EPA-905/5-79-001

PB 80-

THE EFFECTS OF ENVIRONMENTAL REGULATIONS ON CEMENT PRODUCTION AND EXPANSION IN EPA REGION V

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Contract No. 68-01-4147
Task No. 80

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Prepared for

U.S. Environmental Protection Agency
Division of Stationary Source Enforcement
Washington, D.C. 20460

June 1979

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ABSTRACT

This report presents the results of a study to evaluate the effect of environmental regulations on present production and future expansion capabilities of the 24 active cement plants in U.S. EPA Region V. This study was done in response to allegations that environmental regulations are a significant factor in the present Midwest cement shortage. The results of a survey of these 24 plants show that environmental regulations are not significantly affecting overall cement production in Region V. However, retirement of 13 percent of present cement capacity in Region V without replacement, from 1975 to 1978, has probably aggravated the shortage situation. Environmental regulations are apparently a major factor in the reluctance of cement companies to expand capacities. This situation may change in the near future as rising cement prices improve the return on investment from plant expansion, and as acquisitions of smaller cement companies by larger corporations increase the financial capability to expand.

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ACKNOWLEDGMENT

This report was prepared for the U.S. Environmental Protection Agency, Region V, Chicago, Illinois, by PEDCo Environmental, Inc., Cincinnati, Ohio.

The project was directed by Mr. Richard W. Gerstle, and managed by Mr. Michael F. Szabo. Principal authors were Mr. Szabo and Mr. Vijay P. Patel.

Mr. David Kee was the task manager for U.S. EPA Region V, and we appreciate his direction and cooperation.

We also thank the cement companies in Region V, who participated in our survey, and were very cooperative in providing information for this report.

The Portland Cement Association and the Bureau of Mines also provided valuable input for this report.

SECTION 1

SUMMARY AND CONCLUSIONS

This report evaluates the effects of environmental regulations on current production and potential expansion of the 24 cement plants in U.S. EPA Region V.* One additional plant in Ohio, which was closed in 1976 but is being reopened by another company, was not included in the survey because it was in operation only part of 1978 and was only grinding clinker. The report was written in response to allegations that environmental regulations are contributing to a cement shortage in the Midwest, which has slowed construction activity and raised public concern about the causes of the shortage.

In early 1979, PEDCo surveyed each of the 24 plants in operation in Region V. The information in this report is based on that survey, on subsequent contacts with personnel in several of the plants, on information obtained from U.S. EPA Region V and from state environmental control agencies, and on a literature review.

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* EPA Region V consists of the States of Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin.

1.1 BACKGROUND INFORMATION

Many reasons have been cited for the Midwest cement shortage, which started in the West in 1977 and spread eastward to the Midwest by 1978. The major reasons mentioned in the literature include unusually high demand, caused by increased construction; lower production, caused by such short-term factors as bad weather, the 1978 coal strike, transportation bottlenecks and strikes, and shipments of cement from the Midwest to other states; and the effect of environmental regulations on production and expansion capabilities, including some plant closings. Shortages were predicted again for the 1979 building season.

1.2 RESULTS OF PLANT SURVEY

Of the 24 cement plants in Region V, 10 are dry process, and 3 of these 10 plants have preheater kilns, the most energy efficient means of producing cement. Ten plants are wet process, which consumes more energy than the dry process. The remaining four plants have clinker grinding facilities only.

Fifteen of the 24 plants use coal exclusively for normal operation, two use coal and natural gas, two use coal and oil, and one uses oil and gas. The four grinding plants use electricity for grinding.

1.2.1. Effect of Environmental Regulations on Current Production

Only 2 of the 24 active plants reported a serious loss in production (about 50 percent) for 1978; both of these plants, which have preheater kilns, were visited. In one of them, startup coincided with the severe winter of 1978. This circumstance and two catastrophic process failures in the spring of 1978 were responsible for most of the production loss. At the other severely affected plant, nearly all the production loss stemmed from a continuing process problem that caused opacity violations during roller mill startup and when changing from the mill operating mode to a bypass mode utilizing flue gas conditioning towers.

Twelve other plants indicated that environmental regulations are reducing the amount of cement they can manufacture by an average of 2 to 5 percent. The reduction is caused by state regulations that require cement plants to slow or stop kiln rotation when control equipment malfunctions occur, when the control system is shut down during transitions, or when exhaust gas conditions are too unstable for adequate particulate collection. The last circumstance applies particularly to kilns equipped with electrostatic precipitators for particulate control.

Overall production for a normal year with no severe problems, as reported by the 24 plants in operation in Region V, is approximately 94 percent of the design capacity given in the 1977 annual yearbook of the Portland Cement Association. Cement producers generally cite 80 percent of design capacity as representing normal production. Environmental regulations do not, therefore, appear to have a significant effect overall, on production levels in these plants. Figure 1-1 presents the production trend for the plants from 1972 through 1978 and shows that

