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# Field-Scale Performance of Liquid Injection in a Landfill Using Permeable Blankets

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Environmental and economical benefits of liquid injection or leachate recirculation in municipal solid waste (MSW) landfills are well documented. These benefits include: (1) reduction in leachate treatment and disposal costs; (2) accelerated decomposition and settlement of waste resulting in an airspace gain; (3) increase in the rate of gas production; and (4) potential reduction in the post-closure care period and associated costs.

## Conventional Liquid Injection Methods

Most common liquid injection techniques are broadly divided into surface and subsurface application. Surface application consists of: (1) direct application of liquid or spray irrigation of liquid on landfill surface; and (2) surface ponding of liquids. Subsurface application consists of: (1) vertical wells; and (2) horizontal trenches.

Vertical wells and horizontal trenches are the most common liquid injection methods used at relatively old and relatively new, MSW landfills, respectively. Disadvantages and limitations of vertical wells and horizontal trenches include: (1) during installation, excavation of waste may cause odor problems; (2) relatively high capital cost compared to the amount or flux of liquid that can be injected; and (3) potential zones of "dry pockets" between wells or trenches where liquid front cannot reach and hence cannot wet the waste. Such dry pockets can lead to differential settlement of waste and hence higher cap maintenance costs.

## Liquid Injection Using Permeable Blankets

A permeable blanket consists of material having relatively high hydraulic conductivity ($\geq$ 1 cm/s) laid on top of a relatively flat waste surface in a landfill. Thickness of such blanket can range from 100 mm to 500 mm. A perforated pipe is embedded at the center of such blanket where liquid is injected. The key advantages of granular blankets over conventional leachate recirculation methods are: (1) excavation of waste is not needed during the construction of blanket resulting in less odor problems; (2) more uniform distribution of liquid in the landfill potentially reducing differential settlement and resulting post-closure maintenance costs; and (3) significantly greater flux of liquids can be injected in the landfill per unit volume of waste compared to conventional methods for an equivalent capital expenditure.

In this paper we have presented preliminary data we collected from two field-scale permeable blankets made up of recycled shredded tires and crushed glass constructed at an MSW landfill located in Michigan.

These blankets are about 60 m long by 10 m wide each and were instrumented with total 30 embedded sensors to measure water content, pore water pressure, temperature, and vertical stress. A schematic of an instrumented blanket is presented in Fig. 1 and photos of the field-scale blankets are presented in Fig. 2.

Liquid injection trials were conducted at rates ranging from 0.6 to 3.2 $m^3$/hr/m after the blankets were covered with waste. The data collected from the sensors indicated that the injected leachate traveled at rates ranging from 5 m/hr to 100 m/hr depending upon the blanket and the injection flux. The leachate flow through the crushed glass blanket was more uniform compared to the shredded tires blanket. The liquid injection resulted in liquid pressure head build up in the blanket. However, the pressure heads dissipated soon after the leachate injection was turned off. The liquid pressure heads in the blanket were always less than the injection pressure head. This finding is significant as it: (1) demonstrates the hydraulic continuity of the blanket; and (2) dismisses the myth that liquid pressures in the landfill can be greater than the injection pressure for a hydraulically connected subsurface system.

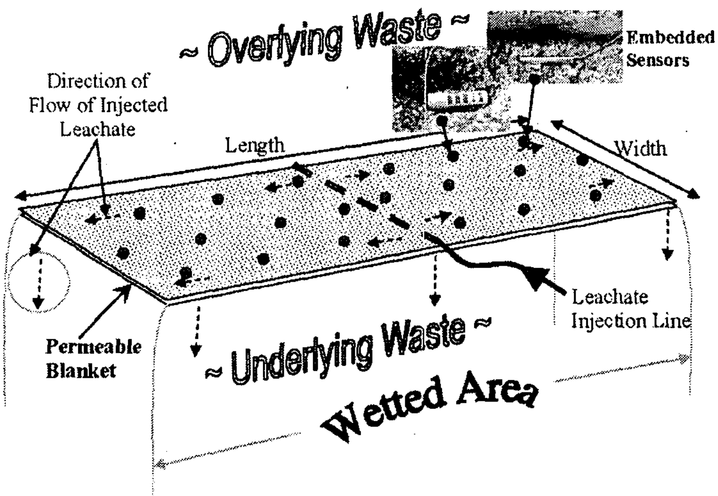


Figure 1: Schematic of an instrumented permeable blanket

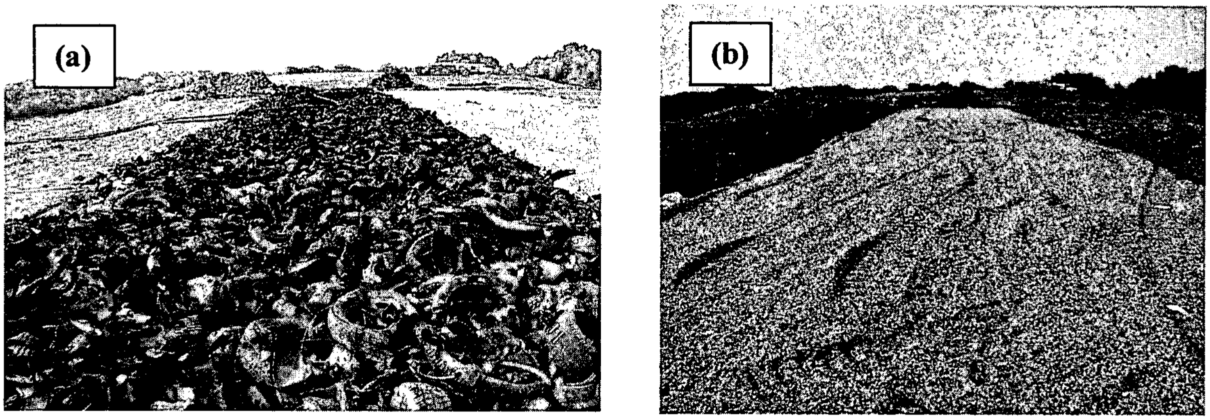


Figure 2: Photograph of the field-scale permeable blankets constructed at an MSW landfill made up of recycled (a) shredded tires; and (b) crushed glass.

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