Selecting the Most Economic Pump

Seal-less Hydra-Cell G25 pumps replaced seal-reliant piston pumps handling recycled solvents on this mixing vessel cleaning system at a German paint manufacturer.

LCC can be a valuable tool in purchase decisions and in budget forecasting. For system designers and for an engineer faced with a pump replacement decision (especially when the previous pump has not been wholly satisfactory) the concept of LCC can be particularly enlightening – but only in comparing one type of pump with another.

Making a pump selection decision in the process industries is not in the first instance a question of choosing manufacturer or model. Before that comes the basic issue is to decide what type of pump to specify or install. Sometimes that choice seems pre-empted - by budgetary constraints, regulatory restriction or reluctance to depart from industry custom and sometimes through simple unawareness of alternatives.

For all specifiers the first consideration is fitness for purpose. The pump must be capable of operating at the flows, pressures and temperatures demanded by the application, and must be able to handle the liquid it is pumping: with due regard to safety and reliability.

Often more than one type of pump can satisfy, to greater or lesser degree, all these requirements. Cost is usually the determining factor and before deciding on the type of pump to be purchased the specifiers is well advised to go beyond initial price and consider the wider picture of Life Cycle Cost (LCC).

It is now more than 10 years since the landmark Guide to Pump Life Cycle Costs was published jointly by Europump and the Hydraulic Institute in the USA. Its publication in 2001 provided practical advice to help plant owners and operators to apply LCC methodology to pumping systems. At the same time it drew attention to what was always known, but not always regarded, that purchase price is not the only consideration – and rarely even the most important cost element – in sourcing and selecting industrial pumps (Fig 1).

Life Cycle Cost is the measure of the true cost of a pump - from purchase to scrapping. It includes energy consumption and the costs of repair and routine maintenance, as well as the original purchase outlay. See Fact Box, on next page, Using guidelines established by the VDMA (Association of German Engineering Shops) lists the elements of LCC more fully. In calculating LCC of an individual pump through time, discounting factors (including years in service, interest rate and inflation) also come into play.

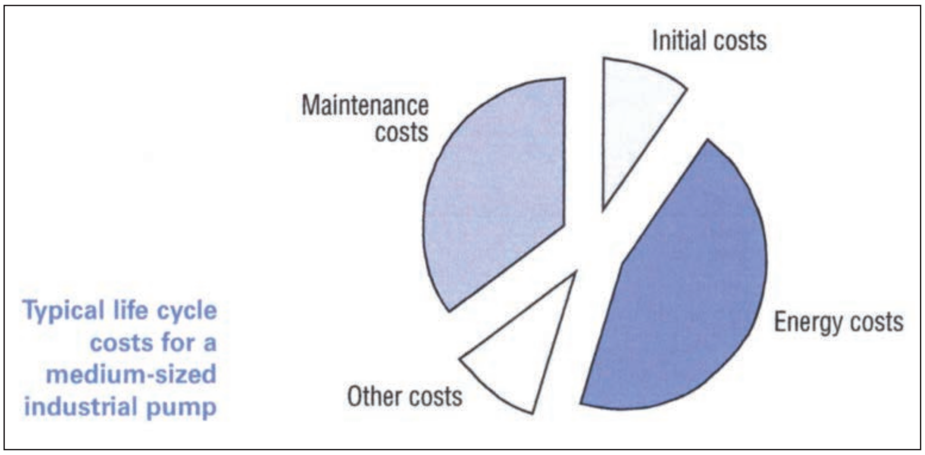

Figure 1: Guide to LCC Analysis for Pumping Systems. Source: Exec Summary.

Elements of Pump Life Cycle Cost

- Initial cost: Purchase price (pump, motor, base, auxiliary devices)
- Installation and commissioning
- Energy costs
- Operating cost (labour cost of normal system supervision)
- Maintenance and repair costs
- Downtime and loss of production costs
- Environmental cost
- Decommissioning and disposal costs

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For example, as a type, centrifugal pumps share certain characteristics that determine performance strengths and limitations and affect their likely LCC profile. But for two centrifugal pumps of similar capacity and materials build, differences in LCC will tend to be minor.

In type comparisons, some of the LCC factors noted in Fact Box can be eliminated. Inflation and interest costs for example can be regarded as neutral – being assigned a common value for type comparison purposes. Other elements such as possible losses arising from production downtime should by no means be ignored in relation to the purchase decision but are difficult to calculate in the strict context of an LCC comparison and should be excluded from the figures to avoid distortion.

