

PUMP ACTION

THE OFFICIAL NEWSLETTER OF THE PUMP CENTRE

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Resilience

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Adaptability

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Top in class

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Shaping the agenda



“Resilience makes us look more closely at what we currently work with and how we might work better”

These are volatile times, during which most of us would perhaps be glad to have the benefit of whatever predictive tool could map out the immediate future.

Sometimes, however, the job is made a little simpler for us – although rarely is the prognosis very heartening.

Such is the case for the water industry in the UK. The picture for the years ahead is sufficiently mapped out for us to know it will be tough.

Industry regulator Ofwat's traditional inflationary measure was the Retail Price Index (RPI). This could now be replaced by 'CPIH' – the Consumer Price Index with an additional element of housing costs.

Ofwat's justification is that CPIH better reflects the experience of the domestic customer, taking account as it does of individuals' rent and mortgage costs.

The fact is that, while water company Totex inflationary costs have broadly aligned with RPI, they have exceeded what would have been the previous CPIH rate. Inevitably this will impact upon margins and what the individual water company endures will be passed, in some form, down the supply chain.

A simultaneous drop in delivery levels would be neither

acceptable nor desirable. So cost savings will need to be made if service standards are to be maintained or improved on less revenue.

Innovation – the search for new and better ways of working and/or technologies – is an important tool in our armoury. The problem is that revolutionary changes that reap benefits tend to do so further down the line, often after greater initial expense.

The concept of resilience endorses the adoption of the new but focuses ultimately on the issues of reliability and safe investment. It makes us look more closely at what we currently work with and how we might work better.

Whether that references design, asset management or product and system performance, it will play a key part in our ability to survive and prosper in the harsher climate of AMP7.

No surprise then that resilience is the key theme for our next conference. The event's value, though, will be determined by your participation. Let's use the expertise we have in order to ensure a rosier future. ■

John Howarth
Pump Centre Manager
pumpcentre@arcadis.com

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Record London fatberg tackled

Thames Water pumps FOG 'monster' for biodiesel processing

Thames Water engineers are tackling one of the largest pumping challenges on record – disposing of a vast 'fatberg' located in London's sewage network in the Whitechapel area.

Reports estimated that the accumulation of fat oil and grease (FOG) together with sanitary products, is one of the largest ever recorded in the UK – twice the length of a Wembley football pitch and weighing an estimates 130 tonnes.

Thames' head of waste networks Matt Rimmer said the task was made harder, not only by the scale of the blockage, but because it had set hard "like concrete".

Rimmer said that, while

industrial waste contributed to the overall problem, wipes and other sanitary items disposed of from domestic properties were a serious issue that caused waste to accumulate more readily.

Thames and its fellow water companies have been active in the drive to convert fatberg and human waste into recyclable energy and fuel, in preference to opting for landfill solutions. The Whitechapel fatberg has been processed for biodiesel.

Wessex Water, meanwhile, has installed a biogas plant at its sewage works capable of converting waste.

www.thameswater.com

Veolia double win

Second biofilm reactor contract from Yorkshire

Veolia Water Technologies UK has been awarded a contract to supply its AnoxKaldnes moving bed biofilm reactor (MBBR) technology for tertiary ammonia removal at a major Yorkshire Water facility.

The work at Clayton West Wastewater Treatment Works forms part of an upgrade carried out by Morgan Sindall/Sweco Joint Venture.

It is the second such contract that Veolia has been awarded by Yorkshire Water. Four years ago the company completed the successful installation and performance of a reactor at Cudworth WWTW. The new facility consists of a bespoke MBBR design to meet a 3 mg/l ammonia performance requirement.

Veolia has been involved in designing, building and commissioning more than 700 MBBR reference sites, from small package facilities onboard ships to large industrial and municipal installations.

www.veolia.co.uk



■ IMechE director of engineering Dr Colin Brown presents Brian Callingham, Stretham Old Engine Trust chairman, with the Engineering Heritage Award

Jaguar, Concorde, Turing... now Stretham

Engineers honour pioneering pump that drained the Fens

It may not look like a conventional pump, but Cambridgeshire's Stretham Old Engine is the earliest, largest and most complete surviving example of the beam engine and scoop wheels that once populated the flooded fenlands.

Built by Derbyshire firm Butterleys in 1831, it helped revolutionise the drainage system in East Anglia. Powered by steam, it could keep working when conventional wind pumps failed. Last month the engine pump became the latest recipient of an Institution of Mechanical Engineers' Engineering Heritage Award.

The previous 108 winners include Alan Turing's Bombe at Bletchley Park, the E-Type Jaguar and Concorde.

Dr Colin Brown, director of Engineering at the Institution of Mechanical Engineers (IMechE), said: "Stretham Old Engine played a crucial role in keeping the Fens free from

floods for over a hundred years. This award celebrates not just the original ingenuity of the Butterleys' engineers of the 19th century, but also the committed team of volunteers who maintain it in such fantastic condition."

Brian Callingham, chairman of the Stretham Old Engine Trust, said he and his colleagues were honoured that the work of volunteers and the "inspiring vision" of the engineers that originally developed the Stretham Old Engine were recognised.

He remarked: "It is a most fitting tribute to the dedication of my predecessor, as chairman, Keith Hinde OBE, and to his son, Edward, as our engineer. This honour, we feel confident, will be a crucial element in our endeavours to recruit much-needed volunteers to ensure that the contribution the engine makes to the engineering heritage of the Fens will continue to grow."

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The road to resilience

AMP7 will be a rocky ride, but one of Ofwat's main themes provides an exciting opportunity for The Pump Centre 2018 conference to set the agenda – with your help

This year will see the introduction of a new means for measuring inflation in the water industry – one that will have a lasting impact upon those working in the sector.

In January 2018, it is expected that Ofwat will confirm whether the Retail Price Index will be replaced by the Consumer Price Index (CPI) or CPIH – a refinement of CPI that additionally factors in owner-occupier housing costs (hence the 'H').

Pump Centre member AECOM, the international infrastructure firm responsible for government and business assets across 150 countries, recently offered a warning of the implications.

In one of its latest press releases, it predicts that, over the next five years, water industry inflation based on the RPI measure will rise at a significantly higher rate than inflation measured using CPIH as the metric rate.

The challenge facing the water industry, if Ofwat follows through with its intention of using CPI(H) for AMP7, will therefore be how to deliver its programme using a lower inflation rate metric.

The difference between water companies' Totex costs based upon RPI and those based upon CPIH are believed to be significant.

To put that in its recent, historical context, for Asset Management Plan periods (AMPs) that spanned the previous eight years, previous inflationary growth has been broadly aligned with RPI – or actually lower than it.

During the last five years RPI increased by 12%, points out AECOM senior consultant Edward Day.