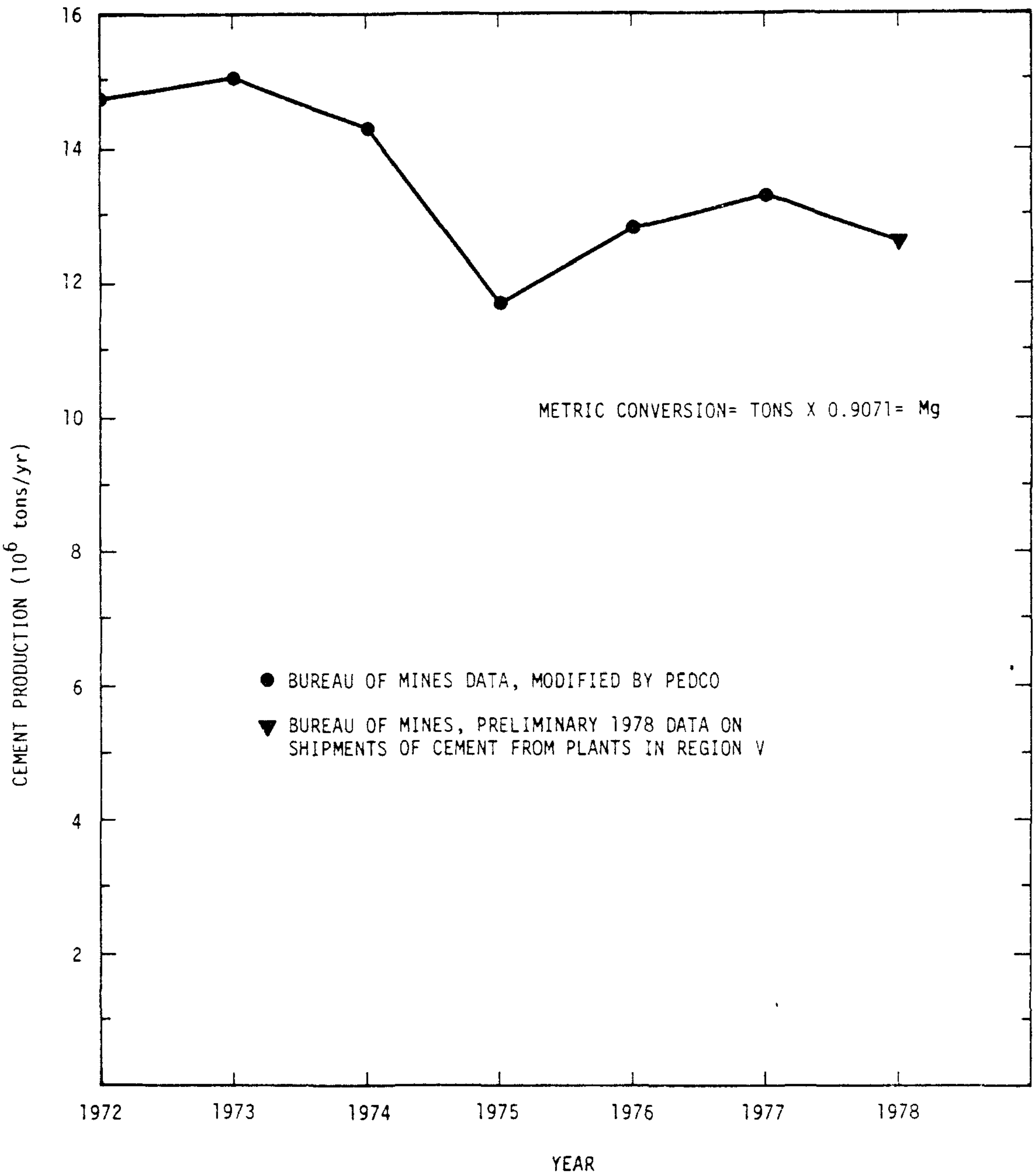

Figure 1-1. Production trends for cement plants in Region V, 1972-1978.

production peaked in 1973, reached a low point in 1975, and has increased each year since, except for 1978. Preliminary figures from the Bureau of Mines on shipment of finished cement from plants in Region V (shipments should be close to production) show that approximately 11,452,000 Mg (12,625,000 tons) were shipped in 1978. This is a slight reduction in production as compared to 1977, and may reflect the short term problems such as extremely bad weather, strikes, and transportation difficulties that occurred in Region V during 1978. This production level is still approximately 80 percent of design capacity for all 24 active plants in the region.

1.2.2 Effect of Environmental Regulations on Expansion of Capacity

Most of the comments elicited by the survey concerned the effect of environmental regulations on expansion of capacity. Only seven plants (two of which are grinding plants) indicated that they could expand capacity; only one plant is actually doing so. Plant personnel cited several deterrents to expansion: the high cost of meeting environmental regulations; low return on investment; and the delay in obtaining permits, which increases the lead time for constructing new plants.

We have analyzed these factors and arrived at several conclusions, which are summarized in the following paragraphs:

The cost of meeting environmental regulations increases the threshold for an adequate return on investment. The contribution of pollution control equipment to the capital investment of a new cement plant in Region V appears to be about 15 percent. (10 percent for air pollution equipment only, according to a recent Portland Cement Association survey of its members). Retrofit costs of pollution control equipment may exceed 25 percent of the net worth of an existing plant in some cases. Operating costs attributable to pollution control equipment for cement plants are scarce because no recent economic studies have been done and only one plant in Region V provided a cost estimate. Maintenance of air pollution control equipment at this plant is estimated to account for 2 percent of the price of cement.

In the future, new regulations to control fugitive dust and hazardous waste will add to plant capital and operating costs. The cement industry, however, is one of many industries facing this problem. The increased cost is passed along to the consumer as higher prices for cement.

The acquisition of small cement companies by larger companies is a continuing trend; since the large companies have greater financial capabilities, they should be better able to invest in expansion. Cement prices may need to be significantly higher in the future to provide the return on investment needed for cement companies to undertake expansion.

Current permit procedures for new plants add substantially to the lead time required for construction and restrict the ability of the cement industry to respond rapidly to a shortage. Under normal conditions, state preconstruction permits, Federal permits [Prevention of Significant Deterioration (PSD) and Best

Available Control Technology (BACT)] should take less than 1 year to review. Plants in a nonattainment area, however, may need additional time for approval or may not be able to be built because of other emission sources. Approval of water and solid waste permits does not usually bring delays, because they are reviewed at the same time as the air permits. Most delays in permit approval occur because the company does not submit adequate information, the review staff at state or Federal agencies is limited, or public hearings lead to objections to the plant that result in the filing of lawsuits.

Permit procedures should be streamlined so that cement companies can build new plants in the shortest possible time with the confidence that control regulations will not be changed part way through the project. U.S. EPA is changing the reporting requirements so that a single application can be used to submit information relating to air, water, and solid waste.

The responses to the survey about cement plants in Region V, plus information in the literature, support the conclusion that--justifiably or not--environmental regulations are playing a role in the reluctance of cement companies to invest in new capacity. The ability to meet increasing demand is the key to a long-term solution to the present shortage and to the prevention of future shortages.

1.2.3 Other Factors Affecting the Midwest Cement Shortage

Several other factors were mentioned by cement companies as contributing to the Midwest cement shortage: unusually high demand, plant closings, and unavailability of equipment.

In 1975 through 1978, about 13 percent of the capacity in Region V was retired without replacement. The retirements involved six plants with a combined annual capacity of 1,890,000 Mg (2,084,000 tons). In conjunction with other, short term problems that occurred in late 1977 and early 1978, these plant closings probably aggravated the cement shortage in the Midwest. At two of the plants, the cost of raw materials was the main reason for closing. At the other four plants, the high cost of complying with environmental regulations was cited as the main reason for closing, although the increased cost of a raw material additive was also a problem at one of these plants. Thus environmental regulations appear to have had an indirect effect on production in Region V by becoming a factor in the decision to close down older plants with marginal control equipment. In most cases, the regulations do not give control agencies the flexibility to adapt requirements to an older plant (for example) that is only marginally out of compliance and could continue to operate profitably for several more years. The cost of an additional environmental control could force such a plant to close. At one plant in Region V, however, a misunderstanding between the cement company and enforcement officials resulted in the plant being closed when it could have remained open for 3 more years under a variance.

The reluctance of cement companies to expand capacity is a serious concern when plants are being closed without replacement. Expansion of capacity to meet demand is of critical importance and overexpansion is unlikely to occur at a time when cement companies are predicting future plant closings.

The question of the cost-effectiveness of the EPA environmental regulations for cement plants is beyond the scope of this report. It is, however, a controversial issue, and further study would be valuable in light of the new regulations that are proposed for fugitive dust and hazardous wastes.

SECTION 2

INTRODUCTION

2.1 PURPOSE OF STUDY

The purpose of this report is to investigate allegations that environmental regulations are a significant cause of the present cement shortage in the Midwest. The study area is Region V (Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin) of the U.S. Environmental Protection Agency (EPA). A survey of each cement plant in Region V provided the basic information in this study about limitations on production and expansion. Section 1 has already summarized the results and conclusions of this study. The remainder of Section 2 discusses background information relevant to the cement shortage, and the outlook for future supplies.

Section 3 provides a brief description of the portland cement process, the major emission points, and applicable control equipment used. A review of Federal and state environmental regulations is also provided.

Section 4 presents the results of the survey of the 24 active cement plants in Region V. This includes a description of the data requested and the reported impacts of environmental regulations on present production and future expansion capabilities.

Section 5 presents case histories from two plants that reported substantial curtailment of production because of environmental regulations. Included in each case history are a description of the specific problem(s) causing production curtailment, company efforts to solve the problem(s), and the outlook for increased production at these plants. A third case history on the events surrounding the closing of a Region V cement plant is also presented.

