Asplund Wastewater Treatment Facility Disinfection System

Presentation to Assembly Enterprise and Utility Oversight Committee

February 16, 2022

Today's Presentation will:

1. Provide overview of the plant and disinfection system

2. Explain some of the operational challenges with the disinfection system

3. Explain some of the recent time sensitive, critical disinfection system purchases

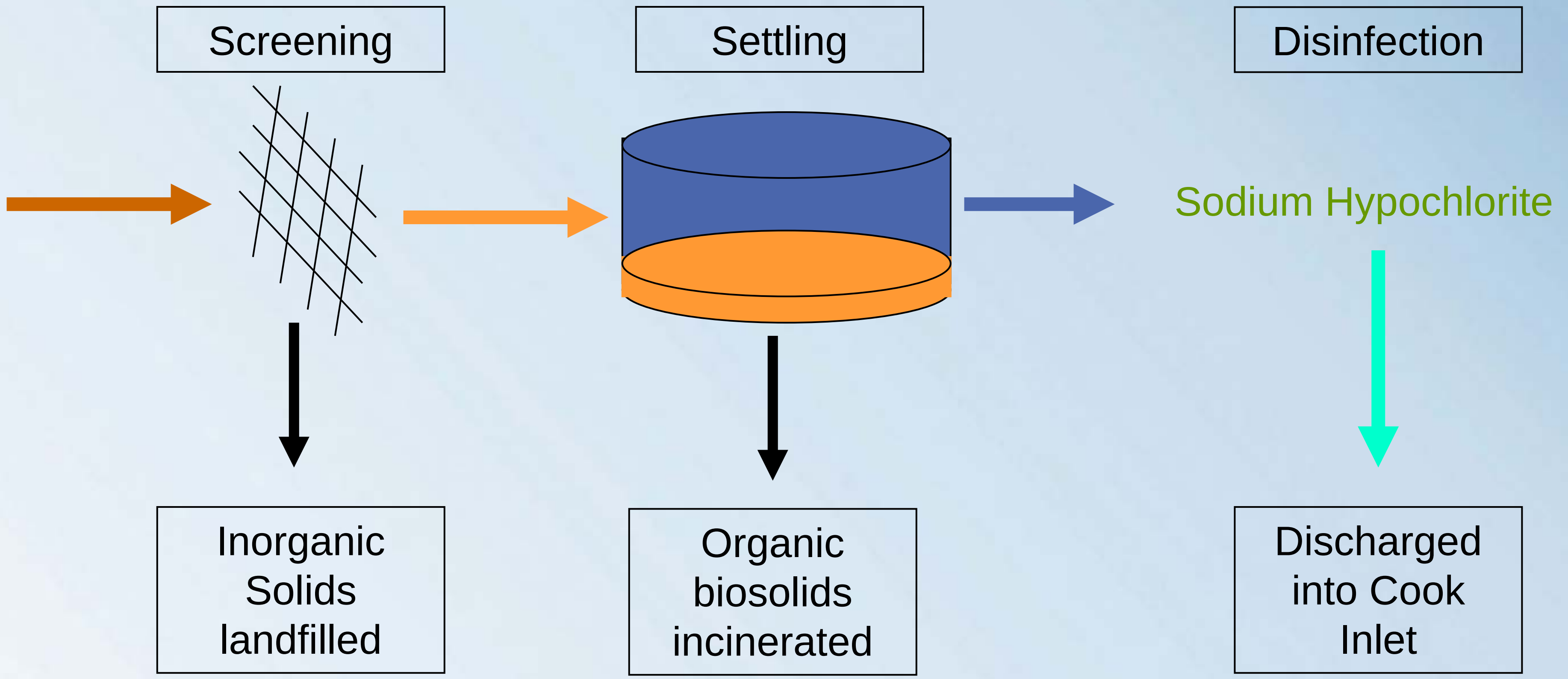
4. Provide notice of what you can expect to see for upcoming Assembly request for the plant and the disinfection system

Asplund Wastewater Treatment Facility

Named for Mayor John M. Asplund, a tireless advocate for wastewater treatment for Anchorage

