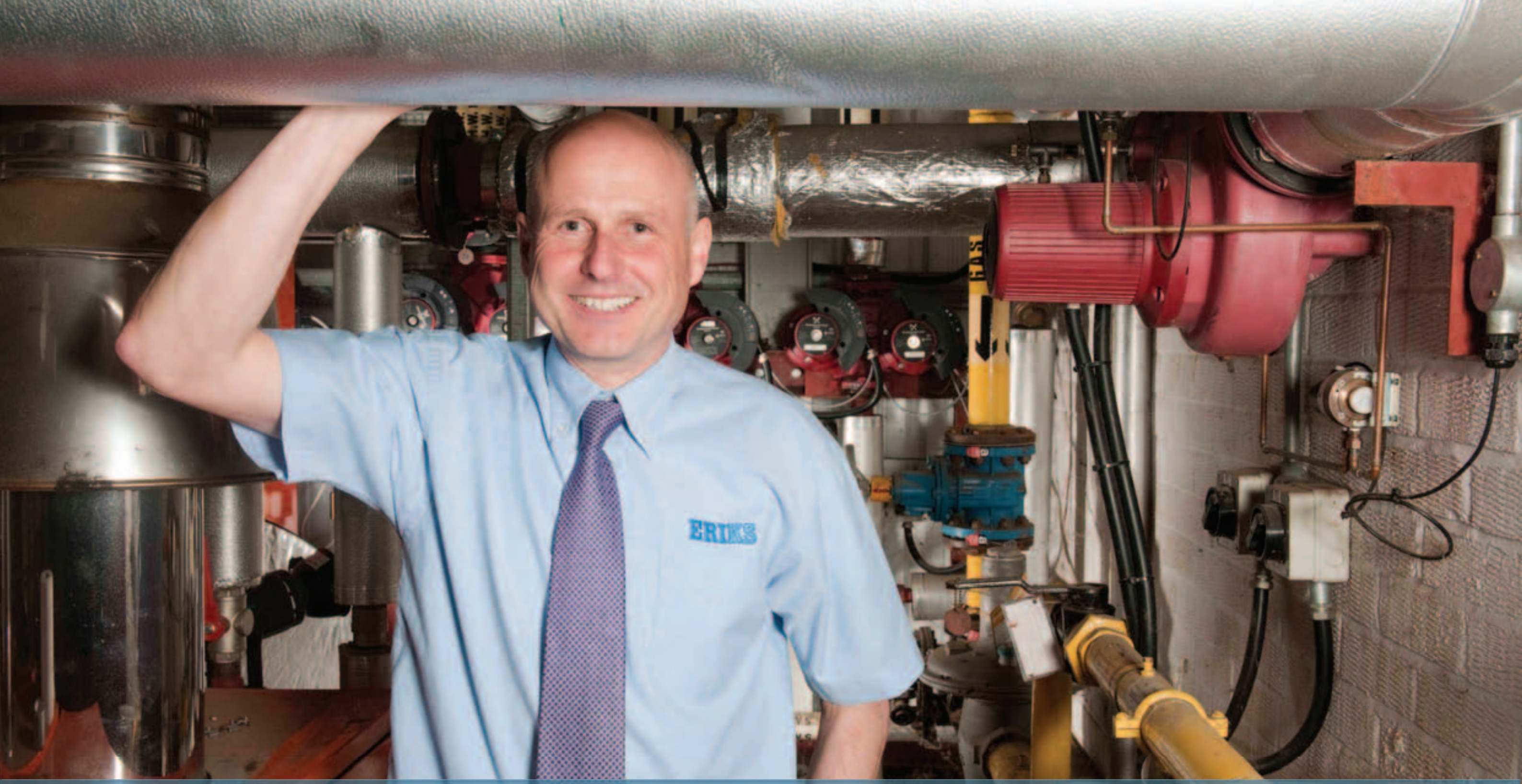

Pumping iron

The vast majority of pumps and fans could be running more efficiently and saving their plant operators serious money. Brian Tinham examines equipment advances and cautionary tales

Although pumps and fans are hardly renowned for rapidly advancing technologies, subtle, but significant improvements are still ongoing at several levels. That means choosing the right equipment, whether for new projects or plant refurbishments, ought to involve a little research – not just straight reordering and installation – if you don't want to miss out on potential energy efficiencies, cost savings and even process and/or product improvements. Best advice is to think of it as due diligence, first ensuring that the pumping system, as installed, is still correct for the application – and making sure you include the drive equipment and controls, too.

