

# LIGNOR™ - MWT

Mine Water-Tailings Treatment Process

NORAM

Safe disposal of mine waste, including tailings, is generally recognized as the single largest environmental challenge facing the mining industry worldwide.

### Environmental problem

Modern mining practices now require adherence to water conservation and protection of the aquatic habitat, as well as leaving a sustainable legacy to the indigenous people who are the key stakeholders in the land left behind after closure.

“So Anglo American doesn’t just stand for investment in mining. We believe in supporting a whole range of activities that help deliver sustainable communities in the long term. Education and skills; language training; new business development, attracting new suppliers; promoting water conservation and clean water; protecting the aquatic habitat; delivering energy efficiency. These are all core areas for Anglo American as a modern mining company.”

Cynthia Carroll, CEO, Anglo American PLC  
Anchorage, Alaska, October 23, 2007

### LIGNOR™ - MRT tailings treatment solution

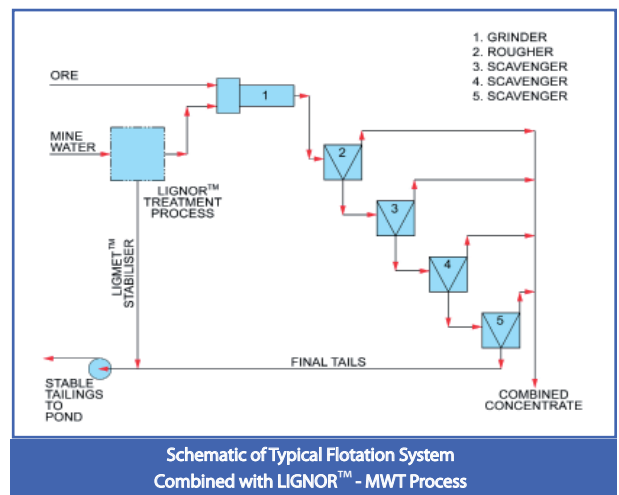
In answer to this challenge, NORAM developed a sustainable and economical process that addresses the concerns of leachable mine tailings when stored above ground or under water, in either sea water or fresh water.

The treatment process, LIGNOR™ - MWT, using wood-based bio-materials treats the contaminated mine water to levels below the British Columbia aquatic life standards, prior to its use in the flotation of ores, whilst LIGMET™, a successful stabilization compound, is produced as a slurry.

LIGMET™, is a ferric lignin derivative (FLD) slurry that contains an abundance of oxygen-containing functional groups, that will form lignin-metal macro-molecular complexes with high stability, through ionic covalent bonding. This LIGMET™ slurry, combined with the tailings, enhances their stability prior to disposal.

The LIGNOR™ - MWT process therefore leaves no environmental residue, reduces the contingent liability to the mine operators whilst reducing the environmental impact of the mine operation, through the treatment of process water and the stabilization of tailings.

An independent tailings mobilization study (2007) teaches that tailings stored in seawater release metals to the receiving environment. Two geochemically-different copper phases contribute to the release: Oxidised copper forms from the oxidation of copper sulphide phases present on the surface of the tailings, and copper precipitates out of the water used in the ore flotation process. The study shows that NORAM’s treatment of the tailings using the patented compound LIGMET™ is most effective at reducing dissolved metals. The major recommendation of the study is that efforts to minimize the use of site water, or the improved treatment of site water before use in flotation of ores, will significantly reduce concentrations of copper and manganese in the tailings that are later released to the receiving environment. The LIGNOR™ - MWT process meets the study recommendation.



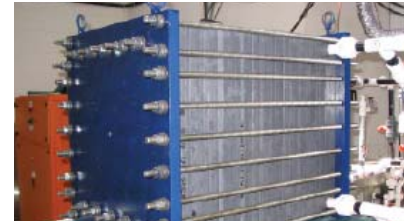
# technology and engineering solutions for the process and resource industries



Nitration



Sulfuric Acid



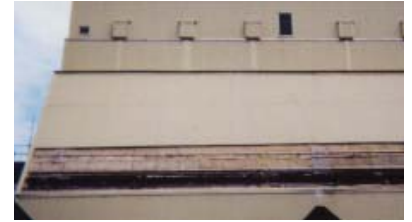
Electrochemical



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<sub>x</sub> 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.

www.noram-eng.com



NORAM Engineering and Constructors Ltd.

Suite 1800 - 200 Granville Street  
Vancouver, British Columbia  
Canada V6C 1S4

Telephone: +1.604.681.2030  
Facsimile: +1.604.683.9164