# landfilldesign.com

## HELP Model
## Hydraulic Evaluation of Landfill Performance

### Problem Statement

The US EPA's HELP (Hydraulic Evaluation of Landfill Performance) model, Schroeder et al. (1994), is a tool for analyzing water balance in landfill lining and capping systems. However, a proper simulation of geocomposite lateral drainage layers in the HELP Model is not well established. A misinterpretation of the model's output results could lead to an unsafe design of the drainage systems in landfills.

Download HELP Model version 3.07 from http://el.erdc.usace.army.mil/products.cfm?Topic=model&Type=landfill.

#### Points for Consideration

1) It was demonstrated that the maximum head on the liner, as calculated by McEnroe's equation, is valid only when the head lies within the thickness of the geocomposite, Ellithy and Zhao (2001). In other words, an unconfined flow has to be maintained within the drainage medium (geosynthetic lateral drainage material in this case) in order to ensure the validity of the McEnroe's equation, Giroud, Zornberg and Zhao (2000). Therefore, the "Max. Head" per the HELP Model output is invalid if it is greater than the drainage layer thickness. In that case, another simulation run has to be performed considering thicker and/or more permeable drainage layer. A valid result is obtained when the calculated head is within the input thickness of the geocomposite drainage layer.

2) Geosynthetic geocomposites are made from polymeric materials which tend to creep over time under sustained normal loads. Reduced thickness causes a reduction in the flow channel, therefore, a reduction in its transmissivity. Other factors such as intrusion of adjacent layers, biological and chemical clogging also cause reduction in Transmissivity values of the geocomposite drainage system. Therefore, it is critical to take long term design-based dimensional and hydraulic characteristics of the geosynthetic drainage layers into the HELP Model input to ensure accurate representation of the performance of the geocomposite.

3) It has been shown that the HELP Model, by incorporating daily average weather data, grossly underestimates the actual impingement rate into the drainage systems, and hence underestimates the head on the liner and results in undersized drainage system, Soong and Koerner (1997). Under-designed drainage systems cause a saturated condition in the overlying soil layer. The detrimental effect of seepage force can be catastrophic especially on side slopes in landfill capping systems. Updated weather data could be incorporated in the HELP Model to give more accurate representation on the current weather data, Ellithy and Zhao (2001).

4) For the design of lateral drainage systems in landfill capping systems, unit gradient approach is recommended for its simplicity and conservative nature. Unit gradient design assumes the impingement rate equal to the hydraulic conductivity of the overlying soil layer. This provides the worst case scenario that is also likely to occur during the life time of the system, considering the extreme weather pattern in recent years.

Please use our Contact Us page to assist you in any of your design needs

### References

Below is a list of papers and reports referred to above. You can download the full text/abstract in *.pdf (Acrobat) format. For more related references on the subject, please visit www.landfilldesign.com.

Ellithy, G., Zhao, A. (2001), "Using HELP Model for Designing Geocomposite Drainage Systems in Landfills", Proceedings of Geosynthetics Conference 2001, Portland, pp. 893-903.

Giroud, J.P., Zornberg, J.G., and Zhao, A. (2000), "Hydraulic Design of Geosynthetic and Granular Liquid Collections Layers", Geosynthetic International, Special Issue on Liquid Collection Layers, Vol. 7, Nos. 4-6. pp. 285-380.

Soong, T.Y. and Koerner, R.M. (1997), "The Design of Drainage Systems Over Geosynthetically Lined Slopes", Geosynthetics Research Institute, Report #19.

Schroeder, P.R., Dozier, T.S., Zappi, P.A., McEnroe, B.M., Sjostrom, J.W. and Peton, R.L. (1994), "The Hydrologic Evaluation of Landfill Performance (HELP) Model:Engineering Documentation for Version 3", EPA/600/R-94/168b, US. Environmental Protection Agency, Risk Reduction Engineering Laboratory, Cincinnati, OH.