Study on Soil Stabilizer in Road Base

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Abstract: In the treatment of roadbed and base course, the strength of cement, lime and fly ash solidified soil is slow to form, shrinkage is large, cracking is easy, water stability is poor, and softening is easy to occur. Soil solidifying agent is a kind of high-performance solidifying agent for improving soil. It has the advantages of fast solidifying speed, high relative strength, small shrinkage and no secondary fluidization of solidified soil. Therefore, this paper studies the soil curing agent in the road base. The traditional road stabilization technology and the soil curing agent technology were analyzed and compared. Studies have shown that soil curing agents can meet various indicators in road base design and are suiTable for road construction.

1. Introduction

In the past ten years, more than ten research institutes and colleges and universities have conducted research on soil solidifying agents in China, and have obtained a number of laboratory research results, and some have also conducted experiments on some railways and highways [1]]. According to a certain amount of addition, the curing agent and the soil can be mechanically or manually stirred and crushed to achieve the required strength index, thereby achieving the purpose of solidifying the soil [2]. Therefore, it is extremely necessary to find an additive that can improve soil water stability, increase strength, and reduce shrinkage. Although there have been cases of successful use of soil curing agents in China, soil curing agents are affected by soil properties in different regions [3]. Therefore, it is feasible to carry out laboratory test research on solidified soil according to the relevant requirements of semi-rigid base. Therefore, it is extremely necessary to find an additive which can improve soil water stability, increase soil strength and reduce drying shrinkage [4]. Especially in the past decade, large-scale projects have been launched, resulting in the shortage of building materials, of which the shortage of high-quality gravel is particularly prominent [5]. The solidifying agent can stabilize various types of soil, and can be used in road, airport, dam, port and various three-dimensional building infrastructure projects [6]. The solidified soil can be used as the basic material of road engineering and can be used in the construction of road engineering. Therefore, how to use local material resources to pave roads has become a research topic at home and abroad. Under this trend, soil stabilizer materials have been widely developed and applied.

Along with the process of national construction, transportation, as the artery of economic construction, is also developing at an unprecedented speed. In the treatment of urban road subgrade, the measures of using cement, lime or fly ash to solidify the soil of road subgrade and base are far from satisfactory [7]. According to the characteristics that stabilized soil needs to be mixed with a certain proportion of lime or cement as catalyst, and referring to the relevant provisions of current codes, stabilized soil basically belongs to the category of semi-rigid base [8]. However, from years of experience, cement, lime or fly ash for road subgrade and base soil solidification treatment measures are far from ideal results [9]. It is technically and economically unsatisfactory, and has defects such as slow formation of strength, large shrinkage, easy cracking, poor water stability, and softening. Compared with the traditional treatment technology, it can be used for local construction, which can save a lot of cement and sand and stone materials. Compared with concrete materials, it can generally reduce the cost by about 30% [10]. Therefore, it is very difficult to directly add a curing agent to the base layer of the road surface in the plain soil. In some areas where there are few gravel or no sandstones, there is a lack of materials that can be directly used in the base and subbase

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of the pavement. At this time, the traditional cement grit scheme is used to make the project cost greatly improved. It has the advantages of “fast curing speed, high relative strength, small shrinkage, and no secondary fluidization in the solidified soil”.

2. Soil curing agent introduction

2.1 Performance and mechanism of soil curing agent

Through the study of the performance and mechanism of soil curing agent, the application examples of different soil curing agents were analyzed to study the reinforcement effect of soil curing agent on the subgrade soil in Tianjin coastal area and the subgrade soil of Jin-Jin Expressway. The role of lime not only reduces the water content of the soil, but also increases the work ability of the solidified soil. Aught-set is a high-performance curing agent for soil improvement. This material is based on cement and is blended with special excitation elements. Because the original road structure design standard is low and the service life is short, which is not in line with the idea of building a modern metropolis in Shenzhen, the use of soil solidifying agent is discussed in a section of the expressway renovation project of a certain section. Site selection and design are highly valued by relevant experts and departments at home and abroad. The implementation of its supporting projects has attracted extensive attention of many domestic design companies. How to deal with the roadbed and base of large vehicles has become the primary problem to be solved in the design. The construction of soil solidifying agent is simpler than the traditional method, which greatly shortens the construction period, saves raw materials such as gravel, fine sand and transportation costs, and simplifies the construction method of cement-lime stabilized layer.

