

302 – LIME TREATED SUBGRADE

SECTION 302

LIME TREATED SUBGRADE

302.1 DESCRIPTION

Mix soil, lime and water either in-place or off-site in a borrow area. Use the mixed materials to construct a uniform lime treated subgrade as shown in the Contract Documents.

BID ITEMS

Lime
Manipulation (Lime Treated Subgrade)
Water (Lime Treated Subgrade) (Set Price)

UNITS

Ton
Square Yard
M Gallon

302.2 MATERIALS

Provide materials that comply with the applicable requirements.

Emulsified Asphalt (SS-1 or CSS-1)	DIVISION 1200
Medium Cure Cutback Asphalt (MC-250)	DIVISION 1200
Liquid Membrane Forming Compounds	DIVISION 1400
Lime	DIVISION 2000
Water for Lime Treated Subgrade	DIVISION 2400

302.3 CONSTRUCTION REQUIREMENTS

a. Preparation and Maintenance of the Subgrade or Off-Site Borrow Area. Before the application of the lime treatment, use automatic grade controlled equipment to trim the surface of the subgrade or borrow area to the specified lines and grades. In irregular areas, trim the subgrade or borrow area by wetting, blading and rolling. Trim borrow areas to the profile established by the Contractor. Uniformly compact the trimmed subgrade or borrow area.

Maintain the subgrade or borrow area as prepared. Provide proper drainage at all times. Correct defects that develop in the subgrade or borrow area.

b. Application of Lime. When the lime is not applied through a mixing chamber to the prepared in-place subgrade or off-site borrow area, scarify the prepared area to a minimum depth of 4 inches and a maximum depth of approximately 1 inch less than the specified depth of lime treatment. The specified depth of lime treatment for in-place areas is designated in the Contract Documents. The Contractor shall determine the depth of lime treatment for off-site areas.

The application rate of lime is based on the weight of soil being treated and is shown in the Contract Documents. If the application rate is not shown in the Contract Documents, assume a rate of 5% of the weight of soil.

Perform the scarification with positive depth control equipment. Do not use a plow or disc for the scarification. The Engineer may approve the use of a positive depth controlled motor grader scarifier on a performance basis.

When pebble quicklime is used, slake it at the jobsite to manufacture hydrated lime slurry, according to **DIVISION 2000** and the following.

Determine the amount of water needed to make slurry from dry quick lime using the following:

$$W_w = ((A+B)/P_s) - W_{QL}$$

Where:

$$A = (\text{Quicklime Delivered}) * (\% \text{ purity in decimal form}) * 1.32 = W_{QL} * P_{CaO} * 1.32$$

$$B = (\text{Quicklime Delivered}) * (\% \text{ inert material}) * 1.0 = W_{QL} * P_I$$

A + B = Total Hydrated Lime Produced (Pay Quantity)

W_w = Weight of Water Required for Slurry of Given Percent Solids, tons

W_{QL} = Quicklime Weight, tons

P_{CaO} = Percent of CaO in the Quicklime, purity (as a decimal)

P_I = Percent of Inert Material in the Quicklime (as a decimal)

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P_S = Percent Solids in the Lime Slurry (as a decimal)
Gallons of Water = $W_w * 2000/8.34$

Use a percent solids between 20 and 40%. Determine the concentration strength of the hydrated lime slurry and rate of application to obtain the percent of lime specified in the Contract Documents and advise the Engineer accordingly. See **TABLE 302-1**.

Apply hydrated lime to the scarified areas as slurry. Use equipment that can apply lime slurry through a system of spray bars and nozzles. Regulate the amount of lime slurry from each nozzle and the speed of the delivery vehicle so that the specified amount of lime is placed on the soil. The concentration of the hydrated lime slurry shall allow the application of the correct quantity of lime without adding an undue quantity of excess moisture to the mixture. The application and mixing of the hydrated lime slurry shall result in a uniform lime concentration.

Test the concentration of the lime suspension at the minimum rate of 1 per day or 1 per mixed batch, whichever is greater; use **TABLE 302-1** and a volume measuring device and scale. Use KT-62, Percent Solids of Lime to determine water requirements for slaking for a percent solids. During slaking, check the density of the solution periodically to determine the time required for complete slaking. The minimum amount of time for slaking is 20 minutes.