Looking at pumps themselves, although good old centrifugal (rotodynamic) pumps have changed little, from a hydraulic perspective, when it comes to stainless steel, multi-stage versions – typically for pressure boosting or feed water applications – efficiency has increased substantially. That's primarily due to improvements with manufacturing tolerances. Maintenance, repair and overhaul specialists such as Eriks report 5–7% efficiency hikes.

Although not as spectacular, similar improvements are being seen with vertical, inline, single-stage pumps, notably for the HVAC (heating, ventilating and air conditioning) market, where efficiencies are now in the low 80% region. As Eriks' business development director for pumps Andy Cruse (pictured above) puts it: "Internals used to be stamped out and spot welded, but manufacturing engineering and assembly methods are a lot better now." He cites leading brands as including Grundfos, ITT, Lowara (Xytem), Wilo and KSB, for sizes up to four inches and 75kW output.

API 610 pumps

Only end suction centrifugal pumps for the process industries – such as ANSI API 610 pumps, aimed at the oil and gas sector – are effectively unchanged. Why? Quite simply, because they are tightly controlled, in terms of flange and shaft thicknesses, bearing sizes, materials of construction etc, in order to deliver characteristic head versus capacity curves, standard fittings and highly predictable reliability metrics. That said, sector specialists, such as Amarinth, which has

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invested heavily in state-of-the-art manufacturing, continue to provide high specification solutions and add-ons to meet demanding project requirements.

Late last year, for example, the company delivered £750,000 worth of API 610 OH2 pumps to ZADCO for a pilot plant, on a lead-time apparently 10 weeks quicker than its nearest competitor. Oliver Brigginshaw, managing director of Amarinth, explains that ZADCO needed a water treatment system fast, in order to meet the pilot plant's operating deadline – and that pumps for the filtration system had to be low shear, so that oil and water would not be emulsified. However, with high levels of H_2S in the stream, the pumps had to be manufactured in a high nickel alloy.

Amarinth used exotic alloys, including Inconel 825, and has since secured further orders from ZADCO to upgrade API 610 VS4 vertical pumps (which it originally supplied in 2009), with advanced flow sensors and external flush lines. The new sensors are to ensure that the pump bearings don't run dry – a health and safety concern in such a hazardous environment, where a major pump failure could cause loss of life.

As for other pump types, it's worth just keeping your ear to the ground for developments, whether technical or commercial. AxFlow GB, for example, which distributes a wide range of pumps from workshops around the UK, has just launched peristaltic pumps, dubbed Realax (from an unnamed manufacturer), with four models in a variety of sizes for low- and high-pressure and flow applications.

Commercial opportunities

The goal, says managing director Tony Peters, is to round off its offerings to the waste water, food and beverage and chemical industries, among others, no doubt competing with the likes of Watson Marlow. "AxFlow takes world-leading products, localises them, in terms of standards, base plate sizes, motors, guarding etc, and offers services around selection, installation and repair," explains Peters. "So we're controlling the design and manufacture of these units for our market."

Other brands in AxFlow's portfolio include: Wilden air-operated double diaphragm pumps, Blackmer rotary sliding vane pumps, Waukesha positive displacement hygienic lobe pumps and Mono progressive cavity pumps. Last year, the firm also acquired Thames Valley Pumps, opening it up to the building services market, primarily with centrifugal pumps.

Beyond pump design and construction, however, one of the most striking changes concerns the increased acceptance and adoption of coatings, from the likes of Belzona, ThistleBond

Optimising industrial fan performance

Industrial fans employed in anything from burners to furnaces, HVAC systems or drying plant are generally critical assets. So to avoid impacting productivity and installation integrity, maintenance and spare part quality should not be compromised.

