Pumping up

Manufacturers make all sorts of claims for new pumps, and the same goes for valves, but Dr Tom Shelley finds that there are some innovations delivering significant improvements

While designs of pumps and valves for the process and related industries had barely altered in decades, changing requirements have recently resulted in some useful improvements. First, the sustained high cost of energy has led to greater focus on efficiencies in pumps and pump systems. Second, innovative solutions have been found to deal with pumping even very difficult suspensions and slurries. Third, smarter module designs are making valve configuration and maintenance easier and quicker. And fourth, better materials are significantly extending the lives of some valves and seals.

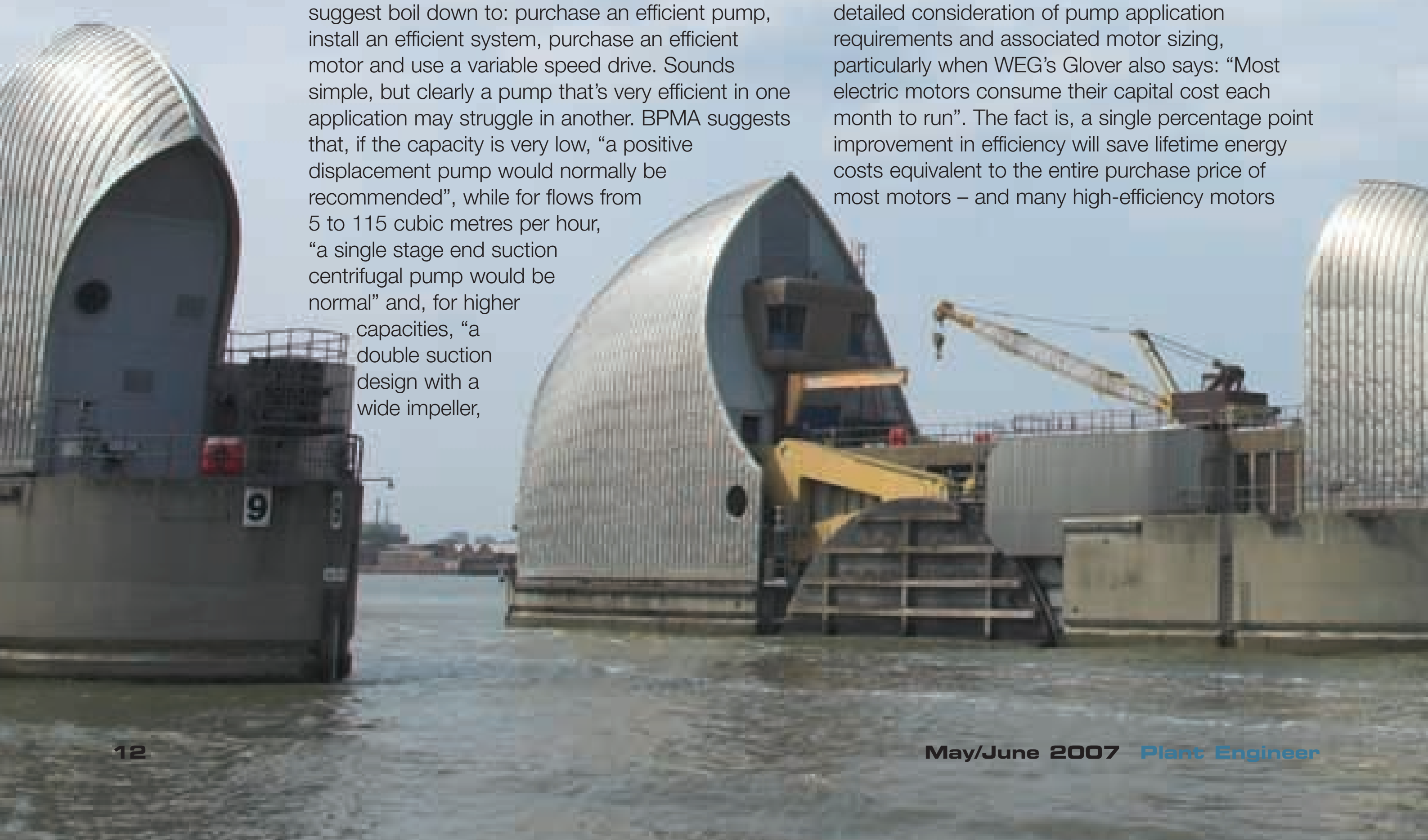
Taking pumps first, some two thirds of the electricity on industrial sites is consumed running electric motors, and 32% of that, or 20% of the total, goes on running motors attached to pumps, according to the British Pump Manufacturers Association (BPMA). "Significant opportunities have been identified to operate pump systems more efficiently, reducing energy consumption and running costs by 30—50%," says the BPMA.