In that same period the figure for CPIH was just 8%: "Combine this regulatory change with the Water Industry Price Review (PR19) process set to be the most challenging to date, the uncertainty surrounding Brexit and its effect on sterling, the significant skill shortages persisting in the infrastructure industry, and increased infrastructure output buoying contractors' margins, and it appears likely that water companies' resultant cost inflation will significantly exceed CPIH during AMP7."

One does not need an economics degree to accept the assertion that a significant rise in inflation will impact margins. Nor the suggestion that the remedy is likely to lie in innovation and more efficient delivery, as costs rise faster than revenues.

This point does not appear to be lost on the water

“The challenge facing the water industry, if Ofwat follows through with its intention of using CPI(H) for AMP7, will be how to deliver its programme using a lower inflation rate metric”



regulator. With the present AMP6 period still at the halfway mark, Ofwat has indicated the key themes of its forthcoming PR19: customer service, affordable bills, innovation and resilience.

The likelihood is that investment levels for AMP7 will be altogether lower than before. Just as this impacts on the water companies, it will also do so upon the supply chain, where firms will come under increased pressure to deliver required outcomes while increasing efficiencies.

The focus on innovation is something that has been encouraged by water companies and contractors for several years but it will be increasingly important that particular innovations prove sustainable long term.

Underpinning this is the new emphasis upon resilience and it is this concept that will form the overarching theme for The Pump Centre's 2018 conference.

Ofwat's insistence upon resilience requires not only factoring in the physical risk such as equipment failure and downtime, but also the wider contextual risks including drought and flooding.

Improving understanding of risk and establishing tolerance levels that are both realistic and

Pump Centre member companies have been asked to make presentations at the 2018 conference. Please apply by Friday 10 November 2017. Should The Pump Centre receive more requests than available presentation slots, a committee made up of the organisation's technical consultants will decide on the final conference programme.

Please note that the committee will make their decision based on the information provided on the form, so please make it as descriptive and comprehensive as possible. The programme will be finalised and announced at the end of November 2017.

For more information, email john.howarth@arcadis.com.



reliability to ensure maximum availability.

“Opportunities and instances of comprehensive knowledge share within the water industry, where all stakeholders have the chance to discuss matters face-to-face, are inevitably rare,” says Howarth.

“The 2018 Pump Centre conference will provide a unique opportunity for us to do so. The insights we share may potentially allow us to influence and shape national strategy and provide thought leadership to the benefit of the industry and its consumers.”

But the ability to fulfil this ambitious brief will depend upon the quality and breadth of members' participation in the conference.

With this in mind The Pump Centre is inviting members to contribute presentation topics that focus on how resilience in the industry can be improved and good practice instituted.

Examples of subject areas are:

- New approaches to system/station design
- Design and application of predictive maintenance techniques including innovative ways of reducing planned and reactive maintenance
- Advances in system control and optimisation
- The use of smart technology to improve efficiency and reliability
- Renewable energy generation
- Better data collection and analysis
- Application of Building Information Modelling (BIM) to pumping systems
- Reducing costs using innovative products and/or solutions
- New standards/changes to existing ones that will impact pumps/system design and/or operation

commercially viable will be key. Thus, any investment made must demonstrate ‘workable resilience’.

Pump Centre manager John Howarth explains how resilience impacts in practice: “Manufacturers and operators have been aware for a long time of various options to improve the reliability of assets and pumping systems.

“The importance of delivering reliable and resilient systems has gained a higher profile across industry with more emphasis being applied at the specification and design stages to meet end user requirements.”

Improved reliability underpins improved resilience, he adds. “Partnering strategies between contractors, suppliers and operators are focusing more on the implementation and facilitation of approaches to improve the resilience of pumps and pumping systems.”

The search for new ways to deliver higher levels of resilience can be broken down into three areas that encompass all parts of the supply chain, explains Howarth.

These include: innovative and intelligent design; smart and good quality maintenance/asset management; and improved product and system

“The insights we share may potentially allow us to influence and shape national strategy and provide thought leadership to the benefit of the industry and its consumers”

Additionally, The Pump Centre is planning 12 25-minute breakout presentations based on or around the key theme. These will be technology based and not product focused, demonstrating how resilience of a pumping system has been, or may be, improved.

Presentation topics sought include Totex reduction case studies and examples describing the implementation of Totex strategies, as well as presentations including comparative metrics or illustrating innovative approaches/products/processes that have delivered demonstrable cost savings.

Given the unprecedented impact of the forthcoming PR19 and the AMP7 period, the question is perhaps less one of whether you can afford time to attend the 2018 Pump Centre Conference, but whether you can afford not to be there. ■



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Progressive approach

Huber Technology was commissioned by South West Water to improve the inlet works facility that serves the town of Exmouth in Devon

South West Water wanted to upgrade its inlet works facility that serves a major area of Devon.

The site is responsible for treating sewage from the town of Exmouth, the county's fifth most populous urban area. With a population of around 35,000 people, it lies at the western end of the Jurassic Coast conservation area.

The inlet facility featured a balance tank which had become increasingly overloaded with build ups of rag and screening. This was threatening the efficient functioning of the entire works and required improvement.

Engineering consultants Tecker had been tasked to oversee the works and approached Huber Technology.

The firm is a supplier of proprietary stainless steel wastewater treatment solutions serving both municipal and industrial markets.

Counting the main UK water companies and their contractors and delivery partners among its clients, it customises equipment – designed and manufactured in Germany – at its workshop facility in Chippenham.

The Exmouth project was split into two sections: supply of a coarse screen to protect the balance and storm tanks;



develop a solution that would minimise downtime. This involved the installation of the coarse screen into a site channel that had been fabricated offsite and which could be mounted on top of the existing balance tank structure.

This was completed and the rising main connections made, with the coarse screen installed into the site channel with the

screening at the inlet works to be maintained. Richard Willis, area manager for Huber Technology, said: "This difficult project was delivered in conjunction with Tecker and already significant improvements can be seen on site, particularly the coarse screen which is protecting the balance tank and fine screens from the large volume of screenings received into the works."

Huber technology supplied included:

- 1x RakeMax 4160/990/40, throughput 1027 l/s peak flow per screen
- 2x EscaMax 5000/1352/6, throughput 363 l/sec peak flow per screen
- 2x WAP/L BG4-V, throughput 4.5m³/hr

The RakeMax screen, designed for municipal and industrial wastewater and process water screening, can adjust for different requirements.

Installation height of the RakeMax above ground level is relatively small and dependent only on the installation height of screenings transport or washing units. ■

www.huber.co.uk

“Already significant improvements can be seen on site, particularly the coarse screen which is protecting the balance tank and fine screens”

and supply of new fine inlet screens and screenings handling equipment.

The challenge on site was to maintain adequate screening while the new screens were installed.

Previously the flow into the balance tank was via four pumped rising mains, with flow to the inlet screens controlled by penstocks in the balance tank.

Huber experts worked with Tecker to

screening discharging directly to a skip.