- Began operations in 1972
- Upgraded in 1989 to 58 MGD capacity, currently operates @ 30 MGD
- Congress added Section 301(h) to Clean Water Act in 1977
- EPA permitted with 301(h) modification in 1985
- EPA reauthorized 301(h) permit in 2000
- AWWU submitted timely application in 2005 and has been on EPA Administration extension since*
- Largest WWTF in Alaska
- AWWU administers an extensive marine monitoring program as a permit condition.
- No adverse environmental impacts.
- *Our permit application process is active & ongoing; updated data & scientific studies are being completed to supplement EPA's anticipated review of the permit application

Asplund WWTF Primary Treatment Process



Treated effluent is discharged 800’ offshore through an outfall diffuser where Cook Inlet tides provide for rapid dispersion.

The Disinfection System is a Mandatory Part of the Wastewater Treatment Process

- Disinfection is the targeted destruction of pathogenic microorganisms

- EPA Discharge Permit Requires Disinfection for pathogen control

  Monthly Avg Permit Limits:

  -850 FC/100mL (fecal coliform)

  -1.2 mg/L TRC (total residual chlorine)

- In the US, water and wastewater disinfection is accomplished almost exclusively by chlorination

- Disinfection system has redundancy, but time is critical for compliant operations due to long lead Items for chemicals and equipment

AWWU Accomplishes Disinfection with On-Site Generated (OSG) Sodium Hypochlorite (aka Bleach)

- Replaced dangerous gaseous chlorine system
- Improved public safety
- Salt + Water + Electricity = Sodium Hypochlorite + Hydrogen gas

The Current Disinfection System at Asplund Has Been in Operation Since April of 2016

- Replaced Chlorine Gas System
- Chlorine gas is a toxic chemical
- US EPA 40 CFR 68 Risk Management Plan requirements absolved
- Reduced Supply Chain Risks and threat to community
- Original construction cost for new system was $19M

OSG Sodium Hypochlorite was Analyzed and has been shown to be the Best Alternative to Meet the Needs of the Community for Disinfection at Asplund

2007 Alternatives Analysis

Table 4: Summary of Equipment and O&M Costs (128 MGD, 12 mg/L CL equivalent as applicable)

	Onsite Generation of 12.5% NaOCl	Onsite Generation of 0.8% NaOCl	Purchased 12.5% Sodium Hypochlorite	Purchased 73% Calcium Hypochlorite	Chlorine Dioxide	UV w/ Integrated Disinfectant	Ozone
Equipment	$ 2,750,000	$ 2,750,000	$ 531,000	$ 969,000	$ 350,000	$ 5,235,500	$ 16,000,000
Annual Equipment O&M	$ 2,250,000	$ 3,282,000	$ 9,782,000	$ 9,439,000	$ 39,700,000	$ 4,398,000	$ 8,500,000
Present Worth	**$ 30,789,973**	$ 43,650,974	$ 122,436,342	$ 118,599,803	$ 495,099,751	$ 60,044,301	$ 121,928,788

