Designation: C 911 – 99

Standard Specification for Quicklime, Hydrated Lime, and Limestone for Chemical Uses[1]

This standard is issued under the fixed designation C 911; 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 specification covers lime and limestone products suitable for chemical uses as shown in Table 1. The type designations signify the following:

Limestone, high-calcium—CL
Limestone, dolomitic—DL
Limestone, magnesian—ML
Quicklime, high-calcium—CQ
Quicklime, dolomitic—DQ
Quicklime, magnesian—MQ
Hydrated lime, high-calcium—CH
Hydrated lime, dolomitic—DH
Hydrated lime, magnesian—MH
Hydrated lime, by-product—BH

NOTE 1—Lime is used in environmental systems when the control of factors influencing the environment such as gases, liquids and solids is required.

1.2 The buyer shall designate the use, as listed in Table 1, and may specify one or more of the type designations in 1.1.

2. Referenced Documents

2.1 *ASTM Standards:*
C 25 Test Methods for Chemical Analysis of Limestone, Quicklime, and Hydrated Lime[2]
C 50 Methods of Sampling, Inspection, Packing, and Marking of Lime and Limestone Products[2]
C 51 Terminology Relating to Lime and Limestone (as Used by the Industry)[2]
C 110 Test Methods for Physical Testing of Quicklime, Hydrated Lime, and Limestone[2]
C 400 Test Method for Quicklime and Hydrated Lime for Neutralization of Waste Acid[2]

3. Chemical Composition and Physical Properties

3.1 The requirements for quicklime, hydrated lime, and limestone for the designated end uses are as shown in Table 1, and are on the basis of the weight of sample taken at the place of manufacture, except as noted in footnote *B* after the requirement. In this case, the requirement is on a moisture and carbon dioxide-free basis.

4. General Requirements

4.1 Quicklime shall be reasonably free of unslakable residues and shall be capable of disintegrating in water to form a suspension of finely divided material. Rapidity of slaking is generally a desirable quality.

4.2 The amount of residue shall not exceed that stated in the physical requirements of Table 1 or as agreed upon between the manufacturer and the purchaser (the residue is the amount of material retained on the screen).

5. Sampling and Inspection

5.1 Conduct the sampling, inspection, rejection, retesting, packing, and marking in accordance with Methods C 50.

NOTE 2—Rags are cooked for the manufacture of paper in a digester under steam pressure with lime or with lime and soda ash. They are then washed to eliminate as much of the noncellulose material as possible. A standard composition without rejection limits is specified for the reason that lime of either higher or lower total oxides, available lime, calcium oxide, or calcium hydroxide than the standard, may safely be used under suitable conditions for the purpose herein specified, depending primarily upon economic considerations. In the present state of the art, it is believed that the more serviceable type of specification for the product herein specified is that which defines a reasonable standard rather than one that fixes actual rejection limits. It is generally recognized that, other things being equal, lime meeting this standard is preferable to lime that does not, and lime surpassing the standard should be considered of premium quality.

NOTE 3—Lime is used in the "milk of lime" or "tank" system of sulfite pulp manufacture for making the cooking liquor. The milk of lime is held in solution or suspension in a series of tanks equipped with suitable agitators. The sulfur dioxide (SO_2) is forced or drawn through these tanks successively. In some cases, the tanks are built on top of each other in the form of a tower. The contents of the first tank are drawn off when the liquor has reached a certain strength (3.5 to 6 % total SO_2) and the contents of the second and third tanks progress to the first and second tanks respectively. The third tank is again charged with fresh milk of lime. There are other systems of absorption that provide for continuous instead of intermittent operation. The function of the lime is to furnish the base for the formation of the bisulfites of calcium and magnesium.

NOTE 4—In the manufacture of silica brick, silica in the form of massive quartzite or quartz conglomerate is ground until the particles are less than ¼ in. (6 mm) in size. Lime in the form of either slaked or hydrated lime is then added in quantities varying from 1.5 to 3.0 % calcium oxide (CaO), with sufficient water to produce about 5 to 7 % moisture content, and the shapes are molded and dried. They are then burned in downdraft or tunnel kilns until most of the quartzite has been converted into tridymite or cristobalite.

