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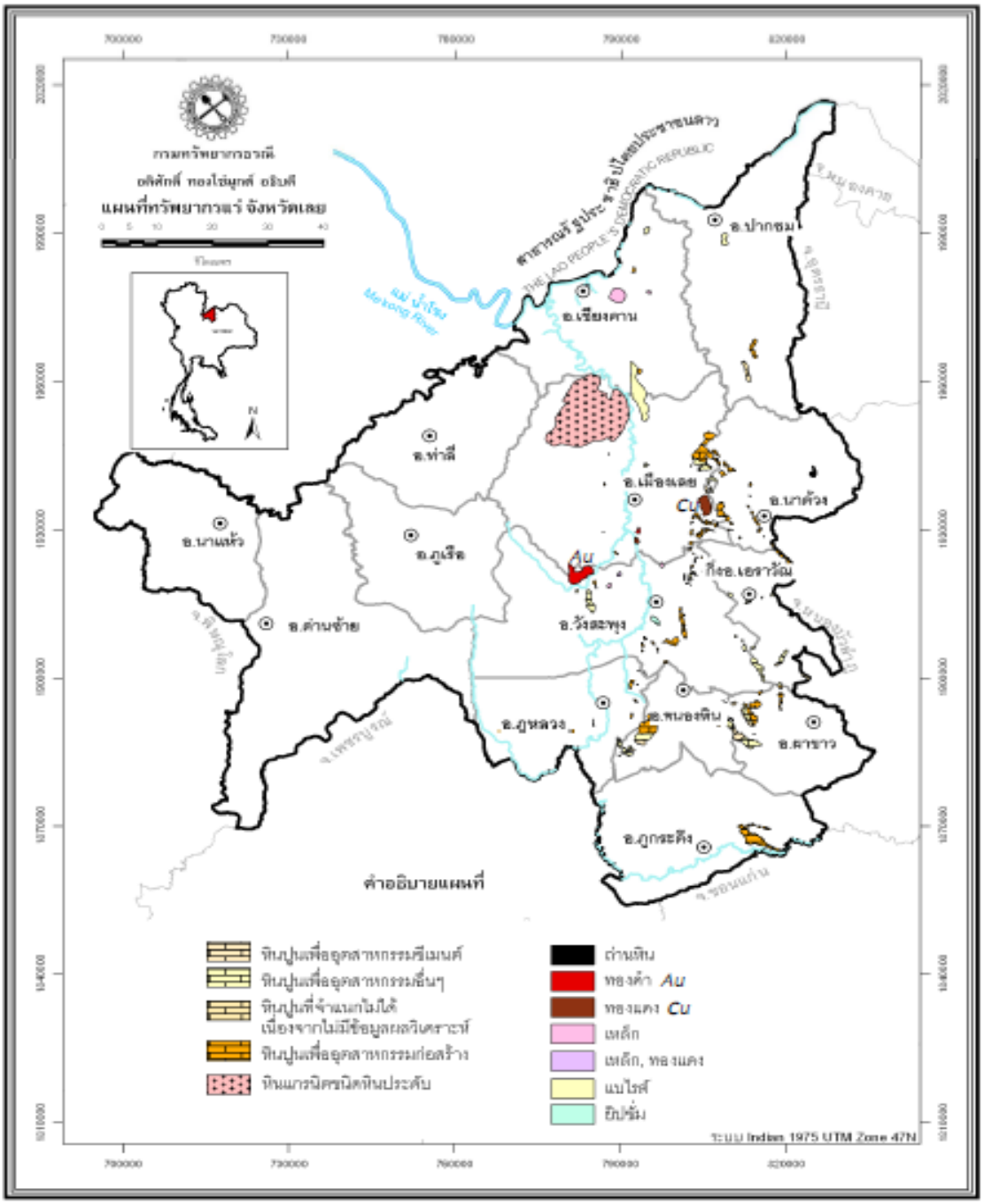
ประมวลภาพการดำเนินงานวิจัย



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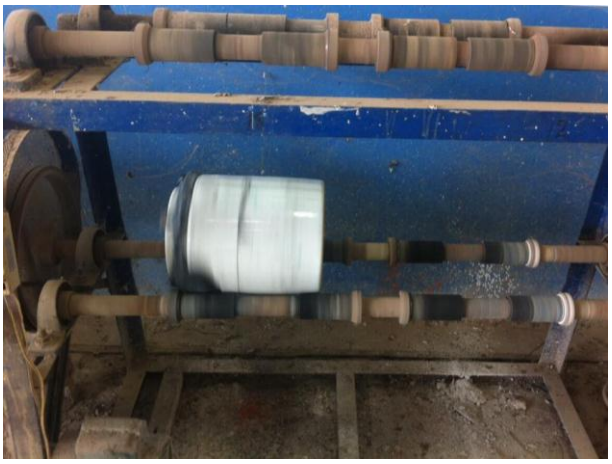
ภาพประกอบที่ 6.2 แกรนิตเหลือทิ้งจากการแปรรูปผลิตภัณฑ์



