

LIGNOR™ - ARD

Acid Rock Drainage Treatment Process

NORAM

Acid Rock Drainage (ARD) is the most serious environmental problem facing the global metal mining industry.

Environmental problem

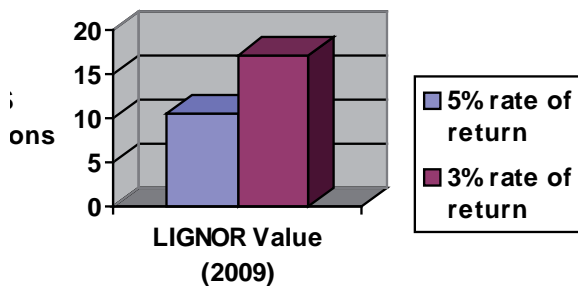
ARD is produced naturally through a series of chemical and biochemical reactions on exposed rock, waste rock, and tailings left behind after mining activities have been completed. The present preferred solution for treating ARD is by the use of lime for neutralizing the ARD to precipitate metals as hydroxides. The operation of a lime neutralization plant may be required to operate in perpetuity, resulting in an expensive liability to the mining companies. Improvements to the process are required to minimize these liabilities.

The LIGNOR™ ARD process advantages:

- Life time cost savings in reagents result in reduced environmental bonding requirements.
- Biologically and chemically stable sludge reduces contingent liability for sludge internment.
- Superior effluent discharge quality.
- Uses bio-materials allowing for a reduced carbon footprint.
- Easily convertible from existing High Density Lime treatment plants.

Economic advantage

In sophisticated regulatory environments, mine companies are required to post a financial security bond to ensure that environmental liabilities due to the formation of ARD on mine sites are controlled. Financial security bonds in Canada can be as high as \$45,000,000.



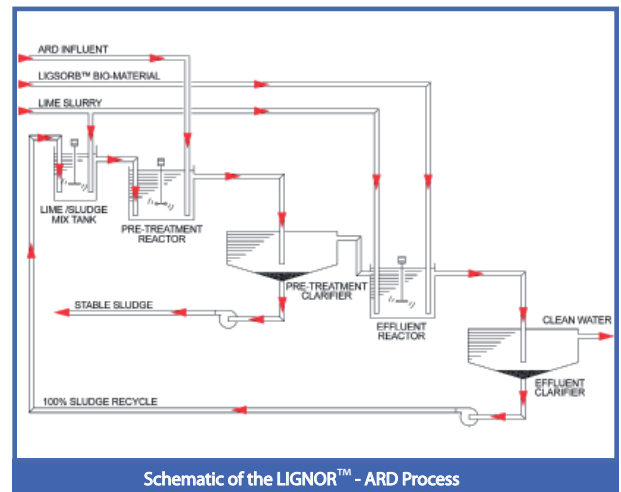
Due to a reduction in reagents costs, the LIGNOR™ process can significantly reduce the bond requirements by millions of dollars.

Reduced contingent liability for sludge internment

Sludge disposal generated from High Density Lime treatment plants presents the mine owner of the abandoned site a serious liability. Internment of the sludge in environments with a different pH to that from which the sludge was produced will cause metals to leach out.

The LIGNOR™ - ARD process reduces liability by producing a biologically and chemically stable sludge in any internment environment.

NORAM's ultimate goal for a solution to sludge internment is to provide industry with sustainable alternatives, by developing waste sludge products such as organic fertilizers, decorative brick manufacture, and building materials.



Superior water quality

Modern mining practice means going beyond compliance in addressing the environmental challenges associated with the production from new mines, and the legacies of past practices. A high- water supply is becoming a scarce commodity worldwide, and is a key resource for mining. Water use needs management to a discharge standard "beyond compliance".

The LIGNOR™ - ARD process produces a high-quality effluent with the ability to remove heavy metals to levels below the BC Aquatic life standard. It is also adaptable to providing drinking water quality with the addition of a desalination plant on the back end.

technology and engineering solutions for the process and resource industries



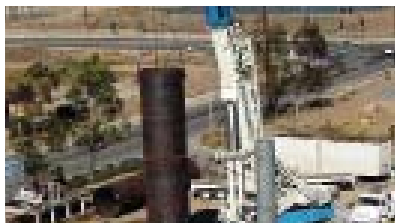
Nitration



Sulfuric Acid



Electrochemical



Biosystems



Pulp&Paper



Environmental

Company Profile

NORAM is a private engineering and technology firm based in Vancouver BC, Canada. We specialize in the development, engineering and commercialization of new chemical processes, and in the improvement and optimization of existing technologies. Since 1988 NORAM has provided leading-edge technologies to the chemical, pulp and paper, minerals processing, wastewater and electrochemical industries.

Today NORAM is the world's leading supplier of nitration technology. In addition, we offer sulfuric acid plants, biological treatment facilities, energy systems, and technologies for the clean-tech sectors.

Our business has developed around the supply of proprietary engineering and equipment packages to our clients.

Core competencies include:

- Nitration and NO_x Technology
- Electrochemical Systems
- Sulfuric Acid Manufacture
- Biological Wastewater Treatment
- Computational Fluid Dynamics & Finite Element Analysis
- Heat Transfer & Heat Exchangers
- Hydrogen, Sulfur and Chlorine Chemistry
- Fluidised Bed Systems
- Energy Storage
- System Closure

Partnering with Innovation and Experience

NORAM works extensively with early-stage technology companies. We draw on established competencies in process design and engineering, provide custom in-house fabrication capabilities, and offer pilot plant and contract research facilities to support the commercialization process.

We've teamed up with organizations around the globe to allow project execution on 5 continents. Our strategic relationships include:

- Bateman Engineering BV
- Canadian Hydrogen and Fuel Cell Association
- ECO-TEC Inc.
- First Chemical Corporation (a DuPont Company)
- FP Innovations
- Kemetco Research Inc.
- Membrane Reactor Technologies
- Ostara Nutrient Recovery Technologies Inc.
- Radiant Technologies Inc.
- Siloxy Limited
- Simon Carves Ltd (Punj Lloyd Group)
- Electrosynthesis Company Inc.

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