Case Studies in Construction Materials 7 (2017) 263–279

Contents lists available at ScienceDirect

Case Studies in Construction Materials

journal homepage: www.elsevier.com/locate/cscm

Short communication

Investigating laboratory parameters of the resistance of different mixtures of soil – lime – fume using the curing and administrative method

Mahmoud Nematzadeh[a,*], Panam Zarfam[b], Mehdi Nikoo[c]

[a] Dezful Branch, Islamic Azad University, Dezful, Iran
[b] Department of Structural Engineering, Science and Research Branch, Islamic Azad University, Tehran, Iran
[c] Young Researchers and Elite Club, Ahvaz Branch, Islamic Azad University, Ahvaz, Iran

ARTICLE INFO

Keywords:
Lime
Fume
Soil stabilization
Testing compressive strength
Endurance

ABSTRACT

Soils treatment is affected by various factors such as density, moisture content and mineral composition of soil and different percentages of materials in soil. Lime soil as a suitable and inexpensive material has been used for decades to stabilize in civil engineering projects; however, the effect of adding fume and curing temperature on strength and stability parameters of the mixture seldom been studied. In this study, soil and water has been studied from Dokhtar Borji in Hosseinieh city in Iran. Based on a laboratory study, we dealt with evaluating the physical and mechanical properties of soils and chemical properties of soil and water. The cylindrical samples of different mixtures of soil- lime- fume were modified using the AASHTO method and compressive strength testing of 7-, 14- and 28-day samples were conducted according to ASTM standards at 27 °C. Analysis was conducted in SAS (Statistical Analysis System) software. Results indicated that the increase in average compressive strength from 7 to 14 and from 14 to 28 days were 62 and 53.57%, respectively. Therefore, by increasing the number of curing days from 7 to 14, the percentage of the compressive strength is at its highest. The study also provided a linear regression equation that determines compressive strength with an accuracy of 95.1%.

1. Introduction

Some soils are inappropriate for application in road construction, foundation beds, dam construction and other civil projects due to unfavorable technical specifications and having significant amounts of clay or silt, thus being considered poor. Such soils create several problems against moisture, low resistance and compressibility due to sensitivity and instability. If change of soil is not affordable, soil improvement methods must be investigated so that the applied method would be economically justifiable and applicable. The most important goals of soil stabilization is the provision of one or more of the following items [1]:

- Effective use of collateral loans;
- Modifying soft and low resistive soils;
- Increasing soil stability;
- Increasing soil bearing resistance;
- Reducing permeability;

* Corresponding author.
E-mail addresses: mahmoud.nematzadeh66@yahoo.com (M. Nematzadeh), zarfam@srbiau.ac.ir (P. Zarfam), sazeh84@yahoo.com (M. Nikoo).

http://dx.doi.org/10.1016/j.cscm.2017.08.002
Received 7 April 2017; Received in revised form 15 July 2017; Accepted 7 August 2017
Available online 25 August 2017
2214-5095/ © 2017 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/BY-NC-ND/4.0/).

- Reducing swelling and contraction of the soil, and
- Reducing soil moisture.

Khtak and Andersland investigated the effect of adding a cellulose fiber on shear strength and stress-strain behavior of Kaolinite clay using triaxial tests, and the results indicated that addition of fibers increases shear strength and ductility of the mixture and the attraction between clay particles and fibers create the appropriate link for transferring the load [2].

Mckenon et al. conducted a comprehensive chemical research on chemical reactions of fume with lime and soil. The results of the study indicate the fact that fume as a matter of improving chemical properties can be used for soil stabilization. Some of these results are as follows [3]: Adding microsilica leads to a severe decrease in aluminum solution, which results in the satisfactory control of sulfate and prevents the inflation of stabilized layers, and adding microsilica plays a significant role in the formation of ettringite in clay soil with a high concentration of sulfate solution. Ettringite formation during the hardening of the mixture increases volume and causes cracks and damage to the stabilized soil [3].

