Designation: D 5050 – 96

Standard Guide for Commercial Use of Lime Kiln Dusts and Portland Cement Kiln Dusts[1]

This standard is issued under the fixed designation D 5050; 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 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:*

C 25 Test Methods for Chemical Analysis of Limestone, Quicklime, and Hydrated Lime[2]

C 109 Test Method for Comprehensive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)[2]

C 110 Test Methods for Physical Testing of Quicklime, Hydrated Lime, and Limestone[2]

C 151 Test Method for Autoclave Expansion of Portland Cement[2]

C 184 Test Method for Fineness of Hydraulic Cement by the 150-µm (No. 100) and 75-µm (No. 200) Sieves[2]

C 187 Test Method for Normal Consistency of Hydraulic Cement[2]

C 266 Test Method for Time of Setting of Hydraulic Cement Paste by Gillmore Needles[2]

C 305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency[2]

C 400 Test Methods for Testing Quicklime and Hydrated Lime for Neutralization of Waste Acid[2]

C 593 Specification for Fly Ash and Other Pozzolans for Use With Lime[2]

C 602 Specification for Agricultural Liming Materials[2]

C 911 Specification for Quicklime, Hydrated Lime, and Limestone for Chemical Uses[2]

D 558 Test Method for Moisture-Density Relations of Soil-Content Mixtures[3]

D 1632 Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory[3]

D 1633 Test Method for Compressive Strength of Molded Soil-Cement Cylinders[3]

D 3155 Test Method for Lime Content of Uncured Soil-Lime Mixtures[3]

D 3551 Practice for Laboratory Preparation of Soil-Lime Mixtures Using a Mechanical Mixer[3]

D 3668 Test Method for Bearing Ratio for Laboratory Compacted Soil-Lime Mixtures[3]

D 4318 Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils[3]

2.2 *Code of Federal Regulations*

40 CFR Part 268 Appendix 1 Toxicity Characteristics Leaching Procedure[4]

40 CFR Part 268.43(a) Treatment Standards Expressed as Waste Concentrations (reserved)[4]

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, 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

[1] This guide is under the jurisdiction of ASTM Committee D-34 on Waste Management and is the direct responsibility of Subcommittee D34.06 on Recovery and Reuse.

Current edition approved Oct. 10, 1996. Published December 1996. Originally published as D 5050 – 90. Last previous edition D 5050 – 90.

[2] *Annual Book of ASTM Standards*, Vol 04.01.

[3] *Annual Book of ASTM Standards*, Vol 04.08.

[4] Code of Federal Regulations available from the Superintendent of Documents, United States Government Printing Office, Washington, DC 20402.

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 food materials, alkalies and sulfur compounds, or both, while others may be primarily composed of uncalcined raw food. 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 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.

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.

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	C 25
Test for Compressive Strength of Hydraulic Cement Mortars	C 109
Physical Testing of Quicklime Hydrated Lime, and Limestone	C 110
Test for Autoclave Expansion of Portland Cement	C 151
Tests for Fineness of Cement	C 184
Test for Normal Consistency of Cement	C 187
Test for Setting of Hydraulic Cement by Gillmore Needle	C 266
Mechanical Mixing of Hydraulic Pastes and Mortars of Plastic Consistency	C 305
Neutralization of Acid Waste	C 400
Fly Ash and Other Pozzolans for Use with Lime	C 593
Agricultural Liming Materials	C 602
Quicklime, Hydrated Lime and Limestone for Chemical Use	C 911[A]
Moisture-Density Relations of Soil-Cement Mixtures	D 558
Soil-Cement Compression and Flexure Test Specimens, Making and Curing in the Laboratory	D 1632
Compressive Strength of Molded Soil-Cement Cylinders	D 1633
Lime Content of Uncured Soil-Lime Mixtures	D 3155
Laboratory Preparation of Soil-Lime Mixtures Using a Mechanical Mixer	D 3551
Bearing Ratio of Laboratory-Compacted Soil-Lime Mixtures	D 3668
Liquid Limit, Plastic Limit, and Plasticity Index of Soils	D 4318
Toxicity Characteristic Leaching Procedure	40 CFR Part 268 Appendix 1
Treatment Standards Expressed as Waste Concentrations (reserved)	40 CFR Part 268.43

[A] Suggest an alternative test procedure to determine basicity factor(s) when used in dry application as in Test Methods C 400.