One way of isolating significant differences between types of pump in terms of LCC was adopted in a pump comparison study undertaken in 2005 by Dr-Ing Friedrich Wilhelm Hennecke, a senior figure in the German pump industry. Dr Hennecke while pump chief at BASF was co-editor of the original 2001 Guide to Pump LCC. In retirement he continues to serve the industry in Germany and internationally.

In the 2005 study he identified four points of comparison as yielding significant differences between the five types of pump investigated. All data for the study was supplied by the pump manufacturer in each case. Points of difference were:

1. Initial cost, including motor, base and couplings.
2. Energy cost.
3. Routine maintenance cost.
4. Repair cost.

The pump types represented (each generically different) were the Centrifugal, the Sidechannel, the Peristaltic, the Membrane Piston, and the Hydra-Cell – all except the last being available from several manufacturers. The Hydra-Cell is designed and manufactured by Wanner Engineering, but remains a distinct type generically.

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Each pump manufacturer was invited to submit data for a pump to match specified flow rates from 1 m^3/hr to 8 m^3/hr and an assumed duty cycle of 4000 hrs/yr. In each case LCC was calculated for working at specific pressures from 5 to 100 bar. For higher pressure applications Dr Hennecke took into account only the membrane piston pump and the Hydra-Cell. The other types surveyed 'could not usefully be considered' for working at pressures above 10 bars. It was also noted that in practice not all the pump types were suited for operation in all circumstances. Limiting factors would include temperature, solid content, hazardous fluids and pump pulsation – all excluded for purposes of the survey.

Some results may have caused surprise, including those for relative energy cost, as well as his general conclusion that 'in terms of LCC, the most economic pump overall in the considered range is the Hydra-Cell... and it is not restricted to clean non-abrasive fluids'.

The bar chart Fig 2a summarises the LCC comparison costs for pumps delivering 1.4 m^3/hr at 50 m head (5 bar). Fig 2b shows the overall LCC findings for the same pump types delivering 4.2 m^3/hr.

Underlying the bare figures in the Hennecke study and the strong showing of the Hydra-Cell against more conventional pumps in LCC terms, is a distinctive design (with no dynamic seals to wear or replace) and a unique combination of operating features.

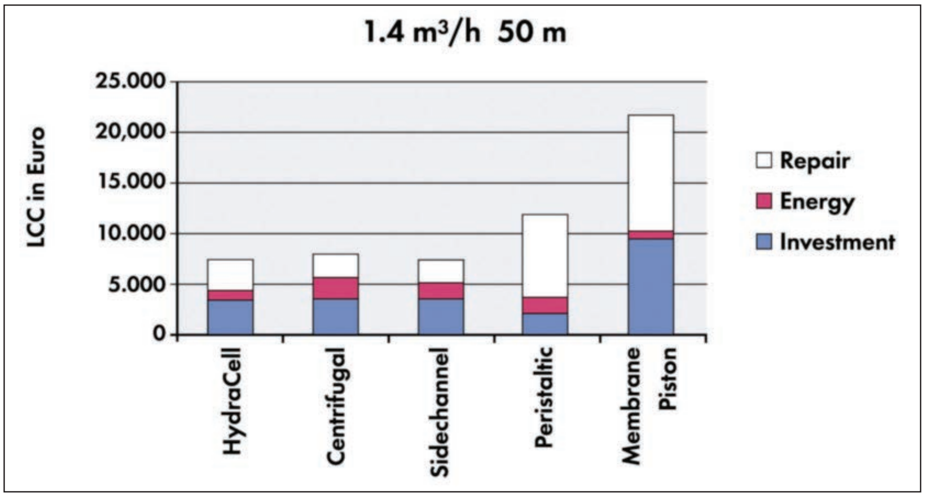

Figure 2a: LCCs for Pumps Delivering 1.4 m^3/hr at 5 bar. (F-W Hennecke)

