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Lower Pennsylvanian
CLAY RESOURCES OF
KNOX COUNTY, ILLINOIS

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ILLINOIS STATE GEOLOGICAL SURVEY
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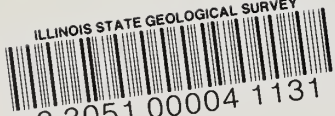
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LOWER PENNSYLVANIAN CLAY RESOURCES OF KNOX COUNTY, ILLINOIS

Walter E. Parham

ABSTRACT

To determine the nature and uses of possible light-burning clay deposits of Knox County, Illinois, about 40 samples of the underclays below the Colchester (No. 2) Coal were collected and tested.

Laboratory tests were made to determine the linear drying and firing shrinkage, water of plasticity, firing color, refractoriness, and bonding properties of the clay. The thickness of the clay, its overburden, and types of associated sediments were recorded from field observations.

The southern part of Knox County is the best area for clay prospecting. The thicker and lighter burning clays come from the southwest part of the county.

INTRODUCTION

Knox County, with Galesburg as its largest city, is in western Illinois between the Mississippi and Illinois Rivers (fig. 1). As the land surface is for the most part covered by Pleistocene glacial deposits, exposures of older rocks occur mainly along the stream valleys. Some of the bedrock exposures contain various clays (underclays) that occur below the Colchester (No. 2) Coal and lower coals. Underclays higher in the stratigraphic section than the No. 2 Coal are not considered in this report.

In general, the rocks of Pennsylvanian age in Knox County slope gently to the east or southeast. The older Pennsylvanian rocks are exposed in the southwest portion of Knox County, and the samples were obtained from that general area. A more complete account of the geology of this region is given by Green (1870).

The physical properties and burning characteristics of the underclays vary widely from one area to another in Illinois. This is one of a series of reports issued by the Illinois State Geological Survey on light-burning clay resources of Illinois counties, designed to aid in the selection of clays for specific uses. Circular 277 dealt with the clay resources of LaSalle County.

REPORT OF TESTS

This report includes locations of existing clay deposits in Knox County, their thickness, overburden, type of underlying and overlying sediment, possible uses, and the results of tests on the physical properties of the clays. The test results include the drying and firing shrinkage of the clay, water of plasticity, fired colors, and bonding properties.

Extrusion and Firing of Test Bars

Each sample of clay was dried and crushed to particles approximately one-fourth inch or less in diameter. The sample was then mixed with enough water to develop plasticity and extruded into three individual test bars, each 1 by 1 by 6 inches. The bars were air-dried for at least two days, then measured to determine the percentage of drying shrinkage of the clay. The first brick was fired at 1832°F, the second at 2012°F, and the third at 2200°F. After each firing, the test bars were measured to determine the percentage of firing shrinkage.