Following agreement on the sequences with Tecker, Huber ensured the hydraulic constraints of the structure were taken into account. This was intended to ensure the screen performed correctly and adequate bypass weirs were provided.

The fine screens and handling plant were added in phases to allow the

Water transformation

One peristaltic pump replaces three diaphragm pumps at major water treatment plant

The Oldenburgisch-Ostfriesischer Wasserverband (OOWV) is a regional water association in the East Frisia region of Germany that not only supplies clean drinking water, but also purifies the wastewater from more than 500,000 people through 46 water treatment plants.

Recently, the water treatment plant at Riepe replaced three diaphragm pumps with a Qdos series peristaltic pump supplied by Watson-Marlow Fluid Technology Group.

“Besides household wastewater, we also have a relatively large amount of wastewater from industrial areas,” explains plant manager Klaus Janssen.

“For this reason, the phosphorous levels in the inflow water are relatively high, at around 15 mg/l on average.

“However, our prescribed phosphorous limit at the point of entry is 2.0 mg/l, although we are in fact striving to not exceed the target limit of 0.5 mg/l,” adds Janssen.

MAJOR MAINTENANCE

In order to achieve this reduction, the wastewater facility uses chemical coagulation which converts the phosphate solution in the water into insoluble phosphate compounds that can then be isolated.

At Riepe, one diaphragm pump supplied the coagulant from underground storage containers into the holding tank, with the actual dosing handled by two further diaphragm pumps – one in constant use and one in standby mode in the event of a failure.

Failure had become an increasingly common outcome, with the pump diaphragms often corroded by the chemical coagulants, making replacement necessary.

“The diaphragm pumps also produce a strongly pulsating flow which, after some time, would lead to signs of wear and tear on the fittings and valves,” says Janssen.

“The maintenance work started

“By relieving us of this workload and the saving on spare parts, the investment has paid off very quickly”

amounting to several hours per month; moreover, we had to hold a whole range of spare parts in stock, including diaphragms and valves.”

A further problem with the diaphragm pumps was suction.

Air drawn in could jam the valves, meaning that the diaphragm pumps were unable to prime and pump.

As a result, the phosphorous limits

diaphragm pumps to operate.

The new Qdos 30 peristaltic pump at the site doses at 150 ml/min, although it offers a maximum flow rate of 500 ml/min – more than enough for occasions when there are high phosphate levels in the water.

The single Qdos pump is able to draw the iron (III) chloride directly from the storage tank, which means that a holding pump, the standby pump, and the holding tank, plus associated float switches and electronics, are no longer necessary, explains Janssen.

“While the accuracy of the diaphragm pumps declined over time as the diaphragms became corroded and worn, the Qdos pump is extremely accurate, so we’ve able to reduce the frequency of recalibration.”



discharged from the plant increased and, in the worst case, meant that the relevant authorities had to be notified.

To avoid this, emergency operations at night or during the weekend were becoming more frequent.

The problem occurred most often whenever the stock of coagulant was replenished.

Here, the chemical dosing lines had to be manually flooded with water to enable the

Dosing phosphorous coagulant iron (III) chloride for over a year, the Qdos 30 pump has cut capital equipment costs and significantly reduced maintenance and repair costs.

Janssen estimates the pump has saved two-five hours per month: “By relieving us of this workload and the saving on spare parts, the investment has paid off very quickly.” ■

www.watson-marlow.com

Fit for grit?

You overlook the issue of grit removal at your peril – forthcoming changes proposed by Ofwat for the next AMP period ensure dealing with it will be crucial, says Jacopa's Neil Sandell

As Ofwat moves to ensure that water companies place an emphasis on resilience (see main feature on pages 6-7) with its new report, the systems thinking required should put grit plant optimisation at the heart of wastewater treatment strategies.

While effective grit removal is often not seen as a key process, it is essential at the preliminary treatment stage. This is because, if grit plant is not performing well or is not able to retain sufficient grit, the downstream effects of even relatively fine abrasive detritus on the rest of the treatment train can be severe.

Grit accumulates wherever flow slows down; in tanks, channels and chambers where if it builds up it will require costly removal.

It also increases wear on expensive equipment, notably pumps, reducing their expected life and increasing maintenance for sensitive parts such as the vulnerable impellers.

Optimisation of grit plant requires proactive, preventive maintenance to ensure equipment does not fail unexpectedly. And when failures do occur they often go unnoticed until serious effects on downstream assets become evident, causing on-going problems for the rest of the treatment process. Optimally functioning grit plant enables utilities both to save money and reduce their environmental impact.



■ Grit problems can have a severe impact on downstream processes

Grit in downstream treatment systems also reduces the available treatment volume and process efficiency. This affects final effluent quality, the amount of energy required to achieve the works' discharge requirements, and the efficient operation of sludge digestion plant.

Jacopa was recently asked to refurbish a J+A Jeta grit trap and classifier at a major treatment works. The company found that the plant had not been running efficiently for years, leading to a massive grit build up downstream that had compromised biofilters, many pumps and other critical plant.

Following refurbishment and commissioning, including plant optimisation, the works is now running far more efficiently.

Jacopa is now offering free health checks for grit plant at WTWs. These enable the firm to identify any

maintenance required and recommend action on refurbishment and optimisation.

When problems do occur, their impact on downstream processes can be severe, and costly.

A Totex strategy must then include protecting vital assets, such as pumps, but cutting operational expenditure (Opex) is also an important element within the overall plan.

This has generated an intensified focus on maintenance rather than the previous capital-intensive solutions.

Utilities have a new mandate to get more out of existing assets by ensuring that they continue to operate at optimum performance levels.

Jacopa has a portfolio of products for grit removal, as well as classifier systems and grit pumps for a variety of site configurations and requirements.

Examples include the J+A crossflow detritor grit trap – designed to remove 95% of 0.2mm grit to produce a largely grit-free effluent that's well-washed and drained – and the J+A Jeta grit trap, providing a high level of grit removal within a minimal footprint and slow-rotating mechanism.

Given that removing grit from treatment systems can create significant cost and downtime can jeopardise compliance, addressing grit plant optimisation is in reality a smart investment in the efficient operation of a treatment works. ■

www.jacopa.com

“Failures often go unnoticed until serious effects on downstream assets become evident, causing on-going problems for the rest of the treatment process”

Progressive approach

The sewage sludge market is ripe for development but success depends upon efficient transfer and mixing, as Anglia Water appreciated when it turned to Seepex for assistance

While process optimisation, economies of scale and deregulation will all play a part in the continued increase in energy generation by the water industry, correct equipment selection remains crucial.

Pumps in particular are vital to the water sector and need to take into account individual needs.

Correct pump selection will give the optimum return on investment, so a thorough understanding of the product to be handled – and the process requirements – should be considered, with tailor-made packages often providing the best solution. Minimising the energy use of equipment is important and progressive cavity pumps have the ability to maintain flow, even with varying pressures and different sludge viscosities.

