What makes the Hydra-Cell pump versatile?

If you are an engineer working in the process industries... if today you have to choose a pump for a new system, or replace a pump in existing plant... How will you choose? Two suggestions. Keep an open mind. Think about versatility

You may agree that the first consideration governing the purchase decision about a pump in the chemical and process industries should be fitness-for-purpose. How safely and efficiently it will do the job for which it is required.

Next will come cost, not just purchase price but estimated over the whole lifetime of the pump and expressed as Life Cycle Cost (LCC).

But another factor closely related to both cost and fitness-for-purpose is the versatility of the pump. How adaptable is it? As we shall see below, this question can directly affect initial plant cost and system design as well as operational issues such as spare parts inventories and training of maintenance and repair staff. It is also is an indicator of all-round performance.

To be truly versatile, a pump must operate over a wide range of pressures and flows, be able to handle a variety of liquids – hot, cold, thin, viscous, abrasive and corrosive - and perform in many different environments.

No pump in recent years has made more impact in the process industries for its breadth of application than the seal-less, hydraulically balanced Hydra-Cell pump manufactured by Wanner Engineering. In October last year Wanner won notable recognition at the Institution of Chemical Engineers Awards 2007 when its submission for the AMEC Award for Excellence and Innovation in SMEs was 'Highly Commended' – emerging from a shortlist of achievements in fields as diverse as stem cell production, wireless network technology and ultrasonic water metering.

The company's submission focused on metering applications. Its pumps are characterised by electronic VFD flow control and a uniquely compact design, with multiple diaphragms in a single head (figure 1) giving exceptionally smooth delivery. The judges agreed that Wanner's Hydra-Cell Metering Solutions package added up to 'the first major advance in metering technology in a generation', with potential for substantial cost savings over a wide range of metering applications.

Pump specifiers (not only those concerned with metering and dosing) have many options, so there is a temptation to 'play safe' and go for the familiar, or opt for whichever type of pump is known to have been used previously in similar circumstances.

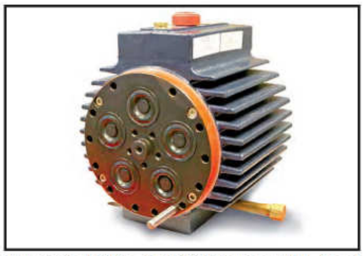

Figure 1: Hydra-Cell G35 pump with head exposed. Incorporation of the 5 diaphragms in a single head reduces the size of the pump and virtually eliminates pulsation

So far from being 'safe', that decision would have been costly if a reliable alternative pump could have been used instead – one that would use less energy, need less maintenance, cost less to repair; an alternative that would be easier to design-in, be less bulky, have a smaller footprint; one that would be easier and less expensive to control accurately over a wide turndown range; one that delivers a smoother flow, with lower pulsation and reduced need for dampeners.

If such features are important, and the alternative pump has them. If it can handle the liquid to be pumped and can provide the flow/pressure performance the application demands - then it is certainly worth considering.

In the process industries and elsewhere, that successful 'alternative pump' has often been the Hydra-Cell, as the case files of Wanner International can testify. And frequently its success can be traced to the pump's versatile design.

Generically different from other types of pump, the Hydra-Cell has a simple, rugged build in which elastomeric diaphragms; flexed sequentially by hydraulic pressure, provide the pumping action. They also isolate hydraulic fluid in the drive end from whatever fluid is to be pumped. The pump's few wetted parts are available in a variety of materials compatible with almost any liquid – hot or cold.

There are no dynamic seals in the pump and the diaphragms operate in hydraulic balance, unstressed even at high pressures. Under abnormal system conditions, such as partial vacuum, which can occur, if an inlet filter becomes blocked, Wanner's patented Kel-Cell feature protects the diaphragms against rupture, allowing the pump to run dry without damage.

This unique combination of features underlies the versatility of the pumps and enables them to meet apparently conflicting needs at the same time.

Figure 2: Spray Dry plant for enzyme production

A Danish company, making extrusion machinery for the production of animal feeds, had experimented with various types of pumps to find one that could effectively handle all the different ingredients used by its customers. Some of the pumped liquids are abrasive, while some contain solids. Required flow rates vary widely – calling for a pump capable of 15:1 turndown ratio. None of the pumps was satisfactory. A piston pump was marginally better than some types, but it had severe limitations. There were problems with seal wear, with consequent falling away of accuracy, and poor repeatability.

The machinery company looked for another positive displacement pump (but one without seals) that would resist abrasive liquids, sustain high accuracy and efficiency, and be able to run dry. The Hydra-Cell G10 finally chosen met all these criteria and was successfully fitted on all extruders for both home and export. The one model is able to pump the full-required range of liquids, delivering outputs from 80 l/hr up to 1225 l/hr.

In Sweden, a chemical producer selling to the paper industry faced a similar problem. The dispensing equipment it provided along with its chemical products originally incorporated diaphragm metering pumps. Customers needed to measure flows with a magnetic flow meter, so a pulsation dampener was included in the system. To handle big variations in flow and pressure, pumps of different sizes were needed, and dampening pressure adjusted. By standardising on the Hydra-Cell G03 pump, the chemical company was able to lower prices and provide its customers with a more flexible system.

The pump is controlled by frequency inverter and driven through a gearbox. A Hydra-Cell unloader valve is included in the line.

One system covers all situations. The unit is smaller; flow rate is flexible, with a big turndown ratio (and if necessary the motor can be changed without changing the pump). There is no need for a pulsation dampener. Installation and start-up are faster.

