

SUB-APPENDIX D6-K

Finger Drain Service Life Calculation

Finger Drain Service Life Calculation
Ridge Landfill, Chatham-Kent, Ontario

Job No: 18111331(4000)(1)

Prepared by: F. Barone
 Reviewed by: F. Gondim

Date: March 5 2020

A conservative estimate of the service life of the finger drains with respect to biochemical clogging and leachate drainage can be obtained using the methodology described in the document "Evaluation of Service Life of the Engineered Components of Landfills" prepared for the Ontario Interim Waste Authority (IWA) by R. Kerry Rowe Inc, Golder Associates, Fenco MacLaren and Dillon, dated October 1994, with the assumptions that:

- i) all of the calcium in the leachate entering the finger drains precipitates to form biochemical clog matter that occupies the pore spaces in the clear stone, and
- ii) the height of the clog zone in the clear stone (relative to the base of the finger drain) varies linearly from 0 m at the uphill end of the finger drain (30 m from the toe of the finger drain) to the full 3.7 m thickness of clear stone backfill at a distance of 5 m from the toe of the finger drain.

The width of the finger drains is 1m. For these conditions, the total volume of clogged clear stone at the end of the service life is 65 m³ (i.e., 5 m x 3.7 m x 1 m + 0.5 x 25 m x 3.7 m x 1 m). The porosity reduction at any given point in the clogged zone of the clear stone at the end of the service life is 0.45 (i.e. a reduction in porosity from an initial value of 0.48 to a final value of 0.03). Therefore, the total volume of clog material (V_{CLOG}) at the end of the service life is approximately 30 m³ (i.e., 65 m³ x 0.45). The time frame to generate this volume of clog corresponds to the service life of the finger drain, and can be conservatively estimated using the equation:

$$T = \frac{V_{CLOG} \times P_{CLOG} \times f_{ca}}{q_o \times L \times S \times C_{ca}}$$

where,

T = service life of the finger drain with respect to biochemical clogging (years),

V_{CLOG} = total volume of clog material in the finger drain at the end of its service life (m³)
 = 30 m³

P_{CLOG} = dry density of the clog material = 1,500 kg/m³

f_{ca} = fraction of calcium in the clog material
 = 0.26

q_o = annual average leachate generation rate via moisture percolation through the final cover
 = 0.15 m/y

L = horizontal distance from the toe of the finger drain to the central peak of the landfill
 = 400 m

Finger Drain Service Life Calculation
Ridge Landfill, Chatham-Kent, Ontario

Job No: 18111331(4000)(1)

Prepared by: F. Barone
Reviewed by: F. Gondim

Date: March 5 2020

S = spacing of the finger drains
= 25 m

C_{ca} = average calcium concentration in leachate collected by the finger drains
= 250 mg/L (from leachate pumping chamber monitoring data)
= 0.25 kg/m³

Substituting the above values into the equation gives a service life of approximately 30 years for the finger drains.

Attachment: Figure 1: Historical Calcium Concentration from the Leachate Pump Station Gorman-Rupp Pump at the Ridge Landfill

Figure 1: Historical Calcium Concentration from the Leachate Pump Station Gorman-Rupp Pump at the Ridge Landfill

