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GATES COLON

Recent Advancements on Expansive Soils Elsevier
Traditional soil stabilizers such as lime and cement are widely used to reduce swell and shrinkage behavior and enhance strength properties of expansive soils through the formation of cementitious products. However, the manufacturing process of these calcium-based stabilizers, such as lime and cement, need large amounts of water and emit gases such as CO, CO2, NOx, and SO2 that are harmful to the environment. Hence, environmentally-friendly techniques are often sought out by the civil infrastructure industry (Puppala et al. 2018a, 2019b, George et al. 2019a, Congress and Puppala 2019).In this research, an alternative stabilizer termed as liquid ionic soil stabilizer(LISS) was used to treat expansive soils from North Texas. Although LISS has shown a reliable record of successful stabilization treatment of subgrades for over 20 years in Texas, there is a lack of in-depth studies which try to identify the probable stabilization mechanisms and quantitatively evaluate the efficacy of such treatments. This research work primarily aimed at addressing these issues through an extensive laboratory testing program encompassing a series of macro-scale engineering tests and micro structural analyses.Two types of expansive soils with different clay mineral compositions were collected from different locations in Texas and are used as control soils in the present laboratory testing program. These soils were modified by treating the soils with three different dilution ratios of LISS additive. The dilution ratio is defined as the volume of concentrated liquid ionic stabilizer per unit volume of water. The research study included four major tasks to study the effects of LISS stabilization and these are: (a) performing physical, chemical and microstructural tests, (b)evaluating engineering properties, (c) assessing stabilization mechanisms, and (d)numerical modeling to evaluate the post-treatment improvements in the performance of slopes and pavement subgrades stabilized with LISS. The collected soil samples were treated at three different dilution ratios to study the effect of stabilizer dosage on the improvements in basic and engineering properties of the problematic soil. Test results and analyses provided comprehensive characterization of the basic and advanced soil properties,improvements in engineering properties of treated soils, and an in-depth understanding of the stabilization processes at a micro level. The mineralogical and microanalysis studies were also performed to examine the stabilization mechanisms in terms of chemical reactions, mineralogical changes, and other modifications that might have resulted in improvements in the engineering properties at the macro level.The results from the macrotests that included physical, chemical, and engineering tests showed that the LISS is an effective alternative environmental friendly soil stabilizer, which can enhance the strength and stiffness of problematic expansive soils to moderate levels. The LISS also inhibits the swell potential of expansive soils and slightly reduces the plasticity index and linear shrinkage ratio.The reductions in swell potentials were associated with an increase in strength and stiffness (resilient moduli) properties for all the different soil-dilution ratio combinations used in this research study. Among the three dilution ratios used in this research, the double chemical ratio (10 ml/gallon) which had the highest concentration of LISS exhibited the optimum performance based on the overall improvements in engineering properties such as strength, stiffness, and reduction in swell potential.The probable stabilization mechanism was determined by comparing the microstructural test results of Field Emission Scanning Electron Microscopy with Energy Dispersive Spectroscopy (FESEM-EDS) and X-ray Powder Diffraction(XRD) for both untreated and soils treated at the third ratio. Additional macro tests,including variation in moisture content, pH, Consistency Limits and grain size distribution with curing time, were also used to comprehend the changes in the properties of the treated soil. The SEM images depicted that the soil particles flocculated upon addition of LISS and a phospho-rich compound were formed that bonded the soil particles after treatment. The intensity of the clay minerals peaks in the XRD plot was found to decrease when the soil was treated with LISS at the double chemical ratio. The FESEM and XRD results suggest the formation of products formed by the reactions of clay particles with the LISS additive. Moreover,the moisture content of soil gradually decreased by around 3%, and the grain sizeof the treated soils varied with an increase in curing time period, indicating the progressive utilization of water to form reaction products that can bind the clay particles and result in improvement in engineering properties of problematic soils.The pH of LISS increased from 3 to 7.8 in 20 days, which exhibited a progressive chemical reaction in this period of time. However, the consistency limits of LISS treated soils before and after treatments were nearly the same and no major enhancements were noted in the consistency limit values.In order to evaluate the feasibility of using LISS as an alternative soil stabilizer, two case study examples involved with pavement design and slope stability were analyzed. From the results and analysis of the modeling, the pavement design life of treated expansive soil was higher than that of untreated expansive soils. Also, the global factor of safety (FOS) of treated Dallas soil was slightly increased by 13% as compared to the section without any soil treatment.More studies and field treatment sections will provide more insights into the effectiveness of LISS treatments to enhance soil properties that can provide better support of civil infrastructure.

