

MINE WATER

Is it an obstacle or an opportunity?

Special Report*



Modern technology and new devices are now providing possible solutions to water challenges associated with mine water.

Water plays an essential role in many of the industries Canadians depend on for economic and social prosperity, including coal mining, but in recent years there has been growing concern about the long-term impacts of coal mining activities on water quality.

Of primary concern is small (but significant) quantities of selenium that can be released from coal mines into groundwater or surface waters when precipitation percolates through waste rock or runs through mining operations.

Selenium is sometimes referred to as the “essential toxin.” According to David Kratochvil, President of BioteQ Environmental Technologies, Vancouver, selenium is toxic but it is also a micronutrient that our bodies require. “If we don’t have enough selenium in our bodies we suffer, and if we have too much, it’s toxic. The range between not enough and too much is extremely narrow, and that is very unique to selenium compared to other substances,” says Kratochvil.

The concern is the accumulation of selenium in the food chain, which has been directly linked to reproductive issues in fish species, and impacts on ungulates like cattle and horses.

According to Tom Sandy, the Denver-based Technical Director of CH2M HILL’s Industrial Water Group, the impacts of selenium were first noticed in the late 1970s in California and Idaho, and traced back to phosphorous mines, and have since been found in a range of industries including mining, downstream oil and gas refining, and power generation.

“Over the past 30 years, scientists and toxicologists have been looking at this issue to determine appropriate selenium limits. The challenge is that toxicity is very site specific. It depends on the site geology, the background water quality, and the type of species that are impacted,” says Sandy.

It can take a miniscule amount of selenium (as low as 5-10 ppb) to have an impact – levels that have previously been difficult to measure.

Robin Parker, Mine Water Engineer at

Kerr Wood Leidal Associates, Burnaby, attributes this recognition to advancements in measurement technology. “Twenty years ago it was a challenge to even know selenium was an issue. There wasn’t recognition that there was a water quality problem until we actually started to see some effects, and this was possible because we began to measure water quality.”

Selenium from mining appears most commonly in two forms: Selenium (IV) and Selenium (VI). With current technology, Selenium (IV) is easily removed using a combination of lime and ferric co-precipitation, a common treatment method for the mining industry. The Selenium (VI) is much harder to remove, and is the primary threat to water quality in the coal mining industry today.

Today’s Treatment Technology

According to Jacques Groenewald, Senior Geoscientist with Summit Environmental, Vancouver, one of the most effective ways to mitigate the effects of coal mining is to avoid creating the problem in the first

place. "There is a lot of effort going into managing the leachate before it goes into the environment. Monitoring surface water and groundwater downstream also helps us to understand the impacts."

The emphasis on managing selenium before it becomes a problem is echoed by Parker. "A lot more effort is going into water management now than in the past. Today, mining companies are doing what they can to avoid contamination, and to keep clean water clean." One way to achieve this is by creating diversions and interceptions that direct water away from spoil piles.

Of course, mitigation is not always possible, so various treatment technologies are available. One of the most prominent of these technologies is biological selenium reduction. Various products using this technology are currently on the market, including those from GE and Envirogen. Biological selenium reduction involves using bacteria to reduce Selenium (VI) to elemental selenium (a

solid). The bacteria do this by accumulating selenium in their cells until they become laden with it. Selenium is then bled from the system in the form of biological sludge, which is stored in dedicated facilities or special landfills.

While biological selenium reduction is a sound process that has been proven on a large commercial scale, it is not perfect. Implementation costs can be high, and currently little is known about the long-term stability of the waste by-product it generates, leaving uncertainty for the industry about its long-term impacts. This uncertainty is what makes experts like Kratochvil uneasy. "Nobody knows if producing this solid waste is the right way to go. It seems to be the only way to go, but the industry doesn't know if this will cut it in the long-term."

According to CH2M HILL's Tom Sandy, "There isn't a one-size fits all treatment method." High costs are a concern, because of the lengthy time horizon for treatment. Coal mining companies must

pay to maintain compliance with selenium regulations, and the net present value of the cost of water treatment can be an alarming figure for many. When reviewed over a project's life cycle, these costs can be a hindrance to mining projects going ahead, or even staying open.

