

International Network for Acid Prevention's Path Forward

Terrence Chatwin

International Network for Acid Prevention (INAP), USA

ABSTRACT

Expanded populations increase potable and agriculture water use, as well as all other needs for clean water including mining. These pressures have focused International Network for Acid Prevention's (INAP's) efforts to foster best practice to maintain water quality throughout the mining industry. In addition, 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 is recognized for its effort in the prevention and mitigation of acid-rock drainage (ARD) through the publication of the GARD Guide, a global best practice guide for ARD prevention. A key element to the success of INAP has been their partnership and support by the Global Alliance, a network of regional organization committed ARD prevention and sustainable mining. To increase INAP's influence and further promote these best practices, we are committed to expanding our partnerships not only with the Global Alliance; but with other like organizations including governmental and non-governmental agencies to educate stakeholders through short courses and on-line presentations. To support its use, we are producing an on-line PDF file of the GARD Guide to allow users to print hard copies of the document. We are also continually updating the GARD Guide with new and relevant information and best practice.

Recognizing the value of inputs from all partners and stakeholders, INAP hosted a "Path Forward Symposium" at the 9th ICARD, where excellent recommendations were proposed and compiled into a report that was used by INAP in its strategic planning process. We look forward to further outstanding suggestions from all stakeholders to assist INAP in its path forward in supporting the mining industry in its sustainable development.

Keywords: ARD, acid drainage, INAP, GARD Guide

INTRODUCTION

With the expansion of human population, the need for increased food, water, material and energy have increased. Each of these required resources places its own specific requirements on clean water. This rapid growth of and competition for water usage, as well as, unexpected drought in certain regions have raised water costs and forced many water users to focus on availability and true value of water. This increased demand combined with inadequate mine closure actions have resulted in an adverse perception of mining's impact on present and future water quality, which in turn has resulted in increased regulatory and societal pressures on the mining industry. INAP and its member companies have raised their review of water resource issues to the highest levels.

Some forms that these pressures on the mining industry have taken are lower water discharge levels for dissolved metals and other contaminants. They have also resulted in higher bond requirements for mine closures and more stringent financial assurances for final closure options. Also in the United States (USA), there are limitations to how mine discharges can be treated post closure. Two states in the USA will not accept perpetual water treatment as a final closure option (Kempton et al., 2010).

Combining these pressures for clean water with the potential adverse impacts of acid rock drainage (ARD) and metal leaching can create significant problems for the mining industry. ARD is one of the most serious and potentially enduring environmental problems of the mining industry, as indicated by the high liability cost carried by many mining companies to cover potential liabilities of ARD and metal leaching. Effective prevention of acid drainage is a formidable challenge, to which INAP, the mining industry and its stakeholders have committed a strong effort to foster best practice to enhance water quality within its member's operations and throughout the mining industry. In addition, 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, remedial and waste management practice.

Who is INAP?

INAP is an international network of mining companies dedicated to the prevention and mitigation of acid rock, saline and neutral drainage (ARD), (SD) or (ND) and metal leaching in the support of sustainable mining. INAP was formed in 1998 to coordinate and facilitate global research, information transfer and capacity building on the management of sulfide mine wastes, acid rock drainage and metal leaching (www.inap.com.au, 2014). Since then, INAP has grown into a proactive, global leader in the field

We have also organized workshops that address technical, economic, and societal and policy issues. These workshops provide a discussion forum of issues and result in identifying research needs and opportunities. Within these workshops, INAP works to link these issues with interested parties to develop possible solutions and initiatives.

INAP plays a strong supporting role in major ARD events. The International Conference on Acid Rock Drainage (ICARD) is sponsored by INAP every 3 years. At this time, I would like to

recognize the International Mine Water Association, who is partnering with INAP and the Global Alliance in sponsoring the Tenth ICARD/IMWA 2015 Conference. Our close relationship with IMWA is based on our shared objectives and our commitment to sustainable mining. We are pleased to share this venue with our “kindred spirits”.

ICARD is a key platform for information transfer and discussion of ARD prevention and mitigation processes, mine waste management methodologies, developments in geochemistry, characterization, modeling and prediction and innovative treatment techniques. This forum is open to all mining industry stakeholders. Through this conference and focused workshop, INAP identifies and promotes best practice in ARD prevention, supporting continuous improvement in mine waste management and closure, and seeking innovative solutions to critical ARD issues.

