MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF AERONAUTICS - STANDARD SPECIFICATION
P-155
Lime-Treated Subgrade

DESCRIPTION

1.1 This item shall consist of constructing one or more courses of a mixture of soil, lime, and water in accordance with this specification, and in conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the engineer.

MATERIALS

2.1 **Hydrated Lime.** Hydrated lime shall conform to the requirements of ASTM C-207, Type N.

2.2 **Commercial Lime Slurry.** Commercial lime slurry shall be a pumpable suspension of solids in water. The water or liquid portion of the slurry shall not contain dissolved material in sufficient quantity naturally injurious or objectionable for the purpose intended. The solids portion of the mixture, when considered on the basis of "solids content," shall consist principally of hydrated lime of a quality and fineness sufficient to meet the following requirements as to chemical composition and residue.

(a) Chemical Composition. The "solids content" shall consist of a minimum of 70%, by weight, of calcium and magnesium oxides.

(b) Residue. The percent by weight of residue retained in the "solids content" of lime slurry shall conform to the following requirements:

Residue retained on a No. 6 (3360-micron) sieve	Max. 0.0%
Residue retained on a No. 10 (2000-micron) sieve	Max. 1.0%
Residue retained on a No. 30 (590-micron) sieve	Max 2.5%

(c) Grade. Commercial lime slurry shall conform to one of the following two grades:

Grade 1. The "dry solids content" shall be at least 31%, by weight, of the slurry.
Grade 2. The "dry solids content" shall be at least 35%, by weight, of the slurry.

2.3 **Water.** Water used for mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product. Water shall be tested in accordance with and shall meet the suggested requirements of AASHO T 26. Water known to be of potable quality may be used without test.

2.4 **Soil.** The soil for this work shall consist of *materials on the site or selected materials from other sources* and shall be uniform in quality and gradation, and shall be approved by the engineer. The soil shall be free of roots, sod, weeds, and stones larger than 2½ inches.

COMPOSITION

3.1 **Lime.** Lime shall be applied at the rate specified on the plans for the *depth of subgrade treatment shown.*

3.2 **Tolerances.** At final compaction, the lime and water content for each course of subgrade treatment shall conform to the following tolerances:

Material	Tolerance
Lime	± 0.5%
Water	+2%, -0%

WEATHER LIMITATIONS

4.1 **Weather Limitations.** The lime-treated

subgrade shall not be mixed while the atmospheric temperature is below 40°F or when conditions indicate that temperatures may fall below 40°F within 24 hours, when it is foggy or rainy, or when soil or subgrade is frozen.

EQUIPMENT

5.1 Equipment. The equipment required shall include all equipment necessary to complete this item such as: grading and scarifying equipment, a spreader for the lime or lime slurry, mixing or pulverizing equipment, sheepsfoot and pneumatic or vibrating rollers, sprinkling equipment, trucks, and truck scales. All machinery, tools, and equipment shall be on the site and approved by the engineer prior to the beginning of construction operations and shall be maintained in a satisfactory working condition throughout the construction period.

CONSTRUCTION METHODS

6.1 General. It is the primary requirement of this specification to secure a completed subgrade containing a uniform lime mixture, free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth, and with a smooth surface suitable for placing subsequent courses. It shall be the responsibility of the contractor to regulate the sequence of his work, to use the proper amount of lime, maintain the work, and rework the courses as necessary to meet the above requirements.

Prior to beginning any lime treatment the subgrade shall be constructed and brought to grade as specified in Item P-152 "Excavation and Embankment" and shall be shaped to conform to the typical sections, lines, and grades as shown on the plans or as established by the engineer. The material to be treated shall then be excavated to the secondary grade (proposed bottom of lime treatment) and removed or windrowed to expose the secondary grade. Any wet or unstable materials below the secondary grade shall be corrected, as directed by the engineer, by scarifying, adding lime, and compacting until it is of uniform stability. The excavated material shall then be spread to the desired cross section.

If the Contractor elects to use a cutting and pulverizing machine that will remove the subgrade material accurately to the secondary grade and pulverize the material at the same time, he will not be required to expose the secondary grade nor windrow the material. However, the contractor shall be required to roll the subgrade, as directed by the engineer, and correct any soft areas that this rolling may reveal before using the pulverizing machine. This method will be permitted only where a machine is provided which will insure that the material is cut uniformly to the proper depth and which has cutters that will plane the secondary grade to a smooth surface over the entire width of the cut. The machine must give visible indication at all times that it is cutting to the proper depth.

6.2 Application. Lime shall be spread only on that area where the first mixing operations can be completed during the same working day. The application and mixing of lime with the soil shall be accomplished by the methods hereinafter described as "Dry Placing" or "Slurry Placing." When hydrated lime is specified, the contractor may use either method.

(a) Dry placing. The lime shall be spread uniformly over the top of the subgrade by an approved screw-type spreader box or other approved spreading equipment. The amount of lime spread shall be the amount required for mixing to the specified depth which will result in the percentage determined in the job mix formula.

The lime shall be distributed in such manner that scattering by wind will be minimal. Lime shall not be applied when wind conditions, in the opinion of the engineer, are detrimental to a proper application. A motor grader shall not be used to spread the lime. The material shall be sprinkled, as directed by the engineer, until the proper moisture content has been reached.

