Innovative Analytical Characterization of SoilTech MK. III Polymer Stabilized Geomaterials for Unique Design and Construction of Pavements

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Abstract – Stabilization techniques have long been used for purposes of enhancing the geotechnical engineering properties of pavement geomaterials. These techniques mainly include mechanical, traditional hydraulic (cement, lime, fly ash etc), bituminous, polymer and other non-traditional liquid chemical stabilization. Liquid chemical stabilization has yet to gain popularity due to lack of proper scientific and engineering background and pragmatic performance justification based on enhanced Research and Development (R&D). In due consideration, the main challenges associated with stabilization that require rigorous R&D include: i) developing stabilization techniques that can be effectively useful for inferior construction materials that are usually rendered useless; ii) determining optimum batching ratios for varying geomaterials to enhance mechanical stabilization prior to application or addition of stabilizing agents; iii) selection of appropriate stabilizing agents that are chemically compatible with the applicable geomaterial; iv) determining the optimum content to be added to the geomaterial in order to achieve optimally enhanced physical and mechanical properties whilst minimizing associated detrimental effects such as cracking; v) developing sophisticated and advanced analytical modelling techniques that can effectively characterize the behaviour of stabilized geomaterials both quantitatively and qualitatively. In this Study, sophisticated analytical models are employed in characterizing and fostering the salient properties of SoilTech Mk. III polymer stabilizing agent with respect to theoretical and pragmatic consideration including: i) interlayer nano-polymer migration effects; ii) elastomeric properties; iii) enhanced response to compaction effects; iii) enhanced tensile characteristics; iv) increased resilience to deformation; v) expanded range of stress-strain elastic limits; and, vi) appreciable resistance to cracking under excessive loading. On the other hand, appropriate methods of design involving advanced geotechnical engineering concepts related to the Elastic Limit Design Criterion (ELDC) and Modulus-Thickness Design Criterion (MTDC) are also introduced. The prowess of these methods, developed for both unreinforced and stabilized pavements, with fundamental objectives of achieving prolonged pavement design life through protracted maintenance of the elastic properties, is demonstrated by ensuring that the impact of imposed loads and environmental changes is contained within the linear elastic region. The most distinguished advantage of the ELDC and MTDC, which is also distinctly demonstrated in this paper, is that all design parameters derived are based on only three primary parameters; namely, the pavement thickness, elastic modulus and the cumulative ESALs (Equivalent Single Axle Loads), to which all other parameters are correlated. Non-linearity is analysed based on the soils mechanics concepts of the KHSSS (Kinematic Hardening Small Strain Stiffness). Due to the successful application and cost-construction time effectiveness of these methods of design, this Study also proposes the application of the elastic limit stress-strain and modulus- thickness ratio concepts as the appropriate quasi-mechanistic methods of design for polymer stabilized pavement geomaterials.

Keywords**:** SoilTech MK. III**,** Elastic limit design, modulus-thickness ratio, elastic modulus, elastic limit strain, elastic limit stress, Poisson's ratio, pavements