

Port Edwards Membrane Conversion Evaluation

Great Lakes Bi-National Toxics
Strategy Mercury Workgroup
December 6, 2006

Agenda

- ✔ Introduction
- ✔ Chlorine Production Technologies
- ✔ Port Edwards Plant Overview
- ✔ Membrane Conversion Evaluation
- ✔ Questions

Chlorine Production Technologies

Electrochemical Reactions



Cell Technologies

- ▼ Mercury
- ▼ Diaphragm
- ▼ Membrane

Mercury Cells

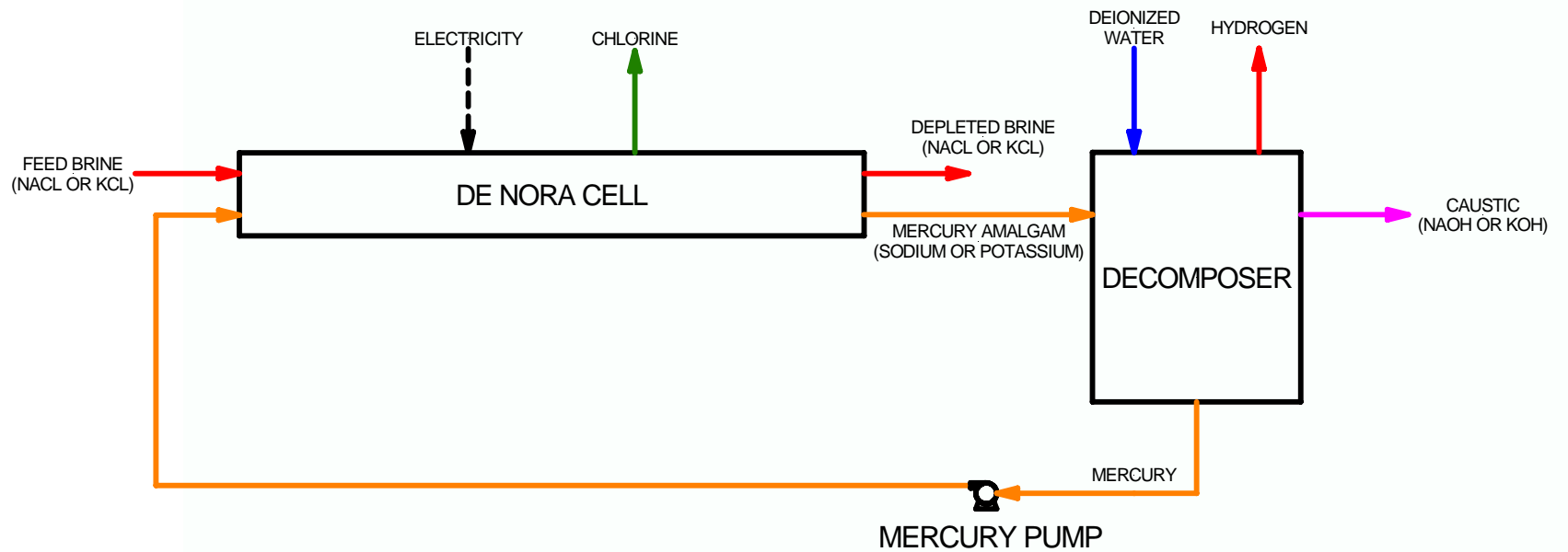
▼ Advantages

- Lower brine purity requirements
- High purity NaOH and KOH product
- NaOH and KOH produced directly at 50% concentration

