ON-SITE SODIUM HYPOCHLORITE GENERATION

2018 OREGON OPERATORS CONFERENCE

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PSI On-Site Disinfection
A UGSI SOLUTIONS COMPANY

WECI
Whitney Equipment Company, Inc
Basic Disinfection Methods

1. Ozone
2. UV

3. Chlorination
   - Chlorine Gas
   - Bulk Sodium Hypochlorite
   - Calcium Hypochlorite Tablets
   - On-Site Generation of Sodium Hypochlorite
Equivalent Values of Chlorine Forms

1 Pound of chlorine gas

= 

1 gallon 12% solution sodium hypochlorite solution

= 

1.55 pounds calcium hypochlorite (65%)

= 

15 gallons 0.8% sodium hypochlorite “On-Site” solution
On-site Sodium Hypochlorite Generation
On-site Sodium Hypochlorite Generation

- Basic Operating Theory
- Characteristics of 0.8 % Sodium Hypochlorite
- Design Recommendations
- Cost Analysis Information
On-site Sodium Hypochlorite Generation

- Produces 0.8% Hypo At Point of Use
- Originally Introduced In 1930s
- Significantly improved in the 1970s
- Continually being improved
Principal of Operations

- Salt
- Water
- Electricity

\[ \text{NaCl} + \text{H}_2\text{O} + 2E = \text{NaOCL} + \text{H} \]

\[ 3 \text{ lb} + 15 \text{ gals.} + 2 \text{ KwH} = 0.8\% \text{ NaOCL} \]
500 PPD (Factory Testing)
1,000 ppd system in operation
PROCESSES ARE THE SAME
Water is sent through a twin tank softener to remove calcium.
Dual tank units are used for...
The softened water is fed to a brine tank.
80 gallon/800 pound HDLPE brine tank
200 gallon/2000 pound salt storage tank
500 gallon/5000 pound brine tank
4000 gallon/40,000 pound FRP tank with pneumatic fill system
A single truck can deliver up to 40 tons per single load.
Brine is then fed at a given ratio based on system capacity 1 part brine for every 10 parts fresh water.
Based on system capacity a speed adjustable gear pump is used to deliver brine solution.
Depending on water temp a heat exchanger, heater, or chiller is used for providing optimum efficiency.
Many manufacturers use acrylic cells which allows for quick operation analysis.
Clear body allows for visual inspection of the cell and process.
Power supply/Rectifiers are used for providing DC current to cells.
Small rectifier is incorporated into the system skid
Larger rectifiers are installed close by.
Hypo tanks and feed systems come in many sizes and shapes depending on capacity.
HDPE and FRP tanks are used for storing solution.
We recommend 2-3 days of storage capability to get through unforeseen issues

- For example:
  1. 100PPD Facility Demand
  2. 15 Gallons X 100(PPD) = 1500 gallons per day
  3. 1500(GPD) X 3 = 4500 Gallons of on-site storage
Blowers are used to dilute hydrogen to below “Lower Explosive Limits”
Vents are used to purge hydrogen prior to hypochlorite flowing to the storage tanks.
Tank farm outside housing both brine and hypo
Dosing pumps are used to feed hypo
Pumps are mounted on Skids for ease of installation and maintenance
They can also be supplied loose
Systems are based on application and style of pump
Various control packages are available
Industrial PLC are packaged for optimum compatibility.
Displays are custom configured
If an alarm is registered the possible cause and correction(s) are displayed on screen.
Set points are operator selected through the display by using password.
Byproducts

- Hydrogen gas, vented to atmosphere
- 1/35 of a pound Hydrogen per every pound of chlorine equivalent
- Concentration below detectable flame limit
- Brine waste from water softener regeneration
• Day tank can be used with commercial NaOCl

• Concentration difference (0.8% vs 12%) allows 15 day supply

• Redundant tank and dosing pumps assure operational reliability
Operation & Maintenance

- De-Scaling of the electrode from Calcium deposits
- Replacement of water and brine filters
- Storage & Brine tank inspections
- Electrode replacement every 9-10 years depending on use + your salt & water quality
CHARACTERISTICS OF 0.8% HYPOCHLORITE

• Very Stable due to low concentration

• Minor Total Dissolved Solids impact
  For every 1 P.P.M. dose T.D.S is increased by 3 P.P.M

• More effective oxidant than commercial hypo due to Oxidation Reduction Potential (O.R.P) changes of the brine solution as it passes through a conventional cell
Cell Life (Operational Considerations)

- Directly Related to Frequency of Maintenance
- Salt Quality
- Feed Water Temperature
- Feed Water Hardness
RISK MITIGATION

• OSHG Solution < 1.0% HazMat Threshold

• Eliminates Requirement for Dual Containment

• Salt is Only Material Handled

• Can Reduce Formation of carcinogenic compounds
DESIGN CONSIDERATIONS

- OSHG Size Assumes 100% Utilization
- Hypo Tank (15 Gallons of Solution = 1 LB Chlorine)
- Chemical Metering System
- Salt Storage/Briner
### System comparisons

<table>
<thead>
<tr>
<th>Material</th>
<th>Cost</th>
<th>Usage</th>
<th>Operating Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt</td>
<td>$0.04/pound</td>
<td>3.0 pounds</td>
<td>$0.12</td>
</tr>
<tr>
<td>Water</td>
<td>0.003/gallon</td>
<td>15 gallons</td>
<td>$0.04</td>
</tr>
<tr>
<td>Power</td>
<td>0.10/KWH</td>
<td>2.0 KWH</td>
<td>$0.20</td>
</tr>
</tbody>
</table>

Cost for 1 Pound of Chlorine Equivalent: $0.36/pound

Depending upon efficiency of manufacturer selected, cost can vary between $0.36/lb and $0.612/lb.
Including electrode replacement, what is the operating cost on a per pound basis?

Include necessary softeners, storage tanks, metering pumps and instrumentation!

What is the total system cost?

15 – 20 Year Life cycle cost?
Thanks For Your Time

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