This is specifically important when feeding heat exchangers to ensure the most efficient transfer for heating sludge.

Currently, a significant proportion of sewage sludge is treated by water authorities in their own large, centralised treatment centres, which take dewatered sludge from their smaller satellite treatment works.

However, the trend for water companies to treat only their own sludge is set to change as a result of the Water 2020 report, published by the regulator Ofwat, which is designed to kickstart a market for treated sewage sludge.

Integrating pumps with complementary equipment, such as special live bottom silos, boundary layer injection systems and back-mixing technology, together with intelligent control systems, is crucial for



■ Anglian Water uses Seepex pumps to mix sludge cake with water

reliability, performance and cost efficiency.

Anglian Water is the largest water and water recycling company in the UK by geographical area, supplying more than six million homes and business customers in the east of England with clean water and treatment services.

During the previous AMP5 period, the company installed sludge reception centres and advanced energy generation using thermal hydrolysis at three locations within their area. It was important that

“As well as lower capital costs, operating costs were reduced”

these plants were as efficient as possible to provide the double advantages of reduced energy consumption and increased generation.

Anglian Water installed Seepex progressive cavity (PC) pumps for efficient sludge transfer and mixing duties.

Lesley Eaton, business development and marketing manager for Seepex, explains why: “PC pumps were chosen as they can handle both low and high viscosity products, can pump sludge with DS% (dry solids) up to 45%, and are not hindered by solid particles.

“In addition, their good discharge pressure capabilities enable long-distance pumping, and their non-pulsating flow characteristics make them a popular choice for many wastewater applications.”

Open hopper pumps for high solids transfer (up to 30% dry solids in this case) and liquid transfer pumps formed part of the package, while a visit to an existing sludge treatment plant demonstrated how efficiencies in installation could be achieved, removing the need for conveyors in parts of the process.

This was achieved by using customised pumps fitted directly to silo outlets which could back-mix sludge cake with dilution liquid to the required ds% needed for energy generation. Integrated controls linked the liquid addition and back-mixing silo pumps to ensure optimised mixing.

Says Eaton: “As well as lower capital costs, operating costs were reduced by using very small amounts of liquid injected constantly to the outlet of the pump. This produces a lubricating boundary layer around the sludge, reducing friction losses and hence operating pressure.”

As a result, the load on the pump was reduced and service intervals were extended by using the boundary layer system, made possible by the accurate dosing characteristic of PC pumps. ■

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Emptying the pockets

Pumps are frequently blamed for the air blockages that cause problems for sewage stations and mains. The fault often lies elsewhere, cautions Hydraulic Analysis Limited's [Glyn Addicott](#)



■ HAL has developed the Pipeline Condition Monitor (PCM)

Research shows that an estimated 10% of sewage pumping stations and rising mains in the UK are suffering from air locking due to inadequate air release facilities.

Air blockages typically result in the following issues:

- Pressure at the pumping station rises gradually when the pumps start
- If centrifugal pumps are installed, the design (consent) flowrate is not achieved during a normal pumping cycle due to the air pockets
- High pressures are created by the trapped air with frequent bursts occurring
- Sedimentation due to low velocities
- If positive displacement-type pumps are installed, pipeline operating pressures can rise to more than double the design pressure.

Bursts are particularly common in uPVC pipelines as this material is prone to fatigue failures – there are design limits relating to the pressure variations which uPVC mains can be subjected to when pumps stop and start.

POLLUTION THREATS

Pollution fines for assets that experience multiple failures can exceed £0.5 million, with Category 2 pollution events and prosecutions becoming increasingly common.

The solution to preventing pollution incidents lies in practical engineering to identify, address and resolve the cause of the pipeline failures. While it is accepted that these aged rising mains need replacing, the current scale of the undertaking makes it unrealistic over the next decade.

Not all vulnerable rising mains are necessarily at the end of their useful life. These mains are fatigued and operating outside of their design envelope due to air blockages causing flow restrictions and higher pumping pressures/surge pressures.



■ Work is taking place with a number of UK water companies to lower pipeline operating pressures

pack (eliminating the need for a mains power supply) and communication via GPRS signal.

Benefits include:

- Pressure readings taken every minute, accessed via a secure web browser
- Alert notification via SMS or email if pressures fall outside expected operating envelope
- Visibility of burst, assisting improved reaction timings and avoiding possible escalation to a Category 2 pollution event

- Can fit both pre-existing sites and new assets

A low-pressure alarm system is utilised to monitor the static non-pumping pressure and transmit data to the cloud.

Any notable decline in the non-pumping pressure may indicate liquid is being lost from the system, i.e. the rising main has failed. Alarm sensitivities are calibrated on site to ensure that transient events due to pump operations do not generate false alarms.

AIR VALVE MODIFICATIONS

PCM data from a pumping station during a typical DWF day – before and after a number of key pipeline air valves were replaced – showed key improvements, post-modification:

- A stable and repeatable static head revealed trapped air had gone
- Pumping station operating pressure had reduced from 3.8 barg to 2.6 barg
- Surge pressures had reduced from 7.5 barg to 5 barg
- Pump stop/starts had halved by repairing the pumping station sump level control system (HAL had identified a fault with the stop/start settings which was contributing to pipeline fatigue)
- RAG status had altered from red to green

This is now a healthy asset from a hydraulic perspective (this does not account for pipe material condition, just system stability).

TRAINING

Once a stable pressure regime is achieved, HAL trains call centre analytic teams to understand and interpret alarms. The control centre can then receive alarms directly to improve burst response times and ensure round the clock alarm monitoring.

HAL has multiple contracts with UK water companies for the installation of pipeline condition monitors on rising mains.

Units are currently operational on 28 Severn Trent Water wastewater pumping stations and we have successfully detected and called in over 10 failures on these Severn Trent assets in the past 18 months (Severn Trent Water average 93 rising main failures every year). ■

www.hydraulic-analysis.com

However, they can often be returned to near design conditions with a few minor modifications. These include servicing or replacing a critical air valve or adjusting the pump stop/start levels and sequencing.

The root cause of rising main failures is mainly attributed to the pumps but, in our experience, pump operation is often a secondary issue as the pump is trying to deliver into a blocked rising main.

It is the pipeline condition causing the reduced flowrates and bursts, not the pumps which are simply responding to the conditions and trying to overcome the blockages.

The pumps deal with what is in front of them and will always operate at a given point on their performance curve, even if it is not ideal or efficient.

Hydraulic Analysis Limited (HAL) is working with a number of UK water companies to reduce rising main bursts, lower pipeline operating pressures, reduce surge pressures, and increase flowrates through site pressure and flow logging combined with a desk based hydraulic (surge) analysis.

Once solutions have been identified and implemented (air valve repair, pump repairs, blockages cleared), a further phase of monitoring is completed to validate improvements made and calculate any other factors that may be affecting asset condition or performance.

