Offshore Hypochlorite Generation

Biofouling Control: Water Flood, Cooling Water, Fire Water Loops
The purpose of onsite generation of sodium hypochlorite solution from seawater is to economically and safely produce this powerful biocide and disinfecting agent in offshore applications.

When injected into the cooling water circuits, onsite generated sodium hypochlorite solution provides efficient protection to the equipment against the growth of organic fouling (micro and macro). This occurs without the undesirable side effects of commercial hypochlorite (such as the buildup of hard deposits by reaction of excess alkalinity with the substances dissolved in water) or the safety hazard connected with the transportation, storage and handling of chlorine gas. Because this technology eliminates dependency upon outside suppliers and the heavy costs of purchased commercial products, it finds application in a broad spectrum of offshore facilities requiring biofouling control of water systems.

SANILEC®/SEA CLOR® for the on-site generation of hypochlorite from raw seawater have demonstrated reliable, economic and low maintenance operation in numerous installations throughout the world.

**Chemistry**

The process is based on the partial electrolysis of sodium chloride contained in raw seawater. The seawater enters into the SANILEC/SEA CLOR electrolyzer, equipped with electrodes energized under direct anodic and cathodic current. In this condition the aqueous solution of sodium chloride (NaCl), which is completely dissociated as Na+ ion and Cl- ion reacts at the anode to generate free chlorine.

Successive chemical reactions take place in the seawater among the products of the electrolysis: the OH- ions migrate from the cathodic area and react with Na+ and Cl2 near the anode, which produces sodium hypochlorite (NaOCl) and hydrogen.

This overall chemical reaction can be expressed as follows:

\[ \text{NaCl} + \text{H}_2\text{O} \rightarrow \text{NaOCl} + \text{H}_2 \]

**Process Description**

Pressurized seawater is delivered to the SANILEC/SEA CLOR System where it is strained to 0.8mm to remove suspended solids. The seawater passes through a manual valve, a flow orifice (passive type) and a flow transmitter that provides local indication and low flow shut down. The seawater then passes through the electrolyzer cell and exits the cell as sodium hypochlorite solution and byproduct hydrogen gas.

The solution then passes through a tank or cyclone to separate the hydrogen. The hydrogen is diluted with air using a blower to a safe level. The hypochlorite is then injected at a fixed flow rate with variable concentration to provide proper biofouling control to seawater systems.

**Dosing Schemes**

**Small Capacity Unit:**
- Continuous dose – fixed flow; 50% capacity
- Shock dose – fixed flow; 100% capacity

**Large Capacity Unit:**
- Continuous dose – fixed flow; 100% capacity
- Shock Dose – double flow; 200% capacity (Turn on standby unit)
Sodium Hypochlorite Generator Cells

Severn Trent De Nora is a joint venture between Severn Trent Services (formerly Exceltec/Eltech Systems) and the Seaclor division of Gruppo Denora. The parent companies developed the SANILEC and SEACLOR technologies. SANILEC and SEACLOR electrolyzer cells generate over 1,000,000 kg/h of sodium hypochlorite in installations throughout the world. Severn Trent De Nora (STDN) offers three different mechanical configurations of electrolyzer cells. STDN will select the best cell configuration for the application. When selecting a cell configuration we consider the application, seawater characteristics, cost, size, weight, pressure, maintenance and historic preference.

SANILEC® Tube Type | SANILEC® Plate Type | SEACLOR® Cells

SC288 (Front View) | SC288 (Rear View, Cell Cover Removed)
Fire Water Systems
Offshore facilities that use seawater for their Firewater System must consider Biofouling. Mussels and algae can restrict the intake to firewater and jockey pumps. Restrictions in flow can compromise the performance of this vital safety equipment. STDN will supply a skid-mounted package that provides a shock dose of sodium hypochlorite at set intervals to the firewater pump caisson, and a continuous dose of sodium hypochlorite to the jockey pump caisson. The shock dose keeps the firewater pump caissons clean and free from macrofouling. The continuous dose maintains the Firewater Main Loop algae and slime free.

