LINKING THE WORLD TO ELIMINATE ACID ROCK DRAINAGE[1]

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Abstract. Acid drainage continues to be one of the most serious and potentially enduring environmental problems for the mining industry. The International Network for Acid Prevention (INAP) is an industry group actively seeking to eliminate the liabilities associated with acid drainage through networking, sharing information and research. Recognizing that regional groups with acid drainage programs would benefit from a global dialogue and sharing of information, INAP facilitated the creation of the Global ARD Alliance, composed of MEND (Mine Environment Neutral Drainage Program), ADTI (Acid Drainage Technology Initiative), ACMER (Australian Centre for Minerals Extension and Research) and PADRE (Partnership for Acid Drainage Remediation in Europe), covering Canada, United States, Australia and Europe.

This paper will explore the activities of INAP in advancing a global agenda of networking, sharing information and research to aid in our understanding and path towards eliminating the liabilities associated with ARD.

Additional Key Words: Global Alliance, technology transfer, networking, research

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[1] Paper presented at the 7th International Conference on Acid Rock Drainage (ICARD), March 26-30, 2006, St. Louis MO. R.I. Barnhisel (ed.) Published by the American Society of Mining and Reclamation (ASMR), 3134 Montavesta Road, Lexington, KY 40502

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7th International Conference on Acid Rock Drainage, 2006 pp 623-629
DOI: 10.21000/JASMR06020623

http://dx.doi.org/10.21000/JASMR06020623

What is INAP?

The International Network for Acid Prevention (INAP) is an industry based initiative that aims to globally coordinate research and development into the management of sulfide mine wastes. The principal objectives of INAP are to promote significant improvements in the management of sulfidic mine materials and the reduction of liability associated with acid drainage through knowledge sharing and research and development of technology. To meet these objectives INAP will:

- Achieve a significant reduction in the liability associated with mine materials through information sharing, collaborative research and implementation of best management practices through the complete mining business cycle.
- Build credibility with key stakeholders through their engagement in the affairs of INAP and the collaborative development of a worldwide guide based on best management and technical practices as applied to acid prevention and control
- Establish an organization with demonstrated structure and abilities to make long-term improvements in acid prevention and other environmental issues on the basis of global cooperation and action.

How is INAP Organized?

INAP Members are mining companies who wish to work collaboratively to address acid drainage. INAP reports to a Board (made up of Senior Managers elected by the member companies) and the Operating Committee, which coordinates the technical ideas and issues to ensure the topics important to industry, are addressed.

The main activities of INAP are directed by an Operating Committee (OpCom) appointed by the Board. The committee comprises of several Senior Technical Representatives from the member companies and its main responsibilities are to:

- ensure the technical and communication needs of the Members are identified and prioritized
- establish working groups for specific technical issues in keeping with Member interest
- develop programs and projects to meet the technical and strategic communications objectives of INAP
- identify industry needs, knowledge gaps and drive the development of research ideas and proposals
- facilitate the approval and conduct of brokered research projects
- ensure the continuity of the International Conference on Acid Rock Drainage (ICARD)
- develop a global network of organizations external to INAP to share and exchange information, and seek partnerships.

The Technical Manager supports the Board and Operating Committee by maintaining information transfer systems, reporting and administrative services.

INAP members currently include BHP-Billiton, Rio Tinto, Phelps Dodge, Barrick, Newmont, INCO, Falconbridge, and Placer Dome.

How did INAP get started?

In 1997 a group of Canadian mining companies met to review the success of the Mine Environment Neutral Drainage (MEND) program and to consider future activities. Two important conclusions were agreed upon. The first was that the Canadian mining industry should fund a small secretariat in Ottawa in partnership with Natural Resources Canada to support a high level of technology transfer within Canada and to oversee the completion of existing MEND programs.

The second conclusion was that it was important for industry to continue the momentum of MEND but on an international scale. It was recognized that mobilizing the knowledge and experience found around the world would be critical to the continuation of the progress achieved under the MEND program. On this basis a small task force was established to explore possible alternatives for the development of an industry led initiative on a global scale.

At the ICARD meeting in Vancouver in 1997, informal meetings were held with industry, government, consulting and university representatives to discuss initial ideas. These discussions were instrumental in validating the need for an industry led initiative and in refining some of the concepts. Out of this process grew the idea that a focused meeting of industry and external experts should be held to test the validity of the concepts and to test the resolve of the interested parties.

With strong support from Canadian and Australian companies, an international committee with representatives from Australia and the United States was formed to organize a meeting in Vancouver during February, 1998. The meeting was attended by 18 companies and 14 university, consultant and government experts. The beliefs underlying the need for INAP were strongly endorsed but its initial focus on research was questioned. The overriding conclusion was the development of a solid knowledge base covering the collective experience of INAP's members around the world would be invaluable in the dissemination of effective practices, the identification of knowledge gaps and the formation of effective research proposals. The sharing of information on past successes and failures alone was viewed as sufficient justification for the formation of INAP.