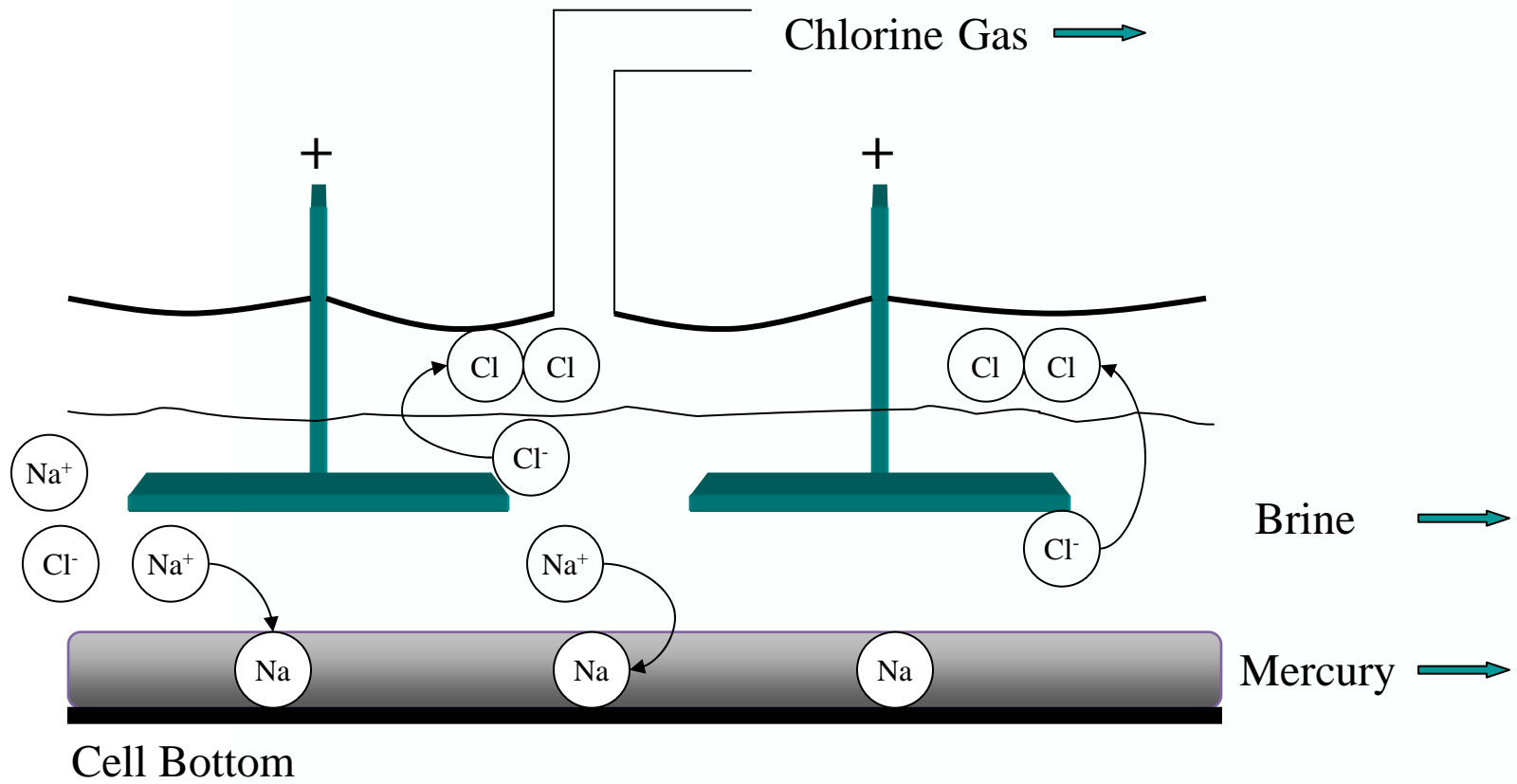
▼ Disadvantages

- Highest power consumption
- Mercury Emissions

Mercury Cell



Mercury Cell Operation



Diaphragm Cells

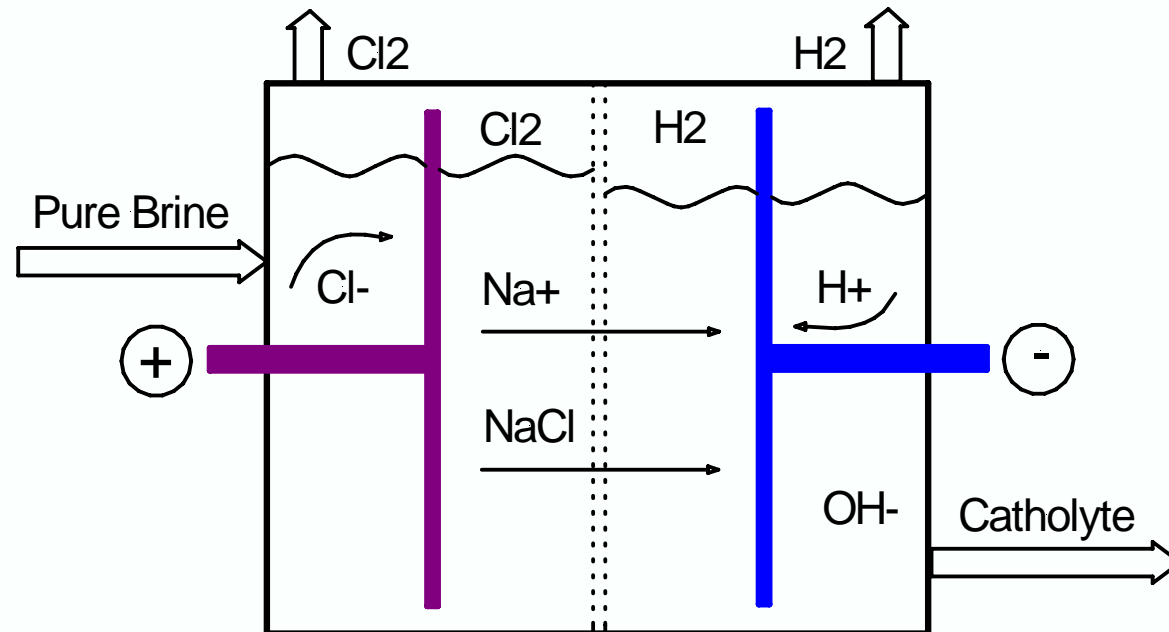
▼ Advantages

- Lower brine purity requirements than membrane cells
- Lower power consumption than mercury cells
- Simpler cell equipment than mercury cells

