

# The Mechanical Properties of Soil Curing Agents and Their Application in Engineering

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**Abstract:** The relevant classification of curing agents and the mechanisms of different soil curing agents are discussed. On this basis, we will talk about the application of soil curing agents in different fields.

**Keyword:** Soil Curing Agents, Chemical Mechanisms, Engineering

## 1. Introduction

Soil solidifying agent is a new kind of material developed to solve the problems caused by bad soil. The manufacturing process is to mix organic and inorganic materials. The application technology has good indicators, low construction cost, easy implementation and short construction cycle, which is more beneficial to ecological environment protection. Proper soil curing agent shall be added during construction to stabilize the soil and achieve the required load capacity. In engineering construction, curing agent can replace the commonly used engineering materials and save more capacity resources. The use of curing agent in solving soil problems is convenient for construction and effectively reduces the construction cost. Therefore, soil curing agent has potential value in various fields of engineering.

## 2. Related Characteristics of Soil Stabilizer

### 2.1 Concept of Soil Curing Agent

At present, in China, curing agents can be divided into physical, chemical and biological curing agents. Chemistry is a new kind of non-toxic and harmless construction materials synthesized from inorganic and organic materials. After a series of reaction changes, the use purpose of engineering projects that change the soil. When too much free water in barren soil is crystallized from the solution by solute, the crystal combines with a certain amount of water molecules, which reduces the surface current of soil micelles. After being separated by the charges adsorbed by micelles, the thickness decreases, the conductive compounds increase, and tend to agglomerate. Volume expansion reduces the percentage of pores in the soil in the total volume of the soil. After the solidified soil forms the overall structure, it can reach the ratio of dry density that cannot be formed by ordinary construction form to the standard maximum dry density.

### 2.2 Classification of Soil Curing Agents

Inorganic curing agent: in the form of powder, the main curing agent usually includes waste and slag discharged by industrial and mining enterprises in production activities. Activator is also one of the components of inorganic curing agents, including various sulfates, and also contains a small amount of surfactants, materials used to change the state of solution interface system in the production process. The soil uniformity of bad soil after mixing the curing agent needs to be consistent with the soil color of powdered curing agent; the drying degree and wetting degree of the solidified soil with liquid curing agent are consistent, and there is no agglomeration state. The performance is relatively stable, which can be maintained for 30 ~ 50 years under normal circumstances. After adding the above materials, the construction cost is significantly reduced, so it also has the significance of environmental protection and energy conservation.

Biological enzyme curing agent: it is produced by anaerobic respiration of organic compounds, and the liquid state is the main presentation state. As an environment-friendly biocatalyst, biological enzyme shows its efficacy in poor soil, so that inorganic and organic substances in soil will more and more quickly form structural layers with small pore size. Under the action of external pressure, the impermeable structure makes the soil unbreakable.

Organic polymeric curing agent: this kind of curing agent is as liquid as biological enzyme soil curing agent, and is widely used in domestic and foreign markets in the 21st century. People usually regard the reaction process of this kind of action as physical property, because it will not change the internal structure of the most important component of clay rock, but by covering the soil particles, the adsorption force is generated on the surface, so that the individuals formed after coagulation and cementation are solidified.

### ***2.3 Curing Mechanism of Soil Curing Agent***

Put the curing agent into the bad soil to make its reaction uniform, and make the water, activator and other materials produce the reaction of physical and chemical properties. After the reaction, crystals appear in the process of reaction, showing the shape of stone, and the sediments are adhered by crystals after crystallization. The effect of activator improves the structural hardness of the whole experimental body and increases the surface tension of the experimental body. The hardness of bad soil is enhanced through the action process that cannot be reversed. For example, the sludge has no strength, the proportion of free water is high, and can flow freely. After reacting with the curing agent, it can be integrated and used for a long time, so it can be used as a high load material in the project.

The load-bearing capacity of clay is very low, and a large amount of water inside is one of the influencing factors. Reducing water will improve the load-bearing capacity. In addition to aluminum, most clays also contain trace elements such as magnesium, iron, sodium, potassium and calcium. Because the nature of soil is not compact and concentrated, that is, if it is concentrated by external pressure, the compact system will not appear. The reaction process occurs when the curing agent is added to the clay. Crystals are precipitated in the reaction process, which can be used to fill the gap between particles and improve the ability to resist the invasion and corrosion of acidic substances and external pressure; for the bad soil after manual treatment, the powder particles between the soil form a centralized structure. The formation process of the structural system is the hydrolysis of clinker minerals and water or the hydration releases heat to obtain water silicate, water silicate, etc.

#### ***2.3.1 Inorganic Soil Curing Agent***

Inorganic soil solidifying agent is hydrated with raw soil material under an experimental operation, and the reaction produces aqueous crystal material. The aqueous solid crystalline material reacts with primary minerals and secondary minerals to form crystals in various forms. After these particles are connected, the network system that is not easy to change is formed, and a few will form enough to fill the space between structures or improve the structure in the soil. A team found that the factors affecting the strength, water resistance and frost resistance of materials. First, minerals precipitate in the pores of sediments to form authigenic minerals and consolidate the sediments into rocks, which is the main source of strength of cement reinforced soil. Therefore, it can be proved that the main factor affecting its properties is the raw soil material reaction is the production quality; Similarly, a team studied the influencing factors of material properties in Binzhou area. The above team tests made clear the consolidation effect of cement composite consolidated soil and a conclusion. The reaction among consolidation agent, cement and clay became a dense, fixed and strong structural system.

