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Permeability characteristics of some soils from South West Nigeria for use as barrier soils

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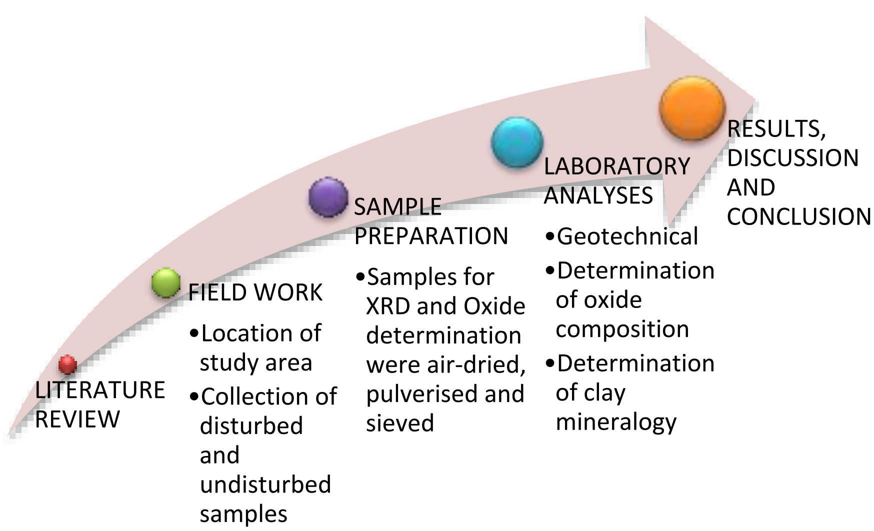
Summary

The rapid rate of technological advancement has attracted the application of engineering geology in construction works such as roads, buildings, dams as well as in siting sanitary landfills just to mention a few.

Both domestic and industrial wastes are generated everyday with little or no concern about their proper disposal. Failure to properly dispose these wastes in well-constructed and well lined sanitary landfills will pose a threat to both the ground and surface water through contamination via leaching of contaminants generated in the landfill (Olayinka and Olayiwola, 2001; Abimbola et al., 2005; Shonuga, 2008). Therefore, one of the crucial parameters in the design of waste disposal facilities is the permeability of the base of the proposed landfill or the lining material.

Thus, the permeability characteristics of some South Western Nigeria soils were evaluated with a view to determine the ones that can meet the requirements for use as soil barriers in landfills since barrier soils (particularly clays) act as ground water pollution control mechanism.

Workflow



Results and Conclusions

The grain size distribution shows that the soils are well-graded with adequate amount of fines (clay and silt) and sufficient gravel size fraction. The plasticity chart suggests that the soils are of low to medium plasticity. The XRD revealed the presence of two types of mixed clays: those composed of kaolinite and bentonite and those composed of kaolinite and illite; this confirms the plasticity of the samples. Furthermore, the soils contain high percentage of quartz and albite with subordinate abundances of nacaphite, offretite, cacoxenite, cordierite, clinocrysotite. The high silica content as seen in the analysis for the oxide composition confirms the high quartz content in the XRD and high percentage of sand size fraction in the grain size distribution. In this research, the coefficient of permeability was determined in three different ways: in the **laboratory using the falling head permeameter**, **estimation from grain size parameter** and **estimation from consolidation test**. The results showed that the coefficient of permeability of the soil samples determined in the laboratory by the falling head permeameter range from $1.45X10^{-9}$ to $1.18X10^{-6}$ m/s, the permeability estimated from the grain size range from $4.32X10^{-9}$ to $1.73X10^{-6}$ m/s and the permeability estimated from consolidation at the highest laboratory pressure of 800 KN/m^2 range from $9.85X10^{-10}$ to $1.25X10^{-7}$ m/s.

Conclusively, the suitability of these soils evaluated for use as soil barrier has been established. All the twenty (20) samples (CL1 to 20) **but** six (6) i.e. CL2, CL4, CL5, CL8, CL10 and CL15 meet up with Allen (2000) recommendation of 10^{-10} to 10^{-8} m/s optimum permeability for barrier soils in attenuating contaminants to the barest minimum.

Further research should be aimed at evaluating the effect of clay provenance on its permeability as well as the volumetric estimate of the clay deposit for its full economic potential to be ascertained.

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