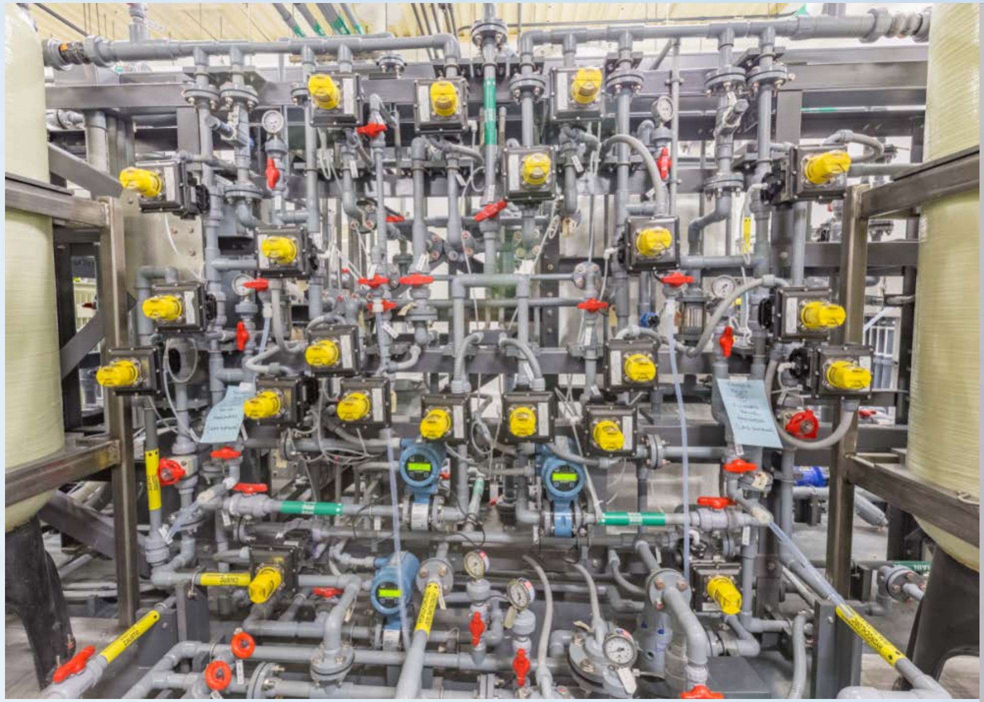
2023 ESTIMATED COSTS FOR HYPO GENERATION EQUIPMENT OPERATING 80% OF THE TIME DURING THE YEAR	2023 ESTIMATED COSTS FOR PURCHASED 12.5% HYPOCHLORITE
Chlorine Feed Rate	Chlorine Feed Rate
AVG = 2266 gpd	AVG = 2266 gpd
$ 3,639,332	$ 5,902,070

Historical Comparison of Operating On-Site Generation vs. Purchase 12.5% Hypochlorite

SUMMARY OF OPERATING COSTS					2022 ESTIMATED COSTS FOR PURCHASED 12.5% HYPOCHLORITE
	YEAR				Chlorine Feed Rate
Description	**2019**	**2020**	**2021**	**2022**	**AVG = 2266 gpd**
Electric Power Costs	$ 144,082	$ 190,090	$ 237,494	$ 242,794	$ 8,050
Mat'ls and O&M Labor (Incl. all Work Orders)[1]	$ 226,647	$ 174,389	$ 210,937	$ 235,604	$ 35,000
Task Orders (PM Services)	$ 1,710	$ 10,845	$ 6,660	$ 29,433	$ -
Replacement Electrolyzers and Capital Investment[2]	$ 314,116	$ -	$ 83,000	$ 314,106	$ -
Plant Operator Labor[3]	$ 224,640	$ 224,640	$ 224,640	$ 224,640	$ 74,880
Chemicals - Salt[4]	$ 366,768	$ 445,020	$ 581,810	$ 629,248	$ -
Chemicals - 15% Caustic[5]	$ 124	$ 62	$ -	$ -	$ -
Chemicals - 15% HCL[6]	$ 133,474	$ 193,362	$ 218,164	$ 324,240	$ -
Chemicals - 38% Bisulfite[7]	$ 17,310	$ 18,523	$ 25,648	$ 75,330	$ -
Chemicals - 15% Sodium Hypochlorite[8]	$ 1,359,208	$ 446,688	$ 224,559	$ 213,522	$ 2,911,885
Process Water Costs[9]	$ 12,347				$ 26,550
Totals	**$ 2,800,426**	**$ 1,703,619**	**$ 1,812,912**	**$ 2,288,917**	**$ 3,056,365**

Operational Goal – Minimize Purchase of Sodium Hypochlorite and Replacement of Equipment

The Disinfection System at Asplund Generates High-Strength Sodium Hypochlorite (12.5%)



- Complex Process w/ion selective membranes
- Integrated Plant Controls & Monitoring
- Highly sensitive to chemical and environmental changes; requires regular and routine Maintenance
- Annual Costs Vary ~ $1.7 to $3.5* Million
  - *Supplementary chemical purchase
  - *The replacement equipment