(b) Slurry placing. The lime shall be mixed with water in trucks with approved

distributors and applied as a thin water suspension or slurry. Commercial lime slurry shall be applied with a lime percentage not less than that applicable for the grade used. The distribution of lime shall be attained by successive passes over a measured section of subgrade until the proper amount of lime has been spread. The amount of lime spread shall be the amount required for mixing to the specified depth which will result in the percentage determined in the job mix formula. The distributor truck shall continually agitate the slurry to keep the mixture uniform.

6.3 Mixing. The mixing procedure shall be the same for "Dry Placing" or "Slurry Placing" as hereinafter described:

(a) First Mixing. The full depth of the treated subgrade shall be mixed with an approved mixing machine. Lime shall not be left exposed for more than six hours. The mixing machine shall make two coverages. Water shall be added to the subgrade during mixing to provide a moisture content above the optimum moisture content of the material and to insure chemical action of the lime and subgrade. After mixing, the subgrade shall be lightly rolled to seal the surface and help prevent evaporation of moisture. The water content of the subgrade mixture shall be maintained at a moisture content above the optimum moisture content for a minimum of 48 hours or until the material becomes friable. During the curing period, the material shall be sprinkled as directed. During the interval of time between application and mixing, lime that has been exposed to the open air for 6 hours or more, or to excessive loss due to washing or blowing will not be accepted for payment.

(b) Final mixing. After the required curing time, the material shall be uniformly mixed by approved methods. If the mixture contains clods, they shall be reduced in size by blading, discing, harrowing, scarifying, or the use of other approved pulverization methods so that the remainder of the clods shall meet the following requirements when tested dry by laboratory sieves:

	Percent
Minimum of clods passing 1½ inch sieve	100
Minimum of clods passing No. 4 sieve	60

6.4 Compaction. Compaction of the mixture shall begin immediately after final mixing. The material shall be aerated or sprinkled as necessary to provide optimum moisture. Compaction should begin at the bottom and shall continue until the entire depth of mixture is uniformly compacted. The entire thickness of the treated subgrade shall be compacted to a density of at least 93% of maximum density at optimum moisture, as determined by the compaction control tests in Item T-611.

The material shall be sprinkled and rolled as directed by the engineer. All irregularities, depressions, or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding or removing material as required, and reshaping and recompacting by sprinkling and rolling. The surface of the course shall be maintained in a smooth condition, free from undulations and ruts, until other work is placed thereon or the work is accepted.

In addition to the requirements specified for density, the full depth of the material shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, tests will be made by the engineer. if the material fails to meet the density requirements, it shall be reworked to meet these requirements. Throughout this entire operation, the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and shall conform with the typical section shown on the plans and to the established lines and grades. Should the material, due to any reason or cause, lose the required stability, density, and finish before the next course is placed or the work is accepted, it shall be recompacted and refinished at the sole expense of the contractor.

6.5 Finishing and Curing. After the final layer or course of lime-treated subgrade has

been compacted, it shall be brought to the required lines and grades in accordance with the typical sections. The completed section shall then be finished by rolling, as directed, with a pneumatic or other suitable roller sufficiently light to prevent hair cracking. The finished surface shall not vary more than 3/8 inch when tested with a 16-foot straightedge applied parallel with and at right angles to the pavement centerline. Any variations in excess of this tolerance shall be corrected by the contractor, at his own expense, in a manner satisfactory to the engineer.

The completed section shall be moist-cured for a minimum of 7 days before further courses are added or any traffic is permitted, unless otherwise directed by the engineer. Subsequent courses shall be applied within 14 days after the lime-treated subgrade is cured.

6.6 Thickness. The thickness of the lime-treated subgrade shall be determined by depth tests or cores taken at intervals so that each test shall represent no more than 300 square yards. When the base deficiency is more than ½ inch, the contractor shall correct such areas in a manner satisfactory to the engineer. The contractor shall replace, at his expense, the base material where borings are taken for test purposes.

6.7 Maintenance. The contractor shall maintain, at his own expense, the entire lime-treated subgrade in good condition from the start of work until all the work has been completed, cured, and accepted by the engineer.

METHOD OF MEASUREMENT

7.1 The yardage of lime-treated subgrade to be paid for shall be the number of square yards0 completed and accepted.

7.2 The amount of lime to be paid for shall be the number of pounds of hydrated lime (or the calculated dry-lime content of the lime slurry) used as authorized.

BASIS OF PAYMENT

8.1 Payment shall be made at the contract unit price per square yard for the lime-treated subgrade of the thickness specified. The price shall be full compensation for furnishing all material, except the lime, and for all preparation, delivering, placing and mixing these materials, and all labor, equipment, tools and incidentals necessary to complete this item.

8.2 Payment shall be made at the contract unit price per pound of lime. This price shall be full compensation for furnishing this material; for all delivery, placing and incorporation of this material; and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item P-155-8.1 Lime-treated subgrade-per square yard.

Item P-155-8.2 Lime-per ton.

TESTING AND MATERIAL REQUIREMENTS

Test and Short Title

AASHO T 26 - Water
FAA T-611 - Density

Material and Short Title

ASTM C 207 - Lime