WiscLEACH© 2.0 Tutorial

Department of Civil and Environmental Engineering
Jackson State University

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Software Website: http://wiscleach.engr.wisc.edu

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WiscLEACH© 2.0

• A web-based computing tool to evaluate groundwater impacts from beneficial use of industrial byproducts in roadway stabilization and embankment/structural fill applications.
  – The tool is based on three analytical solutions to the advection-dispersion-reaction equation that describe transport in the vadose zone and groundwater (Li et al. 2006, 2011)
  – The application was designed to be computationally efficient and can be used without experience in numerical modeling.

• WiscLEACH is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
  – Contact Information for Q & A: Dr. Lin Li (lin.li@jsums.edu), Department of Civil and Environmental Engineering, Jackson State University, Jackson, MS 39217-0168, US
  – Acknowledgement: Financial support for the development of WiscLEACH software was provided by the Recycled Materials Resource Center and Wisconsin Department of Natural Resources Waste Reduction and Recycling Demonstration Grant and Alliant Energy.

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A computing tool to evaluate groundwater impacts from beneficial use of industrial byproducts in roadway stabilization and embankment/structural fill applications. The tool is based on three analytical solutions to the advection-dispersion-reaction equation that describe transport in the vadose zone and groundwater. The application was designed to be computationally efficient and can be used without experience in numerical modeling. © 2011. Developed by Dr. Lin Li at Jackson State University.

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There are nine modules for simulation scenarios:

- Roadway stabilization
  - 2D Model
    - Water leach test
    - Column leach test – adsorption control
    - Column leach test – User defined pattern
  - 3D Model
    - Water leach test
    - Column leach test – adsorption control
    - Column leach test – User defined pattern

- Embankment/Structural Fill Application
  - 3D Model
    - Water leach test
    - Column leach test – adsorption control
    - Column leach test – User defined pattern
Module #1: Roadway Stabilization (2D model) - Water Leach Test

- Select the menu/Roadway Stabilization/2D Model/Water Leach Test

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Initial Webpage After Launching Module #1

Enter input data

Conceptual model in Module #1
Data Input Windows for Module #1

- Enter geometric variables, including point of compliance, pavement width, shoulder width, depth to groundwater table, depth to top of stabilized layer, depth to bottom of stabilized layer.
- Enter precipitation and simulation time.
- Enter hydraulic properties of layers above the groundwater table.
- For water leach test, enter contaminant name and leaching concentration from WLT test. Enter WLT scaling factor, retardation factor in stabilized layer and in subgrade.
Data Input Windows for Module #1 (Cont’)

- Enter aquifer properties.
- Select output at the Point of Compliance.
- Select concentrations are to be reported at monitoring well locations. Enter coordinates of these locations. The coordinates are defined based on the coordinate system shown in conceptual model.
• Enter coordinates of monitoring well locations (maximum locations = 6).

• Select if 2D contour graphs are desired, and enter times when contours are to be output. (maximum contour = 4)
  Note: contouring can require considerable processing time.

• Enter the axis intervals for the contour graph axis.

• Click it to run the WiscLEACH model
WiscLEACH is running in the web browser. The results are calculated.

### 2D Water Leach Test

**Enter Site Parameters:**
- Point of Compliance: 2.0 (m)
- Pavement Width: 10.4 (m)
- Shoulder Width: 1.5 (m)
- Depth to Groundwater: 6.0 (m)
- Depth to Top of Stabilized Layer: 0.10 (m)
- Depth to Bottom of Stabilized Layer: 0.469 (m)
- Infiltration Rate: 0.365 (m/yr)
- Maximum Simulation Time: 200.0 (yr)

**Enter Hydraulic Properties above Groundwater Table:**

<table>
<thead>
<tr>
<th>Property</th>
<th>Pavement</th>
<th>Stabilized Layer</th>
<th>Subgrade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic Conductivity (m/yr)</td>
<td>1.0</td>
<td>1.0</td>
<td>0.042</td>
</tr>
<tr>
<td>Porosity</td>
<td>0.33</td>
<td>0.33</td>
<td>0.33</td>
</tr>
</tbody>
</table>

