Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

| | |
|---|---|
| AP42 Section: | 11.3 |
| Background Chapter | 4 |
| Reference: | 19 |
| Title: | *Stationary Source Sampling Report: Lee Brick And Tile Company, Sanford, NC, Compliance Testing, Tunnel Kiln,* Entropy Environmentalists, Inc., Research Triangle Park, NC, February 1978. |

AP-42 Section 11.3
Reference NOT USED
Report Sect. 4
Reference 19

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ENTROPY ENVIRONMENTALISTS, INC

SPECIALISTS IN SOURCE SAMPLING

# STATIONARY SOURCE SAMPLING REPORT

LEE BRICK AND TILE COMPANY
SANFORD, NORTH CAROLINA
COMPLIANCE TESTING
TUNNEL KILN

FEBRUARY 1978

PERFORMED FOR
PULLMAN-SWINDELL, INC.

P.O. Box 12291, Research Triangle Park, North Carolina 27709
Phone 919-781-3550

REPORT CERTIFICATION

The sampling and analysis performed for this report was carried out under my direction and supervision.

Date February 17, 1978 Signature _____

Roy N. Doster

I have reviewed all testing details and results in this test report and hereby certify that the test report is authentic and accurate.

Date February 17, 1978 Signature _____

D. James Grove, P.E.

TABLE OF CONTENTS


| SECTION | PAGE |
|---|---|
| INTRODUCTION | 1 |
| SUMMARY OF RESULTS | 2 |
| PROCESS DESCRIPTION AND OPERATION | 7 |
| SAMPLING AND ANALYTICAL PROCEDURES | 10 |
| APPENDICES | 12 |
| A - Particulate Results and Calculations | |
| B - Particle Sizing Results and Calculations | |
| C - Field, Analytical, and Process Data | |
| D - Test Participants | |
| E - Sampling and Analytical Procedures | |
| F - Calibration Data | |

# INTRODUCTION

Stationary source sampling was performed at Lee Brick and Tile Company, Sanford, North Carolina to determine the particulate emissions from a coal-fired tunnel kiln. Three sets of simultaneous particulate tests were made on each of the two kiln stacks on February 9, 1978. In addition, a particulate sizing test was performed on each stack.

Observing the testing were Paul Sieffert and Scott Frame of Pullman-Swindell, Inc., and Sammy Amerson of the North Carolina Department of Natural Resources and Community Development.

The measurements made for stack gas flow rate and particulate emissions were made according to North Carolina Department of Natural Resources and Community Development recommendations.

The following sections of this report treat the summary of results, a brief description of the process and its operation, and the sampling and analytical procedures used.

## SUMMARY OF RESULTS

Presented in Table 1 below are the emission rates as determined by the six particulate emission tests performed on the tunnel kiln outlets. The values shown are reasonably consistent and reflect the non-changing nature of the process.

Table 1

Particulate Emissions

| Test Set No. | Pounds Per Hour South | North | Total |
|---|---|---|---|
| 1 | 24.0 | 2.01 | 26.0 |
| 2 | 22.5 | 1.89 | 24.4 |
| 3* | 19.4 | 1.71 | 21.1 |
| Avg. | 22.0 | 1.87 | 23.8 |

*During the third set of tests, the kiln doors were not opened.

According to North Carolina Regulation 2D.0515, the maximum allowable emission rate is 17.7 pounds per hour. This is based on a process weight rate of 8.90 tons per hour and includes an estimate of the coal being combusted.

