## Professional Practical Experience

Optimum Water Technologies management and technical team understand the electrochlorination business. With an average of 15-20 years of experience in design, development, engineering, installation, commissioning, and technical support, each member of Optimum Water Technologies' team is dedicated to serving our valued clients.

## Spares and Service

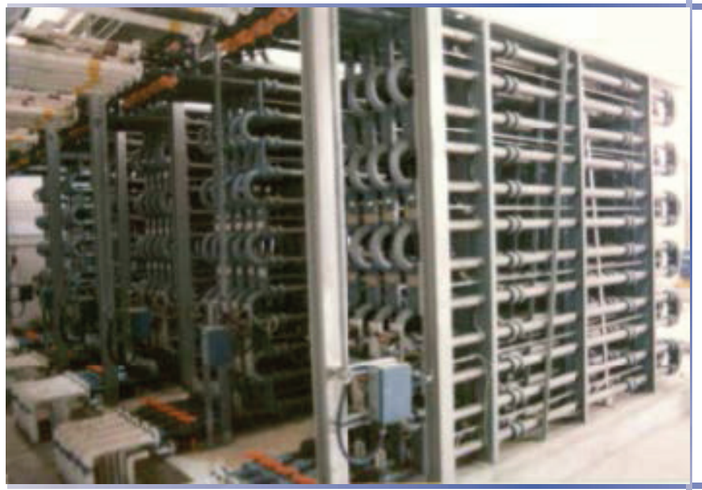
In addition to supplying new systems, Optimum Water Technologies supplies cost effective support to existing electrochlorination plants, including:

Electrolyzer Replacement – OPTIChlor® can replace existing competitor systems for low capital cost, lower maintenance cost and continuous operation.

Spare Cell Components – Optimum Water Technologies supplies competitively priced OPTIChlor® spare parts as well as spares for other systems, including parallel plate cells and tubular cells.

Anode Coating – Optimum Water Technologies' affiliated company, Optimum Anode Technologies, is a leading supplier of anode coating and plating through its modern facility located near Los Angeles, California.

Commissioning and Technical Support – Our team of experienced service engineers has the knowledge and experience to commission systems that solve complex technical problems.



For more information about Optimum Water Technologies products and services or to request a no-obligation price quotation, we invite you to visit us at: www.optimumwater.com.sg or Email: info@optimumwater.com.sg

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OWT-3013

OPTIMUM WATER TECHNOLOGIES™

# Optimum Water Technologies Effective Biofouling Management for Land-based and Offshore Facilities

Our precious planet is more than 2/3 covered by water. This provides for an abundant supply of inexpensive cooling water for coastal power plants, desalination, chemical plants, and offshore facilities. Yet, plant managers, engineers, and operators face the challenge of keeping the cooling systems from being attacked by bio-species lingering in the seas and oceans. Macro-fouling (mussels, clams, oysters) and micro-fouling (bacteria, slime, algae) form deposits on condenser tubes, heat exchange surfaces, and piping systems resulting in unexpected plant shutdowns and losses in production.

Chlorine can be used to kill such species before the seawater enters the process. However, gaseous chlorine is a lethal chemical and requires strict safety and regulatory compliance. Sodium hypochlorite (often referred to as bleach or hypochlorous acid in solution), as a biocide or disinfectant, is accepted around the world as a proven and effective means of treating water and is a safer and more cost-effective alternative to using chlorine gas. Sodium hypochlorite, in low concentrations, is safe and can be handled nearly as easily as water. However, transportation of sodium hypochlorite can be expensive and when stored, the product degrades over time to reduce its effectiveness. Electrochlorination (EC) is the process of generating sodium hypochlorite on site using mainly salt, electricity, and water in the exact quantity needed for effective bio-fouling control.

Optimum Water Technologies' business focus is to help you in managing your plant cooling system biofouling by offering electrochlorination products and services for safe, reliable and effective seawater treatment. Our dedicated team of hands-on managers, engineers and technicians each have over 15 years of electrochemical experience working with land-based and offshore systems.

## Chlorine on Demand

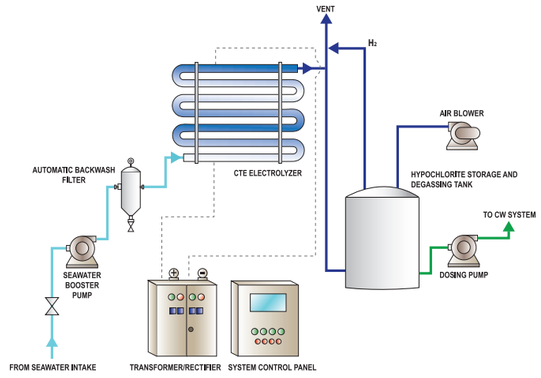
Optimum Water Technologies' CTE System utilizes reliable yet cost effective and proven electrochlorination technology to provide maximum life cycle cost for power plants, chemical plants, desalination plants and offshore installations.

