UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

JUN 30 1983

MRI

Mr. Frederick W. Eaton
Environmental Coordinator
W. R. Grace & Company
Construction Products Division
62 Whittemore Avenue
Cambridge, Massachusetts 02140

Enclosure 2

Dear Mr. Eaton:

The plant visit report on the W. R. Grace & Company perlite/vermiculte plant in Irondale, Alabama, has been rewritten as requested in your June 20, 1983, transmittal and is considered a final report. None of the information contained in the trip report is considered confidential by W. R. Grace & Company, as indicated in your transmittal.

Thank you for including the emission test report on Grace's Libby facility with your trip report comments. We respectfully request that you submit the three Section 114 information requests mailed to W. R. Grace & Company on December 30, 1982, by July 22, 1983. If you have any questions or additional comments, please contact me at (919) 541-5595.

Sincerely yours,

William J. Neuffer

William J. Neuffer
Industrial Studies Branch
Emission Standards and
Engineering Division

Enclosure

MIDWEST RESEARCH INSTITUTE
4505 Creedmoor Road
Raleigh, N.C. 27612
Telephone (919) 781-5750

FINAL

Date: May 13, 1983
Finalized June 29, 1983

Subject: Site Visit: W. R. Grace & Company, Irondale, Alabama
Calciners and Dryers in Mineral Industries
EPA Contract 68-02-3817; ESED Project 81/08
MRI Project 7702-L

From: Amy J. Nelson AJN

To: William Neuffer
ESED/ISB/SSAS (MD-13)
U.S. Environmental Protection Agency
Research Triangle Park, N.C. 27711
(919) 541-5595

I. Purpose

To observe the operation of a perlite expansion furnace, a vermiculite expansion furnace, and the air pollution control equipment associated with each furnace.

II. Place and Date

W. R. Grace & Company
2601 Commerce Blvd.
Irondale, Alabama 35210
(205) 956-9545
April 13, 1983

III. Attendees

W. R. Grace & Co., Construction Products Division

Frederick W. Eaton, Environmental Coordinator
Corporate Office, Cambridge, Mass.
(617) 876-1400
Clarence Duckworth, Plant Manager; Irondale, Ala.

Alabama Bureau of Environmental Health

Mohammed N. Huda, Inspector
Birmingham, Ala.
(205) 933-9110, ext. 1212

U.S. Environmental Protection Agency

William Neuffer, ISB

Midwest Research Institute

Lloyd T. Taylor, MRI/Raleigh
Stacy G. Smith, MRI/Raleigh
Amy J. Nelson, MRI/Raleigh

IV. Discussion

The major points of discussion during this site visit were: (1) various W. R. Grace & Co. (Grace) plants, (2) perlite and vermiculite expansion furnaces, and (3) air emission control systems. An information request was sent to Mr. Eaton in December 1982 and will be returned to Mr. Neuffer as soon as possible with further information about the Irondale facility and three other Grace plants (Milwaukee, Wis.; Enoree, S.C.; Libby, Mont.).

A. General Discussion

The following information was provided by Mr. Eaton. Grace operates 28 expansion plants in the U.S. Expanded vermiculite is the primary product produced at these 28 facilities; expanded perlite is also produced at Grace's Irondale, Ala.; Pompano Beach, Fla.; and Wilder, Ky. plants. Perlite expansion facilities at Milwaukee, Wis.; Denver, Colo.; Trenton, N.J.; and Omaha, Nebr. have been closed in the past 15 years. The shutdowns were due mainly to reduced product demand and competition from vermiculite for product uses. Perlite is much more difficult to process than vermiculite, i.e., very abrasive and takes much more heat to expand. Grace is currently expanding perlite primarily for horticultural uses. Grace does not mine perlite. They purchase most of their perlite ore for expansion from large mines such as Grefco, Inc., and Johns-Manville in New Mexico.