MONITORING FOR IMPROVEMENT

Utilising our expert knowledge in surge and pipeline analysis, HAL has specifically developed an effective long-term rising main monitoring solution: the Pipeline Condition Monitor – PCM.

This is tailored to identify the root cause of problems and to provide real, valuable data on which key decisions can be made. The solution comprises a singular piece of pressure monitoring equipment, powered independently by a battery

“It is the pipeline condition causing the reduced flowrates and bursts, not the pumps which are simply responding to the conditions and trying to overcome the blockages”



Digging deep

Can you save on energy costs without either investing in kit upgrades or reducing the scale of your operation? It's challenging, but it's not impossible, explains ABB's [Martin Richardson](#)

If you had to cut 20% from your domestic energy bill, how would you go about it? Just to make it more interesting, let's say you were not allowed to purchase any additional energy-saving equipment and you had to use the same number of appliances and run them for the same amount of time as you currently do. There's no question that it would be tough.

Yet, on average, that's the percentage that water and wastewater service providers say they must cut from their annual energy bill in order to remain competitive. Any reduction in the quality and reliability of the services they provide is not an option.

Simultaneously, they must meet their obligations under AMP6 to manage capital and operational expenditure in order to deliver positive customer outcomes and keep prices down.

LOOKING FOR SAVINGS

In most cases, greater efficiency can be achieved by optimising the electrical system driving existing pump systems.

An electrical system typically comprises a transformer, variable speed drives (VSDs), electric motors, switchgear and cabling. The savings can be significant – in excess of 20%. It's just a case of knowing where to look.

Many pump systems are far less efficient than they may appear to be. Often when specifying such a system, designers simply multiply the catalogue efficiencies for each component to get an overall system efficiency.

■ **Reducing pump speed by 2 Hz offers 12% energy saving typically on a pump system**

If each component is listed as 98% efficient, there may be an assumption that the entire system will be likewise. In reality the overall efficiency could be as low as 86%. How does this occur?

Firstly, catalogue efficiencies are based on manufacturers giving their best figures under laboratory conditions.

For example, motor direct-on-line (DOL) efficiencies are reported on a pure sine wave. No factory or public power supply is a pure sine wave, so actual DOL efficiencies are likely to be up to 2% lower.



■ **Martin Richardson, water framework manager – drives & controls, ABB**

Your voice counts

There's a wealth of expertise and knowledge you have to share as a Pump Centre member – so let's hear from you...

We have received an enthusiastic response to our call for contributions from members but we want to give even more of you the opportunity to share your news and views.

If you want to submit a feature for our Technical Viewpoint/On Site sections, or



“Many pump systems are far less efficient than they may appear. Often when specifying, designers simply multiply the catalogue efficiencies for each component”

Furthermore, EN 50598-2, a relatively new standard for VSD efficiency, defines that manufacturers should publish their figures based on their default factory setting.

Manufacturers use different default settings. ABB uses 4 kHz as a default switching frequency; other manufacturers choose to use 2 kHz.

This lower switching frequency improves the figures the manufacturer can publish for the VSD efficiency. In practice, the system efficiency is worse.

Secondly, simply connecting components together overlooks some fundamental lessons of physics which cause them to react with each other in unexpected ways; adding a VSD or a PQF (power quality filter), or passive filter can impact on system efficiency.

With these insights, utilities planning greenfield sites can avoid energy use disappointment.

But what about existing electrical systems? The good news is certain components can be fine-tuned, replaced or adjusted to improve the overall efficiency.

Additional savings can be achieved by ensuring the individual components of a pump's electrical system are optimised. Selecting the most efficient motor for the duty could increase efficiency by up to 5%.

LESS SPEED, MORE SAVINGS

However, the greatest savings are achieved by reducing the speed of the pump. A 2 Hz reduction in speed provides typically a 12% energy saving on a pump system.

One option is switching to parallel pumping – running two pumps at slower speeds rather than one at full speed.

Changing the control philosophy of the VSD driving the pump motor to pump slower for longer also cuts energy use.

This is particularly effective when used to switch the operation of pumps to lower tariff periods. That alone can reduce energy costs by thousands of pounds annually. ■

www.new.abb.com/uk/campaigns/water-totex/system-efficiency



update us on your company for the Members pages, we would be glad to hear from you.

Also, if time doesn't allow you to send in a finished article or background material, but you are keen to highlight a current issue or best practice, send a short letter for publication in the forthcoming issue of *Pump Action*.

As your membership publication, our success depends on your input, knowledge and experience.

Don't delay – get in touch with us now by emailing john.howarth@arcadis.com.

■ Selecting the most efficient motor for the task could increase efficiency by up to 5%

Pulling together

Our new section reflects the growing importance of joint venture contracts but, explains Pump Centre chairman **Bob Went**, it's going to need your help to make it work

Since its inception The Pump Centre has addressed the needs of its members through a wide range of activities, including standards development, training, networking, consultancy, and the unique annual conference and exhibition.

Membership is drawn from a wide range of industries and industry sectors arranged into

companies that partner to form a Joint Venture (JV) company, which contracts with the water company to deliver all or part of its capital programme for a given period.

JVs comprise a mixture of contractors and consultants whose capabilities and experience fit the requirements of a water company's capital programme or part of it.

This change in capital

and the relationships between all the parties involved.

The style and content of specifications across the industry, including compliance with regulatory requirements and national and international standards (including WIMES), has added another dimension to the process of continuous change.

To reflect these changes within the water industry, The Pump Centre has decided to include a Joint Ventures section in future editions of the newsletter.

This will include specific content relative to the areas mentioned above and provide an opportunity for members to include news, updates and articles of interest to the wider membership.

News articles could include details of joint venture appointments, awards of projects, structure, or changes, and articles of interest could include those relating to projects, energy-saving achievements, challenges with BIM (building information modelling), and matters related to WIMES (water industry mechanical and electrical specifications), etc.

To give the most comprehensive overview of what's happening on the joint ventures front, your help will be needed.

So get in touch at your earliest opportunity and share your information with us in order that we can include it in our next issue.

Whether it's a finished article or a few bullet points on email, we want to hear from you. ■

Contact John Howarth
(john.howarth@arcadis.com)
for more information



users, manufacturers, and component and service supplier groups.

The dominant sector of Pump Centre membership is the water industry, comprising all the major water and sewerage companies and many water-only companies.

In recent years the UK water industry has changed significantly in many ways, including how firms deliver their capital programmes. These are now almost invariably delivered by a consortium of

programme delivery mechanism has also required significant changes in the shape and responsibility of staff in the water companies' engineering departments.

Many now work as part of the JV team and others may be working in a liaison role. The changes have also significantly affected everyone in the supply chain. These are wide-ranging, including approaches to design and construction, procurement,

WIMWG on course

In the first of our regular updates reporting on the progress of The Pump Centre's three collaborative projects, here is an outline of the work undertaken by the Water Industry Maintenance Working Group

The WIMWG has just entered its fourth year of activity and due to the enthusiasm and commitment of its members continues to provide an excellent forum for the exchange of knowledge on maintenance activities.