Stabilization of Highly Expansive Bentonite Soil Using Polypropylene Fiber and Ground Granulated Blast Furnace Slag Springer
Expansive soils are one of the most serious problems which the foundation engineer faces. Several attempts are being made to control the swell-shrink behavior of these soils. One of the most effective and economical methods is to use chemical additives. Fly ash and desulphogypsum, both of which are by-products of coal burning thermal power plants, are accumulating in large quantities all over the world and pose serious environmental problems. In this study, the expansive soil was stabilized using the fly ash and desulphogypsum obtained from Çayýrhan Thermal Power Plant. Fly ash and desulphogypsum were added to the expansive soil from 0 to 30 percent. Lime was used to see how efficient fly ash and desulphogypsum on expansive soil stabilization were, and was added to the expansive soil from 0 to 8 percent. The properties obtained were chemical composition, grain size distribution, consistency limits, swelling percentage, and rate of swell. Fly ash, desulphogypsum, and lime added samples were cured for 7 days and 28 days, after which they were subjected to free swell tests. Swelling percentage decreased and rate of swell increased with increasing stabilizer percentage. Curing resulted in further reduction in swelling percentage and further increase in rate of swell. 25 percent and 30 percent fly ash and desulphogypsum additions reduced the swelling percentage to levels comparable to lime stabilization.

Geotechnical Investigations and Improvement of Ground Conditions Independently Published
The expansive nature of the soil has been a major problem in the engineering field, as its shrinking and swelling phenomenon damages the building structures, bridges, roads, etc., and provokes potential failures in the various infrastructure. Hence, a detailed investigation of the soil types and their properties before any construction is important. With the pre-knowledge of the soil types, different stabilization techniques can be applied in the field to reduce the swelling or shrinkage property of such soils. There are different methods to identify such properties of soil; among them, the Atterberg limit, consolidation test, and expansivity index test are the widely practiced methods. The present study investigates the use of polypropylene fiber, and ground granulated blast furnace slag (GGBS) mixed separately with highly expansive commercially available bentonite soil to reduce the expansivity index and other swelling & shrinkage parameters. The percentages of the fiber used were 0%, 0.25%, 0.5%, 0.75%, and 1.0% mixed with bentonite soil by dry weight. The proportions of GGBS were 0%, 5%, 10%, and 15% mixed with bentonite soil by dry weight. The index properties of the treated bentonite soil were tested by the Atterberg limit test, specific gravity test, and linear shrinkage test. The engineering properties

were performed by compaction, expansivity index, and one-dimensional consolidation test. SEM, EDX, and electrokinetic tests were performed for microstructural analysis of the soil particle. Respective designated standards were followed for the various test. The result shows a significant reduction in the expansivity and swelling index of the bentonite soil while treated with either of the additives, i.e., fiber or GGBS. The reduction in the expansivity index of the soil mixed with fiber ranged from 29.04 to 47.41% at 0.25% to 1.0% of the fiber content. With the GGBS additive, the expansivity index reduced impressively from 75.9% to 80.49% at the 5% to 15% of GGBS content. Similarly, there is a substantial reduction in the swelling pressure, which ranges from 24.97% to 66.43% with the addition of 0.25% to 1.0% fiber and from 21.86% to 46.07% with the addition of 5% to 15% GGBS. This research is focused on the use of additives polypropylene fiber and GGBS as the best alternatives for stabilizing highly expansive bentonite soil. The study also ensures that the sustainability of the environment can be achieved by the practical application of industrial wastes like GGBS.

