

SECTION 302 – CHEMICAL SUBGRADE TREATMENT

302.01 Description.....	1
302.02 Reserved.....	1
302.03 Materials	2
302.04 Equipment.....	3
302.05 Limitations	4
302.06 Preparing the Existing Subgrade.....	5
302.07 Extra Depth Stabilization	5
302.08 Applying Chemical Stabilizer.....	6
302.09 Mixing and Mellowing.....	7
302.10 Compaction and Finishing	8
302.11 Transverse Joints.....	9
302.12 Curing	10
302.13 Tolerances and Reconstruction	10
302.14 Method of Measurement.....	11
302.15 Basis of Payment.....	13

DESCRIPTION

302.01 Description

This work consists of treating in-place subgrade material with the specified chemical stabilizer, including Portland cement, lime, and fly ash. This work includes preparing the existing subgrade, distributing the specified stabilizer percentage, moisture conditioning, initial mixing and mellowing (if required), final mixing, compacting, finishing, and curing. The subgrade shall be treated in substantial conformity with the lines, grades, compacted thickness, and cross-section shown on the plans.

302.02 Reserved

302.03

MATERIALS

302.03 Materials

A. Chemical Stabilizer

1. Lime

Provide either hydrated lime or quicklime meeting **921.04**.

2. Portland Cement

Provide portland cement meeting **901.01**.

3. Fly ash

Provide Class C fly ash meeting **921.15**.

B. Water

Only use water that meets the requirements of **921.01**.

C. Soil

Use in-place subgrade material. Remove particles of aggregate retained on a three-inch sieve and deleterious substances, such as roots, stumps, and other vegetable matter from the subgrade and replace with suitable material.

Where chemical subgrade treatment is included in the project drawings, use the type and percentage of chemical stabilizer indicated.

If the need for chemical subgrade treatment is identified by the Department during construction, complete a mix design to determine the appropriate type and percentage of chemical stabilizer. Prepare the mix design in conformance with the Department's Soil Stabilization Testing Manual. Submit the design to the Department for approval.

D. Bituminous Material

For use as a curing agent, provide bituminous material as specified in:

302.04

PG64-22, 70-22, 76-22, and 82-22	904.01
Emulsified Asphalt,	
Types allowed for Tack Coat in 403.....	904.03

Provide emulsified asphalt, of a type allowed for Tack Coat in 403, meeting the test requirements specified in Table 904.03-1.

The Contractor may select the type of bituminous material to use for curing.

EQUIPMENT

302.04 Equipment

A. Distributing Equipment

Provide equipment to distribute the chemical stabilizer uniformly, at the required rate and without excessive loss.

When a bulk stabilizer is used, provide approved mechanical spreader(s) having adjustable strike-off gate(s), or other approved spreading equipment constructed so as to provide positive control of the spread. Approval of a spreader will be contingent upon its known or demonstrated ability to make distribution of chemical stabilizer within the tolerances allowable.

B. Slurry Equipment

When lime slurry is used, mix hydrated lime with water to produce lime slurry or, at the Contractor's option, produce lime slurry at the job site by the use of equipment specifically manufactured for the slaking of quick lime.

Use slurry tanks equipped with agitation devices to slurry quicklime on the project or other approved location. The Engineer may approve other slurring methods.

Provide a pump for agitating the slurry when the distributor truck is not equipped with an agitator. Equip the distributor truck with a sampling device, when using commercial lime slurry.

302.04

C. Mixing Equipment.

Perform mixing with approved rotary-type mixers or other approved equipment that is capable of positive depth control and provides a visible indication of the cut depth at all times. Provide mixing equipment that cuts and pulverizes to the specified depth with cutters that plane to a uniform surface over the entire width of the cut. Provide mixing equipment that creates a uniformly mixed subgrade as specified in **302.10**.

D. Compaction Equipment

Provide compaction equipment of the size and weight required to obtain the specified density and quality of finished surface.

CONSTRUCTION REQUIREMENTS

302.05 Limitations

Handle and store chemical stabilizers in completely enclosed, moisture resistant containers until immediately before use. Store bagged chemical stabilizers in weatherproof buildings with adequate protection from ground dampness. Do not mix additives from different sources in storage. Do not use additives that have been contaminated or exposed to moisture.

Do not stabilize areas that will not be covered with the succeeding stage of sub-base or base construction during the same construction season.

Do not apply chemical stabilizers:

1. to frozen subgrade material;
2. if the air temperature in the shade is less than 40 °F;
3. during periods of high winds; and
4. to areas that cannot be mixed and sealed as specified in **302.09** on the same day as application.

