Assessment & Enhancement of Hydrocarbon Natural Attenuation using Biofilms

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Assessing Sulphanilamide Catabolic Activity in Boreholes at a Contaminated Site

Six boreholes drilled to 18 m depth (COMACCHIO MC305 Hollow Stem Auger Rig)

1 m 0.1 m core samples removed from 10 m depth and 2 L of groundwater collected

Aerobic & anaerobic flasks prepared and $^{14}$CO$_2$ recorded

Conclusions
Significant levels of catabolic activity were observed in boreholes across the site
Some evidence that where sulphanilamide concentrations were higher catabolic activity was also higher
Difference in levels of catabolic activity under aerobic and anaerobic conditions only in high concentration borehole

But
These measurements are obtained under laboratory conditions

<table>
<thead>
<tr>
<th>Borehole</th>
<th>Sulphanalimide (mg L$^{-1}$)</th>
<th>Aerobic activity (%)</th>
<th>Anaerobic activity (%)</th>
<th>Water (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>263</td>
<td>55</td>
<td>40</td>
<td>7.6</td>
</tr>
<tr>
<td>2</td>
<td>171</td>
<td>9</td>
<td>15</td>
<td>7.6</td>
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<td>11</td>
<td>28</td>
<td>5.6</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>43</td>
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<td>5.6</td>
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<tr>
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<td>3</td>
<td>46</td>
<td>46</td>
<td>5.6</td>
</tr>
<tr>
<td>6</td>
<td>0.3</td>
<td>16</td>
<td>19</td>
<td>4.7</td>
</tr>
</tbody>
</table>

Sigma

Conclusions
Carbon felt & pumice appear most suitable

Issues outstanding
How much lipid mass is required for CSIA analysis
Will the in-situ data reflect the laboratory based microcosm data

Development of In-Situ Sampler

1. Surrogate aquifer material
   - Expanded Perlite
   - Carbon Felt
   - Pumice Stone

2. Material loaded with $^{13}$C tracer & deployed in the field

3. Bio-film develops & $^{13}$C assimilated into biomass

4. $^{13}$C Lipid Extraction
   (Persuasive evidence of biodegradation if $^{13}$C levels increase from ~1 ‰ (natural abundance) to ~ 10,000 ‰)

5. Compound Specific Isotope Analysis
   (See Figure 5)

Borehole 1
263 mg L$^{-1}$ sulphanilamide in groundwater ~ 50% biodegraded

Borehole 5
3 mg L$^{-1}$ sulphanilamide in groundwater ~ 45% biodegraded

Borehole 6
0.3 mg L$^{-1}$ sulphanilamide in groundwater ~ 20% biodegraded