Unseparated cells. Unseparated cells are also sometimes referred to as *undivided* cells. The overall chemical reaction that occurs within an unseparated electrolytic cell is the production of sodium hypochlorite (NaOCl) and hydrogen (H_2) gas from a sodium chloride (NaCl) solution in water:

$$NaCl + H_2O \rightarrow NaOCl + H_2\uparrow \qquad \text{(Eq 3-1)}$$

At the anode surface, where oxidation occurs, chloride ions from the salt are oxidized to initially produce dissolved chlorine gas (Cl_2):

$$2\,Cl^- \rightarrow Cl_2 + 2\,e^- \qquad \text{(Eq 3-2)}$$

Once produced, the chlorine gas rapidly dissolves in and reacts with water (hydrolyzes) to produce both hydrochloric acid (HCl) and hypochlorous acid (HOCl):

$$Cl_2 + H_2O \rightarrow HCl + HOCl \qquad \text{(Eq 3-3)}$$

As a result of these reactions, both chemical and electrolytic, the pH of the solution near the anode surface tends to be acidic due to the production of protons.

Electrochemical reactions taking place at the cathode surface use water as an electron acceptor, which is reduced to produce both hydrogen gas (H_2) and hydroxide ions (OH^-):

$$2\,H_2O + 2\,e^- \rightarrow H_2(\uparrow) + 2\,OH^- \qquad \text{(Eq 3-4)}$$

Because of the formation of hydroxide ions during this process, the solution near the cathode typically is caustic (pH greater than 12). The hydrogen gas that is evolved at the cathode surface must be safely removed from both the OSG system and the produced oxidant solution, a topic that is covered in a later portion of this chapter. In the *undivided* cell of most OSG systems, in which the solutions at the anode and cathode are free to mix, the hydroxide ions that are produced at the cathode will combine with the acids produced at the anode, resulting in the formation of hypochlorite.

$$HOCl + OH^- \rightarrow H_2O + ClO^- \qquad \text{(Eq 3-5)}$$

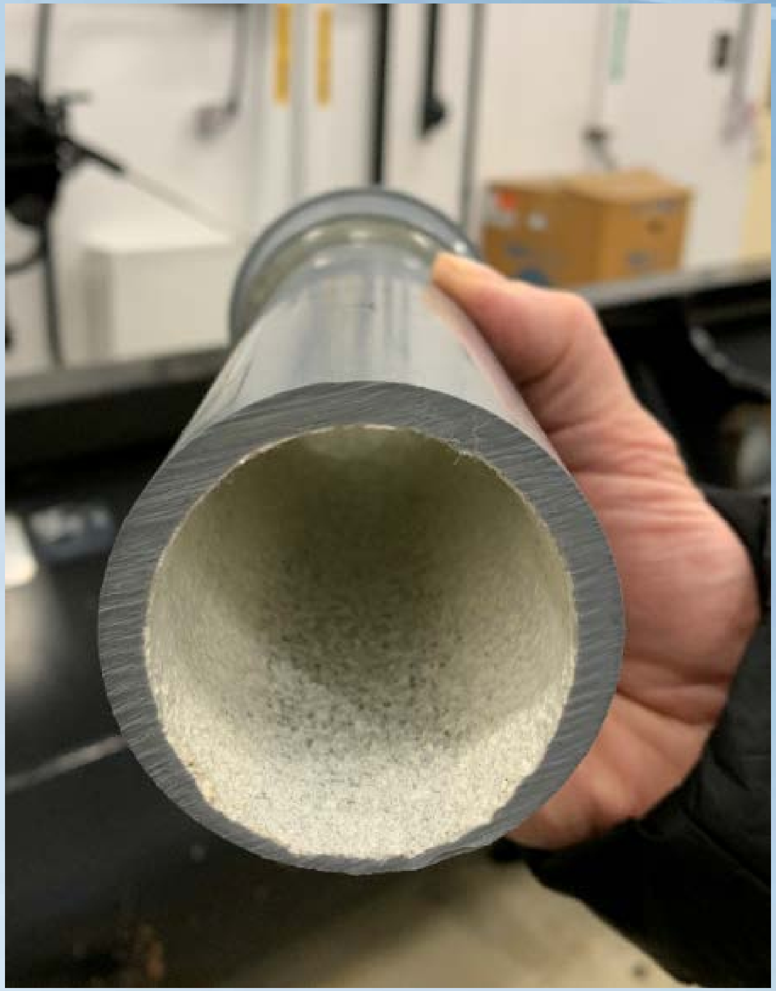
Compliance Requires Reliable Operations, System Knowledge & Ongoing Learning & Adaptation

