Groundwater Recharge of Urban Runoff after Biological Treatment in Geotextile Filters

Cevat Yaman, Ph.D., Eyup Korkut, Ph.D. and Roger Marino

Stormwater Runoff Impacts on Stream Quality

- Frequent flows from impervious surfaces
- Reduced groundwater recharge
- Pathogens (animal derivation)
- Suspended Solids (degradable and inert)
- Reduction in biodiversity
- Aesthetic and recreational value
Plan View of a Typical Separate Sewer System Configuration

Objectives

1-To capture suspended solids from runoff, colonize a geotextile filter with the attached microorganisms and decompose organics.
2-To limit permeability loss from solids accumulation by maintaining biomass in an endogenous condition that mineralizes the substrate.
3- To provide a well-treated effluent for local groundwater recharge.
Layout of a Local Runoff Treatment and Recharge System

Physical Classification of Stormwater Constituents

1- Screenable floating litter
2- Settleable organic and inorganic solids
3- Colloidal inorganic solids (silt and clay)
4- Hydrocarbon fuel and lubricant globules and solutes
5- Colloidal organic solids
6- Dissolved organics
7- Dissolved inorganic solids
Profile of a Treatment and Recharge System

Geotextile Biofilters
Advantages of Dispersed Runoff Recharge

• Removal of worst quality urban runoff from stream inflow

• Promotion of groundwater recharge and base flow of nearby waterway

• Does not promote basement flooding

Laboratory Setup of Geotextile Filter Columns
Woven Geotextile

SEM Picture of a Nonwoven Geotextile
Nonwoven Geotextile with Biomass Growth

TSS Removals

TSS Removal Rates

Rounds

Initial TSS
Final TSS
BOD$_5$ Removals

NH$_4$ Removals
Permeability vs HLR

K Residual vs HLR

(3a and 5a indicate fresh GT replacement)

Permeability Loss vs HLR
Geotextile Samples with Biomass

Permeability Results of the Two-filter Phase

<table>
<thead>
<tr>
<th></th>
<th>$K_{\text{initial}}$ cm/sec</th>
<th>$K_{\text{final}}$ cm/sec</th>
<th>$K_{\text{loss}}$ cm/sec</th>
<th>$K_{\text{loss}}$ %</th>
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</thead>
<tbody>
<tr>
<td>Aerobic Geotextile Column</td>
<td>0.927</td>
<td>0.925</td>
<td>0.002</td>
<td>0.2</td>
</tr>
<tr>
<td>Granular Column</td>
<td>0.758</td>
<td>0.660</td>
<td>0.098</td>
<td>13</td>
</tr>
</tbody>
</table>
Conclusions

• The concept of this study appeared to be applicable to dispersed “non-point” sources such as stormwater (urban).

• Porous NW GTs provided secondary standards in treatment, removing TSS and BOD$_5$ (< 10 mg/l) and Ammonia nitrogen (< 2 mg/l).

• HLR is only limited by the natural soil permeability.