Analysis of Soil Improvement and Construction Technology of Highway Roadbed Expansive Soil

Liu,Bing
CSCEC ROAD AND BRIDGE GROUP CO.,LTD. Shijiazhuang, Hebei, 050001, China

Abstract: Expansive soil roadbed is a kind of disease problem in our country highway project with extremely wide harm, our country highway project in the process of operation, often due to the existence of expansive soil in the roadbed structure and cost extension, construction cycle extension, etc. At the same time, improper handling of the expansive soil will also be followed by the vehicle traffic will bring great safety hazards. Therefore, how to do a good job for highway roadbed expansion soil soil improvement has become a key entry point to ensure the safe operation of highway projects. This article mainly analyzes the improvement method of expansive soil, and the construction technology of highway roadbed expansive soil improvement is explored, hoping to ensure the safe operation of the highway to provide reference.

Keywords: Highway roadbed; Expansive soil; Soil improvement; Construction technology

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Expansion of the soil itself is extremely special material, with the expansion of the moisture content of the soil within the change, the entire volume of the soil body will fluctuate at any time. In the case of very high moisture content, the swelling and softening of expansive soils can occur, seriously affecting the bearing capacity of the highway subgrade for the superstructure of the road. At present, the expansion of the soil in the global distribution is extremely wide, and taking into account the soil with the change of moisture content will appear expansion and contraction of the problem, once the project touches the expansion of the soil area, will bury a hidden hidden danger, in serious cases, and even produce a large area of geologic disasters, for the stability of the overall structure of the highway to bring the threat is not to be underestimated. Especially for some relatively high grade highway construction, expansion soil affects not only the safety of highway engineering, this hidden danger is a long-term potential. This article is to explore the different technologies and methods of soil improvement for expansive soils at home and abroad, hoping to provide certain reference for the development of related industries.

1. Improvement Measures for Expansive Soils

(1) Chemical modification

There are three main types of chemical improvement methods for expansion maps that are commonly used today.

First, lime improvement method. Lime improvement method is the most widely used means to deal with expansive soil in China's highway roadbed, mainly utilizing the ionic interaction of lime to improve the soil properties of expansive soil. Lime can be quickly dissolved under the condition of water, at the same time, it will decompose a large number of calcium ions under the condition of water. Most of the minerals in the expanded soil contain many potassium ions and sodium ions, in this process potassium and sodium can

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About the Author

Liu,Bing (1989-09), Hebei Province, Nangong City, Cscec Road and Bridge Group Co .,LTD Shijiazhuang, engineer, Main research direction is road transportation engineering.

be replaced with calcium ions, so that the water content of the soil is quickly reduced, thus avoiding the expansion and contraction of the expanded soil in the presence of water changes. Subsequently, these ion-exchanged calcium ions can produce another chemical reaction with carbon dioxide in the air to form high-strength calcium carbonate, which is more water-stable. Thus, the cohesion and water stability of expanded soil can be effectively guaranteed.

Second, fly ash improvement method. Fly ash is mainly the waste residue of gas in the coal furnace after coal combustion, and the application of fly ash material has the advantage of low cost in the improvement of expansive soil soil properties. At the same time, fly ash also contains a large number of tin oxide and iron trioxide and other substances, by interacting with the ions in the expansive soil, it can effectively improve the properties of the expansive soil itself. Fly ash particles are relatively fine, and if they are evenly distributed in the expansive soil, it is also beneficial to the expansive soil to avoid fissures under long-term water circulation.

Third, cement improvement method. The cement improvement method is mainly aimed at improving the internal chemical structure and composition of expansive soils, which can effectively strengthen the connectivity between the particles of expansive soils and the degree of compressive resistance to the outside by means of cement material and the ionization of expansive soils through regimentation and carbonic acid reaction.

(2) Biological improvement technologies

Many microorganisms in nature will secrete an organic substance, and this organic mucus can also enable the soil to generate clusters of particles, and at the same time, the metabolism of microorganisms in the soil will also enable the original geological environment to be effectively improved, so that the original minerals in the expansive soil continue to precipitate or be metabolized into a new product. The long-term survival of microorganisms in expansive soil can produce a large number of bacteria or sediments, and these sediments have a certain degree of viscosity, which can combine the particles of expansive soil organically, so as to fill up the gaps in the expansive soil, and solve the problem of cracks or holes in expansive soil. However, the biological improvement method is still in the research stage, and the application in the actual project has not reached the corresponding conditions.