That's the message from Jeremy Salisbury (pictured below), marketing manager with maintenance, repair and overhaul specialist Brammer UK. He also points out that, whether centrifugal or axial, fans are generally driven by electric motors, meaning high energy consumption, if not correctly commissioned, controlled and maintained. That's especially the case, given that most motors are over-sized and driven at full speed, with antiquated damper-based throttling. Furthermore, operational environments tend to be harsh, with fan performance affected typically by extremes of heat, gases, dust and particulates.

That said, one of the most common causes of failure is misalignment, typically resulting from damaged or incorrectly installed shafts and worn bearings, or incorrect alignment of the drive train. Another common cause is poorly balanced components – typically fan rotor blades.

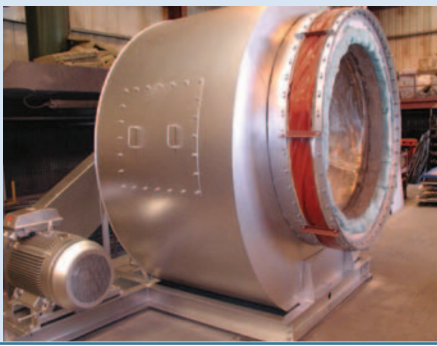
"Poorly aligned or balanced components can result in issues such as excessive vibration, noise and heat, all of which increase energy consumption, while subjecting the fan and other components to unnecessary stress, potentially shortening product life," observes Salisbury. "Meanwhile, load on the motors is also increased by misaligned shafts, meaning the motor consumes more power."

His advice: once equipment has been properly installed and configured, implement a predictive maintenance regime. "Tools such as thermal imaging cameras and vibration monitoring equipment can deliver both snapshot information and real-time, continuous performance analysis," he states. Together, those mean areas of concern can be identified and planned shutdown organised for realigning, repairing or replacing components. "Costs of condition monitoring tools pale into insignificance, compared with the cost of an unplanned shutdown."

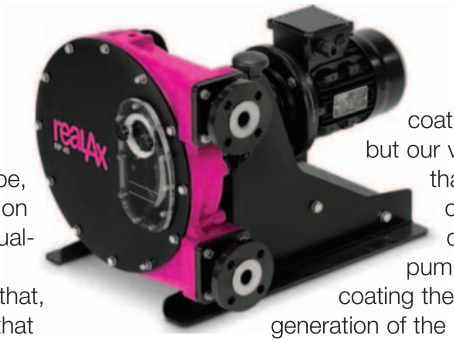
Next up, however, is appropriate lubrication. "Incorrect or insufficient lubricant is responsible for more than one third of industrial bearing failures. Once again, costs of unplanned downtime can be significant, but they are exacerbated if the fan bearing is difficult to access," says Salisbury. "Correct lubricant type and lubricating at the right intervals together go a long way towards removing these concerns by protecting bearing surfaces."

As for lubricant specification, he reminds plant engineers and technicians that plant environment, operating speed, temperature, contamination risk and ease of re-lubrication are among key factors to consider. "For fans operating at high speeds in high temperature environments, an oil-based lubricant will both protect and cool. However, in dusty or dirty conditions, a grease may be preferred, as it will ensure bearings are protected against contamination and enhance sealing."

What about those times when service life becomes poor and mean time between failure of bearings is becoming an issue? Salisbury recommends root cause failure analysis to identify areas of improvement, rather than simply re-ordering replacement parts. "Solutions could range from specifying different bearing types to low friction seals and even automated lubrication systems. As well as self-aligning bearings, which negate the need for manual realignment, items such as spherical roller bearings and toroidal bearings, which allow for axial expansion and misalignment, are proven in a variety of demanding applications."



Such changes also offer potential for both process improvement and cost savings, as fans running at lower temperatures can often operate at higher speeds, while maintenance and lubrication intervals can also be extended.



and Henkel. Eriks' Cruse makes the point that a lot depends on the application and the pump type, but, for example, they work well on centrifugal cast iron, single- or dual-stage pumps of six inch OD and above for water service. "Below that, the smaller surface areas mean that payback becomes minimal. But, if you've got large surface areas, then when pumping water you can expect a 4% improvement, in terms of hydraulic efficiency, due to reduced friction."

