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Maximum Allowable Gas Pressure for SCA Final Cover System Veneer Stability

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CALCULATION PACKAGE COVER SHEET

Client: Honeywell **Project:** Onondaga Lake SCA Final Cover Design **Project/Proposal #:** GD5497

TITLE OF COMPUTATIONS **MAXIMUM ALLOWABLE GAS PRESSURE FOR SCA FINAL COVER SYSTEM VENEER STABILITY**

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MAXIMUM ALLOWABLE GAS PRESSURE FOR SCA FINAL COVER SYSTEM VENEER STABILITY

PURPOSE

The purpose of the analysis presented in this calculation package is to evaluate the maximum allowable gas pressure that can be applied underneath the geomembrane component of the Sediment Consolidation Area (SCA) final cover system before it results in an unacceptable veneer stability factor of safety.

METHODOLOGY

Static slope stability analysis of a cover system considering gas pressure underneath the geomembrane can be estimated using an infinite slope stability analysis developed by Thiel [1998]. The infinite slope stability factor of safety equation, as formulated by Thiel [1998], is:

$$FS = \frac{\alpha + (\gamma H cos\beta - u_{g-allow}) tan\delta}{\gamma H sin\beta} \quad (1)$$

where:

FS	=	target factor of safety;
α	=	geomembrane interface adhesion;
γ	=	unit weight of the soil cover on top of the geomembrane;
H	=	thickness of the soil cover on top of the geomembrane;
β	=	slope inclination;
δ	=	geomembrane interface friction angle; and
$u_{g\text{-}allow}$	=	maximum allowable gas pressure.

Rearranging the above equation, the maximum allowable gas pressure underneath the geomembrane layer of the final cover system corresponding to a specified factor of safety can be calculated using the following equation:

$$u_{g-allow} = (\gamma\ H\ cos\beta) - \frac{(FS\ \gamma\ H\ sin\beta - \alpha)}{tan\delta} \quad (2)$$

DESIGN PARAMETERS

Evaluation of the maximum allowable gas pressure underneath the SCA final cover system requires information on the interface shear strength between the components of the final cover system. The following parameters are used in the analyses presented herein:

γ	=	120 pcf, average unit weight for SCA final cover system soil layers;
H	=	2.0 ft, as shown in the design drawings;
β	=	16.7° (3.33 horizontal to 1 vertical slope, steepest final cover slope);
α	=	100 psf, as described below;
δ	=	30°, as described below; and
FS	=	1.50, target.

The values for interface adhesion (α) and interface friction angle (δ) are selected based on typical values from technical literature [Koerner and Narejo, 2005] for the most critical interface in the final cover system (i.e., interface between the non-woven geotextile and the leveling layer material).

RESULTS & SUMMARY

Analyses are performed to evaluate the maximum allowable gas pressure ($u_{g\text{-allow}}$) using the assumed interface shear strength parameters for the critical interface of the SCA final cover system and the steepest slope of the final cover.

$$u_{g-allow} = (120\ pcf \times 2\ ft \times \cos 16.7°) - \frac{(1.50 \times\ 120.0\ pcf \times 2.0\ \text{ft}\ \times\ \sin 16.7° - 100.0\ psf)}{\tan 30.0°}$$

$$u_{g-allow} = 223.9\ psf\ = 43.0\ inch\ H_2O = 0.11\ atm$$

The maximum allowable gas pressure underneath the geomembrane layer of the final cover system is calculated as 223.9 psf (equivalent to 43.0 inches of water column or 0.11 atm), as shown above.

REFERENCES

Koerner, G.R., D. N. Narejo (2005). "Direct shear database of geosynthetic-to-geosynthetic and geosynthetic-to-soil interfaces." *Geosynthetic Research Institute*, GRI Report #30.

Thiel, R.S. (1998). "Design methodology for a gas pressure relief layer below a geomembrane landfill cover to improve slope stability," *Geosynthetics International*, 5, 589-617.