▼ Disadvantages

- NaOH and KOH produced at ~25% concentration
- Solid salt produced during evaporation
- Low product purity
- Asbestos traditionally used for diaphragm

Diaphragm Cell



Membrane Cells

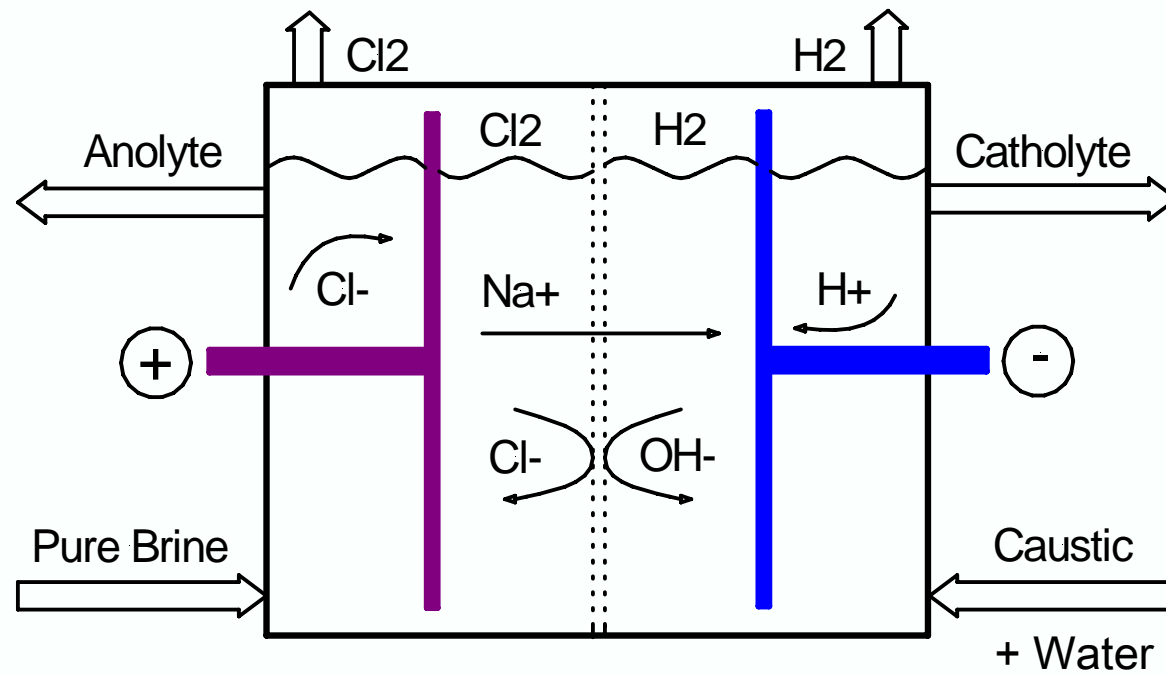
▼ Advantages

- Lowest power consumption
- High purity NaOH and KOH product
- No mercury or asbestos emissions

