

Expansive Soil Stabilization Using Marble Dust and Bagasse Ash

R. Ali¹, H. Khan², A. A. Shah³

¹Student of Civil engineering, Sarhad University of Science and Information technology, Peshawar, Pakistan

²Lecturer, Department of CIVIL engineering, SLIT Peshawar, Pakistan

³Chairman, Department of Civil Engineering, SLIT Peshawar, Pakistan

Abstract: This research is an attempt to investigate the effect of marble dust and bagasse ash on the stabilization of expansive soils. Expansive soils are always characterized by their high expansion, high moisture content, high compressibility, high shrinkage on drying along with wide polygonal cracks and sufficient swelling on wetting. Expansive soils (problematic soils) are present in different parts of the world and extensively found in many locations particularly in Pakistan. In KPK province we select five different sites and collect soil sample and determine their index properties. While selecting sites we visually inspect the soil and collect soil sample from areas having wide cracks in soil in dry condition. From the index properties of all the soil samples, district Bannu soil were classified as expansive soil having liquid limit greater than 50% and plasticity index greater than 30%. Currently different techniques are in use for improvements of expansive soil but most of them are uneconomical. For expansive soil improvement we use marble dust and bagasse ash which are already burden on our natural environment. Utilizing these wastes for the improvement of expansive soil will be the best alternative. Different lab tests on expansive soil without the addition of these waste and with the addition of these waste were performed and their effect on swelling and other properties were determined. Finally, marble dust and bagasse ash can be utilized to treat and stabilize the expansive soil as economical alternative to Portland cement and other (expansive) chemical stabilizers. The use of bagasse ash and marble dust for stabilization applications is an economical and environmental solution of the problems associated with its disposal process.

Keywords: Expansive soil, Expansive index, Swell pressure, Bagasse ash, marble dust.

1. Introduction

Expansive soils are those that experience significant volume changes associated with changes in water contents. It expands when water is added and shrinks when they dry out. An expansive soil expands due to the presence of highly reactive clay minerals such as montmorillonite and smectite. This continuous change in soil volume can cause light structure built on this soil to move unevenly and crack. This damage is more than twice the damage from floods, hurricanes, tornadoes, and earthquakes combined (Jones and Holtz, 1973). Problems of expansive soils has appeared as cracking and break-up of pavements, roadways, building foundations, slab-on-grade members, channel linings, irrigation systems, water pipelines, sewer lines and gas pipeline. Soils sample were collected from five different districts including district Swat, Bannu, Mardan and Peshawar (Site 1 & 2) and their index properties were determined. From the index properties of the entire soil sample district Bannu soil were considered as expansive soil having liquid limit greater than 50% and plasticity index greater than 30%. Generally main properties of expansive soil are swelling properties which affect both the long and short term stability of the structure foundation built on this soil. Therefore it is necessary to improve the soil properties to avoid damages to the structure. Bagasse ash and marble dust are used to improve the properties of expansive soil which are available in large amount and are produced in huge amount by the sugar cane and marble industry. Bagasse ash is high in silica, calcium, and other minerals. Bagasse ash and marble dust are added in 0%, 4%, 8% and 12% separately and the results were compared.

2. Materials and Methods

In this study marble dust are used which are taken from marble industry (Haji Khan marble industry) located near Rawalakot interchange motorway. Similarly bagasse ash is collected from the sugar mills Mardan. Expansive soil are collected from kosha village, tehsil domail, district Bannu.



Figure 1: Satellite image of Kosha village, Tehsil Domail, District Bannu

3. Selection of Sites

While selecting sites for collecting expansive soil sample we visually inspect the ground surface. Expansive soils can be easily recognized in the dry season by the deep cracks (a yardstick can be easily inserted), soil is rock hard when dry,

Stabilization Of Expansive Soils Using Waste Marble Dust A

Nimur Rahaman Durjoy

A decorative red circular graphic with a gradient, positioned to the right of the author's name.

Stabilization Of Expansive Soils Using Waste Marble Dust A:

Stabilization of Local Expansive Subgrade Soil using Marble waste powder with Lime Amdegebreal Endalew, 2020-03-19
Thesis M A from the year 2016 in the subject Engineering Civil Engineering grade Very Good course Master s Thesis Work language English abstract Expansive soils are the most problematic soils due to their property of swelling and expansion with the influence of variable moisture a number of civil engineering structures were destroyed A billions of US dollars spent worldwide each year to mitigate the problem The presence of expansive sub grade soil results pavement distress and damage Removing the expansive soil and replacing with the competent material is applied to mitigate the problem which is very expensive and time consuming for long hauling distance and thick layer expansive soil This study presented stabilization of local expansive sub grade soil using marble waste powder with lime The marble waste powder was collected in Addis Ababa from Ethiomarble processing enterprise Gulele branch and the lime was collected at Gast Solar Mechanics in Addis Ababa Free swell index test Atterberg limit test Proctor test unconfined compressive test California Bearing Ratio Tests swelling potential and swelling pressure test were used to evaluate properties of treated and untreated soils The expansive subgrade soil was treated using 5% 10% 15% 20% and 25% marble waste powder with fixed 3% lime respective combinations by weight of the soil The optimum percent combination for this study was 10% marble waste powder with 3%lime based on soaked CBR swell soaked CBR swelling pressure and swelling potential test result values Optimum proportion of stabilizers improve CBR Value from 0 65% to 4 19% reduce swelling pressure from 1000kpa to 440kpa increases MDD from 1 21 to 1 29 and reduce PI from 78% to 48 4% Keywords marble waste powder lime expansive soil CBR UCS swelling pressure MDD OMC