A major element of INAP is the identification and promotion of ARD prevention best practice. The most effective best practice tool INAP has produced is the Global Acid Rock Drainage Guidance Document (GARD Guide). The GARD Guide is a compilation and update of all of the ARD, AMD, ND and SD documents and compendia from across the globe. It includes information from not only hard-rock mining but coal mining as well. The GARD Guide was rolled out in 2009 at the Eighth ICARD as a web-based guidance document located at (www.gardguide.com), which is available and free for all to use. The original publication was compiled by an international team lead by Golder and Associates with many external academic and consulting authors. The web-based format was designed to facilitate updating and expanding the document, and it is readily available for those users connected to the web.

INAP's partners

There are eight regional partners that support INAP's goal of preventing ARD and metal leaching, which form the Global Alliance (GA). These organizations represent significant technical and regional expertise on ARD and metal leaching prevention, mitigation and mine waste management. These regional partners are listed below:

- Australia - The Sustainable Minerals Institute–Knowledge Transfer (SMIKT)
- Canada – The Mine Environmental Neutral Drainage Program (MEND)
- China – The Chinese Network for Acid and Metalliferous Drainage (CNAMD)
- Europe – The Partnership for Acid Drainage Remediation in Europe (PADRE)
- Indonesia - The Indonesian Network for Acid Drainage (INAD)
- South Africa – The Water Research Commission (WRC)
- South America – The South American Network for Acid Prevention (SANAP)
- United States – The Acid Drainage Technology initiative (ADTI)

INAP is also keen to engage other regional organizations focused on prevention and treatment of ARD and encourage them to join the GA.

A major activity of the GA members is to host or to assist in the planning of the ICARD. Each ICARD is hosted by a GA member or its associate. The Eighth ICARD held in Skelleftea, Sweden and was hosted by the Swedish Association of Mines (SveMin) and supported by PADRE. The Ninth ICARD was hosted by MEND, in Ottawa, Canada. The Tenth and current ICARD is being

hosted by Gecamin with support from SANAP. GA members in Australia (SMIKT) and in the United States (ADTI) have also hosted the ICARD.

In recognition of the strength of the GA, INAP hosts a reception at the ICARD for the GA where they can network and update one another on their regional activities. During this reception each member organization has an opportunity to inform the Alliance on their efforts and successes. INAP would also like to recognize recent relevant reports that have been published by Global Alliance members. In 2014, MEND published an excellent report on mining-impacted waters entitled, *Study to Identify BATEA for the Management and Control of Effluent Quality from Mines, MEND Report 3.50.1* (MEND 2014). The Water Research Commission of South Africa has published many articles and report that are available at their website (www.wrc.org.za).

Over the past six years, ADTI has been working on a set of five workbooks that have been published through the Society of Mining, Metallurgy and Exploration (SME). These volumes include:

- Basics of Metal Mining Influenced Water
- Mitigation of Metal Mining Influence Water
- Mine Pit Lakes: Characteristics, Predictive Modeling and Sustainability
- Techniques for Predicting Metal Mining Influenced Water
- Sampling and Monitoring for the Mine Life Cycle

All of the editors and many of the authors of these volumes are members of ADTI. This is an outstanding accomplishment for an organization that is composed totally of volunteers and is self-sustaining.

As well as the Global Alliance, INAP partners with many consultants, service providers, governmental, non-governmental organizations as well as local communities and other mining industry stakeholders. The next section of the paper will illustrate how INAP partners with many organizations with common interests to build capacity and transfer information to a broad range of mining industry stakeholders.

INAP'S CURRENT ACTIVITIES

We believe that the role INAP performs in its current activities not only demonstrates its commitment to the prevention and mitigation of ARD, but it also shows our willingness to be a transparent partner to achieve strong communications with and build capacity within our stakeholders. We also seek to foster best practice throughout the mining industry's waste and drainage management plans and continually improve operations and prevent ARD.

Research

In this paper, actions that INAP and its partners have organized and implemented to prevent and mitigated ARD and metal leaching will be presented. These actions have included a gap-driven research project that focused on a key industry need, mine-waste management. Typically, these

efforts concentrate on large-scale projects that require large collaborative efforts or large scale demonstration. An example of this large-scale project is the Diavik country rock instrumentation study in Northern Canada performed by the University of Waterloo, the University of British Columbia and the University of Alberta. Whereas, INAP's financial funding commitment was small compared to the total funding, we did represent a consortium of international mining companies, who assisted technical planning and review from its inception. INAP has supported this project for almost a decade. The lessons learned from this large-scale, long-term project has been very rewarding and valuable and has resulted in a substantial mine-waste management bond reduction for Diavik.