(3) Physical improvement techniques

Firstly, edging method, which is mainly to set some waterproof materials in the form of adhesive in the periphery of expansive soil area, so as to effectively avoid the penetration of external water into the soil, and to ensure that the expansive soil will not undergo large shrinkage and expansion changes in the subsequent application process. Especially in the expansion soil area with more rainwater, the use of edge wrapping technology can make the expansion soil not easy to come into contact with water, and always ensure a relatively high strength.

Secondly, fiber blending method. This technology in the application process is in the expansion of soil internal mixed with artificial fiber, these fiber elements mainly contain geotextile, geomembrane and geogrid. When the expansion of the soil after water absorption, its volume will rapidly expand and soil softening problems, at this time, the gap between the soil particles will continue to expand, the volume of the soil will grow rapidly. By inserting these fibers into the soil, a strong shear force and friction will be generated at the boundary between the fibers and the soil, which will play a restraining role on the further expansion of the volume of the expanded soil and avoid the large-scale deformation of the expanded soil.

Third, weathered sand improvement technology. First of all, you can add some weathered sand particles in the expanded soil, enhance the proportion of coarse aggregate content within the expanded soil, so that the gap between the expanded soil particles can be effectively filled, when the volume of the expanded soil in

the event of water volume increase, these coarse aggregates can be resisted in the particle space, to avoid the further expansion of the volume of the expanded soil. Secondly, it is also possible, by mixing a non-expanding material in the expansive soil, which non-expanding material is not hydrophilic, to effectively reduce the hydrophilic characteristics of the expansive soil through the combination between this material and the original particles of the expansive soil.

2. Key Points of Construction Technology for Improving the Soil Properties of Expansive Soil in Road Subgrades

(1) Control of raw materials

Take the lime filling method as an example, the lime method is one of the most significant improvement methods for soil improvement of expansive soils. Before the filling and mixing of the roadbed material, the lime material applied in the field should be tested first to ensure that the quality and chemical activity of the lime material meet the requirements. For example, in the raw material testing process, we need to know the content of calcium oxide and magnesium oxide ions in the lime material to ensure that the content of calcium ions and magnesium ions in the lime material is controlled within a reasonable range. In addition, the water content in the lime mixing process should be controlled, and premixing test should be carried out in advance before mixing and mixing with expansive soil.

(2) Layered filling and compaction

The improvement of expansive soil is of great merit, through the self-discharging transportation vehicles, can be improved expansive soil filler transported to the need to fill the site, and then layered paving, according to the grade of the highway roadbed and the requirements of the thickness of the roadbed and other data for measurement, so as to ensure that the expansion of the amount of soil cubic meters of the scientific nature of the earth. In addition, in order to ensure that the compaction degree of different levels in the roadbed structure can meet the normative requirements, it is also necessary to use compaction machinery and equipment, in the expansion of the soil filler area for crushing, crushing, usually, the width needs to be more than 25 centimeters of the expansion of the soil side side, so as to ensure the compaction coefficient. If there is a localized area of insufficient compaction when rolling, it is also necessary to dig out the rain expansion soil mixture, and fill and roll again.

(3) Construction quality testing and control

For the improvement stage of expansive soil roadbed, after paving and compaction, it is necessary to test the specific compaction degree of the roadbed structure, the content of mixed active ingredients, and the moisture content of the mixture. Among them, for the compaction degree of detection, the specific use of the ring knife method and sand filling method, in order to ensure that the degree of compaction, to meet the normative requirements, before entering the next step of the process. Once the localized compaction degree does not meet the specification requirements, it should be re-filled and rolled, and then re-tested. In addition, for the improved expansive soil paving, in the moisture content monitoring should be taken in a random sampling method, for some of the more stringent requirements of the grade of pavement, random sampling density should be increased. Under normal circumstances, the number of monitoring points of improved expanded soil star per 1000 square meters of roadbed structure should be more than four.

3. Conclusion

In summary, expansive soil has obvious hydrophilic characteristics, which is easy to swell when it meets

water, and shrinkage and cracking will occur when the moisture content is low. In the process of highway foundation construction, this significant characteristic of expansive soil will seriously affect the strength of the roadbed structure, and even make the highway hide huge safety risks in the subsequent operation. At present, the improvement of expansive soil can be roughly divided into physical, chemical and biological three major technical methods, of which physical and chemical technology is the most widely used. In the application of chemical technology, it is necessary to pay extra attention to the mixing and compaction technology of modified expansive soil, so as to ensure the effect of soil improvement of expansive soil of highway roadbed project.

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