PREPARED BED BIOREMEDIATION OF CONTAMINATED SOILS

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WHAT IS SOIL TREATMENT IN A PREPARED BED?

Land Treatment (Also Known as Landfarming and Land Application) Technology is the Basis for Prepared Bed Soil Remediation

Land Treatment: An above ground remediation technology for soils that reduces concentrations of organic waste constituents through biodegradation.

Technology involves spreading excavated contaminated soils in a thin layer on the ground surface and stimulating aerobic microbial activity within the soils through aeration and/or the addition of nutrients and moisture.

A prepared bed land treatment unit (LTU) is designed with a liner to prevent leaching of waste constituents.
• Landfarming technology developed in petroleum refining industry to treat waste streams in soil

• Landfarms were established at all major oil refineries

• Land "farming" process similar to that used for good agricultural cropping practices (the "crop" in landfarming is the microbes)
  - cultivate for aeration
  - cultivate to mix soils and nutrients
  - fertilize
  - maintain water availability
  - control pH
• Landfarming technology adapted to remediating contaminated soils
  - more monitoring required
  - regulations concerning construction of treatment cells more rigorous
  - costs increased as result of construction standards and monitoring costs
Flux of O₂ into soil by diffusion

1. \[ J_{DM} = -D_a^s \frac{dC}{dx} \]
   - \( D_a^s \) (cm²/s) = diffusion coefficient (soil gas diffusivity)
   - \( C \) = gas conc.
   - \( x \) = soil depth

2. Fick's Second Law
   \[ \phi \frac{dC}{dt} = D_a^s \frac{\partial^2 C}{\partial x^2} + R \]
   - \( \phi = a_i \) (air) porosity
   - \( R = \) gas consumption rate
   - when \( R = 0 \), measure \( \frac{d\phi}{dt} \) and \( \frac{d\phi}{dx} \)

3. \[ \frac{2D_a^3(C_0 - C_a)}{R} = \frac{L^2}{2} \]
Values for bulk density, porosity, and air filled porosity

<table>
<thead>
<tr>
<th>Parameter</th>
<th>0% Moisture</th>
<th>10% Moisture</th>
<th>15% Moisture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk Density (gm/cm³)</td>
<td>1.25</td>
<td>1.22</td>
<td>1.45</td>
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<tr>
<td>Total Porosity</td>
<td>0.53</td>
<td>0.54</td>
<td>0.45</td>
</tr>
<tr>
<td>Air-Filled Porosity</td>
<td>0.53</td>
<td>0.41</td>
<td>0.23</td>
</tr>
</tbody>
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Pore Distribution Model of Oxygen Diffusion in Contaminated Soil. Where Ds is the oxygen diffusivity coefficient $D_o \text{S}$ in the soil gas, and Da is the oxygen diffusivity coefficient in air.
Fig. 29. Schematic of laboratory soil diffusion apparatus.