Commercial Systems Treating both High and Low Strength Perchlorate Applications Utilizing Ion Exchange

By
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Agenda

• IX Development Chronology
• ISEP & ISEP+ Systems
• Pilot Tests
• Operating Systems
  – High Strength Application
  – Low Strength Application
ISEP & ISEP+ Systems

• 1/98 – CCC conducted first lab tests
• 8/98 – Completed first successful field pilot tests
  • San Gabriel Valley, CA
• 1/99 – Completed perchlorate removal and destruction pilot tests
  • NASA’s Jet Propulsion Lab – Pasadena, CA
• 11/99 – First remediation system
  • Henderson, NV
• 2/00 – First potable water system
  • LaPuente, CA
Ion Exchange Process

• **Removal/Regeneration – IX resin**

\[
\begin{align*}
\text{ClO}_4^- + R\text{-Cl} & = R\text{-ClO}_4^- + Cl \\
R\text{-ClO}_4^- + \text{NaCl} & = R\text{-Cl} + \text{NaClO}_4
\end{align*}
\]

(R) – IX resin

• **Destruction – Catalytic Reduction**

\[
\begin{align*}
\text{NaClO}_4 + 8\text{H}^* & = \text{NaCl} + 4\text{ H}_2\text{O}
\end{align*}
\]

(H*) – hydrogen source
ISEP & ISEP Systems

• ISEP System – Continuous ion exchange process to remove perchlorate and nitrate from water

• ISEP+ System – Continuous ion exchange process to remove and destroy perchlorate and nitrate from water
ISEP Illustration

**ISEP Design Features**
- Configuration flexibility
- Reduced resin inventory
- Simplified control philosophy
- Reduced regeneration chemicals
- Steady state operation

**Diagram Details**
- Feed (all blue cylinders)
- Product
- Rinse In
- Regen In
- Regen Out
- Rinse Water

**Rotation Direction**
- ROTATION DIRECTION
Plants located in:
- Kansas (2) 300 to 500 gpm
- Wisconsin (2) 3500 to 5000 gpm
- California (2) 50 to 300 gpm
- Minnesota (3) 200 to 1000 gpm
- United Kingdom (1) 1000 gpm
Figure 1. Schematic of the ISEP® Ion Exchange Process
Figure 2. Block-Flow Diagram of the ISEP+™ Process
Figure 3. Perchlorate Removal in the ISEP®

Non-Detectable ClO$_4^-$ Levels Recorded as 4 ppb

Figure 3. Perchlorate Removal in the ISEP®
Figure 4. Destruction of Perchlorate in the Reactor
Figure 5. Sulfate Removal in the Nanofiltration Process
Henderson, NV Remediation

• Remediation application
• Instillation designed to treat perchlorate containing seep water draining into Lake Mead
• System was commissioned in November 1999 and has been in continuous operation since that time
Henderson, NV Remediation

• Ion exchange system is designed to remove 100 ppm of perchlorate
  – Actual levels have varied from 80 – 110 ppm
• System designed to treat 450 gpm of water
  – Flow rates have varied from 200 – 560 gpm
• System designed to achieve 97 % perchlorate removal
  – Typical effluent perchlorate effluent levels are non detectable on an ion selective electrode (<2 ppm)
La Puente Valley County Water District ISEP System

- 2500 gpm drinking water application
- Designed to treat perchlorate, volatile organics, NDMA, and 1,4-dioxane
- System was commissioned in February 2000
La Puente Valley County Water District

- ISEP System accepted by CADHS for perchlorate and nitrate drinking water applications
- Operating permit currently under review by CADHS – Metropolitan District
- Emergency use permit approved
- Currently ISEP system is operating 19 hr/day to control perchlorate plume
Capital Costs

- Estimated Capital January 1999: $4,600,000
- Actual Capital 03/31/00: $4,070,041
  - Engineering and permits for DOHS Testing: $882,608 (Budgeted $314,399)
  - Total: $4,952,649
  - Overrun: $352,649
# La Puente Operational Costs

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<th>Budget 1/99</th>
<th>Actual</th>
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<td>Wells*</td>
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<td>Booster</td>
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<td><strong>Total</strong></td>
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<td><strong>Savings</strong></td>
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Summary

- ISEP Systems capable of treating both high and low strength perchlorate applications at very low waste brine levels
- ISEP+ Systems capable of treating and destroying perchlorate at very low or zero waste levels