▼ Disadvantages

- Significantly higher brine purity requirements
- NaOH and KOH produced at ~30% concentration
- Capital cost

Membrane Cell



North American Mercury Cell Plants

- ✓ 33 plants closed
- ✓ 5 converted
- ✓ 7 currently expected to operate past 2008

Port Edwards Plant Overview

Site Information

- ✔ Built in 1967
- ✔ Formerly owned by Vulcan Chemicals, BASF, and Wyandotte Chemicals
- ✔ DeNora Mercury Cells
- ✔ 34 Acres
- ✔ 81 Employees
- ✔ 38+ Years without a Lost Work Case

Port Edwards Products

- ✓ Chlorine (Cl_2)
- ✓ Caustic Soda (NaOH)
- ✓ Caustic Potash (KOH)
- ✓ Hydrochloric Acid (HCl)
- ✓ Potassium Carbonate (K_2CO_3)

Chlorine (Cl₂)

- ✓ Purification of water
- ✓ Refrigerants
- ✓ PVC / Plastics
- ✓ Polyurethane ingredients
- ✓ Chlorinated solvents
- ✓ Bleach
- ✓ Medicines

Caustic Soda (NaOH)

- ✓ Vegetable oil refining
- ✓ Process fruits & vegetables
- ✓ Paper pulp
- ✓ Detergents / soap
- ✓ Petroleum refining
- ✓ Bleach

Caustic Potash (KOH)

- ✓ Detergents / soaps
- ✓ Alkaline batteries
- ✓ Fertilizers
- ✓ Aqueous paint strippers
- ✓ De-icing chemicals
- ✓ Potassium carbonate
- ✓ Computer chips

Hydrochloric Acid (HCl)

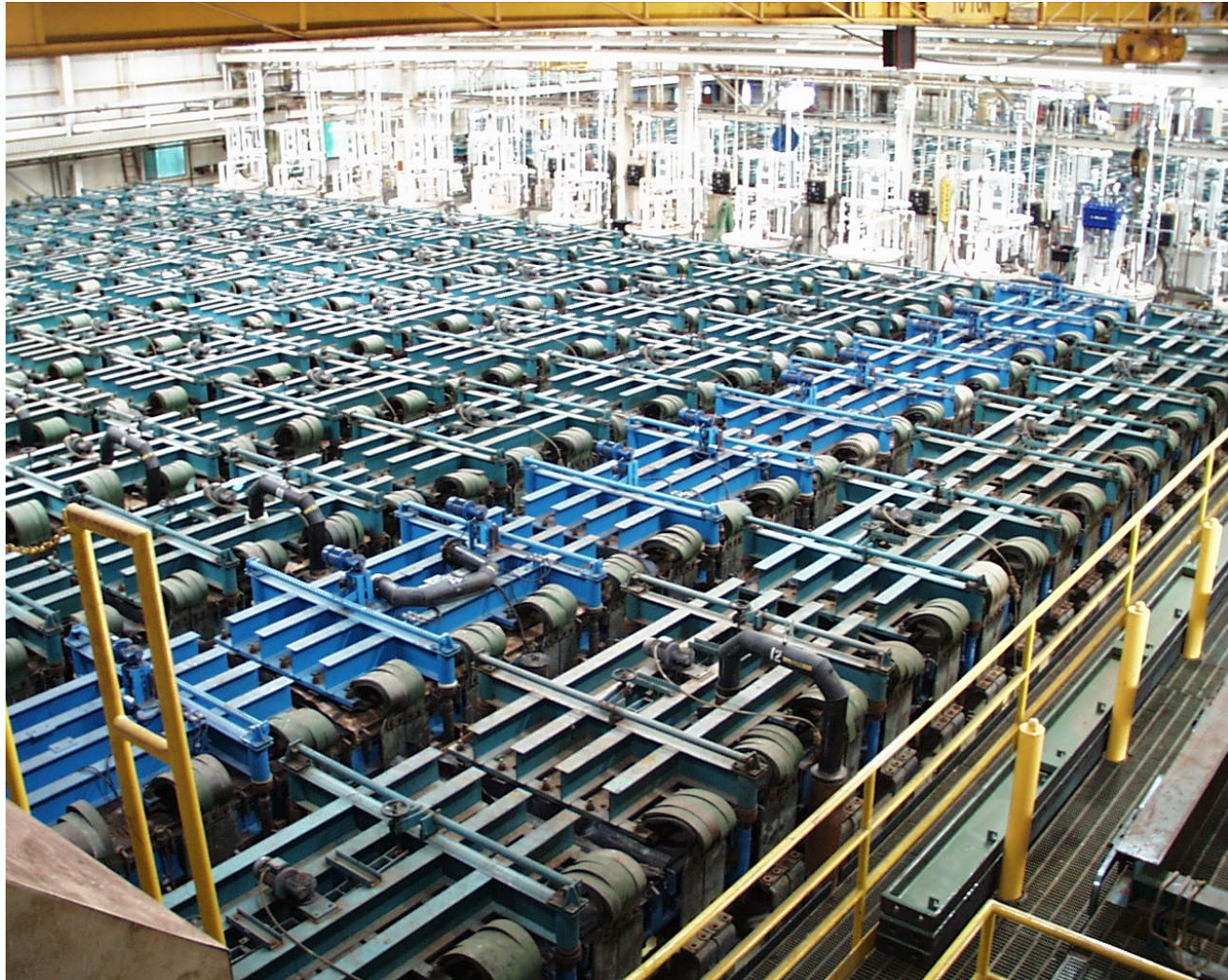
- ✓ Acidizing oil wells
- ✓ Chemical intermediate
- ✓ Ore reduction
- ✓ Food processing
- ✓ Pickling & metal cleaning
- ✓ pH adjustments

