AP-42 Section 11.28
Reference 5
Report Sect. BR
Reference 6

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

OCT

C.P.D. ENG

October 6, 1981

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

Enclosure 3

Dear Mr. Eaton:

The plant visit report on W.R. Grace's vermiculite mill at Enoree, South Carolina has been rewritten as requested in your September 2, 1981, transmittal and is considered a final report. In addition, I have included a few items as discussed with you in a subsequent telephone conversation. As mentioned in your transmittal letter, none of the information contained in the trip report is considered confidential by W.R. Grace and Company.

Again, thanks for your help. If you have any questions or additional comments, please contact me at (919) 541-5595 by October 19, 1981.

Sincerely yours,

William J. Neuffer

William J. Neuffer
Stationary Source Analysis Section
Industrial Studies Branch
Emission Standards and
Engineering Division

Enclosure

cc: Steve York, RTI

DATE: OCT 6 1981 Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

SUBJECT: Trip Report for the September 30, 1980, Visit to W.R. Grace and Company, Enoree, South Carolina ESED Project No. 81/08

FROM: William J. Neuffer WJN
Stationary Source Analysis Section, ISB, ESED (MD-13)

TO: Gilbert H. Wood, Chief
Stationary Source Analysis Section, ISB, ESED (MD-13)

PURPOSE

To obtain detailed information and data on dryers and expansion furnaces and associated air pollution control equipment used in the production of vermiculite. This mineral may be part of the source category for the Phase I study of Mineral Calciners and Dryers (ESED Project Number 81/08).

PLACE AND DATE

W.R. Grace and Company
Enoree, South Carolina 29335
September 30, 1980

ATTENDEES

Mr. Gary Vaplon, General Manager, Construction Products Division, W.R. Grace and Company, Enoree, SC 29335 (803) 969-3353

Mr. Floyd Stewart, Administration Manager, W.R. Grace and Company, Enoree, SC 20335 (803) 969-3353

Mr. Frederick W. Eaton, Environmental Coordinator, Construction Products Division, W.R. Grace and Company, 62 Whittemore Avenue, Cambridge, MA 02140 (617) 876-1400

Mr. Claude T. Miller, Environmental Quality Manager, Bureau of Field and Analytical Services, South Carolina Department of Health and Environmental Control, R129 One Park Avenue, Suite 217; Greenwood, South Carolina 29646 (803) 223-0333

Mr. Rodney Wilson, Mechanical Engineer, U.S. EPA, OAQPS, ESED, ISB, SSAS (MD-13) Research Triangle Park, NC 27711 (919) 541-5595

Mr. W. Larry Elmore, Civil Engineer, U.S. EPA, OAQPS, ESED, ISB, SSAS (MD-13) Research Triangle Park, NC 27711 (919) 541-5595

Mr. William Neuffer, Environmental Engineer, U.S. EPA, OAQPS, ESED, ISB, SSAS, (MD-13) Research Triangle Park, NC 27711 (919) 541-5595

Discussion

The vermiculite ore is mined from open pits by dozers and loaded by draglines into 25 ton haul trucks. Normally, ore is hauled from two mines on one 10-hour shift, four or five days per week. Ten to twelve trucks are used to haul the ore. Mines or deposits are located in parts of three counties and are from 4 to 28 miles to the mill located near Enoree. The average haul distance is approximately 12 miles. Approximately 80-85 personnel are employed at the mine and mill and 30 at the expanding plant.

The ore as mined is composed of seven or more associated minerals, contains 14% surface moisture, and is 90-95% smaller than 2.5 cm (1") in size.

At the mill, ore is dumped into piles in an open area and is blended by a dozer before being fed to the mill. The separation process used is the wet type utilizing flotation to remove the vermiculite from the clay, hornblende, feldspar, amphibole, and other minerals. The vermiculite concentrate is then dewatered by a belt filter to approximately 20% surface moisture content. The filtered concentrate is dried in an 18.3 meters x 2.1 meters (60 foot long x 7 foot dia.) rotary, direct-fired dryer. The surface moisture in the concentrate is reduced to 3 or 4%. The concentrate is then conveyed by bucket elevators to a series of vibrating screens that separate it into three sizes, (#3, 8-28 mesh; #4, 20 +60 mesh; and #5, minus 50 mesh) with an average bulk density of 55 lbs/cf. All sizes are stored in silos. Additional flat building storage is available for the #3 and #4.