The main objectives of WIMWG are:

- To develop a forum for the exchange of information relating to maintenance of plant and equipment in the UK water industry.
- To generate best practice guidance notes on a wide range of maintenance-related topics via appropriate benchmarking activities, technical events and, where possible, pilot studies and test trials.

WIMWG allows those with an interest in maintenance to benefit significantly from the knowledge

“With its busy programme, this group continues to be a key player in the development of maintenance activities”

and experiences of their peers in other companies and gives them the opportunity to collaborate in pilot studies, technical events and discussions relating to high-level strategy, common problems and new technology.

The group is managed and facilitated by The Pump Centre and includes representatives from the Environment Agency, Heathrow Airport and 16 water

companies, providing many opportunities for group members to drive consistency and standardisation.

However, members also see great value in highlighting where they have differing approaches, understanding why that is the case, and thereby developing their expertise.

WIMWG meets every 2-3 months at a variety of locations throughout the UK, each meeting being centred around a key theme.

This year, meetings have been hosted by Yorkshire Water, Anglian Water and The Pump Centre with work focusing on developing best practice and guidance documents for:

- Statutory and legislative tasks
- Failure mode analysis
- Asset integrity strategies

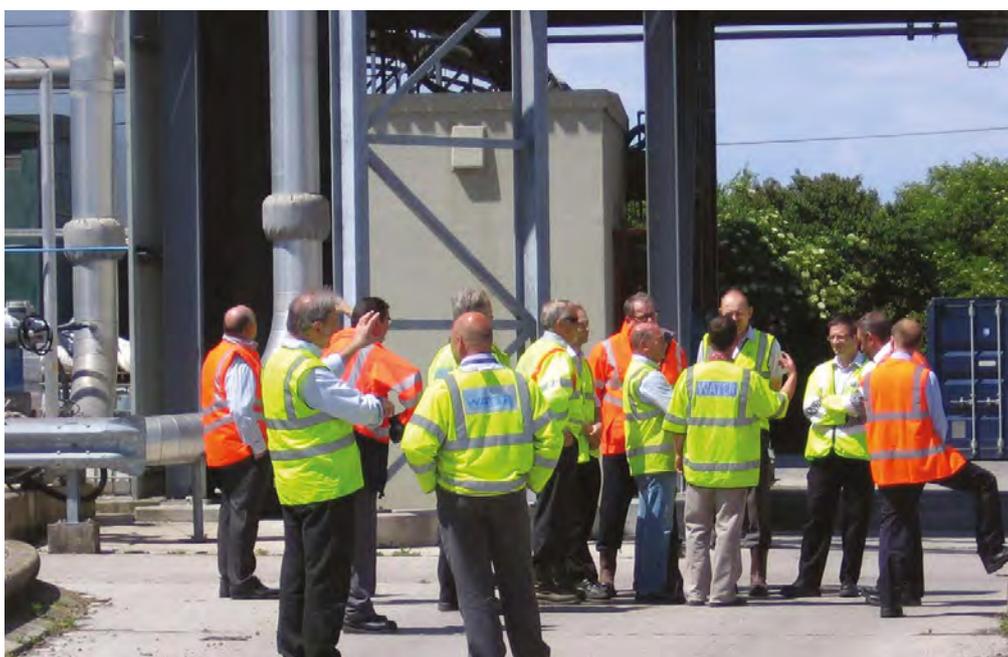
The remaining meetings this year will be hosted by Scottish Water and Dwr Cymru, the former being a two-day event incorporating an Awareness Day on asset integrity strategies.

There is an opportunity at every meeting for group members to raise issues, request help, or provide information on a new topic.

Items raised at the gatherings are many and varied and this year have included such diverse topics as testing of emergency lighting, maintenance of scraper bridges, gas bag inspections and magnetic drives.

With its busy programme, this group continues to be a key player in the development of maintenance activities and their management within the UK water industry. ■

- For updates on this and other projects go to: bit.ly/PumpProjects



Tailored to your every need

Pump Centre services don't operate a 'one size fits all' approach. Two innovative types of niche event – mini conferences and awareness days – are available to suit your particular needs

There is a sizeable number of members who will have attended one or both of The Pump Centre's mini conferences this year.

The Scottish Water version was staged last month at the Garfield House Hotel in Glasgow, with the Yorkshire Water one pre-dating it in July.

Scotland is a regular fixture on The Pump Centre agenda; it has been the pioneer for the mini conferences and has hosted these for several years.

In 2017 Yorkshire became the second area and the first region in England to adopt the format. On the back of this growing success, The Pump Centre is now preparing the ground for two further ones elsewhere (see below).

So what is the purpose of the mini conferences and why have they proved so successful?

MINI CONFERENCES

As you might be aware, a large proportion of members spend much of their working lives employed or contracted in the water industry. It's important that water industry personnel and

suppliers understand the changing demands of this sector.

It's important too for water companies that their employees understand the work The Pump Centre does, whether or not they are closely involved in it themselves.

For these reasons, mini conferences are based on a partnership with individual water companies and, where possible, are held in venues local to the organisation. The location might be the company's head offices, or an adjacent hotel or conference centre.

Each event is built around a technical theme. The main concept is decided by the water company which will aim to promote the value of event to its employees.

For example, Scotland's recent conference theme was improving reliability in the water industry. Co-organiser was Brian Spence, senior strategist at Scottish Water, with support from Martin Faulds.

The technical presentations came from one of The Pump Centre's most experienced consultants, Dennis Goodlad (formerly of Thames Water and

Eye openers

Pump Centre Awareness Days offer the chance for a grassroots response to member demand

Awareness Days are another variation on The Pump Centre's extensive provision of events and technical themes that are specially tailored to the training and budgetary needs of specific audiences and locations.

COMMON INTEREST

While mini conferences are organised with the involvement of an individual water company, the awareness days are each developed by The Pump Centre team, or a number of Pump Centre members

with a common technical interest.

Typically, up to four Awareness Days are staged annually, with two new ones due to be added to the schedule shortly.

The first of the newcomers is this month's Asset Integrity Strategies on 8 November in Glasgow.

Seven water companies will be presenting, together with the team responsible for asset based maintenance for Heathrow Airport. Each will describe its logic for defining criticality and prioritising tasks, plus

they will feature case studies and effectiveness reviews.

The second new awareness day, hosted at the Lymm Hotel in Warrington early next year (date to be announced) is 'Introduction to the Water Industry'.

IN THE KNOW

The event will offer a primer for newcomers who have recently become involved in the water sector. It will describe the structure and organisation of the UK water industry,



Jacobs) and Scottish Water's Kirsty Briggs and RWGM's Ian Farrell.