2.2 Mechanism of Soil Stabilizer

Soil stabilizer is a new chemical material used to improve the physical and mechanical properties of soil to meet the requirements of Engineering technology. At present, the soil stabilizer used in engineering can be divided into two categories, i.e. ionic stabilizer and composite stabilizer. Soil is an important part of road construction for a long time. However, the loss caused by the bad characteristics of the soil to the construction is also inestimable. It can stabilize a variety of different types of soil, can be used for highway, first-class and second-class highway basement, for the stability of Weak Roadbed and low traffic highway, agricultural road network pavement structure layer or surface layer. Due to the low standard of urban road design in the early stage of the city construction, after the road has been used for a long time, the main roads and sidewalks of the roads have different degrees of disease, which directly affects the safety and comfort of driving. It is also the main reason for the emergence of soil curing agents such as EN-1, 155, HAs and EFsHA in recent years. According to the performance of these additives, it is extremely necessary to carry out in-depth research on the application in roadbed and basement in combination with field engineering. . Cement soil has quite high strength and water resistance, but the cement soil shrinkage is very easy to crack. The expansion and contraction of the soil cause the road to be tumbling and sag, which is easy to cause water immersion and damage the roadbed structure and shorten the road. Service life.

3. Application of curing agent in road engineering

3.1 Soil physical property test

After the soil sample was taken for particle analysis, the fine particle group content of the soil was 36.8%, and the fine-grained soil was located above the plastic line A, so it can be judged that the soil is clay sand. The soil was subjected to a light compaction test by dry soil method according to JTJ057-94 (T0804-94), and the maximum dry density was 1.85 g/cm3, and the optimum water content was 16.5%. In order to ensure the linearity of the roadbed elevation and the overall longitudinal section, the solidified soil method is adopted instead of the corresponding gravel base layer and the cement stabilized gravel base layer, and the Aught-set soil curing agent is proposed. .

Take a small piece of sample with a water content close to the plastic limit, first hand-turn it into an oval shape, and then gently roll it on the frosted glass plate with the palm of your hand. Small vibratory roller or vibratory rammer are used to supplement the rolling of the parts that can not be rolled by roller such as road edge and widened section. Under the action of forming pressure, mineral particles are closely contacted, so that the solidified soil reaches a certain degree of compactness. At this time, the solidified soil is in the optimum water content, and the solidified agent particles are evenly dispersed and encapsulated in the soil particles, which makes the whole soil in a certain pressure. Because the stabilizer improves the water stability of soil, the original hydrophilic stabilized soil is changed into hydrophobic stabilized soil. The strength of stabilized soil mixed with stabilizer is still very high. However, the stabilized soil without reinforcement agent gradually hydrolyzes and loses the plate body under the condition of long-term immersion, and becomes loose body, which greatly reduces the strength of the stabilized soil.

Raw material preparation and experiment: Soil analysis, selection of raw materials for the experiment using low liquid limit clay, remove more than 4cm particles (Table 1). The curing agent is Aught-set curing agent with a specific gravity of 3.08g/cm3, fineness of 0.8mm, and the number of square-hole sieves is less than 3% (Table 6).

Table 1 Drawing test results Table

Sample number	Limit/%	Plastic limit/%	Plasticity index
1	36.70	23.67	13.66
2	38.54	23.54	13.58
3	35.64	23.68	11.58
4	35.69	24.12	10.39

Table 2 Chemical Composition Table of Curing Agent

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	OS	Other	Burning loss
16.1	8.0	2.4	60.1	0.9	12.1	0.4	0.3

3.2 Physical properties of experimental soils

The optimum moisture content of soil varies with the proportion of supplementary materials added. The purpose of compaction test is to determine the optimum moisture content and maximum dry density of soil through experiments. Therefore, this test is aimed at the compaction test of plain soil and triad soil (that is, test soil with additives such as cement lime). When the asphalt mixture is not cooled through, the flat joint is planed artificially to connect the working joints at right angles. When the cutting machine is used as the flat joint, it should be carried out when the mixture is cooled but not hardened on the day of laying. The test results show that the above ratio meets the requirements of 7D compressive strength greater than 0.8MPa of highway or first-class highway subbase, and the requirements of CBR load-bearing ratio and resilience modulus of highway subgrade. In addition, the fly ash in the curing agent is in the form of a spherical glass body, and the active activator can effectively activate the activity of the octahedron and the octahedron in the glass body and the soil in the fly ash to form hydrated silicic acid. Calcium and hydrated calcium aluminate. Since the internal stress of the soil curing agent offsets part of the contraction force, the relative shrinkage of the consolidated soil is small, and the curing agent can be used for the soft foundation treatment in the road, airport, and house construction projects and the large-scale modification of the old road. In this way, the impermeability, frost resistance and crack resistance of the consolidated soil are fully improved, and the early solid strength of the conventional solidified material in the solidification of the soil is low, the water stability is poor, the fatigue strength is low, and the dry shrinkage is large. Problems such as easy cracking and short delay time.