**Enter Contaminant Properties:**
- Contaminant Name: Cr
- Leaching Concentration from WLT test (mol): 0.04433
- Water Leaching Test Scaling Factor: 4.0
- Retardation Factor in Stabilized Layer: 7.0
- Retardation Factor in Subgrade: 3.5

**Enter Aquifer Parameters:**
- Transferring data from 143.132.96.67.
After simulation, the results are allowed to graphically output.
Webpage to Visualize Model Output for Module #1

After simulation, the concentrations at the monitoring locations are allowed to graphically output. The graphic can be saved as separated file.
After simulation, the maximum concentrations at the POC during the maximum simulation time are plotted. The figure can be saved as separated file.
After simulation, the 2D contour can be plotted (contour shaded or line format) at the specified time. The graphic can be saved as separated file.
Module #2: Roadway Stabilization (2D model) - Column Leach Test – Adsorption Controlled

- Select the menu/Roadway Stabilization/2D Model/Column Leach Test – Adsorption Controlled

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Conceptual model in Module #2

Enter input data

Conceptual model in Module #2
Data Input Windows for Module #2

- Date input are similar to Module #1, except:
  - For column leach test – adsorption controlled module, enter column leaching data where adsorption-controlled release can be assumed with instantaneous linear and reversible sorption.
Module #3: Roadway Stabilization (2D model) - Column Leach Test – User Defined Pattern

Select the menu/Roadway Stabilization/2D Model/Column Leach Test – User Defined Pattern

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Initial Webpage After Launching Module #3

Enter input data

Conceptual model in Module #3
Data Input Windows for Module #3

- Date input are similar to Module #1, except:
  - For column leach test – user defined pattern module, enter leachate concentrations at various time.
Module #4: Roadway Stabilization (3D model) - Water Leach Test

• Select the menu/Roadway Stabilization/3D Model/Water Leach Test

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Initial Webpage After Launching Module #4

Enter input data

Conceptual model in Module #4
Data Input Windows for Module #4 (Cont’)

- Date input are similar to Module #1, except
  - Enter lateral grid space.
  - Enter lateral dispersivity.
Data Input Windows for Module #4 (Cont’)

- Date input are similar to Module #1, except:
  - Enter lateral location for POC
  - Enter lateral location for MW locations
  - Enter lateral location for contours
Webpage to Visualize Model Output for Module #4

After simulation, results can be plotted and saved as separated file.
Module #5: Roadway Stabilization (3D model) - Column Leach Test – Adsorption Controlled

- Select the menu/Roadway Stabilization/3D Model/Column Leach Test – Adsorption Controlled

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Initial Webpage After Launching Module #5

Enter input data

3D Column Leach Test - Adsorption Controlled

Enter Site Parameters:
- Point of Compliance: 20.0 (m)
- Pavement Width: 10.4 (m)
- Shoulder Width: 1.5 (m)
- Lateral CCRs Half Width in y-direction: 0.5 (m)
- Depth to Groundwater: 6.0 (m)
- Depth to Top of Stabilized Layer: 0.38 (m)
- Depth to Bottom of Stabilized Layer: 0.68 (m)
- Infiltration Rate: 0.365 (m/yr)
- Maximum Simulation Time: 100.0 (yr)

Enter Hydraulic Properties above Groundwater Table:

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Pavement</th>
<th>Base</th>
<th>Stabilized Layer</th>
<th>Subgrade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic Conductivity (m/yr)</td>
<td>18.25</td>
<td>3650</td>
<td>0.19</td>
<td>1.0</td>
</tr>
<tr>
<td>Porosity</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
</tr>
</tbody>
</table>

Enter Contaminant Properties:
- Contaminant Name: Cadmium
- Initial Effluent Concentration from CLT test (mg/l): 0.032
- Scaling Factor (Default=1): 1.0
- Retardation Factor in Stabilized Layer: 3.5
- Retardation Factor in Subgrade: 3.6