Meanwhile, with a coincidental nod to 2017 and '18 conference themes (see pages 6-7), Yorkshire Water opted to focus on how to develop a proactive asset operation and maintenance approach to drive a Totex-based outcome for achieving asset resilience.

SHARING AND TRAINING

In effect these events function as a cross between a conference and a training event, explains Pump Centre manager John Howarth: "I think the value of it is that it allows water companies to bring different

people in different areas of the business together to discuss topics which are of specific interest to them.

"It's about promoting knowledge share but also internal debate as well. There's also a training element so people are picking up skills around topics of interest."

Numbers vary according to location and themes but will generally fluctuate between 50 and 80 delegates, making it easier to accommodate cost-effectively in smaller spaces.

There's also an opportunity for a limited number of Pump Centre members to set up table top stands in order to raise awareness about their products and services.

BOOK EARLY

It appears that 2017 is shaping up as the year the mini conference has really taken off.

Hot on the heels of newcomer Yorkshire Water comes Anglian and Northern Ireland Water who are currently in discussion about importing a similar format. With two water companies already participants and another pair preparing to follow, there could one day be a full calendar of mini conferences throughout the UK.

The Pump Centre is keen to make the mini conference available to as many collaborators as possible.

So if you are keen to talk about participating, now is a good time to open discussions and avoid the subsequent rush. The Pump Centre staff are happy to hear from you about your ideas.

• *For more information, contact Jim Eaves (call 07968 707 753 or email jim.eaves@arcadis.com)*

with a focus on the roles of engineers, including the following areas:

- Historical perspective
- The regulatory framework and the AMP cycle
- Water company structures and financial arrangements
- The roles of contractors, suppliers and consultants
- Engineering roles and responsibilities within the water industry
- Current and future challenges

CONTACT:

• *For more information, contact Jim Eaves (call 07968 707 753 or email jim.eaves@arcadis.com)*

To reserve places, contact Karen Bridgeman (call 01925 964 030 or email karen.bridgeman@arcadis.com)



■ One Pump Centre Awareness Day focused on building information modelling (BIM)

The brightest and the best

There is a host of new talents waiting to be discovered and the chances are that some of them are in your company. With your help we can put them in the spotlight

Two questions for you:
Do you have a promising talent among your engineers who is in the early stage of their career?

Have you nominated them for The Pump Centre Young Engineers Awards 2018?

Christmas may be coming around fast but the deadline for nominations is even sooner – 1 December. So if you haven't taken the opportunity to promote your promising staff and with it, your company, then you need to act now.

CATEGORIES

There are now three categories – professional, technical and apprentice – and anyone who fits the criteria and works for

a Pump Centre member company or their associated contractors and consultants is eligible.

To qualify for nomination in the Professional Young Engineer category the candidate must be 28 years of age or less on 1 March 2018 and have a formal qualification in an engineering



or related subject.

To qualify for nomination in the Technician Young Engineer category the candidate must be 24 years of age or less on 1 March 2018 and have proven experience on engineering projects as

Young Engineers Award – facts and figures

In addition to the three nominated awards, there is a fourth prize named in honour of Pump Centre stalwart, Derek Jackson, founder/chairman of Hidrosta

Total winners: 22

First award: 2008 (one award to Nick Wills – Aesseal)

Professional/Apprentice categories created: 2009 (Mellish Kett – Severn Trent/Nicole Cuerden – Biwater Treatment)

Derek Jackson Award created: 2016 (Charlie Lake – Wessex Water)

Technician category created: 2017 (Abigail

Stephenson – Gilbert Gilkes & Gordon)

No of female winners: 3

No of companies who have won awards: 16

Multiple winners: Severn Trent Water 4
Gilbert Gilkes & Gordon 3

Wessex Water 2



Timeline

- **Friday 1 December 2017:** Nomination forms to be completed and submitted
- **December 2017:** Stage 1 judging (assessment of nomination forms and selection of finalists)
- **January 2018:** Shortlisted finalists notified
- **Wednesday 7 March 2018:** Stage 2 interviews at Best Western Calcot Hotel, Reading
- **March 2018:** Candidates informed of results
- **2 May 2018:** Winners announced at Pump Centre Conference Dinner, Telford

■ **The 2017 winners of the Young Engineer Awards – (left to right) Jamie Mills (Xylem Water Solutions), Christina Man (Arup), Abigail Stephenson (Gilkes) and Stefan Sadnani (Anglian Water)**

workshop or in the field on hands-on based tasks.

SELECTION PROCESS

In each category, the selection process will comprise two stages. Stage 1 comprises an assessment of the

applications. The nomination forms will be the only thing that the judges will have available to them to draw up a shortlist of finalists.

In Stage 2, all finalists will be invited for interview and to give a presentation. The outcome of this process will be the selection of the award winners.

More details of the Stage 2 process will be supplied to the finalists.

The awards and prizes will be presented at The Pump Centre Conference Dinner to be held at the

Telford International Centre on the evening of Wednesday 2 May 2018.

The winning candidates will each receive a commemorative certificate or trophy, gift vouchers worth up to £200 and a one-day Pump Centre training course of their choice worth up to £350.

In addition, the winning candidates and all shortlisted finalists will each receive a copy of The Pump Centre Pumping Station Design Guide and an

invitation to The Pump Centre Conference Dinner and Awards ceremony.

• *If you would like to nominate one of your Young Engineers, contact John Howarth (john.howarth@arcadis.com) for a nomination form*



appropriate to their field of work.

The candidate will likely be spending most of their time working outside the workshop in a less hands-on role, have a level of responsibility commensurate with that of a technician engineer, and possibly be working towards a formal qualification in engineering or a related subject.

To qualify for nomination in the Apprentice Young Engineer category the candidate must be 22 years of age or less on 1 March 2018, have proven experience on engineering projects as appropriate to their field of work, and primarily be working in the

nomination forms received to draw up a list of finalists.

Nominators and nominees should therefore ensure that they complete all sections of the nomination form and include sufficient information to allow the judges to accurately assess their



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Sustainable Productivity

Broad appeal

The attraction of Pump Centre membership extends across a wide range of companies with differing specialisms. Here are just some of the latest recruits

EGGER PUMPS



Egger specialises in the manufacture of pumps for solids-laden or gas infused liquids that are particularly useful in applications such as grit removal, sludge recirculation and food waste slurries.

Over the past 70 years the company has developed from small beginnings to become a major Swiss manufacturer. Due to careful expansion, Egger has preserved its independence and to this day remains a family business with more than 350 employees.

It has been at the forefront of the development of the vortex torque flow impeller and gas-handling hydraulic designs.

UK and Irish customers are supported by its team based at Barnsley, South Yorkshire.

www.eggerpumps.com

R&M UTILITY

Utility and Civil Engineering Services

R&M Utility & Civil Engineering has become a major name in the South West and South Wales since its foundation 13 years ago.

Its main areas of work include civil engineering, no dig, potable water, landscaping, marine works,

CCTV and building maintenance.

