215-R-715 CHEMICAL MODIFICATION OF SOILS

(Adopted 02-20-20)

The Standard Specifications are revised as follows:

SECTION 215, BEGIN LINE 1, DELETE AND INSERT AS FOLLOWS:

SECTION 215 – CHEMICAL MODIFICATION OF SOILS

215.01 Description

This work shall consist of the modification of soils by uniformly mixing portland cement, fly ash, *or* lime ~~or a combination of the materials~~ with soil to aid in strength gain and achieving the workability of soils ~~having excessive moisture content~~.

MATERIALS

215.02 Materials

Materials shall be in accordance with the following:

Fly Ash*, Class C* 901.02
Lime .....913.04(b)
Portland Cement, Type I .....901.01(b)
Water 913.01
Note: Quicklime or portland cement may be used dry or as a slurry.

~~Soils containing greater than 6% by dry weight calcium/magnesium carbonate, or organic material, or having a maximum dry density of less than 95 pcf, or with a soluble sulfate content greater than 1,000 ppm shall not be used in the subgrade. The density shall be determined in accordance with AASHTO T 99, the loss on ignition shall be determined in accordance with AASHTO T 267, the calcium/magnesium carbonate shall be determined in accordance with ITM 507, and the sulfate content shall be determined in accordance with ITM 510~~*Soils for chemical modification shall meet the following requirements.*

Soil Property	*Test Method*	*Requirement*
Maximum Dry Density	*AASHTO T 99*	*≥ 90 pcf*
Organic Material	*AASHTO T 267*	*≤ 6%*
Sulfate Content	*ITM 510*	*≤ 1,000 ppm*

CONSTRUCTION REQUIREMENTS

215.03 Testing and Mix Design

The Contractor shall be responsible for ~~all tests required to determine the chemical modifier type and optimum chemical modifier content for modification of the soils. The modifier selection, laboratory testing, and~~*the* mix design~~,~~. *The mix design* shall be performed by an approved geotechnical consultant in accordance with the Department's Design Procedures for Soil Modification or Stabilization.

The quantities for hydrated lime, quicklime, or portland cement shall be based on ~~4.0%~~*5.0%* of the maximum dry density of the soils. The quantities for lime by-products shall be based on ~~5.0%~~*6.0%* of the maximum dry density of the soils. The quantities for fly ash class C shall be based on 12.0% of the maximum dry density of the soils. Class F fly ash shall not be used ~~except in combination with lime or cement~~.

If hydrated lime, quick lime, lime by-products or portland cement are used, test results and the geotechnical consultant recommendations shall be submitted to the Engineer prior to use. If fly ash ~~or any combination of chemical modifiers are~~*is* used, the test results and the geotechnical consultant recommendations shall be submitted to the Engineer and to the Office of Geotechnical Services for approval at least ~~five~~*three* business days prior to use. If the modifier as bid is not appropriate for the soils encountered, portland cement shall be used. Portland cement, fly ash, lime, and lime by-products shall be from the Department's list of approved sources.

The quantity of chemical modifier may be adjusted for different soil types. However, the source or type of chemical modifier shall not be changed during the progress of the work without approval. A change in source or type shall require a new mix design.

215.04 Storage and Handling

The chemical modifier shall be stored and handled in accordance with the manufacturer's recommendations.

215.05 Weather Limitations

The chemical soil modification shall be performed when the soil has a minimum temperature of 45°F, measured 4 in. below the surface, and with the air temperature rising. The chemical modifier shall not be mixed with frozen soils or with soil containing frost. Chemical soil modification shall only be performed in areas which are going to be paved during the same construction season.

215.06 Preparation of Soils

The soils shall be prepared in accordance with 207.03. All aggregates which are larger than approximately 3 in. encountered before or after mixing the soils and chemical modifiers shall be removed.

215.07 Spreading of Chemical Modifiers

Where type A-6 or A-7 soils are used or encountered, the surface shall be scarified to the specified depth prior to distribution of the chemical modifier. ~~If a combination of modifiers is used, the modifiers shall be mixed mechanically prior to being incorporated.~~ The chemical modifier shall be distributed uniformly by a cyclone, screw-type, or pressure manifold type distributor. If a slurry is used, the surface shall be scarified prior to the distribution of the slurry. The chemical modifier shall not be applied when wind conditions create problems in adjacent areas or create a hazard to traffic on any adjacent roadway. The spreading of the chemical modifier shall be limited to an amount which can be incorporated into the soil within the same work day. If weather causes stoppage of work or exposes the chemical modifier to washing or blowing, additional chemical modifier may be spread when the work resumes.

215.08 Mixing

The chemical modifier, soil, and water when necessary, shall be thoroughly mixed by rotary speed mixers ~~or a disc harrow~~. The mixing shall continue until a homogenous layer of the required thickness has been obtained. One hundred percent of the material, exclusive of rock particles, shall pass a 1 in. (25 mm) sieve and at least 60% shall pass a No. 4 (4.75 mm) sieve. The mixing depth shall be 14 in. *The gradation test shall be performed in accordance with ITM 516.*

The chemically modified soil mixture shall be at least 1% above the optimum moisture content during mixing and compaction. Water shall not be added to the chemically modified soil when the moisture content of the soil exceeds 3% above optimum moisture. Water shall be added during mixing only.