1. Libby, Montana. Grace mines vermiculite ore from two deposits; one located in Libby, Mont., and one in Enoree, S.C. The Libby, Mont., deposit is the largest deposit in the world. Mr. Eaton estimated that the plant has 40 years of ore reserves. The Libby mining facility was rebuilt in 1974-1975 to increase ore recovery. At that time, four rotary dryers were replaced with one fluid-bed dryer (FBD) with approximately the same energy consumption as the four rotary units combined. The process flow diagram for the new Libby mill is shown in Figure 1.

Grace utilizes a primary cyclone and a baghouse for particulate emission control at Libby. All collection equipment is enclosed in the mill building. The plant produces all five sizes of vermiculite concentrate (1-5); No. 1 is the largest grade of concentrate, and No. 5 is the smallest. No. 5 is usually not expanded but is sold to gypsum manufacturers for use

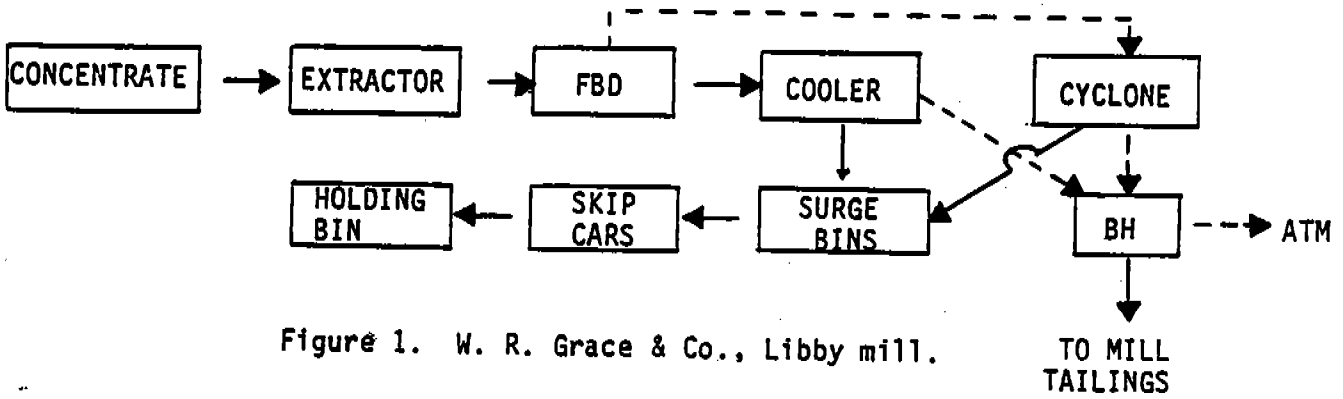

Figure 1. W. R. Grace & Co., Libby mill.