2.2 BACKGROUND OF CEMENT SHORTAGE IN THE MIDWEST

The shortage of cement now plaguing the Midwest began in California in late 1977 and spread eastward to other parts of the country. Cement prices have escalated because of the shortage, and there have been costly delays in construction projects and disruption of employment patterns.

2.2.1 Causes

Different sources have suggested various causes of the present shortage in general and applied specifically to the Midwest.[1,2,3,4] The major causes cited from these sources are summarized below.

2.2.1.1 High Levels of Construction--

The Portland Cement Association (PCA) projected that rising interest rates and scarcity of credit would cause house construction to peak in early 1978 and then decline to a sustainable level. This projection, however, proved wrong. Construction began on more houses during the first 7 months of 1978 than during the same period in 1977, and total construction value was 3 percent higher in the first half of 1978 than in the first half of 1977.

2.2.1.2 Lower Production Levels--

There are a number of reasons cited for the failure to meet demand. One is the lack of capital investment earlier in this decade. During the early months of 1978, inclement weather, fuel supply problems attributed to the coal strike, and energy conversions from petroleum to coal firing kilns reduced the normal buildup of product inventories. Because many plants delayed their usual maintenance shutdowns to make up lost production, extended downtime occurred during the building season.

Aggravating the shortage in the Chicago area was the 2-month closing of locks on the Illinois Waterway.[2] Three producers that together supply one-third of the area's cement use the Waterway. Also, strikes at some remaining plants reduced overall supplies.

2.2.1.3 Shipments to Areas of Earlier Shortages--

The shortage that started in the West in late 1977 resulted in higher prices for cement and drew supplies from plants in the Midwest, which would normally stockpile cement during the winter. Shipments to areas of earlier shortages thus reduced supplies in the Midwest.

2.2.1.4 Environmental Regulations--

There are allegations that stringent environmental regulations implemented since the passage of the Clean Air Act of 1970 caused several older plants to close prematurely in the early

1970's. In addition, the large capital expenditures required to achieve compliance have reportedly prevented other plants from implementing energy conservation programs, plant modernizations, and capacity expansions. Expansion takes from 3 to 4 years, which includes time to get necessary environmental permits.

2.2.1.5 Price Fixing--

Some building and labor leaders[5] have alleged that the cement manufacturers have created a false shortage to force up the price of cement. California, Kansas, and Oregon have filed suits charging several companies with conspiring illegally to fix or maintain prices for cement and allocate territories.

2.3 OUTLOOK FOR FUTURE CEMENT SUPPLIES

According to the PCA, it seems that only reduced demand from the home building industry would bring about significant relief in 1979. Although supplies appear adequate to meet national demand, regional shortages will probably occur through 1980. About 4.5 million tons of new capacity is scheduled for operation nationwide between 1978 and 1980, but the closing of older plants and kilns will somewhat offset these additions.

Most experts believe that the long-term outlook for adequate supplies depends on the cement industry's ability to expand capacity and obtain the necessary environmental approvals to construct new plants.[1,2,5] The PCA predicts a growing market for cement. Some problems, however, could affect the cement industry. These problems include the cost of new plants ($90 to

$110/ton of annual capacity),[1] the implementation of wage and price guidelines, and the overexpansion that might result from the cyclical nature of the construction industry.

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SECTION 3

REVIEW OF PORTLAND CEMENT PROCESS
AND ENVIRONMENTAL CONTROLS/REGULATIONS

3.1 PROCESS DESCRIPTION[1,2,3]

Portland cement is a powdered material which, with water, forms a paste that hardens slowly, bonding rock, gravel, and sand into concrete. Portland cement production involves quarrying, crushing, grinding, blending, clinker production, finish grinding, and packaging. Figure 3-1 depicts a typical process flow diagram for portland cement production.

Limestone and shale are blasted from quarries, usually close to the cement facility. The raw materials are transported to the primary crusher by truck, railroad car, or conveyor belt.

The primary crusher (gyratory, jaw or roll) reduces the size of rocks to between 15 and 25 cm (6 and 10 in.) across. After the rocks are broken, they are carried by conveyors to the secondary crushers, usually of the "hammer mill" type, which crushes them to less than 2 cm (3/4 in.) across.

The crushed raw materials then undergo a fine grinding process, which further reduces their size. The fine grinding can be done by the wet or dry process. In the wet process, raw feed is combined with water to form a slurry consisting of more than one-third water. This slurry is discharged from the mill and