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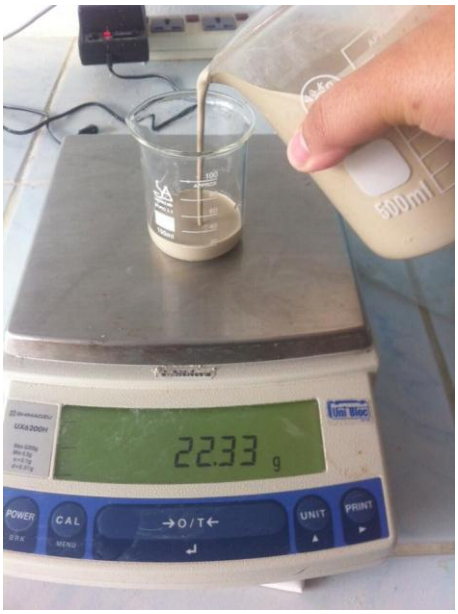
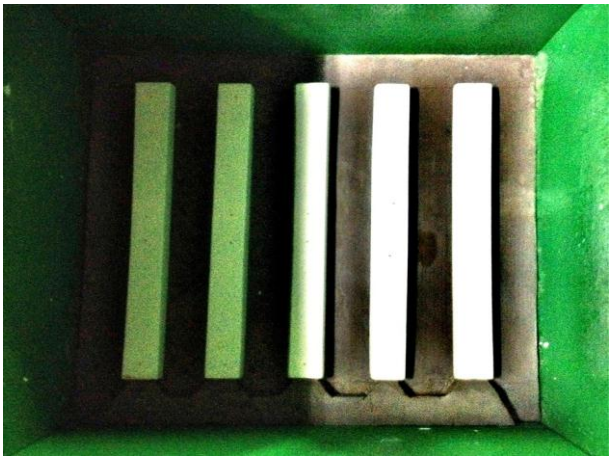


ภาพประกอบที่ 6.5 การตรวจสอบความถ่วงจำเพาะของน้ำดิน



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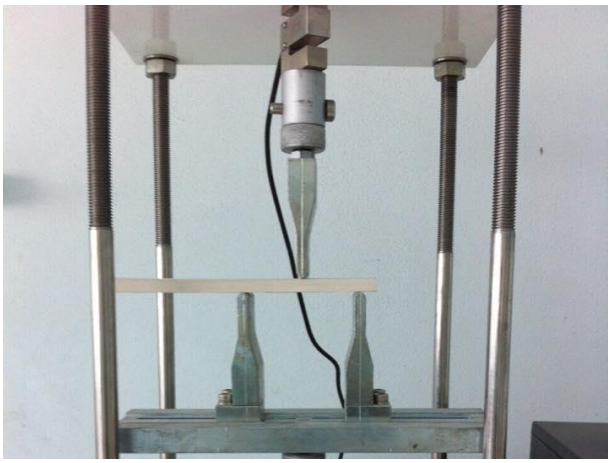

ภาพประกอบที่ 6.10 การทดสอบความต้านทานแรงดัดแบบ Three point bending

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ภาคผนวก ข
มาตรฐาน ASTM ที่ใช้ในงานวิจัย

Designation: C326 – 09

Standard Test Method for Drying and Firing Shrinkages of Ceramic Whiteware Clays[1]

This standard is issued under the fixed designation C326; 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 covers the determination of linear shrinkage of ceramic whiteware clays, both unfired and fired.

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 The purpose of this test is to obtain values of shrinkage after drying and firing of clays or bodies or both, under various processing conditions to enable designers to determine the proper size of mold or die so as to produce a predetermined size of fired ware.

3. Test Specimens

3.1 Test specimens shall be round bars approximately 0.75 in. (19 mm) in diameter by 5 in. (127 mm) in length.

3.2 Test specimens may be prepared either by casting or plastic forming, as circumstances require. At least ten specimens shall be prepared. For cast specimens the molds may be either one-piece, or two- or more-part molds; in either instance sufficient space shall be provided to allow solid casting without piping. Where plastic-forming is employed, the clay-water mass shall be brought to a consistency that permits the making of specimens rigid enough to allow careful handling without distortion immediately after the test specimen is made. Plastic-formed test specimens shall be made either by extrusion or by pressing in a suitable metal mold. Where a vacuum pugmill is used, a vacuum of not less than 25 in. (635 mm) Hg shall be maintained during the forming operation. Where no vacuum attachment is used, the plastic clay shall be thoroughly hand-wedged to eliminate entrapped air as a preliminary to forming test pieces.