Table 2 and 3 on the following pages give the individual test summaries for the tests performed at stack #1 (south) and stack #2 (north), respectively. Table 4 presents the results from the two particle sizing tests performed. In



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TABLE 2

SUMMARY OF RESULTS, PARTICULATE EMISSIONS

KILN STACK #1, SOUTH

| RUN NUMBER | 1 | 2 | 3 |
|---|---|---|---|
| DATE | 2/ 9/78 | 2/ 9/78 | 2/ 9/78 |
| STACK TEMPERATURE, DEG. F | 306. | 303. | 308. |
| PERCENT EXCESS AIR | 565. | 565. | 565. |
| PERCENT ISOKINETIC | 96.8 | 96.1 | 99.5 |
| STACK FLOW RATE SCFM* DRY | 20905. | 21714. | 21012. |
| STACK FLOW RATE ACFM,WET | 31560. | 32827. | 31912. |
| VOLUME OF GAS SAMPLED SCF* DRY | 60.89 | 70.21 | 63.42 |
| PARTICULATES, EPA METHOD 5: | | | |
| CATCH - MGRAMS | 528.7 | 550.0 | 443.2 |
| CONCENTRATION - GR/DSCF* | 0.1337 | 0.1206 | 0.1076 |
| EMISSION RATE - LBS/HR | 23.96 | 22.45 | 19.38 |

* 68 DEG F, 29.92 IN. HG

TABLE 3

SUMMARY OF RESULTS, PARTICULATE EMISSIONS

KILN STACK #2, NORTH

| RUN NUMBER | 4 | 5 | 6 |
|---|---|---|---|
| DATE | 2/ 9/78 | 2/ 9/78 | 2/ 9/78 |
| STACK TEMPERATURE, DEG. F | 336. | 336. | 335. |
| PERCENT EXCESS AIR | 565. | 565. | 565. |
| PERCENT ISOKINETIC | 98.7 | 97.6 | 95.4 |
| STACK FLOW RATE SCFM* DRY | 1522. | 1422. | 1461. |
| STACK FLOW RATE ACFM,WET | 2376. | 2226. | 2281. |
| VOLUME OF GAS SAMPLED SCF* DRY | 19.05 | 17.83 | 17.90 |
| PARTICULATES, EPA METHOD 5: | | | |
| CATCH - MGRAMS | 190.6 | 179.9 | 158.9 |
| CONCENTRATION - GR/DSCF* | 0.1541 | 0.1554 | 0.1367 |
| EMISSION RATE - LBS/HR | 2.01 | 1.89 | 1.71 |

* 68 DEG F, 29.92 IN. HG

Table 4

Particle Size Summary

| ----Stack #1 (South)------ | | ----Stack #2 (North)------- | |
|---|---|---|---|
| Aerodynamic Diameter (microns) | Cumulative % Less Than Stated Size | Aerodynamic Diameter (microns) | Cumulative % Less Than Stated Size |
| 10.7 | 93.0 | 15.7 | 97.6 |
| 6.72 | 80.6 | 9.79 | 96.1 |
| 4.48 | 63.2 | 6.55 | 88.6 |
| 3.11 | 43.5 | 4.55 | 80.6 |
| 1.96 | 29.2 | 2.85 | 71.6 |
| 1.01 | 10.1 | 1.48 | 56.7 |
| 0.61 | 2.5 | 0.91 | 48.2 |
| 0.41 | 1.7 | 0.63 | 36.3 |
| Median Size: approx. 3.3 microns | | Median Size: approx. 1.3 microns | |

addition to the Andersen tests, the first set of simultaneous tests used cyclones ahead of the filter. No large particles were caught, although some small particles did adhere to the cyclone's surface due to static electricity.

## PROCESS DESCRIPTION

Lee Brick and Tile Company in Sanford, North Carolina manufactures bricks, which involves the screening and blending of the raw materials, and the drying and firing of the final, shaped, product.

The firing of the bricks takes place in a tunnel kiln, with the bricks traveling on cars on rails through the kiln. After a set time, a car leaves the kiln at the same time a car is entering the kiln at the other end. At this time, doors at the end of the kiln are opened, allowing ambient air to enter uncontrolled.

Firing takes place in six steps: evaporation of free water, dehydration, oxidation, vitrification, flashing, and cooling. The actual fire zone is located near the middle of the kiln, with the 2000°F temperature provided by the combustion of coal. As shown in Figure 1, ambient air is used to cool the bricks and conversely preheat the air for the firing zone. Also some of the preheated air is ducted to the brick dryer for drying the bricks. The kiln is exhausted by two fans at opposite ends of the kiln.

