Kossge International Symposium on Soil & Groundwater Environment
October 27-28, 2005 Mayfield Hotel, Seoul, Korea

Influence of Accumulated Leachate on Settlement and Analysis of In-Situ Geotechnical Properties of Landfill Site

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Abstract

The influence of accumulated leachate on the settlement of the landfill and the geotechnical properties of underlying clayey soil are analyzed using the in-situ measured settlement data. Consolidation data is back-calculated from the settlement data and compared with the laboratory scale consolidation data. It was found that the settlement was retarded by the accumulated leachate and the consolidation properties obtained from the field measurement was 1.5 times higher than the laboratory obtained data, which gives the importance of field measurement of geotechnical data during the operation period.

The landfill of interest was operated for 8 years from 1992 to 2000. Staged disposal was adopted up to 8 stage and the height of each stage was 5m. Interim cover soil of 50cm thick was well compacted to prevent the infiltration of rainwater and the hydraulic conductivity was measured as 8.0×10^{-6}–2.96×10^{-5} cm/sec (Jang et al. 2002). Leachate level was accumulated up to 14m until the fourth disposal stage since the well compacted interim cover soils prevented the vertical flow of leachate within the landfill (Jang, 2000).

The underlying clayey soil is classified as CL in Unified Soil Classification (Table 1, Dong-Ah, 1996). CPT data at the design stage of the landfill shows that the underlying soil is in the over-consolidated state with high strength from the surface down to 1.5m deep due to desiccation effect(Fig. 1). At the soil depth of 14–14.5m, the effective present soil pressure and pre-consolidation pressure were estimated as 1.3kg/cm^2 and 1.85kg/cm^2 , respectively, and the OCR was calculated 1.42.

The leachate accumulation has influenced on the settlement of the landfill subsurface by the waste load. The unit weight of the waste was calculated as 1.0-1.1t/m^3 from the data of field pressure measurement plate. Up to the fourth stage of waste disposal, the increase of effective stress from the waste load was negligible due to the accumulated leachate and the settlement increase was low during that period (Fig. 2). The settlement of the clayey ground was increased significantly after the fourth stage, because the effective waste load becomes greater than the pre-consolidation pressure of the foundation soil.

The compression index back-calculated from the settlement data of foundation soil was shown with laboratory compression index in Fig. 3. It was found that the former was 1.5 times greater than the latter, which means that the settlement of the ground at the design stage of the landfill was seriously underestimated. To examine the accuracy of the field void ratio and the compression index, the settlement recalculated using the two properties was compared with the settlement data measured from the field and it was found that the two results are quite close each other (Fig. 4).

Reference

1. Dong-Ah Constrcution Co., Report of Preliminary Design of Sudokwon No. 1 Landfill, 1996, 301p.
2. Jang, Y.S., "Analysis of Flow Behavior in a Landfill with Cover Soil of Low Hydraulic Conductivity," Environmental Geology, Vol. 39, No. 3/4, Jan., 2000, pp. 291-298.
3. Jang, Y.S., Y.W. Kim, and S.I. Lee, "Hydraulic Properties and Leachate Level Analysis of Kimpo Metropolitan Landfill, Korea," Waste Management, International Journal of Industrial Hazardous and Radioactive Waste Management, Science and Technology, 22, Mar. 2002, pp. 261- 267.

Table 1 Geotechnical Properties of Clayey Subsurface Soils for Sudokwon No. 1 Landfill (Dong-Ah, 1996)

Natural water content (%)		35 ~ 45
Dry unit weight (t/m^3)		1.20 ~ 1.25
Saturated unit weight (t/m^3)		1.60 ~ 1.80
Specific gravity		2.7
Initial void ratio		1.0 ~ 1.2
Atterburg limits	Liquid limit (%)	35 ~ 45
	Plasticity index (%)	10 ~ 20
OCR		1.0 ~ 1.5
Soil type (Unified classification)		CL