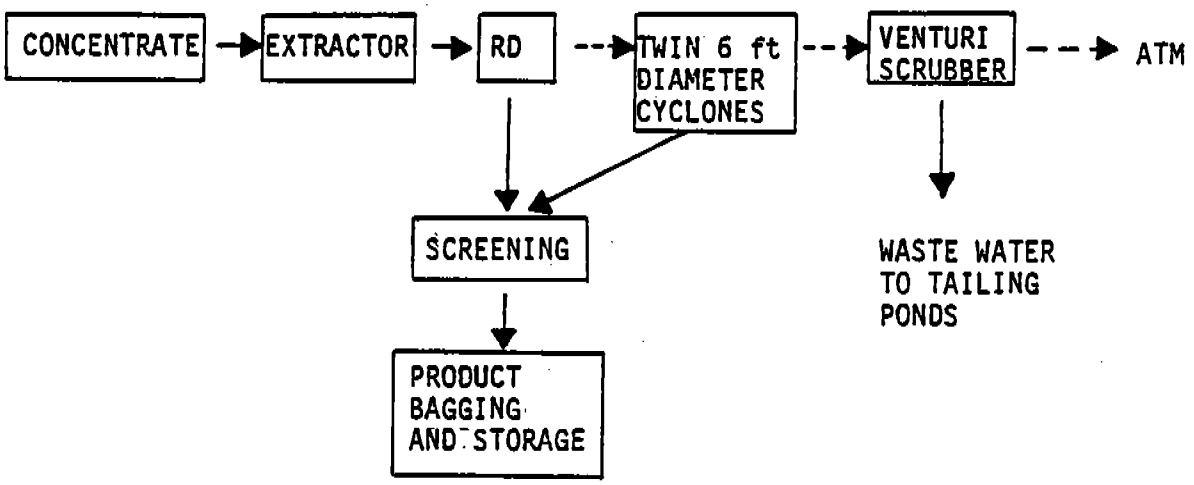

Figure 2. W. R. Grace & Co., Enoree mill.

— — → AIR FLOW

——→ PRODUCT FLOW

in fire retardant wallboard. Mr. Eaton stated that Grace does not envision any further expansions or modifications in the drying section of the Libby plant. (Mr. Eaton will send Mr. Neuffer a complete emission test report for the FBD and baghouse control.)

2. Enoree, S.C. The second largest U.S. vermiculite deposit is near Enoree, South Carolina. The Enoree mill is essentially a smaller version of the original Libby mill. Grace mines and beneficiates vermiculite ore and dries it in a rotary dryer (RD). A screening plant follows the dryer to separate concentrate sizes 3, 4, and 5. Sizes 1 and 2 are not produced at Enoree. A section of the process flow diagram for the Enoree mill is shown in Figure 2.

A venturi scrubber was installed at Enoree because the cost of an auxiliary heater to avoid condensation problems in the baghouse was prohibitive. A baghouse was preferred for fines recovery. In general, Grace utilizes baghouse control whenever possible; however, problems with the dew point often require that the baghouse be enclosed in a building and/or supplemental heat be added to the gas stream in insulated ducting.

Grace also operates four vermiculite expansion furnaces at Enoree, each with a product collection cyclone and baghouse. Grace designs and builds all of its own vermiculite furnaces. Other companies utilize either Grace-designed furnaces, furnaces manufactured by the Strong Company of Pine Bluff, Arkansas, or others. All vermiculite expansion facilities that Grace has have baghouse control on their expansion furnaces. All fabric filter bags comply with asbestos NESHAP regulations.

3. Vermiculite Expansion. The pre-sized, dried vermiculite concentrate is expanded one grade at a time. Increased loading to the baghouse results as concentrate size decreases. The smallest concentrate to be expanded is No. 4, which produces a particulate loading rate to the baghouse of approximately 4.5 kg/h (10 lb/h). According to Mr. Eaton, variations in ore quality exist due to the location of the deposit and the wet processing involved; however, these variations in ore quality, including particle size, do not affect particulate emissions. It is much more cost effective to ship the more dense, dried ore to the expansion plants; therefore, every effort is made to reduce the unexpandable rock content prior to shipping.

Expanded No. 4 vermiculite is used primarily for lightweight concrete. In some cases, an asphalt emulsion is applied to the expanded particles as they fall out of the furnace. The coating makes them water repellent and useful as a masonry fill. Expanded No. 3 vermiculite is usually in great demand because of its industrial, horticultural, and mixed product usage. The coarse No. 1 vermiculite is most commonly used as a loose-fill insulation.

4. Perlite Expansion. There are two main types of perlite expansion furnaces: horizontal and vertical. The Perlite Corporation of Chester, Pa., makes both types, while the Silbrico Corporation in Hodgkins, Ill.,

produces only a vertical model. Most facilities use one of these two brands. The trend in the industry is toward the smaller diameter, vertical types because of their higher fuel efficiency. There is no difference in the difficulty of emission control between the vertical and horizontal units. In both types, all perlite concentrate charged to the furnace, less nonexpandables, is air-conveyed to the product collection cyclone. Both types of furnaces are typically controlled with baghouses. Bags are normally replaced once a year; however, because of the abrasive nature of perlite, some bag replacement may be required more frequently.