There's also the obvious corrosion prevention and the perhaps less obvious reduced maintenance issues that such coatings have proved themselves very capable of delivering. "New and refurbishment pumps can be worthy candidates for treatment in our workshops. Given the increasing cost of energy, water companies are certainly turning to coatings – for example, on water supply pumps," explains Cruse.

What's more, costs are low and manufacturing methods are straightforward, with surface preparation involving grit blasting and leaching out salts on cast iron pumps, followed by hand, brush or spray application. "Some companies suggest coating the impeller and the body, but our view is that there is a clear risk that you can change the pump characteristic. There's also some debate about high-head pumping applications, where coating the impeller can prevent generation of the head. Also, on small impellers, a coating could restrict the flow of fluid through the vanes. So we just coat the static components – inside the volute and the suction casing."

Clearly, with process pumps in the chemical or food and beverage industries, it's a different story, given that many are supplied with appropriate liners on all surfaces – not just on the body internals, but also the impellers. Some manufacturers and application specialists also harness chemical resistant coatings on standard cast iron units to extend the application of lower cost pumps, but sensible advice is to watch what you're being offered and get specialist support.

Reverse engineering

All of which illustrates the importance of careful consideration when it comes to pump repair, replacement or refurbishment. Cruse warns plant engineers off relying too heavily on desktop surveys that typically advise installing a variable speed drive to turn down the pump running rate, promising that energy usage will be halved. That's the ideal world, not necessarily reality, he says, emphasising that the key is first re-checking pump performance against its required duty.

Unless pressure tappings have been fitted, Eriks uses a high quality non-intrusive ultrasonic flowmeter for the job, which Cruse confirms delivers accuracy to within 2% of that achievable using a top-end inline magnetic flowmeter. "We just clamp on the flowmeter and, from the results, construct the system characteristic curve, so we can review the selection, in terms of output, head and flow, based on reality," explains Cruse.

"It's fairly simple, but it's very important to understand what's there and whether the duty has changed," he adds. "Also, pumps, just like motors, are generally over sized. If we can down size and reduce capacity, we can save on capex and opex – and that can result in very substantial cost reduction."

Opex is the big one here. "Studies show that the purchase price of a water pump, for example, is just 1% of the lifecycle cost. Maintenance is then 4%, while 95% represents the cost of energy," states Cruse. And the figures aren't wildly different in the general process industries. "Capex is typically 5%. Maintenance is harder to determine, because there's more variability than in water, which is a relatively benign duty. But by far the most significant cost remains energy." PE

Cutting costs with variable speed drives

Probably 80–90% of electric motor-driven pumping installations would benefit from the installation of variable speed drives, yet less than 10% have been so equipped. So says Steve Barker, head of energy efficiency and environmental care at Siemens, and also chair of the drives group at GAMBICA (the trade association for the control, automation and laboratory technology industries).

But drives alone are not enough. Barker reminds plant engineers that they need to consider the overall system. "What are the characteristics of the pump? What are its demands? Your design needs to match those – and that also means looking at all the elements in the drive chain, such as belts for alignment and gearboxes. Look at the mechanical issues first and also the electrical side – for example, is the earth bonding and shielding correct? Then establish whether it's financially advantageous to install variable speed control."

His point: if you engineer the application properly from the outset, then you can expect to reduce capex by optimising the equipment size and type, as well as opex, in terms mainly of energy efficiency. "If a variable speed drive does look good, then it's about selecting a motor capable of operating from an inverter supply. That means checking the motor insulation is suitable – which they mostly are, unless you're retrofitting to an old unit – and taking care with potential bearing current issues. My advice would be that anything above a 280 frame size must have an insulated non drive end bearing, which isn't standard, so would have to be specified."

Beyond that, Barker suggests checking the speed range involved. "Modern variable speed drives do compensate to some extent for changes in motor efficiency as speed reduces. But it's worth understanding the application and balancing losses against the alternative of installing a permanent magnet machine."

Generally, the answer will be to stick with your conventional squirrel cage induction motor. That is, unless the application requires a very wide speed range and you want to eliminate mechanical gearboxes – which is unlikely on pumps, fans and compressors – or you need very precise speed control.