Keeping dry

Innovative dewatering systems meet challenges head-on, writes Julie Fitz-Gerald

Dewatering systems are pivotal in construction and mining industries, providing reductions in groundwater levels to allow for the building of structures or mine developments below groundwater level.

With large-scale construction developments depending on dry working conditions in order to reach completion stage on time and on budget, dewatering systems play a crucial role in the overall success of these projects. Likewise, in mining development proper installation and control of dewatering systems can have a large impact on the overall safety, efficiency and economics of the entire mining operation.

Dewatering may sound straightforward in theory: through a network of wells and sumps, water is continuously pumped in order to lower the water table, allowing for the construction or mining sites to carry out their operational mandate. However, in practice, contractors face many challenges.

Martin Preene, dewatering specialist and groundwater engineer at Preene Groundwater Consulting, has 30 years of experience in the investigation, design, installation and operation of groundwater control and dewatering systems. Having worked on projects around the world and as current vice-chairman of the British Geotechnical Association (BGA), Preene is well versed on the various challenges that can arise.

One of the biggest issues he has witnessed is accurately estimating groundwater conditions at a given site. Preene explains: "Often the ground investigation information still leaves some uncertainties in groundwater conditions, particularly in relation to permeability, which can be difficult to estimate.

"This means the dewatering system can't be sized with a high degree of confidence, and might need to be up-rated or modified part-way through installation. This can cause delays and interfere with the construction programme. More focus on groundwater issues during ground investigations would help avoid these problems on many sites."

Seb Fisher, managing director of Groundwater Engineering, adds ►

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Water discharge from a dewatering system

Dewatering applications: a cofferdam (above); inside a factory (above right); and an excavation (right)

that other problems include geotechnical, contamination, and discharge issues – a direct result of dewatering.

When it comes to mining, determining exactly what type of natural materials lie beneath the ground before installation can be difficult to pinpoint.

"On mining projects a key challenge is the natural variability of the ground," says Preene. "Open-pit mines tend to have a very large footprint, and underground mines may be very deep with a complex network of shafts, roadways, levels, etc. It should be expected that such large undertakings might encounter ground in some areas that is different from what was anticipated from information available at the design stage.

"An example might be a roadway in an underground mine running out of competent rock into a more fissured fault zone. This might result in much greater inflows, and, if the dewatering plan is not adequate, could result in the mine being flooded."

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BEST PRACTICES

Mitigating these challenges for both the construction and mining sides of dewatering comes down to following best practices.

For Fisher, correct installation, using appropriate materials suited to individual projects, an awareness of environmental legislation for the abstraction and discharge of groundwater, and monitoring water quality are all vital best practices. To ensure the entire process goes more smoothly, his emphasis is on proper technique at the drilling stage.

"The correct installation of wells is fundamental to the development and efficient running of the wells once they have been installed. The drilling element of the work, having drilling operatives who know what they are doing and are competent, is important," Fisher notes.

For Preene, it is understanding the groundwater conditions and assessing the system as soon as installation begins that is crucial.

"The best dewatering systems, on either construction or mine sites, are based on realistic interpretation of the ground conditions – neither excessively optimistic nor pessimistic – and are designed to be robust and flexible, so that they can be readily upgraded if groundwater conditions are more challenging than expected.

"Ideally, as soon as the dewatering installation begins, data and feedback from the installation – drilling logs, water levels and pumping rates – should be used to form an early opinion as to whether the dewatering design is adequate or is likely to need up-rating. Looking at the early data in this way can avoid delays later if higher flow rates are encountered or if the target drawdown is not achieved," explains Preene.

To further facilitate the process, he also suggests communicating the objective of the dewatering process to everybody on the job site, so that each crew member knows that it is an important step in getting the project rolling.

Another benefit of greater communication is better care for the actual system.

"If the guys on site digging the holes and driving the trucks know what a dewatering well looks like and that it is important, they are more likely to look after the equipment," Preene advises.

Achieving this kind of united approach, particularly on mining sites, is a big challenge, according to Mike Deed, managing director of Geoquip Water Solutions (GWS). "Often there are many interested parties, and getting them to co-ordinate their aims and objectives as well as make decisions can sometimes be challenging," explains Deed.

INDUSTRY OF INNOVATION

Higher efficiency rates and cost savings are constantly spurring ideas and innovation within the groundwater industry, particularly in the field of dewatering, where developments in monitoring

Rotary drilling for a dewatering well

capabilities are achieving both of these goals.

Preene comments: "I think the big changes recently are in control and communication. Lots of pump manufacturers now offer control systems that can be monitored and adjusted remotely; you can have a pump on a site in Kazakhstan and monitor its performance from your desk in the UK.

"If this data is used properly, it will allow early identification of problems – allowing better preventative maintenance – and assessment of pump suitability, allowing a pump owner to make an informed decision about whether to swap out an inefficient or oversized pump for a more appropriate unit."

Decreases in efficiency and performance caused by well clogging have also led to inventive new ways to keep dewatering systems pumping at full capacity. With the constant presence of water – and the metals and minerals it contains – coursing through these systems, conditions are ripe for clogging to occur.

"Iron-related bacteria and associated biofilms and residues can affect well performance for long-term projects and sometimes in the short-term in particularly bad conditions," Deed explains.