Do not leave chemical stabilizers exposed to the open air for a period of 6 hours or more.

Do not allow traffic or equipment on the spread chemical stabilizer other than that required for spreading, watering, or mixing.

302.06 Preparing the Existing Subgrade

Grade and shape the existing roadway in reasonably close conformity (up to 0.1 ft below planned subgrade elevation) with the lines, grades, and cross-sections shown on the Plans or as directed by the Engineer.

Remove all grass turfs and other deleterious substances from the subgrade and prepare the subgrade as specified in **207.03**.

Correct wet or unstable underlying foundation material, if encountered, as directed by the Engineer.

Scarify and partially pulverize the existing soil to the required depth after shaping. Carefully control the depth of scarification so that the soil below the planned treatment depth remains undisturbed.

302.07 Extra Depth Stabilization

If directed by the Engineer or if material cannot be mixed uniformly to the required depth, perform extra depth stabilization as follows:

1. Blade the overlying material to the sides.
2. Incorporate the chemical stabilizer and any necessary water, into the underlying material at the rate and to the depth specified.
2. Thoroughly mix and compact the stabilized soil mixture to obtain the required stability.
3. Moisten the compacted surface, and cover with the previously windrowed subgrade material.
4. Stabilize and compact the overlying subgrade material, which will serve as the curing medium.

Curing and mellowing periods will not be required for the stabilized underlying material unless otherwise directed by the Engineer. Curing and mellowing are required for the surficial layer.

302.08

302.08 Applying Chemical Stabilizer

After preparing the subgrade as specified in **302.06**, apply the chemical stabilizer using the dry or slurry application method. Use the slurry application method unless otherwise shown on the Plans.

Do not allow traffic other than water trucks or spreading and mixing equipment to pass over the spread chemical stabilizer until it is mixed with the subgrade material.

Discontinue immediately any procedure that results in excessive loss or displacement of the chemical stabilizer. Do not allow the chemical stabilizer to be exposed to the open air for more than 4 hours.

Prepare, transport, and distribute stabilizer on the roadbed in a manner that will not cause injury, damage, discomfort, or inconvenience to individuals or property. Do not apply stabilizer when wind conditions, as determined by the Engineer, are such that blowing stabilizer becomes hazardous to traffic, workmen, adjacent property, or results in adverse impact upon the public. Do not apply dry chemicals pneumatically.

Do not spread the chemical stabilizer on standing water.

A. Dry Application

Spread the chemical stabilizer at the required rate, using an approved spreader that will uniformly distribute the material without excessive loss.

B. Slurry Preparation and Application

Mix chemical stabilizer with water in approved agitating equipment, and apply to the roadway as a thin water suspension or slurry through approved distributing equipment. The distributing equipment shall be equipped to continuously agitate the mixture from the mixing site until applied on the roadbed. Proportion the mixture so that the dry solids content is at least 30% by weight.

302.09 Mixing and Mellowing

In dry applications, immediately after applying the chemical stabilizer, scarify the course, if necessary, and mix to the required depth, width, and cross-sections.

In slurry applications, perform successive passes over a measured section until the specified percentage of chemical stabilizer has been distributed. After each successive pass, incorporate the slurry into the soil with approved mixing equipment.

Incorporate chemical stabilizer into the soil to the depth needed to provide a finished course of chemically-stabilized material conforming to the specified thickness and surface requirements.

If applying the chemical stabilizer as a slurry, ensure that the water added with the slurry does not cause the moisture content of the chemical-soil mixture to exceed the above tolerance.

A. Cement and Fly Ash

Continue mixing, and applying water as necessary, until a homogeneous mixture of soil, chemical stabilizer, and water is obtained. During the mixing operation, add the quantity of water needed for the moisture content of the mixture to be between 2 and 5% above its optimum moisture content, unless otherwise directed by the Engineer.

Pulverize and mix until 100% of the material, except for gravel and stone, will pass a 1-inch sieve, and 60% by dry weight will pass the No. 4 sieve.

B. Lime

Continue mixing, and applying water as necessary, until a homogeneous mixture of soil, chemical stabilizer, and water is obtained that is free of soil clods larger than 2 inches in size. During the mixing operation, add the quantity of water needed for the moisture content of the mixture to be between 2 and 5% above its optimum moisture content, unless otherwise directed by the Engineer.