Maintenance Objectives ~ Procure Long Lead Items ahead of failure, Planned Shutdowns for the Replacement of Equipment

- Hypochlorite Use – Gallons per Day
  - ~1,600 to 2,400 - Winter Months
  - ~3,500 to 4,000 – Summer Months
- System Production
  - Max ~ 4000 Gallons per Day
  - Current ~ 2,400 Gallons per Day
  - Production decreases as equipment degrades
- Storage ~ 2 to 3 Weeks or ~ 53,000 Gallons --- Hypochlorite Degrades over time and must be used relatively quickly
- Nationwide Shortage of Hypochlorite in the summer of 2021 lead to EPA using the Section 1441 of SDWA, or Defense Production Act, to manage distribution of hypochlorite to water utilities across the US; did not affect AWWU*
- *Supply chain disruptions, long lead items and chemical price increases have affected AWWU

Failure Points Causing Unanticipated Maintenance and Shutdowns

- Chlorinated Polyvinyl Chloride (CPVC) Degradation in Piping and Tanks
- Component Failure (Pumps/Instrumentation/ heaters/coolers/rectifiers)
- Premature life of electrolyzers

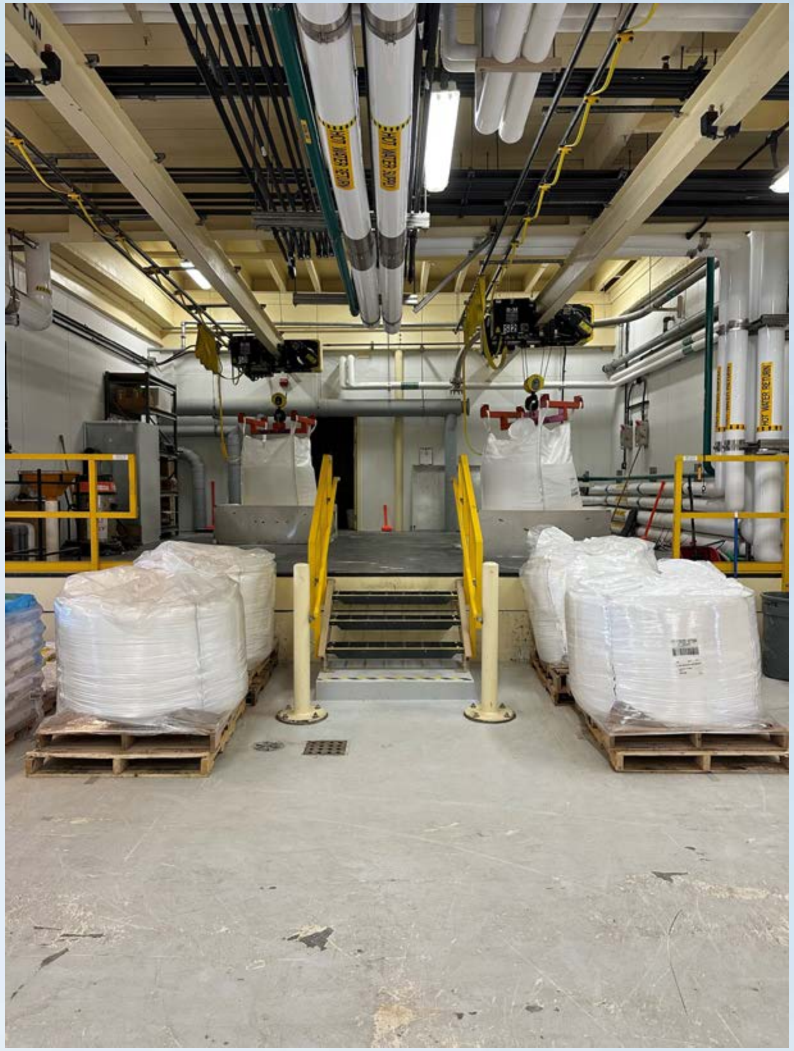


To be Pro-Active vs. Reactive We Are Investing in the System and our Workforce

- Add Redundancy
  - Supplementary Storage of 12.5% Hypochlorite to allow for shutdowns
  - Get Replacement Equipment in Inventory

- Strengthen the System
  - Adjust maintenance schedules to actual equipment life cycles
  - Plan System Maintenance & Upgrades

- Increase our Ability to Maintain
  - Staff availability and specialized training
  - Proactive emergency use contracts (chemicals, ETC vendor services for parts & components, etc.)



Past Assembly Action - January 10th New Salt Contract Approved