The combination of curing agent and raw soil material can lay the foundation for the strength level of solidified soil in the early stage; the performance of all aspects of the soil is improved in the later stage of use, which depends on the cementitious material formed by the consolidation agent and the soil. Except for clay minerals, because the soil particle size of clay minerals is small, there are a large number of small particles of secondary minerals, and they have good activity, so they themselves can be used as high-quality cementitious materials. The micro particles of clay minerals not only form the surface and have strong ability to destroy chemical bonds, but also react rapidly. It is relatively easy to react with the curing agent. It is used to stabilize the soil.

#### ***2.3.2 Biological Enzyme Curing Agent***

It has the characteristics of biodegradable, and after mixing with the soil, under the catalysis of enzymes, it enhances the cohesion between the soil and reduces the soil expansion coefficient.

According to the service life of the project using this kind of curing agent, the service life of various projects is about 7~8 years. The biological enzyme curing agent has been continuously expanded in the domestic and foreign markets and has been highly praised in different fields.

### ***2.3.3 Organic Polymers***

According to the variety of stock solution, organic compounds can be divided into single component and multi-component. For the process of converting low molecular weight into polymer, macromolecular chains with carbon as the main element are generated. Its function is to cement particles, and the environment in which it occurs is in the environment of bad soil; The repulsive force caused by space problems in the interior of organic polymers absorbs too much water in the soil. Based on this principle, a scholar made experiments with acrylic acid. The reason is that the surface hydroxyl condensation dehydration between different silica chains and the bonding of soil particles can achieve the required engineering capacity.

## **3. Application of Soil Curing Agent in Engineering**

### ***3.1 application of Soft Foundation***

When the soil bound water reaches saturation, it can not be used as foundation in construction engineering. Curing agent is the key to solve this problem. The traditional materials used at ordinary times, such as lime, cement and other solidified materials, can only solve two situations. On the one hand, the content of Jiaoling stone is low, and on the other hand, the content of water is low. On the contrary, a typical example is the new composite R-H + soft soil strong curing agent, which uses ionization to change the hydrophilicity of soil particles and become the same surface characteristics as sand particles. As a kind of cementitious material, it can increase the compactness and achieve the purpose of curing soft soil; One of the typical cases of sludge solidification technology is also included. There are a large number of microorganisms in the sludge, and the water content in the cells of microorganisms is high. The structure of cells is destroyed through chemical reaction. After the release of water in cells, hydration reaction occurs, and harmful substances are wrapped in them in the form of network to realize resource utilization; According to the development status of the national form, hsc301 curing agent shows advantages in dealing with the problems in Tianjin coastal area. Its mechanism and action process can be divided into three categories: physical mechanics, chemical hydration reaction and physicochemical water adsorption.

### ***3.2 application of Soil Curing Agent in Highway Engineering***

Many studies have shown that the performance of soil curing agent is a little outstanding compared with that of traditional solidified soil materials. In areas with unfavorable conditions and harsh environment, traditional cement and other solidified soil materials are extremely precious. In order to prevent environmental damage and waste of resources, the solidified soil after the action of soil curing agent can better reflect its advantages as the base and subbase of the road.

According to Shi Liping's research, aught set soil curing agent has six groups, which can form early strength, exchange ions, improve the strength of consolidated body, maintain stability and fatigue resistance. The potential activity of soft soil is stimulated, which greatly improves the curing effect. The calculation and experimental results show that compared with the traditional curing agent, the energy consumption of cement using this kind of curing agent is reduced by 30% ~ 50%, and the cost is saved by 20% ~ 30%. This kind of curing agent has been applied successively in Xinjiang Taklimakan desert highway and Ningxia Qingtongxia dam town south; Base seal curing agent belongs to ionic curing agent. According to the experimental results, the curing agent is more suitable as base material in cold areas. Changchun in Northeast China is subject to solidification treatment. Due to its location in cold areas, the impact of long-term storage of materials in water should be considered. Through one month's immersion practice in water, it is concluded that the solidified soil mixed with this material has good water stability.

### ***3.3 Application of soil solidifying agent in Hydraulic Engineering***

Canal seepage prevention is an engineering measure to reduce the loss of resources caused by water source leakage. Maintaining slope stability is the condition for the stability of soil mass at a certain degree of slope height and slope angle. These two aspects are the two major problems that must be

encountered in water conservancy projects. Soil solidifying agent plays a positive role in solving these problems. HEC series of high strength and high water resistance soil curing agent is developed to solve this problem. Its components can be divided into two parts: one can stimulate the active components of the consolidated soil material, and the other can also dilute other active components. The test results of the curing agent show that the chemical reaction with soil is rapid and gradual, non-toxic, tasteless and pollution-free; According to the curing characteristics and environmental conditions, Wei Wei and other personnel used a brand of curing agent in Tianjin. The results show that the technology is feasible under the condition of low engineering strength requirements. From the perspective of economy, it can be seen that the effect on channel lining shows high cost.

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