



International Network for Acid Prevention (INAP)

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Abstract

Acid rock drainage (ARD) or acid and metalliferous drainage (AMD). is one of the most severe and potentially enduring environmental problems of the mining and minerals industry. High liability costs carried by many mining companies to cover potential costs of ARD/AMD are a clear indication of the magnitude of the problem. Unmitigated, ARD/AMD can result in water quality impacts that could well be the industry's most significant financial and credibility risk. Effectively preventing acidic drainage is a daunting challenge that requires all of a mining company's technical and managerial resources. Successful ARD/AMD prevention also entails engaging industry stakeholders throughout the entire life-cycle of a mine.

The International Network for Acid Prevention (INAP) is an international network of mining companies dedicated to the prevention and mitigation of acid rock, saline and neutral drainage and metal leaching to support sustainable mining. INAP is committed to assist in building capacity of all stakeholders whether they be large or small operators, regulators or communities through relevant research, information transfer and continuous improvement of operational and remedial practice. INAP has grown into a proactive, global leader in the field. INAP is in turn supported by the Global Alliance, which pulls together technical expertise and knowledge from across the world.

The key element in INAP's sustainable mining program is the development and maintenance of globally-recognized, authoritative technical guides, such as Global Acid Rock Drainage (GARD) Guide and the Global Cover System Guidance Document, both international best practice guides to address issues for the prevention of acid-rock, neutral and saline drainage.

In this presentation, examples of best practices and how mining companies can obtain value from the technical guidance documents will be given along with an update on future projects, including how INAP is working to make the GARD Guide more effective and useful to all stakeholders worldwide. Lastly, a few words on the Global Alliance, and how INAP works closely with these groups that have significant technical and regional expertise on ARD/AMD to offer.

Keywords: INAP, acid rock drainage, GARD Guide

Introduction

Acid rock drainage (ARD) or acid and metalliferous drainage (AMD). is one of the most severe and potentially enduring environmental problems of the global mining and minerals industry. The potential for acidic drainage to form from mining has been known since at least 1556 and ARD was observed as early as 1698 associated with coal mining in Pennsylvania (BC Acid Mine Drainage Task Force, 1989). Research into the process of ARD/AMD formation and methods to minimize its impact has been ongoing for over 50 years.

At first, successful revegetation of tailings sites was thought to be a sustainable solution but it was soon realized that this major environmental issue persisted and could require in perpetuity treatment if poorly managed. There was a need to better understand the processes involved, and for new remedial technologies to be developed and demonstrated. Much progress has been made in the last 25 years through a number of research organizations and consortiums resulting in a considerable body of scientific and engineering guidance available on ARD/AMD.



Who is INAP?

INAP is a global industry led group of mining companies focused on the adoption of site-specific best practices to prevent acid rock drainage (ARD) or acid and metalliferous drainage (AMD). Responsible management of these materials, some reactive, through to beyond closure is critical. INAP provides an international focus on this issue to mobilize information, experience and resources to prevent ARD/AMD. The network was created in 1998. Present members are: Anglo American, Barrick Gold Corp, BHP, Kinross Gold, Newcrest Mining, Newmont Mining, Rio Tinto Ltd, Teck Resources, Detour Gold and Lundin Mining. INAP is operated as a company, registered in Australia. The Technical Manager is Gilles Tremblay. INAP has an operating committee made up of member company representatives, and its activities are overseen by the INAP Board.

Benefits of INAP membership are primarily associated with its support for best practice and the development and transfer of knowledge. These benefits include:

1. INAP initiates and supports site-based projects which return significant benefits to its members. These benefits can provide immediate financial benefit, as demonstrated by the Diavik scale-up project that resulted in a \$40 M CDN bond reduction, as well as reduced closure costs by avoiding or minimizing the need for long-term water management. INAP provides leveraged seed money to promising research projects helping attract funding from government, academic and industry sources.
2. INAP facilitates the development and maintenance of globally-recognized, authoritative technical guides, such as the GARD and Global Covers guides, that serve to:
 - a. Promote proven ARD/AMD management strategies
 - b. Lend credibility to broad adoption of pragmatic strategies aiding industry in regulatory engagement and permitting
 - c. Reduce environmental risks and financial liabilities across the industry.