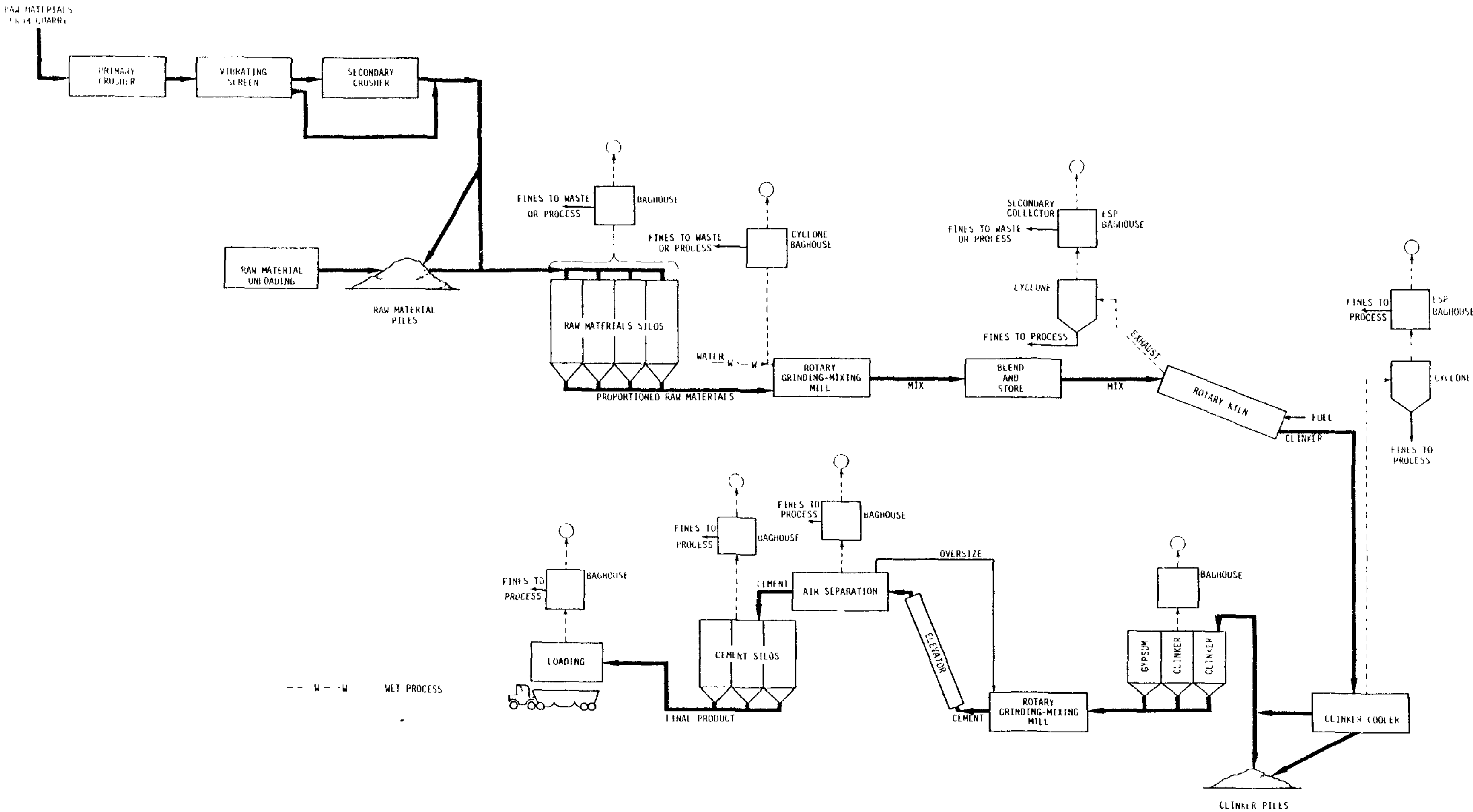

Figure 3-1. Process flow diagram for Portland cement production.[1]

stored in huge open tanks, where additional homogenization takes place. The slurry is then pumped into the kiln. In some instances, moisture is removed by vacuum filters, thickeners, or hot kiln exhaust gases. In the dry process, the raw materials may be dried separately before grinding, but more commonly, grinding and drying are done simultaneously. Exhaust from the rotary kiln that follows this step supplies hot gases for drying.

The wet slurry or the dry mix is fed into a rotary kiln (Figure 3-2) to form cement clinker. The kiln is fired with oil, gas, or coal. As the feed travels through the kiln, it is dried, calcined, and partly fired at a temperature of about 1600°C (2900°F). Newer fuel saving techniques for clinker production include longer kilns, and suspension and traveling grate preheaters.

In a suspension preheater, dry raw feed is fed downward through a series of cyclones against an upward hot gas flow, resulting in an effective countercurrent heat exchange. The hot gas from the kiln exhaust does not require any additional heat input, although some flash preheating systems are now being introduced.

In a traveling grate preheater system, ground raw feed is pelletized and discharged to a hopper at the feed end of the traveling grate. A uniform bed of pellets is spread across the full width of the traveling grate. The pellets are heated and partially calcined before entering the rotary kiln.

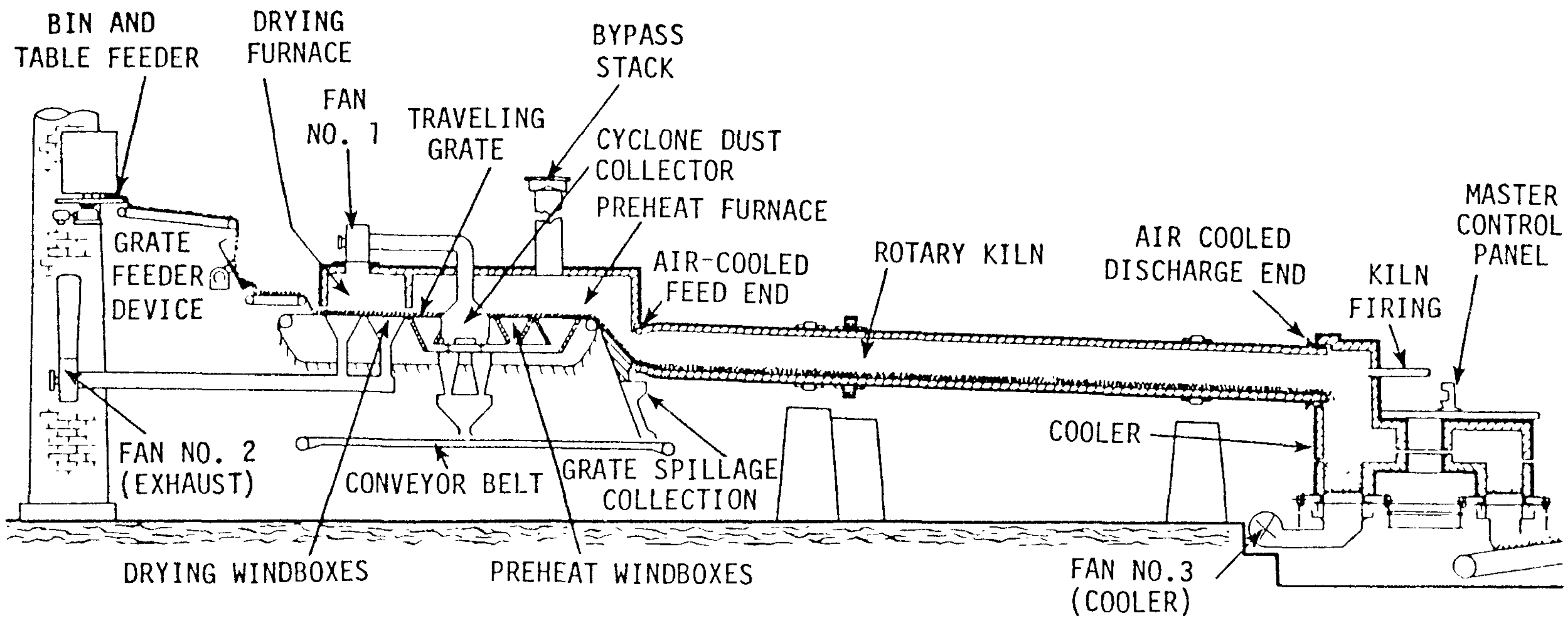

Figure 3-2. Schematic of a rotary kiln.[4]

For all kiln types the clinker drops from the lower end of the kiln into some form of cooler where its temperature is quickly reduced. New or modified designs carry the clinker on a perforated grate through which air is forced. A portion of hot overgrate air is used as combustion air for the kiln. The amount of overgrate air is governed by the kiln excess air.

Clinker is mixed with about 5 percent gypsum (to regulate the concrete's setting time), then ground and mixed in a grinding mill. Milled cement is classified by a cyclone separator, and the oversize material is returned to the mill. The cement is conveyed to silos and then bagged or shipped in bulk by truck, rail, or barge.

3.2 MAJOR EMISSION POINTS[1,2,3]

Particulate matter is the primary pollutant from the manufacture of cement. The potential sources of emissions from portland cement plants are illustrated in Figure 3-1. Kilns, clinker coolers, and dry milling operations constitute the main sources of particulate emissions. Sources of fugitive emissions include quarry sites, transfer points, storage piles, and loading area.

Small amounts of nitrogen and sulfur oxides may be emitted from kilns and driers because of the fuels fired to supply heat. Table 3-1 summarizes emission factors for cement manufacturing, from AP-42, reference 5.

TABLE 3-1. EMISSION FACTORS FOR CEMENT MANUFACTURING WITHOUT CONTROLS[a]

Pollutant	Dry process		Wet process	
	Kilns	Dryers, grinders, etc.	Kilns	Dryers, grinders, etc.
Particulate[b]				
lb/ton	245.0	96.0	228.0	32.0
kg/MT	122.0	48.0	114.0	16.0
Sulfur dioxide[c]				
Mineral source[d]				
lb/ton	10.2		10.2	
kg/MT	5.0		5.0	
Gas combustion				
lb/ton	Negligible		Negligible	
kg/MT	Negligible		Negligible	
Oil combustion				
lb/ton	4.2S[f]		4.2S	
kg/MT	2.1S		2.1S	
Coal combustion				
lb/ton	6.8S		6.8S	
kg/MT	3.4S		3.4S	
Nitrogen oxides				
lb/ton	2.6		2.6	
kg/MT	1.3		1.3	

[a] These emission factors which are taken from Reference 5, include emissions from fuel combustion, which should not be calculated separately.

