# Improvement of Locally Available Materials using Bentonite for use as a Liner Material of an Engineered Landfill

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Due to open solid waste dumping, the water and soil pollution by leachate has now become a major environmental problem in Sri Lanka. In the engineered landfills, bottom liners are used to prevent the migration of contaminant in to the ground water. Different types of liner materials are being used in the construction of liners of municipal landfills over the world. Compared to the liner materials such as Geosynthetic Clay Liners (GCL) and High Density Polyethythene (HDPE), Compacted Clay Liners (CCL) are more economical, if materials are locally available. Therefore, in this study, the suitability of a locally available soil was investigated for use in landfill liners. For this purpose two soil samples were obtained from Bandaragamawatta (Soil L1 and Soil L2) situated in the Matale district of Sri Lanka and the same soil was mixed with 5% (w/w) and 10% (w/w) bentonite as possible candidate materials. According to CEA, 2003 guidelines the maximum recommended hydraulic conductivity is $1 \times 10^{-9}$m/s for 1m thick clay liner and $5 \times 10^{-12}$ m/s for soil-bentonite mixtures. The liner materials were prepared by compacting soil or soil-bentonite mixtures to obtain 100% degree of standard Proctor compaction. Both unamended soils obtained from Bandaragamawatta exhibited lower hydraulic conductivity than the maximum recommended value. The soil-bentonite mixtures resulted in higher hydraulic conductivity than the unamended soils which therefore did not comply with the CEA guidelines. In practice, the liner is exposed to leachate which is highly contaminated from different organic and inorganic pollutants. Therefore the leachate effect was evaluated by investigating the hydraulic conductivity using 1M $CaCl_2$ as permanent liquid. Expansiveness of soils was investigated by free swell index test. Further, variation of volumetric shrinkage limit with bentonite percentage was investigated. Free swell index tests indicate that the degree of expansiveness increased from 18.2% to 58.3% for Soil L1 and from 0.0 % to 145% when the bentonite percentage added varied from 0% to 10%. The volumetric shrinkage too increased from 4.5% to 11.5% for Soil L1 and from 2.5% to 9.5% for Soil L2 for the same increment of bentonite percentage from 0% to 10%.

**Key words:** Bentonite, Free swell index, Hydraulic conductivity, Liner materials, Shrinkage limit