

## COMPARISON BETWEEN THE DRAINAGE CAPACITY OF A 30 CM THICK GRANULAR LAYER AND THE DRAINAGE CAPACITY OF INTERDRAIN GEOCOMPOSITES IN LANDFILL CAPS

### 1. DRAINAGE CAPACITY OF THE GRANULAR LAYER

The drainage capacity of a natural granular layer can be estimated using Darcy's Law:

$$q = K \cdot i \cdot e \quad (\text{Darcy})$$

Where:

- q: flow per unit of length (m<sup>3</sup>/s/m)
- K: permeability = 10<sup>-3</sup> m/s (typical permeability of gravel used in landfills)
- i: hydraulic gradient (adimensional)
- e: thickness of the granular layer = 0.3 m

### 2. DRAINAGE CAPACITY OF INTERDRAIN DRAINAGE GEOCOMPOSITES

The drainage capacity of a drainage geocomposites estimated using the Transmissivity Test (ISO 12958-1999) and depends on:

- the normal pressure on the plane of the geosynthetic
- the hydraulic gradient
- surrounding conditions

The drainage capacity of the drainage geocomposite at various pressures (10, 20, 50, 200, 500kPa) and gradients (i=0.03, i=0.1, i= 0.5 and i=1) is found using the Transmissivity Test.

In the case of a landfill cap, the pressure on the drainage geocomposite will be less than:

$$\sigma = \gamma \cdot h = 20 \cdot 1 = 20 \text{ kN/m}^2 = 20 \text{ kPa}$$

Where:

- h = maximum depth = 1 m
- $\gamma$  = density of the ground = 20 kN/m<sup>3</sup>

The hydraulic gradient is defined as:  $i = \frac{\delta h}{L} = \text{sine } \beta$

Where:

- $\delta h$ : loss of pressure head (m)
- L: distance covered by the fluid along the direction of flow (m)
- $\beta$ : slope angle

The flows corresponding to other gradients not tested are estimated using the following expression:

$$q_{i_2} = q_{i_1} \cdot \frac{\sqrt{i_2}}{\sqrt{i_1}} \quad (\text{Rimoldi, 1989})$$

Where:

- $q_{i_1}$ : drainage capacity corresponding to the gradient tested  $i_1$  (m<sup>3</sup>/s-m)
- $q_{i_2}$ : unknown drainage capacity corresponding to the untested gradient  $i_2$  (m<sup>3</sup>/s-m)
- $i_1$ : tested hydraulic gradient immediately above the gradient  $i_2$
- $i_2$ : Hydraulic gradient corresponding to the desired drainage capacity.

*This calculation is the result of our revised and corrected knowledge. INTERMAS refuses to accept any responsibility deriving from its use in works schemes and provides it purely for information purposes.*

### 3. DRAINAGE CAPACITY OF GRANULAR MATERIAL VS INTERDRAIN GEOCOMPOSITES: RESULTS, COMPARISON AND SAFETY FACTORS

In the following table, the drainage capacity of a 30 cm layer of gravel is calculated (using Darcy) and that of INTERDRAIN drainage geocomposites for different gradients (possible slope inclinations) submitted to 20 kPa of pressure (corresponding to 1m of earth). The two values obtained are compared by calculating the safety factor (SF =  $\frac{q_{\text{INTERDRAIN}}}{q_{\text{GRAVAS}}}$ ).

LANDFILL CHARACTERISTICS			DRAINAGE GRAVEL FLOW			FLOW DRAINED BY INTERDRAIN GMG GEOCOMPOSITES						FLOW DRAINED BY INTERDRAIN GM GEOCOMPOSITES					
i	$\beta$	$\sigma$	K GRAVELS	t GRAVELS	q GRAVELS	q GMG412		q GMG512		q GLG612		q GM412		q GM512		q GL612	
gradient	slope angle	pressure	permeability	thickness	flow	flow	SF	flow	SF	flow	SF	flow	SF	flow	SF	flow	SF
-	°	kPa	m/s	m	m <sup>3</sup> /s/m	l/s/m	-	l/s/m	-	l/s/m	-	l/s/m	-	l/s/m	-	l/s/m	-
0.02	1.15	20	10 <sup>-3</sup>	0.30	0.01	0.06	6.00	0.11	11.00	0.17	10.00	0.13	13.00	0.15	15.00	0.23	23.00
0.05	2.87	20	10 <sup>-3</sup>	0.30	0.02	0.09	4.50	0.16	8.00	0.27	7.50	0.21	10.50	0.23	11.50	0.36	18.00
0.1	5.74	20	10 <sup>-3</sup>	0.30	0.03	0.13	4.33	0.28	9.33	0.38	7.33	0.30	10.00	0.33	11.00	0.51	17.00
0.2	11.54	20	10 <sup>-3</sup>	0.30	0.06	0.22	3.67	0.42	7.00	0.58	7.17	0.52	8.67	0.59	9.83	0.81	13.50
0.3	17.46	20	10 <sup>-3</sup>	0.30	0.09	0.27	3.00	0.51	5.67	0.71	5.78	0.64	7.11	0.73	8.11	1.00	11.11
0.4	23.58	20	10 <sup>-3</sup>	0.30	0.12	0.31	2.58	0.60	5.00	0.82	5.08	0.74	6.17	0.84	7.00	1.15	9.58
0.5	30	20	10 <sup>-3</sup>	0.30	0.15	0.35	2.33	0.67	4.47	0.92	4.53	0.83	5.53	0.94	6.27	1.28	8.53
0.6	36.87	20	10 <sup>-3</sup>	0.30	0.18	0.48	2.67	0.90	5.00	1.16	6.44	0.98	5.44	1.27	7.06	1.48	8.22
0.7	44.43	20	10 <sup>-3</sup>	0.30	0.21	0.52	2.48	0.97	4.62	1.25	5.95	1.05	5.00	1.37	6.52	1.60	7.62
0.8	53.13	20	10 <sup>-3</sup>	0.30	0.24	0.55	2.29	1.04	4.33	1.34	5.58	1.13	4.71	1.47	6.13	1.71	7.13
0.9	64.16	20	10 <sup>-3</sup>	0.30	0.27	0.59	2.19	1.10	4.07	1.43	5.30	1.19	4.41	1.56	5.78	1.81	6.70
1	90	20	10 <sup>-3</sup>	0.30	0.30	0.62	2.07	1.16	3.87	1.50	5.00	1.26	4.20	1.64	5.47	1.91	6.37

Table 1. Comparison between the drainage capacity of 30 cm of granular material and the drainage capacity of INTERDRAIN geocomposites. The drainage capacity of INTERDRAIN geocomposites has been estimated using the ISO 12958-1999 standard (with 380\*300 (mm) probes and rigid aluminium plates). Source: INTERMAS NETS SA.

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