3.3 The test specimens, cast or plastic-formed, shall be suitably identified and marked with shrinkage reference lines 4 in. (102 mm) apart on the long axis of the specimen. The shrinkage reference lines may conveniently be made with a gage with knife edges at zero and 4 in. (102 mm) and marking must be done as soon as the bars can be handled without distortion.

3.4 The marked specimens shall then be placed on a lightly oiled pallet with semi-circular grooves 0.40 in. (10.2 mm) in diameter and allowed to dry at 68 to 100°F (20 to 40°C) for 24h. The purpose of the semi-circular (half round) grooves is to maintain straightness of the bars during drying. During this preliminary drying period, the bars shall be turned 90° several times at 2-h intervals to eliminate possible warping in the vertical direction. After the initial drying period, the specimens shall be placed in a drying oven at 200 to 230°F (100 to 110°C) and further dried for 24 h.

3.5 The drying shrinkage of the test specimens should be determined in accordance with Sections 4 and 5. The specimens can now be fired according to a suitable firing schedule to the desired temperature and the procedures of Sections 4 and 5 applied to determine the total shrinkage.

3.6 The test bars must be clearly identified as to whether they were cast or extruded, and shrinkage data likewise identified because of slight differences in shrinkage between cast and extruded bars.

4. Shrinkage Measurement

4.1 Measure the distance between shrinkage reference marks on dried or fired specimens to the closest 0.004 in. (0.1 mm) with calipers of suitable accuracy. Record the average of at least ten measurements (one measurement on each of the group of ten or more specimens).

5. Calculation

5.1 Calculate the linear drying shrinkage as a percentage of plastic length, as follows:

$$S_d = \frac{L_p - L_d}{L_p} \times 100 \quad (1)$$

[1] This test method is under the jurisdiction of ASTM Committee C21 on Ceramic Whitewares and Related Products and is the direct responsibility of Subcommittee C21.04 on Raw Materials.

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

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where:
S_d = linear drying shrinkage, %,
L_p = plastic length of test specimen, and
L_d = dry length of test specimen.

5.2 Calculate the total linear shrinkage after drying and firing of clay shrinkage specimens as a percentage of plastic length, as follows:

$$S_t = \frac{L_p - L_f}{L_p} \times 100 \quad (2)$$

where:
S_t = total linear shrinkage after drying and firing, %,
L_p = plastic length of test specimen, and
L_f = fired length of test specimen.

5.3 When desired, volume shrinkage may be calculated from linear shrinkage, as follows:

$$\text{Volume shrinkage, \%} = [1 - (1 - S/100)^3]\,100 \quad (3)$$

where:
S = linear shrinkage, %.

5.4 The shrinkage factor is used to convert fired sizes to plastic sizes or mold sizes. Calculate as follows:

$$\text{Shrinkage factor} = L_p/L_f \quad (4)$$

where:
L_p = plastic length of test specimen, and
L_f = fired length of test specimen.

6. Precision and Bias

6.1 The direction of flow in forming influences the orientation of the clay particles and the shrinkage. The shrinkage value should be related to the method of forming as well as the dimension of the ware.

6.2 When the original reference points are 100 mm apart, the precision of the shrinkage measurement is ± 0.1 %.

6.3 Measurements of drying shrinkage on one dimension of specimens all formed by the same method should yield a standard deviation of 0.1 % or less.

6.4 Measurement of total linear shrinkage after drying and firing on one dimension of specimens should yield a standard deviation of 0.25 % or less.

7. Keywords

7.1 clay; drying shrinkage; firing shrinkage

SUMMARY OF CHANGES

Committee C21 has identified the location of selected changes to this standard since the last issue (C326–03) that may impact the use of this standard.

(*1*) Addition of 1.2 describing the use of units in this test method, with renumbering of the subsequent subsection of the Scope.

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Designation: C373 – 88 (Reapproved 2006)

Standard Test Method for Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products[1]

This standard is issued under the fixed designation C373; 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 covers procedures for determining water absorption, bulk density, apparent porosity, and apparent specific gravity of fired unglazed whiteware products.