Expand.

The concentrate is shipped by rail (closed hopper cars) to vermiculite expanding plants located in the Southeast and to gypsum plant customers (sizes 4 and 5), generally in 100 lb bags, via truck or rail box cars. Approximately 25% of the total concentrate produced by the mill is exfoliated at the expanding plant located on the property at Enoree.

The tailings from the wet mill and the waste rock from the expanding plant are pumped to settling basins. The water overflows to additional reservoirs for clarification and is recycled to the mill. There is no water discharge from the ponds. Filled basins are reclaimed by smoothing them over with a dozer and planting rye or millet and sericea.

No growth or expansion is planned for the facility.

A more detailed description of the dryer and expanding furnaces and their associated air pollution control equipment follows:

A. DRYER

The rotary, direct-fired dryer reduces the surface moistures to approximately 2 to 4% so that expansion in the furnaces is maximized. The dryer and mill is operated 24 hours per day, 5 to 7 days per week, 50 to 52 weeks per year. The designed process rate is 15-18 tons per hour, but the average production rate is approximately 15 TPH. The process rate varies with characteristics of the ore. Annual production is approximately 100,000 tons. Production rate varies directly with the vermiculite content of the ore. Between 20 and 25% of the mill input becomes the final vermiculite concentrate. The dryer product is weighed by a belt scale and also in rail cars when shipped. Number 5 fuel oil is used at the rate of 6.5 gallons per ton of dried product. The expected life of the dryer is 10 years. Repair cost for the dryer is not available as the records are not kept separately from the other equipment in the mill.

Two of the principle factors affecting optimum concentrate drying are temperature and air flow through the dryer. Prior to 1974, control devices on the dryer air handling system were twin 5-foot diameter cyclones in parallel. In October 1972, stack tests were conducted to determine if the dryer source emission was in compliance with allowable South Carolina particulate and visual emission regulations. Average results of three stack tests after the cyclones operating at a dryer process weight rate of 17.97 tons per hour were:

| | | |
|---|---|---|
| Stack Gas Flow (ACFM) | 19642 | (556 $m^3$/min) |
| Stack Gas Temperature (°F) | 180 | (82°C) |
| Particulate Emissions (GR/SCF) | 0.678 | (1.55 g/$DNm^3$) |
| Mass Particulate Emissions (lbs/hr) | 80.04 | (36 Kg/hr) |
| Allowable Emissions (lbs/hr) | 28.4 | (13 Kg/hr) |

Based on observed, sampled, and calculated test conditions/results, Grace determined that the only workable and acceptable control device for this source application was a wet scrubber, as the gas temperature was too close to the dew point. Bid specifications for the secondary control device listed all test conditions and required as minimum guaranteed performance, 85% efficiency of proposed scrubber inlet loading. Assuming this efficiency for the above test conditions, the outlet particulate concentration would be .102 gr/dscf.

The unit selected was a Model VT-9 venturi scrubber with liquid separator and fan manufactured by Pollution Control Systems. The device is operated at its guaranteed condition of 8" w.c.$\Delta P$ and 130 GPM through the venturi at an established air flow of approximately 21,000 ACFM. The secondary control device was installed in 1974 at a total capital cost of $55,000. With exception of initial corrosion problems with the mild steel fan casing and stack, no operating problems have existed since these parts were changed to stainless steel. The scrubber is checked and repaired as required during the scheduled weekly preventive maintenance mill shut down.

At Grace's other vermiculite mine/mill complex in Montana, concentrate is dried by a fluid bed dryer and particulate emissions are controlled with a baghouse. No emission test data are available. Selection of a type of dryer would depend on economics and process design.