INAP is currently working with O'Kane Consulting and a group of international experts from Canada, Australia, and the USA to prepare a "Global Soil Cover System Design Guidance Document." The planning and organization of this project goes back to 2011 at the Seventh Acid and Metalliferous Drainage Workshop in Darwin. At a plenary session, Dr. Bruce Kelley, formally the Global Practice Leader - Environment at Rio Tinto Limited spoke on the management of mine wastes. As he pointed out, the biggest job of most mining companies is to manage their waste, since over 98% of the materials they handle consist of overburden, low-grade ore, mine waste and tailings. He described managing this waste as the elephant in the room. The discussion following that presentation resulted in an ad-hoc group of about 40 who stayed for an hour after the meeting discussing approaches to address this issue. By the next morning a group had been formed to prepare and submit a proposal to INAP. The INAP Operating Committee welcomed the proposal and requested further review. Further discussion was carried on at the INAP Path Forward Symposium held at the Ninth ICARD in Ottawa in May 2012.

In 2013, INAP entered into an agreement with O'Kane Consulting (OKC) to prepare a guidance document on the design and construction of soil cover systems. In organizing the technical team, O'Kane Consulting and INAP felt the need for global input for this document. Consequently, a global technical advisory group (TAG) was formed to review and advise O'Kane on this project. Not unexpectedly, some of that original Australian Ad hoc committee are on this TAG. INAP has reviewed the first draft of the document and O'Kane and the TAG have responded to our suggestions and comments. This document is scheduled for presentation at the Tenth ICARD in Santiago in 2015.

Capacity Building

A key element of INAP's strategy to prevent and mitigate ARD is to support the enhancement and development of technical and leadership capacity of mining stakeholders including regulators, small operators and exploration companies and communities, particularly in developing regions where training and experience is less available to stakeholders.

Since its publication, the GARD Guide has become such an integral part of INAP capacity building program. To promote the GARD Guide and train stakeholders in its use, INAP and its Global Alliance partners have sponsored and organized short courses across the globe. A GARD Guide short course was presented prior to the Tenth ICARD/IMWA meeting here in Santiago, Chile.

Those presenting include a member of the ADTI Steering Committee and another who was a supporter of the SANAP organization. INAP has been very pleased with outcome of these GARD Guide short courses. For example a few years ago, a GARD Guide short course was organized and presented in Turkey (Personal Communications Rens Verburg, 2013). Resulting from this short course, a committee was organized to translate the GARD Guide Executive Summary into Turkish. In addition to the GARD Guide Executive Summary being translated into Turkish, it has been translated into Spanish, French and German as well.

To assure that there are global opportunities for short courses on the GARD Guide in remote locations, INAP has also entered into an agreement with EduMine for an internet GARD Guide course which is presented within the EduMine web-based educational program.

Since its roll-out in 2009, the GARD Guide has been updated three times. The original version of the GARD Guide was compiled by an international team of consultants and academics lead by Golder and Associates. Since that first version, the following organizations and consulting firms have participated in additions and upgrades to the GARD Guide:

- Natural Resources Canada - Canada
- Environmental Geochemistry International - Australia
- Earth Systems - Australia
- EcoMetrix Inc. - Canada
- Knight Piesold / Sovereign Consulting Inc - USA

As you will note from this list, they are geographically diverse, and they were not part of the original GARD Guide production team. INAP desires that the entire mining consulting and service community recognize and support the best practices compiled in the GARD Guide. If there are best practices or relevant case studies that have not been include in the GARD Guide, let us know, so together, we can correct the oversight.

One of the modifications that GARD Guide users have requested is the addition of more case studies of actual mining operations. Many of the recent upgrading editors and reviewers were requested to include brief case studies that would focus on specific best practices and illustrate how they can upgrade the operations or express lessons learned from less effective actions. Numerous case studies have been added from a variety of climatic and geochemical regimes. INAP thanks these consulting firms and governmental agencies for their efforts to broaden the GARD Guide perspective and strengthen its value to our stakeholders.

INAP has received numerous requests for a GARD Guide hard copy. Consequently, INAP and its service providers have formatted the GARD Guide as a printable PDF file thus allowing users to print all or sections of the GARD Guide has a hard copy. This printable version of the GARD Guide is found at www.gardguide.com and is presently available to all stakeholders.