3. INAP provides a forum for industry experts and managers to meet and candidly discuss common challenges, opportunities and solutions.
4. INAP facilitates knowledge transfer and collaboration across the mining, academic, consulting and regulatory communities through the International Conference on Acid Rock Drainage (ICARD), workshops on recent advances in the field, newsletters and its Global Alliance network. It galvanises global expertise on ARD/AMD prevention and management.

INAP has also successfully coordinated an international network of AMD/ARD practitioners which includes key regional ARD/AMD organizations. The Global Alliance (GA) partnership was launched in 2003 and is an international model of interaction among organizations involved in acidic drainage research. The GA brings numerous benefits to the partners, including minimizing research duplication, maximizing research dollars, worldwide links, and enhanced technology transfer capabilities. Members of the Global Alliance include:

- The Sustainable Minerals Institute (SMI) in Australia,
- The Acid Drainage Technology Initiative (ADTI) in the USA,
- The Mine Environment Neutral Drainage (MEND) program in Canada,
- The International Mine Water Association in Europe
- The Water Research Commission (WRC) in South Africa
- The South American Network for Acid Prevention (SANAP)
- The Indonesian Network for Acid Drainage (INAD).

INAP continues to drive the expansion of ARD/AMD efforts across the globe. In 2016, INAP focussed its effort on Australia to encourage an ongoing interaction among the ARD/AMD community, including INAP companies, ARD/AMD consultants, regulators and other stakeholders. Dr Bruce Kelley, one the founding members of INAP, continues to spearhead these efforts that have resulted in an Australian network that is more active. Annual meetings are being held which



include INAP company member business followed by a more general INAP/AMD meeting. The overarching focus of the meetings are to gain a better understanding of ARD/AMD issues, expertise, capacity and capability across Australia, with a number of presentations scheduled, but also covers other aspects such as project development, the Australian AMD Workshop and ICARD conference. The success of the Australian model, using a very experienced ARD/AMD practitioner to provide support and coordination through INAP is an option that could be pursued on a limited basis in other regions.

INAP’s achievements and current activities

One of INAP’s major achievements has been the development, publication and promotion of the GARD Guide, a global practical, reference document on “how to” prevent, minimize and control ARD/AMD under all climatic conditions. This guide brings together the best technical and management practices to enhance the capabilities of global ARD/AMD practitioners. It is free for use by all mining industry stakeholders and can be downloaded from www.gardguide.com. It references and makes ample use of numerous guidance documents including those published by the Australian Department of Industry Tourism and Resources, MEND (Canada), WRC (South Africa) and US Environmental Protection Agency (US EPA). While this guidance document is not prescriptive, increasingly regulatory agencies are recommending its use by proponents, operators and land managers. Examples where it is referenced include the US EPA, the Interstate Technology and Regulatory Council (ITRC) web pages and in mining guidance documents prepared by International Finance Corporation (IFC).

Since its roll-out in 2009, the GARD Guide has been updated three times and plans are in place for a fourth update. The original version of the GARD Guide was compiled by an international team of consultants and academics lead by Golder. Since that first version, numerous organizations and consulting firms have participated in additions and upgrades to the GARD Guide. A review of all

chapters was conducted in 2017 by numerous experts and their recommendations will be used to select chapters for upgrades starting in 2018. Feedback received to date has been largely positive. INAP continues to look for ways to improve the Guide, including making the guide more accessible by providing summaries with key messages for the non-technical users at the beginning of each chapter and providing guidance to the user on which option is most appropriate in the circumstances at a specific site.

Early in 2018 INAP released the Global Cover System Design – Guidance Document. This document, like the GARD Guide, is intended as a best practice summary to assist mine operators, designers, and regulators to address issues where cover systems can be employed. It builds on previous technical guidance documents on cover system design, construction, and performance monitoring. The Global Cover System Guidance Document will be of interest to individuals who are seeking more detailed information than what is outlined in Section 6.6.6 of the GARD Guide – Engineered Barriers.