Detailed Illustration of Contingent Management Practices for Cement Kiln Dust Butterworth-Heinemann

Earthwork projects are critical components in civil construction and often require detailed management techniques and unique solution methods to address failures. Being earth bound, earthwork is influenced by geomaterial properties at the onset of a project. Hence, an understanding of the in-situ soil properties is essential. Slope stability is a common problem facing earthwork construction, such as excavations and shored structures. Analytical methods for slope stability remain critical for researchers due to the mechanical complexity of the system. Striving for better earthwork project managements, the geotechnical engineering community continues to find improved testing techniques for determining sensitive properties of soil and rock, including stress-wave based, non-destructive testing methods. To minimize failure during earthwork construction, past case studies and data may reveal useful lessons and information to improve project management and minimize economic losses. This volume is part of the proceedings of the 1st GeoMEast International Congress and Exhibition on Sustainable Civil Infrastructures, Egypt 2017.

Soil Stabilization in Pavement Structures: Pavement design and construction considerations John Wiley & Sons

Expansive soils have been known to cause deterioration among all aspects of civil infrastructure for many years primarily due to the presence of clay minerals like Montmorillonite. Replacing these problematic soils is not a viable solution in that it is costly and time consuming. Although many stabilization techniques are available, chemical stabilization has proven to be an important tool in arresting the swell/shrink behavior of expansive soil, which is a major source of distress problems for most infrastructures built on this type of soils. Of the chemical stabilizers available in the market, lime and cement stabilizers are the two most widely used chemical additives for improving expansive clays and increasing the overlying structures integrity; they improve the soil's workability, strength, swelling potential, and bearing capacity. Generally, lime stabilization develops due to base-exchange and cementation between the clay particles and lime (Croft, 1967). On the other hand, cement stabilization improves soil properties as a result of cementitious bonds between the calcium silicate and aluminate hydration products present in cement and soil particles (Nelson and Miller, 1992). Furthermore, durability of the stabilization is an important aspect for any chemical stabilization design. To assess the durability of the stabilization design, chemically treated soil samples are subjected to wetting/drying studies to understand the longevity of the stabilization under climatic changes from summer to winter and vice versa. The samples are also subjected to leachate studies to determine the permanency of the stabilization due to rainfall infiltration. Both of these studies are often conducted as separate studies on separate soil samples. However, in reality the wetting process and the rainfall infiltration occur simultaneously. Hence, a new research study was undertaken in which an attempt was made to combine both phases of durability studies and perform a combined study that addresses both the wetting/drying and leachate aspects of durability. For this purpose a new device was developed which can replicate rainfall infiltration and wetting processes simultaneously. This process reduces the time required for durability studies by half and the data obtained show that this approach is repeatable and provides new insights in understanding the durability of the chemical stabilization. A total of four soils were chosen along the pipe alignment in the IPL pipeline project for this study. These soils vary from low to high compressibility having plasticity index values ranging from 26 to 62, indicating medium to high expansiveness. Additionally, if these soils are used in the pipe bedding or haunch regions, they can cause excessive swelling pressures in the presence of water and damage the pipe, hence these soils were stabilized with either lime or cement-fly ash and were tested for durability in the newly developed combined device. Volumetric strains, weight changes, unconfined compressive strength changes and calcium ion concentrations were monitored over the course of the study. Many mix designs underwent durability, yet all four soils were stabilized effectively with 3% cement-10% fly ash as the treated soils completed 14 cycles of durability and maintained their strength. Although previous studies have shown similar results when tested with the conventional methods, further testing is recommended with both the conventional and combined methods for soils with similar PI. These additional tests will help further understand the similarities in the modified (combined) approach and the conventional methods.

