

Clear Solutions

June 2002

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In Focus: Acid Water

Acidification of surface and groundwater by acid rain, acid rock drainage and acid sulfate soils is a significant issue across the mining, industrial, agricultural and urban sectors. Experience shows that dealing with acidic water can be a costly, long-term problem if not managed correctly.

Acid Rock Drainage and Acid Sulfate Soils

The generation of acid associated with Acid Rock Drainage (ARD) and Acid Sulfate Soils (ASS) occurs when iron sulfide minerals, such as pyrite (FeS_2), present within soils, rocks and mine workings are oxidised by contact with air. Acid generation is accelerated by warm, wet climates, low pH, elevated water temperatures, high soluble iron (III)/iron (II) ratios, the presence of some forms of bacteria and the absence of natural neutralising material (eg. limestone - CaCO_3). The process of acid generation, in nearly every case, is initiated by human activity (eg. agriculture, mining, road construction, urban development). The rate of oxidation and hence acid generation varies with a number of factors and, as a result, acid production often proves a long-term liability.

The solubility of most metals naturally present in the environment is increased by interaction with low pH solutions. This results in the production of acid water with high contents of dissolved metals.



(Above) Acid water generated from acid sulfate soils, northern Australia (Left) Acid Drainage from historical mining activities in Tasmania, Australia.



Metal-bearing acidic water generated from ARD and ASS often finds its way into nearby streams, rivers, lakes, and groundwater. This can have extreme ecological impacts, affecting the beneficial use of waterways downstream of the source of acid. Impacts range from slight limitations on the use of the water to the production of water with toxic levels of metals. Without management this can result in the need for expensive control, treatment and rehabilitation programs and can create long term environmental liabilities.



Welcome to **Clear Solutions**. This biannual newsletter produced by Earth Systems explores up-to-date water treatment issues, solutions and technologies. We encourage you to contact us with feedback on its contents and make suggestions for future issues.

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About Earth Systems

Earth Systems is an environmental consulting group that has developed and implemented water management strategies for almost 10 years. We provide:

- Specialist water quality advice;
- Integrated water treatment systems;
- Equipment service and maintenance;
- Contract treatment; and
- Equipment lease.

Earth Systems has developed innovative treatment technologies that can be packaged into a range of integrated water treatment systems suitable for use at industrial facilities, mine sites or remote locations. Our team includes more than twenty professional staff and associates.

Earth Systems has worked in more than 15 countries and offers consulting and management services in the water, wastewater, mining, solid waste, environmental data and environmental research fields world wide.

Contact us for our latest catalogue of water treatment equipment, or for assistance with your water quality issues.

water.treat@earthsystems.com.au

The cost of acid rock drainage

Complete oxidation of all of the pyrite contained within 1 million tonnes of rock, soil or coal containing 1wt% pyrite would produce acid requiring ~13,200 tonnes of hydrated lime [Ca(OH)₂] to completely neutralise. At US\$90 / tonne the reagent cost alone would be US\$1.2M – and this assumes 100% efficiency of reagent use.

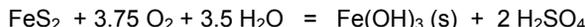
pH and acidity are not the same

pH only partly describes your acid problems. Total Acidity is a more accurate measure of your potential liability and what your treatment requirements may be.

For a more comprehensive explanation of what the difference may mean to your acid management strategies, contact us at Earth Systems for an information sheet.

Acid Production

The production of acid from the oxidation of iron sulfides can be represented by the following summary reaction:

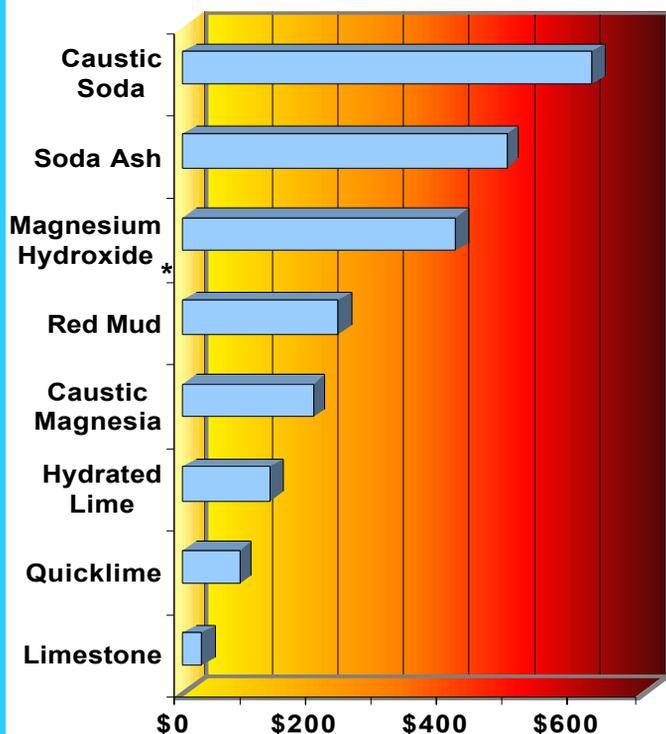


Iron sulfide (pyrite), oxygen and water react to precipitate ferric hydroxide and produce soluble sulfuric acid.

The two main acid forming steps in this reaction are the initial oxidation of the iron sulfide and the formation of the metal hydroxide from the aqueous metal ion.

Acid Rain

The process of acid generation in the formation of acid rain is chemically similar to that for ARD and ASS. Oxidation of the iron sulfides occurs during the combustion of fossil fuels at elevated temperatures rather than low temperature atmospheric oxidation. This leads to the production of sulfur dioxide gas (SO₂) which ultimately reacts with atmospheric water to produce sulfuric acid (H₂SO₄).



