Quality Criteria for Deepwell Disposal of Industrial Fluids

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Injection Well vs. Disposal Well

- *Injection well* means a well into which “fluids” are being injected (for EHR, storage, disposal, coal gasification, or ore exploration)

- *Disposal well* means a well used for the disposal of waste into a subsurface stratum (for CCS, long term storage, or disposal)
TYPICAL INDUSTRIAL WASTE DISPOSAL WELL

Gauge on injection tubing

Gauge on tubing - casing annulus

Surface casing

Cement

Annulus (positive pressure)

Cementing stage coliar

Cement

Protection casing

Injection tubing

Packer

Perforations

Wellhead

Fresh water zone

Confining layer

Disposal zone

1300 - 1600 m
Legislation

- The ERCB regulates all subsurface injection under the OGCA.
- As per section 39 of the OGCA all schemes for subsurface storage or disposal of industrial fluids or other substances have to be approved by the ERCB.

AB legislation: http://www.qp.alberta.ca/
ERCB directives: http://www.ercb.ca/portal/server.pt?
Legislation

- ERCB approval under s 39 (1), OGCA
  - (c) the gathering, storage and disposal of water produced in conjunction with oil or gas,
  - (d) the storage or disposal of any fluid or other substance to an underground formation through a well,
Legislation – Role of AEW

- **Role of the Minister of the Environment**
  (defined in the OGCA)
  - Protection of non-saline groundwater
  - Determine waste suitability for deepwell injection
Legislation – Role of AEW

- **OGCA, section 39**
  - (2) ERCB shall refer the application to the Minister of Environment
  - (3) Minister of Environment may impose conditions
  - (4) Minister of Environment has discretion re referral
  - (5) Minister of Environment delegation of power
  - (6) Variance re (3) subject to Lieutenant Governor direction agreement
Currently, the ERCB refers to the Minister of Environment applications for Class Ia wells/caverns, only

- AEW has delegated to the ERCB the administration of subsurface related environmental issues
- Referral detail in Bulletin 2010-17 (clarifies Bulletin 2007-06)
- Applications for CCS injection wells for CCS with or without EHR not captured by current ERCB referral process to AEW.
AEW Policy

**POLICY NO. ES-99-PP1**

- Deepwell injection is an acceptable industry practice for aqueous industrial and hazardous waste with limited recycling potential
- Off-site Class Ia wells receiving third party HW require a PIN from AEW (EPEA, s 188).
- A PIN for receivers is issued upon application to operators of off-site Class Ia wells
- HW deemed suitable for deepwell injection is as per D051, except for the pH (range: 4.5-14.0)
Deepwell Disposal of Industrial Fluids

- Resource conservation/pollution prevention
- Prohibitions (ww, run-off, spent oils/solvents, diesel inverts, BATEA)
- Ww quality must meet 2.3 and 2.4 of D051
- Waste classification as per WCR (if disposed off-site)
- Fluids injected as per class of well (D051)
- Surface storage facilities (OGCA or EPEA)
Deepwell Disposal of Industrial Fluids

- Information Required
  - Location of the proposed well
  - Estimated daily and annual injection volumes
  - Depth to usable groundwater
  - Identification of each ww stream, sources, volumes
  - Ww characteristics
  - Rationale for deepwell injection
Deepwell Disposal of Industrial Fluids

- Specific Well Class Criteria
  - Class Ia: specific fluids & criteria
  - Class Ib: specific aqueous fluids & criteria
  - Class II: brines or brine equivalent fluids
  - Class III: CO₂, acid gases, solvents, inert gases (storage or EHR)
  - Class IV: H₂O, steam for HC recovery

Detail in D051 at http://www.ercb.ca/portal/server.pt?
Deepwell Disposal of Industrial Fluids

- **General Criteria**
  - pH between 4.5 and 12.5
  - Does NOT meet surface discharge criteria
  - Non-halogenated organic fraction or less than 10% by mass except if
    - it is untreatable sand or crude/oil water emulsion, or
    - it is an antifreeze or dehydration fluid with > 60% H₂O
  - Halogenated organic compounds in a total combined concentration less than 1000 mg/kg, and
  - PCB concentration of less than 50 mg/kg.
Deepwell Disposal of Industrial Fluids

