Radiochemical Analysis

- How is radiochemistry different?
- North Dakota Regulations
- Acceptable Test Methods
- Understanding Radiochemistry Results
Radiochemistry vs. Standard Analytical Chemistry

- Measures energy rather than mass
- MDCs rather than MDLs
- TAT limitations due to in-growth
- No hold-time issues or temp requirements
  - except radon
- Raw instrument result is always reported
- Negative results
North Dakota Regulations

Å Disposal of TENORM waste is prohibited in municipal solid waste landfills and inert landfills.

Å Disposal of radioactive waste not meeting the definition of TENORM or TENORM waste exceeding 50 pCi/g combined radium is prohibited in all landfills.

Å Background radionuclide concentrations are required for the groundwater monitoring network and leachate collection system prior to receipt of TENORM.

Å Landfills that meet the North Dakota TENORM acceptance regulations, may accept TENORM wastes as long as the combined Radium-226/Radium-228 activity is less than 50 pCi/g.

Å Landfills accepting TENORM waste must monitor leachate for radioactivity at the same frequency of their current groundwater monitoring program.
Leachate Concentrations

Radon: 4000 pCi/L
Combined Radium: 5.0 pCi/L
Adjusted Gross Alpha: 15 pCi/L
Total Uranium: 30 ug/L

* If leachate exceeds these concentrations, groundwater must be monitored for radionuclides.
Approved Test Methods

http://www.ndhealth.gov/aq/rad/licensed_tenorm_testing.htm

Analytical Methods:

1) HASL-300

2) EPA 901.1M (Gamma Spectroscopy)

Screening Method for Disposal:

1) Gamma Spectroscopy utilizing 186 keV peak
Gamma Spectroscopy

Radium-226 peak at 186.1 keV
Uranium-235 peak at 185.7 keV

Requires 21 day in-growth for secular equilibrium and utilizes progeny to remove interference.

Screening technique high bias results.
Approved Test Methods
Landfill Leachate

North Dakota does not have specific methods required for leachate or aqueous radiochemical samples.

Standard gamma spectroscopy analysis cannot provide MDCs low enough to achieve the regulatory limits.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Typical Method</th>
<th>Regulatory Limit</th>
<th>Typical MDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radon</td>
<td>SM 7500-Rn</td>
<td>4000 pCi/L</td>
<td>400 pCi/L</td>
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<tr>
<td>Radium-226</td>
<td>EPA 903.1, EPA 903.0, EPA 9315</td>
<td>5 pCi/L (w/ Ra-228)</td>
<td>1 pCi/L</td>
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<tr>
<td>Radium-228</td>
<td>EPA 904.0, EPA 9320</td>
<td>5 pCi/L (w/ Ra-226)</td>
<td>1 pCi/L</td>
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<tr>
<td>Adjusted Gross Alpha</td>
<td>EPA 900.0, EPA 9310, SM 7110C</td>
<td>15 pCi/L</td>
<td>3 pCi/L</td>
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<tr>
<td>Total Uranium</td>
<td>ASTM D5174, 200.8, EPA 908.0</td>
<td>30 ug/L</td>
<td>&lt; 1.0 ug/L</td>
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</tbody>
</table>
### Gamma Spec Results

#### Analytical Results - Radiochemistry

**Parameters**
- Method
- Act ± Unc (MOC) Cerr Trac
- Units
- Analyzed
- CAS No.
- Qual

<table>
<thead>
<tr>
<th>Sample</th>
<th>Lab ID</th>
<th>PWS</th>
<th>Site ID</th>
<th>Collected</th>
<th>Received</th>
<th>Matrix</th>
<th>Sample Type</th>
<th>Results reported on a “dry-weight” basis</th>
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</thead>
<tbody>
<tr>
<td>Radium-226</td>
<td>EPA 001.1</td>
<td></td>
<td></td>
<td>12/21/15 12:05</td>
<td>12/21/15 10:00</td>
<td>Solid</td>
<td></td>
<td>56.26 ± 0.406 (0.762) C/NA TNA 5.89 ± 0.001 C/NA TNA</td>
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<tr>
<td>Radium-228</td>
<td>EPA 001.1</td>
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<td></td>
<td>12/21/15 12:15</td>
<td>12/21/15 10:00</td>
<td>Solid</td>
<td></td>
<td>2.37 ± 0.001 (0.159) C/NA TNA 1.52 ± 0.001 C/NA TNA</td>
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<tr>
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<td>EPA 001.1</td>
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<td>12/21/15 10:00</td>
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<td></td>
<td>8.38 ± 1.238 (0.351) C/NA TNA 2.30 ± 0.012 (0.843) C/NA TNA</td>
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<tr>
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<td></td>
<td>12/21/15 12:30</td>
<td>12/21/15 10:00</td>
<td>Solid</td>
<td></td>
<td>7.07 ± 1.138 (0.290) C/NA TNA 2.33 ± 0.031 (0.197) C/NA TNA</td>
</tr>
<tr>
<td>Radium-226</td>
<td>EPA 001.1</td>
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<td></td>
<td>12/21/15 12:35</td>
<td>12/21/15 10:00</td>
<td>Solid</td>
<td></td>
<td>3.25 ± 0.050 (0.156) C/NA TNA 1.47 ± 0.043 (0.318) C/NA TNA</td>
</tr>
</tbody>
</table>

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**Report of Laboratory Analysis**

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Analytical Result

Minimum Detectable Concentration (MDC)

Uncertainty
Thank You – Questions?

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