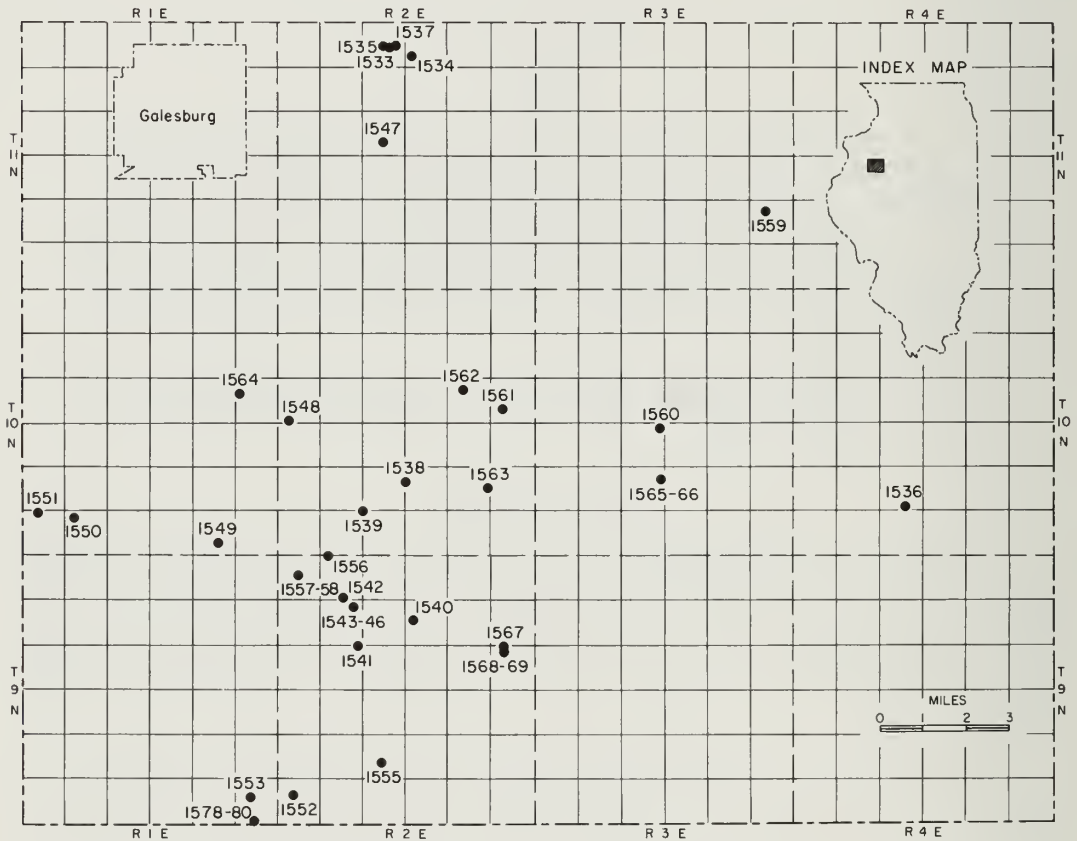


Fig. 1. - Map of portion of Knox County showing locations of outcrops sampled.

Water of Plasticity

The water of plasticity was determined for each sample at the time the test bars were extruded. Water of plasticity is that amount of water that must be added to a clay sample in order to develop plasticity. In general, the greater the water of plasticity, the greater the shrinkage during drying and firing of a given clay.

Color of Fired Test Bars

All of the clay samples in this study were obtained from outcrops, and it is probable that weathering has altered the burning color of the clay. For a better indication of true burning color it would be necessary to obtain unweathered samples of the clay from drill holes near the area in question. A weathered, light-burning clay generally burns darker than unweathered clay from the same deposit, owing to the oxidation of pyrite in the clay and to the fine dissemination of iron throughout the clay deposit.

High-Temperature Properties

The mineral analyses by X-ray, the colors of the fired test bars, and past experience indicate that none of the samples from Knox County studied in this report would withstand temperatures of PCE (pyrometric cone equivalent) 28 or higher.

Bonding Tests

Because underclays are sometimes used as a bonding clay for foundry sands, bonding tests were run on all the samples. The clays were first ground in a disc grinder. A 2000-gram mixture of 92 percent bonding sand and 8 percent clay was made and mixed dry for two minutes in a sand muller. Water was then added to the mixture in the muller and three minutes of wet mixing followed. The wet mixtures were placed in sealed jars and allowed to set overnight in order to give the water enough time to mix thoroughly with the clay. Mixtures were made with various amounts of water — 30 ml, 35 ml, and 45 ml. For some samples of the stronger bonding clays, additional mixtures with 55 ml of water were made.

The tests were run in a manner described in the Foundry Sand Handbook (American Foundrymen's Society, 1952). Listed in the following tables under "Bonding properties" are figures representing the green compression strength in pounds per square inch (GCS psi). This is the maximum strength developed by the clay at its optimum water content.

Results of all tests made appear on the following pages in tabular form.

RESULTS OF TESTS

SAMPLE 1533

NE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 4, T. 11 N., R. 2 E.

Thickness: Ft. In.

Overburden			
Overlying rocks	50	Extrusion properties	Good
No. 2 Coal	1-2	Water of plasticity, percent	20.0
Underclay (sample 1533)	$\frac{1}{2}$ -1	Linear drying shrinkage, percent	6.0
Sandy nodules and calcareous shale			
Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	3.0	3.0	----
Total linear shrinkage, percent	9.0	9.0	----
Fired color	Brick red	Brick red	----
Surface texture of fired test bar: Bloating started at 2012°F.			
Bonding properties: 4.50 (GCS psi); 1.70 (optimum H ₂ O).			
Possible uses: Flower pots.			

SAMPLE 1534

NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 3, T. 11 N., R. 2 E.

Thickness: Ft. In.