[b] Typical collection efficiencies for kilns, dryers, grinders, etc., are: multicyclones, 80 percent; electrostatic precipitators, 95 percent; electrostatic precipitators with multicyclones, 97.5 percent; and fabric filter units, 99.8 percent.

[c] The sulfur dioxide (SO_2) factors presented take into account the reactions with the alkaline dusts when no baghouses are used. With baghouses, approximately 50 percent more SO_2 is removed because of reactions with the alkaline particulate filter cake. Also note that the total SO_2 from the kiln is determined by summing emission contributions from the mineral source and the appropriate fuel.

[d] These emissions are the result of sulfur being present in the raw materials and are thus dependent upon source of the raw materials used. The 10.2 lb/ton (5.1 kg/MT) factors account for part of the available sulfur remaining behind in the product because of its alkaline nature and affinity for SO_2.

[f] S is the percent sulfur in fuel.

3.3 APPLICABLE CONTROL EQUIPMENT

The main pollution control devices in the portland cement industry are mechanical collectors, electrostatic precipitators (ESP's), gravel beds, and fabric filters (baghouses). Combinations of these devices are sometimes used depending upon the operation and exhaust gas temperature. Only a few plants use high-energy venturi scrubbers.

The kiln is the largest emission source in a cement plant, the most difficult to control properly, and thus the most likely to be controlled inadequately. A fabric filter or an ESP is usually installed on the kiln. Wet scrubbers have proved to be impractical for this application. Many kilns are also equipped with mechanical collectors to remove coarse particles from the dust.

Kiln exhaust gases are cooled in spray-towers by bleed air or a combination of the two to a temperature of 232° to 288°C (450° to 550°F) before entering fabric filters. These filters are usually made of glass or Nomex fabrics, which can withstand temperatures as high as 290°C and 230°C (550°F and 450°F), respectively. Higher temperatures accelerate the aging of bag fabrics. Thus, when fabric filters are used on dry process kilns, gas temperatures are of primary concern.

Conversely, fabric filters used on wet process kilns must be protected from gases reaching the dewpoint [usually in the range of 130° to 150°C (270° to 300°F)]. This is achieved by providing an outer layer of insulation on precleaning cyclones, ductwork, and hoppers.

When ESP's are used on dry kilns, water cooling and conditioning exhaust gases can overcome problems of resistivity and sulfate buildup. Wet process kilns have the proper moisture and temperature characteristics for effective electrostatic precipitation. As with fabric filters, extensive thermal insulation must be provided on wet process kilns to prevent condensation of water vapor within ESP's or fabric filters. Several installations with preheaters utilize exhaust gases from the kiln to dry the raw material. This increases the moisture content and reduces the temperature of the gases entering the ESP.

All or a portion of the dust collected in ESP's or fabric filters may be recycled to the process. This depends on the alkaline content of the dust. Use of a cyclone as a precleaner usually reduces the alkaline content of the dust passing through to the secondary collector, from which it is recycled to the process. If dust from the kiln has low alkalinity, a cyclone may not be used and all of the dust collected in the ESP or fabric filter will be recycled.

Clinker cooler dust requires a high-efficiency control device. ESP's are not generally used for clinker cooler control, but have been successfully applied at several installations. Gravel bed filters are achieving some popularity for control of clinker cooler emissions. The filter medium consists of silica gravel, which is insensitive to temperature. Gravel bed filters can handle gases as hot as 540°C (1,000°F) with no cooling or conditioning required.

Raw and finish milling processes are best controlled by fabric filters, although ESP's can effectively clean exhaust streams from finish mills. The control devices, connected in a closed loop with air separators, transport the collected material back to the process for cement production.

At the numerous transfer points in a cement plant, cloth filters are often used to recover dust. Properly designed hoods, used with 0.5 - 2 m^3/s (1,000 - 4,000 cfm) fans, can effectively control emissions. At some plants, water sprays are used to minimize emissions from transfer points.

Table 3-2 summarizes the types of control equipment used by cement plants in Region V.

3.4 REVIEW OF ENVIRONMENTAL REGULATIONS

3.4.1 New Source Performance Standards

Pursuant to Section III of the Clean Air Act, the Administrator of the U.S. Environmental Protection Agency promulgated standards of performance for new and modified portland cement plants on December 23, 1971 (36 FR 15704). These standards are applicable to portland cement plants whose construction or modified was commenced after August 17, 1971. The standards limit particulate emissions from the kiln to 0.15 kg/metric ton (0.30 lb per ton) of feed (dry basis) to the kiln and from the clinker

TABLE 3-2. SUMMARY OF CONTROL EQUIPMENT ON MAJOR EMISSION POINTS[a]

Emission point	Number of plants reporting			
	ESP	Fabric filter	Other	Combination
Kiln	12	5		3[b]
Clinker cooler		9	6[c]	3[d]
Grinding mill		21	1[e]	

[a] The total number of plants reporting was 24.

[b] One multicyclone and ESP, one multicyclone and fabric filter, and one ESP and fabric filter.

[c] Two multicyclone, three gravel bed filters, and one planetary cooler.

[d] One multicyclone and ESP and two combinations of one gravel bed filter and fabric filter.

[e] One Norblo dust collector.

cooler to 0.05 kg/metric ton (0.10 lb per ton) of feed (dry basis) to the kiln. The opacity limits are 20 percent for emissions from the kiln; 10 percent for emissions from the clinker cooler, and 10 percent for emissions from other equipment. Appendix A fully delineates the New Source Performance Standards (NSPS) pertinent to the portland cement industry.

Federal regulations allow each state to develop a program for enforcing NSPS within its boundaries. Thus, many states and local regulations allow particulate emissions to vary with the rate of input of raw materials.

3.4.2 State Emission Regulations

Applicable particulate emission regulations for each of the six states within U.S. EPA Region V are presented in detail in Appendix B. For existing sources, Minnesota, Michigan, and Wisconsin have specific regulations for cement plants. For new sources, all of the states except Indiana have specific regulations for cement plants. Of the five states having specific regulations for new sources, all but Wisconsin have regulations identical to the Federal NSPS. Table 3-3 compares particulate emission regulations for existing and new sources in the six states of U.S. EPA Region V.

3.5 WATER POLLUTION CONTROL REGULATIONS APPLICABLE TO CEMENT MANUFACTURING PLANTS

Cement manufacturing plants may be subject to Federal, state, or local water pollution control regulations.

