Shear Behavior of Stabilized Clays Mixed with Shredded Paper

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ABSTRACT

Soft clay sludge with high water content is usually stabilized with stabilizers such as cement. Stabilized soils have high strength, however, brittle shear behavior. On the other hand, the fiber reinforced soil was sometimes used in earth works to improve the mechanical properties. To improve brittle shear behavior of stabilized clays, the authors carried out a series of mixing test of soft clays with cement or magnesia and shredded paper as a fiber. And unconfined compression tests of cement and/or magnesia (magnesium oxide) stabilized clays mixed with shredded paper were performed.

As the result, by mixing with shredded paper, the unconfined compression strength of cement and/or magnesia stabilized clays increases and the shear deformation behavior is improved.

KEY WORDS: Cement, magnesia, reuse, shear behavior, shredded paper, soft clay, soil improvement.

INTRODUCTION

Cement stabilization method, which is a popular method among the chemical ground improvement methods, was widely used in many construction sites to improve the mechanical properties of very soft soils with high water content. Cement stabilized soil has high strength, however, brittle shear behavior. Because the brittle shear behavior of cement stabilized soil is quite different from the shear behaviors of conventional soils, it occasionally becomes a disadvantage, for example, in case which cement stabilized soil was used as a backfilling material after excavation works. To use the cement stabilized clay in the many construction sites, it is necessary to improve its disadvantage.

On the other hand, total amount of waste paper reached about 5.5 million ton per year in Japan and it was disposed or incinerated without reusing to the recycled paper because of the short paper fiber. Shredded copy paper is good quality fiber and it has high tensile strength and absorbent property. It is a good ground improvement material by mixing with soft clay.

To improve brittle shear behavior of chemical stabilized clay, the authors carried out a series of mixing test of soft clay with cement, magnesia and shredded paper. And unconfined compression tests of cement and/or magnesia stabilized clays with shredded paper were also performed. In this study, the shear behaviors of cement and/or magnesia stabilized clays mixed with shredded paper are compared and discussed.

SHREDDED PAPER

After the enforcement of the Act for Protection of Personal Information in 2005, the amount of shredded paper dust from public and business offices rapidly increases. The shredded paper is hard to recycle because paper fiber of shredded paper is too short to regenerate for the recycled paper. Thus, total amount of waste paper reached about 5.5 million ton per year in Japan and it was disposed or incinerated without reuse.

Many kinds of paper shredder machine were produced in Japan. Also, the shape of shredded paper is quite different. Noodle cut, cross cut and spiral cut were typical shapes of the shredded paper. Cross cut type is the most popular among three types of shredded paper. Fig.1 shows the shape of the shredded paper of cross cut type. The cross cut shape of shredded paper gradually became small and short after the Act for Protection of Personal Information. Fig.2 shows the frequency distribution of length of shredded paper in Akashi National College of Technology (ANCT). In our campus, there is no paper shredder machine of noodle cut type. As our expected, the cross cut type was predominant. Although the width of shredded paper was about 3 millimeter which was almost constant regardless of shredder machines, the length of shredded paper was scattered from 1.7 to 3.1 centimeter. The mean length of shredded paper was 2.3 centimeter. In this study, shredded paper with around 2.3 centimeter in length was used.

Paper fiber of copy paper is a good quality and it has high tensile strength, and absorbs water. A ground improvement technique using waste paper chips was proposed in Japan (Bon terrain Committee, 2005). Therefore, we expected that it is a good ground improvement material by mixing with soft clay.