Another process with diverse, potentially incompatible, pumping requirements is Reverse Osmosis (RO). Its many applications range from acid recovery to conversion of seawater into drinking water. Individual system requirements vary, but all of them call for the fluid to be streamed along the membrane at elevated pressure and with little or no pulsation. (RO and Nanofiltration (NF) membranes are susceptible to mechanical damage).

Few types of pumps combine high pressure capability with very low pulsation, so separation systems often need significant extra expenditure on dampeners to flatten the pulses. Moreover, most pumps capable of high pressures rely on dynamic seals and are intrinsically vulnerable to the very fluids that RO systems are commonly required to purify.

Figure 3: A Hydra-Cell G25 pump was used to pump this viscous, extremely abrasive resin at pressures up to 70 bar for the batch production of undersea cables

This was one of the reasons why a Hydra-Cell G35 pump was chosen to feed an RO system purifying used rinse water in a UK confectionery plant. The membrane rejects sugars while the pure water permeate is available for re-use. A piston pump or other type with seals would have been at risk because of crystallisation of sugar at the seals, threatening problems of seal wear and leakage. That did not apply to the Hydra-Cell pump, and its low-pulsation flow is easily controlled by frequency inverter linked to a pressure sensor, maintaining constant optimum pressure at the RO membrane.

Koch Membrane Systems, an acknowledged leader in membrane filtration technology, cites low pulsation, as well as high pressure capability and economical use of energy, in choosing Hydra-Cell as the main high pressure pump in its separation systems. KMS has used the pumps in both Reverse Osmosis and Nanofiltration (NF) processes. Current projects include production-scale and pilot plant systems manufactured for the pharmaceutical industry. The systems enable product recovery from processes and treatment of waste streams offering substantial volume reduction prior to thermal oxidation. One production-scale NF system incorporates Hydra-Cell G35 pumps operating at 35 bar to deliver an aqueous stream with a percentage of waste organic solvents to the NF membrane. The design of the pump automatically rules out seal leakage, which would be unacceptable on this application.

Spray drying is another application where needs can conflict. In a German chemical plant a high-pressure triplex metering pump was delivering aqueous emulsion with 40% solids to the atomising nozzles at temperatures up to 80°C, but was costing 10,000 Euros/year to maintain and repair. The Hydra-Cell G25 pump that replaced it delivered the same 60 bar pressure and flow rate, but with lower pulsation - resulting in a more homogenous product. Following a 3-month trial the pump showed no signs of wear and over the next 2 years no repairs were needed – only a precautionary routine annual replacement of potentially wearing parts.

Indian manufacturers of spray dry equipment have also altered their preferences. Shachi Engineering, whose recent installations have included spray dryers for dyes, agrochemicals and enzymes (Fig.2) formerly used piston plunger pumps but now fit Hydra-Cell pumps wherever possible. Pinpointing reasons for this change of thinking, Shachi list: seal-less design, with no leakage, compact size, high efficiency (hence reduced power consumption) low maintenance and easy repair, and constant pressure, through low pulsation.

Some of these same features in a different environment last year prompted a Mumbai manufacturer of heat exchangers to install Hydra-Cell G35 pumps to handle machine tool coolant in one of its machining centres. The new pumps replaced gear pumps made by a manufacturer of international repute. Though of good quality, these high pressure pumps were subject to wear and tear caused by metal particles in the coolant fluid. Fitting the Hydra-Cell units – which allowed no risk of contact between the drive end of the pump and the pumped fluid - avoided problems of wear, thereby reducing machine downtime, increasing operational efficiency and generating cost savings.

No pump can claim to be exceptionally versatile unless it can handle product of widely varied viscosity, but in practice very thin, non-lubricating liquids such as turpentine do present problems for those that rely on the pumped medium to lubricate their seals. Other types of pump may have difficulty with viscous product. The Hydra-Cell however can handle a full range from very thin liquids to slurries and abrasive adhesives (figure 3).

A worldwide concern these days is energy consumption, and the energy used by an industrial pump for a given flow and pressure output is directly related to its pumping efficiency.

A Hydra-Cell pump working at high pressures achieves efficiencies in the region of 85%. This is very high compared with many other types of pump, and it means that the Hydra-Cell can often be fitted with a motor smaller than that required by an alternative pump for equivalent flow/pressure performance. How does that work out in practice? The following example is not untypical.

A German chemical company had been using a magnetic drive centrifugal pump with 55kW motor to transfer polystyrol into a process line from a remote storage tank over a distance of 5.8 km. After careful consideration of several alternative units, the company replaced the original pump with a Hydra-Cell G35, which only needed a 13.2kW motor (figure 3).

Much lower power consumption was only one factor in its favour. Other

Figure 4: Low energy G35 pumps feeding polystyrol into distant process line

units in contention included a 4-stage centrifugal pump with double axial face seal, and a multi-stage canned motor pump. The G35 had a clear price advantage and the pumping efficiency of the Hydra-Cell was double that of its competitors.

The final decisive factor was heat energy input. Polystyrol tends to flocculate if liquid temperature rises above 60°C. Because of their pumping action, none of the centrifugal pumps could perform without dragging heat energy into the liquid at more than twice the rate of the Hydra-Cell pump.

Two years after it went into service, the pump was still working well and no spare parts had been required. Inspection at that time revealed no visible wear. The company was able to instigate a programme for precautionary replacement of valves and diaphragms at 4-yearly intervals. The cost of spare parts was modest, and the work could be carried out in-situ within 2-3 hours. ■

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