NOTE 5—In the softening of water for municipal and industrial supplies, lime is used alone or with coagulant aids to produce a precipitate

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that assists in the clarification of water, removal of bacteria, and removal of hardness. Lime and soda ash may be used together for softening water. The lime serves as a chemical reagent in water softening. The only useful constituent of the lime is the calcium oxide content of the quicklime or hydrated lime capable of reacting with the other chemicals in the water or added to it. Inert material, besides reducing the value in proportion to its amount, also makes more sludge to be disposed of for a given amount of chemical action and thus reduces the capacity of the equipment in which it is used.

NOTE 6—In addition to water softening, lime is also used for silica removal from boiler feed-water, and for color removal and clarification of water for municipal and industrial supplies, for most such applications, high-calcium lime is preferred. However, for silica removal from boiler feedwater, dolomitic lime should be employed.

NOTE 7—In manufacture of calcium hypochlorite bleach, lime hydrate in water suspension is reacted with chlorine. Lime hydrate suitable for this application should be rapidly reactive, low in sludge-forming impurities, and particularly low in iron oxide, that may catalyze bleach decomposition.

NOTE 8—When determining the quantity of liming material for the neutralization of liquid acidic wastes, use is made of an acid value–basicity factor relationship. Acid value and basicity factor test methods are in the Appendix. Calculate the acid value–basicity factor relationship as follows:

$$\text{Acid Value} \times \frac{56.08}{98.08} \times \frac{1}{\text{Basicity Factor}} = \text{grams of lime} \qquad (1)$$

6. Test Methods

6.1 The chemical analyses shall be made in accordance with Test Methods C 25.

6.2 The physical tests shall be made in accordance with Test Methods C 110.

7. Keywords

7.1 calcium oxide; calcium silicate; chemical uses; dolomitic hydrated lime; dolomitic lime; dolomitic limestone; dolomitic quicklime; high calcium hydrated lime; high calcium limestone; high calcium quicklime; hydrated lime; hypochlorite bleach; industrial uses; industrial waste; lime; limestone; lime by-product; magnesian hydrated lime; magnesian limestone; magnesian quicklime; quicklime; silica brick; sulfite pulp

APPENDIXES

(Nonmandatory Information)

X1. TEST METHOD FOR FREE CALCIUM OXIDE IN HIGH-CALCIUM HYDRATED LIME

X1.1 Scope

X1.1.1 This test method covers the determination of the amount of free calcium oxide (CaO) in high-calcium hydrated lime capable of being hydrated by steam at atmospheric pressure.

X1.2 Summary of Test Method

X1.2.1 This test method is based on the principle of gain in weight of CaO when it is hydrated to form calcium hydroxide $(Ca(OH)_2)$.

X1.2.2 The sample is dried, subjected to steam at atmospheric pressure, again dried, and the gain in weight calculated to CaO.

X1.3 Apparatus

X1.3.1 *Drying Oven*, thermostatically controlled, CO_2-free atmosphere.

X1.3.2 *Analytical Balance*.

X1.3.3 *Steam Bath*, as shown in Fig. X1.1.

X1.4 Procedure

X1.4.1 Weigh a clean, dry, 10-mL Erlenmeyer flask on an analytical balance.

NOTE X1.1—Once started, complete the test without interruption.

X1.4.2 Add to the flask, by means of a widestem funnel, 3 to 5 g of the lime to be tested. Reweigh to get the exact sample weight.

NOTE X1.2—The flask should be kept stoppered at all times, except when weighing, drying, or steaming.

X1.4.3 Place the flask in the drying oven that has been previously heated to 120°C, and maintain at this temperature for 30 min. Remove, stopper, cool in a desiccator, and weigh.

NOTE X1.3—Oven atmosphere can be kept CO_2 free by placing therein a container of soda lime, quicklime, or other suitable CO_2-absorbing medium.

X1.4.4 Place the flask and the sample in a vigorously boiling steam bath and steam for 30 min. Protect the flask in the steam bath by a drip shield during the steaming period. Remove the flask to the oven, dry for 30 min at 120°C, stopper, cool in a desiccator, and weigh.

X1.4.5 Record all weighings to the fourth decimal place.

X1.5 Calculation

X1.5.1 Calculate the percentage of water and CaO as follows:

$$\text{Free water, \%} = [(W_1 - W_2)/S] \times 100 \qquad (X1.1)$$

$$\text{Free CaO, \%} = \frac{(W_3 - W_2) \times 3.114}{S} \times 100$$

where:
W_1 = weight of sample and flask before drying,
W_2 = weight of sample and flask after drying,
W_3 = weight of sample and flask after steaming and drying, and
S = weight of sample.