

FEATURES AND BENEFITS

- Proven low Na_2S residual with resulting higher O_2 Delignification pulp viscosity.
- High O_2 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.

WHITE LIQUOR OXIDATION

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 SO_2 scrubbers. FOWL can be used in the Eop and OP bleaching stages. Use of FOWL in O_2 Delignification improves the effectiveness of the oxygen, by eliminating side reaction with thiosulphate.

TYPICAL VALUES

POWL (Partially Oxidized)

- Oxidation of Na_2S to $\text{Na}_2\text{S}_2\text{O}_3$
 - 110°C operating temperature
 - <5% conversion to SO_4
 - <1.0 g $\text{Na}_2\text{S}/\text{L}$ residual
 - 10 minutes residence time
 - >90% O_2 consumed
 - ~11-15 lb O_2/T pulp

FOWL (Fully Oxidized)

- Oxidation of Na_2S to Na_2SO_4
 - 125°C operating temperature
 - 80% conversion to SO_4
 - $\leq 0.5\text{g}$ $\text{Na}_2\text{S}/\text{L}$ residual
 - 30 minutes residence time
 - >90% O_2 consumed
 - ~22-26 lb O_2/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 O_2 . Gases are internally recycled, reducing consumption. Intense agitation overcomes the rate-limiting step of O_2 transfer into the liquid phase, allowing a smaller reactor volume.

With the cooler included within the reactor shell, a lower operating temperature can be achieved. 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.

NORAM Engineering and Constructors Ltd.



COMPANY PROFILE

NORAM is an engineering and technology development firm based in Vancouver, Canada. Founded in 1988, NORAM employs a highly qualified technical staff of approximately one hundred. NORAM has a global client base and has successfully completed projects on five continents.

Today NORAM is the world's leading supplier of mononitrobenzene (MNB) plants, a key intermediate in the production of polyurethane. In addition, NORAM offers sulfuric acid equipment, biological treatment facilities, energy systems, and technologies for the chemical, minerals processing, environmental, and pulp & paper industries.

NORAM offers proprietary technology to customers through engineered equipment and complete chemical plants. NORAM's core competencies include:

- Biological Treatment Technologies
- Electrochemical Systems
- Energy Systems
- Environmental Technologies
- Feasibility Studies
- Fluid Dynamics & Finite Element Analysis
- Heat Transfer Systems Design
- Nitration Technology
- Project Management
- Pulp & Paper Technologies
- Sulfuric Acid Manufacture

PARTNERING WITH INNOVATION AND EXPERIENCE

NORAM is focused on the development, commercialization and supply of established and novel processes. With its entrepreneurial culture, NORAM has a demonstrated track record of thinking outside the box to provide innovative solutions. Technologies can be evaluated and integrated into an advanced engineering solution based on first principles.

NORAM has made its mark internationally by supplying proprietary systems to various industries world-wide. NORAM can bring this expertise and innovative ideas to your projects.

NORAM has established strategic relationships with the following organizations:

- ◆ Bateman Engineering BV
- ◆ Canadian Hydrogen and Fuel Cell Association
- ◆ Eco-Tec
- ◆ First Chemical Corporation (A DuPont Company)
- ◆ FP Innovations
- ◆ Kemetco Research Inc.
- ◆ Membrane Reactor Technologies
- ◆ Ostara Nutrient Recovery Technologies Inc.
- ◆ Radient Technologies
- ◆ Siloxy Limited
- ◆ Simon Carves Limited (Punj Lloyd Group)
- ◆ The Electrosynthesis Company

NORAM Engineering and Constructors Ltd.
Suite 1800 - 200 Granville Street
Vancouver British Columbia Canada V6C 1S4
Telephone: +1 604.681.2030
Fax: +1 604.683.9164

Visit us on the internet at
www.noram-eng.com