**Title: Injection Well Best Practices**
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# WELL INJECTION BEST PRACTICES

Creating injection slurries for disposal of oil and gas field waste is **standard practice** for managing solid waste in environmentally sensitive regions:

- Offshore
- Tundra
- Marsh
- Remote areas

Otherwise, waste would be left in reserve pits, land-farmed, or discharged into the ocean, **damaging the environment and threatening the health of the human population**.

## Slurry injection relies on hydraulic fracturing science to create subsurface voids for storing solids.

### Key Concerns about Injection

- Containment of injection waste
- Prevention of humanly perceived seismic activity

Appropriate design standards and constant monitoring of controlling parameters will mitigate much of the concern.

## Safe operations are always the highest priority for well operators.

Both surface and subsurface risks must constantly be evaluated using real-time surveillance to ensure the surface pressures and subsurface behaviors are within bounds.

Problems can be managed when you base your planning and operations on understanding subsurface behavior.

### BEST PRACTICE - Proper Site Research, Construction, and Operation

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Determine workflow based on:

- Well logs
- Offset well performance
- Geomechanics
- Fracture simulation and optimization

Perform proper zonal selection and well construction and remodel the initial parameters once the well is drilled.

Build safe margins into your operating procedures using:

- Log analysis
- Break down and fall-off tests
- Fracture and flow simulations

## BEST PRACTICE - Manage Injection Fluids to Prevent Formation Damage

Matrix injection is prone to plugging - you need to monitor for fractured injection sites.

Typical Causes of Near-well Damage:

- Oilfield bacteria
- Calcium carbonate
- Sulfates
- Iron compounds
- NORM - naturally occurring radioactive materials such as Ra-226 and Ra-228

Monitor your formation after drilling at all times.

## BEST PRACTICE - Use Injection Diagnostics to Predict Failure Before It Happens

Safe operations require real-time monitoring - continually monitor both the surface pressure and subsurface fracture behavior to assure containment.

Typical Injections:

- Matrix Injection (Injection of water into the disposal zone’s rock matrix.)

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- Water Injection
- Slurry Injection

**Diagnostic tests** forecast injection performance trends that indicate potential types of damage and when work-overs may be required.

| | |
|---|---|
| **Fall-Off Test** | • Perform daily<br>• Conduct after shut-in<br>• Analyze for information on fracture containment in-zone, near-well damage, and reservoir properties |
| **Step-Rate Test** | • Perform quarterly<br>• Conduct at different rates to determine when fracturing occurs, in-situ stress, and rock strength<br>• Interpret fracture closure and propagation pressures to confirm fracture geometry and injection zone |

## BEST PRACTICE - Minimize All Magnitudes of Seismic Activity

There is a **complex web of potential causes**, two of which are injection near crystalline basements and the use of high rate injection.

Nearly all cases of suspected **injection-induced seismic activity** perceived by humans have involved communication between disposal zones and basement faults.

Operators must **avoid activation** of faulted basement rock:

- Injection in strata near crystalline basements
- Injection zones proximal to faults penetrating into basement

Studies show **high injection rates** (>300,000 bbl per month) are much more likely to be associated with induced **seismic events** and includes **propagation into faults** or other wells.

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## Advantek Waste Management Services has helped clients inject 1.5 billion barrels of oilfield and other hazardous waste for more than 50 of the biggest national and international oil companies.