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Laboratory Investigation of the Effect of "NICOFLOK" Polymer on the Compressive and Tensile Strength of Desert and Coastal Sand at the pavement Layers

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ABSTRACT: Dune sand can be easily found on beaches and deserts. In this study samples from beaches of the Caspian Sea in Astara and Mazandaran and also from deserts around Kerman were recognized and collected. The effect of adding Nikoflok polymer with cement to samples after stabilization was investigated. This study aims to improve the compressive and tensile strength of samples made of dune sand from beaches and deserts to assess the possibility of using them with cement in the subgrade, sub-base and base. 200 samples with 3, 6, and 12 percent of cement, 0.3, 0.6, and 1.2 percent of Nikoflok and dune sand were made and underwent 7, and 28 day compressive and indirect tensile tests. Also, the strength degradation of samples under 45 cycles of freeze-thaw was investigated. The results showed that by stabilizing dune sand with cement and Nikoflok, its compressive and tensile strength increases and it can be used in pavement layers.

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1. INTRODUCTION

There are wide beach regions in the north and south and vast deserts in the center of Iran. The materials of these regions are mostly poorly graded dune sand which cannot be used in concrete mixtures due to low strength and lack of coarse aggregate[1]. A general method to increase the quality and bearing capacity of materials is stabilization and by considering the conditions such as weather, soil, stabilization goal, environmental issue, and economic issues, the admixture is determined.

Alkarni and Elkholy investigated the effect of adding cement to dune sand of deserts in Saudi Arabia. To do this they produced samples with different cement ratios which underwent compressive and shear strength tests after curing. The results of this study showed that adding cement increased mechanical properties[2]. Palmerovich and Vladimirovich used ANT, NANO STAB, and Nikoflok with cement as a stabilizer in materials with different ratios of crushed aggregates and sand. The results showed that using Nikoflok polymer can increase 5 and 7 days compressive and tensile strength. In this study, Nikoflok/cement weight ratio was 0.1[3].

So in this study considering vast beaches and deserts in the north, south, and center of Iran, by sampling dune sand in Caspian sea beach at Astara and also desert regions around Kerman and producing standard compacted samples stabilized with cement and Nikoflok polymer, properties of these materials were investigated to determine whether they can be used in pavement layers.

2. EXPERIMENTAL STUDY

In this study dune sand from Astara and Mazandaran, and also from Kerman, cement manufactured in Ardebil, beverage water of Ardebil and Nikoflok polymer were used. In this study after grading and compacting test with obtained moisture ratios, compacted samples stabilized with cement were made according to ASTM-D558[4] from both samples of dune sand. The cement percent was 3, 6, and 12 according to experiments and also the Nikoflok/cement weight ratio was 0.1 according to previous studies. Then compressive and indirect tension strength tests were conducted on the samples after 7 and 28 days of curing. Also, samples with 45-day curing underwent 45 freeze-thaw cycles according to ASTM-C666[5].

3. RESULTS AND DISCUSSION

1- As shown in Figs. 1 and 2 Nikoflok polymer increased 7-day strength of samples with cement as the stabilizer. This increase for dune sand from the beach was 23.7% and for dune sand from the desert was 20% on average. The maximum increase in dune sand from the beach relates to the cases with

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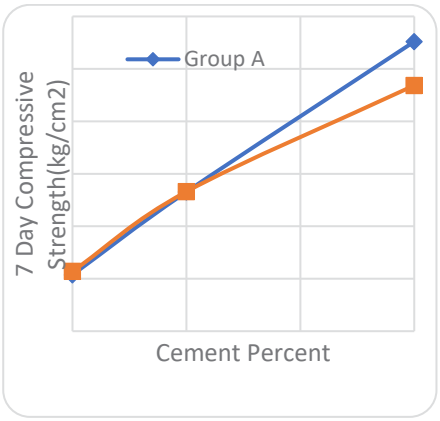

Fig 1. Results of Use Cement in coastal sand (Group A) and desert (Group B) on 7 days Compressive Strength

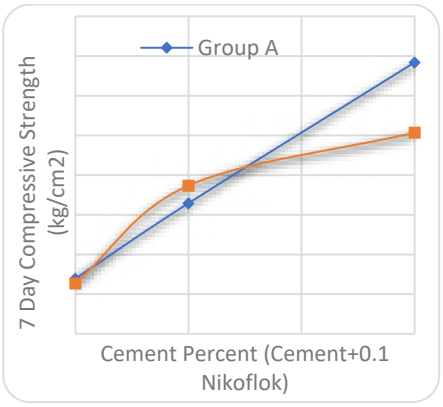

Fig 2. Results of Use Nicoflok with Cement in coastal sand (Group A) and desert (Group B) on 7 days Compressive Strength

