EVALUATION OF AGING EFFECT ON GEO-PHYSICAL, CHEMICAL AND MECHANICAL PROPERTIES OF DUMPED MUNICIPAL SOLID WASTE

*Piumali Thilini Abeywickrama[1], Ken Kawamoto[1,2]

1. Saitama university, 2. International Institute for Resilient Society, Saitama University, Japan

Developing countries are commonly operating open dumping or landfilling for disposing non-pretreated Municipal Solid Waste (MSW). Due to rapid population growth and lack of lands, abandoned waste dumping sites are highly demanded for the redevelopment and construction especially at big cities and their surrounding in developing countries. It is essential to conduct slope stability analysis and engineering designs to prevent failures of vertical expansions and to sustain post closure land use measures on MSW dump sites. Studying long term behaviors of physical, chemical and mechanical properties of dumped MSW therefore becomes prerequisite. Being degradable, it signifies the necessity of evaluating aging effect on MSW properties. In this study, a comprehensive laboratory testing program of direct shear test with 100mm diameter and 40mm thick specimen size was performed followed by compaction testing on dumped MSW with different ages. Tested samples were collected from three dumping sites in Sri Lanka located in intermediate, wet, and dry climatic zones.

The results indicated that Loss on Ignition (LOI) decreased with the dumped age of tested samples. For all tested samples, measured specific gravities ranged between 1.7 to 2.9 and correlated inversely to LOI values. Electrical conductivities decreased with the age of MSW and pH values ranged between 7 to 8. Data were statistically analyzed and derived LOI as an indicator parameter to evaluate the aging effect on other tested properties. The finer fractions in particle size distributions are increasing with age. Measured compaction properties are highly correlated with LOI. Maximum dry unit weight ($g_{d,\ max}$) is increasing with age and optimum moisture content is decreasing with age. Insitu dry unit weights were found as 40-70% of $g_{d,\ max}$.

Cohesion is ranged from 0-44 kN/m^2 and friction angle is ranged from 8-58° at 1%, 5% and 15% shear strain levels. There is a unit weight and strain dependency of shear strength parameters of dumped MSW and three types of stress-displacement responses were identified. These behaviors are due to the existence of fibrous materials differently in compositions whose reinforcement aptitude becomes activate for normal stresses greater than 50kN/m^2. The convex shaped curves with a continuous increase of shear resistance are observed for the normal stresses greater than 50kN/m^2. The curves with yielding point are observed for normal stress of 25kN/m^2. Hambanthota dumped MSW which are in mix with sea sand, gives curves which are continuously increase of shear resistance with an upward curvature, followed by asymptotic approach. Dumped MSW mixing with sand, is therefore recommended as a suitable fill material. The study further confirms the feasibility for end uses on dumped waste with appropriate precautions and the tested values are useful as input parameters for slope stability analysis.

Keywords: Solid waste, direct shear test, compaction