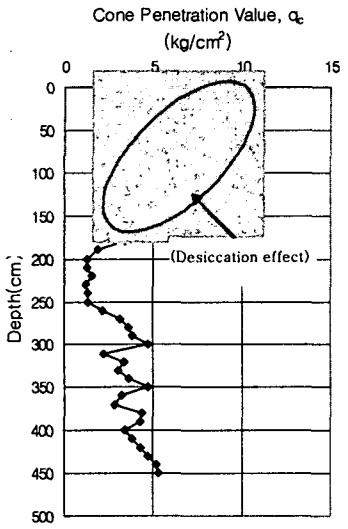

Fig.1 Cone penetration value qc, versus depth field

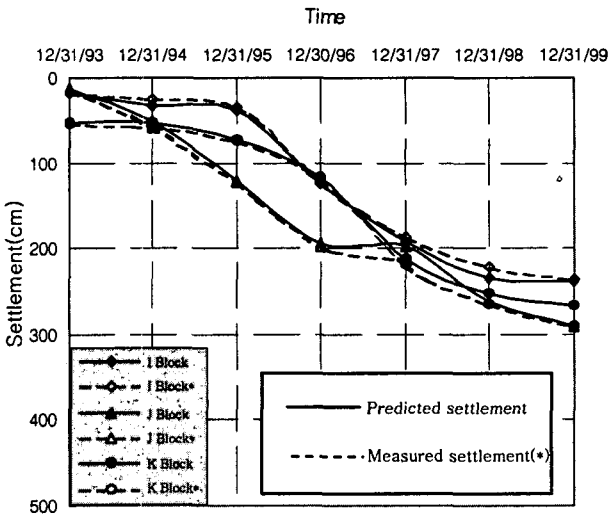

Fig. 4. Comparison of predicted settlement from , back-calculated compression index with measured settlement.

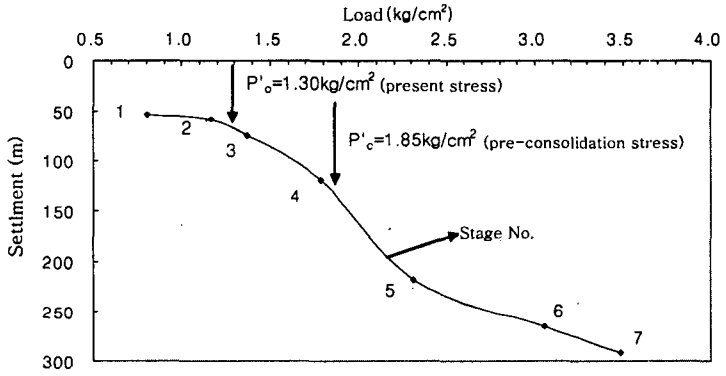

Fig. 2 Changes of settlement of the landfill ground with the staged waste loading in K block

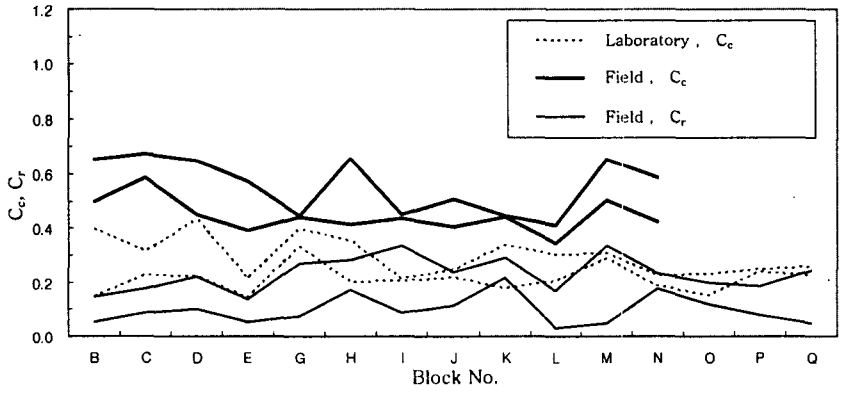

Fig. 3 Comparison of the Range of In-situ and Laboratory Compression Index (C_c : virgin compression index, C_r : O.C. compression Index)