Everything You Always Wanted to Know About Class I Injection Wells in Texas

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Questions to be Answered

• What are Class I Injection wells?
• Who uses these wells?
• What is being injected?
• How much is being injected?
• Where is it being injected?
  – Geographically
  – Geologically
• What sorts of operational issues arise?
Background

- Unknown when underground injection in Texas first began, but the first major project was in 1938 and involved injection of brine at an East Texas oil field.
- Class I injection wells in Texas first became regulated with the 1961 Injection Well Act, however records for “Class I” injection well disposal volumes go back to 1953.
What is a Class I Injection Well?

• Defined as “industrial and municipal waste disposal wells which inject fluids beneath the lowermost formation containing an underground source of drinking water within one-quarter mile of the wellbore.”

Lowermost Underground Source of Drinking Water (USDW)

Injection Zone

Confining Zone
Who uses Class I disposal wells in Texas?

- petroleum refineries
- organic chemical producers
- inorganic specialty chemical and pharmaceutical producers
- fertilizer plants
- meat processors/tanneries
- uranium mines
Total number of active permits = 165, August 2015
Distribution of Waste Producers, August 2015
based on number of active permits

*facilities that produce both organic and inorganic chemicals were categorized into organic chemical producers
*facilities that refine petroleum and produce ammonia were categorized into petroleum refineries

H = Hazardous
NH = Non-Hazardous

H organic chemical producer
NH mixed
NH fertilizer plant
NH uranium mine
other

H petroleum refinery
NH leather tannery
NH electric power generator
NH cement manufacturer
NH inorganic chemical producer
H copper refinery

H = Hazardous
NH = Non-Hazardous
Total Annual Injected Volume of Class I Wells in Texas

Max Annual Volume ≈ 7 billion gallons in 1987

Cumulative Volume ≈ 248 billion gallons
Source Reduction and Waste Minimization

Injection Well Act of 1961

Injected volume of waste (mm gallons)

Counts of wells and facilities

Wells
Facilities
\[ M = \frac{(k / \phi)_{\text{max}}}{h} \int_0^h \left( \frac{k}{\phi} \right) \, dz \]

where:

\( k \) = permeability at vertical location \( z \)
\( \phi \) = porosity at \( z \)
\( h \) = thickness of the layer
Class I Injection Wells: Active Permits in the Texas Panhandle
Over 44 billion gallons of wastewater have been injected into the Panhandle through Class I wells as of December 2014.
Class I Injection Wells: Active Permits in the Southern Gulf Coast
Figure 5. Structure map of northern Gulf of Mexico Basin region showing basins, uplifts and other structural features in the Gulf Coast region that influenced deposition. Modified from Ewing and Lopez (1991) and Li (2006).
North: closer to coast, younger rocks

South: farther inland, older rocks

Hardage et al. 1995
Almost 70 billion gallons of wastewater have been injected into the Southern Gulf Coast through Class I wells as of December 2014.
Class I Injection Wells: Active Permits in the Northern Gulf Coast
Figure 5. Structure map of northern Gulf of Mexico Basin region showing basins, uplifts and other structural features in the Gulf Coast region that influenced deposition. Modified from Ewing and Lopez (1991) and Li (2006).
Over 125 billion gallons of wastewater have been injected into the Northern Gulf Coast through Class I wells as of December 2014.
Class I Well Ages in Texas from Active Permits

Calculated based on 2014 reference frame
Operational Issues in Class I Disposal Wells

- Increased injection pressures
- Sanding or plugging of injection reservoir
- Loss of annulus pressure due to leaks in long string casing, tubing, or packer
- Loss of integrity of cement behind the long string casing due to corrosion

Source: Lyondell permit application
Remedies to Correction Operational Issues

Common Remedies:
• Perform acid job or sand clean-out
• Add perforations
• Replace tubing and packer
• Perform cement squeeze on casing
• Install liner
• Drill Sidetrack

TCEQ Notification Requirements for Remedies:
• Notification of well stimulation
• Submittal of workover plan and workover report
• Application for minor modification, minor amendment or major amendment, depending on specific work done
Note: 41 Workovers during this time; 17 wells had undergone multiple workovers
Additional Operational Issues

• Temporary Abandonment (TA)
  – 7 wells in 2015 (out of 105 installed wells)
  – TA Wells have higher incidence of challenges during closure

• No-Harm Letters
  – The Texas Railroad Commission (RRC) reviews Class I permit applications to ensure that the well operations “will not injure or endanger any known oil or gas reservoir” and issues “no-harm” or “potential-harm” letters
  – This is a requirement for new well applications, renewal applications (10-year renewals) and some major amendment applications

• Competition for Pore Space
Summary

• Texas geology is ideal for deep waste disposal wells
• Hydrocarbon-related industries comprise over half of the number of active Class I permits in Texas, followed by commercial industries disposing of mixed waste streams, uranium mines, and fertilizer plants
• Annual injected volume peaked from 1987 through 1997; volume trends may be partially explained by the economy, oil and gas production, and TCEQ’s waste minimization requirements
Summary, cont.

• The greatest number of active permits, wells, and highest waste volumes are along the Gulf Coast

• The Gulf Coast geology has more uniform lithology than the Panhandle area

• Operational issues sometimes arise and may require workovers, such as re-perforating, tubing replacement, or more extensive workover such as sidetracks; permit modifications or amendments may be needed to address workovers

• Multiple new Class I injection well permits are currently being processed (existing and new facilities)
Questions?

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