Injection Wells for Responsible Leachate Management
Regulatory, Technical and Economic Considerations

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Intro: Basics of Deep Well Injection

Classes of Injection Wells

Class I Wells
- Inject industrial and municipal wastes
- Chemical Plant
- Municipal Waste Treatment Plant
- Injection of brine into oil deposits
- Produced water and also disposal of brine after recovery
- Brine Injection/Disposal Well
- Water Treatment Plant

Class II Wells
- Inject brine into oil deposits to recover oil and natural gas
- Produced water and also disposal of brine after recovery
- Brine Injection/Disposal Well
- Water Treatment Plant

Class III Wells
- Inject fluids to deplete and extract minerals like uranium, salt, copper, and sulfur
- Uranium Solution Mining
- Uranium Solution Mining
- Uranium Solution Mining

Class IV Wells
- Class IV wells, burned by the EPA, are shallow wells used to dispose of hazardous or radioactive waste
- Manufacturing Plant
- Apartment Building

Class V Wells
- Shallow wells used to dispose of non-hazardous waste
- Non-hazardous Waste

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Class VI - CO₂ Sequestration
Intro: Class I vs. Class II Wells

Class I (800)
- Location, Design
- Artificial Penetrations 2\(\frac{1}{2}\) mi
- Geologic Siting
- Drinking Water Protection
- Operating Program
- Monthly Reporting
- Chemical Compatibility
- Annual/Biennial Testing
- Financial Assurance

Class II (175,000)
- Location, Design
- Artificial Penetrations 1/4 mi
Intro: Class I Wells

Inject non-hazardous and hazardous industrial wastes into deep, confined rock formations, typically thousands of feet below the lowermost source of drinking water.
Is Deep Well Injection Supported?

- Strict Surface Water Discharge Criteria
- Many Facilities Zero Discharge
- Perceived Certainty from Changing Regulations
- Regulators Understand Challenges
- Support Overall Permitting & Approval

Deep Well Injection IS Supported by Regulators
Regulatory Considerations

- EPA Implements Class I Program
- State Primacy for Class I Wells
- State Ban on Class I Wells
Regulatory Considerations

Deep Well Injection is a Responsible Fluid Disposal Option

- Proper Well Design
- Suitable Geology
- Continuous Monitoring
- Sampling & Reporting
- Financial Assurance
- Environmental Protection
Regulatory Considerations

Measures to Protect Drinking Water

- Great Vertical Separation
- Nearly Impermeable Formations
- Redundant Casing Strings
- Cement Between Casing Strings
- Continuous Monitoring
- Contingency Planning
- Regular Well Testing & Reporting
Regulatory Considerations

Understand your Schedule and Regulatory Timelines

• Review Timelines Vary: 6 – 24 months
• Schedule Pre-Permit Meeting w/ Regulators
• Provide Frequent Updates
• Expect Public Participation
  • Comment Period
  • Hearing, if Requested
  • Response Period, if Necessary
Regulatory Considerations

Local Issues Drive National Awareness

- Understand Where Your Operation Falls
- Promote Education
- Be Proactive
Geologic Suitability

- Sufficient Confining Interval
- Sufficient Injection Interval
  - Rate: 200-2,000 gpm
  - Pressure: 0-2,000 psi

Technical Considerations

- Dolomitic carbonate
  Depth 11,236’, Porosity 3 to 5%

- Silica cemented sandstone
  Depth 3,580’, Porosity 10 to 15%

- Shale
  Depth 2,800’
  Porosity 0 to 1%
Technical Considerations

Chemical Compatibility

Influent Characterization is Critical to Well Performance

Landfill force main
Iron precipitate

Downhole image (3047’)
No biological growth

Sidewall image (3044’)
Filamentaceous algae
Technical Considerations

Chemical Compatibility

• Treatment
  • Filtration
  • Disinfection
  • Mass removal

Biocide and anti-scalant totes

Cyclonic filtration
Technical Considerations

Surface Facilities Design

• Pump Sizing
• Pressure, Rate, Quality Monitoring
What it Looks Like...

Rig Example

- Diesel-Powered Rotary Drill Rig
- Draw Works: Twin 475 HP Motors
- Twin 1000 HP Pumps
- Mud Pits, Water Tank, Fuel Tanks
- Independent Generator
- Record/Monitor Equipment
- 110’ Derrick, 15’ Substructure
- Racking Board: 12,000’ of Drill Pipe
- 50’ x 50’ Footprint
- 350,000 lb Hookload
What it Looks Like...

Casing, Cementing

- Steel/Fiberglass Casing (20-3.5”)
- All Casing Cemented to Surface
What it Looks Like...

Geophysical Logging
• Porosity, Lithology, Fractures
• Borehole Diameter
• Sufficient Cementing
What it Looks Like...
Economic Considerations

- **Feasibility Study**
  - 0.5-3 mos
  - $5-$25K

- **Permitting**
  - 6-24 mos
  - $50-$200K

- **Construction**
  - 6-24 mos
  - $1.8-$6M

- **Operations**
  - 20+ yrs
  - $150-$500K/yr
# Economic Considerations

<table>
<thead>
<tr>
<th>Location</th>
<th>Depth (ft)</th>
<th>Rate (MGD)</th>
<th>Pressure (psi)</th>
<th>Capital ($)</th>
<th>Annual O&amp;M ($)</th>
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</thead>
<tbody>
<tr>
<td>South Florida</td>
<td>3,500</td>
<td>2.0</td>
<td>40</td>
<td>$6.3M</td>
<td>$225K</td>
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<td>Southeast Illinois</td>
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<tr>
<td>Kansas</td>
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<td>0.45-1.25</td>
<td>gravity</td>
<td>$1.6M</td>
<td>$150K</td>
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</table>
Economic Considerations

Economic Considerations

May be Converted to Commercial Use

• 6 to 24-month ROI
• Additional Groundwater Monitoring
• Increased Fluids Analysis
• May Accept Hazardous Waste Streams IF
  • Waste Treated to Non-Hazardous, or
  • Modeling Demonstrates 10,000-year Sequestration
  • Provide Greater Financial Assurance
Summary: Benefits of an Injection Well

- Responsible Leachate Handling
- Leachate Better Quality than Groundwater
- Permanent Storage Below Drinking Water
- Redundant Protective Systems
- Eliminates POTW Requirements
- Smaller Footprint than Lagoons
- Long-Term Asset
- Additional Revenue Generator
Summary: Don’t Rule it Out…

Deep Well Injection is a Responsible Fluid Disposal Option

- Evaluate all Options Accurately
- Determine if Technically Feasible
- Assess if Timelines Meet your Needs
- Be Aware of Outside Stakeholder Influences
Deep Well Injection is a Responsible Fluid Disposal Option…and Cost Competitive!

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