The main objectives of a Grace plant are product purity and in-plant dust collection. All plants stress good housekeeping and utilize vacuums instead of brooms to clean around equipment.

B. Process Description--Irondale

Grace operates one perlite expansion furnace and one vermiculite expansion furnace at its Irondale facility. Each furnace is equipped with a cyclone, baghouse, and product bagging equipment.

1. Perlite. Grace expands coarse-grade perlite for horticultural uses in its Perlite Corporation Model VS-450 vertical expansion furnace. The pre-sized perlite concentrate is fed into the 0.7-m (28-in.) diameter stainless steel furnace through a surge preheater at a rate of 908 kg/h (2,000 lb/h). Four variable speed screw feeders on the side of the furnace inject the perlite 1.5 to 1.8 m (5 to 6 feet) above the combustion burner. The perlite is expanded 4 to 20 times its original volume in the hot zone of the furnace at temperatures of 982° to 1093°C (1800° to 2000°F). Baghouse exhaust fans convey [170 m^3/min (6,000 cfm)] the expanded perlite particles through 30.5-cm (1-ft) diameter circular dictwork to a 1.75-m (69-in.) diameter product collection cyclone. The collected perlite falls through a cooler/ classifier unit prior to bagging. The air stream from the product cyclone and cooler/classifier cyclone passes through a four-compartment Perlite Corporation baghouse prior to being emitted to the atmosphere. Figure 3 shows an expansion furnace with the Perlite Corporation cyclone and baghouse that is similar to the system used at Grace.

2. Vermiculite. The vermiculite expansion furnace is a Grace-designed Model D-18. The dried vermiculite concentrate from Grace's Libby, Mont., mill is carried from railcars to a concentration hopper by a belt conveyor. The concentrate is then carried by belt feeder and bucket elevator up to a drum feeder located at the top of the 45.7-cm (18-in.) diameter stainless steel furnace expansion tube. The furnace gas temperature controls the rate of concentrate feed through the six feed pipes which surround the combustion burner. The vermiculite expands 8 to 10 times, from a density of 0.9 g/cm^3 (55 lb/ft^3) to 0.10 to 0.13 g/cm^3 (6 to 8 lb/ft^3) as it falls through the furnace and is then carried through a discharge chute into a finished product elevator. The expanded vermiculite passes over a vibrating screen (stoner) to separate the unexpandable rock. The final product is