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. Significance and Use

2.1 Measurement of density, porosity, and specific gravity is a tool for determining the degree of maturation of a ceramic body, or for determining structural properties that may be required for a given application.

3. Apparatus and Materials

3.1 *Balance*, of adequate capacity, suitable to weigh accurately to 0.01 g.

3.2 *Oven*, capable of maintaining a temperature of 150 ± 5°C (302 ± 9°F).

3.3 *Wire Loop, Halter, or Basket*, capable of supporting specimens under water for making suspended mass measurements.

3.4 *Container*—A glass beaker or similar container of such size and shape that the sample, when suspended from the balance by the wire loop, specified in 3.3, is completely immersed in water with the sample and the wire loop being completely free of contact with any part of the container.

3.5 *Pan*, in which the specimens may be boiled.

3.6 *Distilled Water*.

4. Test Specimens

4.1 At least five representative test specimens shall be selected. The specimens shall be unglazed and shall have as much of the surface freshly fractured as is practical. Sharp edges or corners shall be removed. The specimens shall contain no cracks. The individual test specimens shall weigh at least 50 g.

5. Procedure

5.1 Dry the test specimens to constant mass (Note 1) by heating in an oven at 150°C (302°F), followed by cooling in a desiccator. Determine the dry mass, *D*, to the nearest 0.01 g.

NOTE 1—The drying of the specimens to constant mass and the determination of their masses may be done either before or after the specimens have been impregnated with water. Usually the dry mass is determined before impregnation. However, if the specimens are friable or evidence indicates that particles have broken loose during the impregnation, the specimens shall be dried and weighed after the suspended mass and the saturated mass have been determined, in accordance with 5.3 and 5.4. In this case, the second dry mass shall be used in all appropriate calculations.

5.2 Place the specimens in a pan of distilled water and boil for 5 h, taking care that the specimens are covered with water at all times. Use setter pins or some similar device to separate the specimens from the bottom and sides of the pan and from each other. After the 5-h boil, allow the specimens to soak for an additional 24 h.

5.3 After impregnation of the test specimens, determine to the nearest 0.01 g the mass, *S*, of each specimen while suspended in water. Perform the weighing by placing the specimen in a wire loop, halter, or basket that is suspended from one arm of the balance. Before actually weighing, counterbalance the scale with the loop, halter, or basket in place and immerse in water to the same depth as is used when the specimens are in place. If it is desired to determine only the percentage of water absorption, omit the suspended mass operation.

5.4 After the determination of the suspended mass or after impregnation, if the suspended mass is not determined, blot each specimen lightly with a moistened, lint-free linen or cotton cloth to remove all excess water from the surface, and determine the saturated mass, *M*, to the nearest 0.01 g. Perform the blotting operation by rolling the specimen lightly on the wet cloth, which shall previously have been saturated with water and then pressed only enough to remove such water as will drip from the cloth. Excessive blotting will introduce error

[1] This test method is under the jurisdiction of ASTM Committee C21 on Ceramic Whitewares and Related Products and is the direct responsibility of Subcommittee C21.03 on Methods for Whitewares and Environmental Concerns.

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by withdrawing water from the pores of the specimen. Make the weighing immediately after blotting, the whole operation being completed as quickly as possible to minimize errors caused by evaporation of water from the specimen.

6. Calculation

6.1 In the following calculations, the assumption is made that 1 cm^3 of water weighs 1 g. This is true within about 3 parts in 1000 for water at room temperature.

6.1.1 Calculate the exterior volume, V, in cubic centimetres, as follows:

$$V = M - S \quad (1)$$

6.1.2 Calculate the volumes of open pores V_{OP} and impervious portions V_{IP} in cubic centimetres as follows:

$$V_{OP} = M - D \quad (2)$$

$$V_{IP} = D - S \quad (3)$$

6.1.3 The apparent porosity, P, expresses, as a percent, the relationship of the volume of the open pores of the specimen to its exterior volume. Calculate the apparent porosity as follows:

$$P = [(M - D)/V] \times 100 \quad (4)$$

6.1.4 The water absorption, A, expresses as a percent, the relationship of the mass of water absorbed to the mass of the dry specimen. Calculate the water absorption as follows:

$$A = [(M - D)/D] \times 100 \quad (5)$$

6.1.5 Calculate the apparent specific gravity, T, of that portion of the test specimen that is impervious to water, as follows:

$$T = D/(D - S) \quad (6)$$

6.1.6 The bulk density, B, in grams per cubic centimetre, of a specimen is the quotient of its dry mass divided by the exterior volume, including pores. Calculate the bulk density as follows:

$$B = D/V \quad (7)$$

7. Report

7.1 For each property, report the average of the values obtained with at least five specimens, and also the individual values. Where there are pronounced differences among the individual values, test another lot of five specimens and, in addition to individual values, report the average of all ten determinations.

