

INFLUENCE OF CHEMICAL ADMIXTURE ON MARINE SOIL

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Abstract—When soil loses the moisture content below the ground, it creates the volume reduction in the soil and causes shrinkage cracks on the soil surface. This condition creates moderate to severe problematic damage to the Geotechnical Engineering works. Shrinkage of the soil occurs in many ways, but chemical admixture technique is a world-wide technique to reduce the shrinkage of the soil. In this research paper, using Potassium Carbonate (K_2CO_3) as a chemical admixture in various proportions such as 0%, 1%, 1.5% and 2% in marine soil to reduce the shrinkage characteristics of the soil. Use of Potassium Carbonate (K_2CO_3) in marine soil and observed the behaviour of chemical in the soil. Results are concluded that the shrinkage limit is reduced by 32.27% in addition of optimum percentage of chemical.

Keywords— Atterberg's limit, Shrinkage limit, Marine soil, Potassium carbonate, Cation exchange capacity:

INTRODUCTION

The soil in the ocean has some of the richest soil for plants to grow. There are sand, kelp, mud, small pieces of coral in the soil. Clay often causes difficulties in construction with its low strength and stiffness. This has caused serious problems in geotechnical engineering works. Because of weak soil causes damage to the foundation of the building and cracks along the road pavement. This type of soil is known as marine soil.

The shrinkage in the soil occurs due to the absence of water in the soil. The shrinkage of the soil mainly depends on the presence of illite mineral of the clay. Shrinkage of the soil is reduced in many ways, but chemical admixture technique is a world-wide technique to reduce the shrinkage of the soil.

The main aims of this research is to analyse the Atterberg's limit, determination of the shrinkage characteristics of the marine soil and improving the shrinkage characteristics of the soil by adding potassium carbonate in various proportions such as 0%, 1%, 1.5% and 2% respectively.

MATERIAL AND METHODOLOGY

Material

Marine soil, Potassium Carbonate

Marine soil: Marine soil was collected from the Khambhat District, Gujarat. In marine soil, presence of material are marine sediment, any deposit of insoluble material, primarily rock and soil particles, transported from land areas to the ocean by wind, ice and rivers, as well as the remains of marine organisms, products of submarine volcanism, chemical precipitates from seawater and material from outer space.

Potassium carbonate (K_2CO_3): The chemical formula of Potassium carbonate is K_2CO_3 . It is an inorganic compound and is a white coloured salt and in form of solid. It is used in production of soap and glass. The other name of Potassium carbonate is carbonate of potash and dipotassium carbonate.

Methodology

All the Laboratory tests such as liquid limit, plastic limit, shrinkage limit, standard proctor test, unconfined compressive test and cation exchange capacity are done based on IS:2720.

A. Properties of Marine soil:

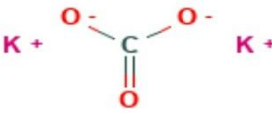
Table 1: Properties of Marine Soil

Sr. no.	Description	value	Unit
1.	Natural water content	15.21	%
2.	Specific gravity	2.63	-
3.	Liquid limit	39.2	%
4.	Plastic limit	19.6	%
5.	Classification	CI	-
6.	CEC value	37.52	meq/100g
7.	Mineral	Illite	-

8.	Shrinkage limit	13.85	%
9.	Volumetric shrinkage	38.81	%
10.	Linear shrinkage	15.06	%
11.	Shrinkage ratio	1.62	-
12.	Maximum dry density	1.799	g/cc
13.	Optimum moisture content	22	%
14.	Unconfined compression test	0.130	kg / cm ²
15.	Swell pressure	0.456	kg / cm ²
16.	Free swell index	20	%

B. Properties of Potassium carbonate (K_2CO_3):

Table 2: Properties of Potassium carbonate

Sr. no.	Parameter	Potassium carbonate
1.	Chemical formula	K_2CO_3
2.	Molecular weight	138.205 g/mol
3.	2D Structure	
4.	pH	11.6
5.	Market price	Rs. 320/- per 500 gms

Preparation of soil sample: Take a 1 gm of potassium carbonate and add with the amount of 1.25 ml distilled water and dissolved it. After dissolving chemical in distilled water, it can be used in different proportion such as 0%, 1%, 1.5% and 2% respectively by taken weight of soil sample.