TABLE 3-3. EMISSION REGULATIONS FOR STATES IN U.S. EPA REGION V[a]

State	Particulate emission limitations		Comments
	Existing sources	New sources	
Ohio	Process weight equation and 20% opacity limit	Same as NSPS	Fugitive dust restriction
Illinois	Process weight equation	Same as NSPS	
Minnesota	Limitation based on gas volume or 99% collection efficiency; 90% and no violation of ambient air regulations allowed in rural areas	Same as NSPS	
Indiana	Process weight equation	Process weight equation (same as existing sources)	
Michigan	Kiln - 0.25 lb/1000 lb gas Clinker cooler - 0.30 lb/1000 lb gas Grinding, crushing & other material handling - 0.15 lb/1000 lb gas over 15,000 bbl/day - plant must apply to state for maximum limitation	Same as NSPS	Fugitive dust regulations pending
Wisconsin	Kiln: 0.30 lb/ton feed; clinker cooler: 0.10 lb/ton feed	Kiln - 0.20 lb/1000 lb gas Clinker cooler - 0.30 lb/1000 lb gas Grinding, drying, mixing, conveying, sizing or blending - 0.20 lb/1000 lb gas	Fugitive dust restrictions

[a]metric conversions: 1b = 0.454 kg; 1 ton = 1016 kg; 1 bbl = 171 kg.

3.5.1 Federal Regulations

Facilities which discharge their effluent via a point source into surface water of the United States are subject to Effluent Limitations Guidelines. The limits are set out in an NPDES (National Pollution Discharge Elimination System) permit. The permit is obtained either from the Regional Administrator or the state (where the state is authorized by the Regional Administrator to issue NPDES permits). A copy of the effluent limitations guidelines as set out in 42 FR 10681, February 23, 1977 is shown in Appendix C.

3.5.2 State Regulations

In many instances a state's water quality standards are more stringent than the Federal regulations. Thus, a state may set out discharge limitations based on the location of the plant, type of receiving stream, flow and other characteristics. The limitations are highly variable and too numerous to mention. However, copies of the individual regulations may be obtained from the state environmental protection agency (or department of natural resources).

3.5.3 Local Regulations

When a facility discharges its effluent into a local publicly owned treatment works (POTW) it is subject to pretreatment standards set out by the local POTW. These standards may limit discharges of heavy metals, biological oxygen demand, total suspended solids, pH, etc. Most POTW's also place a surcharge on the effluent; the surcharge is usually based on a formula which relates the quality of wastewater, BOD and suspended solids in excess of a specified value to the surcharge.

3.6 SOLID WASTE REGULATIONS

Solid waste regulations do not impact cement plants as much as the air and water pollution regulations. Most of the process related solid water in cement plants is in the form of dust and this is recycled; the small qualities that remain are disposed of in impoundments or sanitary landfills.

The Resource Conservation and Recovery Act (RCRA) of 1976 which will be implemented in 1980 will put strict controls on impoundments and sanitary landfills, and may impact cement plants to some extent.

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SECTION 4

SURVEY OF CEMENT PLANTS IN U.S. EPA REGION V

4.1 REVIEW OF PLANTS SURVEYED

PEDCo surveyed and received responses from all 24 active cement plants in EPA Region V. A breakdown of plants surveyed, by state, along with design production, capacity, and type of fuel used, is shown in Table 4-1; Figure 4-1 shows the distribution of the plants within the six states of Region V.

4.1.1 Fuel Use Data

Fifteen plants use coal exclusively, two use coal or natural gas, two use coal or fuel oil, one uses fuel oil or natural gas for kiln operation. Four plants grind clinker only.

The overwhelming use of coal in these plants is a result of the current energy situation, in which coal is cheaper and in more adequate supply than oil and natural gas and less subject to interruption in supply (especially than natural gas). The coal, however, causes higher rates of particulate emissions during transitional periods and equipment malfunctions.

4.1.2 Type of Process

Ten plants in Region V are dry process, and three of these have preheater kilns. The other 10 plants with operating kilns are wet process, which consumes more energy than the dry process.

TABLE 4-1. REVIEW OF CEMENT PLANTS SURVEYED

Facility	Total state production[a] x 10^6 Mg/yr (10^6 tons/yr)	Type of process	Type of fuel
Michigan	5.71 (6.29)		
Aetna Cement Corporation, Essexville		Grinding[b]	N/A
Dundee Cement Company, Dundee		Wet	Coal
Medusa Cement Company, Charlevoix		Wet	Coal
National Gypsum Company, Alpena		Dry	Coal
Peerless Cement Company, Detroit		Wet	Coal
Penn - Dixie Industries, Inc., Petoskey		Wet	Coal
Wyandotte Cement, Wyandotte		(Grinding)	N/A
Ohio[b]	2.12 (2.34)		
Columbia Cement Corporation, Zanesville		Wet	Coal
General Portland, Inc., Paulding		Wet	Coal
Marquette Company, Pedro		Dry	Coal
Medusa Cement Company, Toledo		Dry	Coal
Southwestern Portland Cement Company, Fairborn		Wet	Coal/oil
Normal production 10^6 mg/yr (10^6 tons/yr)			
Indiana	2.91 (3.21)		
Lehigh Portland Cement Company, Mitchell		Dry	Coal

TABLE 4-1 (continued)

Facility	Total state production[a] x 10^6 Mg/yr (10^6 tons/yr)	Type of process	Type of fuel
Indiana (cont'd.)			
Lone Star Industries, Inc., Greencastle		Wet	Coal
Louisville Cement Company, Speed		Dry[d]	Coal/oil
Louisville Cement Company, Logansport		Wet	Coal
Universal Atlas, Buffington		Dry[d]	Coal/gas
Illinois	2.55 (2.81)		
Illinois Cement Company, La Salle		Dry[d]	Coal
Medusa Cement Company, Dixon		Dry	Coal/gas
Marquette Company, Oglesby		Dry	Coal
Missouri Portland Cement Company, Joppa		Dry	Coal
Wisconsin	0.34 (0.38)		
Medusa Cement Company, Manitowoc		Wet	Oil/gas
National Gypsum Company, Superior		(Grinding)	N/A
Universal Atlas Cement, Division of U.S. Steel Corporation, Milwaukee		(Grinding)	N/A
TOTAL EPA Region V Production	13.63 (15.03)		

[a] Reported by each plant, and summarized by state.

[b] One wet process coal fired kiln presently inactive although it does meet environmental regulations; plant has adequate supply of clinker from another Aetna Company plant.

[c] SME Cement, Inc. plant in Middlebranch, Ohio not included in survey, since plant is being refurbished after being closed in 1976, and only operated during a portion of 1978 for grinding of cement clinker only.

[d] Equipped with a preheater kiln.

N/A - Not applicable.

