Designation: C874 – 11a

Standard Test Method for Rotary Slag Testing of Refractory Materials[1]

This standard is issued under the fixed designation C874; 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 describes a procedure for comparing the behavior of refractories to the action of molten slag in a rotating test furnace. A reference material should be included in each test and run for comparison. No numeric results are obtained from this test method. Numeric evaluation of test results is the responsibility of the test operator. The test and equipment are patterned after a method developed by Valley Dolomite Corporation[2].

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *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. Significance and Use

2.1 This test method outlines a procedure which, when appropriate evaluation methods are added, can be useful in the development of new products or in the selection of products to be used in contact with a particular slag composition.

2.2 A gradient exists through the test specimens that is controlled by the thermal conductivity of the specimens and backup material. The slag is constantly renewed so that a high rate of corrosion is maintained. The flow of the slag can cause mechanical erosion of materials. The tilt and rotational speed of the furnace will affect the amount of mechanical erosion.

2.3 Use caution in interpreting results when materials of vastly different types are included in a single run. Care must be taken to prevent oxidation of carbon-containing materials during heat up; failure to do so can result in highly erratic results. A reference refractory specimen, or specimens, should be used for comparison.

3. Apparatus

3.1 *Furnace,* consisting of a cylindrical shell, typically 18 in. (456 mm) long and with a 10 in. (254 mm) inside diameter, mounted on rollers and motor driven. Both the rotation and tilt of the furnace along its long axis should allow for adjustment.

3.2 *Burner*—A gas-oxygen torch capable of heating the furnace to 3200°F (1760°C). The burner should be equipped with flowmeters to monitor gas and oxygen flows.

3.3 *Optical Pyrometer.*

3.4 *Tools,* for (*1*) a means of feeding slag pellets into furnace, and (*2*) to assemble and dismantle the furnace.

3.5 *Gas Atmosphere Analyzer and Sampling Equipment.*

3.6 *Mold,* to form plastic, castable, and rammed samples.

3.7 *Molds,* to form slag pellets.

3.8 *Abrasive Saws,* to cut brick samples.

3.9 *Supply of Granular Refractory Backup Material.*

3.10 *Safety Equipment.*

4. Test Specimens

4.1 Test specimens should be 9 in. (228 mm) long and have a cross section as shown in Fig. 1. The 1.75 by 9 in. (44 by 228 mm) face should be an original surface.

4.2 One or more reference samples should be included in each test run.

5. Assembly

5.1 Six test specimens, as described in Section 4, shall constitute a test lining. This lining can be assembled around a hexagonal shaped mandrel with 1.75 in. (44 mm) faces and taped or steel-banded for subsequent handling. The lining should be positioned midway in the 18 in. (456 mm) length of the shell. Any suitable granular or refractory castable material may be installed behind the test lining.

5.2 It has been found convenient to use precast plugs to fill the two ends of the shell. These should be 4.5 in. (114 mm) thick by 10 in. (254 mm) in diameter to fit inside the shell. The hexagonal holes in the plug should match those of the test

[1] This test method is under the jurisdiction of ASTM Committee C08 on Refractories and is the direct responsibility of Subcommittee C08.04 on Chemical Behaviors.

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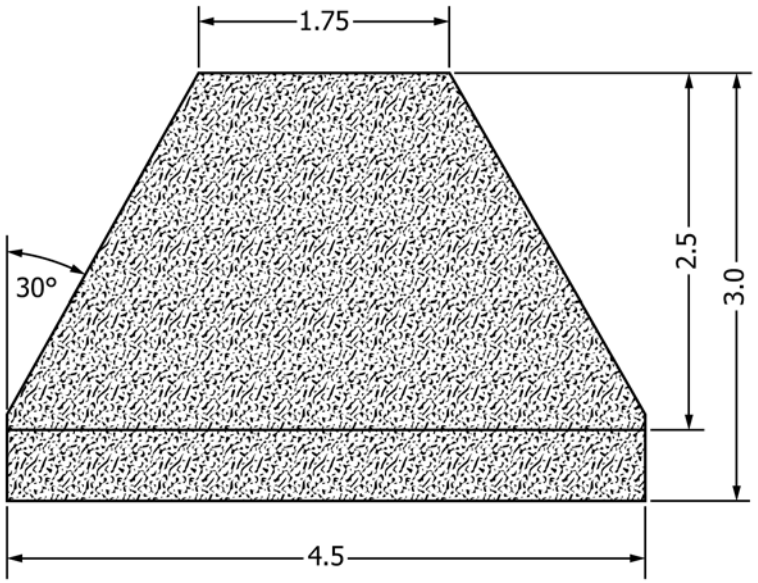
[2] Cash, P., "Measuring Refractory Resistance to Hot Slags," *Ceramic Age*, August 1966, pp. 20–29.