In April 1998, the six companies that provided the leadership for the Vancouver meeting agreed to formalize the organization of INAP and its objectives. This let to a meeting in Vancouver in August 1998 where the INAP Members Agreement was finalized and work on the technical program was initiated. INAP was officially launched in October, 1998.

What has INAP Achieved since Launching in 1998?

While INAP has a defined structure, the bulk of the activities are conducted on a voluntary basis. In order to effectively communicate and disseminate information, INAP developed a web page as a means of making information available to members, as well as the public. With a web page (www.inap.com.au), member companies could provide access to acid rock drainage (ARD) information at the operating site level. Being a global organization, this would allow mining operators in Houston, B.C. or Santiago, Chile access company experts and information on ARD.

The web site provides information on INAP related activities, case studies documenting ARD technologies of member sites, results of studies or site specific research conducted by members, and summaries of research projects by members.

Projects sponsored by INAP have evolved from several areas, including open calls for proposals, unsolicited proposals, proposals from regional organizations, gaps identified at workshops, linkages with site specific projects, and ideas generated by INAP. Projects have been covered a number of broad topics, including: Waste Rock Characterization, Wet Covers, Dry Covers (semi-arid/arid and temperate), Pit Lakes, Co-Disposal, Pit Lakes, Treatment, Prediction, Heap Closure, Risk Assessment and Breakthrough Technologies. Some of the projects that INAP has sponsored include:

Co-Disposal

A literature review of the application of co-disposal of waste rock and tailings was completed. A workshop was organized to identify opportunities for the co-disposal of tailings and waste rock as a means of preventing the formation of ARD and to develop a path forward for future research work in this area. The main conclusions from the workshop were that co-disposal is being practiced in the coal mining sector, particularly in Australia. However, most of those applications are in confined areas (e.g. tailing ponds or pits). In contrast, very little research has been conducted in the hard-rock mining sector. The theory of co-disposal and potential benefits or concerns with respect to geotechnical and geochemical stability are reasonably well known. Co-disposal covers have a high probability of success and further work in this area continues to be supported by INAP.

Waste Rock Characterization

This project is an excellent demonstration of two companies embarking on individual projects, but through INAP they were able work together and increase the value of their projects by combining them. Kennecott's Ridgeway Mine (Rio Tinto) and Inco's Whistle Mine were proceeding to dismantle waste rock dumps. This project was an opportunity to examine these dumps to advance the understanding of the geochemical and hydrological nature of waste dumps and the extent of oxidation zones through a sampling and analysis program. Researchers from the University of Queensland and University of British Columbia conducted a field program to collect samples from the site and complete the analysis. The final results of this project were presented in 2002.

Scale-up – Review Phase

It is believed that information from the large-scale waste rock test piles could significantly improve the techniques used to predict waste dump behavior and to plan for the management of sulfidic wastes dumps. The review phase for this project involved collecting existing information from operations that may have data from existing waste rock dumps or large scale tests. The outcomes of this project have been a database of information to be used in refining the scope of work for the future scale up project (see below).

Gel Sampler

Studies have suggested that free metal ion concentration would be a better predictor of metal bioavailability. The use of diffusive gradient in thin-films (DGT) has the potential to overcome difficulties with present techniques, but some aspects require further research before its use can be recommended. An extensive literature review was completed and as

well as testwork to validate the use of DGT and its use as a potential technique as a predictor of metal toxicity.

Treatment Workshop

A treatment workshop provided a forum for INAP member companies to discuss common issues and challenges at active water treatment operations to help optimize operations and costs. The workshop stimulated considerable discussions, and common issues were identified.

Workshop on Waste Characterization

Held in Australia, this workshop brought together industry and researchers to discuss current projects underway. The workshop was an opportunity for members to understand the status of INAP and related research into ARD prediction, including the Scale Up and Waste Rock Dump Characterization Projects. The workshop also provided an opportunity for INAP member and wider audience participation in discussion of future directions for this research.

Workshop on Wet Covers

In conjunction with the annual MEND and BC Ministry of Energy and Mines ARD Workshop, INAP co-sponsored a session to improve the understanding and use of water covers and to identify generic issues that require additional research. Using the MEND manual on Water Cover Design as a guide, a multi-stakeholder group was assembled to discuss gaps and issues.

Long-term Performance of Dry Covers

The objective of this project was to address the issue of long-term stability and functionality of dry covers for controlling ARD. A brief literature review combined with interviews with cover operators and dry cover system designers attempted to identify factors that affect long-term performance and to evaluate current modeling tools to identify deficiencies in terms of predicting long-term performance. The second part of the project examined available field data from operating covers to evaluate long-term performance. INAP continues to maintain an active program and interest in this important area, in part through some of its member companies.

Evaluation of the Deterioration of the Rum Jungle Waste Rock Cover

Two waste rock dumps at the Rum Jungle uranium mine in Australia were covered in 1984 to reduce water infiltration to less than 5% of incident rainfall. This was one of the first applications of an engineered cover in Australia. For ten years after cover establishment, the cover met the specifications. In subsequent years, the monitoring has indicated an increase in infiltration, but no evaluation has been conducted to determine the factors for this increase. This project used field and laboratory techniques to determine the present physical, chemical mineralogical, biological and hydrological characteristics of the covered waste rock dumps at Rum Jungle. The data generated compared with the technical specifications used during construction of the covers and monitoring data to determine the reasons for the change in the covers. The project identified the inadequate soil depth layer for maintaining cover saturation, as well as bioturbation processes playing roles in the cover performance.