Many organizations use and reference the GARD Guide. INAP was pleased that the U.S. Environmental Protection Agency (US EPA) translated to Spanish and appended the executive summary of the GARD Guide to the Central American Free Trade Act *EIA Technical Review Guideline: Non-Metal and Metal Mining* (US EPA, 2012). The GARD Guide is also referenced in the

US EPA CLU-IN webinar on mining – resources and is linked and referenced in the Interstate Technology and Regulatory Council (ITRC) web page on mining waste treatment technology selection (www.itrcweb.org/miningwaste-guidance/other_resources.htm) (ITRC viewed 2014). The GARD Guide will also be referenced in future mining guidance documents prepared by International Finance Corporation (IFC) (Personal communication, John Middleton, IFC, 2013).

I also met with Dr Anthony Hodge, the president of International Council for Mining and Metals (ICMM) and we discussed how INAP and ICMM could team to support our joint water management and conservation programs.

Another key partnership that INAP is seeking to enhance is teaming with universities and research centers. These centers of learning and research train future miners, engineers, planners, managers and regulators for the mining industry and develop innovative ARD mitigation methods.

In a recent discussion with a mining engineering professor, it became apparent how important it is to emphasize sustainable mining and ARD prevention to all technical disciplines including those that explore, develop, construct, operate and close a mining operation. To achieve this shared responsibility of preventing ARD and maintain clean mining discharges, requires the engagement of all mining industry stakeholders.

Not only do our academics train the students, but they are on the cutting edge of innovative research to produce the new tools to prevent, model, predict and mitigate ARD. Hence, it is important that INAP and our collaborative partners are teaming with universities and research centers. I know ADTI has had a university consortium as a key element of their program. I believe that this should be implemented in all Global Alliance organizations to engage universities in our programs and objectives and to keep us informed of new and relevant tools and programs that are being developed within the academic community. This connection is of particular interest in the field of biogeochemistry where new tools are developing on a regular basis.

One activity that INAP and the Global Alliance is implementing to strengthen its ties with the academic community is the new program to recognize brief (four to five page) case study based on published work of current investigations or operations. As discussed earlier, case studies are a very effective tool to illustrate best practice principles. By limiting the length of the case study, we believe that they can be focused on a specific practice relevant to ARD prevention, and that they can be harvested from the current literature describing current operations or research activities. Students can seek out mentors in either academic or operational venues and create lasting relationships. In addition, these case studies will be useful for illustrating best practice and lessons learned for future students. The results of the first Case Study Competition will be presented at the Tenth ICARD in Santiago. We believe that it will be successful in not only developing useful and relevant case studies, but it will also develop lasting inter-generational relationship that will strengthen the mining industry.

Sulfate Treatment Workshop

Through INAP and ADTI members, a Sulfate Treatment Workshop was organized and presented in Salt Lake City on February, 27-28, 2014. One hundred and ten delegates from five different countries attended this meeting. The program included a broad ranging panel discussion with six separate presentations. An additional twenty-one presentations or case studies and innovative processes were given. At the conclusion of the program, five breakout sessions were held to discuss future efforts. Following the technical program, a field tour of the Kennecott reverse osmosis plant, which treats sulfate-bearing groundwater, was held. As well as recognizing ADTI's crucial support, I would also like to recognize the workshop's sponsors – Veolia Water, Golder Associates and Arcadis, US.

Path Forward Symposium

Recognizing the value of inputs from all partners and stakeholders, INAP hosted a "Path Forward Symposium" prior to the Ninth ICARD. The INAP path forward symposium was attended by over 70 ARD experts from across the globe. The program consisted of seventeen presentations on innovative ARD technologies and other ideas relevant to ARD prevention. The symposium format allowed each presenter five minutes to present his/her idea followed by two minutes for questions and answers. Needless to say, a lot of information was disseminated in a short period of time. It was like an extended "elevator presentation." These talks were then followed by detailed discussion by focus groups. The themes of the four discussion groups included: 1) Biogeochemical processes and tools, 2) Mine-waste management, 3) Innovative treatment technologies and 4) Stakeholder engagement. Following the breakout sessions, a short summary meeting was held to organize and compile the discussion points and findings. These findings were disseminated to the attendees. A second summary session was convened following the ICARD to focus on some of the salient points made at the symposium. At this session many excellent recommendations were proposed and compiled into a report that was discussed at the INAP Strategic Planning Meeting held in November 2013. This strategic planning meeting was facilitated by Dr. Dirk van Zyl, a well respected consultant and professor at the University of British Columbia.

