A FEASIBILITY STUDY FOR THE DRAINAGE AND PROTECTION OF GMC (GEO MULTICELL COMPOSITE) AS A LEACHATE COLLECTION SYSTEM IN LANDFILL

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ABSTRACT

GMC (Geo Multicell Composite) is a advanced methods for the leachate collection system in landfill. The objective of this study is the drainage of leachate and protection of the geomembrane to test the application possibilities of GMC as a Leachate Collection·Removal and Protection System (LCRPs). This research is conducted to measure the permeability in the steep slope, puncture and leaching test of the GMC in landfill. As the results, the GMC has a proper permeability and puncture strength as a LCRPs in landfill.

Keywords: GMC, landfill, drainage, leachate, LCRPs

INTRODUCTION

When the leachate leaks from the landfill, it has a lot of the environment problems. The geomembrane liner is needed, and the quick drainage of the leachate is required to prevent the leaking of the leachate. The geomembrane liner can be damaged from the sharp waste or the equipment of waste filling-up. The safely protecting facility for the geomembrane liner has to be set up.

Generally, landfill consists of drainage and protection layer (snad, crash gravel), geomembrane liner (HDPE etc.), geotextile or geocomposite and compacked clay layer. The GMC was installed on the drainage layer along the slopes of the landfill liner that can be applied reliably construction of the landfill.

Types of LCRPs in Korea

The several types of LCRPs are using the protection layer with sand bag, the leachate collection layer with waste tire and the protection layer with rubber chip block in Korea. However, these types have several problems. For example, sand bags can be damaged by heavy or sharp waste. Waste tires can not be supplied adequately. Rubber chip block can occur transformation by weight of waste.

GMC technology is developed as a advanced methods for the leachate collection system in landfill. Also, the product has rapid drainage of leachate, and is able to prevent damages of LCRPs. As long as GMC installed on top of the liner, the liner could be protect from a certain force and improve the function of the leachate collection (Fig. 1). Thus, this study suggests a feasibility on GMC of the leachate collection system in landfill.

Fig. 1 Installation for the GMC test

What is GMC?

Figure 2 shows the a schematic cross-section with GMC in the side slope. GMC consists of PET mat, geotextile and geonet. These have abilities of protection and drainage. Geonet is bounded by heat with vertically and horizontally. So, this cell (GMC) is charged by drainage material such as crash gravel and course sand. In addition, GMC envisioned each sheet in consideration of the thickness and width to secure the duability of the geomembrane (FML : Flexible Membrane Liner) to protect the stable and efficient construction of a drainage layer.

Therefore, the objective of this study is the drainage of leachate and protection of the geomembrane to test the application possibilities of GMC as a LCRPs.

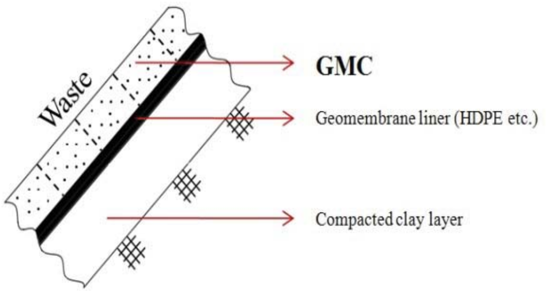

Fig. 2 A schematic cross-section with GMC in the side slope

TESTING METHODS

Testing methods are composed of physical properties test, function test and leaching test.

Physical Properties Test

Fig. 3 Maximum particle size of filler

Maximum particle size

The filler (crash gravel) in GMC is the most important ability to drain the leachate. In order to measure the maximum particle size randomly selected crash gravels were measured using vernier calipers (Fig. 3).

Moisture content

GMC and crash gravel dried at room temperature were measured the moisture content (initial moisture content) by KS F 2306 method. Also, GMC and crash gravel were soaked in distilled water and measured the moisture content (final moisture content) to predict the amount of absorbed water in rainfall and leachate.

pH

Because the variation of pH maybe affected the landfill leachate, initial pH was controlled pH 4, 5, 6 7 and 8 of the artificial rainfall. Change of pH measured 3 times during operating time using pH meter (Neo PDC-700L Multimeter, Istek, Korea).

Function Test

Puncture test

The geomembrane liner can be damaged from the sharp waste or the equipment of waste filling-up. Thus, puncture test is performed for protection of geomembrane. The puncture test was measured 5 times by KS F 0744 method to compare with GMC and prior method (rubber chip block method).

Permeability test

The horizontal permeability was measured 3 times using horizontal permeability by ASTM D 4716 to estimate the drainage of GMC. The vertical permeability was measured 3 times using vertical permeability coefficient by KS F 2322 to estimate the drainage of filler. GMC was compared with prior method (rubber chip block method) to estimate the drainage both GMC and filler.

Leaching test

The leaching test for heavy metals was performed with GMC because of the affecting of leachate in landfill. To estimate the possibility of heavy metal elution, 5 items (Pb, As, Cd, Cr^{6+} and Cu) were measured 3 times by KSLT (Korean Standard Leaching Test) method.

RESULTS

Physical Properties Test

Maximum particle size

Particle size of drainage material measured 5 times. The most of size is 20~50mm. Also, maximum particle size (filler) of drainage material is about 38.8mm.

Moisture content

Moisture content analyzed both initial and final. Initial moisture content is 0.23% and final moisture content is 2.98%. Thus, this technology is contained about 2.75% moisture content in the leachate collection system in landfill.

pH

The test results show change of pH was converged to pH 8 during the operation time by lime composition. In general, the pH of the landfill leachate indicates acidic condition. Therefore, the change of pH influence buffering effect by the drainage material.

Function Test

Puncture test

Table 1 shows the puncture strength test results comparison with GMC and rubber chip block. The results of puncture test with GMC compared to other types of construction method show more superior.

Table 1 The puncture strength test results comparison with GMC and previous method

Classification	Puncture strength (N)	Puncture strength (kgf)	Reference
GMC	1374.5	140.2	N = 9.80665kgf
Rubber Chip Block	783.6	79.9	

Permeability test

Table 2 shows the permeability test result comparison with GMC and other construction method. Drainge function of GMC is more superior than the legal standard and other construction method.

Table 2 The permeability test results comparison with GMC and previous method

Classification	GMC	Rubber Chip Block	Reference
Horizontal permeability (m^2/s)	8.0×10^{-4} (GMC)	4.6×10^{-4}	Legal standard (slope) : > 3×10^{-5}
Vertical permeability (cm/s)	5.0 (crash gravel)	7.5×10^{-1}	Legal standard (bottom) : > 1×10^{-2}

Leaching test

Table 3 shows the results of leaching test with GMC by KSLT. The results of leaching test with GMC below the legal standard. Thus, the occurrence of heavy metal pollution is not considered.

Table 3 The results of leaching test with GMC by KSLT

Classification	Standard (mg/L)	Concentration (mg/L)
Pb	3.0	1.5
As	1.5	0.9
Cd	0.3	N.D.
Cr^{6+}	1.5	0.2
Cu	3.0	2.0

CONCLUSIONS

The intensity of puncture with GMC measured 1374.5N (140.2kgf) that is stronger than previous method (rubber chip block). The results of hydraulic conductivity (vertical permeability) with GMC has 5.0cm/sec that are satisfied the legal standard in Korea, and then it is much higher than the other LCRPs. The results of leaching test with GMC below the legal standard. Thus, the occurrence of heavy metal pollution is not considered.

Therefore, the authors can surmise that GMC is very applicable material as a LCRPs in the landfill.

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