

Investigating Geophysical Characteristics of Bentonite Clay Soil with Mixture of Kasaoka Clay and Tochi Clay Soils

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1. Abstract

The subject of the paper is to investigate the geophysical characteristics of bentonite clay soils with a mixture of Kasaoka clay and Tochi clay. The bentonite clay soil (KunigelV1-commercial name in Japan) is a type of clay soil that is composed primarily of the clay mineral montmorillonite and characterized by high liquid limit values, high plasticity, and shrink-swell potential, and low shear strength. To investigate the geophysical characteristics of bentonite clay soil with a mixture of Kasaoka clay and Tochi clay soils, the following methods could be employed: Particle size distribution (PSD) analysis, Atterberg limits, Free Swell ratio, X-ray diffraction (XRD) analysis. The combination of clay soils reduced the liquid limit to 109.10%, and FSR 2.0% values and improved the mineral composition of kunigelV1 bentonite clay soil. **KW:** KunigelV1, geophysical characteristics, FSR, Atterberg limit, clay mixtures

2. Introduction

The bentonite clay soil (KunigelV1-commercial name in Japan) is a type of clay soil that is composed primarily of the clay mineral montmorillonite and characterized by high liquid limit values, high plasticity, and shrink-swell potential, and low shear strength [1]. The fundamental problem of this clay soil is associated with moisture variations and shows significant swell-shrink characteristics[1, 2]. The primary objective of this study is to improve the geotechnical characteristics of bentonite clay soil with the mixture of Kasaoka and Tochi clay soils. The soil significantly swells when it absorbs the water presented in Fig 1.

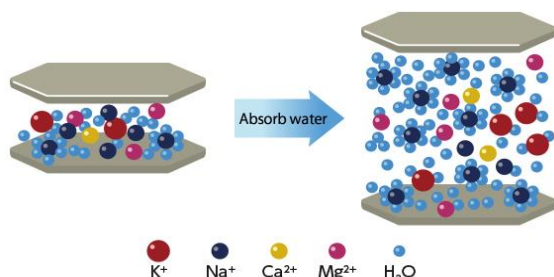


Figure 1. Schematic representation of swelling of bentonite clay soil [3]

3. Materials and Methodology

The materials used for this study were bentonite-Kunigel V1 clay soil, Kasaoke clay, and Tochi clay soil. The materials were proposed based on the physical properties, engineering characteristics, and mineralogical compositions. The basic geophysical characteristics are described in Table 1.

Table 1: Geophysical characteristics of the clay soil types.

S.NO.	Test characteristics	Types of clay soils			
		Bentonite	Kasaoka clay	Tochi clay	Clay Mixture
1	Liquid Limit, %	365.4	55.5	39.3	109.10
2	Plastic Limit, %	22.2	24.7	19.9	29.2
3	Plastic Index, %	343.2	30.8	19.4	79.9
4	Free Swell Ratio, %	4.5	1.0	0.7	2.0
5	Clay, %	52.5	50.9	48.3	54.3
6	Silt, %	43.7	45.1	39.7	42.6

The methods employed in this study were mainly laboratory experiments such as the Atterberg limit, particle

size analysis, and free swell ratio. In addition, the XRD analysis was used to analyze the mineralogical composition of the mixture of the clay soil. During the experiment, 28 % of bentonite-kunigelV1, 36% of Kasaoka, and 36% of Tochi clay were used to make a mixture of the soil.

4. Results and discussions

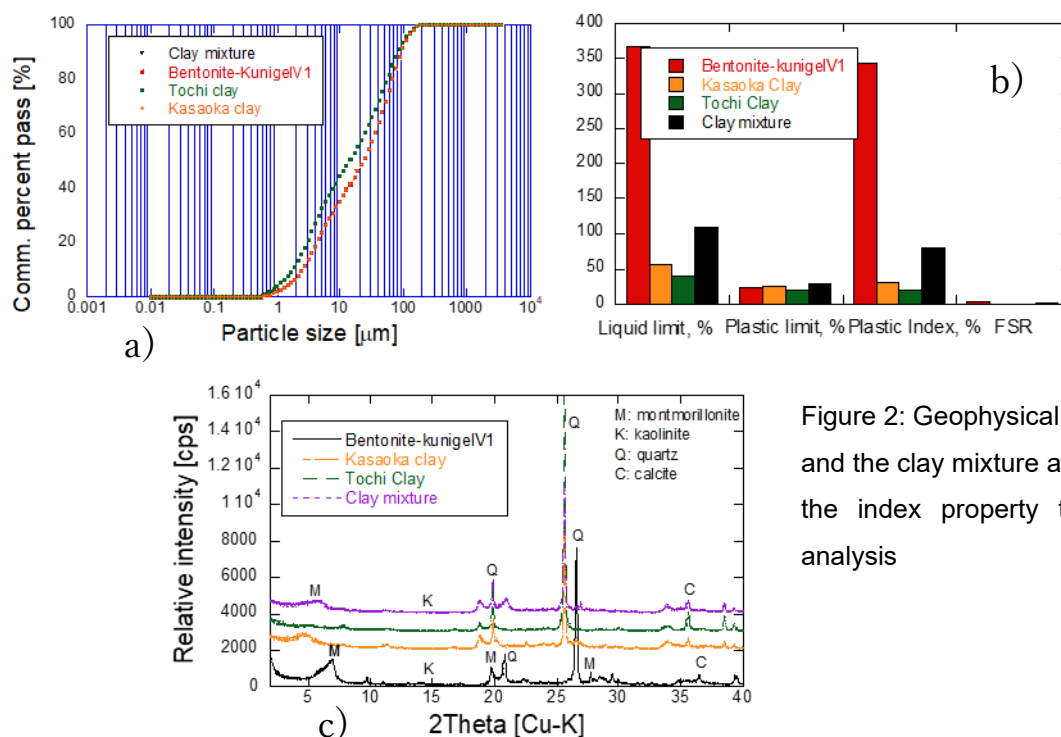


Figure 2: Geophysical properties of the clay soil and the clay mixture a) particle size analysis, b) the index property test, c) X-ray diffraction analysis

The engineering property of the clay mixture was improved with the addition of Kasaoka and Tochi clay. Since these clay minerals do not show high swelling behaviors however it helps to balance the Kunigel V1's significant expansion behavior. The clay soils have possessed a similar range of particles in Figure 2 (a); however, the index property values significantly vary due to montmorillonite clay minerals in Figure 2 (b&c).

The X-ray diffraction test revealed that the clay soils contain major clay minerals such as montmorillonite, Kaolinite, quartz and calcite in Figure 2 (c). Hence, the clay soil is subject to substantial swelling, compressibility, and cracking at moisture variation.

5. Conclusions

This study revealed that the combination of the Kasaoka clay soil and Tochi clay soil improved the engineering property of the bentonite clay soil. The liquid limit value for bentonite-kunigelV1 clay soil is reduced by 208% from 365.4% to 109.10%, the plastic index by 203% from 343.2% to 79.9%, and FSR by 203% from 4.5 to 2.0. The study concluded that the investigation of the clay soil helped to make new clay soil with different geophysical characteristics and engineering properties.

6. Acknowledgments

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7. References

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