Pumps Centre members will be familiar with the company's work in promoting clean water supply – it often undertakes large pipe-laying projects to connect private homes and commercial premises to the water mains.

It's also an active promoter of sound environmental policy with an emphasis on sustainable procurement and construction.

www.rmutility.com

EVOQUA



Evoqua Water Technologies describes itself as the world leader in helping municipalities and industrial customers protect and improve the world's most fundamental natural resource.

Just in the USA, the company treats more than 70% of municipal wastewater capacity that serves more than 225 million people.

Evoqua also works with the 20 largest food and beverage firms in the USA, 90% of the 20 largest petroleum refiners, 90% of the biggest chemical companies, and 60% of US Navy ships which use its CAPAC technology.

Worldwide, its R&D locations focus on waste reduction, energy efficiency, desalination, and water (including reuse and wastewater treatment).

www.evoqua.com

NIVUS



Instrumentation for the water industry is Nivus' specialism.

The company's products encompass flow measurement, level measurement, data logging and evaluation, water quality and analysis.

Wastewater treatment, flowing water and water supply, pump stations and stormwater treatment are just some of the areas that benefit from its applications.

Founded in Germany by Udo Steppe, Nivus this year celebrates its half century.

The company has also expanded into ultrasound and radar as well as data transmission and management.

www.nivus.com

PELL FRISCHMANN

Pell Frischmann offers engineering, development and management consultancy for a range of private and public sector clients.

Annually the company is responsible for more than £1 billion-worth of construction projects throughout the world.

With offices in the Middle East, India and Eastern Europe in addition to its UK head office, it has won a number of prizes including a Queen's Award for International Trade.

Process technology, power and various aspects of water and wastewater are among the many sectors Pell Frischmann serves.

In the water industry, it is currently involved in an ambitious project to create a water strategy for war-torn Afghanistan.

www.pellfrischmann.com

Do the practical

Continuing personal development is a phrase often used but not always understood. Practical workplace knowledge must be its defining characteristic



Continuing Professional Development or CPD is becoming an increasingly common aspect of work training.

To begin with, what is CPD? If we define it as a requirement placed on a professional body's members to demonstrate they carry out some form of regular job-related learning, and record the fact, then we might say this is something that organisations such as The Pump Centre have done for years.

A more precise definition is provided, not surprisingly, by the CPD Accreditation Service itself: 'Accredited CPD training means the learning activity has reached required continuing professional development standards, with learning value scrutinised to ensure integrity and quality'.

In the last four years the approach transformed in the engineering sector from one of ad-hoc checks to one of

“Participatory learning with genuine relevance to the scope of a job. That is the essence of CPD”

testing whether individuals had maintained a commitment to CPD into something more formal and proactive.

In 2013 the Engineering Council indicated that by 2017 it wished to see all professional engineering institutions introduce random reviewing of registrants' CPD returns for the past 12 months.

While that system is now in place and training course attendance offers one means to fulfil CPD obligations, things remain confusing. For example, there has been no absolute requirement for training courses to be formally CPD

accredited in order for them to count as workplace CPD. Additionally, there are no hard and fast rules as to what actually constitutes CPD.

The Pump Centre is considering the usefulness or otherwise of having formal CPD accreditation for its courses.

However, regardless of the eventual decision, Pump Centre courses provide a very useful component of an individual's workplace CPD and for evidentiary purposes attendance certificates are available on request.

The majority of training courses listed in this section involve detailed, practical training from experts in their field, with evidence of the user's attendance.

In other words, participatory learning with genuine relevance to the scope of a job. That is the essence of what continuing professional development is all about. ■

Training & Awareness Day Programme 2018

TITLE	DATE	FULL PRICE
Sewage Pumping Station Design (Reading)	31 Jan 18	£350 + VAT
Understanding Pumps & Pumping (Warrington)	6-7 Feb 18	£595 + VAT
Pumps & Pumping Systems for Non-Engineers (Reading)	28 Feb 18	£350 + VAT
Pumps & Pumping Systems Introduction, Intermediates & Advanced (Reading)	13-15 Mar 18	£795 + VAT
Pumps & Pumping Systems – Introduction (Reading)	13 Mar 18	£350 + VAT
Pumps & Pumping Systems – Intermediates (Reading)	14 Mar 18	£350 + VAT
Pumps & Pumping Systems – Advanced (Reading)	15 Mar 18	£350 + VAT
Introduction to Water Treatment Process (Warrington)	20 Mar 18	£350 + VAT
Introduction to Sewage Treatment Process (Warrington)	21 Mar 18	£350 + VAT
Pumps & Pumping Systems for Non-Engineers (Reading)	18 Apr 18	£350 + VAT
Sewage Pumping Station Design (Reading)	16 May 18	£350 + VAT
Pumps & Pumping Systems Introduction, Intermediates & Advanced (Reading)	19-21 Jun 18	£795 + VAT
Pumps & Pumping Systems – Introduction (Reading)	19 Jun 18	£350 + VAT
Pumps & Pumping Systems – Intermediates (Reading)	20 Jun 18	£350 + VAT
Pumps & Pumping Systems – Advanced (Reading)	21 Jun 18	£350 + VAT
Pumps & Pumping Systems for Non-Engineers (Reading)	4 July 18	£350 + VAT
Understanding Pumps & Pumping (Warrington)	10-11 July 18	£595 + VAT
Introduction to Water Treatment Process (Warrington)	4 Sept 18	£350 + VAT
Introduction to Sewage Treatment Process (Warrington)	5 Sept 18	£350 + VAT
Sewage Pumping Station Design (Reading)	19 Sept 18	£350 + VAT
Pumps & Pumping Systems Introduction, Intermediates & Advanced (Reading)	9-11 Oct 18	£795 + VAT
Pumps & Pumping Systems – Introduction (Reading)	9 Oct 18	£350 + VAT
Pumps & Pumping Systems – Intermediates (Reading)	10 Oct 18	£350 + VAT
Pumps & Pumping Systems – Advanced (Reading)	11 Oct 18	£350 + VAT
Understanding Pumps & Pumping (Warrington)	6-7 Nov 18	£595 + VAT
Sewage Pumping Station Design (Reading)	14 Nov 18	£350 + VAT
Pumps & Pumping Systems for Non-Engineers (Reading)	21 Nov 18	£350 + VAT
Efficient Pump Motors & Controls (Warrington)	TBC	£350 + VAT
Efficient Pump Motors & Controls (Reading)	TBC	£350 + VAT
Corrosion for Engineers (Warrington) – 2 Days	TBC	£595 + VAT
Metals for Engineers (Warrington) – 2 Days	TBC	£595 + VAT
Understanding Pump Maintenance (Warrington) – 2 Days	TBC	£595 + VAT

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**Rotary Lobe Pump
(Rotados)**

25 - 100m³ hr
10 - 4 bar



Sigma Range
17 - 1000 l/h
4 - 16 bar

