IMPROVEMENT OF COMPRESSIBILITY CHARACTERISTICS OF WASTE MATERIAL BY DYNAMIC COMPACTION

Rathnayaka R.I.A.* and Kulathilaka S.A.S.

Department of Civil Engineering, University of Moratuwa, Moratuwa

Open dumping is the most prevalent method of waste disposal in Sri Lanka. These sites, which are currently used as waste dump yards in urban areas, will have to be rehabilitated to be converted to be used as parks, roads or for other different construction projects. Establishing the strength and stiffness characteristics of these waste materials at different levels of degradation and how these characteristics can be enhanced to suit the proposed developments is a major challenge. The mechanisms of settlement that govern the solid waste material are numerous and complex. Bowders et al. (2001) reported that there are many reasons behind this behaviour of waste such as extreme heterogeneity of the wastes, their own particle deformability, the large voids present in the initial waste fill, and their biodegradability. According to Watts and Charles (1990) and Manassero et al. (1996), the settlement behaviour of MSW is often classified as occurring in several distinct phases. Primary consolidation of solid waste occurs due to the self-weight of the waste or application of surcharges such as fill over the time. Primary compression is then followed by the secondary compression. Secondary compression occurs due to biodegradation process in waste fill, and it can take years for this settlement to complete depending upon various phases of waste that it consists of.

This paper presents a study of the effectiveness of dynamic compaction as a technique of enhancing the compressibility characteristics of waste dumps. MSW was subjected to dynamic compaction in a laboratory test setup, and another MSW sample was kept uncompacted. Next, MSW samples in both compacted as well as in non-compacted state were subjected to loading in a Rowe Cell of diameter 150 mm and height 50 mm and results were analysed to establish the compressibility characteristics, namely coefficient of volume compressibility (m_v), compressibility index (C_c), coefficient of consolidation (C_v) and coefficient of secondary compression ($C\alpha$). Finally, results were compared to assess the effect of dynamic compaction on compressibility characteristics of MSW and the effectiveness of the process is compared with that of preloading.

Compression index of MSW that was subjected to dynamic compaction was reduced to about 50% of the compression index of the non-compacted MSW. Recompression index values of non-compacted MSW values are less than about 10% of compression index values of non- compacted MSW samples. Similarly, results obtained for coefficient of volume compressibility shows greater reduction by preloading compared to dynamic compaction. Both preloading and dynamic compaction show significant effectiveness in reducing the coefficient of secondary consolidation. In conclusion, compressibility characteristics of MSW can be improved significantly using both preloading and dynamic compaction. According to results observed in this study preloading can be considered as the more effective method. However, depending on the composition and the degradation level of the MSW sample used these results can be changed. Considering the time, it takes to achieve the required compressibility reductions by preloading, dynamic compaction can be considered as another advantageous option.

Keywords: preloading; dynamic compaction; compressibility; consolidation

* Correspondence: rathnayakaaloka@gmail.com