The soil was tested for compactness. The curve of soil dry density and water content is obtained by curve fitting method, as shown in Figure 1.

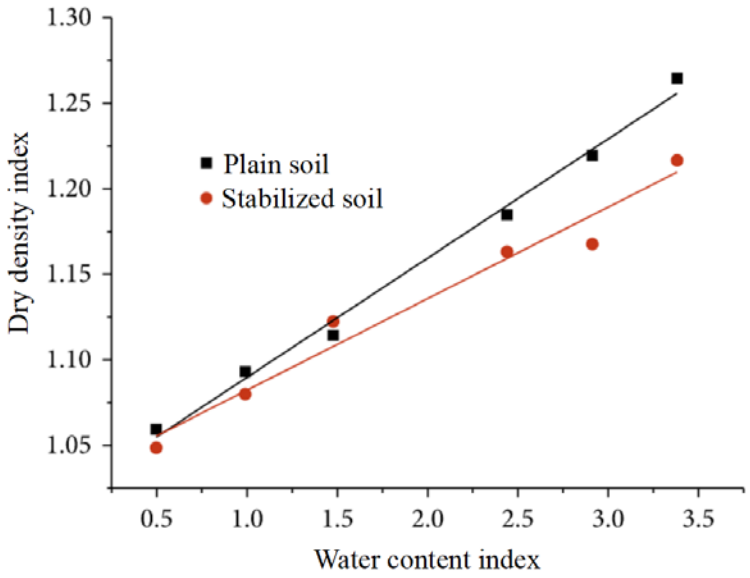

Fig.1. Soil water content and dry density curve

In recent years, the municipal government has invested a great deal of manpower, material and financial resources to carry out major renovation of urban roads, and the road intact rate has been greatly improved. In the treatment of urban road roadbed, traditional methods mostly use cement, lime and fly ash to solidify soft soil with high water content and abundant organic matter, in order to seek the strength and water stability of roadbed and base to meet the design requirements. In recent years, many provinces and municipalities have successively applied the technology of soil stabilizer to many fields and received good results. The paver uses a tensioned wire rope near the center line of the road as the longitudinal datum line of the paver, and controls the operation of the paver together with the transverse slope sensor. It can decompose minerals and soil molecules in the soil, recrystallize it, and generate new chemical bonds, thus forming a soil solidified layer to change the soil from hydrophilic to hydrophobic. This is also a necessary condition for re-recrystallization of the solidified soil. Secondly, after the soil is compacted, the mineral particles are closely connected. Under the action of the ionic solution, the ions between the mineral particles are exchanged to produce new salts to achieve the purpose of recrystallization. The higher the compactness, the higher the compressive strength; when the other conditions are the same, there is a linear relationship between the compactness and the compressive strength.

4. Conclusion

Soil curing agents have been widely used in foreign countries. With the development and opening up of Binhai New Area, the development of related infrastructure has been promoted. The solidified soil must be catalyzed by the inorganic binder to ensure its strength and water stability. Due to the improvement of the strength, the design requirements can reduce the thickness of the road, reduce the road materials, and do not need to dig a lot of bad soil, so that the freight can be saved by about 80%, and the engineering cost is reduced. The curing agent can be directly mixed with the soil to save the material cost, transportation cost and paving cost of the excavation freight and stone powder slag of the old soil layer, and the construction period is greatly shortened. Therefore, the application of curing agents in road engineering is promising. Although the application of soil solidifying agent in road engineering is relatively short, it is still in the stage of popularization. However, it has proved that it is feasible to apply it to road construction in areas without gravel and with less gravel. It not only has good engineering quality, but also has high economic efficiency. At the same time, it has high social and environmental significance for the large-scale utilization of fly ash. On the premise of a large number of experimental data, some useful conclusions were obtained through the summary and analysis of experimental data, which accumulated design experience and provided experimental basis for the popularization and

application of soil stabilizers. Therefore, soil solidifying agent has broad application prospects.

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