Additionally, INAP has sponsored ADTI projects related to the development of workbooks for Waste Characterization and Pit Lakes.

A key project that INAP has been promoting and is currently sponsoring is the Scale-up Project.

Diavik Scale-up Project

When carrying out ARD predictive investigations, a structured approach, using a range of tests, with strict adherence to quality control is essential. The use of standard methods, the collection and testing of representative samples, and testing of representative numbers, are key components of scale-up and to effective transfer of information. However, there is currently no agreement as to 'standard' methods when examining waste rock, and the link between the predictions from laboratory-based tests and actual field behavior is unclear.

Using a suite of standard static, kinetic and field test methods for waste rock, the scale-up project objectives include:

- Determining and defining the factors required to scale up laboratory static and kinetic tests to determine rates of acid production, consumption and metal release to field scale for waste rock;
- Contributing to the development of an industry world-wide standard for laboratory static and kinetic tests, and field test piles;
- Where appropriate, developing new protocols for ARD prediction
- Providing a repository of geochemically well defined rock samples that could be used for further research.

The Scale-up project represents a large and ambitious project for INAP. Diavik, a Rio Tinto operation, approached INAP to collaborate on the development of the scale-up project at their northern project site. This project will evaluate and compare the suite of static and kinetic test results, as well as small, medium and full-scale waste piles as a means of improving our understanding of prediction of waste rock drainage. MEND is also a sponsor of this project, and all participants see great value in the data set that will result. Natural Sciences and Engineering Research Council (NSERC) and Canada Foundation for Innovation (CFI) are also supporting the project. The project has completed the first year on development, and the project sponsors continue monitor the progress. INAP aims to have a number of similar scale-up projects running in other climatic and geographical regions in the future.

How does INAP link the world to eliminate ARD?

INAP, being a global yet largely virtual organization, understands that partnerships on a global scale are essential in leveraging the global efforts to eliminate ARD. Recognizing that regional groups or programs already exist in countries around the world, INAP does not intend to replace these regional efforts in ARD. Rather, INAP would like to help strengthen these organizations efforts, and link them to other regional organizations. As an industry group, we are keen to see that duplication is minimized. INAP believes that the regional organizations have specific strengths in areas of ARD.

INAP has therefore promoted the formation of the Global ARD Alliance that includes the following organizations: Mine Environmental Neutral Drainage (MEND) program in Canada; Acid Drainage Technology Initiative (ADTI) in the United States; Australian Center for Minerals Extension and Research (ACMER) in Australia; and the Partnership for Acid Drainage Research in Europe (PADRE) in Europe. The terms for membership include a willingness to share information and to work collaboratively with like organizations across the world. Without the

opportunity to share ideas and work programs, these regional groups run the risk of duplicating and repeating fundamental research which is either on-going or has been completed in another part of the world. Equally, groups may attempt to cover all areas related to ARD, and therefore do not have the resources to focus in on the pressing issues in their host country. INAP is attempting to provide informal support to regional organizations, and encourage them to concentrate on key areas. By helping these groups access information from around the world on ARD, a truly global network is evolving.

As an example, in 2001 INAP participated in a workshop on ARD convened in Santiago, Chile. The concern for ARD issues is emerging in Chile, and through linkages with the acid drainage group of the Consejo Minero, INAP was able to provide speakers to their first workshop on ARD. Through continued liason, INAP is effective in directing the group to locating best practice ARD management information globally.

The benefits of the Global Alliance are evident with greater dialogue between regional organizations and interchange of technical information. The regional organizations have attended regional workshops and each organization has been able to supply key speakers for various conferences and workshops.

Currently the Global Alliance is collaborating on the INAP project to develop the scope for a Global ARD Guide. The development of a Global ARD Guide by INAP is seen as an opportunity to apply best science reflecting a risk-based approach. The intent is to develop a guide based on best technical and management practices with the objective of creating a body of work with high industry and external stakeholder credibility. The guide is envisioned to be web-based, hence will be a 'living document', evolving with our knowledge of the issues and being intimately tied to current best practice.

What are the challenges to INAP's success?

Resources, industry consolidation and competing priorities will challenge the future success of INAP. The organization relies upon member contributions of information and input to be successful. Industry consolidation continues to reduce the membership, leading to rationalization of key contributors. The drive for new company members of INAP will continue. However, INAP continues to provide exceptional value to members and the quality projects and information exchange occurring within INAP is a demonstration of the organizations relevance.

Conclusion

INAP has been effective in developing a global industry network charged with pursing an agenda for eliminating the liability associated with ARD. With international members, linkages with world wide regional ARD organizations, projects relevant to the international membership, and meetings and workshops conducted world wide, INAP will continue to support the global eliminization of ARD liabilities in the mining industry.