Conceptual model in Module #5
Data Input Windows for Module #5

- Date input are similar to Module #4, except:
  - For column leach test – adsorption controlled module, enter column leaching data where adsorption-controlled release can be assumed with instantaneous linear and reversible sorption.
• Select the menu/Roadway Stabilization/3D Model/Column Leach Test – User Defined Pattern

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Initial Webpage After Launching Module #6

Enter input data

Conceptual model in Module #6
Data Input Windows for Module #6

- Date input are similar to Module #4, except:
  - For column leach test – user defined pattern module, enter leachate concentrations at various time.
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- Select the menu/Embankment/Structural Fill Applications/3D Model/Water Leach Test
Initial Webpage After Launching Module #7

Enter input data

Enter Site Parameters:
- Point of Compliance: 30.0 (m)
- Pavement Width: 6.0 (m)
- Shoulder Width: 4.0 (m)
- Lateral Byproduct Half Width in y-direction: 0.5 (m)
- Depth to Groundwater: 10.0 (m)
- Depth to Top of Byproduct Layer: 1.0 (m)
- Depth to Bottom of Byproduct: 4.0 (m)
- Depth to Ground Surface: 5.0 (m)
- Embankment Side Slope H:V: 2.00 (m)
- Infiltration Rate: 0.19 (m/yr)
- Maximum Simulation Time: 300.0 (yr)

Enter Hydraulic Properties above Groundwater Table:

<table>
<thead>
<tr>
<th>Property</th>
<th>Pavement</th>
<th>Base</th>
<th>Compact Clay Layer</th>
<th>Byproduct Layer</th>
<th>Subgrade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic Conductivity (m/yr)</td>
<td>18.26</td>
<td>3660</td>
<td>0.042</td>
<td>1.0</td>
<td>3.66</td>
</tr>
<tr>
<td>Porosity</td>
<td>0.33</td>
<td>0.33</td>
<td>0.33</td>
<td>0.33</td>
<td>0.33</td>
</tr>
</tbody>
</table>

Enter Contaminant Properties:
- Contaminant Name: Cadmium
- Are byproducts in different layers? Yes No
Data Input Windows for Module #7 (Cont’)

- Date input are similar to Module #4, except
  - Select the byproducts in different layer. If “No”, the byproducts is in one layer. Enter the WLT concentration and scaling factor.
  - If “Yes”, the byproducts are in different layers. Enter WLT concentration in each Δz layer.
Data Input Windows for Module #7 (Cont’)

• Date input are similar to Module #4, except:
  – Enter lateral location for POC
  – Enter lateral location for MW locations
  – Enter lateral location for contours
Webpage to Visualize Model Output for Module #7

After simulation, results can be plotted and saved as separated file.
Module #8: Embankment/Structural Fill Applications (3D model) - Adsorption Controlled

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• Select the menu/Embankment/Structural Fill Applications/3D Model/Adsorption Controlled
Initial Webpage After Launching Module #8

Enter input data

Conceptual model in Module #8
Data Input Windows for Module #8

• Date input are similar to Module #7, except:
  – For column leach test – adsorption controlled module, enter column leaching data where adsorption-controlled release can be assumed with instantaneous linear and reversible sorption.
Module #9: Embankment/Structural Fill Applications (3D model) - User Defined Pattern

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• Select the menu/Embarkment/Structural Fill Applications/3D Model/User Defined Pattern
Initial Webpage After Launching Module #9

Enter input data

Conceptual model in Module #9
Data Input Windows for Module #9

- Date input are similar to Module #7, except:
  - For column leach test – user defined pattern module, enter leachate concentrations at various time.
Software Developers

• The algorithms used in WiscLEACH© 2.0 were developed by Dr. Lin Li of Jackson State University.

• The web-based WiscLEACH © 2.0 were developed by Dr. Lin Li, Dr. Duanjun Lu, and Ms. Cindy Mei Wu of Jackson State University.
Publications on WiscLEACH