Rice Taylor & Francis

This paper investigates the effectiveness of using cement by-pass dust, copper slag, granulated blast furnace slag, and slag-cement in reducing the swelling potential and plasticity of expansive soils. The soil used in this study was brought from Al-Khod (a town located in Northern Oman) where structural damage was observed. The first stage of the experimental program dealt with the determination of the chemical, mineralogical, and geotechnical characteristics of the untreated soil. The soil was then mixed with the stabilizers at 3, 6, and 9% of the dry weight of the soil. The treated samples were subjected to liquid limit, plastic limit, swell percent, and swell pressure tests. Furthermore, the cation exchange capacity, exchangeable cations (Na^+, Ca^{++}, Mg^{++}, and K^+), and pH of the treated samples were also measured. The study showed that copper slag caused a significant increase in the swelling potential of the treated samples. Other stabilizers reduced the swelling potential and plasticity at varying degrees. The study further indicated that cation exchange capacity and the amount of sodium and calcium cations are good indicators of the effectiveness of chemical stabilizers used in soil stabilization.

Expansive Soils Woodhead Publishing

This volume includes a collection of technical papers covering two important research topics in geotechnical engineering: (1) the behavior and treatment of expansive soils, and (2) the characterization of rock properties. The twelve studies on expansive soils include investigations into novel stabilization techniques for expansive soils using different admixtures or mechanical consolidation techniques, as well as new experimental approaches to evaluate the behavior of expansive soils. They also include an evaluation of wetting boundary conditions on the volume change of expansive soils, as well as the role of hydrologic boundary conditions in arid climates. The four studies on rock properties include thermo-hydro-mechanical behavior of gypsum rock, role of rock strength in blastability, indirect methods to estimate rock strength, and variations in isotope distributions in Permian rocks. The two broad themes in this collection, as summarized above, are representative of local challenges facing geotechnical engineers in the Middle East, but their contributions can also be extended to other regions of the world. This volume is part of the proceedings of the 1st GeoMEast International Congress and Exhibition on Sustainable Civil Infrastructures, Egypt 2017.

Advances in Characterization and Analysis of Expansive Soils and Rocks Elsevier

Olive Processing Waste Management contains a comprehensive review of literature and patent survey concerning olive processing waste. Over 1,000 citations are presented. Wastes considered include olive cultivation solid waste, wastes arising from classical, three- and two-phase olive mills and wastes generated during table olive processing. In addition, information is presented concerning the management of spent olive oil (e.g. from cooking). The book is divided into five parts. Part I presents background information concerning the characterization of olive processing wastes, their environmental impacts if disposed untreated and the effect of utilised olive-mill technology on the quantity and quality of generated wastes. Part II presents physical, thermal, physico-chemical, biological and combined or miscellaneous processes for treating olive-mill wastes. Part III concerns information on utilization of such wastes with or without prior treatment. Part IV concentrates on table olive processing waste and presents information regarding its characterization, treatment and uses. Part V presents an economical and legislative overview regarding olive-mill waste. The book contains a bibliography, glossary of terms used in the text, subject, patent and author indices as well as pertinent internet sites and authorities. Complete coverage of all available literature and patents concerning olive processing waste including economic and legislative issues Critical review of up to date utilized processes concerning treatment and uses of such waste Determination of research needs for further utilization of such wastes

Stabilized Earth Roads BoD – Books on Demand

The book comprises select proceedings of the 2016 annual conference of the Indian Geotechnical Society (IGC 2016), with technical papers on the theme “Ground Improvement and Geosynthetics”. The papers cover a wide range of topics, including chemical modification using admixtures, microbial-induced carbonate precipitation, geopolymers, fly ash and other industrial wastes, modification using geosynthetic materials such as natural and synthetic fibers, expanded polystyrene (EPS) geofoam, prefabricated vertical drains, geosynthetic encased-granular columns and mechanical densification through sand columns. This book is a valuable reference for researchers and practicing engineers alike.

Unsaturated Soil Mechanics in Engineering Practice Academic Press

This book consists of select peer-reviewed papers from the International Conference on Sustainable Environmental Engineering and Science (SEES) 2019. The main focus of the book is to propose sustainable technologies to address the growing environmental challenges. The contents cover several topics of relevance such as air pollution, solid waste management, wastewater treatment, industrial pollution, and suggests eco-friendly and cost-effective techniques to tackle them. Given the range of topics covered, the book will be useful to researchers and professionals working in the multidisciplinary area of sustainability.