Cooling Water
In any marine application where seawater is used for cooling, biofouling must be considered. The buildup of marine growth reduces efficiency, decreases the time between required maintenance and shortens the life of the process equipment. STDN provides a skid-mounted package that receives pressurized seawater and produces sodium hypochlorite at a concentration of 40 to 1660 ppm. Sodium hypochlorite can be injected at any point within the vessel to control marine growth. The product can be varied 0-100 percent to maintain the desired residual.
System Capacity:
12-288 lbs/day (0.22-5.4 Kg/h)

Area Classification:
Class 1, Division 2 Group C, D (certified by NRTL)

Environmental Rating:
40°C, salt laden, 100% humidity

Hydrogen:
Includes hydrogen separation and dilution systems

Direct Injection Discharge Header:
Single Point

Approx. Weights:
Shipping: 2041 Kgs  Operating: 2151 Kgs

L = 2.5M
W = 1.2M
H = 2.5M

System Capacity:
2.8-8.4 lbs/day
(0.05-0.16 Kg/h)

Area Classification:
Safe Area

Environmental Rating:
35°C (max), indoor rated

Hydrogen:
Direct Injection

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<th>Model</th>
<th>Amount of Seawater to be Treated @ 2ppm m3/h</th>
<th>Amount of Seawater to be Treated @ 0.5ppm m3/h</th>
<th>System Output Rating kg/h</th>
<th>Lbs/Day</th>
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<th>Max Cl2 ppm</th>
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Water Flood
In a typical water flood package sodium hypochlorite is used to restrict marine growth in the seachest, condenser, heat exchanger and downhole. Reduced marine growth in the condenser and heat exchanger can increase efficiency and significantly reduce the requirement for maintenance. Sodium Hypochlorite injected with the seawater in downhole applications can prevent slime and marine growth in the oil bearing substrate.

Water Flood Application
System Capacity:
960-2400 lbs/day (18.1-45.4 Kg/h)

Area Classification:
Class 1, Division 2 Group C, D
(Certified by NRTL)

Environmental Rating:
40°C, salt laden, 100% humidity

Hydrogen:
Includes hydrogen separation and dilution system

Discharge Header:
Gravity Feed

Approx. Weights:
Shipping: 6347 Kgs
Operating: 8400 Kgs

Continuous Dosage Capacity:
192-384 lbs/day (3.6-7.3 Kg/h)

Shock Dose Capacity:
(7.2-14.4 Kg/h) both trains

Area Classification:
Class 1, Division 2 Group C, D or safe
(Certified by NRTL)

Environmental Rating:
40°C, salt laden, 100% humidity

Hydrogen:
Includes hydrogen separation and dilution system

Discharge Header:
Up to 15 Barg

Approx. Weights:
Shipping: 7030 Kgs
Operating: 7484 Kgs

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<th>System Output Rating kg/h Lbs/Day</th>
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**Standard Unit**
- Y-strainer
- Manual Isolation Valve
- Flow Orifice
- Pressure Indicator, 2 1/2"
- Flow Switch
- Electrolyzer cell
- No Hydrogen Separation Equipment
- Visual Flow Indicator
- PVC Piping and Valves
- Transformer
- Control/Rectifier panel
  - PLC (AB1200)
  - MMI (AB300)
  - Rectifier Circuit
  - Main Circuit Breaker
  - Main Contactor
  - No Motor Starters
  - Seawater Cooled Rectifier
- NEMA 4X Enclosure

**Inlet Options**
- Cu/Ni Inlet Piping
- High Pressure Regulator
- Duplex Basket Strainer
- Automatic On/Off Valve
- Flow Transmitter
- Pressure Indicator, 4 1/2"
- CPVC Piping and Valves
- FRP Piping

**Outlet Options**
- Cyclone
- Vent Stack
- Blowers
- Degas Tank
- Dosing Pumps
- Level Control Valve
- Dosing Header(x4)

**Control/Rectifier Panel Options**
- Air Cooled Rectifier
- NEMA 3R Enclosure
- NEMA 7 Enclosure
- PLC(AB-SLC5/04)
- MMI(5" Color)
- Blower Motor Starters
- Dosing Pump Motor Starters

**General Options**
- Class 1, Div 2, Group C/D rated
- Custom Painting
- 2 x 100% Trains
- 2 x 50% Trains
- Chemical Cleaning System
- Skid Coaming
- Severe Temperature Rating
- Sunshield

**HMA-POGC**
(Australasia Official Representative of Severn Trent De Nora)
Contact: Glenn Chow
Tel: 02 9428 7355 | Mobile: 0409 923 515
Email: gchow@hmagroup.com.au