- Class Ia wells: specific fluids & criteria (~25)
  - General criteria plus
  - Heavy metals > Schedule 1 or s 13(2)(d) WCR
  - PIN as per WCR for wells receiving 3rd party hazardous fluids
Deepwell Disposal of Industrial Fluids

- **Class Ib wells**: specific fluids & criteria (~167)
  - pH between 6.0 and 9.0
  - Flash point > 61°C, except
    - Untreatable sand or oil/H₂O emulsion
    - Antifreeze/dehydration fluid
  - Heavy metals ≤ levels schedule 1 or s.13(2)(d), WCR
  - XOC < 100 mg/kg
Deepwell Disposal of Industrial Fluids

- Class II wells: produced water or brine equivalent fluids (~1261)
  - Produced water
  - Brine from salt caverns or solution mining operations
  - Water-based pigging fluids
  - Brine reject or backwash
  - Water containing polymers or other chemicals (EHR)
  - Waste fluids from circulation during cementing
  - CaCl₂ water
Deepwell Disposal of Industrial Fluids

- **Class III wells:** HC and specific gases (storage/EHR)
  - Solvent or HC for EHR
  - Sweet gas for storage
  - CO, N\textsubscript{2}, O\textsubscript{2}, air or other gases (storage/EHR)
  - Acid gases (disposal/storage/well cycling operations)

- **Class IV wells:**
  - Fresh water (potable water)
  - Water vapor/steam
Deepwell Disposal of Industrial Fluids-SHTC

“The deepwell shall be used as approved by the ERCB for disposal of the following:

(a) on-site produced liquid effluent from:
   (i) the stabilization-size reduction facility; or
   (ii) the physical-chemical treatment facility; or
   (iii) the water treatment facility; or

(b) the industrial runoff from the water treatment facility which is excess to the facility’s requirements; or

(c) any waste received from off-site sources that may be disposed of into a Class 1a well, according to ERCB Directive 51, March 1994, as amended from time to time.”
Deepwell Disposal of Industrial Fluids-SHTC

- SHTC (HW Treatment Plant – EPEA approval)
  For each waste stream injected (Class Ia)-daily, monthly, and annually, as applicable
  - Total volume
  - Flow rate pH
  - TSS
  - TOC
  - PCB
  - TCB
Deepwell Disposal of Industrial Fluids – Example

- **Chemical Plant (process ww – EPEA approval)**
  - Parameters identified in previous slide per general criteria
  - For each waste stream injected (Class Ia)
  - Total volume and daily flow rate *(monthly and annual reports)*
  - BOD, COD, TOC
  - O&G
  - Phenols
  - $\text{PO}_4^{3-}, \text{NH}_3^+, \text{NO}_3^-$
Deepwell Disposal of Industrial Fluids – Example

- Pipeline Waste (pigging sludge)
  - Liquid (fails the liquid paint filter test)
  - $^{210}\text{Lead} < 100 \text{ Bq/g}$
  - Radiation dose: $<< 0.3 \text{ mSv/year}$
  - $2 < \text{PCB} < 50 \text{ mg/kg}$

Question: How to manage this waste?

Deepwell Disposal of Industrial Fluids – Example

- **Pipeline Waste (pigging sludge)**
  - Liquid (fails the liquid paint filter test)
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Question: **How to manage this waste?**

- Liquid low PCB NORM waste with activity below UDRL.
- Low activity NORM waste that can be deepwell injected into a Class Ia or Class Ib well or, once stabilized, disposed of as solid waste into a Class I landfill.
- Can be solidified by stabilization.
- Class I Landfills are not part of the EC “environment”.
Deepwell Disposal of Industrial Fluids

- **What to test for?**
  - Formation fluid (metals, TDS, TSS, routine $\text{H}_2\text{O}$ cations & anions, m-AHC, VHC-F1, EHC-F2/F3)
  - Each waste stream (raw materials, chemical process and technology, reactions, products, and by-products)
  - General criteria (class 1a wells: listed waste)
    - pH, TDS, TSS (surface water quality criteria)
    - Non-halogenated organic fraction < 10%
    - Halogenated organic compounds < 1000mg/kg
  - Flash point
Deepwell Disposal of Industrial Fluids

Recommendations:

- Water resource conservation
- Protect non-saline groundwater
- Update quality criteria for fluids going for disposal
- Monitor injected fluids, injection well, and receiving formation
- Use subsurface injection as a sustainable BATEA technology
Questions?

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