Overburden			
Overlying rocks	40	Extrusion properties	Very poor
Coaly streak	$\frac{1}{4}$	Water of plasticity, percent	20.0
Underclay (sample 1534)	1+	Linear drying shrinkage, percent	4.0
Base covered			
Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	0.0	0.0	----
Total linear shrinkage, percent	4.0	4.0	----
Fired color	Yellow-brown	Tan	----
Surface texture of fired test bar: Bloating started at 1832°F.			
Bonding properties: 8.65 (GCS psi); 2.10 (optimum H ₂ O).			
Possible uses: Bonding clay, lightweight aggregate.			

SAMPLE 1535

NW $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 4, T. 11 N., R. 2 E.

Thickness: Ft. In.

Overburden			
Overlying rocks	40	Extrusion properties	Good
Coaly streak	1/8	Water of plasticity, percent	20.5
Underclay (sample 1535)	4-5	Linear drying shrinkage, percent	4.0
Green clay band			
Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	2.5	4.5	6.5
Total linear shrinkage, percent	6.5	8.5	10.5
Fired color	Salmon	Brick red	Tan
Surface texture of fired test bar: Bloating started at 2200°F.			
Bonding properties: 4.08 (GCS psi); 1.80 (optimum H ₂ O)			
Possible uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.			

SAMPLE 1536

SW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 28, T. 10 N., R. 4 E.

	Thickness:	Ft.	In.		
Overburden					
Overlying rocks		15		Extrusion properties	Good
Coal			5	Water of plasticity, percent	26.0
Underclay (sample 1536)		2+		Linear drying shrinkage, percent	6.0
Base covered					
Firing temperature			1832°F	2012°F	2200°F
Linear firing shrinkage, percent			4.5	+3.0	----
Total linear shrinkage, percent			10.5	3.0	----
Fired color			Brick red	Brick red	----
Surface texture of fired test bar: Bloating started at 2012°F.					
Bonding properties: 10.3 (GCS psi); 2.6 (optimum H ₂ O).					
Possible uses: Bonding clay, lightweight aggregate.					

SAMPLE 1537

NW $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 4, T. 11 N., R. 2 E.

	Thickness:	Ft.	In.		
Overburden					
Overlying rocks		20		Extrusion properties	Poor
Shale (sample 1537)		25+		Water of plasticity, percent	22.0
Base covered				Linear drying shrinkage, percent	4.0
Firing temperature			1832°F	2012°F	2200°F
Linear firing shrinkage, percent			3.0	8.5	5.5
Total linear shrinkage, percent			7.0	12.5	9.5
Fired color			Red-brown	Brick red	Brick red
Surface texture of fired test bar: Has rough edges. Bloating started at 2200°F.					
Bonding properties: 4.65 (GCS psi); 1.75 (optimum H ₂ O).					
Possible uses: Structural clay products, sewer pipe, drain tile, pottery, flower pots.					

SAMPLE 1538

SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 27, T. 10 N., R. 2 E.

	Thickness:	Ft.	In.		
Overburden					
Overlying rocks		25		Extrusion properties	Poor
No. 2 Coal			2+	Water of plasticity, percent	20.0
Underclay (sample 1538)		5 $\frac{1}{2}$ -6		Linear drying shrinkage, percent	4.0
Sandstone					
Firing temperature			1832°F	2012°F	2200°F
Linear firing shrinkage, percent			1.5	7.0	0.0
Total linear shrinkage, percent			5.5	11.0	4.0
Fired color			Salmon	Brick red	Brick red
Surface texture of fired test bar: Bloating started at 2200°F.					
Bonding properties: 4.60 (GCS psi); 1.75 (optimum H ₂ O).					
Possible uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.					

SAMPLE 1539

NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 33, T. 10 N., R. 2 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	25		Extrusion properties	Fair
No. 2 Coal	2+		Water of plasticity, percent	21.0
Underclay (sample 1539)	4		Linear drying shrinkage, percent	4.5
Sandstone				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.5	6.5	8.0
Total linear shrinkage, percent		6.0	11.0	12.5
Fired color		Salmon	Brick red	Brick red

Surface texture of fired test bar: Edges slightly rough at 2200°F.

Bonding properties: 4.25 (GCS psi); 1.62 (optimum H₂O).

