Advective Leakage through Composite Liners

by

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Liners are NOT Impermeable!
Liners Leak!

Liner Leakage Estimation - CCL

→ Darcy’s Law
→ $Q = k_i A$
Compacted Clay Liner

600 thk. Clay
(k = 1 x 10^-9 m/s)

???
m³/acre/yr

Liner Leakage
Estimation – Composite Liner


\[ Q = 0.976 \ C_{q0} \left[ 1 + \ 0.1 \left( \frac{h}{t_{UM}} \right)^{0.95} \right] \ d^{0.2} \ h^{0.9} \ k_{UM}^{0.74} \]

\( C_{q0} \) (good contact) = 0.21
\( C_{q0} \) (poor contact) = 1.15

Liner Leakage
Assumptions

\( \rightarrow \) 300 mm leachate head
\( \rightarrow \) Poor to Good QA/QC
\( \rightarrow \) 1cm² circular hole defect
@ 1 defect per acre in GM component
RCRA Subtitle D Composite Liner

- GM or FML
- 600mm thk. Clay
  \( k = 1 \times 10^{-9} \text{ m/s} \)
- ??? m³/acre/yr

GCL/FML Composite Liner

- GM or FML
- GCL = 5 mm thk
  \( K = 1 \times 10^{-11} \text{ m/s} \)
- ??? m³/acre/yr