Expansive Soils Chemical Stabilization of Expansive Soils Using Liquid Ionic Soil Stabilizers (LISS)Traditional soil stabilizers such as lime and cement are widely used to reduce swell and shrinkage behavior and enhance strength properties of expansive soils through the formation of cementitious products. However, the manufacturing process of these calcium-based stabilizers, such as lime and cement, need large amounts of water and emit gases such as CO, CO_2, NO_x, and SO_2 that are harmful to the environment. Hence, environmentally-friendly techniques are often sought out by the civil infrastructure industry (Puppala et al. 2018a, 2019b, George et al. 2019a, Congress and Puppala 2019).In this research, an alternative stabilizer termed as liquid ionic soil stabilizer(LISS) was used to treat expansive soils from North Texas. Although LISS has shown a reliable record of successful stabilization treatment of subgrades for over 20 years in Texas, there is a lack of in-depth studies which try to identify the probable stabilization mechanisms and quantitatively evaluate the efficacy of such treatments. This research work primarily aimed at addressing these issues through an extensive laboratory testing program encompassing a series of macro-scale engineering tests and micro structural analyses.Two types of expansive soils with different clay mineral compositions were collected from different locations in Texas and are used as control soils in the present laboratory testing program. These soils were modified by treating the soils with three different dilution ratios of LISS additive. The dilution ratio is defined as the volume of concentrated liquid ionic stabilizer per unit volume of water. The research study included four major tasks to study the effects of LISS stabilization and these are: (a) performing physical, chemical and microstructural tests, (b)evaluating engineering properties, (c) assessing stabilization mechanisms, and (d)numerical modeling to evaluate the post-treatment improvements in the performance of slopes and pavement subgrades stabilized with LISS. The collected soil samples were treated at three different dilution ratios to study the effect of stabilizer dosage on the improvements in basic and engineering properties of the problematic soil. Test results and analyses provided comprehensive characterization of the basic and advanced soil properties,improvements in engineering properties of treated soils, and an in-depth understanding of the stabilization processes at a micro level. The mineralogical and microanalysis studies were also performed to examine the stabilization mechanisms in terms of chemical reactions, mineralogical changes, and other modifications that might have resulted in improvements in the engineering properties at the macro level.The results from the macrotests that included physical, chemical, and engineering tests showed that the LISS is an effective alternative environmental friendly soil stabilizer, which can enhance the strength and stiffness of problematic expansive soils to moderate levels. The LISS also inhibits the swell potential of expansive soils and slightly reduces the plasticity index and linear shrinkage ratio.The reductions in swell potentials were associated with an increase in strength and stiffness (resilient moduli) properties for all the different soil-dilution ratio combinations used in this research study. Among the three dilution ratios used in this research, the double chemical ratio (10 ml/gallon) which had the highest concentration of LISS exhibited the optimum performance based on the overall improvements in engineering properties such as strength, stiffness, and reduction in swell potential.The probable stabilization mechanism was determined by comparing the microstructural test results of Field Emission Scanning Electron Microscopy with Energy Dispersive Spectroscopy (FESEM-EDS) and X-ray Powder Diffraction(XRD) for both untreated and soils treated at the third ratio. Additional macro tests,including variation in moisture content, pH, Consistency Limits and grain size distribution with curing time, were also used to comprehend the changes in the properties of the treated soil. The SEM images depicted that the soil particles flocculated upon addition of LISS and a phospho-rich compound were formed that bonded the soil particles after treatment. The intensity of the clay minerals peaks in the XRD plot was found to decrease when the soil was treated with LISS at the double chemical ratio. The FESEM and XRD results suggest the formation of products formed by the reactions of clay particles with the LISS additive. Moreover,the moisture content of soil gradually decreased by around 3%, and the grain sizeof the treated soils varied with an increase in curing time period, indicating the progressive utilization of water to form reaction products that can bind the clay particles and result in