Proceedings of Indian Geotechnical and Geoenvironmental Engineering Conference (IGGEC) 2021, Vol. 1

Arvind Kumar Agnihotri, Krishna R. Reddy, H. S. Chore, 2022-11-24 This book presents select proceedings of the Indian Geotechnical and Geoenvironmental Engineering Conference IGGEC 21 Various topics covered in this book include geotechnical engineering earthquake geotechnical engineering geoenvironmental engineering ground improvement transportation geotechnics waste management and sustainable engineering The book will be a valuable reference for researchers and professionals in the discipline of civil materials geoenvironmental engineering landfills hydrogeology ground improvement and earthquake geotechnical engineering **Ground Improvement Techniques** T. G. Sitharam, C. R. Parthasarathy, Sreevalsa Kolathayar, 2021-03-24 This volume presents select papers presented at the 7th International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics The papers discuss advances in the fields of soil dynamics and geotechnical earthquake engineering Some of the themes include slope stability shallow and deep foundations geosynthetics ground improvement techniques etc A strong emphasis is placed on connecting academic research and field practice with many examples case studies best practices and discussions on performance based design This volume will be of interest to researchers and practicing engineers alike **Ground Improvement and Reinforced**

Soil Structures C. N. V. Satyanarayana Reddy, Sireesh Saride, A. Murali Krishna, 2021-07-27 This volume comprises the select proceedings of the Indian Geotechnical Conference IGC 2020. The contents focus on recent developments in geotechnical engineering for sustainable tomorrow. The volume covers the topics related to advances in ground improvement of weak foundation soils for various civil engineering projects and design construction of reinforced soil structures with different fill materials using synthetic and natural reinforcements in different forms.

Waste Utilization in Geotechnical Practice Sandeep Samantaray, Subhashree Samantasinghar, Soumendra K. Mohanty, Vivek, Abinash Sahoo, Deba Prakash Satapathy, 2025-06-05 The book provides a comprehensive overview of how the innovative use of waste materials not only addresses environmental challenges but also provides sustainable cost-effective solutions for construction, making it an essential resource for professionals in the field. Waste pollutes ground resources and sub-surface water if disposed of without proper treatment, which requires large areas. This waste can be utilized as a sustainable alternative to conventional construction materials. Environmental scientists and geotechnical engineers are increasingly challenged to solve environmental problems related to waste disposal facilities and the cleanup of contaminated sites. This book explores how various types of waste materials can be effectively used in geotechnical construction projects related to soil and foundation. The volume covers properties of different waste materials, methods for testing and characterizing them, potential environmental impacts of using waste materials in geotechnical projects, and the design considerations and techniques for incorporating those waste materials into geotechnical structures. The economic and regulatory aspects of waste utilization in geotechnical practice, including the potential cost savings and the protocols governing the use of waste materials in construction projects, are discussed. The book serves as an informative and practical guide to land-based waste disposal and its potential applications in soil improvement. Audience: Researchers, civil engineers, students, and policymakers working in geotechnical engineering, civil engineering, environmental science, and waste management.

Geoenvironmental Engineering Arvind Kumar Agnihotri, Krishna R. Reddy, Ajay Bansal, 2024-08-20 This book contains peer-reviewed and selected papers presented during the International Conference on Environmental Geotechnology, Recycled Waste Materials, and Sustainable Engineering (EGRWSE 2023) held at NIT Jalandhar. It discusses the recent innovations, trends, concerns, practical challenges encountered, and the solutions adopted in waste management and engineering, geotechnical, and geoenvironmental engineering, infrastructure engineering, and sustainable engineering. This book can serve as a useful resource for researchers, educators, policymakers, and professionals working in the field of civil engineering, chemical engineering, environmental sciences, and public policy.