After completing mixing operations, reshape the treated course to the approximate lines, grades, and cross-sections, and seal with a pneumatic-tire roller, and other approved equipment as necessary. Crown the

302.10

surface to provide surface drainage. Allow the lime-stabilized subgrade to mellow for 1 to 7 days as directed by the Engineer. Note that the characteristics of the soil, temperature, and rainfall may influence the mellowing period necessary. During the mellowing period, maintain the entire surface of the treated course in a moist condition.

After the required mellowing period, reshape and grade the initially mixed material to the required lines, grades, and cross-sections.

Thoroughly mix the previously mixed material with approved mixers while adding water as necessary.

Continue mixing until 100% of the material, except for gravel and stone, will pass a 1-inch sieve, and 60% by dry weight will pass the No. 4 sieve.

The quantity of water added shall be such that at the end of the final mixing and during compaction and finishing operations the percentage of moisture in the mixture and the unpulverized soil lumps will not vary more than plus or minus 3% from the specified optimum moisture of the lime-soil mixture.

302.10 Compaction and Finishing

Immediately after completing the final mixing, blade the material to uniform thickness and shape, and start compaction operations. Use sheepfoot rollers to compact the material in a continuous operation until the entire depth of the chemically stabilized-soil mixture is uniformly compacted to the required density. The Contractor may remove the sheepfoot rollers when a surface mulch not exceeding 1 inch remains. Lightly scarify the resulting surface and shape to the required lines, grades, and cross-sections within the tolerances specified in **302.13**. Perform final rolling with the roller specified by the Engineer.

Provide a completed chemically stabilized subgrade that is smooth, dense, well-bonded, unyielding, and free of cracks or loose material.

Compact the chemically stabilized-soil mixture in layers as shown on the Plans. The Department will determine the maximum density and optimum moisture content of the chemically stabilized-soil mixture according to AASHTO T 99. The sample used to determine the maximum density and optimum moisture content will be representative field samples of the chemical stabilizer-soil mixture that have undergone the same treatment as the chemically stabilized subgrade being tested.

302.11 Transverse Joints

For density testing purposes, the Department will divide the completed subgrade treatment into lots of approximately 10,000 square yards, and will perform five density tests on each lot. The average dry density of each lot shall not be less than 100% of maximum density, and no individual test shall be less than 97% of maximum density.

Immediately scarify, moisten (if required), rework, and compact to the required density all areas that do not meet density requirements at no additional cost to the Department.

Complete compaction within 2 hours after the addition of cement for cement-stabilized subgrade. Complete compaction within 6 hours after the addition of fly ash for fly ash-stabilized subgrade. Complete compaction of lime-stabilized subgrade after mellowing and remixing.

For field verification of compressive strength, the Department will divide the completed subgrade treatment into lots of approximately 40,000 square yards, or the area stabilized in one day, whichever is less. A sample will be obtained from three randomly selected locations in each lot. Each sample will be compacted using Standard Proctor energy, tested for water content, cured in an airtight plastic bag for 7 days, subjected to a 24-hr capillary soak, and tested in unconfined compression. The average unconfined compressive strength shall meet or exceed the minimum value recommended by the mix design with no strengths more than 25% below the minimum.

302.11 Transverse Joints

Create transverse joints perpendicular to the roadway alignment, as needed, to accommodate the end of each day of subgrade construction. Cut a vertical surface into the previously compacted chemically stabilized subgrade. Mix the chemical stabilizer with the soil, place to the required depth next to the joint. Continue conventional subgrade stabilization operations after the joint, and compact adjacent to the joint as specified in **302.10**.

In the area adjacent to the joint where special stabilization operations are required, the Department will perform two additional density tests. The average dry density these tests shall not be less than 100% of maximum density, and no individual test shall be less than 97% of maximum density.

302.12

302.12 Curing

After finishing the chemically stabilized subgrade as specified in **302.10**, seal the surface by applying one of the bituminous materials specified in **302.03.D** using a pressure distributor at the rate of 0.10 to 0.25 gallons per square yard, as directed by the Engineer or as shown on the Plans. Heat or otherwise prepare the bituminous material to ensure uniform distribution and apply as soon as possible.

Do not allow traffic or equipment on the finished surface until the stabilized subgrade has cured for a total of 7 days with an ambient air temperature above 40 degrees Fahrenheit. Calculate curing days as 24-hour days for which the ambient air temperature remains at or above 40 degrees Fahrenheit. Curing days do not have to be consecutive.

Make every reasonable effort to completely cover the stabilized roadbed with the specified pavement courses before suspending work for the winter months.

302.13 Tolerances and Reconstruction

The Department will determine the thickness of the completed chemically-treated subgrade by measuring test holes at random locations as specified in Departmental procedures. Use diluted hydrochloric acid or phenolphthalein to indicate the presence of calcium and ensure that the chemical stabilizer is mixed to the desired depth. The measured thickness at the locations shall not deviate from that shown on the Plans by more than plus 1-1/2 inches or minus 1 inch.

