TDA Septic System Studies at the University at Buffalo

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June 2, 2009
Project 1: Concept through Prototype: Pilot Scale Studies at Amherst NY POTW

Pilot Scale testing of TDA carried out at POTW to evaluate:

- Hydraulic Permeability
- Treatment Performance
- Chemical Leachability
Project 1: Concept through Prototype: Pilot Scale Studies at Amherst NY POTW

All parameters were tested on old tires, new tires, and stone in parallel units.
Permeability of TDA is equivalent to stone (horizontal & vertical).

Age of Tires had no effect on performance.

Based on pilot scale testing, tire chip aggregate provided equal treatment of wastewater constituents such as BOD$_5$, COD, TSS, ammonia-nitrogen, and nitrate.
Leaching under conditions operative in leachfields contribute little detectable semivolatile and no detectable volatile organic compounds which are of concern for groundwater protection.

Analine was the only semivolatile.

Leaching under the same conditions results in higher metal concentrations.

Barium, iron, manganese, and zinc were found in concentrations above baseline (stone). Lead was non-detect.
Of the metals observed in higher concentrations, only iron and manganese were typically above groundwater effluent limitations for Class GA groundwater.

For both iron and manganese, the MAC is 600 ug/L.
In 2000, a full-scale septic system using TDA was installed in Niagara County.

It serves a tire recycling facility, employing 12-15 persons over two shifts comparable to a 4-person household.
Project 1: Concept through Prototype:
Development of Pilot Scale System at Modern

✓ Most recent data for septic system effluent: Summer, Fall 2008
✓ Average flow: 160 gal/d
✓ Average BOD₅ = 97 mg/L
✓ Average VSS = 32 mg/L
**Project 1: Concept through Prototype:**
Development of Pilot Scale System at Modern

<table>
<thead>
<tr>
<th>Trench</th>
<th>Aggregate</th>
<th>Soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1&quot; Tire</td>
<td>Sand</td>
</tr>
<tr>
<td>2</td>
<td>Stone</td>
<td>Sand</td>
</tr>
<tr>
<td>3</td>
<td>2&quot; Tire</td>
<td>Sand</td>
</tr>
<tr>
<td>4</td>
<td>2&quot; Tire</td>
<td>Clay/Silt</td>
</tr>
<tr>
<td>5</td>
<td>Stone</td>
<td>Clay/Silt</td>
</tr>
<tr>
<td>6</td>
<td>1&quot; Tire</td>
<td>Clay/Silt</td>
</tr>
<tr>
<td>7</td>
<td>2&quot; Tire</td>
<td>Clay/Silt</td>
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<tr>
<td>8</td>
<td>Stone</td>
<td>Clay/Silt</td>
</tr>
<tr>
<td>9</td>
<td>1&quot; Tire</td>
<td>Clay/Silt</td>
</tr>
</tbody>
</table>

- **Legend:**
  - ○ - Well
  - ----- - Trench

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**Center for Integrated Waste Management**
The State University of New York
Project 1: Concept through Prototype: Development of Pilot Scale System at Modern
Project 1: Concept through Prototype: Development of Pilot Scale System at Modern

✓ Water Levels measured weekly for nearly two years in each trench and compared based on media type

✓ For soils rated at 5-10 MPI:
  1” & 2” TDA performed as well as stone or better.

✓ For soils rated at 45-60 MPI:
  2” TDA = or > stone.  1” TDA slightly < than stone.
Continuing Concerns Associated with Using TDA in Septic Systems

- **Integrity**
  - Ability to retain its shape?
  - Support distribution pipe?
- **Hydraulic performance**
  - Clogging?
  - Dissipation of applied wastewater to surrounding soils (conductivity?)
- **Chemical release**
  - Harmful chemical constituents?
Project 2 – Long Term Performance
Continuing Studies at Modern Pilot System

✓ Slug Tests to Evaluate Hydraulic Permeability as Opposed to Weekly Trench Levels
According to the Hvorslev solution, it is expected that a plot of $\log dh$ versus time ($t$) would be linear.