B. <u>EXPANDING FURNACE</u>

One of Grace's thirty vermiculite expanding plants in the United States is located adjacent to the Enoree Mill. Approximately 35% of the exfoliation grade concentrate produced at the Enoree mill is exfoliated in the four furnaces at the Enoree expanding plant. Concentrate is taken from mill production or silo/flat storage and conveyed to three 50 ton/day silos at the expanding plant. Concentrate retrieval from the day silos to furnace hoppers via belt conveyor and bucket elevator is automatic based on size selection and demand.

All vermiculite expanding furnaces operated by Grace are designed and built by the company. At Enoree there are three Model D-16 and one D-18 furnaces. These two design furnaces with accessory equipment are basically identical, except the D-16 has a 16" ID refractory expansion chamber and the D-18 has an 18" ID stainless steel tube. All exfoliation takes place within the furnace tube and all other accessory equipment is for product cooling, dust control, and separation of non-expandable material from the finished product. Depending on product demand, the furnaces operate 24 hours per day, 5 days per week, 52 weeks per year, with a process feed rate of approximately 1.25 ton/hour furnace. Each furnace at Enoree is fired on #2 fuel oil and has a maximum burner rating of 2.2 MM BTU/hr. Furnace temperatures are relative for control purposes and operate in the range of 1300-1600°F, depending on various operating parameters. Exfoliated vermiculite at Enoree having a bulk density of 6-8 lbs/cf, is bagged at the furnace as finished or intermediate product or conveyed to rail hopper cars for bulk shipment.

As part of the dust control facilities, each furnace assembly has a 24" Ø furnace cyclone, 54" Ø primary cyclone, and baghouse as the secondary control device. As shown on typical process flow diagram Figure 1, furnace draft is provided by the main vent system fan and all particulates collected in the furnace cyclone are returned to the process. All other points of dust generation and/or potential emission sources are tied into the primary cyclone through appropriate ducting. Collected 54" Ø cyclone fines are returned to the product or can be diverted to waste depending on product specifications. The secondary control device on all Grace expanding furnaces is a fabric filter (baghouse) ranging in fabric area from 800 to 960 ft$^2$. At Enoree, all four expander control devices (baghouses) are Flex-Kleen Model 84RA80 with 800 ft$^2$ of fabric area. These units, operating at approximately 5400 ACFM, are automatic reverse air cleaning and use 14 oz. Nomex bags having a permeability of 25-35 cf/ft$^2$ @ 0.5" w.c. Thus, air to cloth ratio (ft/min) is approximately 6.8 to 1. Fabric cleaning using 100 psig compressed air can be by variable sequence timer or differential static pressure.

On two or three occasions, particulate emission stack tests have been conducted on expanders with baghouse controls by Grace consultants or State agencies. Baghouse dust loading varies with concentrate size (8-10 lbs/hr max) but actual particulate emissions average 0.1 lbs/hr. As a general rule, air flows per expander are 5500 ACFM @ 230°F, but the conditions can vary from unit to unit. Thus, the outlet particulate emissions were .002 gr/acf.

In 1972, baghouses were installed on the three Enoree D-16's at a total capital cost of $15,000 each. Present day capital costs are $25-$30,000. Annual maintenance costs including bag replacement every 12-24 months is approximately $1000.

Conclusions

The determination of one control device that is the best system of continuous emission reduction for dryers and for vermiculite expansion furnaces may be difficult. Due to moisture and temperature parameters, baghouse performance may deteriorate if blinding occurs. Auxiliary heaters and/or insulation of the ducts and baghouse may be required to keep the exhausted gas sufficiently above the dew point. The resulting costs incurred may push the industry to select other control devices.

No emission results of the scrubber outlet were available. If one assumes a control efficiency based on the scrubber manufacturer guarantee, the outlet would be .102 gr/dscf. A higher energy scrubber, greater than 8" of water pressure drop, would be required to achieve levels of baghouses controlling dryers in the vermiculite industry. However, these higher energy scrubbers may be more costly than a baghouse on an annualized basis.

As shown by plant emission tests, the baghouse outlet for the expansion furnace averaged .002 gr/dscf. If this performance can be assumed to occur for all new, modified, or reconstructed furnaces, then it is likely there will be little, if any, emission reduction that can be attributed to an NSPS.