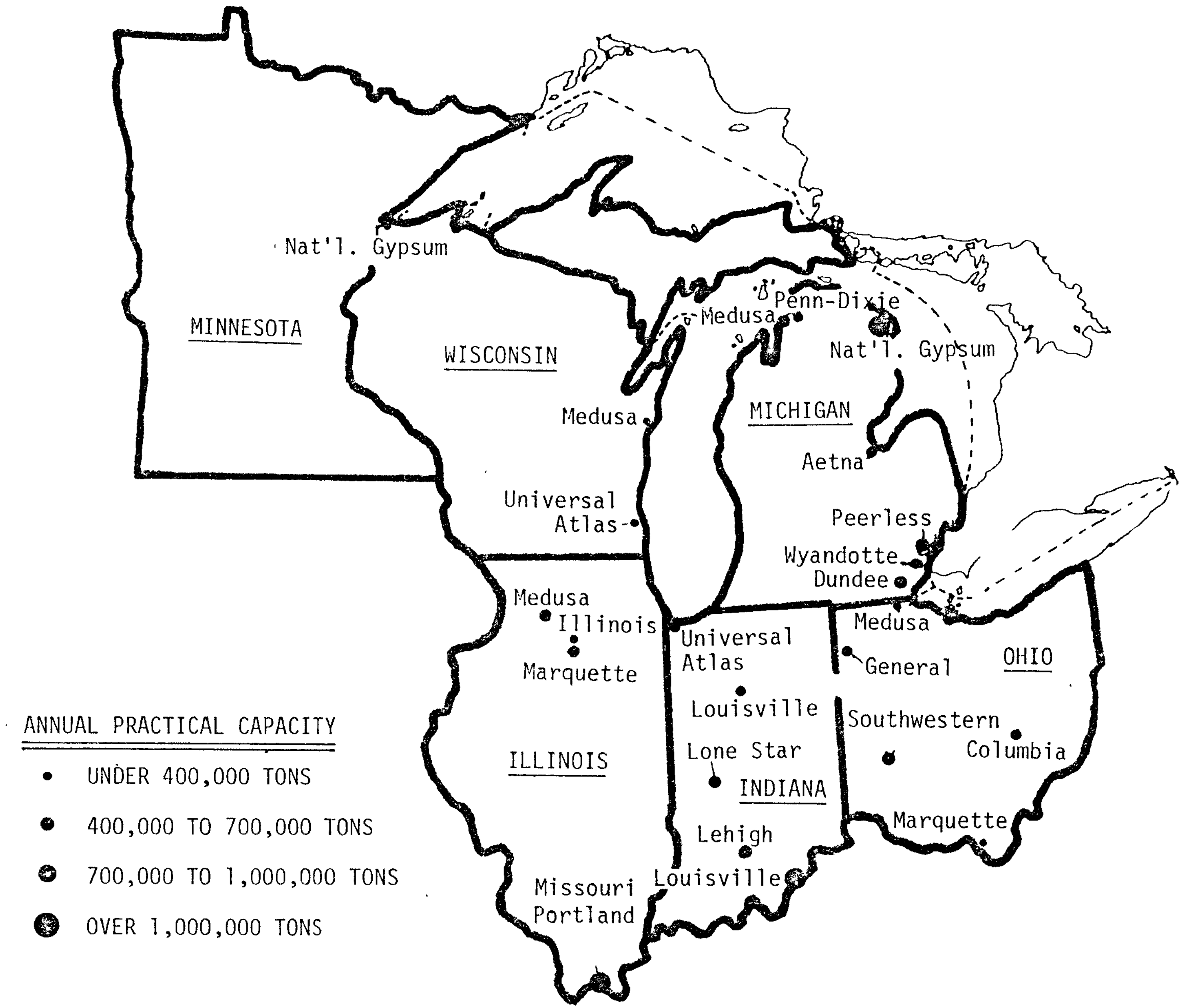

Figure 4-1. Locations and capacities of cement plants located in U.S. EPA Region V.[1]

4.2 DESCRIPTION OF DATA REQUESTED

The survey form first requested general information about the plant: location, type of process, capacity, normal annual operating hours, type of fuel used, major emission points, and associated control equipment. Next, the survey asked whether the plant could meet its present design capacity and whether it could expand production. Finally, the survey asked about the effect of environmental regulations on current production and on future expansion.

A sample survey form is shown in Appendix D.

4.3 ANALYSIS OF REPORTED IMPACTS ON PRODUCTION AND EXPANSION

Appendix E paraphrases the responses of each cement plant in the U.S. EPA Region V to our survey. The plants are not identified by name or segregated by state. Table 4-2 summarizes the factors cited by each cement plant in Region V as affecting production, expansion, and the cement shortage in general. The following sections present a discussion of these factors.

4.3.1 Production

Only 2 of the 24 plants reported a severe loss in production from their design capacities. Most of the production loss at one plant stems from continuing problems with start up of a new preheater kiln. Most of the loss at the other severely affected plant, stems from problems in starting a roller mill and the attendant opacity violations. Both plants are producing about 50 percent of their design capacity. Details of these operating problems are discussed in Section 5.

TABLE 4-2. FACTORS REPORTED AS IMPACTING ON CURRENT PRODUCTION AND EXPANSION OF CEMENT PLANTS IN REGION V

	Loss in current production		Expansion				Other general factors	
Plant No.	Process equipment downtime	Control equipment downtime	Low return on investment	Permit delays/ increased construction leadtime	High cost of meeting environmental regulations	Plant located in non-attainment area	Demand in excess of supply	Plant closings
1				X		X	X	
2	X				X		X	
3	X	X			X		X	
4			X		X	X	X	X
5	X			X	X		X	
6							X	X
7	X					X	X	X
8				X			X	
9	X		X	X	X	X	X	
10			X				X	X
11			X	X			X	X
12	X						X	
13			X		X		X	X
14	X		X	X	X		X	X
15		X	X	X	X		X	X
16							X	
17				X			X	
18		X	X	X	X		X	X
19	X	X			X		X	
20	X		X		X		X	
21			X	X	X		X	
22		X						
23			X			X	X	
24							X	

PEDCo did not obtain actual production totals for each plant in Region V, although the numbers reported by some plants were indicated as being 1978 totals. Rather, the data reported were taken as being indicative of what a plant could produce in a normal year with no severe problems, unless the plant indicated differently on the survey form. Figure 4-2 shows the number of plants reporting achievable production under, at, or over design capacity. Of the 24 plants, 11 are between 80 and 100 percent of design capacity (7 of these 11 are 90 percent or greater); this represents a total production of 6,058,000 Mg (6,678,000 tons). Seven plants representing 5,025,000 Mg (5,540,000 tons) of production are right at 100 percent design capacity. Five plants representing 2,277,000 Mg (2,510,000 tons) report achievable production that is slightly over design capacity. Only one plant [263,000 Mg (290,000 tons)] reported normal production of less than 80 percent of design capacity, which cement producers say represents normal production.[2]

Twelve other plants stated that environmental regulations were reducing production at their plant, typically by 2 to 5 percent. The loss was ascribed to the startup and malfunction of control devices (5 plants) or process equipment (9 plants), causing either a reduction or stoppage of production. During startup, most conventional coal-fired kilns equipped with ESP's operate without controls for several hours. Until the operating temperature is attained in the kiln, there is a risk of explosion

