Water management in mining

Use of water in mining

From the recovery of mineral ores and chemical solutions, washing minerals once they have been extracted, to equipment such as rock cutters, water in mining has many different roles to play. Water can also transport Ores away from the mine site through pipelines in slurry which can minimise road and/or rail transport costs. Clean water is also a very important resource in a mining environment as it is required to meet the drinking, cooking and washing needs of its employees throughout the lifetime of the mine.

With many mining regulations in place it is important that the water quality leaving the mine sites are not affecting water users downstream, using water management in mining minimises the risk of water contamination and prevents polluted water getting into the environment. Surface water and ground water also needs to be monitored for the mine to meet regulatory standards.

The mismanagement of water can disrupt production, as many extraction and washing processes depend upon clean water. Where water is wasted and mismanaged, more water than is necessary can be pumped on to the site at a considerable cost. Properly managed water use can save money as well as optimise production and reduce downtime. Water mismanagement can also lead to environmental damage through unintentional contamination, as well as a dangerous lack of fresh water available for workers.

With the right pipework infrastructure in place to transport, store, supply and drain water, this resource can be properly managed on a mine site to reduce water stress, maintain high water quality, and prevent flooding or environmental damage.

Current global demand for water is at the level of 4,500 billion m^3 a year and is expected to rise to 6,900 billion m^3 by 2030.[1]

70% of water use is agricultural, with industrial accounting for 22% of its use and residential use representing 8%.[2]

Choose the right piping material

For gravity flow or low head pipeline applications, HDPE is an effective solution due to its smooth bore and low resistance to flow. If large volumes of water is being transported, there is also very low friction within HDPE pipes, meaning less drag or turbulence at high flow rates and greater resistance to scaling than traditional materials.

Used for non-pressurised surface and subsurface drainage as well as sanitary sewers, leachate collection and storm-water drainage, HDPE solutions are easy to install and maintain while providing the robust durability required of mining environments. Importantly, HDPE has the capability to transfer its load to the surrounding soil and substrate under stress, resulting in long term structural stability and assisting in the longevity of the pipeline.

Regardless of the PN rating, all HDPE pipes possess the key characteristics that make them suitable for mining applications. Highly resistant to abrasion from both minerals and substrate carried in slurry, they are also resistant to many of the chemicals commonly used in mining and mineral extraction; including acetatic acid, ammonium hydroxide, hydrogen peroxide and calcium hydroxide.

HDPE pipes are generally lighter than traditional materials. They can be supplied in longer lengths than concrete or ductile iron solutions, meaning fewer joints are needed, which further reduces the possibility of leakage. Ideally suited to harsh operating environments, HDPE water management solutions can withstand temperatures in the range of -40°C to +60°C.

Benefits of plastic pipes

Modern manufacturing processes have many additional benefits to PE and HDPE pipework systems. With ongoing technological innovation, plastic piping has become thinner, lighter and more robust than most rigid materials, typically they weigh 94% less than their concrete equivalent.

When looking at transporting materials Polypipe can supply pipes at lengths that allow for the internal dimensions of the shipping containers and maximise their capacity. Once at site, plastic pipes are lighter and easier to handle and so minimise the need for the use of heavy lifting equipment, representing a benefit both in terms of cost and in health and safety.

PE pipes are typically supplied in 6m lengths reducing the number of joints required which not only reduces the potential for leakage but also speeds the installation process.

Electro-fusion or butt-welding techniques form a continuous homogenous pipeline, PE pipes can also be jointed which minimises leakage. Plastic pipes can also be designed in bespoke lengths and angles to enable them to fit around existing infrastructure or difficult terrain.

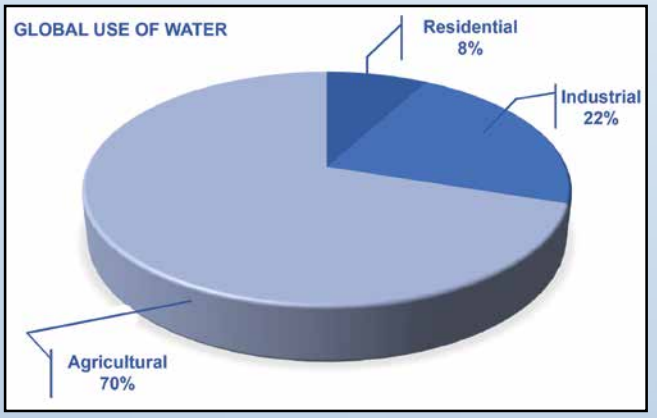

Fig. 1: 22% of global water supply is used by industry.

Serving the infrastructure

As well as the operations directly associated with extraction and processing, mining infrastructure also includes a wide range of social and welfare structures such as housing and community facilities. Water management systems are equally important in dealing with capture, treatment, re-use, attenuation, soakaway and drainage.