8. Precision and Bias

8.1 This test method is accurate to ±0.2 % water absorption in interlaboratory testing when the average value recorded by all laboratories is assumed to be the true water absorption. The precision is approximately ±0.1 % water absorption on measurements made by a single experienced operator.

9. Keywords

9.1 apparent porosity; apparent specific gravity; bulk density; fired whiteware products; water absorption

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Designation: C674 – 88 (Reapproved 2006)

Standard Test Methods for Flexural Properties of Ceramic Whiteware Materials[1]

This standard is issued under the fixed designation C674; 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 These test methods cover determination of the modulus of rupture and the modulus of elasticity of fired ceramic whitewares bodies, formed by any fabrication method, and are applicable to both glazed and unglazed test specimens.

1.2 The values stated in inch-pound units are to be regarded as the standard. The metric equivalents of inch-pound units may be approximate.

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. Summary of Test Methods

2.1 The specimens, either cylindrical, or rectangular, are supported on knife edges over a suitable span and a direct load is applied at the midpoint between the supports at a uniform rate until breakage occurs. The modulus of elasticity may be determined by halting the applied load at definite intervals and measuring the deflection of the specimen at the midpoint to the nearest 0.001 in. (0.025 mm).

3. Significance and Use

3.1 These test methods provide a means for determining the modulus of rupture and the modulus of elasticity, which may be required in product specifications.

4. Apparatus

4.1 *Testing Machine*—Any suitable testing machine may be used, provided uniform rates of direct loading can be maintained.

4.1.1 For all specimens the loading rate should be such that the specimen should fail in approximately 1 min. Table 1 lists loading rates that shall be used for each size specimen. For strengths of specimens intermediate of those specified, interpolation can be used to obtain the equivalent loading rate.

4.1.2 For the prescribed rectangular specimens the loading rate shall be 1000 ± 150 lbs (454 ± 68 kg)/min.

4.2 *Bearing Edges*—For the support of the test specimen, two steel (or high-strength ceramic) knife edges rounded to a radius of 0.125 in. (3.18 mm) shall be provided. The load shall be applied by means of a third steel knife edge rounded to a radius of 0.125 in. When testing rectangular specimens, the supporting members for the bearing edges shall be constructed to provide a means for alignment of the bearing surfaces with the surfaces of the test specimen (it being possible that the rectangular specimen may be wedge-shaped or twisted). The apparatus shown in Figs. 1 and 2 are suggested as suitable devices for ensuring proper spacing and alignment of the bearing edges for rectangular test specimens.

5. Test Specimens

5.1 *Preparation of Specimens*—Form, fire, and finish the specimens by the appropriate methods, following practices used in actual production.

5.2 *Dimensions*—The specimens shall be approximately 1.125 in. (28.6 mm), 0.750 in. (19.2 mm), 0.500 in. (12.7 mm), or 0.250 in. (6.4 mm) in diameter, whichever diameter is most comparable to that of the finished product. The length shall be 6 ± 0.50 in. (153 ± 12.7 mm) to permit an overhang of at least 0.25 in. (6.4 mm) at each end when mounted on the supports. Note that the 0.25-in. specimens may be 3.75 ± 0.25 in. (95 ± 7 mm) long.

5.2.1 The dry-pressed specimens shall be rectangular bars approximately 1 in. (25.4 mm) by 0.50 in. (12.7 mm) in cross section and at least 4.50 in. (114 mm) in length to permit an overhang of at least 0.25 in. at each end when mounted on the supports.

5.3 *Handling*—Observe all due precautions in the forming, drying, and firing to produce straight test specimens of uniform cross section.

5.4 *Storage*—Cool test specimens taken warm from the kiln in a desiccator. If the testing must be delayed, store the bars in the desiccator, or in an electric oven at 110°C, and then cool in

[1] These test methods are under the jurisdiction of ASTM Committee C21 on Ceramic Whitewares and Related Products and are the direct responsibility of Subcommittee C 21.03 on Methods for Whitewares and Environmental Concerns.