Potential emissions from the kiln consists mainly of particulate matter in the form of dust generated by the handling of the bricks, and of combustion products from the coal. No emission control equipment is presently in use.

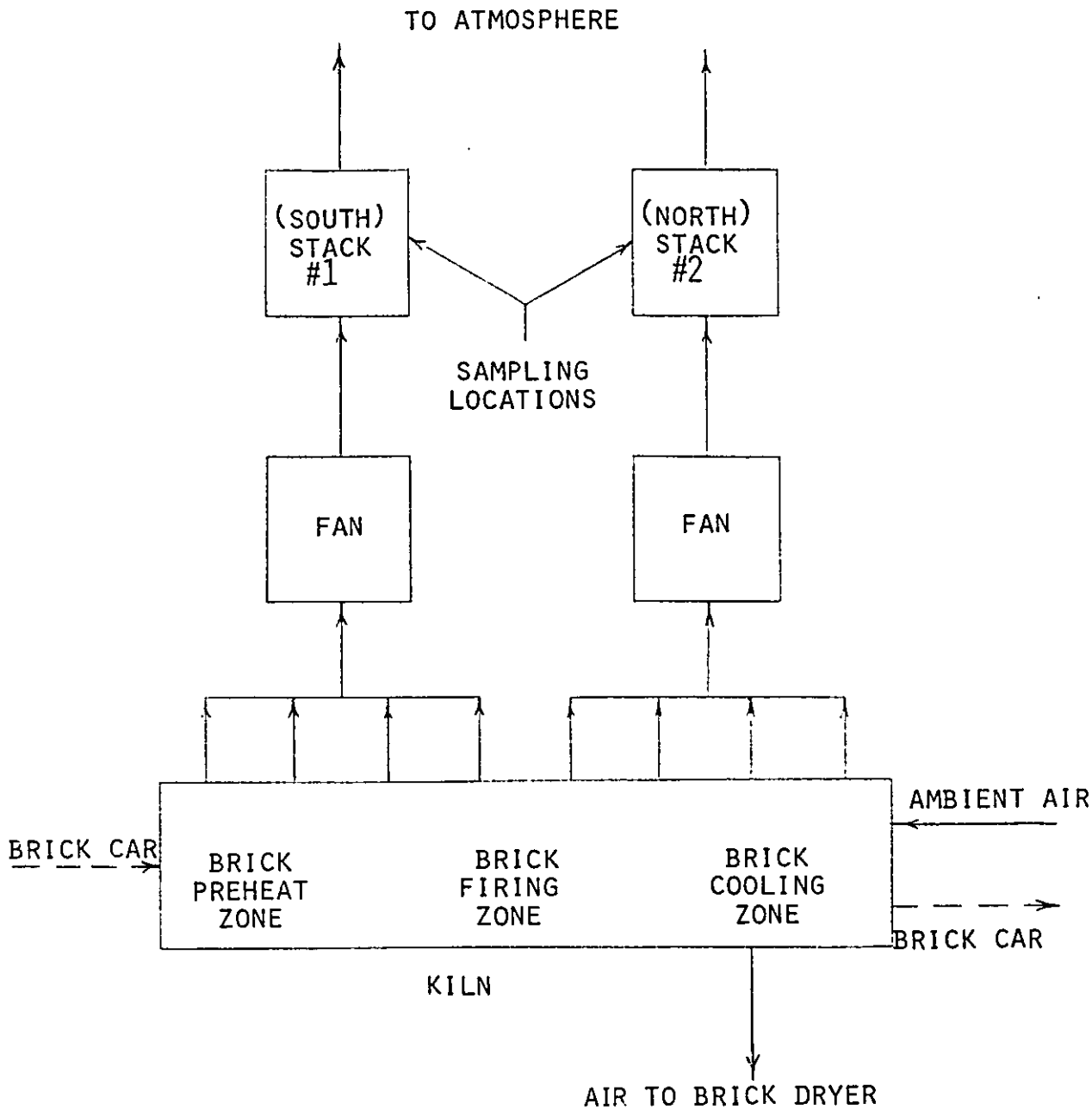


FIGURE 1. PROCESS SCHEMATIC AND SAMPLING LOCATIONS



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During the testing performed at the outlet of the two kiln exhaust fans, the kiln was firing a carload of 8064 type #320 bricks every 100 minutes. With an average brick weight of 3.43 pounds, this converts to a process rate of 8.3 tons of bricks per hour. When the estimated coal usage rate of 0.60 tons per hour is added, the total process weight rate is 8.90 tons per hour.

