Sodium Hypochlorite Operating Experiences

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Objectives

1. Water treatment plants & process needs
2. Evolution of the disinfection process
3. System design from an operating perspective
4. Operational challenges
5. Lessons Learned
SW Shores of Lake Michigan
Holland Water Treatment Plant

- 38.5 MGD conventional treatment plant
- Chemical addition, mixing, flocculation, sedimentation, filtration
- Process chemicals: aluminum sulfate, liquid fluoride & sodium hypochlorite
Muskegon Water Treatment Plant

- 40 MGD conventional treatment plant
- Chemical addition, mixing, flocculation, sedimentation, filtration
- Process chemicals: aluminum sulfate, liquid fluoride & sodium hypochlorite
Evolution of Disinfection Process

- Liquid chlorine hazardous and difficult to handle
- PSM, Hazmat Training-Expensive!
- Emergency response equipment-Expensive!
- Tested chlorine tablets, sodium hypochlorite
- Selected sodium hypochlorite
- Holland, Muskegon, & Traverse City first in area to convert to sodium hypochlorite
Evolution of Disinfection Process

Why Sodium Hypochlorite?
Evolution of Disinfection Process

Safety Concerns

- Employees
- Residential area
- Nearby schools
- Heavy recreational use during summer-parks & beaches
- Bordered by bike paths
- Slow initial emergency response
Advantages of Sodium Hypochlorite

- Simplified PSM
- Minimal Hazmat training
- No scrubbers
- No more ton cylinders
- Ease of off loading or unloading
- Less reporting requirements
- Process Stability
System Design

- Ability to meter off loading
- Ability to dilute bulk deliveries
- Proper pump sizing - size matters
- Easy access to controls
- Input/Outputs for SCADA control, monitoring & alarming
System Design

- Ability to easily calibrate pumps
- Ability to easily drain & flush system out
- Chemical flow pacing
- Ability to meter chemical feed rate
- Auto pump stop if incoming flow drops to zero
System Design

- Easy access for maintenance-preventive/reactive
- Chemical tank monitoring-consider scales for day tank monitoring
- Improved chemical containment facilities
- Safety showers & eye wash stations
System Design

Sodium Hypochlorite Feed System
System Design

Chemical Day Tanks
Operational Challenges

- Off gassing-air bound pumps
- Gasket failures
- Burping
- Product stability-storage
- Valve failures, binding
- Bleaching of clothing
Operational Challenges

Leaking joints and fittings
Operational Challenges

- Corrosion of equipment
- Scaling-pipes, meters, pumps
Operational Challenges

Coating failures
Operational Challenges

Case Study-Holland

- Date: July 21, 1998: Chemical mixing incident
- Contractors on-site completing 10 MGD plant expansion
- Tanker delivery of aluminum sulfate scheduled for morning delivery
- Chemical pumped to third floor storage tank
Operational Challenges

Case Study

- Delivery sodium hypochlorite, not alum!
- Chlorine gas vented when 256 gal of sodium hypochlorite reacted with 400 gal of alum
Operational Challenges

Chlorine Gas Damaged Equipment
Chemical spill sends 8 to hospital!

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Staff writer, Holland Sentinel
Operational Challenges

What chemicals could be a problem when mixed with sodium hypochlorite?

- Ferric Chloride
- Fluosilicic Acid (Hydrofluosilicic Acid)
- Alum (Aluminum Sulfate)
Operational Challenges

Case Study - Muskegon

- Carrier water not treated initially
- Lines became blocked
- Pressure increased
- Flow decreased
Lessons Learned

- Daily inspections
- Exercise valves
- Preventive Maintenance
- Proper use of PPE
- Strainers on pump supply
- Improved HVAC systems in chemical storage areas
Lessons Learned

- Improved Alarming
- Improved inventory control
- Improved Labeling
Lessons Learned

- Detailed chemical delivery procedures
- Delivery check off lists
Lessons Learned

Chemical off loading stations
Lessons Learned

- Eliminate threaded joints
- Use of Teflon tape & thread compound
- Viton Gaskets
- Maintain inventory-valves, seals, & PVC pipe
- Stainless hardware
- Installed off loading sampling station
- Label valves-open/close, valve keys
Lessons Learned

- Improved Monitoring
Lessons Learned

- Repositioned chemical meters
Lessons Learned

- Treated carrier water-phosphate
- Flush chemical feed lines on a regular basis
- Flush out unused pumps
- Treat to avoid CaCl buildup in bulk storage tanks
Future Considerations

- Peristaltic pumps
- Beta testing of diaphragm pump with new pump head design
Acknowledgements

Holland Water Treatment Plant Staff

Muskegon Water Treatment Plant Staff