The process concept of the Optimum Water Technologies System involves the electrochemical production of sodium hypochlorite solution (NaOCl) and hydrogen gas ($H_2$) achieved by passing a DC current through nascent seawater at a defined flow rate and current concentration in an un-separated cell. This process yields the desired sodium hypochlorite concentration (typically 1500-2000 ppm) efficiently and economically.

The seawater flows from the seawater intake system into a prefilter to remove shells and suspended solids and protect the downstream equipment. The **Seawater Booster Pump** provides sufficient head to overcome the pressure drop in the backwash filter, electrolyzers and the piping components. An **Automatic Backwash Filter** removes debris and contaminants that can potentially damage the surface of the electrodes or cause cell blockage.

The CTE Electrolyzer is specifically designed for the efficient electrochemical conversion of seawater salt to sodium hypochlorite. Each electrolyzer module consists of a number of titanium concentric tube anode/cathode pairs connected in a bi-polar assembly to produce a dilute NaOCl solution. The seawater is fed to the annular space between the tubes at a constant flow rate. A small amount of hydrogen gas is produced as a by-product of the reaction.

The **Hypochlorite Storage and Degassing Tank** removes the hydrogen gas from the liquid and the **Air Blower** provides positive venting of the hydrogen gas and air mixture to a safe location and to maintain the hydrogen concentration well below the lower explosive limit. A **Transformer/Rectifier** converts alternating current to direct current to enable the operator to vary the production simply by adjusting the current from the **System Control Panel.** The hypochlorite product is then pumped to the dosing points using the **Continuous Dosing Pumps** and the **Shock Dosing Pumps.**




# Concentric Tube Electrolyzer (CTE) Self-Cleaning Technology for Continuous Operation without Acid Cleaning

## CTE Features and Benefits

### *Continuous, Flexible, and Safe Operation*

- Designed to provide uninterrupted chlorine production with only routine maintenance inspection
- Match product concentration to dosing demand by varying current at constant seawater flow rate
- Available for hazardous area classifications (ATEX, DSEAR, IEC)

### *Self-Cleaning Electrodes – No Acid Cleaning*

- High velocity turbulent flow through the cells prevents formation of calcareous deposits without acid cleaning
- Clean electrodes result in consistently low power consumption throughout the life of the cells

### *Easy Maintenance*

- Cell modules can be maintained while the rest of the system is on-line
- Individual cell components can be replaced in-situ within minutes without needing special maintenance tools, welding, or hydrotesting

### *Proven Anode Coating Technology*

- Choice of Optimum Anode Technologies' ruthenium based mix metal oxide coating for low power consumtium or Pt/Ir coating for maximum durability in cold water and/or areas of high seawater impurities

### *Corrosion Resistant Materials*

- Cells manufactured with all titanium electrodes, ABS fittings, PVC spacers, and FED/EPDM gaskets for long life

### *Precision Manufacturing*

- Cell components manufactured to precision tolerances
- Titanium cell flanges manufactured by rolling (not stamping) to minimize stress corrosion cracking and eliminate leaks

### *Proven System Integrity*

- Complete electrolyzers assembled and tested for mechanical, hydraulic, and electrical integrity

## CTE Electrolyzer Design Data

| | |
|---|---|
| Cell Type | Concentric Tube Bipolar |
| Design Temperature | 50°C (122°F) |
| Design Pressure | 10 Bar (150 psi) |
| Product Concentration | 800-2000 ppm Cl2 |
| Seawater Flowrate per Cell | 5-6 m3/hr (22-26 gpm) |
| Current Density | 1.5-3.5 kA/m2 |
| Cells per Module | Up to 24 |
| Enclosure Material | SS or FRP |
| Anode Material | ASTM SB-338 Gr.2 |
| Anode Coating | Ru(MMO), Pt/Ir or Pt |
| Cathode Material | ASTM SB-338 Gr.2 |
| Cathode Coating | None |
| Cell Fittings/Piping | ABS or PVC |
| Gaskets/O-Rings | EPDM or FEP/EPDM |