



TECH NOTE NO: 13
TITLE: Moisture Limitations for Lime Stabilization
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The attached pages were prepared in response to a request by Joe Depa to provide advice about development of a specification for lime stabilization.

ITEM P-152

MOISTURE LIMITATIONS

In-situ soil moisture content significantly influences earthwork production. Wet soils are a challenge!!! Some typical moisture content spec clauses (prior to compaction) are:

FAA Embankment – Item 152-2.6: +/- 2% OMC

FAA AC 150/5320-6D: Subgrade compaction:

+ For cuts & fills with cohesive soils (PI > 6): - Top 6 inches >90% ASTM 1557. No moisture requirement.

IDOT Embankment – Article 205.05 (2002 Spec Book)

+ Top 24 inches of all embankments shall not contain more than 120% of OMC determined according to AASHTO T 99. The contractor may be permitted the use of an approved additive to effect a quicker drying time.

NOTE: The 120% approach does not provide “stable grades” for all soils. See IDOT Subgrade Stability Manual.

IDOT Subgrade Preparation (Section-301 – 2002 Spec Book):

+ No moisture control; only a compaction requirement (> 95% T-99 [ASTM D-698])

OMP should provide guidance as to when lime modification will be/may be authorized to address “wet soil conditions.”

The following is patterned after IDOT Spec 301.04 (2002 Spec Book):

If wet soils are encountered during embankment construction or subgrade preparation, the Contractor shall take the following steps in an effort to obtain the required moisture content prior to compaction and facilitate achieving the desired level of compaction:

1) Air dry the top (8, ???) inches of the grade. This procedure shall include at least two/?? (8,?? inch) depth processings utilizing discs or tillers each day for (three/???) consecutive good drying days.

An important factor to consider is “**what is is a good drying day**”??

+ Temperature is a very important factor. Temperature >> ?? °F

+ Evapotranspiration (ET) potential can be estimated for a given day. ET > ?? inches/day. Historical data are available for Chicago Land!!!

- 2) Periodically check the moisture contents during processing.
- 3) If acceptable moisture contents are achieved, recompact the layer to achieve the desired level of compaction.
- 4) If the desired level of compaction can not be obtained and/or acceptable moisture contents are not achieved, lime modification (per Specification xxx) **will be/may be** authorized by the Engineer.

This is a very important item!!! St. Louis – Lambert encountered some considerable difficulty concerning this issue!!

A “PAY Item” for lime modification would be needed.
(lime + mixing/manipulation, + ????)

This type of “wording” can be inserted in the FAA Item P-152 specification.
See Section 152-2.6.

LIME-MODIFIED SOIL SPECIFICATION

Suggest using the IDOT Section 302 Spec. (2002 Spec Book) as a pattern.

+ Consider adding “quicklime fines” to accepted lime products (as included in IDOT Section 1012 – 2002 Spec Book.). What is the availability of “quicklime fines” for the project?? Current IDOT specs do not cover “quicklime fines.” A clip from AASHTO M 216-04 is attached.
Also see Section 5 of M 216 for some “wording” on quicklime field application.

+ In 302.05: Remove the part of the sentence relating to “using samples of the project soil etc.”

+ Section 302.07: Include a pulverization requirement: “> 75% less than 1 – inch.”

FAA ITEM SECTION P-155

* Modify the P-155 spec. for OMP use.

* Section 155-2.1: Add Lime Kiln Dust (LKD) to the list of acceptable lime products. Should “quick lime fines” be included??

* 155-2.4: Soil should also be “lime reactive” as defined by IDOT Spec Section 310-02 (2002 Spec book).

* Section 155-3.2” Is +/- 0.5% tolerance for lime realistic for “mix-in-place” construction? Probably too restrictive!! IDOT specs do not address this issue in a “quantitative way.”

* Should clarify the weather limitations are applicable for “fall” but not for spring.

* Section 155-6.3:

+ In the mixing process, should allow for first and final mixing to be conducted sequentially (no lag time) if the pulverization requirements are met.

+Change the minimum clods requirement to **100% passing the 1-inch sieve.**

* Section 155-6.5:

+ A bituminous seal is frequently used for curing. Should be provided as an alternative to “moist-curing.” See IDOT Spec. 310.11 (2002 Spec. Book).

+ Consider the implications of the “subsequent courses constructed within 14 days” clause. Probably would be a “constraining” factor.

QUICKLIME FINES SPECIFICATION INPUTS

* QUICKLIME FINES are quicklime particles from the kiln that are considered "too fine" for subsequent hydration at the lime plant. Not sure what the typical "top size" is. Need to check this out with Chicago area producers and modify the following spec accordingly.

* The attached is a "paste-up" of ARSHTO M 216-04.

3. CHEMICAL COMPOSITION

3.1. Unless otherwise specified, for definitions of terms used in this specification, refer to Definitions of Terms, ASTM C 51.

3.2. Quicklime ~~and hydrated lime~~ for soil stabilization shall conform to the following chemical composition:

| | |
|--|------|
| Calcium and magnesium oxides (on an LOI-free basis, minimum percent) | 90.0 |
| Carbon dioxide (taken at point of manufacture, maximum percent) | 5.0 |
| Free moisture (maximum percent) | 2.0 |

4. PHYSICAL PROPERTIES

4.2. *Quicklime:*

4.2.1. *Fineness of Quicklime*—Quicklime shall all pass a 25.0-mm (1.0-in.) sieve.]??

4.2.2. *Slaking Rate of Quicklime*—Quicklime for soil stabilization shall have a temperature rise of a minimum of 30°C in 20 min as measured by ASTM C 110.

4.2.3. *Residue of Quicklime*—Quicklime for soil stabilization shall have not more than 10 percent residue measured by ASTM C 110.

5. FIELD APPLICATIONS

5.1. When quicklimes are used, ensure that thorough mixing of the lime and soil is accomplished and all lime pebbles have been hydrated with additional water and distributed uniformly throughout the soil. There shall be no lime pebbles present before the compaction operation starts. Check by turning soil with a spade at representative intervals and inspect for visible lime pebbles. Care should be exercised on initial dry applications to minimize environmental dusting.

6. TEST METHOD

6.1. The chemical analysis of quicklime and hydrated lime shall be determined in accordance with ASTM C 25. ~~_____~~