Main measures the organisation's members suggest boil down to: purchase an efficient pump, install an efficient system, purchase an efficient motor and use a variable speed drive. Sounds simple, but clearly a pump that's very efficient in one application may struggle in another. BPMA suggests that, if the capacity is very low, "a positive displacement pump would normally be recommended", while for flows from 5 to 115 cubic metres per hour, "a single stage end suction centrifugal pump would be normal" and, for higher capacities, "a double suction design with a wide impeller, or two pumps in parallel may be selected".

As regards designing an energy-efficient system, however, it's not only about selecting the correct pump and motor, but plant layout, pipe diameters, bends and restrictions. Here again, the BPMA provides advice, having worked with Europump to publish a guide to good system design. A trial copy of its System Assessment Software can be dowloaded from www.bpma-energy.org.uk.

Looking at motors though, Andy Glover of WEG UK observes: "Over-sizing pump motors is costing industry dear because of increased capital costs and reduced efficiency." He blames "a widespread culture of overrating motors", saying that engineers at various stages of the pump system design process add 10 or 15% to the motor capacity, 'just to be on the safe side'. On the other hand, BPMA advises: "Select the motor to drive a glanded pump with a power reserve of approximately 5—20% above that theoretically required." And there's plenty of engineering experience and burned fingers out there that would concur with that.

Nevertheless, it does point to a need for more detailed consideration of pump application requirements and associated motor sizing, particularly when WEG's Glover also says: "Most electric motors consume their capital cost each month to run". The fact is, a single percentage point improvement in efficiency will save lifetime energy costs equivalent to the entire purchase price of most motors – and many high-efficiency motors



Below: The Thames Barrier water defence system, now 25 years old and with its harder hydraulic seals now coming to the end of their useful lives

improvements

provide savings three to four times better than that.

But there's room for even greater improvement. Mike Smith of Deritend makes the point that energy efficiency is about more than just high-efficiency motors. He argues that users need to look at motors, pumps, gearboxes and the possibility of using variable speed drives. Reducing pump flow by throttling means an instant energy waste that can simply be calculated by multiplying the pressure drop across the throttle by the flow rate. In addition, torque required to turn a centrifugal pump is proportional to the speed squared, while the work done by the motor, which is closely related to energy consumption, is torque multiplied by speed.

Energy-saving measures

Hence, if a motor and pump combination is run at half speed, energy consumption is one quarter that at full speed, while the amount of energy required to pump each cubic metre of fluid is halved. That's plainly good, but beware those that tell you anything different: a document here from a reputable company claims that at half speed, energy consumption will be one eighth that at full speed. It also ignores the fact that at lower speed, output pressure reduces, meaning there is a certain minimum below which a centrifugal pump can't be run. Overall, variable speed drives, properly coupled to pumps, should pay for themselves quickly – unless flow demands are constant and pumps are always run at optimum speed.

Moving on, suspensions, slurries and viscous liquids all require special types of pumps, and no single type is capable of solving all problems in this class. Walsall-based Netzsch Pumps, for example, has supplied a number of its progressive cavity pumps (PCPs) to the Turner Grain Engineering company, based in Ireland. With capacities of 0.3 to 3.8 cubic metres per hour, these are being incorporated in mills designed and built by Turner for the production of animal feeds.

These pumps can cope with products having viscosities from 100 to 2,000 centipoise – so including hot vegetable oils, palm oils and molasses. Their low shear features also make them suitable for handling shear-sensitive products. With capacities from 0.1 to 500 cubic metres per hour available, they are being successfully used in environmental, food and chemical applications to handle low to highly viscous fluids, with or without entrained solids – including abrasive, aggressive and toxic media.

Netzsch's latest development is the Nemo M.Champ, which includes a patented reversible stator and the company's Clamp-Tec Stator quick clamping system. Points to note: first, the number of components has been reduced from 32 to nine; and second, the design of the integrated, double-length reserve stator means it can be simply removed and reversed, providing maintenance engineers with an instant replacement. The pump also features, as standard: two horizontally-mounted, tangential nozzles to allow for optional parallel connections to pipelines; a space-saving bevel gear drive; and a shaft seal with rubber bellows incorporated into the pump housing.

Another company that produces these impressive machines is PCM, whose UK base is in Corby. PCM was founded in 1932 by René Moineau, inventor of the PC pump. Its latest development, the EcoMoineau, is 30% shorter than conventional PCPs, and the company claims it's also cheaper to purchase, operate and maintain. It also says that no space needs to be left around it for removing the stator and rotor. Beyond that, a connecting rod design reduces fibre entanglement and all pumps are provided with mechanical seals,

Control valve standards

ISA, the US-based global instruments and controls association, has submitted three control valve standards to ANSI.

ISA-75.08.01 'Face-to-face dimensions for integral flanged globe-style control valve bodies (Classes 125, 150, 250, 300 and 600)' applies to valves from 15 to 400 mm, with top, top and bottom, port, or cage guiding.

