Seeking ultimate pump efficiency

Every plant owner wants their pumps to be energy efficient, but there is sometimes a trade-off to be made to ensure greater operational reliability. Bryan Orchard reports

Operating reliability and greater energy efficiency would appear to be the prime concerns of many pump users. The two concerns are not wholly incompatible, for greater reliability means less downtime and fewer spare parts, while more efficient motors contribute to reduced energy costs. Once pumps are installed and commissioned, it is expected that other than for regular activities such as greasing, cleaning etc, they should not need to be touched again until planned maintenance comes around. Sacrificing some degree of energy efficiency if there are fewer breakdowns is typically acceptable. Simply attaching the latest energy efficient motor will not necessarily reduce energy costs significantly.

"It is essential that the pump must do its job for the user, giving high reliability, low cost of repair and energy efficiency while being totally invisible to the surrounding environment," says AxFlow managing director Tony Peters.

"Environmentally friendly, energy efficient, lowest life-cycle costs, low noise, no leaks, high reliability and low cost of repair – all [these] come at a cost, and often the buyer's budget is not large enough to buy the perfect pump. Pity the pump manufacturer as it is difficult to optimise all these operating parameters because, when all is said and done, the purchaser always looks at the cost. Low costs and high complexity are not good bedfellows."

SPP Pumps water business unit manager Martin Bagg adds that capital cost is in most instances a fraction of the whole life cost of a typical pumping installation.

"Energy, unplanned downtime with resultant loss of productivity and replacement of lower life expectancy consumable parts such as seals and bearings equates to as much as 80-90% of total life-cycle cost," he says.

Running costs

Pump systems account for a major share of all electricity consumed for industrial purposes, which is why users are now much more concerned about their equipment's power consumption than they were only a few years ago.

"There have always been good reasons for engineers in the process industries to be interested in the energy costs of pumping," says Paul Davis, Wanner International managing director.

"Pumping systems in the US, for example, have been estimated to use around one-third of total energy consumed in the industrial sector, which in turn accounts for a third of all energy consumed in the US."

Depending on the scope of analysis, the potential savings on energy in current industrial systems range between 30% and 40%. There are many reasons why too much energy is still being wasted in connection with pump operation. In processing facilities and refineries, for example, maximum priority is attached to productivity and fast restarting following repairs. Often, this is achieved at the expense of a hydraulically optimised system.

Oversized and undersized valves, inadequate pipe radii and encrusted pipe cross-sections restrict liquid flow and contribute to energy wastage. Another common problem is that pumps are often run in a way that is outside of their original specification, or left unattended for long periods. Aggravating the problem is the fact that many pumps are selected with a 10% or 15% safety margin.

Bagg says in response to the ever increasing cost of energy, life-cycle cost analysis (LCC) is fast becoming the accepted method of evaluation for both capital projects and replacement plant.

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"Various LCC models are available to pump users where capital, energy, maintenance and efficiency degradation costs are assessed to determine the pumps life-cycle cost," he says.

"These models enable the user to make an informed decision based on the true cost of ownership, not just capital cost. Reducing energy consumption through the selection of the most efficient pump has the added benefit of reducing CO2 emissions. Not only does this have environmental benefits, but can assist in reducing emission levies imposed on some high energy users."

Motor efficiency

Daniel Gontermann at KSB adds that there is no single solution or answer to improving the operating efficiency of a pump because any number of factors will influence its performance once it has been installed and commissioned.

"What the pump manufacturer can do," he says, "is to develop a pumping system that utilises the optimum number of energy-saving devices and components and also assist the customer in the pump selection and specification process."

▶ PROBLEM SOLVER

Cutting power and maintenance costs

Engineers at the Seonam water treatment plant in South Korea were facing several interlinked pumping problems on a system in which a mix of MgO2, hydrogen peroxide and water is injected for disinfection and deodorisation. Among other requirements in this application were sustained performance, reliability and accurate flow control to maintain pH balance.

The pumps then in use, screw pumps of the progressing cavity type, proved unable to satisfy these essentials. Though system pressure was only 8 bar, the screw pumps were losing efficiency through seal wear and internal friction. Falling performance was accompanied by rising energy consumption, and made obvious by external leaks.

The immediate cause of these difficulties was the presence of abrasive MgO solids in suspension in the water mix, which can be difficult to handle.

Premature wear when handling abrasives is a potential problem for any type of pump whose design relies on seals or requires a lubricating film between close-tolerance moving surfaces. To replace their screw pumps, and avoid any future risk of seal leaks, engineers at Seonam installed Hydra-Cell G25 pumps, which have no dynamic seals at all in their design.

Other useful features on this application include smooth low-pulse pumping action and stable delivery, with flow accurately variable via a variable frequency driver motor to meet pH requirement. Operating at any pressure up to 70 bar, the pump can handle many different liquids, hot or cold, viscous or thin, clean or dirty – including acids, caustics, slurries and abrasives. It can run dry without damage.

Installing Hydra-Cell pumps cured leak problems at Seonam, while reducing power consumption on the pumping operation by a reported 50%.

Maintenance and repair costs were also reduced, with spare parts relatively fewer and less expensive than those required by progressing cavity pumps.

– The right pump can vastly improve operational capabilities in many cases

Any number of factors will influence a pump's performance once installed