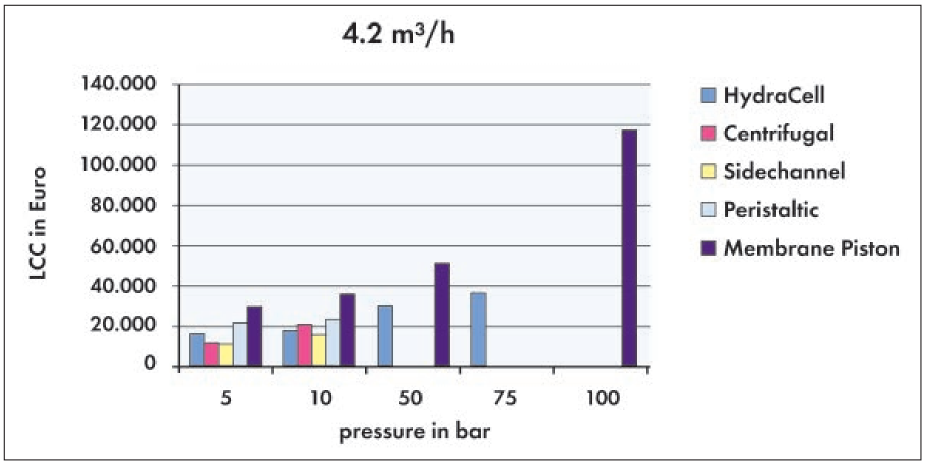

Figure 2b: LCCs for Pumps Delivering 4.2 m³/hr at Various Pressures. (F-W Hennecke)

These include ability to handle abrasives particles, thin non-lubricating liquids, acids and other corrosives. Pumping action is virtually pulse free. The pumps are easily and accurately controlled by VFD; they are true positive displacement pumps, able to work at low or high pressures with negligible reduction in flow. Pumping efficiency is above 90 per cent and – with no seals to wear – sustainable. That is, not subject to industry's most common cause of reduced pump performance. Also they can run dry indefinitely.

In brief, the Hydra-Cell is an unusually versatile pump; with a range of applications that includes metering and dosing, pressure injection, transfer, spray drying, cleaning and seal flushing.

Some Practical Examples...

Progressing cavity pumps delivering an abrasive slurry to spray drying nozzles at a chemical company in the UK were replaced by the seal-less Hydra-Cell pump when packing seals on the previous pumps began to leak. Estimated seal replacement costs were 2000-3000 pound per pump. A peristaltic pump had also been considered, but pulsation was an issue.

A major German chemical manufacturer had been using a magnetic drive centrifugal pump with 55 kW motor to transfer polyesterol into a process line over a distance of more that 5 km.This pump was replaced with a Hydra-Cell pump fitted with a 13,2 kW motor. Several multi-stage centrifugal units were in contention units but the final decisive factor was that the Hydra-Cell pump did not drag excessive heat energy into the line. Polystyrol can flocculate at temperatures above 60 C.

At Seonam water treatment plant in South Korea engineers scored a double success when they replaced leaking screw pumps with Hydra-Cell G25s. Working pressure was only 8 bar, but the screw pumps could not satisfactorily handle MgO_2 abrasives in the liquid. Premature seal wear caused external leaks and cumulative energy wastage as efficiency declined. After the new pumps were installed, there were no more leaks and energy costs on the operation were reduced by 50 per cent.

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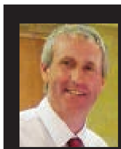
Pumping system with Hydra-Cell G03 serving humidifying nozzles. This pump replaced a 'high-maintenance' piston pump at the plant.

Savings on pump repairs and maintenance costs alone enabled a Swedish chemical plant to recover its investment within the first year following the installation of a Hydra-Cell G25 pumps in place of the piston pumps previously used to feed raw turpentine to burner nozzles. Severe wear had led to frequent breakdown and rebuilding.

Driven by a 30 hp motor and supplying spray guns with 110 l/min of cleaning water at 70 bar in a US seafood processing plant, a Hydra-Cell pump replaced a Pitot tube pump with 50 hp motor on the same duty. Energy savings were in line with the power difference, and there were also substantial savings on repair costs. An entire repair kit for the G35 pump was less than one-third the cost of a mechanical seal for the wear-prone Pitot tube pump.

Each of these situations illustrates one or more ways in which the selection of a particular type of pump – in this case the Hydra-Cell – can help to reduce Life Cycle Cost. The task of the pump specifier is to look carefully at all aspects of the application and match the pump to the job it has to do. Be wary of too easy or too cheap solutions. Be open-minded! ■



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