ISA-75.08.05 'Face-to-face dimensions for butt weld-end globe-style control valves (Classes 150, 300, 600, 900, 1500 and 2500)' applies to valve sizes 15 to 450 mm for Classes 150 to 2,500.

ISA-75.08.06 'Face-to-face dimensions for flanged globe-style control valve bodies (Classes 900, 1500 and 2500)' focuses on 15 to 450 mm sizes, having top, top and bottom, port, or cage guiding.

All standards will help users in piping design by providing unification.

Right: Potato peelings handled by a progressive cavity pump system
Far right: Watson-Marlow Bredel peristaltic pump

built-in hand holes and an integral base frame.

A typical user application is in the Wisbech factory of fresh potato products company Greenvale AP. It is using a PCM GVA pump to discharge waste (potato skins and warm water) from the outlet auger on an industrial washing and peeling machine into a holding hopper. It's also using a second, similar device (GBB hopper pump constructed from stainless steel, fitted with food grade elastomers) to transfer the mashed potato itself. This unit is said to be capable of pumping such materials at 65°C, at a rate of 675 to 1,000 kg per hour.

Different strokes

There are, however, other ways. Buxton Lime Industries, for example, is using four peristaltic pumps, from Watson-Marlow Bredel, to pump thickened clay washings from its latest stone processing plant. Buxton has replaced its conventional thickeners with two 15 metre diameter Eimco Deep Cone paste thickeners capable of 60% w/w. Each thickener is now served by a pair of SPX100 Duplex pumps in a configuration that allows discharge from each unit and simultaneous transfer between thickeners, if necessary, guaranteeing plant availability in the event of a pipe blockage or pump failure. Under normal operation, the pumps deliver at 27 tonnes per hour.

So there are improvements. But, all that said, one of the main wearing parts in all pumps and valves is the seals and, no matter how ingenious they are, nothing is immune. For example, now that the hydraulics in the Thames Barrier water defence system are 25 years old, there is concern that the harder seals are coming to the end of their useful lives. With some 13,000 seals (mostly nitrile, 40 to 80 Shore hardness) on the pump and valve equipment, replacing them will take 13 years. So the dilemma there is an extreme version of all engineers' problems: is it more economical to replace the old, probably obsolete equipment, or strip it out and replace the seals?

Which brings us to another point. Not that long ago, the highest quality seals for arduous applications on valves were made from PTFE. But, as Steve Meadows of ASCO Scientific, explains, that has its limits. "PTFE is not very resilient, does not have good sealing characteristics and is very susceptible to scratching from particulate matter, which can create a leak path across the valve seat, allowing fluid to flow in the closed position."

So now, valve manufacturers are using newer polymers and combinations. ASCO's Series 462 valves, for example, developed for medical, biomedical and analytical work, use a soft DuPont Kalrez disc in a PTFE diaphragm. The diaphragm provides the rigid structure that isolates the fluid from the solenoid, while the Kalrez disc provides a tight seal on the valve seat. Kalrez is an elastomer and so has excellent sealing characteristics, while being very inert. Also, its resilient nature means that particulate matter does not easily scratch it. What's more, if there is any particulate on – or deformation of – the valve seat, the Kalrez disc will conform to it.

Polymers have also made big inroads in valve design. For example, polyethylene gas and water pipes, with a design life of at least 100 years, are currently being used to replace fractured and corroded iron pipes throughout the UK. But Martyn Rowlands, head of marketing for Durapipe, makes the point that similar progress has been made with the associated process valve bodies.

"Thirty years ago, a manual PVC-U ball valve was the only option available to specifiers and contractors," he says. Today, the company's latest VKD ball valve is available in ABS, PVC-U, PVC-C, polypropylene and PVDF – covering all service types, from those requiring resistance to acids and alkalis, aliphatic hydrocarbons and other aggressive chemicals, to others needing greater mechanical strength and resistance to abrasion and impact.

It also has a new, patented Dual Block control, offering resistance to vibration, and the valve is shaped to allow direct, safe and easy installation of an actuation device via PowerQuick, its new actuation module for quick assembly of pneumatic or electric actuators and other control devices. Incidentally, this valve also has a patented Seat Stop system that allows micro adjustment of seats onto the ball while the valve is still in line. PE

Valve selection

- Valves are integral to any pipework system, yet are often specified separately, resulting in incompatibilities and costly maintenance, says Marty Rowlands, Durapipe UK marketing manager
- It is important to consider your valves' purpose and also the media involved
- It makes sense that the valve type should be the most effective for the overall system
- People often specify a valve that is too complex for the task
- Ball valves are best for most isolation requirements, but consider butterfly, diaphragm and other valves for complex and/or automated variable processes
- Actuated valves can be used for safety service to protect plant when a system fails and shut-down needs to be quick, efficient and remote