Moving Away from Chlorine

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Prein&Newhof
Topics for Today

1. Chlorine in the News
2. Recent Efforts in Michigan
3. Practical Aspects of Conversion from Chlorine Gas
Chlorine in the News

KEY SENATORS PREPARE CHLORINE GAS BILL DESPITE WATER INDUSTRY CRITICISM

Boston Globe Newspaper Company.
Chlorine attacks in Iraq spur warnings in US

Chertoff warns treatment plants about chlorine
BY CAROL EISENBERG | carol.eisenberg@newsday.com

The New York Times

THE REACH OF WAR: 14 More American Servicemen Are Killed in Iraq, Most of Them by Makeshift Bombs

USA Today

Feds to enforce chemical security

Toxic Trains and the Terrorist Threat
How Water Utilities Can Get Chlorine Gas Off the Rails and Out of American Communities
By Paul Orum
April 2, 2007
Recent Efforts in Michigan

- **Gaseous Chlorine Reduction Program**
  - **Supporters**
    - Michigan Department of Environmental Quality
    - U.S. Department of Homeland Security
  - **Purpose**
    - To show the benefits of conversion from gaseous chlorine.
    - To share tools used for converting.
    - To discuss your plans and concerns.
    - To answer your questions.
Chlorine Gas from Train Crash Kills 9
Gaseous Chlorine Presentation

- **Why convert from chlorine?**
  - Public Safety Expectations have changed since 2001.
  - Chlorine gas is a deadly hazard.
    - Heavier than air
    - 2 ppm can cause harm
  - Chlorine releases kill people.
  - Chlorine gas can be a weapon.
Gaseous Chlorine Presentation

- Wastewater Treatment Plants
  - UV disinfection eliminates chlorination and dechlorination
  - Fewer Compliance Issues
    - (PSM, SARA Title 3, OSHA, etc.)
  - Possible operational cost savings
  - No Gas System to Maintain
  - Possible DBP Benefits
Gaseous Chlorine Presentation

- **Conversion Options**
  - Liquid Sodium Hypochlorite
    - Space Requirements (1 ton gas = 2000 gal. liquid)
    - New Pumps, Piping & Tanks
    - pH Issues Possible
    - Scaling Issues Possible
    - Operational issues to be considered
  - Purchased?
  - Site-generated NaOCl?
Gaseous Chlorine Presentation

- Converted Plants in Michigan
  - Converted Wastewater Treatment Plants
    - Wayne County Downriver (Wyandotte)
    - Ypsilanti Community Utilities Authority
    - Ann Arbor
    - Grand Rapids
    - Lansing
    - Chelsea
    - Milan
    - Frankenmuth
    - Allegan
Gaseous Chlorine Presentation

- Converted Plants

Chelsea: Open Channel UV

Milan: Closed Pipe UV
Gaseous Chlorine Presentation

- Converted Plants

Chelsea: Converted Chlorine Tank
Gaseous Chlorine Presentation

- Conversion Options

Muskegon: Sodium Hypochlorite Pumps

Holland: Sodium Hypochlorite Pumps
Gaseous Chlorine Presentation

- Conversion Options

Holland: Day Tank

Muskegon: Day Tank
Frequently Asked Questions

- How much does it cost to convert?

<table>
<thead>
<tr>
<th>Size of Plant</th>
<th>Project Cost Range</th>
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<tbody>
<tr>
<td>Up to 1.0 mgd</td>
<td>$5,000 – $400,000</td>
</tr>
<tr>
<td>1.0 mgd – 5.0 mgd</td>
<td>$100,000 – $1.5M</td>
</tr>
<tr>
<td>Over 5.0 mgd</td>
<td>$0.5M +</td>
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</tbody>
</table>
Gaseous Chlorine Presentation

- Frequently Asked Questions
  - Will the DEQ force utilities to convert?
    - No plans to at this time.
  - What are the experiences of utilities that have converted?
    - Generally positive.
Gaseous Chlorine Presentation

- Frequently Asked Questions
  - What about operational costs?
    - Site Specific
    - Gaseous Chlorine vs. NaOCl
      - 1 ton gas = $800.00
      - 2000 gal NaOCl = $1,400.00
      - 150 lbs gas = $150.00
      - 150 gal NaOCl (55 gal) = $210.00
Gaseous Chlorine Presentation

Homeland Security
Science and Technology Directorate
Homeland Security Advanced Research Projects Agency

Chlorine Gas Decision Tool for Water Utilities
Figure 2. Level of Interest in Gaseous Chlorine Initiative

- Already Converted
- Plan to Convert
- Positive Interest
- Refused to Meet

Water Treatment Plant
Wastewater Treatment Plant
Total
Figure 5. Gaseous Chlorine Inventory

- **150 lb cylinders**
- **ton cylinders**
- **rail cars**

Number of Utilities

- Water Treatment Plant
- Wastewater Treatment Plant
- Total

Prein&Newhof
Figure 7. Alternative Technology Considered

- Hypochlorite - bulk deliver
- Hypochlorite - on site generation
- Ultraviolet
- Ozone
- Combined chlorine
- Chlorine Dioxide
- Mixed Oxidant

Legend:
- Water Treatment Plant
- Wastewater Treatment Plant
- Total
Figure 8. Factors Affecting Change

Regulations
Costs
Other

Number of Utilities

Water Treatment Plant
Wastewater Treatment Plant
Total
Figure 9. Obstacles to Converting
Figure 10. Evaluation Results.
Recent Efforts in Michigan

- **Qualitative Results**
  - More experienced personnel more resistant to change.
  - Concern over lack of regulation of other nearby industries.
  - MDEQ still permits gas chlorine use.
  - Gas chlorine leaks happen.
Recent Efforts in Michigan

- Qualitative Results
  - Less security at smaller utilities.
  - Utilities tracking Chemical Securities Act.
  - Water plants tend to switch to hypochlorite.
  - Wastewater plants tend to switch to UV.
  - Utilities that have made the switch are generally satisfied.
Practical Aspects of Conversion

- UV Conversion
- Water Chemistry/Quality Issues
  - Fixed Film Biological Process
  - Industrial Waste Component
  - Effluent Testing
    - Collimated Beam Test
    - UV Transmittance
      - Grab samples or continuous on-line monitor
Practical Aspects of Conversion

- **Phosphorus Removal**
  - Look at Alternate Chemicals
  - Biological Phosphorus Removal

- **Choosing a Technology**
  - Open Channel vs. Closed Pipe
  - Low Pressure vs. Medium Pressure
  - Horizontal vs. Vertical
  - Bells and Whistles
Conclusion

So what does the crystal ball say about chlorine gas? Future actions by Congress are difficult to predict, but it is very possible that the water sector may no longer be excluded from CFATS. The ability to make a local choice about disinfectants will likely be affected by congressional action, so utilities should start considering potential implications.

Utilities are also encouraged to provide the requested information regarding security practices for hazardous materials via the Web-based survey, continue to monitor the issue, and be prepared to defend their local decision-making ability.

Congressional action likely will not mandate the elimination of chlorine gas, but utilities that make the local decision to continue using chlorine has and other materials of concern will likely have to provide the appropriate physical security measures – as yet undefined – to mitigate potential adverse consequences from tampering and/or theft.

– J. Alan Roberson
AWWA Director of Security & Regulatory Affairs