INAP PATH FORWARD

Based on the suggestions made at the Path Forward Symposium and inputs and recommendations by INAP Operating Committee members at the INAP Strategic Planning Meeting in Vancouver, BC a strategic plan was developed to facilitate our planning and future programs. This plan focus on four themes 1) building capacity within INAP, its partners and industry stakeholders, 2) strengthening our communication links with our member companies, our Global Alliance and other stakeholder partners; 3) implementing ARD prevention best practice throughout the entire mining industry; and 4) maintaining continuous improvement. For INAP to be successful in meeting these goals, we need to develop closer ties with our existing and future partners.

Good communications is critical to maintaining quality partnerships and accomplishing our goals. Superior communication combines a well designed message with focused listening and understanding by both parties. Comprehending concerns and desires are often crucial to successful project implementation. Because of the importance of the ARD prevention concept, we often focus

on the message. But to assure successful projects, INAP will work on understanding the needs of our partners as strongly as we focus on project implementation. I believe this approach will lead to stronger partnerships and more shared successes.

Sharing information and experience was a theme that was heard consistently within the planning meeting and path forward symposium. This concept has been exemplified by INAP members as they hosted our Operating Committee (OpCom) meetings. Our last OpCom meeting was hosted by Freeport McMoRan Copper and Gold and held in Tucson, AZ. Following the meeting, we toured the Sierrita and the Bisbee mining sites. During the tour, we observed three water-treatment pilot-plants that were treating discharges from the Sierrita operations. We also toured an innovative water management operation located on the Bisbee tailings management facility. At the end of the tour, one of our experienced OpCom members expressed, "I learned a lot from this tour."

At a separate OpCom meeting, INAP heard a presentation on the Rio Tinto ARD Risk Management Protocol. This program has been operating at Rio Tinto's mining and processing facilities over the past decade and it is based on Rio's corporate-wide review and audit program. The design and implementation of this ARD review program was first presented at the 7th ICARD in 2008. Since that time, the experiences of nearly one hundred audits have been included in the risk management data base covering facilities in a variety of commodities and operating units. Many INAP members have similar programs, and we believe that these resulting discussions on ARD risk management will be informative and valuable to all and help promote the mission of INAP.

Other topics we are looking forward to discussing are developing and implementing ARD management plans throughout the mine-life cycle, working with exploration groups and junior companies to develop early waste characterization data and engaging communities to address their concerns and develop sustainable mining.

CONCLUSIONS

ARD management and prevention is critical to the success and reputation of the mining industry. To achieve these goals, measurement and ongoing improvement of the ARD management plan are necessary throughout the life of mine. Successful implementation of the ARD management plan relies on commitment from company management and the systematic use of ARD management tools including partnering with all stakeholders. We believe that by partnering with all mining industry stakeholders, we will be more successful in achieving our joint goals of preventing ARD and supporting sustainable mining.

Finally, the prevention and mitigation of ARD is becoming more technically viable and more widely applied through the efforts of all mining stakeholders including mining operators, consultants, researchers and suppliers; regulatory agencies; NGOs and the environmental community. We would like to thank all of INAP's partners in this important endeavor to prevent ARD and metal leaching in mining-impacted waters resulting in more clean water for all of us.

REFERENCES

Kempton, H., Bloomfield, T. A., Hanson, J.L., and Limerick, P., (2010) *Environmental Science & Policy*, vol. 1, pp. 558–566.

www.gardguide.com. viewed September 16, 2014.

Hatch, (2014) Study to Identify BATEA for the management and control of effluent quality from mines, MEND Report 3.50.1, pp. 1-614.

CAFTA DR and US Country EIA, (2011) EIA Technical review guideline: non-metal and metal mining, vol. 2, appendix E. GARD Guide (Acid rock drainage) pp. 93-114.

www.itrcweb.org/miningwaste-guidance/other_resources.htm viewed September 16, 2014.

Richard, D. G., Borden, R. K., et. al., (2008) Design and Implementation of a Strategic Review of ARD Risk in Rio Tinto, Proceeding of the 7th International Conference on Acid Rock Drainage (ICARD), March 26-30, 2006, St. Louis , MO, pp. 1657-1672.