

Oxidized White Liquor (OWL)

Higher Pulp Viscosity

Oxidation of white liquor (OWL) allows utilization of the caustic in white liquor for a variety of applications. Use of OWL avoids purchase of fresh caustic and helps mills maintain correct sulfidity and soda inventory.

The white liquor can be partly oxidized (POWL) to thiosulphate, or nearly fully oxidized (FOWL) to sulphate. POWL can be used in Oxygen Delignification, in the Eo bleaching stage, and in SO₂ scrubbers. FOWL can be used in the Eop and OP bleaching stages. Use of FOWL in O₂ Delignification improves the effectiveness of the oxygen, by eliminating side reaction with thiosulphate.

Features and benefits

- Proven low Na₂S residual with resulting higher O₂ Delignification pulp viscosity.
- High O₂ utilization reducing operating costs.
- A unique, compact, single unit, fully instrumented design for quick and easy installation.
- Low operating temperature and superior metallurgy thereby operating outside regions normally associated with caustic stress corrosion cracking.

Typical values

POWL (Partially Oxidized)

Oxidation of Na₂S to Na₂S₂O₃

- 110°C operating temperature
- <5% conversion to SO₄
- <1.0 g Na₂S/L residual
- 10 minutes residence time
- >90% O₂ consumed
- ~11-15 lb O₂/T pulp

FOWL (Fully Oxidized)

Oxidation of Na₂S to Na₂SO₄

- 125°C operating temperature
- 80% conversion to SO₄
- ≤ 0.5g Na₂S/L residual
- 30 minutes residence time
- >90% O₂ consumed
- ~22-26 lb O₂/T pulp

Modular design

Based on technology developed by Air Liquide, NORAM's unique Reactor design consists of one fully assembled unit with a small footprint, which is ready to hook up to mill services. Contained within the unit are the agitator and cooler. The unit is constructed of superior alloy for excellent corrosion resistance.

The self-aspirating agitator is designed for years of low power continuous service. It utilizes >93% purity O₂. Gases are internally recycled, reducing consumption. Intense agitation overcomes the rate-limiting step of O₂ transfer into the liquid phase, allowing a smaller reactor volume.

With the cooler including within the reactor shell, a lower operating temperature can be maintained. This has a number of benefits including: less tendency towards caustic stress corrosion, no Ca Scale, and minimized side reactions to sulfate.

Proven mixing technology

- Reference plants operating for several years.



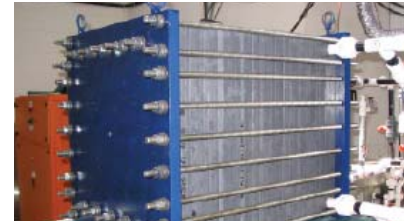
technology and engineering solutions for the process and resource industries



Nitration



Sulfuric Acid



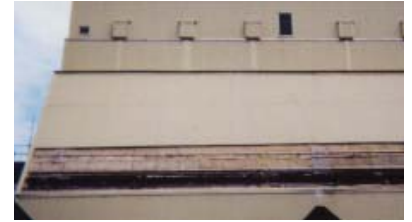
Electrochemical



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.

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