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TABLE 1 Loading Rates for Specimens

Specimen Size, in. (mm)	Span, in. (mm)	Nominal MOR, ksi (MPa)		
		10 (69)	30 (207)	50 (345)
		Loading Rate, lb/min (kg/s)		
1.125 (28.6) diameter	5 (127)	1100 (8.32)	3400 (25.70)	5600 (42.34)
0.750 (19.2) "	5 (127)	300 (2.27)	1000 (7.56)	1700 (12.85)
0.500 (12.7) "	5 (127)	100 (0.76)	300 (2.27)	500 (3.76)
0.250 (6.4) "	3 (76)	20 (0.15)	60 (0.45)	100 (0.76)
1 by 0.50 (25.4 by 12.7)	4 (102)	400 (3.02)	1250 (9.45)	2100 (15.88)

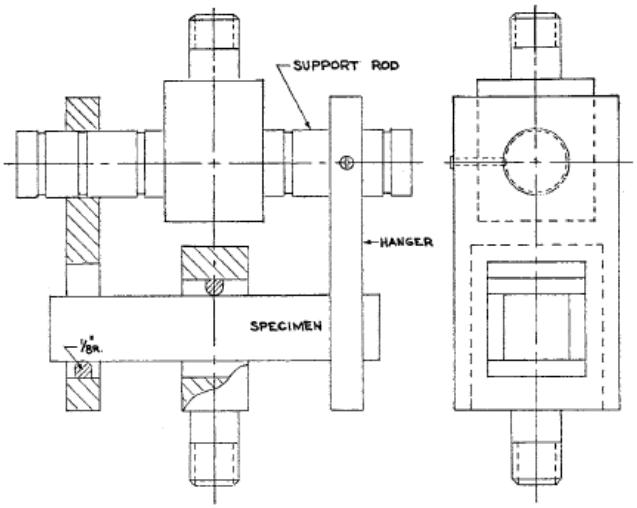

FIG. 1 Suggested Bearing Edge and Specimen Support

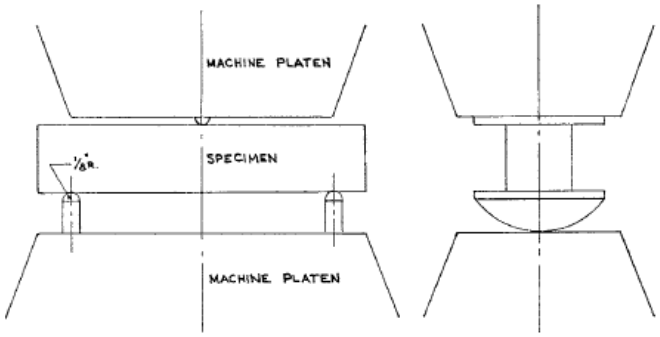

FIG. 2 Alternative Suggested Bearing Edge and Specimen Support

a desiccator before testing. When removing specimens from a hot kiln, take care to avoid thermal shock which will lead to erroneous results.

MODULUS OF RUPTURE

6. Procedure

6.1 Test at least ten dry specimens at room temperature.

NOTE 1—The modulus of elasticity may be determined as described in Sections 10-11 on the same type specimens used for the modulus of rupture test.

6.2 Place the cylindrical specimen on the bearing edges, spaced 5 in. (127 mm) ± 2 % between centers, with the specimen overhanging each end by at least 0.25 in. (6.4 mm). Apply the load at a right angle to the specimen and midway (±2 %) between the supporting edges. Apply the load uniformly at the appropriate rate for the specimen size (see 4.1.1) until failure occurs. Measure the diameter at four approximately equidistant points at the break and take the average to the nearest 0.001 in. (0.0254 mm) for calculation purposes. Break the 0.25-in. diameter rods between 3-in. (76-mm) centers and note this in the report.

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6.2.1 Place the rectangular test specimen on the bearing edges, spaced 4.0 in. (102 mm) between centers, with the specimen overhanging at each end by at least 0.25 in. (6.4 mm). Apply the load at a right angle to the 1-in. (25.4-mm) surface of the specimen and midway between the supporting edges. Break specimens glazed on only one of the 1-in. surfaces with the glazed surface either up or down, but break all of the specimens from any one lot in the same position and record this position. Apply the load uniformly at the rate of 1000 ± 150 lbs (454 ± 68 kg)/min, until failure occurs. Measure the width and thickness at the break to the nearest 0.001 in. (0.0254 mm).

7. Calculation

7.1 Calculate the modulus of rupture of each circular cross section specimen as follows:

$$M = 8PL/\pi d^3 \quad (1)$$

where:
M = modulus of rupture, psi (or MPa);
P = load at rupture, lbf (or N);
L = distance between supports, in. (or mm);
d = diameter of specimen, in. (or mm).

