Experimental Study on Performances of Construction Wastes Clay Lime Mixture

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ABSTRACT

The construction wastes are used in field treatment. To study the performances of the mixture, more than two hundreds of test blocks with different mixture ratio and age are made and tested. The test results show that there is a close relation between aggregate content and test block strength. The block strength increases with aggregate content curing age increase. The test block strength is also relates to lime content. The test block strength increases firstly and decreases then and there exists a reasonable mixture ratio range. The results may be used in subgrade engineering and compound foundation of using construction wastes.1

INTRODUCTION

The using of construction waste is divided into simple utilization, medium utilization and advanced utilization. Simple utilization is backfilling or making mountain landscape directly. Medium utilization of construction waste is using as subgrate of road[1,2]. It also is used in foundation of architecture to replace gravel and sand. Such as the technology of rammed enlarged composite bearing pile[3], deep dynamic advanced compaction pile in hole[4] and recycled aggregate CFG pile, etc. The advanced utilization of wastes is used to make concrete, cycled cement and wall materials. The results of research in present show that the simple utilization needing large field to fill the construction wastes and may lead dust pollution. The advanced utilization may lead high cost and poor economy. The medium utilization is using the construction wastes as filling material under roadbed or as composed

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foundation after crushed in directly. But the property of waste changes randomly and leads to discreteness of foundation bearing capacity. The waste aggregate mixed with clay and lime will produce binding strength and increase stability of foundation in condition of groundwater. The research results may reduce cost and increase economy of the construction engineering.

PROPERTIES OF COMPOSING COMPONENTS

Construction Wastes Crushing and Screening

The construction waste is from a site of demolition and renovation of village. The main components of waste are crushed concrete and crushed clay bricks. The concrete and clay bricks are crushed and screened, then mixed by different ratio as aggregate. The aggregate is shown in Figure 1.

![Figure 1. Aggregate mixing.](image)

![Figure 2. Optimum water content of clay.](image)

Measurement of Optimum Waster Content of Clay

The main component of building lime is CaO and it can react with water in clay. The clay is excavated from the third layer of a construction site. The clay is loess silty clay soil and its optimum water content cure is shown in Figure 2. The curve shows that the optimum water content of the clay is about 10%. It is to say that when the water content of clay is about 10%, the maximum dry density will be obtained.

Test Blocks Making

Based on the code for design of ground base and foundation of highway bridges and culverts, the clay, lime and aggregate ratio of mixture is 40%, 50% and 60%. If the ratio of aggregate is too high, the test block will break because of too low
binding material. Some broken blocks are shown in Figure 3. The curing ages of the test block are 14d, 21d and 28d. A total of 204 test blocks are made for this test. All of the test blocks are sealed and reserved in condition of normal temperature and the blocks are shown in Figure 4.

![Figure 3. The broken test block with low binding strength.](image1)

![Figure 4. The test block in curing process.](image2)

RESULTS ANALYSIS

Effect of Aggregate Content on Strength of Test Block

The relation curves between compressive strength and different aggregate content of 14d age specimen are shown in Figure 5. The curves keep relatively stable with the increasing of lime content because of low reservation age. So the average compressive strengths of three conditions are used for comparative analysis. Corresponding to the aggregate content of 40%, 50% and 60%, the strength of specimen is 2.0MPa, 2.75MPa and 3.74MPa, respectively. It is to say that the specimen compressive strength increases 37.7% and 87% relative to 2.0MPa. It can be seen that the content of aggregate in specimen plays an important role in the strength of test block. But the high aggregate content may result in fragmentation of the test block. The low content of binding materials such as lime and clay will result in low binding strength inside the specimen. So the specimen can’t be made successfully or it keeps a lower strength level.

Effect of Curing Age on Strength of Test block

When the aggregate content is 40%, the curves of relationship between specimen strength and curing age are shown in Figure 6. The specimen compressive strength changes in little range for lime content from 13% to 15%. The average compressive
strengths corresponding to 13%, 15% and 17% lime content are used to comparative analysis. The compressive strength of 14d, 21d and 28d specimens is 2.25MPa, 3.22MPa and 3.88MPa, respectively. It can be seen that the increasing in the strength of the specimen is partly due to the increasing of the cohesive force caused by the chemical reaction between lime and clay. This can be speculated that the strength may have more substantial growth in wet location of foundation treatment engineering because water is needed for chemical reaction.

![Figure 5. The relationship between aggregate block strength.](image1)

![Figure 6. The relationship between curing content and age and block strength.](image2)

**CONCLUSIONS**

The strength of the block is mainly from the content of aggregate in the mixture. The higher the content is, the higher block strength is. But too high aggregate content may result in block broken. The compressive strength of mixture is partly from the cohesive strength between reaction of clay and lime. The compressive strength may increase in wet location of foundation treatment engineering. To the specimen of a certain aggregate or curing age, the strength changes with lime content. There is a reasonable proportion of lime content for the mixture to obtain a higher compressive strength.

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