



# Standard Guide for Commercial Use of Lime Kiln Dusts and Portland Cement Kiln Dusts<sup>1</sup>

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## 1. Scope

1.1 This guide is intended to evaluate and describe lime kiln dusts and Portland cement kiln dusts for uses in commercial applications. This guide is not intended to cover uses for lime or Portland cement.

1.2 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

- C25 Test Methods for Chemical Analysis of Limestone, Quicklime, and Hydrated Lime
- C109/C109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
- C110 Test Methods for Physical Testing of Quicklime, Hydrated Lime, and Limestone
- C151 Test Method for Autoclave Expansion of Hydraulic Cement
- C184 Test Method for Fineness of Hydraulic Cement by the 150- $\mu\text{m}$  (No. 100) and 75- $\mu\text{m}$  (No. 200) Sieves (Withdrawn 2002)<sup>3</sup>
- C187 Test Method for Amount of Water Required for Normal Consistency of Hydraulic Cement Paste
- C266 Test Method for Time of Setting of Hydraulic-Cement Paste by Gillmore Needles
- C305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency

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

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

- C400 Test Methods for Quicklime and Hydrated Lime for Neutralization of Waste Acid
  - C593 Specification for Fly Ash and Other Pozzolans for Use With Lime for Soil Stabilization
  - C602 Specification for Agricultural Liming Materials
  - C911 Specification for Quicklime, Hydrated Lime, and Limestone for Selected Chemical and Industrial Uses
  - C1529 Specification for Quicklime, Hydrated Lime, and Limestone for Environmental Uses
  - D558 Test Methods for Moisture-Density (Unit Weight) Relations of Soil-Cement Mixtures
  - D1632 Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory
  - D1633 Test Methods for Compressive Strength of Molded Soil-Cement Cylinders
  - D3155 Test Method for Lime Content of Uncured Soil-Lime Mixtures
  - D3551 Practice for Laboratory Preparation of Soil-Lime Mixtures Using Mechanical Mixer
  - D6249 Guide for Alkaline Stabilization of Wastewater Treatment Plant Residuals
  - D3668 Test Method for Bearing Ratio for Laboratory Compacted Soil-Lime Mixtures (Withdrawn 1997)<sup>3</sup>
  - D4318 Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- 2.2 *Code of Federal Regulations*
- 40 CFR Part 268 Appendix 1 Toxicity Characteristics Leaching Procedure<sup>4</sup>
  - 40 CFR Part 268.43(a) Treatment Standards Expressed as Waste Concentrations (reserved)<sup>4</sup>

## 3. Terminology

### 3.1 Definitions of Terms Specific to This Standard:

#### 3.1.1 lime kiln dust:

3.1.1.1 Lime kiln dust is the finely-divided particulate matter carried from a lime kiln by the exhaust gases.

3.1.1.2 The composition of the dust is dependent upon the stone being processed, the processing equipment in use, and the fuel being used. Concentrations of combustion by-products,

<sup>4</sup> Code of Federal Regulations available from the Superintendent of Documents, United States Government Printing Office, Washington, DC 20402.

including sulfur compounds usually exceed that of the primary quicklime product. Chemical and physical properties are also dependent upon these same factors and should be evaluated for the use intended.

#### 3.1.2 *portland cement kiln dust:*

3.1.2.1 Cement kiln dust is the finely-divided particulate matter carried from a cement kiln by the exhaust gases.

3.1.2.2 The dust is composed of variable mixtures of calcined and uncalcined feed materials, fine cement-clinker formed during the high temperature processing, fuel combustion by-products, and condensed alkali compounds. Alkalis may be concentrated in the dust through volatilization in the high temperature zones within the kiln then condensed in the exhaust gases as they pass through the dust collection system. The relative quantity of the aforementioned components of Portland cement kiln dust may change from one source to another because of raw material, fuel, and process variations. Some cement kiln dusts may contain large quantities of calcined feed materials, alkalis and sulfur compounds, or both, while others may be primarily composed of uncalcined raw feed. Many Portland cement kiln dusts are easily compacted and reactive with small quantities of water to form a low strength cementitious mass; some may show only mild reactivity and be non-consolidating.

## 4. Significance and Use

4.1 This guide provides a list of applications and appropriate test procedures to establish selected uses for the lime kiln dusts and Portland cement kiln dusts.

4.2 The lime kiln dusts and Portland cement kiln dusts covered by this guide may vary in composition from one source to another. It is therefore advised that the use of such products be undertaken only after their specific compositions, physical properties, performance characteristics, and the anticipated variabilities have been evaluated for the service intended. Until the degree of variability in the dust source or sources has been established, frequent performance testing is recommended.