Possible uses: Structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1540

NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 10, T. 9 N., R. 2 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	15		Extrusion properties	Poor
No. 2 Coal	1	4	Water of plasticity, percent	21.0
Underclay (sample 1540)	5		Linear drying shrinkage, percent	4.0
Sandstone				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.5	6.5	7.0
Total linear shrinkage, percent		5.5	10.5	11.0
Fired color		Salmon	Salmon	Brown

Surface texture of fired test bar: Has rough edges at all firing temperatures.

Bonding properties: 5.10 (GCS psi); 2.10 (optimum H₂O).

Possible uses: Structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1541

NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 17, T. 9 N., R. 2 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	40		Extrusion properties	Poor
Coal	2+		Water of plasticity, percent	17.0
Underclay (sample 1541)(exposed)	2		Linear drying shrinkage, percent	3.5
Sandy shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.5	5.0	2.0
Total linear shrinkage, percent		4.0	8.5	5.5
Fired color		Pink	Salmon	Tan

Surface texture of fired test bar: Bloating started at 2200°F. Surface scum at 2012°F.

Bonding properties: 3.90 (GCS psi); 1.45 (optimum H₂O).

Possible uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1542

SW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 5, T. 9 N., R. 2 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	40	Extrusion properties		Good
Coal	1 $\frac{1}{2}$	Water of plasticity, percent		17.5
Underclay (sample 1542)	2 $\frac{1}{2}$	Linear drying shrinkage, percent		5.0
Sandy shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.0	5.0	5.5
Total linear shrinkage, percent		6.0	10.0	10.5
Fired color		Salmon	Salmon	Tan

Surface texture of fired test bar: Normal.

Bonding properties: 4.41 (GCS psi); 1.50 (optimum H₂O).

Possible uses: Structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1543

SW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 8, T. 9 N., R. 2 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	55	Extrusion properties		Fair
Coal	1 $\frac{1}{2}$	Water of plasticity, percent		23.0
Underclay (sample 1543)	4	Linear drying shrinkage, percent		4.0
Sandstone				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		2.5	8.5	8.5
Total linear shrinkage, percent		6.5	12.5	12.5
Fired color		Pink	Brick red	Brick red

Surface texture of fired test bar: Has slightly rough edges. Bloating started at 2200°F.

Bonding properties: 5.82 (GCS psi); 2.03 (optimum H₂O).

Possible uses: Structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1544

SW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 8, T. 9 N., R. 2 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	52	Extrusion properties		Fair
Coal	1 $\frac{1}{2}$	Water of plasticity, percent		31.5
Underclay (sample 1544)	2	Linear drying shrinkage, percent		5.5
Coal		1 $\frac{1}{2}$		
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		7.5	11.5	0.5
Total linear shrinkage, percent		13.0	17.0	6.0
Fired color		Brick red	Brick red	Brick red

Surface texture of fired test bar: Bloating started at 2200°F.

Bonding properties: 4.27 (GCS psi); 2.07 (optimum H₂O).

Possible uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1545

SW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 8, T. 9 N., R. 2 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	47	Extrusion properties		Fair
Coal		2	Water of plasticity, percent	20.0
Underclay (sample 1545)	3 $\frac{1}{2}$ -4		Linear drying shrinkage, percent	6.5
Coal	1 $\frac{1}{2}$			
Firing temperature	1832°F	2012°F		2200°F
Linear firing shrinkage, percent	1.0	5.0		+2.0
Total linear shrinkage, percent	7.5	11.5		4.5
Fired color	Red-brown	Brick red		Brick red

Surface texture of fired test bar: Bloating started at 2200°F.

Bonding properties: 4.95 (GCS psi); 1.90 (optimum H₂O).

Possible uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1546

SW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 8, T. 9 N., R. 2 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	32	Extrusion properties		Good
No. 2 Coal	1 $\frac{1}{2}$		Water of plasticity, percent	18.0
Underclay (sample 1546)	5		Linear drying shrinkage, percent	5.5
Sandstone				
Firing temperature	1832°F	2012°F		2200°F
Linear firing shrinkage, percent	0.5	4.5		4.0
Total linear shrinkage, percent	6.0	10.0		9.5
Fired color	Salmon	Brick red		Brick red

Surface texture of fired test bar: Slight bloating started at 2200°F.

Bonding properties: 4.56 (GCS psi); 1.80 (optimum H₂O).

