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Acid mine drainage in Australia

Its extent and potential future liability

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A joint initiative of the Office of the Supervising Scientist and the Australian Centre for Minesite Rehabilitation Research

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This report is the culmination of a one year study by Dr John Harries, Project Leader, Environment Division, Australian Nuclear Science and Technology Organisation (ANSTO), and recipient of a Supervising Scientist Fellowship. The study was a joint initiative of the Office of the Supervising Scientist (*oss*) and the Australian Centre for Minesite Rehabilitation Research (ACMRR) and received the support of the Minerals Council of Australia. Funding for the project was provided by *oss*.

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The oxidation of sulphidic mine wastes and the consequent release of acid mine drainage and acid rock drainage, is one of the main strategic environmental issues facing the mining industry. The production of broken waste rock and tailings by mining operations can expose large amounts of pyrite and other sulphides to the effects of water and oxygen. Sulphides in the walls of opencuts and underground workings are also exposed by the mining process. Despite general agreement on the significance of acid mine drainage at Australian mine sites in terms of its impact on the environment, its extent has not been quantified, and the additional costs of managing acid mine drainage have not been estimated.

In order to better understand the impact of acid drainage in Australia and to provide a basis for assessing long-term management options and strategic research needs, the Office of the Supervising Scientist (OSS) and the Australian Centre for Minesite Rehabilitation Research (ACMRR) initiated a study to prepare a status report on acid mine drainage in Australia covering both operational and historic sites. The study was supported by the Minerals Council of Australia.

Information was collected from mine site staff, government department officials and others in Australia who have expertise in the characterisation and management of sulphidic mine wastes. Questionnaires were sent to 317 mine sites considered to be sites where the excavated material could be acid generating. The questionnaires sought information about surface water management, ground water, open cuts, underground workings, water qualities, acid base accounting and the types and amounts of potentially acid generating wastes. Information was also collected on historic mine sites where acid drainage was known to be a problem.

Results from the survey suggest that about 54 sites in Australia are managing significant amounts of potentially acid generating wastes, where significant amounts means more than 10% of the wastes is potentially acid generating or there is more than 10 million tonnes (Mt) of potentially acid generating wastes. About 62 additional sites are managing some potentially acid generating wastes but less than 10% of the total wastes and less than 10 Mt.

The most common approach to managing sulphidic wastes is to install a low-permeability cover over the wastes and/or encapsulating the wastes within non-sulphidic materials. In some cases the low permeable covers are constructed by compacting other mine wastes. The average cost of covering potentially acid generating at currently operating mine sites is estimated to be about \$40 000 ha^{-1}.

For the Australian industry as a whole, the additional cost of managing potentially acid generating wastes at operating mine sites is estimated to be about \$60 million per year. This includes the costs of cover installation, selective placement of wastes, additional waste characterisation and water treatment as appropriate. Over 15 years, the total cost of managing potentially acid generating mine wastes from current mines is \$900 million (1997 dollars) for the whole industry.

Costs of managing acid generating wastes are much greater if sulphide oxidation and release of pollutants is discovered after mine closure. The costs of remediating historic mine sites releasing acid mine drainage are \$100 000 or more per hectare, and these costs would also apply to mine sites where acid drainage is discovered late in mine life or after mine closure. The costs of treating contaminated water-filled voids or seepages from adits would be additional.

These estimated Australian costs are significantly less that the C\$2 to C\$5 billion total liability costs for potentially acid generating wastes at mine sites in Canada estimated by the

Canadian Mine Environment Neutral Drainage (MEND) program. The Canadian liability represents the cost of remediating the currently estimated inventory of acid generating wastes in Canada. The amount of potentially acid generating mine wastes in Canada is similar to the amount in Australia, but the estimated costs of remediation for Canadian sites is three to five times greater than for Australian sites.

The management of potentially acid generating wastes is an important environmental issue; major costs may arise late in mine life or after mine closure if proper waste management strategies are not in place from the beginning of mine operations. The risk of these increased costs late in mine life should be of concern to mine owners. Furthermore, the governments will want to ensure that as far as possible the environmental risks and financial liabilities are minimised and are not transferred to government or the community as a result of poor management of the problem during the life of the mine.

The following recommendations cover four main issues: rehabilitation technologies, mine planning, waste characterisation and technical awareness of acid drainage issues.

Rehabilitation technologies

A wide range of technologies is being used in Australia to manage potentially acid generating mine wastes. Most of the technologies are not proven and their long-term effectiveness is uncertain. There is need for a better understanding of what constitutes an adequate level of isolation for potentially acid generating waste in order to ensure that any environmental impact is acceptable in the long term. The effectiveness of the waste management strategies being used to manage this waste needs to be assessed for Australian conditions.

Recommendation 1

It is recommended that a study be undertaken to:

- collect detailed information on the strategies being applied at the Australian mine sites managing potentially acid generating wastes,
- review monitoring information on past remediation works for information on the effectiveness of different strategies,
- assess the methods being used to predict the long-term performance of strategies now being used at Australian mine sites to control the potential sulphidic oxidation in mine wastes,
- develop guidelines to assist mine managers select appropriate and adequate strategies for managing potentially acid generating wastes.

Mine planning

The management of acid mine drainage depends on knowing the potential for sulphidic oxidation and developing and implementing appropriate mine plans to limit any environmental impact.

Recommendation 2

It is recommended that mine managers be required to:

- assess the risk of sulphidic oxidation in mine wastes, pit walls and underground workings and the generation of contaminated water as a standard part of mine planning,

- integrate the management of any identified potentially acid generating wastes into mine operations,
- regularly review waste management plans based on experience and monitoring.

Waste characterisation

There is a lack of uniformity in the types and numbers of tests being applied in Australia to characterise the acid generation potential of mine wastes and the interpretation of results of those tests.

Recommendation 3

It is recommended that mine managers and mine site environmental officers review the mine waste characterisation studies already undertaken to ensure that all rock types at their site have been tested and that enough tests are carried out to give confidence in the appropriateness of the waste management strategy.

Recommendation 4

It is recommended that guidelines for the application of mine waste characterisation tests at Australian mine sites be prepared, including guidance on sampling procedures, how many samples should be tested, appropriate tests for different ore-bodies and interpretation of results.

Technical awareness

There is a need to improve the level of knowledge and technical awareness of acid drainage issues at many mine sites. Networking between mine sites should be improved to encourage technology transfer on the management of sulphidic materials. The transfer of information on management strategies to smaller operations and companies is particularly important.

Recommendation 5

It is recommended that environmental and acid mine drainage workshops and courses be used to facilitate technology transfer and encourage sharing of experience and research information on managing sulphidic wastes between mine sites.

At the national level there is a need for all stakeholders to contribute towards developing long-term strategies for the management of sulphidic wastes. This requires at the national level the exchange of information on experience and on advances in technical knowledge.

Recommendation 6

It is recommended that working groups be established with input from all stakeholders in the mining industry, including miners, mining companies, consultants, researchers, regulators and environmental protection authorities to identify acid mine drainage issues.

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