Carbonation is an undesirable phenomenon that occurs in the absence of reaction of soil with lime, so that the CO_2 in the air or soil is mixed with lime CaO in lime and creates $CaCO_3$. This occurs when no sufficient pozzolanic clay is available in the combination. $CaCO_3$ is a plastic material that increases the plasticity of the mixture and prevents pozzolanic reaction; therefore, the addition of silica as a pozzolan can be used to prevent carbonation and increase cementation reactions and increase the amount of soluble calcium by adding microsilica, which therefore increases pozzolanic activity [1]. Adding microsilica significantly increases pH. With an increased pH, soil silica is released from its tetrahedral sheet construction and alumina is released from its octagonal sheet construction and the pozzolanic reactions are accelerated [3]. In 2006, Kumar et al. investigated the effect of polyester fibers on clay and found that increasing the amount of fibers significantly increases compressive strength of the soil [4].

Kalkan investigated the impact of wet and dry cycles of clay stabilized by fume and stated the reduction of the swelling feature caused by wet and dry silica in swelling clay by the use of fume. He has also reported the optimal moisture and soil pH and the reduction of plastic feature and specific dry weight of the soil by increasing the fume [5]. In the same year, the effect of fume-lime ingredient in silty sand soils were investigated by Karimi and the results indicated increase in CBR as well as reduction in the devastating impact of sulfates in this type of soil due to the addition of fume and lime. In addition, the increase in soil pH was also evident due to the presence of lime [6].

Hemp- lime concrete is a sustainable alternative for standard wall materials. These material have excellent thermal properties in as a result of their porous structure. This paper explores the acoustic properties of hemp-lime concrete using hydrated lime and pozzolan developed binders as well as hydraulic binders to assess the acoustic absorption of the hemp-lime wall. Hemp concrete with pozzolan lime binders is superior than hydraulic binders in indicating acoustic properties. This offered reduction is affected again as surface porosity. However, construction of hemp-lime provides the potential to achieve standard goals and guides for areas that are in need of audio treatment [7]. Ferrochrome ash is a ferroalloy product. This study is the evaluation of the potential of ferrochrome ash with lime as a substitute for cement in the production of concrete. For this purpose, different properties such as efficiency, new density, compressive strength, flexural strength, bond strength, acid resistance, sulphate resistance for the concrete containing 10–40% ferrochrome was investigated at a 7–10% lime content. Results indicate that concrete properties are improved by inclusion of ferrochrome and lime. In replacement of 47% of ordinary Portland cement, 40% ferrochrome and 7% lime, the properties of concrete are standard or even better at all stages. The results of destructive tests were compared with non-destructive tests. The analysis of the structure (conditions and the hydration degree of gel) confirmed the results. The result of the accepted technical studies of ferrochrome with lime is considered as a cementitious material [8].

Hydration and infrastructure of the concrete containing fume, treatment with different temperatures by measuring the mechanical properties of concrete, determining the non-emitting content of water and calcium hydroxide and investigation of the structure of matrix porosity and pore of concrete were carried out. The results indicate that the influence to improve raw fume on macro properties of concrete and hard hydration are more revealing than the dense fume. The difference between the two types of fume on concrete properties are reduced by high temperatures. At the beginning, the steam tends to stimulate hydration and prevents hydration of the binders at later times. In addition, both raw and dense fume help reduce CH.SF content. High temperature helps reduce porosity and increases the ratio of 4.5 to 50 nanometers in tiny cavities in hard dough [9]. Gopal conducted studies on soil properties with fume as a stabilizer and compared it to other materials. Laboratory studies indicate that soil samples having low strength can be treated through modifying the amount of fume from 5% to 20% of dry soil weight. Treatment soil samples indicated significant improvement in strength characteristics [10].

Today, different methods are used for determining the strength of different samples of soil and even concrete mixtures, among them are the use of artificial neural networks [12–15] and self-organizing systems [16,17]. One of the major problems in construction projects in mountainous and inaccessible areas is the lack of suitable materials where in this experiment, purposes such as obtaining an optimum combination of soil-lime-fume is followed and the study procedure is depicted as a flowchart in Fig. 1.

2. Introducing the tests carried out on samples

2.1. Grading test

Grading Test was conducted for identification and classification of soils and their comparison with other soils. In this study, considering that the soil sample was fine-grained, the hydrometric grading method was conducted according the ASTM D442 standard. Grading test results are provided in Table 1 [11].

Download English Version:

https://daneshyari.com/en/article/4911585

Download Persian Version:

https://daneshyari.com/article/4911585

Daneshyari.com