Designation: D6276 – 19

Standard Test Method for Using pH to Estimate the Soil-Lime Proportion Requirement for Soil Stabilization[1]

This standard is issued under the fixed designation D6276; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This test method provides a means for estimating the soil-lime proportion requirement for stabilization of a soil. This test method is performed on soil passing the 425µm (No. 40) sieve. The optimum soil-lime proportion for soil stabilization is determined by tests of specific characteristics of stabilized soil such as unconfined compressive strength or plasticity index.

1.2 Some highly alkaline by-products (lime kiln dust, cement kiln dust, carbide lime, and so forth) have been successfully used to stabilize soil. This test method is not intended for these materials and any such product would need to be tested for specific characteristics as indicated in 1.1.

1.3 This test method is used to determine the percentage of lime that results in a soil-lime pH of approximately 12.4.

NOTE 1—Under ideal laboratory conditions of 25°C and sea level elevation, the pH of the lime-soil-water solution should be 12.4.

1.4 Lime is not an effective stabilizing agent for all soils. Some soil components such as sulfates, phosphates, organics, and iron can adversely affect soil-lime reactions and may produce erroneous results using this test method.

1.5 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026.

1.6.1 The procedures used to specify how data are collected/recorded and calculated in the standard are regarded as the industry standard. In addition, they are representative of the significant digits that generally should be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user's objectives; and it is common practice to increase or reduce significant digits of reported data to be commensurate with these considerations. It is beyond the scope of these test methods to consider significant digits used in analysis for engineering data.

1.7 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C977 Specification for Quicklime and Hydrated Lime for Soil Stabilization

D421 Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants (Withdrawn 2016)[3]

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D1193 Specification for Reagent Water

D1293 Test Methods for pH of Water

D2216 Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

D4753 Guide for Evaluating, Selecting, and Specifying Balances and Standard Masses for Use in Soil, Rock, and Construction Materials Testing

[1] This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.15 on Stabilization With Admixtures.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

*A Summary of Changes section appears at the end of this standard

D6026 Practice for Using Significant Digits in Geotechnical Data
E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

3. Terminology

3.1 *Definitions:*

3.2 For definitions of common technical terms used in this standard, refer to Terminology D653.

3.3 *Definitions of Terms Specific to This Standard:*

3.3.1 *buffer solution, n*—a solution of specific pH value used to calibrate the pH meter.

3.3.2 *free lime, n*—lime in a soil-lime mixture that has not dissociated into calcium and hydroxyl ions.

3.3.3 *hydrated lime, n*—lime that is predominately calcium hydroxide ($Ca(OH)_2$) or a mixture of calcium hydroxide and magnesium oxide (MgO) or magnesium hydroxide ($Mg(OH)_2$).

3.3.4 *lime content, n*—the ratio expressed as a percentage of the mass of lime to the dry mass of soil.

3.3.5 *lime stabilization, n*—addition of lime to a soil in sufficient quantities to promote long-term pozzolanic reactions that result in strength gain and permanent improvement in stability.

3.3.5.1 *Discussion*—Textural improvement alone, such as reduced plasticity, is often referred to as "modification." Modification can be effected by lime addition rates less than those required for stabilization and may not be permanent.

3.3.6 *quicklime, n*—lime that is predominately calcium oxide (CaO) or calcium oxide in association with magnesium oxide (MgO).

3.3.7 *stabilization, n*—a process to improve the engineering properties of soils at a site or in the laboratory.

4. Summary of Test Method

4.1 A series of specimens is prepared containing a range of percentages of lime content in soil. Measurements of pH are made on slurries of the specimens to determine the lime content of the soil-lime mixture to obtain a pH of at least 12.4.

4.2 The pH of at least 12.4 achieved in this test method results from free lime remaining in the soil-lime mixture. Normally, the pH of the specific lime being used for soil stabilization should be determined and used as the indicator pH.

5. Significance and Use

5.1 The soil-lime pH test is performed as a test to indicate the soil-lime proportion needed to maintain the elevated pH necessary for sustaining the reactions required to stabilize a soil. The test derives from Eades and Grim.[4]

5.2 Performance tests are normally conducted in a laboratory to verify the results of this test method.

5.3 This test method will not provide reliable information relative to the potential reactivity of a particular soil, nor will it provide information on the magnitude of increased strength to be realized upon treatment of this soil with the indicated percentage of lime.

5.4 This test method can be used to estimate the percentage of lime as hydrated lime or quicklime needed to produce a lime stabilized soil. Common candidate soils contain clay minerals and have a Plasticity Index ≥10.

5.5 Agricultural lime (crushed limestone) will not stabilize soil.

NOTE 2—The quality of the result produced by this standard is dependent on the competence of the personnel performing it and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D3740 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with Practice D3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D3740 provides a means of evaluating some of those factors.

6. Apparatus

6.1 *Balance or Scale*—A balance or scale for determining the mass of soil and lime having a minimum capacity of 600 g and meeting the requirements of Specification D4753 for a balance or scale of 0.01 g readability.

6.2 *Sieve*—A 425µm (No. 40) sieve, conforming to the requirements of Specification E11.

6.3 *Glass or Plastic Bottles*—Six 150-mL (or larger) bottles with tight-fitting screw caps.

6.4 *pH Meter*—A pH meter equipped with reference electrode and low-sodium error glass pH-sensitive electrodes (or combination electrode) and a meter capable of displaying 0.01 units pH at 0.02 pH accuracy over a range from 0 to 14. The meter must have a pH set-point of 12 or allow for "user selectable" calibration.

NOTE 3—The electrode used with the pH meter should incorporate a clog resistant junction designed for "dirty" suspended solids solutions to prevent clogging.

6.5 *Drying Oven*—Oven conforming to requirements of Specification D2216.

6.6 *Miscellaneous Equipment*—An airtight, moisture-proof container for preserving the moisture content of the soil; mixing tools and scoops for use in preparing test specimens.

7. Reagents and Materials

7.1 *Water*—Reference to water shall be understood to mean Type II reagent water conforming to Specification D1193. Store the water in a tightly capped container; boil and cool the water immediately before use.

NOTE 4—If the pH of the site water to be used is highly acidic (<6) or highly basic (>9) test results should be checked against a specimen made with the site water rather than Type II water.

7.2 *Buffer Solution*—Use a buffer solution having a pH of 12, either commercially available or prepared in accordance

[4] Eades, J.L., and Grim, R.E., A Quick Test to Determine Lime Requirements for Lime Stabilization, *Highway Research Record No. 139*, 1966, National Academy of Sciences, National Research Council, Highway Research Board, Washington, DC, (pp. 61–72).