Indicative reagent cost per tonne of acid (H₂SO₄) neutralised (AU\$)

Equipment Solutions

The HALT System – Taking the Sting Out of Acid

Acidification of surface and groundwater by acid rain, acid sulfate soils and acid mine drainage often leads to the installation of costly and labor intensive treatment systems. The key cost component in many acid neutralization treatment tasks is the reagent, so the development of a system that utilizes a low cost reagent has the potential to significantly reduce treatment expenditure.

To address the need for low cost, low maintenance, efficient treatment options, Earth Systems has designed and developed the HALT system (Hydro Active Limestone Treatment). This was designed specifically for neutralizing acidic water using the most cost effective reagent, limestone. Limestone has the added benefits of being a natural substance and it cannot over dose the water being treated.

How does it work?

The HALT system grinds limestone gravel, one of the lowest cost neutralization reagents available, to produce an ultra-fine grained slurry. Between 1.5 and 5 tonne per day of limestone can be ground and dispensed by this system. Tests by Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) indicate that in some system configurations 30% of the limestone is ground to less than 0.5 µm producing a highly efficient and reactive slurry.

Reagent cost comparison – The HALT system uses limestone, one of the cheapest, readily available, reagents for acid neutralisation.

** Red Mud is a by-product of aluminum processing that has some demonstrated neutralising capacity.*

Energy requirements for the system are approximately 3 kW or 4 horsepower, with operation possible from 3 phase power, diesel/petrol generator, solar power or even a water turbine.



This system has been designed specifically to use a low cost reagent, efficiently and to operate unattended for extended periods. The system is ideally suited for long term neutralization tasks.

(Left) A HALT system set up to treat acid water generated from acid sulfate soils. Limestone aggregate is fed to the mill from the hopper in the background.

Applications

HALT systems can be used for the treatment of acid mine drainage, the neutralization of acidified catchments, lakes, rivers, streams and groundwater impacted by acid rain or drainage from acid sulfate soils. HALT systems could potentially also be used for pH control along side conventional water and wastewater treatment plants. In addition to limestone, the system is capable of dispensing a range of dry powder reagents.

For more information on the HALT system, or a copy of the latest published HALT article in the March 2002 Journal of the Australian Water Association, contact John Waters at Earth Systems.

water.treat@earthsystems.com.au

Treatment Solutions

Emergency treatment of acidic process water in a storm water pond

A stormwater containment pond containing 10% acid with high metal contents required emergency treatment so that it could meet stringent EPA water quality controls for discharge. The treatment of this acid water was of a matter of urgency to prevent unwanted discharge of metal-rich acid water to the local marine environment. Earth Systems was employed to treat the acid by raising the pH to between 6.5 and 8.5, reduce the heavy metal content to prescribed limits and lower the turbidity (suspended solids content) prior to discharge. The stormwater pond was treated with 500 tonnes of hydrated lime, dispensed by modifying on-site dosing equipment. Addition of the reagent was closely monitored throughout the treatment to ensure correct and efficient dosing to meet pH and heavy metal discharge standards. Treatment of the acid proceeded around-the-clock over 3 weeks. The treated water met all regulatory requirements to enable it to be discharged into the local environment.



Storm water pond containing 10% acid and a high dissolved metal content.

Need Help on Water Quality Issues ?

We understand that site personnel are required to take on many different roles and are often expected to provide expert opinions at short notice.

To help in this area, Earth Systems water quality specialist personnel are available to speak to you regarding any water quality issues you may have. Contact Dr. Jeff Taylor or Dr. John Waters on +61 3 9205 9515, or email: water.treat@earthsystems.com.au

Upcoming Events

- 22-26 July 2002, ICWRER - 3rd International Conference on Water Resources & Environment Research, Dresden, Germany. Organisers: ICWRER Conference Secretariat Tel: +49 351 463 3931, Fax: +49 351 463 7162 E-mail: icwrer2002@mailbox.tu-dresden.de URL: www.tu-dresden.de/fghhihm/normal/frame.htm
- 14-15 August 2002, Ultrapure Water Asia 2002, Grand Hyatt Hotel, Singapore. Organisers: Tall Oaks Publishing Inc Tel: +1 3039736700, Fax: +1 3039735327 E-mail: water@talloaks.com URL: www.ultrapurewater.com/HTM/Asia.HTM
- 12-18 July 2003, 6th. International Conference on Acid Rock Drainage (ICARD), Cairns, AUSTRALIA. For more information contact; Ms Miriam Way, Events Manager, AusIMM; Tel +61 3 9662 3166 Fax +61 3 9662 3662 or email: miriamw@ausimm.com.au. Abstracts due 30-May, 2002

Useful Web Solutions

- US Environmental Protection Agency <http://www.epa.gov/>
- Environment Australia <http://www.ea.gov.au/>
- US EPA Envirofacts Data Warehouse http://www.epa.gov/enviro/index_java.html
- Environmental Contaminant Encyclopedia <http://www1.nature.nps.gov/toxic/index.html>
- European Water Management News: http://www.riza.nl/ewa_news/

Next Issue

- Focus: Clearing Up Turbidity Issues
- Water based dosing units
- Treatment Solutions

Want to find out more ?

Please tick as appropriate

- | | |
|---|---|
| <input type="checkbox"/> Send me information on the HALT System | <input type="checkbox"/> Send me information on Acid Generation and Treatment |
| <input type="checkbox"/> Contact me regarding my Water Quality Issues | <input type="checkbox"/> Send me an Earth Systems Water Treatment Equipment Catalogue |
| <input type="checkbox"/> Suggestions for future issues _____ | |
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**Fax this sheet back to Earth Systems on
(61-3) 9205 9519**