A holistic framework, at both high and conceptual levels is presented for management of reactive materials during operations and at closure. Application of this framework is achieved through the use of a cover system design tool that walks users through relevant climatic factors to optimize cover system design alternatives for a desired performance design criteria (e.g. control of net percolation or oxygen ingress). This allows users to understand more realistic objectives when developing cover system design alternatives based on site-specific climate conditions.

The information provided within the tool is not a replacement for site-specific classification and engineering required for cover system design. However, the tool is a means of beginning early conceptualization to help focus further investigation at a site level and to begin to form realistic expectations for cover system performance at an early stage of a project. The Global Cover System Design document is available from the INAP website.

INAP also participates in collaborative research investigations. Typically, these efforts concentrate on large-scale projects that re-



quire large collaborative efforts or large-scale demonstration. An example of this is a mine waste scale-up project in Northern Canada, which sought to correlate small scale test work with large scale reality. The project concept was conceived by INAP member companies. Sponsors for this university-led project included the mine operator, MEND, the Natural Sciences and Engineering Research Council of Canada, and INAP. The waste management data from this 10-year project helped support a \$40 million CAD reduction in closure bonding associated with the site’s mine waste storage strategy. A secondary benefit of this project was the successful development of many highly qualified students that have since or will soon join the mining and minerals industry.

Recently, INAP agreed to participate in the Toward Environmentally Responsible Resource Extraction Network (TERRE-NET), a multi-institutional and multi- and trans-disciplinary research Network comprised of 15 co-investigators from 7 universities across Canada, with the overarching goal of ensuring the “environmentally responsible, socially acceptable extraction of mineral and energy resources using cutting-edge approaches and technologies”. This five-year initiative is supported by numerous partner organizations, as well as Canadian and international research collaborators.

INAP needs to continue its position of promoting ARD/AMD prevention best practice and excellence in mine closure industry-wide to all stakeholders. In recognition and international acknowledgement for mine sites for their work, INAP is sponsoring an international award for the implementation of best practice in the identification, planning and management of potentially reactive geologic materials at a mining site. The awards will be presented at ICARD, which are held every 3 years.

The first recipients of INAP’s international ARD Best Practice Award were recently announced and are Kinross Brazil for their operation of their Paracatu site in Brazil and Rio Tinto’s Iron Ore Pilbara operations at the corporate level. Both operations were found to exemplify global best practice and deserve international recognition. These awards will

be formally presented to Kinross Brazil and Rio Tinto Iron Ore at the 11th International Conference on Acid Rock Drainage (ICARD) in Pretoria, South Africa in September 2018.

INAP also sponsors and is the home of ICARD, the International Conference for Acid Rock Drainage, which is held every 3 years. The 10th ICARD took place in Santiago, Chile in April of 2015, where over 400 delegates from 22 countries attended 186 technical presentations. The 11th ICARD will be held in Pretoria, South Africa in September 2018 and hosted by the International Mine Water Association (IMWA). Previous ICARDs have been held in Norway (1988), Canada (1991, 1997 and 2012), United States (1994, 2000 and 2006), Australia (2003), and Sweden (2009).

Technology transfer is an important element of collaborative partnerships, especially with partners scattered throughout the globe. Examples of INAP’s technology transfer or capacity building program include specialty workshops and short courses as well as GARD Guide short courses. Funding is also provided to sponsor GA workshops such as the Annual British Columbia / MEND Workshop in Vancouver and INAP members are asked frequently to provide presentations at various national and international events. Newsletters are produced up to three times a year and are a great way to enhance communications and a new INAP website was developed (www.inap.com.au)

Recent Activities of the Global Alliance

INAP’s profile continues to grow internationally. The Global Alliance (GA) is an important part of this growth and GA members are invited to participate in the semi-annual INAP meetings with member companies to network and update the group on their regional activities. The INAP Newsletter is also used as a vehicle to publish key GA activities.