NOTE 1—Dimensions are in inches.
NOTE 2—Six cuts are needed for complete lining.

SI Equivalents	
in.	(mm)
1.75	(44)
2.5	(64)
3.0	(76)
4.5	(114)

FIG. 1 Cross Section of Cut Brick Samples for Lining the Rotary Slag-Test Furnace

lining. For basic slags, the plugs should be formed using a 98 % MgO ramming or casting mix; for acid slags, the plugs shall be formed using a +90 % Al_2O_3 ramming or casting mix. The whole assembly should be held in place by retaining rings bolted to each end of the shell.

5.3 The shell, with the test specimens in place, shall then be placed in its cradle and linkage made to the driving motor.

5.4 The gas-oxygen torch mounting should be adjustable to a position 3 to 5 in. (76 to 127 mm) from the furnace opening so as to be able to fire axially through the furnace.

6. Preparation of Slag Pellets

6.1 Whatever the slag to be used, synthetic or prefused, it should be ground to pass an ASTM No. 30 (600 μm) sieve (equivalent to a 28-mesh Tyler Standard Series) and have suitable binder cast, extruded, or pressed into convenient pellets. A 1 in. (25 mm) diameter by 1.5 in (38 mm) long cylinder is a convenient form. Depending on the slag used, dry pellets of this size will weigh approximately 0.1 lb (45 g). After forming, the pellets are dried, weighed, and counted to determine the number of pellets to be charged into the furnace during the test. Optionally, carbon black may be added to the slag mixture if a reducing test atmosphere is desired.

7. Procedure

7.1 In principle, the furnace is typically tilted 3° axially toward the burner end. Charge preformed slag pellets into the upper end of the tilted rotary furnace. The furnace, preheated by the gas-oxygen torch at the other end, shall be at a temperature to melt the slag pellets. The molten slag washes over the lining and drips from the lower end of the furnace in front of the burner.

7.2 Rotate the furnace at a constant speed, normally 2½ rpm.

7.3 During the test, measure the temperature of the slag by means of an optical pyrometer immediately prior to charging fresh slag. Read the temperature of the slag at the lower one third of the 9 in. (228 mm) long brick specimen every 15 min, and maintain this temperature within ±18°F (±10°C) of the desired test temperature.

7.4 The test atmosphere is usually oxidizing. In special cases, a reducing atmosphere may be desirable which may be obtained using carbon black additives to the slag mixture and a reducing flame. In all cases, atmosphere analyses to identify oxygen pressure and monitoring throughout the run is suggested.

7.5 In a typical basic brick specimen run, heat the furnace to temperature in approximately 2 to 2½ h and soak at temperature for ½ h, during which time charge 2 lb (0.9 kg) of slag pellets to coat the lining and provide a starting bath. Start regular feeding of slag pellets at a rate of 2 to 4 lb (0.9 to 1.8 kg)/h and continue for 5 h. For less slag-resistant fireclay or alumina specimens, coupled with more erosive slags, the amount of slag charged and the time of the run may be reduced.

7.6 At the end of testing, immediately after shutting off the oxygen and gas and the motor, tilt the furnace to a vertical position to allow the remaining slag to drain.

7.7 After the cold furnace is disassembled, saw each identified specimen through the 9-in. (228-mm) length perpendicular to and at the center of the slagged face.

8. Report

8.1 The report should include the following:
8.1.1 Type, source, and composition of the slag,
8.1.2 Test temperature,
8.1.3 Duration of test,
8.1.4 Rate of slag feed and total amount of slag used, and
8.1.5 Any unusual test conditions, such as furnace atmosphere.

8.2 Observations as to the condition of the specimens after testing. It may be desirable to cut the specimens in half and expose a cross-sectional view.

8.2.1 These observations may be, but are not limited to: photographs, written comments, depth or volume of slag cut, depth or volume of slag penetration, change of mineralogy, and development of cracks in the specimens. Procedures used to obtain numerical results involving slag cut or penetration, or both, of the specimens need to be included in the report.

9. Precision and Bias

9.1 *Precision*—No justifiable statement on precision can be made since the results of the test are reported by descriptions and photographs, and the degree of variability cannot be established.

9.2 *Bias*—No justifiable statement on bias can be made since the true or standard value for the degree of disintegration cannot be established by an accepted reference method.

10. Keywords

10.1 corrosion; penetration; refractories; rotary; slag