Above ground plastic drainage systems can be manufactured from HDPE, PVC or ABS and offer a flexible and adaptable solution. These pipes are lightweight, easy to handle and install. Systems benefit from push-fit mechanisms which require no special tools or expertise and there are multiple options for pipe length, diameter and fixings.

Other aspects of infrastructure water management that can benefit from the qualities of plastics systems are large expanses of hard landscaping where extreme rainfall may need to be allowed for. Cellular systems, such as Polypipe's Polystorm offer considerable advantages over traditional soakaway systems based on the use of aggregates to ensure that surface water is cleared quickly and efficiently.

These systems are made from polypropylene which, although has similar properties to polyethylene, has distinct differences. It has excellent electrical and chemical resistance and can be injection moulded to produce extremely tough but lightweight modular units. Such a system is ideal for de-watering, storage and transport infrastructure.

Offering a 95% void ratio, the systems deliver maximum water capture and retention and can be used for attenuation using an impermeable outer layer or for soakaway with a permeable membrane allowing the controlled release of water to surrounding subsoil. Systems are available with load bearing capacities from 20-tons/m² for lightly trafficked or pedestrian areas to 80-tons/m² for lorry parks or roadways.

Pressurised systems vs HDPE gravity systems

Many mining applications rely upon the delivery of high-pressure water requiring powerful pumps and heavy-duty pipework, effective water management systems can often operate successfully without the need for pumps. Tailings management and heap leaching processes can sometimes be configured to use "cost free" gravity flow, along with general rainwater or storm water management as non pressurised systems.

It's common to see pumped pipe systems specified for mining applications, leading to unnecessary expenditure on pumps and high specification pipes, as well as on the ongoing maintenance of the equipment. Fully certified, high quality, high density polyethylene (HDPE) pipes designed for gravity application pressure grade would provide all the required corrosion and abrasion resistance required of mining applications without the added expense of a higher rating.

All pressure pipelines carry a Pressure Nominal (PN) rating, which indicates the pressure (in bar) the pipe can support when the water inside is at 20°C. For all too many gravity applications, PN10 or even PN16 is frequently specified, when the water or slurry within is drip fed, meaning a less expensive gravity pipeline will be more than sufficient for the purpose.

Pump manufacturers typically estimate that a large proportion of a pump's lifetime cost is attributed to energy usage, wear and parts, making them one of the most expensive components on a mine site and even more costly if they are specified when not truly required.

These high operating costs can, in some cases, be avoided by designing a gravity flow solution in preference to a pumped system. Polypipe can assess a mine's water management system design to determine if a pumped system is required, and identify areas where gravity flow is appropriate.

In designing an efficient and safe tailings management facility, for example, establishing a stable water balance will prevent future problems such as overflow. This can be achieved by considering not only the daily inflow and outflow expected of the facility, but also allowing for storm surges. Using a series of gravity pipes to drain into the tailings pond itself can help maintain a manageable, steady flow, while at the other end of the system, gravity pipes can be used to decant water from the dam walls to water treatment facilities.

Heap leaching converts the desired minerals into a chemical compound, which, at the bottom of the leach pile, drains into perforated pipe and is carried by gravity to the final extraction process, usually via a pregnant solution pond. With no pumping required, heap leaching is gaining in popularity offering a minimal level of capital expenditure compared with other more intensive methods though it does require a greater time investment over other methods such as tank leaching.

Bypassing pumped systems at the recovery and wastewater stages can provide tangible cost benefits, but must be carefully planned to ensure the chosen pipes perform at their optimum level.

At the specification stage, the American Water Works Association (AWWA) offers the following guidance in its Standard for PE Pressure Pipe and Fittings (1990): "The working pressure of the system plus recurrent surge pressure associated with a specific piping arrangement or operation should not exceed 150% of the pipe pressure rating."

Utilising a gravity flow system will not only deliver cost savings in terms of avoiding expensive pumps but also with ongoing maintenance.

Sustainability

A key factor of mining and civil engineering projects is that they are expected to have multi generational lifespans and sustainability is a major consideration for materials used in the construction of their permanent infrastructures.

Plastics have the advantage of excellent environmental credentials. This shows through the previously mentioned technological developments which have resulted in hugely reduced materials content without compromise to strength, performance and longevity. Modern production techniques also see a high percentage of recycled material being used and the finished products are ultimately recyclable.

Other environmental benefits include reduction of carbon footprint from transportation because of light weights and the ability to maximise consignments. In fact, in terms of total life cycle, plastics can be considered to be one of the most energy-efficient materials.

The use of plastic pipework systems on major projects can result in high quality, reliable and sustainable solutions across a wide range of applications, in civil engineering projects, mining processes and associated infrastructure developments.

References:

1 National Intelligence Council's Global Trends 2030, 2012
2 Water facts and trends, World Business Council for Sustainable Development, 2006

Contact Polypipe International,
international@polypipe.com,
www.international.polypipe.com/harnessyourh20