7.1.1 Calculate the modulus of rupture of each rectangular specimen as follows:

$$M = 3\ PL/2bd^2 \quad (2)$$

where:
M = modulus of rupture, psi (or MPa);
P = load at rupture, lbf (or N);
L = distance between supports, in. (or mm);
b = width of specimen, in. (or mm); and
d = thickness of specimen, in. (or mm).

8. Report

8.1 Report the following information:

8.1.1 Identification of the material tested,

8.1.2 Data and computed modulus of rupture for each specimen,

8.1.3 The adjusted average of the computed modulus of rupture values (discarding those values from the bars which, upon inspection, show obvious defect), and

8.1.4 In the case of glazed specimens, the position of the glazed surface or surfaces, with respect to the applied load.

8.2 The report may also include:

8.2.1 A description of type of fracture and the behavior of each specimen under load,

8.2.2 Name and rating of the machine used to make the test, and

8.2.3 A graph showing the individual values of modulus of rupture arranged in ascending order.

9. Precision and Bias

9.1 *Precision*:

9.1.1 *Interlaboratory Test Data*—An interlaboratory test was run in 1978 in which randomly drawn samples of five materials were tested in each of four laboratories. One operator in each laboratory tested ten specimens of each material. The components of variance for flexural strength results expressed as coefficients of variation were calculated as follows:

Single-operator component	2.42 % of the average
Between-laboratory component	18.79 % of the average

9.1.2 *Critical Differences*—For the components of variance reported in 9.1.1, two averages of observed values should be considered significantly different at the 95 % probability level if the difference equals or exceeds the following critical differences listed below:

Number of Observations in Each Average	Critical Difference, % of Grand Average[A]: Single-Operator Precision	Between-Laboratory Precision
10	6.72	52.10

[A] The critical differences were calculated using $t = 1.960$ which is based on infinite degrees of freedom.

9.1.3 *Confidence Limits*—For the components of variance noted in 9.1.1, single averages of observed values have the following 95 % confidence limits:

Number of Observations in Each Average	Width of 95 % Confidence Limits, Percent of the Grand Average[A]: Single-Operator Precision	Between-Laboratory Precision
10	±4.75	±36.84

[A] The confidence limits were calculated using $t = 1.960$ which is based on infinite degrees of freedom.

9.2 *Bias*—No justifiable statement on bias is possible since the true value of flexural strength of ceramic whiteware materials cannot be established and will be different for each specific material.

MODULUS OF ELASTICITY

10. Procedure

10.1 Support the specimen in the same way as for the modulus of rupture determination. Set any type of deflectometer capable of indicating to 0.001 in. (0.0254 mm) to measure deflection at mid-span relative to the ends of the span. Apply the load uniformly (see either 4.1.1 or 4.1.2) in accordance with the shape of the specimen. Stop the loading at 15 % increments of the expected total breaking load, as may previously have been determined in the modulus of rupture tests, and record the corresponding deflections.

11. Calculation

11.1 Plot the load-deflection readings to a convenient scale and draw a straight (stress-strain) line to represent, as nearly as possible, the average of the plotted points below the elastic limit. (In some materials, increasing departures from a straight line may be noted at the higher stress. Such evidence of plastic flow, or of non-recoverable strain, indicates that the elastic limit has been exceeded.) If the line does not pass through the zero point, draw a corrected line through this point parallel to the stress-strain line.

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11.1.1 Calculate the modulus of elasticity, E, for rectangular specimens from the coordinates of some convenient point on the corrected line as follows:

$$E = W^1L^3/4\Delta bd^3 \quad (3)$$

where:

W^1 = load coordinate of the selected point, lbf (or N);
L = length of span, in. (or mm);
Δ = deformation coordinate of the selected point, in. (or mm);
b = width of specimen at the center, in. (or mm); and
d = thickness of specimen at the center, in. (or mm).

11.1.2 Calculate the modulus of elasticity, E, for circular cross-section specimens from the coordinates of some convenient point on the corrected line as follows:

$$E = 4W^1L^3/3\pi\Delta d^4 \quad (4)$$

where:

W^1 = load coordinate of the selected point, lbf (or N);
L = length of span, in. (or mm);
Δ = deformation coordinate of the selected point, in. (or mm); and
d = diameter of specimen, in. (or mm).