Technologies for Sustainable Transportation Infrastructures G. L. Sivakumar Babu, Raviraj H. Mulangi, Sreevalsa Kolathayar, 2024-09-05 This book presents select proceedings of the International Conference on Sustainable Infrastructure Innovations, Challenges, and Opportunities 2023 (SIIOC 2023). The topics covered include road user safety and traffic mitigation for sustainable highways, transportation geotechnics, design, and

construction approaches for green highways water and wastewater treatment sustainable cities and challenges in the management of water resources This book serves as a resource material for budding researchers and industry professionals interested in developing solutions for sustainable infrastructure *Sustainable Construction Resources in Geotechnical Engineering* Hemanta Hazarika, Stuart Kenneth Haigh, Babloo Chaudhary, Masanori Murai, Suman Manandhar, 2024-04-08 This book presents select proceedings of the 2nd International Conference on Construction Resources for Environmentally Sustainable Technologies CREST 2023 and focuses on sustainability promotion of new ideas and innovations in design construction and maintenance of geotechnical structures with the aim of contributing towards climate change adaptation and disaster resiliency to meet the UN Sustainable Development Goals SDGs It presents latest research information technological advancement practical challenges encountered and solutions adopted in the field of geotechnical engineering for sustainable infrastructure towards climate change adaptation This volume will be of interest to those in academia and industry alike

Stabilization of Expansive Soil Using Cement and Waste Marble Powder Fatima Khalil Al- Belushiyah (\$eauthor), 2024

Government Reports Announcements & Index, 1977 **Stabilization of Expansive Soils by Using Aggregate Waste, Rock Powder and Lime**, 2004 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 mixing 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

Chemical Abstracts, 2002 *New Ways of Dealing With Soil in Constructions? Soil Stabilization Using Brick, Dust and Cement* Nimur Rahaman Durjoy, 2020-09-10 Bachelor Thesis from the year 2019 in the subject Engineering Geotechnology grade A language English abstract The nature of soil is an ambiguous property unlike it is treated to know the basic engineering parameters Usually soil and soft soils cause difficulties in construction site when having low strength and low stiffness To enhance the engineering property soil needs to be stabilized This study is an experimental base research where brick dust and cement are used to stabilize the soil to explore the more uses of raw materials like this as well as to improve the quality of soft soil at the proposed site of Manikdi Dhaka The soil is classified as a clayey soil and determined the plastic limit liquid limit specific gravity grain size Secondly to compare the strength and characteristics of existing soil before and after treating with the combination of brick dust and cement We used two different mixed ratio and natural soil to conduct this experiment From unconfined compression strength test of natural soil soil with mix ratio Cement Brick Dust Soil 1 1 5 7

and soil with mixed ratio Cement Brick Dust Soil 1 2 7 were 483 7 kPa 737 2 kPa and 967 8 kPa consequently So we found that the stress is increasing with increasing amount of cement and brick dust From The grain size analysis the Cu value of natural soil soil with mix ratio Cement Brick Dust Soil 1 1 5 7 and soil with mixed ratio Cement Brick Dust Soil 1 2 7 were 4 3 5 06 and 3 25 consequently Also we found that the Cc value of natural soil soil with mix ratio Cement Brick Dust Soil 1 1 5 7 and soil with mixed ratio Cement Brick Dust Soil 1 2 7 were 0 84 0 879 and 0 83 consequently So for this three cases the soil sample was poorly graded From the Atterberg limit test the liquid limit for natural soil soil with mix ratio Cement Brick Dust Soil 1 1 5 7 and soil with mixed ratio Cement Brick Dust Soil 1 2 7 were 36 07% 34 63% and 33 17% consequently the plastic limit were 24 81% 22 09% and 21 08% consequently So we can say that the liquid limit and plastic limit is decreasing with increasing amount of cement and brick dust

A Comparative Evaluation of Various Additives Used in the Stabilization of Expansive Soils AA. Al-Rawas,R. Taha,JD. Nelson,H. Al-Siyabi,2002 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

Study of Self Compacting Concrete Using Waste Marble Dust and GGBFS Pratik Gajjar,Paresh Nimodia,2017-03-30

Soil Stabilization of Three Different Soils Using Cement Kiln Dust Shahriar Azad,1998

An Introduction to Soil Stabilization with Portland Cement J. Paul Guyer,2017-02-13 This publication provides introductory technical guidance for civil engineers geotechnical engineers and other professional engineers and construction managers interested in soil stabilization using 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

Problematic Soils and Geoenvironmental Concerns Madhavi Latha Gali,P. Raghuvveer Rao,2020-09-11 This volume comprises select papers presented during the Indian Geotechnical Conference 2018 This volume focuses on discussing the many challenges encountered in geoenvironmental engineering The book covers sustainability aspects related to geotechnical engineering problematic soils and ground

improvement use of geosynthetics and concepts of soil dynamics The contents of this book will be useful to researchers and professionals working in geo environmental engineering and to policy makers interested in understanding geotechnical concerns related to sustainable development *STABILIZATION OF EXPANSIVE SOILS BY ÇAYIRHAN FLY ASH AND DESULPHOGYPSUM*. ,2001 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 ay rhan 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 **Use of High Volume Fly Ash Cement for Stabilization of Expansive Soils with High Soluble Sulfates Content** Carlos S. Piñero Rivera,2000

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