It is suspected that the opening of the kiln doors increases the emissions; therefore, the last of the three sets of tests performed was made without a door opening occurring. As shown in Table 1 in the Summary of Results, the particulate tests did show a decrease in the emissions.

## SAMPLING AND ANALYTICAL PROCEDURES

All sampling and analytical procedures used were those recommended by the U. S. Environmental Protection Agency and the North Carolina Department of Natural Resources and Community Development. Complete details of the equipment and procedures used are described in Appendix E, which is extracted from the Federal Register, August 18, 1977. Also included in Appendix E is a writeup of the Andersen particle sizing equipment and how to use it.

Method 1 was used to determine the number and location of the sampling points. The two kiln exhaust stacks are identical, with each stack cross section divided into 44 equal areas. Two ports labeled A and B, as shown in Figure 2, access the traverse axes, with each axis having 22 points. Every point was sampled for one and a half minutes, giving a total testing time of 66 minutes for each run on a stack.

Velocity measurements were in accordance with Method 2. Molecular weights for the stack gases were determined by Method 3 procedures. Particulate emissions were found using Method 5 analytical and sampling procedures. The particle sizing tests were made using Andersen Mark III Stack Samplers.

All sampling equipment used was manufactured by Nutech Corporation, Entropy Environmentalists, Inc., or Andersen 2000, Inc.

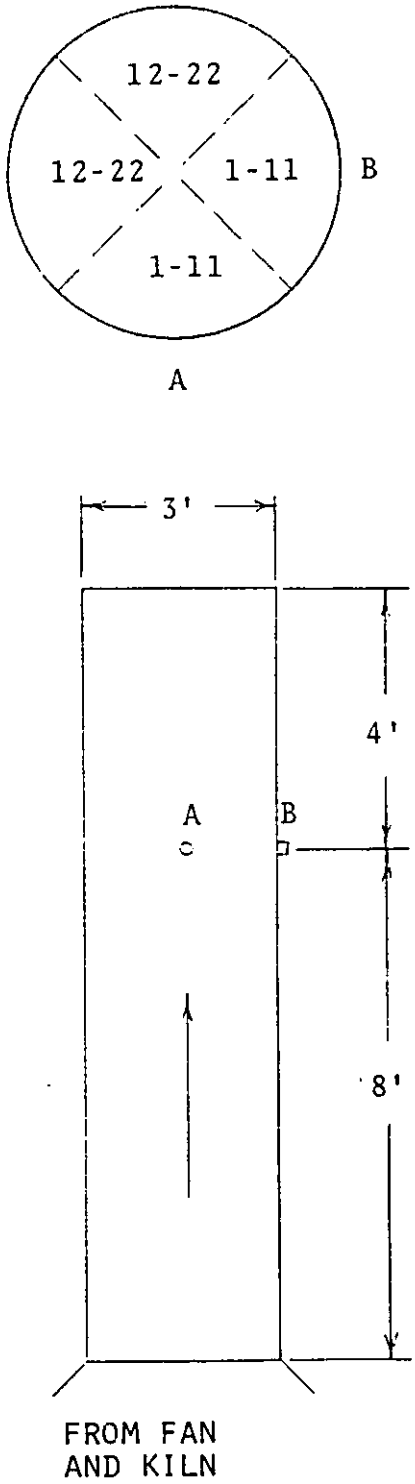


FIGURE 2. STACK DIMENSIONS AND SAMPLING POINT LOCATIONS, KILN EXHAUST STACKS ( 1 AND 2)



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