![Graph showing log head versus time for Trench 3 - Test 1, Well A Hvorslev Model Linearized]
Project 2 – Long Term Performance Continuing Studies at Modern Pilot System

- Sandy Soil Slug Tests:
  - 1 inch TDA filled absorption trenches and stone filled trenches performed equally well in sandy soils
  - 2 inch TDA filled trenches hydraulically outperforms both 1 inch TDA and stone aggregates in sandy soils

- Clay Soil Slug Tests:
  - 1 inch and 2 inch TDA hydraulic performances were statistically similar and both outperformed the stone
Thirty TDA samples were randomly selected from each of the three lifts (0”-6”, 6”-12”, and 12”-18”)

Ten of the thirty samples were digitally imaged into AutoCAD and examined for wire length and overall physical integrity
Project 2 – Long Term Performance
Continuing Studies at Modern Pilot System
Project 2 – Long Term Performance
Continuing Studies at Modern Pilot System

Aggregate Excavation

- Stratified sampling
- Wire length is substantially decreased due to corrosion
- Physical integrity of TDA appears intact
Corrosion results in loss of metals, primarily Fe, Mn, Zn, and Ba from wire.
Organics may leach from the rubber material.
These chemicals may migrate into the soils underlying the aggregate.
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Evaluation of Soil Metal Concentrations Beneath Aggregate

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Underlying Soil Concentrations

Trench 2 Stone Iron Concentrations

Concentration (mg/kg)

Depth (inches)

Iron
Sand Background Iron
Tudini Iron
Tudini Background Iron
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Underlying Soil Concentrations

Trench 1 1 Inch TDA Iron Conc

Concentration (mg/kg)

Depth (inches)

Iron
Sand Background Iron
Tudini Iron
Tudini Background Iron
Underlying Soil Concentrations

Trench 6 1 Inch TDA Zinc Conc

Depth (inches)

Concentration (mg/kg)

- Zinc
- Clay Background Zinc
- NYS Unrestricted SCO
- Tudini Zinc
- Tudini Background Zinc
Underlying soil metal concentrations for Fe and Zn were elevated at the TDA/soil interface over background based on the presence of TDA.

Underlying soil metal concentrations for Zn, Ba, Cr, Mn and Pb, were not elevated over background based on the presence of TDA.

There were statistically significant differences for iron.
Except at the interface where precipitates might accumulate, no concentrations of metals measured were higher than unrestricted NYS Soil Cleanup Objectives.

Reasonably good match between the two sample dates with the exception of the interface concentration
Project Conclusions to Date: Process

- The long term integrity of TDA as an alternative to stone is good based on nearly ten years of field data.
- Hydraulic permeability of TDA is equal or better than stone.
- Treatment potential by biofilms attached to TDA are equal to those of stone.
Project Conclusions to Date: Environmental

- Organics leach little if at all from TDA in short term leaching tests and contribute no detectable organics to underlying soil strata in long term testing.
- Metals do leach and of these, only iron seems to leach at flux rate sufficient to increase soil iron concentrations beyond the soil/TDA interface.
- Other metals that leach are manganese, zinc and barium.
- Lead, often cited as a concern, does not appear to be a concern.
Project 3 – Long Term Performance: Laboratory Studies/Model Predictions

- Current studies at UB focusing on the rate of corrosion in non-saturated conditions to mimic septic systems and curtain drains, etc.
- Goal is a predictive model for these factors
Project 3 – Long Term Performance: Laboratory Studies/Model Predictions

Bench scale studies to evaluate corrosion rates as a function of pH and salt level
Daily measurements of effluent for metals, alkalinity, TDS, pH
No metal results to date but columns have been running for about three months
Data will allow calibration of a corrosion model to predict rates of metal release
Column effluent may be used for subsequent soil column studies