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FULL LENGTH ARTICLE

Assessment of soil mixing with cement kiln dust to reduce soil lateral pressure compared to other soil improvement methods

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KEYWORDS

Soil improvement;
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Abstract The soil lateral earth pressure acting on retaining or wing walls of hydraulic structures is considered the most influential load in structural design of these walls. The general properties of the soil foundation and backfill soil are the factors that control the cost of engineering design of retaining or wing walls of hydraulic structures. Some water structures may be subjected to various forms of damage for reasons related to soil problems. These structures may need rapid intervention to repair these defects which are considered one of the most expensive and most complex flaws in the reform.

In order to improve the mechanical properties of the soil backfill, which are reflected on the cost of new buildings or address problems of existing soil structures, this research compares between different soil improvement techniques, which can be easily applied to these kinds of buildings and has a significant effect. Many field tests were carried out to compare the retaining wall resistance to backfill soil using medium sand soils as backfill material processed in four different methods. These methods are filling sand using common compaction specifications, using sand filled baskets (gabions), soil reinforcement with geogrid and soil mixing with cement kiln dust.

The results of experiments showed that the soil mixing with cement dust is considered the best method among the other used methods, although it may not be the fastest when considering the construction process.

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Introduction

Most of barrages in Egypt have been built many years ago using masonry bricks without reinforcement. The main problem of the masonry structures is their low resistance to tensile stresses. Masonry structures are also sensitive to lateral load such as lateral earth pressure on structure abutments. It is essential to protect the barrage structures due to their

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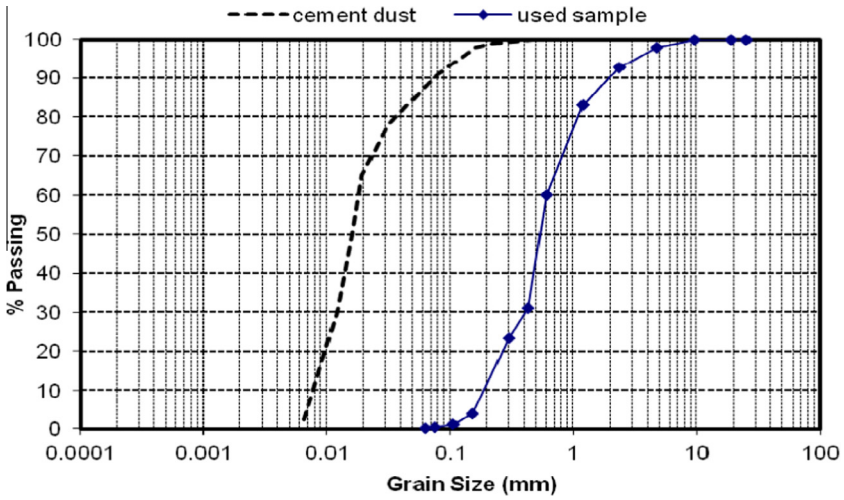

Fig. 1 Grain size distribution curves.

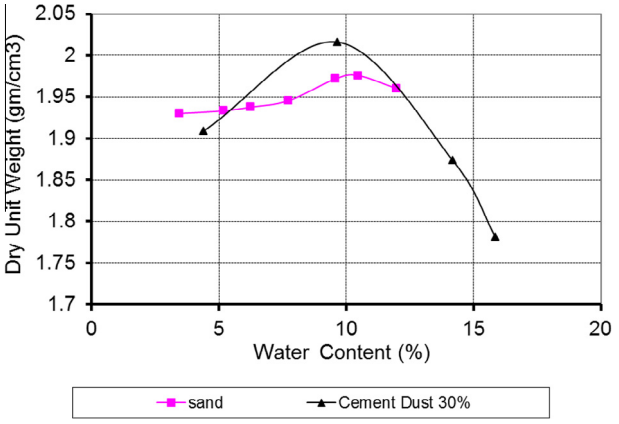

Fig. 2 Compaction test results of sand and mixture of 30% CKD.

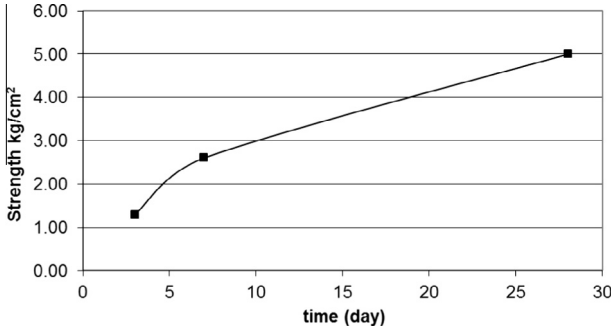

Fig. 3 Unconfined compressive strength for soil and 30% CKD.

importance in the Egyptian irrigation system from the risk of failure due to excessive lateral earth pressure.

Soil improvement is one of the most economical engineering solutions to overcome many of soil problems. Soils may be improved through mechanical effort or addition of chemical or cementitious additives. The importance of this technique is increased when using waste of some industrial materials which is to be mixed with natural soil. CKD can be used as a cementitious material with a variety of soils to improve their engineering properties.

This research investigates the reduction in the lateral earth pressure of soil mixed with CKD compared to reduction in the lateral earth pressure of soil improved by compaction, geogrid reinforcement, or packing in gabions.

Many researchers have studied the effect of mixing soils with CKD. Cement Industry Committee IEEE-IAS [1].

Mohie [2] found that the compaction characteristic of the sand was improved by adding CKD. Considering the seepage control and compressive strength, cement dust proved to have more pronounced effect on the reduction of the sand permeability and enhancement of the compressive strength of the sand.

Experimental work and its result

An experimental program was designed to assess the effectiveness of the suggested technique compared to other common methods. Four field tests were carried out to measure the maximum lateral deflection at the top of retaining wall due to the use of different backfilling materials and techniques. Also the maximum strain was measured near the wall base.

The following sections describe the properties of the material used to compose the backfill and the retaining wall model.

Determination of the Used Materials Properties

Several laboratory tests were conducted to determine the properties of the used material (sand, CKD, geotextile, geonet) as following:

Specific gravity

The specific gravity of sand and cement dust is 2.70 and 3.12, respectively, which indicates that the used cement dust has a specific gravity higher than the used sand.

Grain size distribution

Grain size distribution test was performed in accordance with the ASTM-D422 test method for particle size analysis of soils.