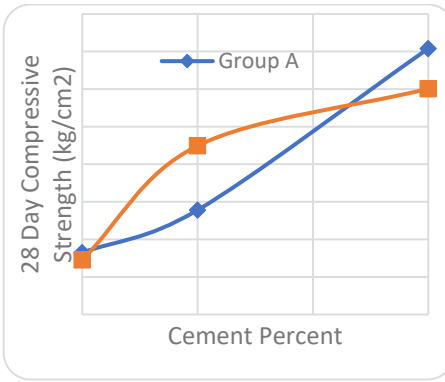

Fig 3. Results of Use Cement and in coastal sand (Group A) and desert (Group B) on 28 days Compressive Strength

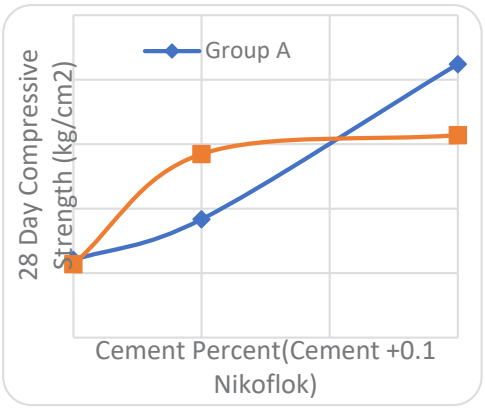

Fig 4. Results of Use Nicoflok with Cement in coastal sand (Group A) and desert (Group B) on 28 days Compressive Strength

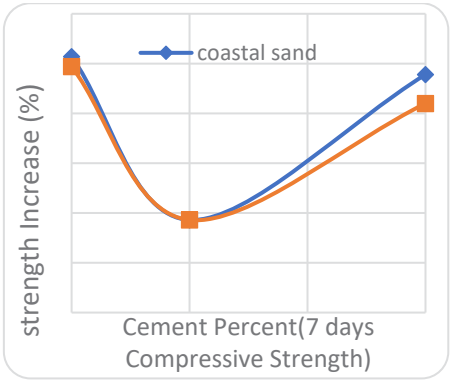

Fig 5. Percent of increase of 7 days Indirect tensile strength with use of Nicoflok Polymer

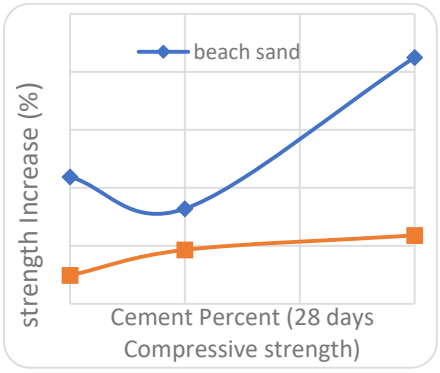

Fig 6. Percent of increase of 28 days Indirect tensile strength with use of Nicoflok Polymer

6 and 12 percent of cement and Nikoflok/cement ratio of 0.1 and in dune sand from the desert relates to the case with 6 percent of cement and 0.6% of Nikoflok.

2- As shown in Figs. 3 and 4 For the case of 28-day strength, samples with 3 percent of cement and 0.3% of Nikoflok have the most increase. The average increase for samples with dune sand from the beach is 32.7% and for dune sand from the desert is 28.9%.

3- As shown in Figs. 5 and 6 Using Nikoflok causes an improvement in dune sand material stabilized with cement. This increase in 7-day strength for samples with dune sand from the beach 18.3% and for samples with dune sand from the desert is 19.6% on average. For 28 day strength, these values became 8.6 and 26.9 percent, respectively. Also for the case of 7-day strength, Nikoflok was the most influential in samples with 3 percent of cement and 0.3 percent of Nikoflok.

This increase is the same for both samples of dune sand and equals 25%. For the case of 28-day strength, Nikoflok was the most influential in samples with 12 percent of cement and 1.2 percent of Nikoflok. This increase for dune sand from the beach equals 11.8 percent and for dune sand from the desert equals 42.5 percent.

4- Generally by increasing cement and Nikoflok percent, the resistance of materials with dune sand from the beach against freeze-thaw cycles increases. But this is not valid for materials with dune sand from the desert and the compressive strength of samples with Nikoflok is low, except for the sample with 3 percent of cement.

4. CONCLUSIONS

Considering the investigations in this study, dune sand materials can be found easily in beaches and deserts and used as a stabilized layer with cement. Considering the region and weather conditions, a suitable mixture can be determined according to the local conditions. It should be noted that for using this mixture as in pavement layers, it should be used with Nikoflok polymer. So using this material with Nikoflok in beaches and deserts can cause a decrease in the construction cost of roads, protect the environment, prevent immethodical extraction of mines and decrease high expenses of extraction, crushing, and transportation of the materials.

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