- High grade salt is a critical raw material
- Ended contract with lower grade salt
- 4 to 6 Week Lead Time
- Low Bid Alaska Garden & Pet Supply
  - Unit price @ $0.50/lb
  - Total Contract Value $1,115,320/year with 4 renewal options
  - All salt will be purchased

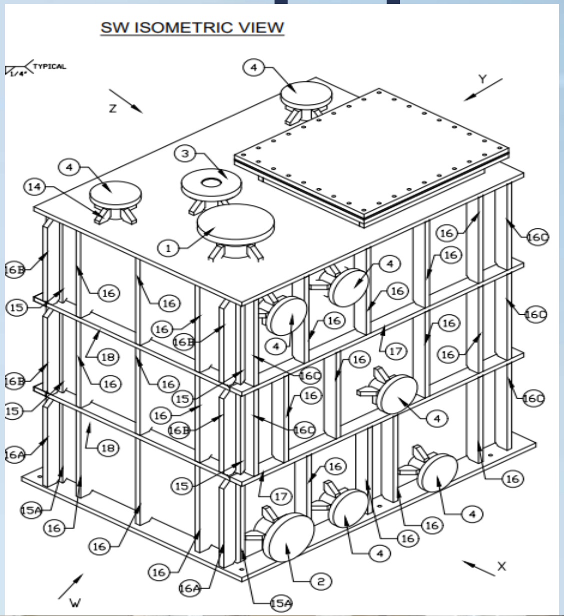
Past Assembly Action - February 7th Emergency Purchase of 12.5% Sodium Hypochlorite

- Waiver to Provide for Open Market Procurement
- Intended to Supplement Process
- 4 to 6 Week Lead Time
- Low Bid Alaska Global Supply
    - Unit Price $6.96 per gallon
    - Total Contract Value $1,113,600
    - As needed for emergency use

Future Assembly Request for the Procurement of Electrolyzers

- Sole Source Procurement to Electrolytic Technologies (ETC)
- 16 Electrolyzers ~ $480,000
- Lead Time 12 -18 Months
- Planned Replacement Based on System Performance

Future Assembly Request for Equipment Replacement



- Chlorinated Brine Tank Replacement
  - Estimated ~$60,000
  - Lead Time 10 to 12 Months

- Brine/Caustic Header Replacement
  - Estimated ~ $400,000
  - Lead Time 6 to 8 Months

Future Assembly Request for Permit Monitoring Contract Amendment

- Contract provides compliance monitoring of permit and receiving waters (Cook Inlet)
- Original contract awarded in 2001 with options to amend
- Permit renewal application filed in 2005 – administratively extended
- Continuity provided by using same contractor
  - Limited vendors for this extensive work in Alaska
- Amendment No. 18: increase of $400K, extend to March 31, 2024

AWWU is committed to operating the facility to meet all permit requirements and protect the marine environment of the Cook Inlet

Questions?