12. Report

12.1 Report the following information:

12.1.1 Identification of the material tested,

12.1.2 Stress-strain data and modulus of elasticity for each specimen, and

12.1.3 In the case of glazed specimens the position of the glazed surface or surfaces.

13. Precision and Bias

13.1 Specific information to support a precision and bias statement for modulus of elasticity is not yet available.

14. Keywords

14.1 ceramic whiteware materials; flexural properties

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ภาคผนวก ค
การเผยแพร่ผลงานวิจัยระดับชาติ
ราชภัฏวิจัย ครั้งที่ 3 ณ มหาวิทยาลัยราชภัฏนครศรีธรรมราช

INARCRU III
ราชภัฏวิจัย ครั้งที่ 3
รวมบทความวิจัย (Proceeding)
เล่ม 2 ด้านวิทยาศาสตร์และเทคโนโลยี
การประชุมวิชาการและนำเสนอผลงานวิจัยระดับชาติและนานาชาติ
“ราชภัฏวิจัย ครั้งที่ 3”
“ สหวิทยาการ งานวิจัย และนวัตกรรมอุดมศึกษาเพื่อการพัฒนาท้องถิ่นไทย ก้าวไกลสู่อาเซียน ”
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เครือข่ายวิจัยสถาบันอุดมศึกษา ภาคใต้ตอนบน

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สมบัติทางเทคนิคของเนื้อดินเซรามิกที่ใช้แกรนิตเหลือทิ้งจากการแปรรูปเป็นวัตถุดิบ
Technical Properties of Ceramic Bodies Using Granite Waste as Raw Materials

ภควดี ศิริหล้า
Pakawadee Sirilar

บทคัดย่อ

แกรนิตเหลือทิ้งจากวิสาหกิจแปรรูปผลิตภัณฑ์ในจังหวัดเลย มีองค์ประกอบทางเคมีที่สำคัญ ประกอบด้วย ซิลิกา อลูมินา แคลเซียมออกไซด์ โซเดียมออกไซด์ และโพแทสเซียมอกไซด์ มีความเหมาะสมที่จะใช้ในการเตรียมเนื้อดินเซรามิก โดยน้ำดินจะถูกเตรียมด้วยการบดวัตถุดิบแบบเปียกร่วมกับ ดินขาว ดินดำ เฟลด์สปาร์ และซิลิกา ควบคุมความละเอียดน้อยกว่า 150 ไมครอน ตรวจสอบความถ่วงจำเพาะของน้ำดินให้มีค่าระหว่าง 1.55-1.60 ขึ้นรูปแท่งทดสอบโดยวิธีการหล่อด้วยแม่พิมพ์ปลาสเตอร์ เผาแท่งทดสอบด้วยเตาไฟฟ้าที่อุณหภูมิ 1075, 1100 และ 1125 องศาเซลเซียส ควบคุมอัตราการเพิ่มอุณหภูมิเท่ากับ 3 องศาเซลเซียส/นาที ทดสอบการดูดซึมน้ำตามมาตรฐาน ASTM C 373-88 ทดสอบความต้านทานแรงดัดตามมาตรฐาน ASTM C 674-88 และตรวจสอบการเปลี่ยนแปลงไพโรพลาสติกหลังการเผา ผลการวิจัย พบว่าการใช้แกรนิตเป็นวัตถุดิบมีผลทำให้การดูดซึมน้ำลดลง โดยมีค่าลดลงต่ำสุด ร้อยละ 1.1 ความต้านทานแรงดัดเพิ่มขึ้น โดยมีค่าเพิ่มขึ้นสูงสุด 22 MPa และการเปลี่ยนแปลงไพโรพลาสติกเพิ่มขึ้น โดยมีค่าเพิ่มขึ้นสูงสุด 9.1 เซนติเมตร หลังการเผาที่ 1125 องศาเซลเซียส

คำสำคัญ: แกรนิต เนื้อดิน การดูดซึมน้ำ ความต้านทานแรงดัด การเปลี่ยนแปลงไพโรพลาสติก

Abstract

Chemical compositions of granite waste from entrepreneur in Loei are silica, alumina, calcium oxide, sodium oxide and potassium oxide. The compositions are important for ceramic body preparation. Wet milling technique is required to mix granite waste with kaolin, ball clay, feldspar and silica for control particle size less than 150 micron. Specific gravity of cast slip is limited in range of 1.55-1.60 before casting with plaster mold. The specimens are fired at three different temperatures: 1075, 1100 and 1125 degree Celsius. Electric kiln is used with heating rate of 3 degree Celsius/min for oxidation firing. Two standard testing and analysis are conducted: water absorption follows ASTM C 373-88 and modulus of rupture follows ASTM C 674-88. Pyroplastic deformation is investigated for all formulations. The results found that using of granite could be lowered water absorption down to 1.1%, improved modulus of rupture up to 22MPa and accelerated pyroplastic deformation up to 9.10 cm after 1125 degree Celsius fired.

Keywords: Granite, Body, Water absorption, Modulus of rupture, Pyroplastic deformation