Possible uses: Structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1547

SW $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 16, T. 11 N., R. 2 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	10	Extrusion properties		Good
Shale (sample 1547)	30±		Water of plasticity, percent	18.0
Base covered			Linear drying shrinkage, percent	4.0
Firing temperature	1832°F	2012°F		2200°F
Linear firing shrinkage, percent	1.0	6.5		5.0
Total linear shrinkage, percent	5.0	10.5		9.0
Fired color	Tan	Brick red		Brick red

Surface texture of fired test bar: Bloating and twisting started at 2200°F.

Surface scum at 1832°F and 2012°F.

Bonding properties: --- (GCS); --- (optimum H₂O).

Possible uses: Structural clay products, sewer pipe, drain tile, pottery, flower pots.

CLAY RESOURCES OF KNOX COUNTY

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SAMPLE 1548

SW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 18, T. 10 N., R. 2 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	25		Extrusion properties	Poor
Coal	1 $\frac{1}{2}$		Water of plasticity, percent	22.0
Underclay (sample 1548)	5		Linear drying shrinkage, percent	5.5
Silty shale				
Firing temperature	1832°F		2012°F	2200°F
Linear firing shrinkage, percent	+0.5		4.5	+5.0
Total linear shrinkage, percent	5.0		10.0	0.5
Fired color	Salmon		Brick red	Brick red

Surface texture of fired test bar: Has rough edges. Bloating started at 2200°F.
 Bonding properties: 2.98 (GCS psi); 1.80 (optimum H₂O).
 Possible uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1549

Center of W $\frac{1}{2}$ of SE $\frac{1}{4}$ sec. 35, T. 10 N., R. 1 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	25		Extrusion properties	Good
No. 2 Coal	1		Water of plasticity, percent	20.5
Underclay (sample 1549)	3		Linear drying shrinkage, percent	5.0
Silty shale				
Firing temperature	1832°F		2012°F	2200°F
Linear firing shrinkage, percent	2.0		7.5	6.0
Total linear shrinkage, percent	7.0		12.5	11.0
Fired color	Red-brown		Brick red	Brick red

Surface texture of fired test bar: Bloating started at 2200°F.
 Bonding properties: 4.93 (GCS psi); 1.70 (optimum H₂O).
 Possible uses: Structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1550

SE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 32, T. 10 N., R. 1 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	30		Extrusion properties	Good
No. 2 Coal	1	4	Water of plasticity, percent	18.0
Underclay (sample 1550)	2+		Linear drying shrinkage, percent	6.0
Base covered				
Firing temperature	1832°F		2012°F	2200°F
Linear firing shrinkage, percent	0.5		3.5	3.5
Total linear shrinkage, percent	6.5		9.5	9.5
Fired color	Salmon		Buff	Tan

Surface texture of fired test bar: Bloating started at 2200°F.
 Bonding properties: 4.60 (GCS psi); 1.70 (optimum H₂O).
 Possible uses: Structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1551
 NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 31, T. 10 N., R. 1 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	10		Extrusion properties	Good
No. 2 Coal	1 $\frac{1}{2}$		Water of plasticity, percent	18.0
Underclay (sample 1551)	3		Linear drying shrinkage, percent	5.0
Silty shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.0	6.0	3.5
Total linear shrinkage, percent		5.0	11.0	8.5
Fired color		Salmon	Brick red	Brick red

Surface texture of fired test bar: Bloating and cracking started at 2200°F.
 Bonding properties: 4.61 (GCS psi); 2.00 (optimum H₂O).
 Possible uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1552
 SW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 31, T. 9 N., R. 2 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	70		Extrusion properties	Fair
No. 2 Coal	2	4	Water of plasticity, percent	19.0
Underclay (sample 1552)(exposed)	3		Linear drying shrinkage, percent	4.5
Limestone nodules				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		2.0	5.5	0.0
Total linear shrinkage, percent		6.5	10.0	4.5
Fired color		Yellow-brown	Brown	Buff

Surface texture of fired test bar: Bloating started at 2200°F.
 Bonding properties: 4.20 (GCS psi); 1.80 (optimum H₂O).
 Possible uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1553
 SW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 36, T. 9 N., R. 1 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	60		Extrusion properties	Good
No. 2 Coal	2		Water of plasticity, percent	18.0
Underclay (sample 1553)	2 $\frac{1}{2}$		Linear drying shrinkage, percent	4.0
Limestone nodules				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		2.5	5.5	1.5
Total linear shrinkage, percent		6.5	9.5	5.5
Fired color		Buff	Light brown	Buff