RESULT AND ANALYSIS

Discussion on Effects of Atterberg's limit and Shrinkage characteristics of marine soil

After addition of potassium carbonate in various proportion such as 0%, 1%, 1.5% and 2% with respect to taken of soil sample and obtained the results are given below:

A. Influence of Liquid Limit:

Table 3: Changes in Liquid Limit of Marine soil

Sr. No.	K_2CO_3 (%)	Liquid limit (%)
1.	Untreated, 0%	39.2
2.	1%	37.0
3.	1.5%	37.2
4.	2%	39.4

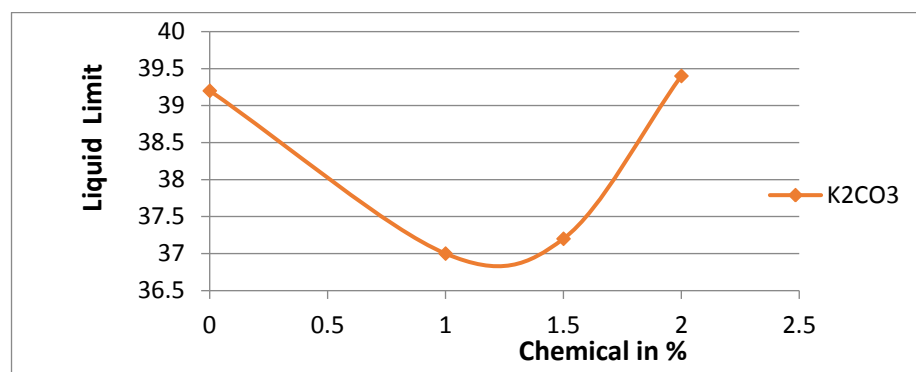


Fig. 1 Graph of Liquid limit VS Chemical in %

B. Influence of Plastic Limit:

Table 4: Changes in Plastic Limit of Marine soil

Sr. No.	K ₂ CO ₃ (%)	Plastic limit (%)
1.	Untreated, 0%	25.7
2.	1%	23.3
3.	1.5%	24.1
4.	2%	26.1

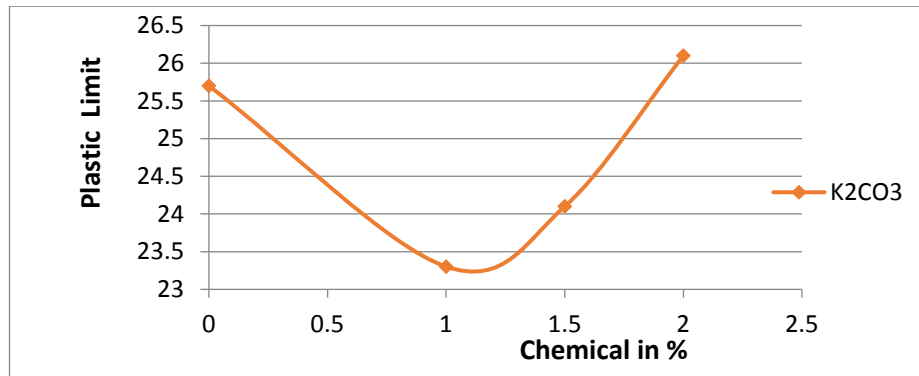


Fig. 2 Graph of Plastic limit VS Chemical in %

C. Influence of Shrinkage Limit:

Table 5: Changes in Shrinkage Limit of Marine soil

Sr. No.	K ₂ CO ₃ (%)	Shrinkage limit (%)
1.	Untreated, 0%	13.85
2.	1%	9.38
3.	1.5%	13.50
4.	2%	15.33

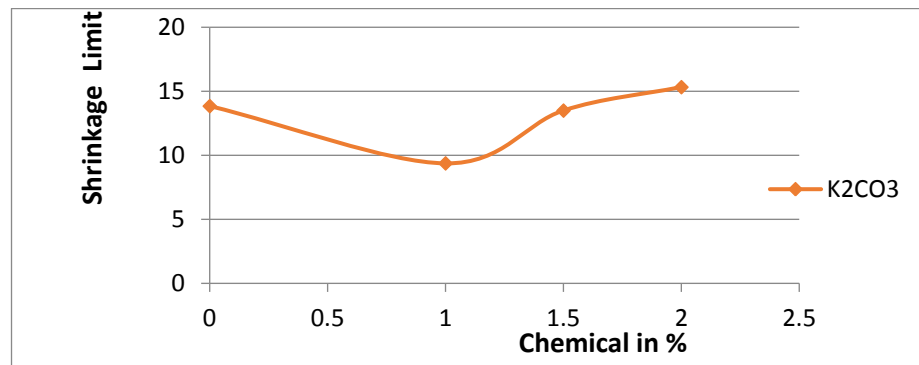


Fig. 3 Graph of Shrinkage limit VS Chemical in %

D. Influence of Shrinkage Ratio:

Table 6: Changes in Shrinkage Ratio of Marine soil

Sr. No.	K ₂ CO ₃ (%)	Shrinkage Ratio
1.	Untreated, 0%	1.62
2.	1%	1.64
3.	1.5%	1.61
4.	2%	1.59