improvement in engineering properties of problematic soils.The pH of LISS increased from 3 to 7.8 in 20 days, which exhibited a progressive chemical reaction in this period of time. However, the consistency limits of LISS treated soils before and after treatments were nearly the same and no major enhancements were noted in the consistency limit values.In order to evaluate the feasibility of using LISS as an alternative soil stabilizer, two case study examples involved with pavement design and slope stability were analyzed. From the results and analysis of the modeling, the pavement design life of treated expansive soil was higher than that of untreated expansive soils. Also, the global factor of safety (FOS) of treated Dallas soil was slightly increased by 13% as compared to the section without any soil treatment.More studies and field treatment sections will provide more insights into the effectiveness of LISS treatments to enhance soil properties that can provide better support of civil infrastructure.Expansive Soils
Expansive Soils provides the reader with easy and specific access to problems associated with expansive soils, characterisitics and treatment, and evaluation and remediation. Set up with contributions from worlwide expert, this main reference guide is intended for engineers, researchers and senior students working on soil
Soil Stabilization Springer
The definitive guide to unsaturated soil— from the world's experts on the subject This book builds upon and substantially updates Fredlund and Rahardjo's publication, Soil Mechanics for Unsaturated Soils, the current standard in the field of unsaturated soils. It provides readers with more thorough coverage of the state of the art of unsaturated soil behavior and better reflects the manner in which practical unsaturated soil engineering problems are solved. Retaining the fundamental physics of unsaturated soil behavior presented in the earlier book, this new publication places greater emphasis on the importance of the "soil-water characteristic curve" in solving practical engineering problems, as well as the quantification of thermal and moisture boundary conditions based on the use of weather data. Topics covered include: Theory to Practice of Unsaturated Soil Mechanics Nature and Phase Properties of Unsaturated Soil State Variables for Unsaturated Soils Measurement and Estimation of State Variables Soil-Water Characteristic Curves for Unsaturated Soils Ground Surface Moisture Flux Boundary Conditions Theory of Water Flow through Unsaturated Soils Solving Saturated/Unsaturated Water Flow Problems Air Flow through Unsaturated Soils Heat Flow Analysis for Unsaturated Soils Shear Strength of Unsaturated Soils Shear Strength Applications in Plastic and Limit Equilibrium Stress-Deformation Analysis for Unsaturated Soils Solving Stress-Deformation Problems with Unsaturated Soils Compressibility and Pore Pressure Parameters Consolidation and Swelling Processes in Unsaturated Soils Unsaturated Soil Mechanics in Engineering Practice is essential reading for geotechnical engineers, civil engineers, and undergraduate- and graduate-level civil engineering students with a focus on soil mechanics.
Springer
Stabilization of expansive soils using lime and cement additives have been used by practitioners over the years. However, recent heaving and premature pavement failures in lime and cement-treated subgrades containing sulfates led to questioning the validity of calciumbased stabilization. When expansive soils containing sulfates are treated with calcium-based stabilizers, the calcium from the stabilizer reacts with soil sulfates and alumina to form the expansive mineral Ettringite. Formation and growth of the mineral Ettringite has been reported as the cause of severe heaving in several pavement failures. Under favorable environmental conditions, Ettringite transforms itself into another expansive mineral, Thaumasite. This heaving is termed as 'sulfate-induced heave' in literature. Several theories have been proposed to understand the heaving mechanisms in sulfate bearing soils. Based on the theoretical background, researchers and practitioners have proposed various methods to treat sulfate soils. Applicability of these methods is mostly limited to soils containing sulfate content less than 8,000 ppm. Soils with sulfate content above 8,000 ppm are termed as 'high sulfate' soils, and chemical treatment of such soils is currently not considered. Hence there exists a research need to create better understanding of the heaving phenomenon in soils with higher sulfate contents and develop practical techniques for stabilizing such soils. This research is designed to aid in understanding the heaving phenomenon in soils with sulfate contents above 8,000 ppm and to develop practical techniques to stabilize such soils. Six soils: four high plasticity clays, one low-plasticity clay soil and one high-plasticity silt, with sulfate contents varying from 200 ppm - 44,000 ppm, were considered for this research. Chemical