Immediately reconstruct areas of chemically-treated subgrade that do not meet thickness requirements. For areas having a thickness greater than that allowed, add sufficient chemical stabilizer to correct the deficiency in stabilizer content. Perform reconstruction, including adding chemical stabilizer, to correct the thickness deviation at no cost to the Department.

After the curing period, proof roll the chemically stabilized subgrade. As directed by the Engineer, repair areas of chemically-treated subgrade that become unstable or that lose the required density or surface finish. Use additional chemical stabilizer and water if and as directed.

Limit hauling over the treated subgrade to the minimum amount necessary to construct the overlying base or sub-base.

When at least one course of base or sub-base has been constructed upon the treated subgrade, the Contractor may resume hauling, provided the layer or layers of base or sub-base are constructed and maintained as specified in **303.10** and **303.11**.

COMPENSATION

302.14 Method of Measurement

A. Chemical Stabilizer

1. Lime

The Department will measure Lime by the ton. Quantities and percentages of lime shown on the Plans are based on preliminary soil investigations and dry laboratory sample tests using hydrated lime. The Engineer will establish the actual application rate from dry density tests conducted just before the start of stabilization work. For quicklime, the Department will determine the accepted quantity by converting the quicklime to an equivalent quantity of hydrated lime as follows:

$$\text{EHL} = 1.32 \text{ QL} \left[1 - \frac{\text{I}}{100} \right]$$

Where:

EHL = Equivalent amount of hydrated lime in tons
 QL = Tons of quicklime accepted
 I = Percent of impurities in the quicklime

The Department will deduct for quantities of lime that have been wasted or not actually used in the work.

2. Cement

The Department will measure portland cement incorporated in the work by the ton in accordance with 109.

3. Fly ash

302.14

The Department will measure fly ash incorporated in the work by the ton in accordance with 109.

B. Chemically Stabilized Subgrade

The Department will determine the area processed by the square yards of treated subgrade, as computed using the length measured at the surface of the treated subgrade and the width shown on the Plans or designated by the Engineer.

C. Extra Depth Stabilization

The Department will classify processing performed using the Direct Application Method, as specified in **302.07**, as Subgrade Treatment, and will measure this work for payment as follows:

- a. If the thickness of the layers processed is equal to or greater than the Plan thickness for normal stabilization, the Department will measure processing by the square yards of each extra depth layer processed.
- b. If the thickness of the layers processed is less than the Plan thickness for normal stabilization, the Department will measure the area in square yards of each extra depth layer processed and will adjust this area to determine the quantity for payment by multiplying the number of square yards processed by the thickness of the layer and dividing by the Plan thickness for normal stabilization. To determine the area of extra depth layers, the Department will measure the length and width used in accordance with **302.14.B**.

D. Water

The Department will measure water by the M.G. (1,000 gallons) using calibrated tanks or distributors, or accurate water meters. The quantity measured for payment will be the amount necessary for subgrade preparation, initial mixing, mellowing, final mixing, compacting, finishing, and curing. The Department will not measure water used to prepare or apply slurry.

E. Bituminous Material

The Department will measure in tons the quantity of bituminous material used and accepted.

F. Preparation of Existing Subgrade

The Department will classify and measure the materials moved, furnished, or disposed of to prepare the subgrade in accordance with **302.06** as provided for under **207**.

302.15 Basis of Payment

The Department will pay for accepted quantities at the contract prices as follows:

<i>Item</i>	<i>Pay Unit</i>
Hydrated Lime	Ton
Portland Cement	Ton
Fly Ash	Ton
Bituminous Material	Ton
Chemically Stabilized Subgrade	Square Yard
Water	M.G.

Such payment is full compensation for providing all materials, equipment, labor, and incidentals to complete the work as specified.

The Department will pay for moving, furnishing, or disposing of material under **207** if the Contract is for any of the following:

1. Combined grading, drainage and paving project,
2. Construction of a base and/or pavement on a road that has been graded under a previous Contract, or
3. Base and/or paving project that includes sections of grading.

For Extra Depth Stabilization, the Department will not pay for any shifting of the overlying material; however, the Department will pay for the chemical stabilizer and water used and for the mixing of the underlying material with the chemical stabilizer and water.

302.15

If repairs to the chemically-treated surface are made necessary by a cause beyond the Contractor's control, the Department will pay for the construction items involved at the contract unit prices.