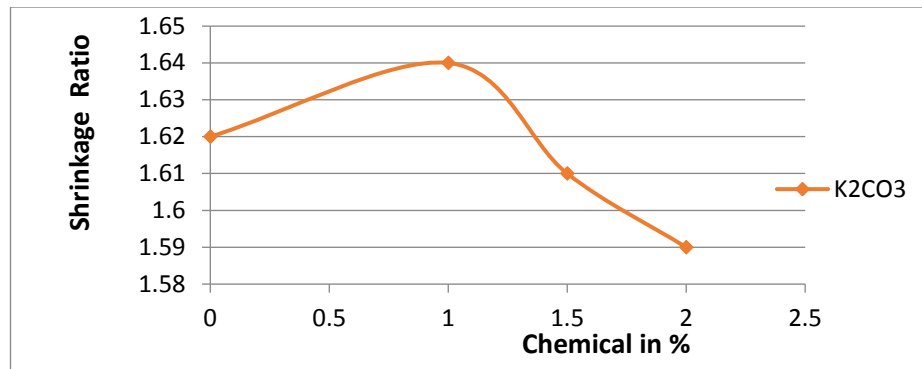


Fig. 4 Graph of Shrinkage ratio VS Chemical in %

E. Influence of Volumetric Shrinkage:

Table 7: Changes in Volumetric Shrinkage of Marine soil

Sr. No.	K ₂ CO ₃ (%)	Volumetric Shrinkage (%)
1.	Untreated, 0%	38.81
2.	1%	39.75
3.	1.5%	38.69
4.	2%	36.02

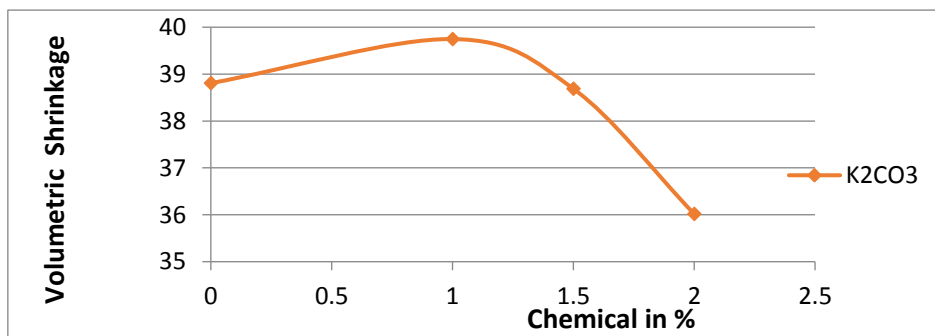


Fig. 5 Graph of Volumetric shrinkage VS Chemical in %

F. Influence of Linear Shrinkage:

Table 8: Changes in Linear Shrinkage of Marine soil

Sr. No.	K ₂ CO ₃ (%)	Linear Shrinkage (%)
1.	Untreated, 0%	15.06
2.	1%	15.78
3.	1.5%	15.08
4.	2%	14.25

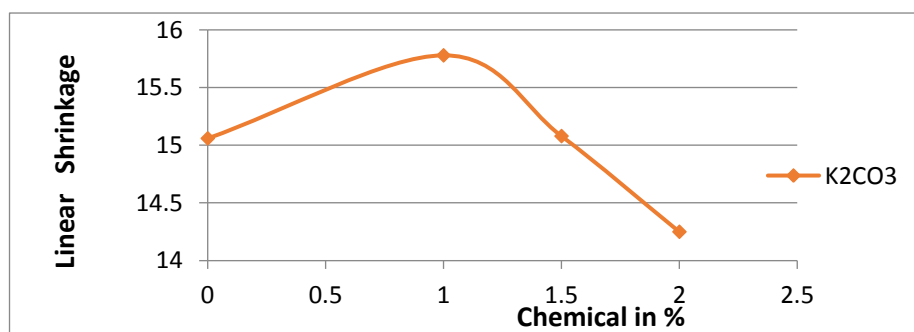


Fig. 6 Graph of Linear Shrinkage VS Chemical in %

Conclusions

After treated the marine soil as adding of potassium carbonate in different proportion such as 0%, 1%, 1.5% and 2% in marine soil. And obtained the results are given below:

- i. The liquid limit is reduced by 5.61% and 5.10% with addition of K_2CO_3 by 1% and 1.5% respectively and increases in value by addition of 2% of K_2CO_3 .
- ii. The Plastic limit is reduced by 9.34% and 6.23% with addition of K_2CO_3 by 1% and 1.5% respectively and increases in value by addition of 2% of K_2CO_3 .
- iii. The Shrinkage limit is reduced by 32.27% and 2.53% with addition of K_2CO_3 by 1% and 1.5% respectively and increases in value by addition of 2% of K_2CO_3 .
- iv. The Shrinkage ratio is reduced by 0.62% and 1.85% with addition of K_2CO_3 by 1.5% and 2% respectively and increases in value by addition of 1% of K_2CO_3 .
- v. The Volumetric shrinkage is reduced by 0.31% and 7.19% with addition of K_2CO_3 by 1.5% and 2% respectively and increases in value by addition of 1% of K_2CO_3 .
- vi. The Linear shrinkage is reduced by 5.38% with addition of K_2CO_3 by 2% respectively and increases in value by addition of 1% and 1.5% of K_2CO_3 .
- vii. As the shown all the results, we can be concluded that the optimum percentage dose of the Potassium carbonate is 1%. The Potassium carbonate is effective chemical to reduce the Atterberg limits and Shrinkage characteristics of marine soil.

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