and mineralogical tests were performed on the untreated soils to establish the clay mineral distribution and composition of the soils. Additional Gypsum was added to the soils with sulfate contents below 8,000 ppm so they could be considered as 'high sulfate'. These soils were treated with lime and mellowed for periods of zero, three and seven days. Following the mellowing, the samples were remixed, compacted and subjected to various engineering, mineralogical and chemical tests. The present high-sulfate soils were treated lime stabilization with varying mellowing periods and treated soils after treatment were subjected to the engineering and chemical tests. Tests results were analyzed to understand the effectiveness of mellowing period on the heaving phenomenon of 'high sulfate' soils. Both Ettringite formation and crystal growth have contributed significantly to the overall swell of the treated soils. Swell trends observed in the treated soils at respective mellowing periods were attributed to the variability in sulfate levels and reactive alumina and silica contents. Treated soils at higher mellowing periods showed lesser sulfate induced heaving when sulfate levels are lesser than 30,000 ppm. At higher sulfate levels, the mellowing did not result in effective treatment of soils. It was also observed that compaction void ratios and soil clay mineralogy have a significant impact on the swell behavior of chemically treated high-sulfate soils at different mellowing periods. Hence, mellowing effectiveness is explained using free energy and massvolume approaches. Threshold void ratio framework comprising of natural soil void ratio and sulfate content was developed to predict Ettringite-induced heaving in chemically treated high sulfate soils at different mellowing periods. Another treatment method using lime-fly ash treatment is also studied on two soils and the test results showed that the combined treatment has resulted in lesser soil heaving in these soils. The improvements here are mainly attributed to low amounts of calcium in the combined chemical additive used here. In the final study, the rate of Ettringite formation and growth in the treated soils was indirectly assessed by measuring stiffness properties using the Bender Element tests. Bender Element tests revealed material softening and subsequent stiffness degradation in chemicallytreated high-sulfate soils, and threshold stiffness loss values were established for the treated soils. This non-destructive study assessment can be used to evaluate the Ettringite induced soil heaving in sulfate soils under various chemical treatments.
Lime Stabilization of Expansive Soils GRIN Verlag
Essential technical information for building on expansive soils--complete with practical, proven design methods. Expansive Soils examines factors that influence the design offoundations and pavements built on expansive soils, and exploreskey design procedures and remedial measures that address thesefactors effectively. Backed by the authors' extensive research andexperience --including interviews with practicing engineers workingwith expansive soils --this authoritative volume is an importantreference text for geotechnical and foundation engineers,geologists, construction professionals, and students. Easy to understand and apply, Expansive Soils contains: * Site investigation techniques for identification andclassification of expansive soils * Heave prediction methods using different types of data --withrigorous treatment of soil suction theory and measurement,oedometer tests, and more * Alternative design procedures for drilled pier and slab-on-gradefoundations, highway and airfield pavements * Treatment and chemical stabilization techniques --including salttreatment; moisture barriers; lime and cement stabilization; andother procedures * Remedial measures such as drainage control, and removal withreplacement and compaction control * Sample problems illustrating practical applications.
Sustainability in Environmental Engineering and Science Springer
This publication provides introductory technical guidance for civil engineers, geotechnical engineers and other professional engineers and construction managers interested in soil stabilization with portland cement. Here is what is discussed: 1. STABILIZATION WITH PORTLAND CEMENT, 2. STABILIZATION WITH LIME, 3. STABILIZATION WITH LIME-FLY ASH (LF) AND LIME-CEMENT-FLY ASH (LCF, 4. STABILIZATION WITH BITUMEN, 5. STABILIZATION WITH LIME-CEMENT AND LIME- BITUMEN, 6. LIME TREATMENT OF EXPANSIVE SOILS.
Soil Stabilization New Age International
Chemical Stabilization of Expansive Soils Using Liquid Ionic Soil Stabilizers (LISS)
Frontiers in Geotechnical Engineering CRC Press