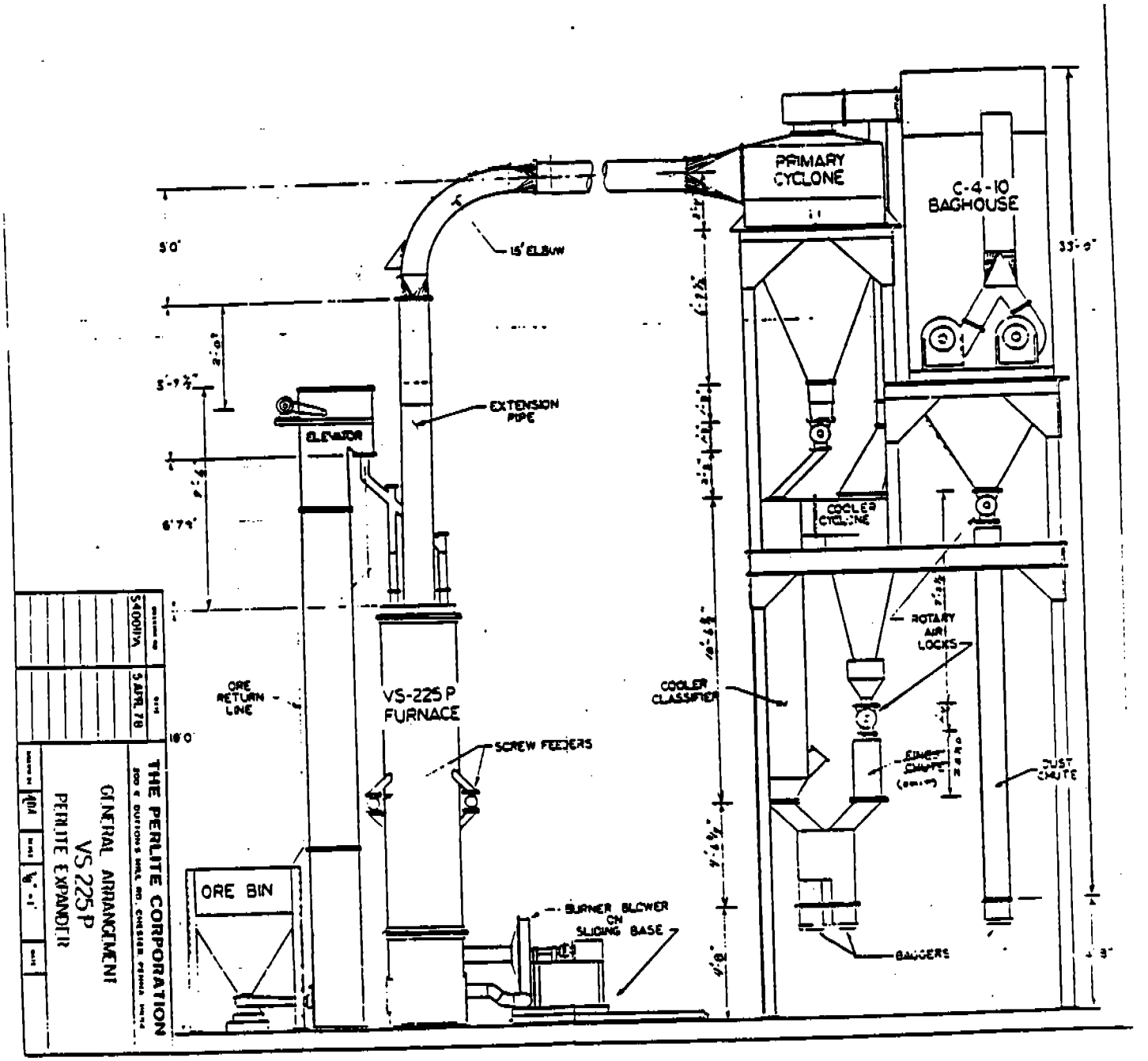

Figure 3. Perlite explansion system
W. R. Grace & Co.

bagged in either 0.08-, 0.11-, or 0.17-m^3 (3-, 4-, or 6-ft^3) bags. The air stream passes through a 137.2-cm (54-in.) diameter cyclone and a Flex-Kleen baghouse prior to being emitted to the atmosphere. The fan that provides the motive force for the furnace system is a Westinghouse 418 designed to deliver 2.7 m^3/min (5,800 cfm) at 2.5 kPa (10 in. w.c.). The complete expansion and control system is located inside the main building. Figure 4 shows the process flow for vermiculite.

C. Control Equipment

1. Perlite. The Perlite Corporation baghouse on the perlite expansion furnace has 213.7 m^2 (2,300 ft^2) of cloth area in woven glass bags. The baghouse is scheduled to be replaced in 6 to 8 weeks with an identical unit. The partitions within the existing unit are eroded, which results in inefficient dust transfer during cleaning cycles. Four fans (one per compartment) operate sequentially to clean the bags. Variable timers sequence the fans and the duration of the off cycle for each fan. The criteria for setting baghouse cleaning frequency are: (1) minimum pressure drop so as to maintain adequate filter cake on the bags, (2) a pressure drop that still maintains adequate dust control and/or product air conveying, and (3) a frequency that does not overtax control equipment and air supply. Mr. Eaton informed us that a number of bags had been replaced the day before our visit. Visible emission (VE) observations made by Mr. Smith and Mr. Neuffer on the two parallel baghouse stacks are given in Attachment 1. Mr. Eaton noted that the periodic occurrences of emissions of higher opacity (i.e., during cleaning cycles) were typical of the Perlite Corporation baghouses operated by Grace.