Surface texture of fired test bar: Has slightly rough edges. Bloating started at 2200°F.
 Bonding properties: 4.37 (GCS psi); 1.85 (optimum H₂O).
 Possible uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1555

SE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 28, T. 9 N., R. 2 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	20		Extrusion properties	Poor
Coal	1 $\frac{1}{2}$		Water of plasticity, percent	18.5
Underclay (sample 1555)(exposed)	5		Linear drying shrinkage, percent	4.0
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		2.5	6.5	6.5
Total linear shrinkage, percent		6.5	10.5	10.5
Fired color		Salmon	Salmon	Brick red

Surface texture of fired test bar: Rough edges develop at 2200°F.

Bonding properties: 4.15 (GCS psi); 1.95 (optimum H₂O).

Possible uses: Structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1556

Center of the N line of NW $\frac{1}{4}$ sec. 5, T. 9 N., R. 2 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	15		Extrusion properties	Good
Coal		7	Water of plasticity, percent	20.5
Underclay (sample 1556)(exposed)	4		Linear drying shrinkage, percent	5.0
Base covered				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.0	7.0	4.5
Total linear shrinkage, percent		6.0	12.0	9.5
Fired color		Pink	Brick red	Brick red

Surface texture of fired test bar: Bloating started at 2200°F.

Bonding properties: 4.38 (GCS psi); 1.70 (optimum H₂O).

Possible uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1557

SE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 6, T. 9 N., R. 2 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	40		Extrusion properties	Poor
No. 2 Coal	1	2	Water of plasticity, percent	22.0
Underclay (sample 1557)	4+		Linear drying shrinkage, percent	5.5
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		2.0	6.5	4.5
Total linear shrinkage, percent		7.5	12.0	10.0
Fired color		Pink	Brick red	Brick red

Surface texture of fired test bar: Bloating started at 2200°F. Surface scum at 2012°F.

Bonding properties: 4.85 (GCS psi); 1.95 (optimum H₂O).

Possible uses: Structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1558

SE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 6, T. 9 N., R. 2 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	60		Extrusion properties	Poor
Coal	thin		Water of plasticity, percent	18.0
Underclay (sample 1558)(exposed)	3 $\frac{1}{2}$		Linear drying shrinkage, percent	4.0
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.5	5.5	+4.0
Total linear shrinkage, percent		5.5	9.5	0.0
Fired color		Yellow-brown	Brick red	Orange-buff

Surface texture of fired test bar: Has rough edges. Bloating started at 2200°F.
 Bonding properties: 5.40 (GCS psi); 1.60 (optimum H₂O).
 Possible uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1559

Center of the N line of SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 25, T. 11 N., R. 3 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	10		Extrusion properties	Fair
Shale (sample 1559)	7+		Water of plasticity, percent	18.5
Base covered			Linear drying shrinkage, percent	3.0
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.0	6.5	6.5
Total linear shrinkage, percent		4.0	9.5	9.5
Fired color		Red-brown	Brick red	Brick red

Surface texture of fired test bar: Has rough edges. Bloating started at 2200°F.
 Bonding properties: --- (GCS psi); ---- (optimum H₂O).
 Possible uses: Structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1560

NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 21, T. 10 N., R. 3 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	40		Extrusion properties	Poor
No. 2 Coal	2	3	Water of plasticity, percent	18.5
Underclay (sample 1560)	3		Linear drying shrinkage, percent	4.0
Calcareous sandstone				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.5	5.5	+1.5
Total linear shrinkage, percent		5.5	9.5	2.5
Fired color		Red-brown	Brick red	Brick red

Surface texture of fired test bar: Has rough edges. Bloating started at 2200°F.
 Bonding properties: 3.52 (GCS psi); 1.35 (optimum H₂O).
 Possible uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1561

SE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 13, T. 10 N., R. 2 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	40	Extrusion properties		Fair
No. 2 Coal	2 $\frac{1}{2}$	Water of plasticity, percent		22.0
Underclay (sample 1561)	4	Linear drying shrinkage, percent		4.5
Sandstone				
Firing temperature	1832°F	2012°F		2200°F
Linear firing shrinkage, percent	2.0	8.0		4.0
Total linear shrinkage, percent	6.5	12.5		8.5
Fired color	Salmon	Salmon		Brick red

Surface texture of fired test bar: Bloating started at 2200°F.