Drivers for Change

The industry is beginning to see changes with regards to how coal mining contaminants are handled. According to Groenewald, companies are looking at the full life cycle of a project before it progresses to production, including the long-term site remediation costs. "If you have a small project that has a number of risks that outweigh the financial value compared to remediation, it's probably a good idea to not progress to another stage," says Groenewald. Pressure from investors has also played a role in changing practices. "Investors nowadays are much more clued in to a company's impacts to the environment. To a certain extent, people don't



NUNA group of companies
Dependable Project Development



We're at work on top of your world

All-weather Roads & Runways
Contract Mining
Dams & Frozen Core Dams
Dikes

Earthworks & Site Development
Exploration Support
Ice Roads & Runways
Large Diameter Drilling

Mine Reclamation – Care & Maintenance
Remote Infrastructure Planning
Site Services & Crushing
Training – Heavy Equipment – Field & Simulator

OPERATIONS & HUMAN RESOURCES OFFICE: EDMONTON 1.877.499.9114

EXECUTIVE OFFICE: VANCOUVER 1.888.734.5773

VANCOUVER BC | EDMONTON AB | YELLOWKNIFE NT | RANKIN INLET NU | PRINCE ALBERT SK | THUNDER BAY ON

www.nunalogistics.com

want to invest in corporations that are going to leave a bad legacy behind.”

But perhaps the greatest driver of change has been selenium guidelines moving to regulation. “The enforcement of selenium regulations created an opportunity because there is a big gap between achieving compliance and doing so, cost effectively,” says Kratochvil. It is this regulation, and the gap in the market for cost-effective solutions, that has driven innovation in the sector.

The Way Forward...

At the cutting edge of new technology for selenium removal is the process of ion exchange. Ion exchange is currently used in hydrometallurgy, and is well-proven commercially – but its application to selenium removal from water is novel. During ion exchange, a resin selectively scavenges Selenium (VI), while leaving other constituents alone. When the resin becomes fully loaded with selenium, it is regenerated with a salt solution. Selenium is then removed from the solution as an iron-

selenium solid, and the salt solution is recycled. This iron-selenium byproduct is more stable than the sludge created by biological selenium removal, and can be used in the metals processing industry.

Ion exchange also allows for a greater reduction in selenium concentrations, as it can remove virtually all selenium from a system. The overall cost savings that are possible with ion exchange are impressive. Systems can be modularized and deployed at multiple sites, and the water does not need to be heated. Kratochvil estimates that, depending on the wastewater flow and composition, “an ion exchange system could reduce the life cycle cost of water treatment by 50% to 80% compared to biological systems.” It is these figures that are making mining companies pay attention.

Ion exchange represents a shift in thinking. Companies are no longer viewing water as a nuisance, but as an opportunity. Today, we are seeing growing environmental departments within mining companies, and a greater integration into their overall operations. Parker says,

“Before, miners were miners. Now, you see the people who manage water operations working with their environmental departments, and making real-time decisions about the effects of what they’re doing.” He adds, “Water was treated as a problem. Now it’s planned up front. It is treated as an important resource with important effects.”

The demand for metallurgical coal for steel production and thermal coal for power generation won’t be going away any time soon – you only need to look around at the modern conveniences we depend on to confirm this. But the need for clean water is here to stay. As long as water continues to play a large role in the mining process, we need to be responsible stewards of this precious resource, now and in the future.

CMJ

*Information for this Special Report provided by Alana Tees, a freelance writer and former Communications Coordinator with the B.C. Water & Waste Association (BCWWA), a professional association of operators, engineers and suppliers who are responsible for ensuring safe, secure, and sustainable water and wastewater systems in British Columbia.



EXPLORE

the depths of our experience

NORWEST

C O R P O R A T I O N

Calgary | Vancouver | Denver | Salt Lake City | norwestcorp.com