Attachment

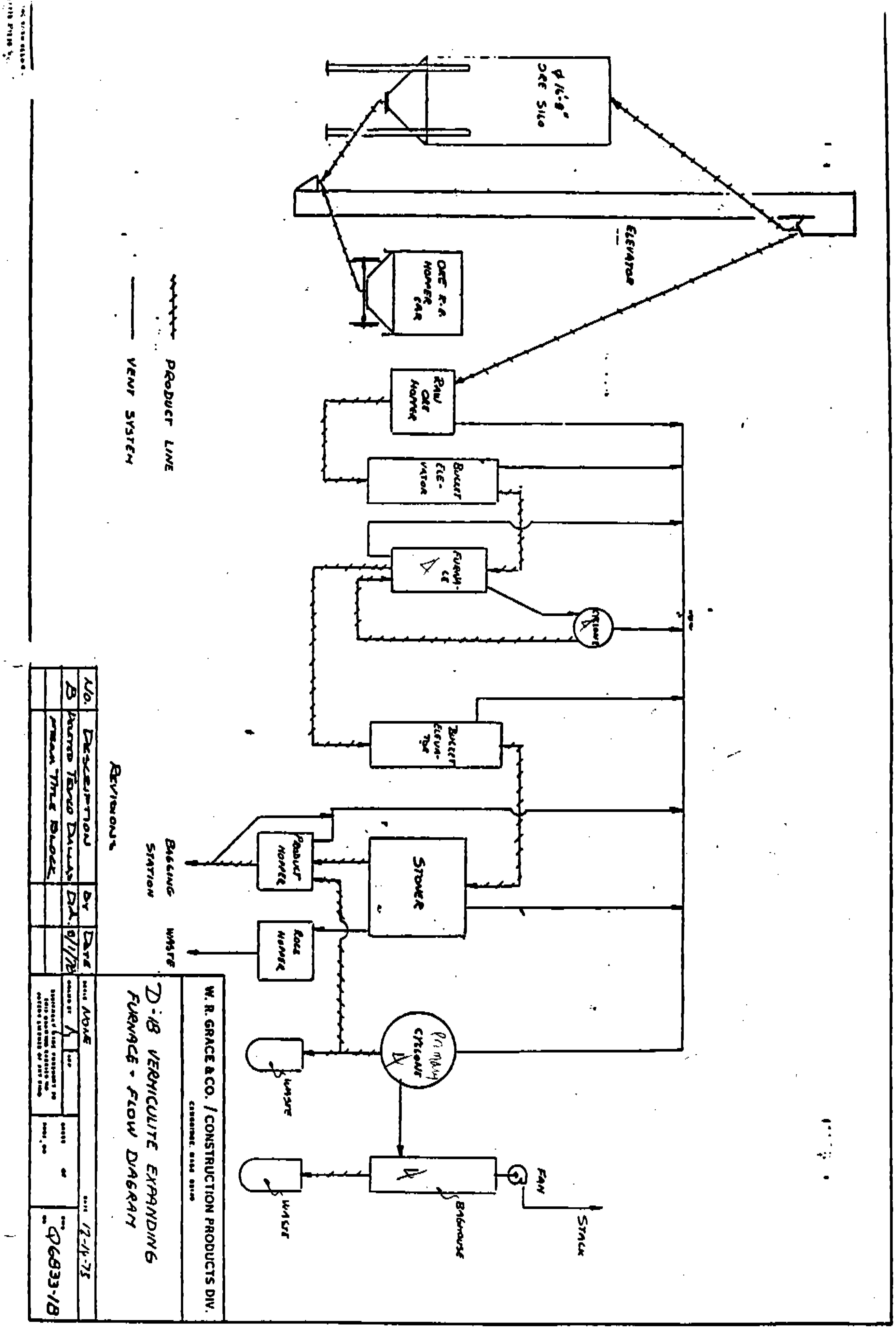


Figure 1. W.R. Grace and Company, Enoree, S.C. - Expansion Furnace