Apply the hydrated lime slurry the same day it is produced. Continuously agitate the hydrated lime after the batch is made. If the liming operation is interrupted, continue agitating the hydrated lime in storage. If the interruption will be lengthy, the Contractor has the option to cease mixing. In either case, prior to resuming liming operations, the Contractor shall re-test the concentration and adjust the rate of application accordingly. The Engineer will verify the results.

Check the lime application, such as pH testing. Other methods, may be used if approved by the Engineer.

c. Adding Water. Add water, as necessary, to facilitate mixing of the hydrated lime slurry and soil. During the initial mixing operation, add water to obtain a minimum moisture content of 8% above the optimum moisture content of the raw soil being treated.

The Engineer will measure the moisture content (KT-11) immediately after the mixing is completed, and before sealing or compacting.

d. Preliminary Mixing. Mix the lime, soil and water to the dimensions specified in the Contract Documents. For off-site borrow areas, the Contractor shall determine the depth and width. For projects containing more than 20,000 square yards of manipulation, positively control the depth of mixing to maintain the specified depth $\pm 1/2$ inch. Use equipment with positive depth control that can maintain cutting or mixing heads in a fixed position relative to the wheels or tracks of the machine carrying the head.

Perform a minimum of 2 passes with the mixer traveling in the primary direction. Continue mixing until 95% of the mixture passes the 2-inch sieve as determined by the Engineer (KT-42).

While mixing, do not disturb the roadway or borrow area beyond the specified limits of the lime treatment.

e. Aging. Seal the mixture to prevent moisture loss by lightly rolling with a pneumatic-tired roller. Blade the surface to shed water.

(1) Material Mixed In-Place. Maintain the mixture in the sealed condition for a minimum of 24 hours prior to commencing final mixing.

(2) Material Mixed in a Borrow Area. Maintain the mixture in the sealed condition a minimum of 24 hours or until the mixture is ready to be used.

In both (1) and (2) above keep the surface moist by spraying with water. If the final mixing is not performed within 14 days of the preliminary mixing, add 1% lime by weight of raw soil, in the final mixing operation. If the Contractor knows the final mixing will not be performed within 14 days, the Contractor may reduce the rate of lime applied in the initial application by 1%, and add the 1% in the final mixing.

f. Final Mixing. After the initial mixing and aging (24 hours) is completed, re-mix the mixture to the specified depth ($\pm 1/2$ inch) and width, until 95% of the mixture passes the 1 1/2-inch sieve and 40% passes the No. 4 sieve as determined by the Engineer (KT-42). Periodic mixing over an interval of time is allowed to facilitate the breakdown in particle size. Bring the mixture to the moisture content required for compaction with a minimum of 3% above optimum of the proctor density of the lime treated soil.

While mixing, do not disturb the roadway or borrow area beyond the specified limits of the lime treatment.

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g. Compaction of the Mixture. When the material is mixed in-place, compact the material after completing the required final mixing.

When the material is mixed off-site, excavate and haul the material to the project site. Place the material on the prepared and trimmed surface, and compact the material.

Compact the mixture to Type B compaction, MR-3-3 moisture control, **SECTION 205**. Blade the mixture to eliminate surface irregularities during the compaction operations. Maintain the moisture content to a minimum of 3% above optimum of the proctor density of the lime treated soil.

h. Finishing and Curing the Lime Treated Subgrade. After the mixture is compacted, use automatic grade controlled equipment to trim the lime treated subgrade to the specified lines and grades. In irregular areas, trim the lime treated subgrade by wetting, blading and rolling. Compact the trimmed surface with a smooth-wheel or a pneumatic-tire roller.

After the compacted mixture is finished, cure the lime treated subgrade for 7 days, by keeping the finished surface moist with water. Do not allow vehicles or equipment (other than watering equipment) on the finished lime treated subgrade during the curing period.

At the Contractor's option, apply an asphalt prime coat instead of keeping the finished surface moist with water. If asphalt prime coat is used, apply SS-1, CSS-1 or MC-250 at the rate of 0.22 gallons per square yard to achieve a minimum of 0.13 gallons per square yard residue. The use of a liquid membrane forming compound is also an acceptable curing medium. Multiple light applications may be necessary to obtain the specified rate of application without run-off.