4.3 Specifications should be prepared to facilitate uses, environmental protection, and engineering designs by the responsible persons.

## 5. Categories for Kiln Dust Uses

5.1 The following applications present a sampling of applications to be considered. Other uses may be considered where similar chemical or physical properties are required.

5.1.1 *Structural Purposes*—Such as additions in the manufacture of glass, brick, block, and other building materials.

5.1.2 *Stabilization Purposes*—With soils to modify the plastic limit or moisture content and in conjunction with or without fly ash (see Specification [C593](#)) to provide stabilized properties to solid and other waste construction products.

5.1.3 *Fixation Purposes*—For neutralization and fixation alone and in conjunction with other materials, both hazardous and nonhazardous.

5.1.4 *Solidification Purposes*—For dewatering waste materials to provide structural and handling properties, for economic and environmental use, and disposal.

5.1.5 *pH Control Purposes*—For use with domestic wastewater sludges to significantly reduce pathogens and to enable domestic wastewater sludges to be safely and economically applied to the land (see Specification [C1529](#) and Guide [D6249](#)).

5.1.6 *Flocculation Purposes*—For use to separate solids from liquids and in multi-purpose processes to treat, dispose, and utilize industrial, municipal, and utility wastes.

5.1.7 *Agricultural Purposes*—A soil conditioner and nutrient source to meet the needs of the agricultural industry (see Specification [C602](#)).

## 6. Determination of Materials Characteristics

6.1 Lime kiln dusts or Portland cement kiln dusts may or may not require slaking for effective use depending on the end use.

6.2 Comparative testing with applications in use or products should be undertaken before applying the dust to specific applications. Lime kiln dusts and Portland cement kiln dusts are variable and may contain inert materials. The degree of variability and the inclusion of materials detrimental to the intended use should be evaluated.

6.3 Testing lime kiln dusts or Portland cement kiln dusts that have been used as a cementitious binder alone or in conjunction with fly ash should be performed on specimens that have been cured and aged to duplicate field conditions or by appropriate specification methods.

6.4 It should be noted that some lime kiln dusts and Portland cement kiln dusts react more quickly than others depending upon the amount of calcined calcium oxide or calcined magnesium oxide clinker, or other cementitious materials and particle fineness. In addition, potassium and sodium compounds may contribute to the reactivity of cement kiln dusts.

6.5 The selection of laboratory tests to evaluate the suitability of materials for a specific application will depend upon the performance requirements of the job and the materials available. A list of test methods and material specifications is given in [Table X1.1](#) of [Appendix X1](#) and may be used in selecting those procedures and requirements pertinent to the application in question.

## 7. Keywords

7.1 construction application; lime kiln dust; Portland cement kiln dust; waste disposal

**APPENDIX**
**(Nonmandatory Information)**
**X1. REPRESENTATIVE RECOMMENDED METHODS**
**TABLE X1.1 Representative Recommended Methods for Determining and Evaluating Characteristics of Lime Kiln Dust and Cement Kiln Dust Suitable for the Intended Purpose**

Characteristics	Test Method
General Laboratory Procedures:	
Chemical Analysis of Limestone Quicklime and Hydrated Lime	C25
Test for Compressive Strength of Hydraulic Cement Mortars	C109/C109M
Physical Testing of Quicklime Hydrated Lime, and Limestone	C110
Test for Autoclave Expansion of Portland Cement	C151
Tests for Fineness of Cement	C184
Test for Normal Consistency of Cement	C187
Test for Setting of Hydraulic Cement by Gillmore Needle	C266
Mechanical Mixing of Hydraulic Pastes and Mortars of Plastic Consistency	C305
Neutralization of Acid Waste	C400
Fly Ash and Other Pozzolans for Use with Lime	C593
Agricultural Liming Materials	C602
Quicklime, Hydrated Lime and Limestone for Chemical Use	C911 <sup>A</sup>
Moisture-Density Relations of Soil-Cement Mixtures	D558
Soil-Cement Compression and Flexure Test Specimens, Making and Curing in the Laboratory	D1632
Compressive Strength of Molded Soil-Cement Cylinders	D1633
Lime Content of Uncured Soil-Lime Mixtures	D3155
Laboratory Preparation of Soil-Lime Mixtures Using a Mechanical Mixer	D3551
Bearing Ratio of Laboratory-Compacted Soil-Lime Mixtures	D3668
Liquid Limit, Plastic Limit, and Plasticity Index of Soils	D4318
Toxicity Characteristic Leaching Procedure	40 CFR Part 268 Appendix 1
Treatment Standards Expressed as Waste Concentrations (reserved)	40 CFR Part 268.43

<sup>A</sup> Suggest an alternative test procedure to determine basicity factor(s) when used in dry application as in Test Methods C400.

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