215.09 Compaction

Compaction of the mixture shall begin as soon as practicable after mixing and shall be in accordance with ~~203 or~~ 207.03 as applicable. Compaction after mixing shall be as follows:

(a) For portland cement modified soils, mixing shall be completed within 1 h of portland cement placement and grading and final compaction shall be completed within 3 h after mixing.

(b) Fly ash modified soils shall be compacted within 4 h.

(c) Lime modified soils shall be compacted within 24 h.

Acceptance of chemically modified soils will be determined ~~by measuring the compaction with a Dynamic Cone Penetrometer, DCP,~~ in accordance with *ITM 508 or* ITM 509 ~~or with a Light Weight Deflectometer, LWD, in accordance with 203.24(b)~~. Testing of the chemically modified soils will begin *a minimum of* 24 h~~ours~~ after compaction.

Acceptance of chemically modified soils will be determined by averaging three LWD tests obtained at random stations determined in accordance with ITM 802. The deflection shall be equal to or less than the allowable average deflection shown in the table below.

Material Type	*Allowable Average Deflection, (mm)*	*Maximum Deflection at a Single Test Location (mm)*
Cement Modified Soils	*0.27*	*0.31*
Lime Modified Soils	*0.30*	*0.35*

For measuring the compaction with a DCP, three random test locations will be determined in accordance with ITM 802 ~~for each 1,500 lft of chemically modified soil for each 2-lane pavement section. The average of the blow counts obtained at the three random locations will be the DCP blow count representing the 1,500 lft section~~. Blow

counts of 15 and above will be used to determine the average for the top 6 in. of a 14 in. lift. Blow counts of 14 and above will be used to determine the average for the bottom 8 in. of a 14 in. lift. Blow counts of 18 and above will be used to determine the average for the 8 in. lift. Locations with test results less than the specified minimum blow counts will be retested and shall be reworked if the minimum blow count is not obtained. *The frequency of LWD or DCP testing will be three tests for each 1,400 cu yds of chemically modified soils.*

The chemically modified soil lift shall meet the following requirements for compaction:

(a) The average DCP blow count shall not be less than 17 for the top 6 in. of a 14 in. lift.

(b) The average DCP blow count shall not be less than 16 for the bottom 8 in. of a 14 in. lift.

(c) ~~The average DCP blow count shall not be less than 20 for an 8 in. lift.~~*Moisture tests for chemically modified soils mixture shall be performed in accordance with ITM 506 every 4 h during chemical and soils mixing.*

(d) One gradation test shall be performed for each 2,500 cu yds of chemically modified soil in accordance with 215.08 and ITM 516.

~~Moisture tests for chemically modified soils mixture will be performed every 4 h during chemical and soils mixing. One gradation test in accordance with 215.08 will be performed for each 2,500 lft of chemically modified soil for each 2-lane pavement section.~~

Construction traffic or equipment will not be allowed on the treated soils until the soil meets the ~~DCP~~*compaction* test requirements.

215.10 Curing

~~The moisture content of the mixture shall be at the optimum moisture content or above the optimum moisture content as determined by the mix design in accordance with 215.03. Moisture content will be determined in accordance with ITM 506.~~ Moisture content shall be maintained *at 1%* above the optimum moisture content for the first 48 h after mixing ~~with quicklime or hydrated lime~~.

215.11 Proofrolling

Proofrolling shall be performed in accordance with 203.26.

215.~~11~~*12* Method of Measurement

The accepted quantity of chemically modified soils*, for the material specified,* will be measured by the square yard, complete in place. All removal and replacement

required to modify the soils below the specified depth will be measured in accordance with 203.27(b).

215.~~12~~*13* Basis of Payment

The accepted quantity of chemically modified soils*, for the material specified,* will be paid for by the square yard, complete in place. *Fly ash, when used, will be paid for as lime.* All removal and replacement required to modify the soils below the specified depth will be paid for in accordance with 203.28.

Adjustment of materials for chemical modification that exceeds the limits of 215.03 will be included in a change order for materials only and paid for as chemical modifier adjustments. If mix design test results show that the chemical modifier as bid by the Contractor is not appropriate and the strength of the modified soil can not be achieved, a price adjustment will be made for the use of portland cement. The price adjustment will be calculated at a cost equal to the difference in the invoice cost of the chemical modifier found to be appropriate for use and the invoice or quoted delivered cost of the chemical modifier as bid by the Contractor. This adjustment will be included in a change order and will be paid for as chemical modifier adjustments. *Fly ash will not be considered for price adjustment.* Payment for chemical modifier adjustments will be made for direct delivered material costs incurred by the Contractor ~~and shall not include any other markups~~*in accordance with 109.05*.

Payment will be made under:

Pay Item	**Pay Unit Symbol**
Chemical Modification, Soils, _____ *material*	SYS

The cost of performing the laboratory tests, providing an approved geotechnical consultant, scarification of the ~~subgrade~~*soil*, spreading and mixing of the chemical modifier and soil, compaction of the resultant mixture, shaping the ~~subgrade~~*soil*, work required due to adjustments of modifier proportioning, additional modification required due to weather conditions, correction of deficient areas, water required for the modification process, modified ~~subgrade~~*soil* trimming, *moisture testing, gradation testing, proofrolling,* and all operations needed to meet the requirements of this specification shall be included in the cost of the pay items of this section.