2. Vermiculite. Table 1 gives the design criteria for the Flex-Kleen baghouse used to control emissions from the vermiculite expansion furnace. The pressure drop through the baghouse is 4.9 to 14.9 kPa (2 to 6 in. w.c.). The frequency of reverse-air pulse cleaning on Grace's vermiculite baghouses can vary from 2 to 30 seconds per header, and on some installations the frequency of cleaning is controlled by pressure differential. The average inlet and outlet dust loadings are 4.5 kg/h and 0.45 kg/h (10.0 lb/h and 0.1 lb/h), respectively. This is equivalent to 0.45 and 0.003 g/m^3 (0.2 and 0.002 gr/acf). The baghouse is designed to remove 99+ percent of the particulates entering the filter. Based on particle size and dust loading, the primary cyclone has a collection efficiency of approximately 97 percent. According to Mr. Eaton, these data are based on actual emission tests for similar units. The VE readings taken on the baghouse stack show 0 percent opacity (Attachment 2).

3. Operation and Maintenance. Grace employees determine when baghouse bags need replacement by monitoring visible emissions. When VE readings indicate continuous emission of particulates, the bags are replaced and/or repaired. Often the bags are laundered two to three times before replacement.

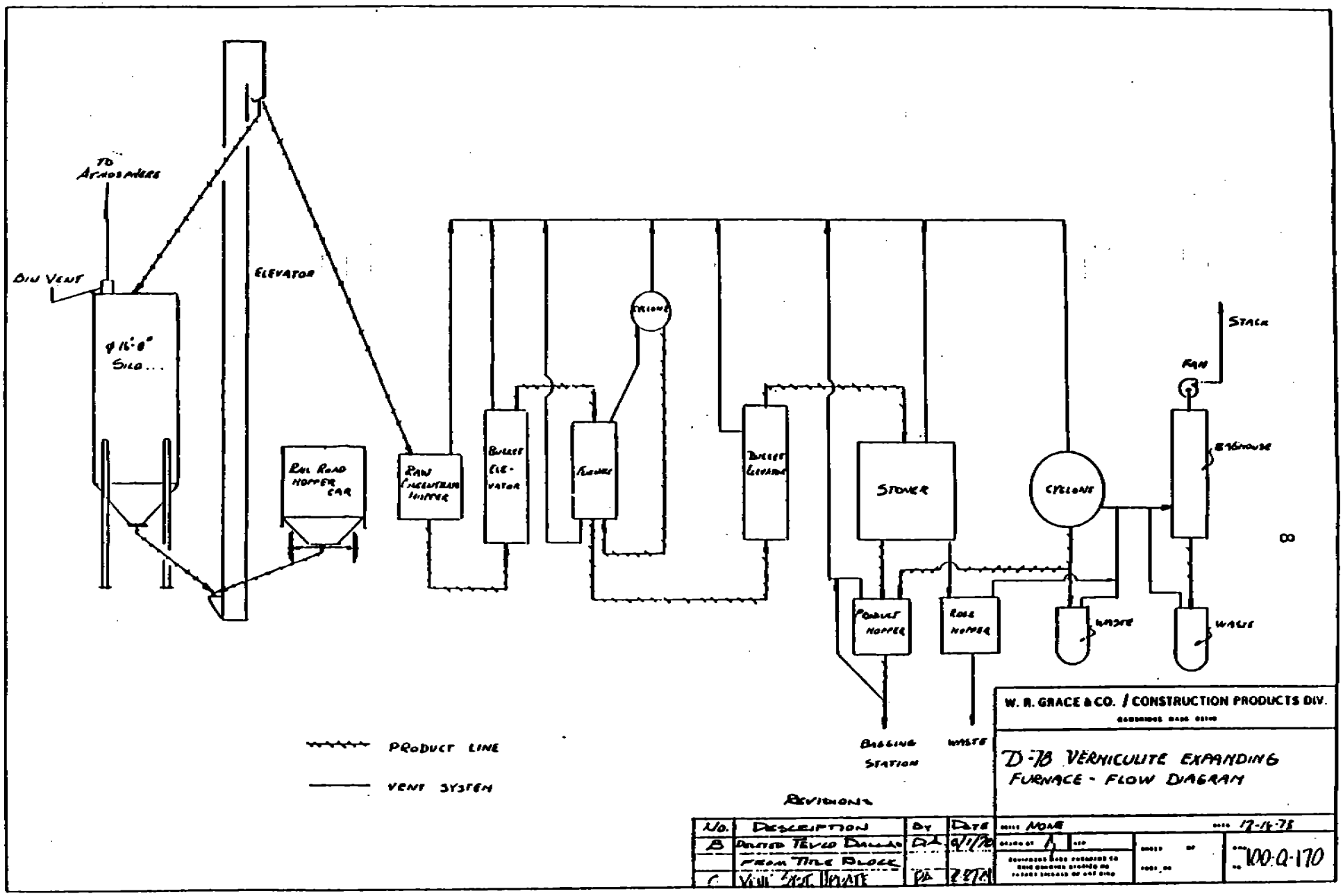

Figure 4. Vermiculite expansion system.

TABLE 1. DESIGN CRITERIA--FABRIC FILTER VERMICULITE EXPANSION FURNACE

Air flow:	5,800 cfm at 230°F
Filter area:	960 ft^2
Air-to-cloth ratio:	6:1
Filter material:	14 oz Nomex felt
Air permeability:	20-30 cfm/ft^2 at 0.5 in. w.c.
Design pressure:	Shell ~13 in. w.c.
Design temperature:	400°F
Cleaning action:	Reverse-air jet, activitated by timer