Bonding properties: 5.80 (GCS psi); 2.05 (optimum H₂O).

Possible uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1562

NE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 14, T. 10 N., R. 2 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	45	Extrusion properties		Poor
Coal	(stripped out)	Water of plasticity, percent		18.0
Underclay (sample 1562)	5	Linear drying shrinkage, percent		4.0
Base covered				
Firing temperature	1832°F	2012°F		2200°F
Linear firing shrinkage, percent	2.5	5.5		+5.0
Total linear shrinkage, percent	6.5	9.5		+1.0
Fired color	Tan	Salmon		Green-brown

Surface texture of fired test bar: Has rough edges. Bloating started at 2200°F.

Bonding properties: 4.15 (GCS psi); 1.95 (optimum H₂O).

Possible uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1563

NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 26, T. 10 N., R. 2 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	30	Extrusion properties		Fair
Coal	1	Water of plasticity, percent		19.0
Underclay (sample 1563)	3±	Linear drying shrinkage, percent		6.0
Base covered				
Firing temperature	1832°F	2012°F		2200°F
Linear firing shrinkage, percent	1.0	4.5		4.5
Total linear shrinkage, percent	7.0	10.5		10.5
Fired color	Salmon	Salmon		Brown

Surface texture of fired test bar: Slight bloating started at 2200°F.

Bonding properties: 3.95 (GCS psi); 2.20 (optimum H₂O).

Possible uses: Structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1564

NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec.13, T. 10 N., R. 1 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	70		Extrusion properties	Fair
Coal (?)	?		Water of plasticity, percent	17.0
Underclay (sample 1564)(exposed)	2		Linear drying shrinkage, percent	5.5
Base covered				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.0	5.0	+5.5
Total linear shrinkage, percent		6.5	10.5	0.0
Fired color		Red-brown	Brick red	Brick red

Surface texture of fired test bar: Bloating started at 2200°F.
 Bonding properties: 3.42 (GCS psi); 2.32 (optimum H₂O).
 Possible uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1565

NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 28, T. 10 N., R. 3 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	25		Extrusion properties	Good
No. 2 Coal	2	8	Water of plasticity, percent	18.5
Underclay (sample 1565)	3		Linear drying shrinkage, percent	5.5
Sandstone				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		2.5	5.0	+10.5
Total linear shrinkage, percent		8.0	10.5	+5.0
Fired color		Yellow-brown	Brown	Green-brown

Surface texture of fired test bar: Bloating started at 2012°F.
 Bonding properties: 6.10 (GCS psi); 2.30 (optimum H₂O).
 Possible uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1566

NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 28, T. 10 N., R. 3 E.

Thickness: Ft. In.

Overburden				
Overlying rocks	22		Extrusion properties	Fair
Sandstone		3	Water of plasticity, percent	16.0
Underclay (sample 1566)	4 $\frac{1}{2}$		Linear drying shrinkage, percent	3.0
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		2.5	6.0	+1.0
Total linear shrinkage, percent		5.5	9.0	2.0
Fired color		Tan	Brown	Brown

Surface texture of fired test bar: Bloating started at 2200°F.
 Bonding properties: 3.38 (GCS psi); 1.70 (optimum H₂O).
 Possible uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1567

NW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 13, T. 9 N., R. 2 E.

Thickness: Ft. In.

Overburden			
Overlying rocks	50	Extrusion properties	Fair
Coal	1 $\frac{1}{2}$	Water of plasticity, percent	20.0
Underclay (sample 1567)(exposed)	1	Linear drying shrinkage, percent	5.0
Base covered			
Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	3.0	5.0	+3.0
Total linear shrinkage, percent	8.0	10.0	2.0
Fired color	Yellow-brown	Brick red	Brick red
Surface texture of fired test bar:	Rough edges develop at 2012°F. Bloating started at 2200°F.		
Bonding properties:	5.09 (GCS psi); 1.95 (optimum H ₂ O).		
Possible uses:	Lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.		

SAMPLE 1568

SW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 13, T. 9 N., R. 2 E.

Thickness: Ft. In.

