

TAKING NOTE OF TELL-TALE SIGNS

As one of the earliest signs of pump failure is increased levels of vibration, **Huw Finney**, head of electronic engineering at Monitran, explains how vibration-based monitoring solutions can improve operational efficiency

Pumps are essential components in many industrial processes. Depending on what is being pumped, the effects of a pump failure will range from a minor inconvenience to a costly and potentially life-threatening situation. This means varying degrees of importance are placed on pumps, which, in turn gives rise to predictive maintenance routines which are tailored to suit.

One of the earliest signs of pump failure is an increase in its levels of vibration and, increasingly, vibration-based monitoring solutions are being fitted to pumps. For example, Bedford Pumps, a manufacturer of medium and large sewage and water pumps, has, at its end-users' requests, supplied many of its products with accelerometers already fitted.

Bedford Pumps is most active in the water treatment industry, and some of its pumps have flow rates of up to 6,000l/second – although the company has experience of pumping at up to 21,000l/second. The majority of its products are submersible and have typical power ratings of 600kW.

When pumping clean water, vibration levels are unlikely to vary from one day to another. As such, reading the levels may not require the use of permanently fixed accelerometers, as hand-held equipment can be used to check levels weekly or monthly.

Continuous monitoring

However, in a wet well, raw, unscreened sewage pumping station, everything that flows down a sewer pipe will get pumped. In theory this is just sewage and waste water, but in practice it can be anything from bits of wood to shopping trolleys. Consequently all pumps going into this environment must be sufficiently robust to withstand shock loading and even blockages. Here, continuous monitoring is a must.

In addition, the pumps are operating in particularly hazardous environments because methane and other potentially explosive gases can be present. As such, any machinery operating in this environment has to be rated EExD (flameproof) and the risk of failure of equipment (causing fire) in this environment must be minimised. Also,

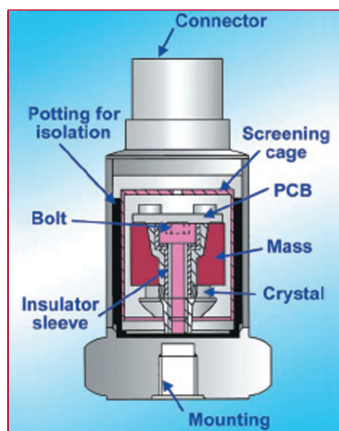
the vibration sensors, such as Monitran's 11851C or 11851W accelerometers, must be intrinsically safe.

As for typical vibration levels, in Bedford Pumps' experience clean water pumps will vibrate at less than 3mm/s during normal operation. For sewage applications though, normal levels will fluctuate around 3mm/s, but if there is a blockage the levels will rise significantly. These high levels can be used to initiate a local shut-down and, if suitable communications are in place, flag the fact to a central control.

As a pump (and its associated motor) is essentially a mechanical device with rotating parts and bearings, each pump will have a unique vibration pattern depending on how it is being loaded. This can be viewed in either the time domain (using an oscilloscope) or, more commonly, the frequency domain (using a spectrum analyser). As parts wear or are damaged by exceeding the manufacturer's recommended operational parameters, so the pattern will change.

Pump faults or problems that can be detected through a change in the pattern include bearing wear and gear defects (such as worn teeth). Further, installation problems such as motor misalignment and cavitation within the pump can also be detected.

In many installations vibration levels of pumps must be recorded, and the



An accelerometer is an electromechanical device measuring acceleration forces. Most contain a mass and piezoelectric crystal. When placed under tension or compression, the crystal generates an electric charge proportional to the acceleration of the mass.



The Bedford Pumps DV.90.23.10 Volute pump has been installed at Thames Water's Datchet Pumping Station (above). Driven by a 6.6kV variable speed motor, this pump has a rated flow of 50 to 225 million litres a day. The assembly is fitted with four accelerometers and seven temperature sensors, all feeding into a Monitran MTN/6000 monitoring unit.

levels should be less than those stipulated in BS 7854-3. However, vibrations within pumps may not originate from within the pump.

In one example, Bedford Pumps recorded excessive levels of vibration on a pump which was not even operational at the time. These vibrations were as a result of resonances within the system's pipework.

Predictive maintenance

As mentioned earlier, varying degrees of importance are placed on pumps. With a few exceptions, the water industry is not placing as much emphasis on predictive maintenance as it could, or arguably, should.

Whilst 'downtime' is not as big a concern as it is in, say, the petrochemical industry, there is still a need to strive for operational efficiency. Further, water treatment processes must avoid spilling to sea or river following a pump failure – as this could result in Environmental Agency fines. You only have to cast your mind back to April 2007, when raw sewage poured into the Firth of Forth, to understand the full implications of pump failure.

In addition it is also worth considering the business and green issues, as unscheduled repairs typically cost more than scheduled maintenance, and any pump that is vibrating excessively is consuming more electrical power than a healthy pump.

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