Cleaning air:	High pressure (100 psig); air supplied by self-contained air compresser

V. Conclusions/Recommendations

Mr. Eaton considers the W. R. Grace & Co. plant in Irondale, Ala., to be typical of perlite/vermiculite expansion facilities. It would be possible to test both the inlet and outlet of the vermiculite baghouse; however, no ports are available. There is inadequate ductwork to test the inlet on the perlite baghouse. The parallel 30.5-cm (1-ft) diameter stacks on the perlite baghouse would be less than ideal for outlet testing; however, outlet testing would be feasible with the proper stack modifications.

2 Attachments

ATTACHMENT 1

Record of Visible Emissions--Perlite

MIDWEST RESEARCH INSTITUTE

RECORD OF VISIBLE EMISSIONS

Company Name: W.R. GRACE & Co.
Plant Address: IRONDALE, AL
Stack Location: PERLITE BH
Weather Conditions: CLEAR, WINDY

Date: 4/13/83
Observer: S.G. SMITH, W J. NEUFFER
Observer's Location: ROOF

TIME						COMMENTS
HR	MIN	SECONDS				SOUTH STACK
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	00	5	5	5	5	NO PUFFS
	01	5	10	5	10	ASSOCIATED
	02	10	5	10	5	WITH THE
	03	5	10	5	5	CLEANING
	04	10	5	5	5	CYCLE WERE
	05	5	10	5	5	OBSERVED
	06					DURING
	07					THESE
	08	5	10	10	5	READINGS
	09	5	5	5	5	
	10	0	10	10	5	
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TIME						COMMENTS
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Attachment 2

Record of Visible Emissions--Vermiculite

MIDWEST RESEARCH INSTITUTE

RECORD OF VISIBLE EMISSIONS

Company Name: W.R. GRACE & CO.
Plant Address: IRONDALE, AL
Stack Location: VERMICULITE BH
Weather Conditions: CLEAR, WINDY

Date: 4/13/83
Observer: A.J. NELSON
Observer's Location: PARKING LOT

TIME						COMMENTS	TIME						COMMENTS
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