"The potentially turbulent, oxygenated environment in a well ►

"I think the big changes recently are in control and communication"

"The future of dewatering is being brought ever closer through recent innovations"

and pumping system provides the energy that iron bacteria need by oxidising the soluble ferrous iron (Fe2+) present in the groundwater to an insoluble ferric form (Fe3+). The life cycle of the bacteria produces a biofilm that typically appears as a slimy or gelatinous red-brown deposit. This biofouling can be difficult to remove."

To combat the problem, Deed says a monitoring and measurement plan, alongside a regular chemical treatment, will ensure that the dewatering system is running as efficiently as possible.

GWS has developed such a plan, known as the BoreSaver borehole maintenance programme, which can return borehole production to nearly the original drilled capacity while helping maintain a continual, problem-free water supply. The programme consists of a downhole camera survey, custom software that analyses the survey results and available water-quality data, as well as BoreSaver, which is a range of approved borehole rehabilitation treatments.

Below: a large submersible dewatering pump

Bottom: iron-oxide encrustation and clogging on a borehole pump

The construction of a new metro system in Australia is a good example of how the BoreSaver maintenance programme was used to battle a clogged, inefficient dewatering system.

According to Deed, the construction took place in an area where the groundwater level was within two metres of ground level. Within six months of dewatering pumping, the system was running well below maximum efficiency due to severe levels of iron-related clogging. To combat the problem, GWS implemented its programme.

"The pumps, pipes and recharge bore were treated with a combined mechanical and chemical treatment using BoreSaver Ultra C and surging technique. This removed the iron-related deposits, and within minutes of the chemical treatment, the back-pressure in the recharge system reduced by 550kPa.

"A regular chemical treatment regime was then implemented to maintain the recharge flow rates. A weekly treatment of the dewatering pumps with BoreSaver Ultra C was also initiated and the pumps were quickly brought back into full service and maintained at optimum operational levels," explains Deed.

In the UK, Crossrail is an exciting new railway under development across London and the southeast, promising to transform transportation across the city. Boode Water Well Systems has been supporting the construction dewatering aspect of the project. According to Scott Dronsfield, managing director of Boode Water Well Systems, the company has been working in conjunction with WJ Groundwater to create a unique system that involves pressure-relief wells and overhead angled installations.

"Boode has supplied BGP gravel-coated PVC screens, which are ideal for installations where

standard gravel packs cannot be used, in this case because of the angled installations," Dronsfield notes.

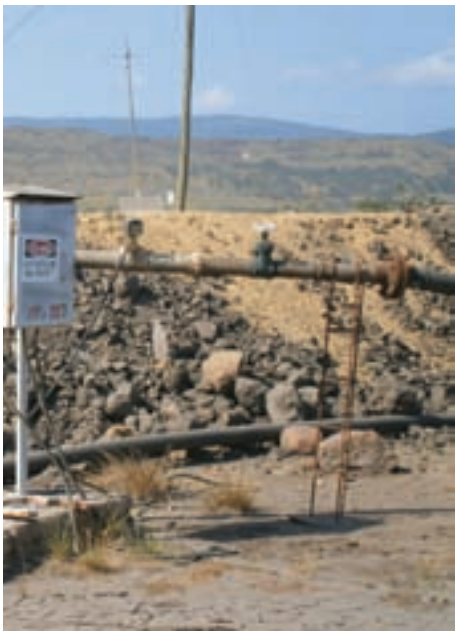
LOOKING TO THE FUTURE

The future of dewatering is being brought ever closer through recent innovations that continue to push the boundaries. Realising energy savings through greater efficiency and lowering environmental impacts are top priorities for dewatering projects and are expected to be areas of development in the coming years.

"You don't need to have a crystal ball to figure out that in the future we will need to reduce the CAPEX (capital expenditure) and OPEX (operational expenditure) of dewatering systems," says Preene.

"One obvious way to achieve this is to look at energy efficiency to drive down OPEX. It may be in the future there will be much greater emphasis on selecting pumps – and generator power supplies, where pumps are electric – based on energy efficiency. This has the double advantage of reducing energy costs and also reducing CO_2 emissions, which will help with corporate environmental targets that are often faced by mining and construction companies," Preene explains.

"Energy efficiency will probably



Centre column: dewatering well at an open-pit mine

Near left: wellpoint dewatering system

be achieved partly by better choice of pumps in the first place and partly by smarter pump control and monitoring systems. After the initial dewatering period, when groundwater levels are drawn down, many pumps are over-rated and running efficiently.

"The addition of control software and communication systems to allow pumps to de-rate themselves in response to demand can have a fairly modest upfront cost, but can save a lot of money if the pumps are operating for extended periods."

Looking to the future, the adoption of technologies from other industries to better assist in the process of dewatering is expected to be an influencing factor within the groundwater industry. "The other factor that will come to bear on dewatering systems is technology transfer in from other industries, where we use established technologies in new dewatering applications," says Preene.

"We are already seeing this, with horizontal direction drilling (HDD) methods, which are proven technologies in the utilities and oil-and-gas industries, beginning to be used to form horizontal dewatering wells beneath open-pit mines."

With water levels rising around the world, the demand for innovative dewatering applications will continue to rise, encouraging the growth of cutting-edge techniques and technologies that will further the industry.

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Boode supplied BGP gravel-coated PVC screens for Crossrail