydra-Cell pump on the same system to perform the work of the five linked traditional metering pumps.

Energy cost is not the only useful comparison in pump selection, but it is closely related to pump efficiency, which, in turn, depends largely on the fundamental design and type of the pump. In choosing pumps for metering and related duties in the oil and gas industry, pump type is often a clearer guide than pump model. That is partly because individual manufacturers have historically worked within the constraints of standards laid down by bodies such as the American Petroleum Institute (API), designed to ensure certain levels of accuracy, build and product safety, to be followed by those who comply.

Note that some pumps are loosely termed 'metering pumps' if they can perform repetitively on a relatively undemanding application where strict accuracy and consistency through time are not critical. Eventually all pumps wear, but the rate at which it happens varies widely. Some pumps are more exposed than others to causative factors. A pump that is prone to wear (typically of dynamic seals, drive shaft, gears, piston, hose or screws) fails to fully qualify as a metering pump because its accuracy will reduce unpredictably, gradually or not, from the outset. Pumps whose flow is affected by opposing pressure (e.g. centrifugal pumps) are likewise ruled out.

API's Standard 675, adapted in 1994 and twice revised, is written for the oil, gas and petrochemical industries, and is concerned with controlled-volume positive displacement pumps of reciprocating design. It originally applied to traditional hydraulically-balanced diaphragm metering pumps, which are often the conventional choice in petrochemical applications where accuracy is a prime consideration. However, technology has moved on significantly.

While the design of the hydraulically-balanced diaphragms in Hydra-Cell pumps is unconventional, these pumps have certain principles in common with traditional metering pump designs. In both pump designs, the diaphragms are balanced hydraulically between the process liquid and the actuating medium, which is typically hydraulic oil. The two liquids are never in direct contact – a considerable advantage in handling difficult process liquids. It also allows for more accurate discharge pressures than that of a pump in which the diaphragm is mechanically actuated.

A major difference between a Hydra-Cell pump and a traditional metering pump is that the latter only has a single large diaphragm per head, while the former pumps incorporate three or five small diaphragms in a single compact pump head. The contrast is apparent in the size, bulk and complexity of a traditional pump that has an equivalent flow and pressure capability. The pay-off for simpler design takes various forms: one is reduction in the size of motor required, enabling ongoing savings in energy consumption.

Case studies

India

At a leading Indian oil and gas company's site, a single Hydra-Cell pump with multi diaphragms replaced a battery of five linked traditional metering pumps on a gas condensate application. A site engineer recently won an internal competition for his site's contribution to reliability and best practice after creating a report that focused on the results achieved using this pump. Among other benefits, the report mentioned the pump's compact design, reducing CAPEX and OPEX, and its accurate, consistent flow with fixed volume of oil replenishment on every stroke. It also pointed out that no pulsation dampener was required, as flow was virtually pulseless. With no need for dynamic seals, the pump was leak-free and the three-diaphragm-single-head design minimised pulsation (Figures 1 and 2).

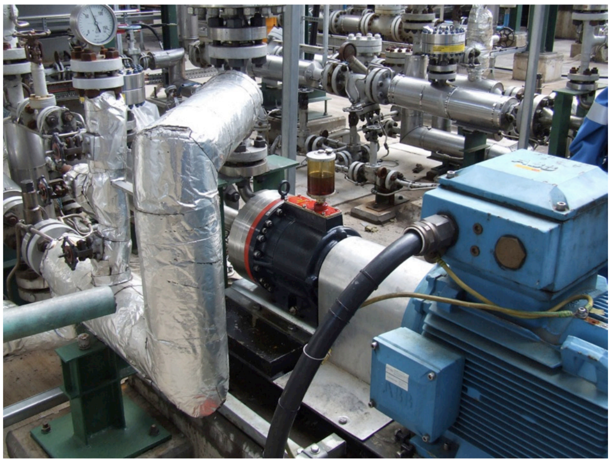

Figure 3. Pumping a hot water and chemicals mix to flush out main process pipes and minimise corrosion.

Figure 4. Hydra-Cell Q155 pump on transfer duty at a lease automatic custody unit.

Saudi Arabia

The Saudi Arabian analytical laboratories of an international oil company needed to continuously monitor the condition of an acidic mud slurry containing HCl in concentrations ranging from 2 – 10% and containing up to 25% of solid particles. A metering pump was required to pump the slurry round a circulation loop at pressures up to 10 bar. To ensure accurate readings, liquid flow at the analyser had to be volumetrically accurate and free of pulsation. The laboratories opted for a Hydra-Cell metering pump as it could operate at required pressure and handle viscous liquid and its high content of abrasive solids, while its smooth flow made pulsation dampeners unnecessary.

China

Canned motor pumps transferring gas condensate at a China Petroleum plant were continually breaking down. The process liquid, on which the plant also relied to lubricate vulnerable parts, contained water, sand particles and corrosive chloride ions. Premature wear, frequent failures and high maintenance costs continued until the plant replaced the canned motor pumps with seal-less Hydra-Cell pumps. A year later, the new pumps were still running smoothly, with no maintenance needed and no problems to report.

Features mentioned by engineers at the plant included ability to run dry without damage if, for example, an inlet filter blocked, as well as the ease and accuracy of electronic control via frequency inverter when varying flow by adjusting motor/pump speed.

Europe

Removal of hard deposits from internal surfaces of pipes and process vessels may be carried out by delivery of a hot mix of chemicals and water at high pressure and temperature. To clean a steam cracker at a site in Germany, the company used a Hydra-Cell G25 pump. The flow rate of the decoking mix was up to 68 l/min., pressures to 70 bar. The coke build-up had to be removed periodically, as a number of processess on the site depended on the efficient working of this vessel. The pump proved reliable and cost-effective for this task.

In a similar application elsewhere (Figure 3), the main process pipes at a refinery carry liquids with a high H_2S content. These may also contain particles. To minimise internal corrosion, the pipework must be flushed out thoroughly after every cycle. The flushing liquid, a hot water and chemicals mix, is delivered at pressures up to 40 bar, and the water temperature is 85°C.

Plunger pumps have previously been chosen for this work. However, they have limitations, one of which is that they rely on dynamic seals and packing, which wear and so are not leak-free. On this site, the user preferred to rely on a compact seal-less pump. The Hydra-Cell met the requirements as it had no dynamic seals, minimal maintenance, and the ability to run dry without damage. Moreover, pumped liquid is 100% contained, removing the potential of environmental harm.

Conclusion

Pumping process liquids in metering, dosing, or injection applications is not a simple business. Equipment specifiers know their product, system requirements and the need to sustain high standards of accuracy, while avoiding waste of energy and other operational resources. If they are to make a fully informed choice, they should also be aware of developments in pump design and be able to take advantage of user experience outside their own organisation. This article has identified the types of pump that qualify as true metering pumps.