In the first chapter, Tania Pardo, Teresa Fresno, Vanessa Álvarez-López, and María Touceda-González review central aspects of phytostabilisation techniques for recovering trace elements contaminated soils. The possible future of phytotechnology is evaluated by reflecting on legislation, research evolution, and field implementation. In the second chapter, Essien Udo, Ph.D. presents a study using laboratory investigations to discover problems linked to Coastal residual soils at plain and modified conditions, using the knowledge that residual soil parameters have a substantial effect on the overall performance or non-performance of sub-base and base course formations. Next, in the third chapter, Giovanni Santarato, Anna Albertini, Marco dAttoli, Fabio Navi, Marco Occhi, Federico Fischanger, Gianfranco Morelli, Martino Leoni, Tiziana Apuani, Francesco Loddo, and Gaetano Ranieri present research on techniques of soil consolidation and stabilisation by way of expanding resin injections. Supplementing this, V. Ortega-López, M. Skaf, and A. Santamaría discuss the way Ladle Furnace basic Slags might be used to stabilise natural clayey soils in the fourth chapter. In the fifth chapter, Lucile Saussaye, Lydia Leleyter, Didier Hennequin, Mohamed Boutouil, and Fabienne Baraud assess the effect of nitrate ions on the mechanical performances of soils treated with hydraulic binders, determining that treatment with hydraulic binders improves both the physical and mechanical characteristics of soils, thus permitting them to be used in a variety of geotechnical applications. Afterwards, Shuaishuai Wu, Zhengguo Gao, Shiyang Li, Wenbo Cui, and Xin Huang propose a confined stabilised soil pile as a possible new foundation treatment method in the sixth chapter. In the seventh chapter, Hao Yu, Xin Huang, Jianguo Ning, and Zhanguo Li present a study where three types of composite stabilisers with different AFt formation rates were used to stabilise two kinds of soils. In the eighth and final chapter, Jonathan Oti, PhD expresses findings that it is possible to stabilise clay soil with lime based systems incorporating WS or WTRG for use as improved filling material in road building and other applications.
Quantification and Stabilization of Expansive Soils in Mississippi Springer
Expansive soils are a worldwide problem that poses several challenges for civil engineers. Such soils swell when given an access to water and shrink when they dry out. The most common and economical method for stabilizing these soils is using admixtures that prevent volume changes. In this study the effect of using rock powder and aggregate waste with lime in reducing the swelling potential is examined. The expansive soil used in this study is prepared in the laboratory by mixturing kaolinite and bentonite. Lime was added to the soil at 0 to 9 percent by weight. Aggregate waste and rock powder were added to the soil at 0 to 25 percent by weight. Grain size distribution, Atterberg limits and swell percent and rate of swell of the mixtures were determined. Specimens were cured for 7 and 28 days. This method of treatment caused a reduction in the swelling potential and the reduction was increased with increasing percent stabilizers.
Effects of Lime Stabilization on Expansive Soils in the Hartford Area John Wiley & Sons
New Materials in Civil Engineering provides engineers and scientists with the tools and methods needed to meet the challenge of designing and constructing more resilient and sustainable infrastructures. This book is a valuable guide to the properties, selection criteria, products, applications, lifecycle and recyclability of advanced materials. It presents an A-to-Z approach to all types of materials, highlighting their key performance properties, principal characteristics and applications. Traditional materials covered include concrete, soil, steel, timber, fly ash, geosynthetic, fiber-reinforced concrete, smart materials, carbon fiber and reinforced polymers. In addition, the book covers nanotechnology and biotechnology in the development of new materials. Covers a variety of materials, including fly ash, geosynthetic, fiber-reinforced concrete, smart materials, carbon fiber reinforced polymer and waste materials Provides a “one-stop resource of information for the latest materials and practical applications Includes a variety of different use case studies
A Comparative Evaluation of Various Additives Used in the Stabilization of Expansive Soils Springer Nature
This volume includes a collection of technical papers on an important topic in geotechnical engineering; the behavior and treatment of expansive soils. The research studies include investigations into novel stabilization techniques for expansive soils using different admixtures or mechanical consolidation techniques, as well as new experimental approaches to evaluate the behavior of expansive soils. They also include an evaluation of wetting boundary conditions on the volume change of expansive soils, as well as the role of hydrologic boundary conditions in arid climates. The volume is based on the best contributions to the 2nd GeoMEast International Congress and Exhibition on Sustainable Civil Infrastructures, Egypt 2018 – The official international congress of the Soil-Structure Interaction Group in Egypt (SSIGE).