INAP also seeks to recognize recent relevant reports that have been published by Global Alliance members. In 2017, MEND published a report that examines and compares alternatives to conventional slurry for the management of tailings. This report presents a snapshot of the current state-of-



practice in the mining industry in Canada, and other countries with similar climatic conditions. It looks at the technologies used to dewater tailings, how tailings are placed and managed, and evaluates their relative efficacy in addressing physical and geochemical risks. The report titled Study of Tailings Management Technologies MEND 2.50.1, can be downloaded from the MEND website at <http://www.mend-nedem.org>.

The Water Research Commission (WRC) actively contributes to South Africa’s water knowledge base by funding fundamental water research, growing scientific capacity and disseminating knowledge to a broad range of stakeholders through focused workshops and relevant guidance documents. One excellent example of the type of information available is the launching of a national mine water atlas for South Africa (<http://www.wrc.org.za/Pages/MineWaterAtlas.aspx>). It shows the critical interplay between mining and water resources and is the most extensive set of documents of its kind. More articles and reports are available from the WRC website at (www.wrc.org.za).

The major effort of Acid Drainage Technical Initiative (ADTI) has been the preparation, editing and publication of a set of 6 workbooks in the Management Technologies for Metal Mining Influenced Water series. The sixth volume, Geochemical Modelling for Mine Site Characterization and Remediation is now available. This handbook describes the important components of hydrogeochemical modelling for mine environments, primarily those mines where sulphide minerals are present – metal mines and coal mines. Copies of the six handbooks from this series can be purchased from the SME online bookstore at <http://www.sme.org/books/>.

The transfer of information on developed technologies to partners and the public has always been an important element for GA members. Workshops are a very effective way of bringing ARD/AMD practitioners together. The annual BC-MEND ARD/ML Workshop in Vancouver, the biannual Australian AMD Workshop and the annual International Mine Water Association (IMWA) Congress are examples put on by regional organizations that bring together technical presentations from leading global practitioners.

Future Development Opportunities

INAP is continually looking for new ways to improve ARD/AMD management. In particular it is focused on an industry wide and global approach. Some of the ideas currently under consideration include:

- Can the successful scale up project in Canada at Diavik be extended to include other geographies, climates and different mineralogy? Could similar projects be run in Australia, South America or Africa?
- Poor management of waste rock is the major contributor to the ARD/AMD problem globally. How can waste rock piles/dumps be constructed in a way that reduces the risk of ARD generation?
- Improving our understanding of the global extent of pit lakes and voids, including their locations, chemistries, liabilities and opportunities that they might offer? Are there better ways to obtain data on these to inform closure considerations?
- Effective mine planning is one of the keys to improving ARD/AMD management. How can mine planners be more effectively engaged? This might include specific, less technical sections in the GARD guide, input into mine planning workshops and webinars providing a better understanding in hydrogeochemistry, and changes to mine operating practices.
- Development of a powerful business case around ARD/AMD management. This would enable more effective engagement of company senior management.
- Understanding treatment options that are currently operating as a black box. How can mine operators have more confidence and understanding of the numbers from suppliers?
- Develop and share more effective tools to evaluate risks for ARD/AMD, neutral drainage and salinity, across the industry.
- Develop a suite of powerful case studies. Learning from failures is very important. A financial case study highlighting the benefits of effective mine planning could also be of value.
- Harnessing the power of major workshops and conferences to better identify major, industry wide ARD/AMD best practices and new opportunities.



INAP will be focusing on these and other issues as part of its on-going strategy and project implementation plan.

Conclusion

INAP evolved through an urgent need to combat a global environmental issue. It remains a powerful example of how companies can work collaboratively and collectively when faced with major challenges. INAP has also brought ARD practitioners together through its Global Alliance, enabling far better connectivity between industry issues and those with the skills to address them. Over the past number of years, many sites have successfully demonstrated that these issues can be successfully managed to avoid legacy environmental impacts. Importantly INAP

is industry led and its member companies continue to drive for leadership in addressing one of the most significant environmental issues facing the industry.

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**PILOTING OF THE
WASTE DISCHARGE
SYSTEMS**

