Review of Source-Terms for a Repository in Tuff

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# INTRODUCTION

- Need for Cooperation and Consensus on Repository PA

- PA = Far-field PA + Near-field PA

- Summary of Selected PA Reports/Documents

<table>
<thead>
<tr>
<th>REPORT</th>
<th>ORGANIZATION</th>
<th>ROLE OF NEAR FIELD</th>
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</thead>
<tbody>
<tr>
<td>Project '90</td>
<td>SKI</td>
<td>HIGH</td>
</tr>
<tr>
<td>SKB-91</td>
<td>SKB</td>
<td>HIGH</td>
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<tr>
<td>TVO-92</td>
<td>TVO</td>
<td>HIGH</td>
</tr>
<tr>
<td>PACE-90</td>
<td>USDOE</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>WISP</td>
<td>USNAS</td>
<td>HIGH</td>
</tr>
<tr>
<td>PHASE 1</td>
<td>USNRC</td>
<td>LOW</td>
</tr>
<tr>
<td>PAR</td>
<td>PNC</td>
<td>HIGH</td>
</tr>
<tr>
<td>Kristallin</td>
<td>Nagra</td>
<td>HIGH</td>
</tr>
<tr>
<td>EIS (Draft)</td>
<td>AECL</td>
<td>HIGH</td>
</tr>
</tbody>
</table>

- Evident Importance of Near-field within PA, as Well as Feedback to Site Characterization and Waste Package Design.
POSSIBLE EMLACEMENT CONFIGURATION
FOR SELF-SHIELDED WASTE PACKAGE
DESIGN CONCEPT

TUNNEL BACKFILL
(SAND, BENTONITE, ADDITIVES)

EMPLACED SELF-SHIELDED PACKAGES

~ 3.0m

NEXT EMLACEMENT POSITION

30 TO 60 cm

1.3 m

PREPLACED BACKFILL

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INTERA SCIENCES
Steady-State Mass Transfer Rate for Diffusive-Advective Transport (Chambre' 1991)

\[ M_b = \frac{4 \pi \varepsilon \Psi D_b r_0 c_s [Sh r_1 \sqrt{K}]}{[(Sh - 1) \sinh d + r_1 \sqrt{K} \cosh d]} \]

\[ K = \frac{\lambda K_b}{D_b} \]

\[ d = (r_1 - r_0) \sqrt{k} = b \sqrt{k} \]

\[ Sh = \frac{1 + 0.5 Pe}{1 + 0.63 \sqrt{Pe}} \]

\[ Pe = \frac{r_1 U}{D_b} \]

where:

- \( \varepsilon \) = porosity of backfill,
- \( D_b \) = species diffusion coefficient,
- \( r_0 \) = waste-form radius,
- \( r_1 \) = radius of backfill/rock interface,
- \( \lambda \) = decay constant for the species,
- \( c_s \) = constant concentration of the species at the waste-form surface,
- \( K_b \) = retardation coefficient in the backfill,
- \( b \) = backfill thickness,
- \( Sh \) = Sherwood number,
- \( Pe \) = Peclet number,
- \( U \) = groundwater pore velocity,
- \( \Psi \) = degree of saturation.
Normalized Release Rates as a Function of Decay, Sorption, and Backfill Thickness

- $^{243}$Am
- $^{241}$Am
- $^{99}$Tc

Normalized Release Rate

$d = b \left[ \lambda \frac{K_b}{D_b} \right]^{1/2}$

$b = 1 \text{ m}$
$K_b = 10,000$
$D_b = 3.15 \times 10^{-2} \text{ m}^2/\text{yr}$
Diffusion Coefficients as a Function of Volumetric Water Content (Conca 1990)

Volumetric Water Content (%) vs. Diffusion Coefficients (D) (cm²/s)

- D of Free Water

- Symbols and Data Points:
  - ○: soils and silts
  - △: whole rock cores
  - □: gravels
  - +: Kunigel V1
  - ●: tracer diffusion tests in compacted bentonites

The graph shows a trend where the diffusion coefficients generally increase with increasing volumetric water content.
Inferred Water Distribution in Partially Saturated Tuff Gravel (Conca 1990)

Pondular Water Elements & Water Films

$D_s = 3.1 \times 10^{-6} \text{ cm}^2/\text{sec}$

$D_0 < 10^{-11} \text{ cm}^2/\text{sec}$

$K_0 < 10^{-10} \text{ cm/sec}$

Net Water Infiltration