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ACARP MATTERS

USING SCIENCE TO DETERMINE OPTIMAL MINE WATER MANAGEMENT PRACTICES

Managing mine water within the constraints of a highly variable climate remains a critical issue for mining companies operating in Australia. Over the past 10 years ACARP has funded a series of projects aimed at building a body of knowledge across three key themes – potential impacts of mine water releases, mine planning under a variable climate region, and technology, particularly lower cost water treatment. This work has helped operations better understand the risks and opportunities associated with sustainable management of water and water borne salt on their sites.

"Licence to operate depends upon mitigation of environmental impact in the regions in which our businesses have their activities. Open cut mining has the potential to capture water during the intense rainfall events typical of summer storms and cyclones, and some of this water must be released to the environment to allow mining to continue," said ACARP industry monitor and Rio Tinto's Manager Environment, HSEC, Coal Australia, Stuart Ritchie.

"The industry continues to improve its management of potential environmental impact by investigating optimal water management practices and better understanding the mechanisms of potential impact of water releases while maintaining compliance with associated water quality licence conditions. The research projects provide new and novel approaches for the industry to improve the sustainability of mining within the environment in which it operates."

The first research theme – potential impacts of mine water releases – was a response to the imposition of water release conditions by state governments that were underpinned by very basic science and that were not practical.

C18033 Assessing Impact of Sulphate in Saline Mine Site Discharge in Seasonally Flowing Streams in the Bowen Basin

C19024 Guidelines for Establishing Ecologically Sustainable Discharge Criteria in Seasonally Flowing Streams (available soon)

C21037 Managing Mine Water Under Extreme Climate Variability

Potential Impacts of Mine Water

"There was very little information, which is why ACARP insisted on funding projects that helped us gather the scientific data to better understand the Fitzroy Basin catchment environment. As a result, we're in a much better position to obtain release conditions that are backed up by scientific evidence," said ACARP industry monitor and Anglo American Environmental Specialist Claire Cote.

Recently completed projects that address discharge water quality include Assessing Impact of Sulphate in Saline Mine Site Discharge in Seasonally Flowing Streams in the Bowen Basin; and Guidelines for Establishing Ecologically Sustainable Discharge Criteria in Seasonally Flowing Streams.

Sulphate is often associated with saline mine water stored on site but few studies have identified the impacts of sulphate on aquatic organisms, making it difficult to set criteria for mine water discharge. In the first project researchers developed locally relevant ecosystem protection trigger values for sulphate in the Fitzroy Basin. Prior to

C21041 Designing a Mine for Both Drought and Flood - A Vulnerability and Adaptive Capacity Study

C21043 Integrated Forward and Reverse Osmosis System for Mine Water Reuse

C21033 Modelling the Water, Energy and Economic Nexus

this work there were no trigger values for sulphate in Queensland or elsewhere in Australia.

In the second project researchers developed guidelines for flow and water quality conditions to limit environmental impacts from mine site discharge. They quantified the impact of saline discharge on aquatic ecosystem processes by examining changes in microbial community structure and function below the river bed, and the dynamics of system flushing under highly-variable seasonal river-flow conditions. They also determined the sustainable salt load for the river system and drew on the results of previous ACARP projects.

Mine Planning Under a Variable Climate Regime

The number one risk facing the coal industry, according to Claire Cote, is climate variation. “It impacts on production because our storms are becoming more and more intense and are having greater impact on our ability to return to production quickly,” she said. Although many sites better managed the impacts of seasonal climate variation and have invested in infrastructure such as dams, pipework and pumps, they need timely, accurate forecasts and to understand the implications of those forecasts in order to adequately prepare for extreme weather events. Researchers have completed two projects that have investigated climate related issues: Managing Mine Water Under Extreme Climate Variability; and Designing a Mine for Both Drought and Flood - A Vulnerability and Adaptive Capacity Study.

Stuart Ritchie believes the first project represents a first step (proof-of-concept) that the Bureau of Meteorology Predictive Ocean Atmosphere Model for Australia (POAMA) forecasts could help improve water management decisions, enabling mines to avoid non-compliant discharge after high rainfall events and maximise water use efficiency during dry periods. “The singularly important finding of this research project is that it showed that mine sites in the Bowen Basin, in general, could prevent non-compliant discharge following high rainfall events if operators had access to accurate and timely information on seasonal rainfall variation and pump crews were able to use this information towards strategic decision making opportunities,” he said.

As a result of the second project, Australian coal mines are now able to assess their vulnerability to extreme weather conditions and identify adaptation options to reduce that vulnerability using a methodology developed by CSIRO. Known as Climate Related Adaptation from Terrain Evaluation Results (CRATER), this methodology uses a Geographic Information System (GIS) and it can be integrated into a mine’s current risk assessment methodology. It uses pre-existing data that is available on site. This data can be used to model a range of ‘what if’ scenarios that are specific to the mine being evaluated, including mine size, positioning of infrastructure, location of pits, site morphology and resources/capital available. The three-step process is designed to help decision-making by identifying hot spots, adaptation options and the options most suited to the mine at the time.

“It’s a very clever piece of work in demonstrating what you can do with what you already have,” Claire said.

Technology

Through the third research theme, ACARP is funding projects that seek to deliver more cost effective technological solutions to onsite water management, including water treatment. Reverse osmosis is proven technology for desalinating mine water, however it remains an expensive and energy intensive option. A new water treatment solution was explored in the Integrated Forward and Reverse Osmosis System for Mine Water Reuse project. In this work, CSIRO proved at laboratory scale that it’s integrated forward and reverse osmosis system can potentially offer a significant reduction in energy use, chemical use, piping infrastructure and operating costs in desalinating mine water.

In the second project – Modelling the Water, Energy and Economic Nexus – researchers constructed a standard systems model of a mine site that showed how the main energy tasks interact with energy imports and energy exports. The model also includes an integrated risk framework for interpreting model output, so that onsite and off site impacts of various water and energy management strategies can be compared in a managerial context. The software will be released as an open source tool.

Looking Ahead

ACARP
Australian Coal Industry's Research Program
PO Box 7148 Riverside Centre
Qld 4001 Australia

Phone 07 3229 7661
Email acarpmatters@acarp.com.au

Claire said these projects were critical pieces of work that continued to build on the coal industry's mine water management body of knowledge, and had value beyond mining companies. "I have had SunWater come in to talk about some ACARP work that was done five or six years ago because they were doing some planning – forecasting demand in the basin – and they wanted to know if the research findings were still valid, which I was able to confirm," she said.

She said potential impacts of the discharge of mine water releases, climate and technology projects would remain key research themes, although the focus on discharge water quality was expected to diminish. Interactions with groundwater and planning for the sustainability of final voids were expected to become more important research themes over time.