Impact of differential settlement on leakage through geomembranes in waste covers: A field and numerical investigation

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Abstract. This study evaluates the impact of differential settlement on leakage through geomembrane holes in landfill and mine tailings covers. Conducted at the Queen's University Experimental Liner Test Site, the research spanned two sections with 4H:1V slopes over 13 months. Section B, featuring a 3 m x 2 m depression (0.12 - 0.17 m deep), exhibited a 51-fold increase in leakage compared to the uniform Section A without depression (493L vs 11.1 L). Intriguingly, during colder months with lower precipitation, leakage in Section B surged by 43%, contrary to the lesser leakage observed during warmer, wetter months. 3D numerical models corroborate these findings, attributing the increased leakage during cold periods to reduced temperature-induced hydraulic conductivity of the cover sand. The research provides insights for design and inspection to effectively manage contaminant leakage in waste covers.

First field experiment to quantify the effect of differential settlement on leakage through a geomembrane hole for waste cover applications (Fig. 1, 2). Comparison of substantial leakage increase due to depression versus a slope without differential settlement (Fig. 3). Use of a calibrated 3D numerical model to illustrate increased leakage at colder temperatures for equivalent precipitation levels (Fig. 4).

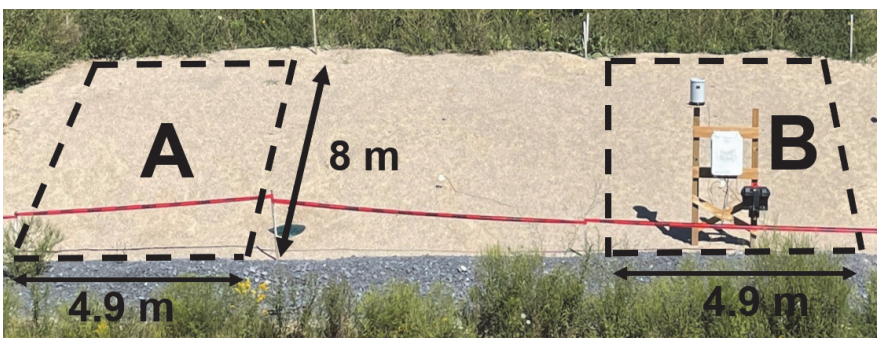

Fig. 1 Constructed Sections A and B.

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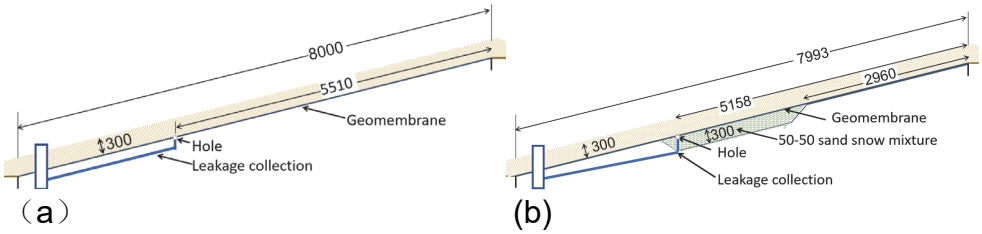

Fig. 2 Cross sections of the field GMB leakage experiments (a) Section A (b) Section B (unit: mm)

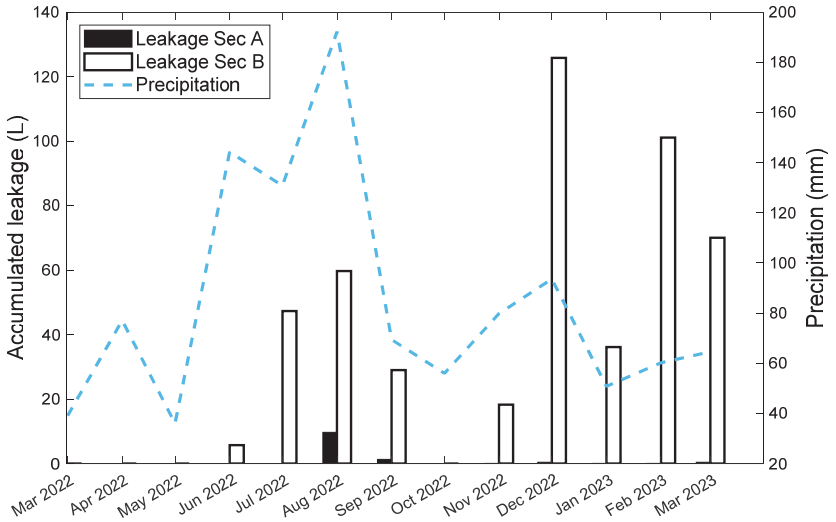

Fig. 3 Monthly precipitation and leakage: Section A vs Section B

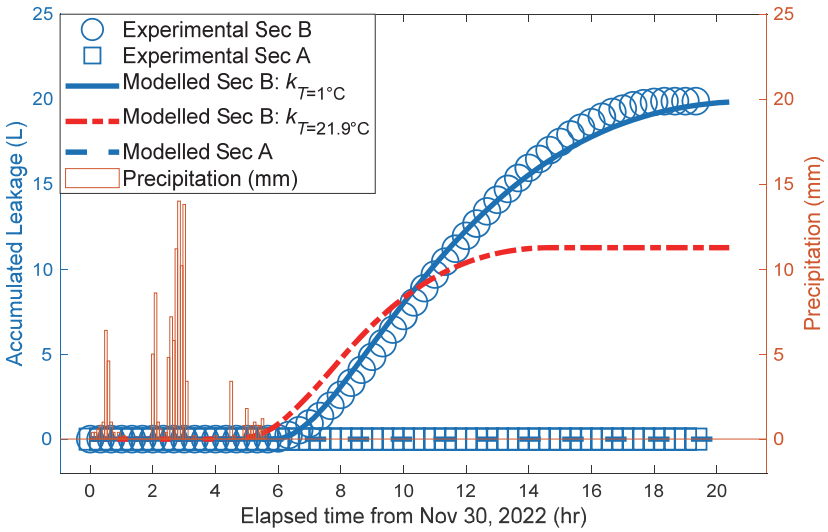

Fig. 4 Leakage over time following 23.1 mm rainfall event since November 30