Potassium Carbonate (K_2CO_3)

- ✓ Quality glass -TV & computer
- ✓ Rubber antioxidants
- ✓ Liquid detergents
- ✓ Fertilizers & herbicides
- ✓ Pharmaceuticals
- ✓ Cattle feed



Existing Cell Room



Mercury Emissions

- ✔ Approximately 1300 pounds/year emitted to the environment
- ✔ 25% of the reported emissions in Wisconsin
- ✔ #1 emitter of mercury in Wisconsin

Membrane Conversion Evaluation

Conversion Challenges

- ✓ KOH and NaOH Production
- ✓ Plot Plan
- ✓ Capital Cost
- ✓ Financial Justification

Port Edwards Conversion History

- ✓ 1988 – Conversion and 140% Cl₂ expansion dropped due to elimination of chlorine bleaching in the paper industry.
- ✓ 1998 – Conversion and 70% Cl₂ expansion dropped when developing state mercury cap and trade regulations for mercury excluded chloralkali.

Port Edwards Conversion History

- ❖ 2000 – Evaluated purchase of used cell room from the Holtrachem facility in Acme, NC for NaOH production. The project was dropped after another plant purchased the cells for spare parts.
- ❖ 2005 – Current project initiated using 1998 estimate as a starting point and reducing the capacity expansion.

Key Modifications

- ✓ Membrane Cells
- ✓ Brine Mercury Treatment
- ✓ Secondary Brine Filtration
- ✓ Brine Ion Exchange
- ✓ Brine Chlorate Destruction
- ✓ Brine Chemical Dechlorination
- ✓ Brine Sulfate Removal

Key Modifications

- ✓ Evaporation
- ✓ Boiler
- ✓ Cooling Tower
- ✓ Water Deionizer
- ✓ Chlorine Emergency Vent Scrubber

Project Justification

- ✔ Increase Power Efficiency by 30%
- ✔ Reduce Annual Fixed Costs
- ✔ Capital Avoidance
- ✔ Increase Capacity
- ✔ Environmental Benefits

Community & Agency Contacts

- ✓ US EPA
- ✓ WDNR
- ✓ Wisconsin Department of Commerce
- ✓ State and Federal Legislative Contacts
- ✓ Alliant

Project Status

- ✔ Design and estimate complete
- ✔ Capital cost is \$70MM - \$80MM
- ✔ Title V air permit containing one year MACT extension has been issued
- ✔ Public Service Commission considering special rate request required to provide affordable and stable power pricing

Project Status

- ✔ Presented project to Superior Plus board
- ✔ Over \$700,000 and 9,000 manhours spent to date on study
- ✔ Expect to spend \$1MM to complete the study
- ✔ Awaiting Public Service Commission Ruling

Project Schedule

- ✓ Expect Public Service Commission ruling by year end
- ✓ Expect start up would occur 2 to 2-1/2 years after board approval

Questions?