When a base course or subbase is to be constructed upon the lime treated subgrade, the Engineer may reduce the curing period to when the lime treated subgrade gains sufficient strength to support the construction and hauling equipment. Repair any damage to the lime treated subgrade due to construction of the base course or subbase.

i. Seasonal Limitations. Do not perform lime treatment operations if the ambient air temperature is below 40°F, or the soil is frozen.

(1) Projects with Rigid Pavement. Cover the finished lime treated subgrade with base or pavement before it is subjected to freezing. If the lime treated subgrade is not covered by base or pavement and is subjected to freezing, re-compact the lime treated subgrade before placing any pavement. The Engineer will determine the extent of the re-compaction.

(2) Projects with Flexible Pavement. Cover the finished lime treated subgrade with the specified lift of HMA or aggregate base before it is subjected to freezing. If lime treated subgrade is not covered with a lift of HMA or aggregate base and is subjected to freezing, add additional lime and re-compact the lime treated subgrade before placing any pavement. The Engineer will determine (by laboratory or field tests) the additional quantity of lime to add, if any, and the extent of the re-compaction.

302.4 MEASUREMENT AND PAYMENT

The Engineer will measure lime by the ton. If bagged lime is used, the Engineer will use the net weight marked on the bag by the manufacturer for the measurement. If certified railroad car or certified truck quantities are used, the Engineer will use the net weight of the lime for the measurement.

Using the relationship for Pure Quicklime (CaO) $\times 1.32 =$ Hydrated Lime (Ca(OH)_2), determine the basis of pay for jobsite slaked hydrated lime (A+B) according to **subsection 302.3b**, using the certified lime purity for each load.

Calculate the pay quantity for carbide lime as follows:

$$\text{Pay Quantity} = (\text{Weight of material delivered}) (\% \text{ solids})$$

The percent moisture will not be credited toward water for pay.

The Engineer will measure the manipulation of the lime treated subgrade by the square yard. Material placed beyond the neat lines indicated in the Contract Documents is not measured for payment without approval by the Engineer.

The Engineer will measure water used for lime treated subgrade by the M Gallon using calibrated tanks or water meters. The Engineer will measure water used for subgrade preparation, mixing subgrade and lime, compacting and curing the lime treated subgrade. The Engineer will not measure water used for slaking the lime,

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dust control, water wasted through the Contractor's negligence or water in excess of the quantity required for mixing and compacting the lime treated subgrade.

If the Contractor opts to use asphalt prime coat or liquid membrane forming compound to cure the lime treated subgrade, the Engineer will not measure the asphalt prime coat for payment or liquid membrane forming compound.

The Engineer will not measure for payment, the lime, manipulation or water used for adding additional lime or re-compaction if:

- The off-site borrow area mixture is not used within 14 days of the preliminary mixing.
- The lime treated subgrade is not covered with pavement before it is exposed to freezing temperatures.

Payment for "Lime" and "Manipulation (Lime Treated Subgrade)" at the contract unit prices and "Water (Lime Treated Subgrade) (Set Price)" at the contract set unit price is full compensation for the specified work.

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TABLE 302-1: STRENGTH OF HYDRATED LIME SLURRY	
Lb. per gal. of suspension	Lb. Ca (OH)₂ per gallon, suspension
8.41	.135
8.50	.272
8.58	.412
8.66	.546
8.75	.691
8.83	.830
8.91	.962
8.99	1.106
9.08	1.244
9.16	1.392
9.25	1.517
9.33	1.679
9.41	1.816
9.50	1.948
9.58	2.09
9.66	2.23
9.75	2.38
9.85	2.52
9.91	2.68
10.00	2.80
10.08	2.94
10.16	3.09
10.24	3.24
10.33	3.39
10.41	3.52
10.49	3.71
10.58	3.86
10.66	4.00
10.74	4.15
10.83	4.29
10.91	4.45
11.00	4.60
11.08	4.73
11.16	4.90
11.25	5.04
11.33	5.18
11.41	5.32
11.50	5.49
11.58	5.62
11.66	5.78
11.75	5.95
11.83	6.09
11.91	6.22
12.00	6.37
12.08	6.51