Overburden			
Overlying rocks	55	Extrusion properties	Good
No. 2 Coal	1 $\frac{1}{2}$	Water of plasticity, percent	18.0
Underclay (sample 1568)	3 $\frac{1}{2}$	Linear drying shrinkage, percent	5.0
Green clay band			
Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	3.5	7.0	+2.0
Total linear shrinkage, percent	8.5	12.0	3.0
Fired color	Brick red	Brick red	Brick red
Surface texture of fired test bar:	Bloating and twisting started at 2200°F.		
Bonding properties:	6.07 (GCS psi); 1.80 (optimum H ₂ O).		
Possible uses:	Lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.		

SAMPLE 1569

SW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 13, T. 9 N., R. 2 E.

Thickness: Ft. In.

Overburden			
Overlying rocks	60	Extrusion properties	Fair
Coal	1 $\frac{1}{2}$	Water of plasticity, percent	22.5
Underclay (sample 1569)	5 $\frac{1}{2}$	Linear drying shrinkage, percent	5.5
Sandstone			
Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	2.5	7.0	5.0
Total linear shrinkage, percent	8.0	12.5	10.5
Fired color	Salmon	Salmon	Brown
Surface texture of fired test bar:	Slight bloating started at 2200°F.		
Bonding properties:	6.12 (GCS psi); 1.80 (optimum H ₂ O).		
Possible uses:	Structural clay products, sewer pipe, drain tile, pottery, flower pots.		

SAMPLE 1578

SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 36, T. 9 N., R. 1 E.

	Thickness:	Ft.	In.		
Overburden					
Overlying rocks		31		Extrusion properties	Good
Coal			8	Water of plasticity, percent	25.0
Underclay (sample 1578)		2		Linear drying shrinkage, percent	6.0
Coal			2		
Firing temperature			1832°F	2012°F	2200°F
Linear firing shrinkage, percent			3.5	8.5	+2.0
Total linear shrinkage, percent			9.5	14.5	4.0
Fired color			Dark pink	Brick red	Brick red

Surface texture of fired test bar: Bloating started at 2200°F.

Bonding properties: 7.22 (GCS psi); 2.30 (optimum H₂O).

Possible uses: Bonding clay, lightweight aggregate, structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1579

SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 36, T. 9 N., R. 1 E.

	Thickness:	Ft.	In.		
Overburden					
Overlying rocks		33		Extrusion properties	Fair
Coal			2	Water of plasticity, percent	21.0
Underclay (sample 1579)		5	8	Linear drying shrinkage, percent	3.5
Coal streak					
Firing temperature			1832°F	2012°F	2200°F
Linear firing shrinkage, percent			2.0	8.0	8.0
Total linear shrinkage, percent			5.5	11.5	11.5
Fired color			Pink	Salmon	Red-brown

Surface texture of fired test bar: Has rough edges.

Bonding properties: 5.88 (GCS psi); 2.37 (optimum H₂O).

Possible uses: Structural clay products, sewer pipe, drain tile, pottery, flower pots.

SAMPLE 1580

SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 36, T. 9 N., R. 1 E.

	Thickness:	Ft.	In.		
Overburden					
Overlying rocks		38		Extrusion properties	Fair
Coal streak			1/8	Water of plasticity, percent	23.0
Underclay (sample 1580)		4	2	Linear drying shrinkage, percent	5.0
Sandstone					
Firing temperature			1832°F	2012°F	2200°F
Linear firing shrinkage, percent			1.5	9.0	7.5
Total linear shrinkage, percent			6.5	14.0	12.5
Fired color			Pink	Salmon	Brick red

Surface texture of fired test bar: Slight bloating started at 2200°F.

Bonding properties: 4.50 (GCS psi); 1.70 (optimum H₂O).

Possible uses: Structural clay products, sewer pipe, drain tile, pottery, flower pots.

SUMMARY

Most of the clay deposits tested can be used for making structural clay products, lightweight aggregates, flower pots, drain tile, sewer pipe, and pottery.

The underclays studied in this report are for the most part similar in their behavior. The majority had low strengths as bonding clays. Those with the higher strengths probably are associated with a thin, green clay lying below them that has good bonding properties but is too thin in this area to be used commercially.

Thickness of the overburden in the areas sampled ranges from 10 to 70 feet, but generally is from 25 to 40 feet.

The most favorable areas for prospecting for clay are in the southern part of the county. The thicker underclays generally are found along the southwest border of the county close to Warren and Fulton Counties. The lightest burning clays were obtained from the southwestern part of the county.

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