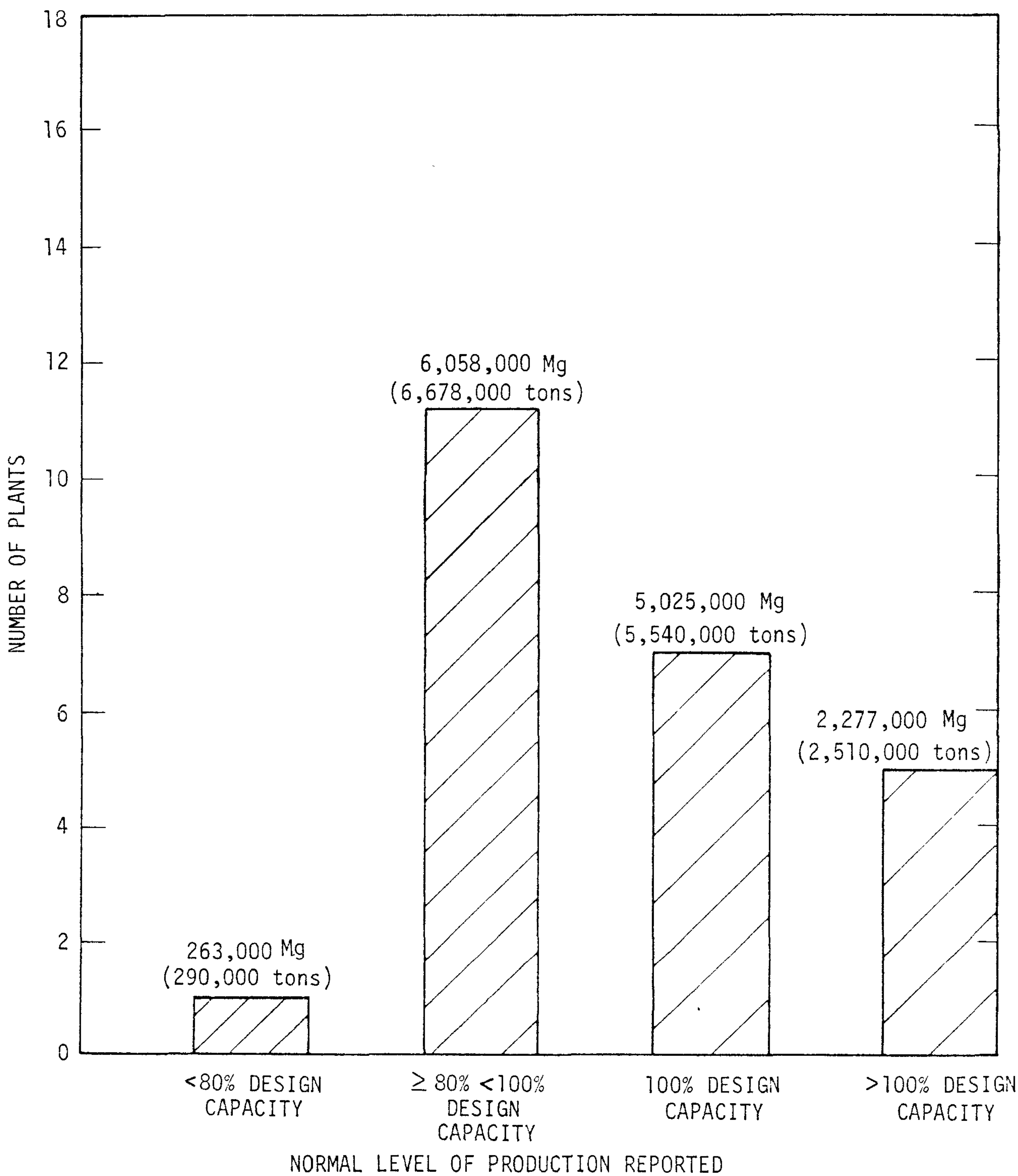

Figure 4-2. Level of production for cement plants in U.S. EPA Region V.

of combustibles in the ESP. The feed rate of raw materials is also reduced. Plants with preheater kilns experience periods of high opacity at several stages: during startup of roller mills, when switching from mill and kiln to kiln only, or vice versa.

Two companies that operate plants under a process weight regulation said that their cement production was limited to that feed rate at which the compliance emission test was performed. One company estimated that this limitation leads to another 5 percent loss in production: the plant could operate at a higher level, but with marginal control device performance.

Six plants reported that environmental regulations have no effect on production rates, and five plants reported achievable production numbers that are somewhat over design capacity (103 to 111%).

All but one of the plants (a white cement plant) indicated that demand in their areas is presently outstripping supply.

Production trends from Bureau of Mines' data[3] spanning 1972 through 1978 are shown in Table 4-3. These data show that production in Region V peaked in 1973, reached a low point in 1975, and has been increasing each year until 1978. Preliminary data from the Bureau of Mines on finished cement shipments from plants in Region V show that approximately 11,452,000 Mg (12,625,000 tons) were shipped in 1978. This figure should be close to production levels of finished cement, and indicate that production declined slightly from 1977 to 1978, perhaps reflecting the

TABLE 4-3. CEMENT PRODUCTION TRENDS IN U.S. EPA REGION V, 1972-1978[3]

States	Production x 1000 tons[a]						
	1978	1977	1976	1975	1974	1973	1972
Ohio	2,104	1,956	2,190	2,292	2,918	3,117	2,885
Michigan	5,599	5,568	5,118	4,634	5,844	6,007	6,181
Indiana and Wisconsin[b]	3,212	2,799	2,738	2,432	2,928	3,156	2,866
Illinois	2,020	1,915	1,849	1,481	1,592	1,531	1,540
Minnesota[c]	-	-	-	100	160	160	160
Masonry Cement (All States)	Included in total	1,052	934	840	900	1,063	1,015
Totals	12,625	13,290	12,829	11,779	14,342	15,034	14,647

[a] Bureau of Mines data; 1972-1977 figures include cement produced from imported clinker; 1978 figures are preliminary and indicate shipments of cement from plants in Region V.

[b] 560,000 tons/yr deducted for Kentucky except for 1978 when it waas not included.

[c] Estimated by PEDCo; only plant in state closed in 1975.

Metric conversion: tons x 0.9071 = Mg.

short term problems such as extremely bad weather, strikes, transportation problems and unexpectedly high demand that occurred in 1978. The lower production level for 1978 still represents approximately 80 percent of the design capacity of the 24 active plants in Region V.

In summary, the 24 cement plants in Region V reported that production could be approximately 13,634,000 Mg (15,030,000 tons) during a normal year without major problems, or about 94 percent of the design production 14,524,000 Mg (16,011,000 tons). This figure is far better than the 80 percent production rate that occurred in 1978 and is considered normal, and indicates that environmental regulations are not significantly affecting production rates at cement plants in Region V, although some problems at these plants are control equipment oriented. The decrease in production attributed by some plants to environmental regulations would be substantial if regained but would still not be enough to meet demand such as that experienced in 1978.

4.3.2 Expansion

The survey elicited many more comments about the effect of environmental regulations on expansion than on production. Only 7 plants (2 of them grinding plants) indicated that they could expand capacity. Only 1 plant is presently in the process of expansion. This section discusses each of the factors reported as affecting expansion potential for cement plants in Region V.

4.3.2.1 High Cost of Meeting Environmental Regulations--

Twelve plants cited the high cost of complying with environmental regulations as one factor deterring cement companies from expanding production. The implication is that funds that could be used for expansion are being diverted to pollution control. These are also cited as playing a major role in the premature closings of several cement plants in recent years. (These closures are discussed in Section 4.3.3).

Stringent environmental regulations and the effects of inflation have made the purchase of pollution control equipment a major expenditure for cement plants and for other industries as well. To remain in compliance, plant personnel must perform regular preventive maintenance on control equipment. When malfunctions do occur, the cost of production is increased. The added costs are especially noticeable at plants where less maintenance was performed in earlier years when regulations were not as strict. The end result is higher prices for cement.

Proposed new regulations for fugitive dust and hazardous wastes may also increase capital and operating costs for cement plants. In fact, three cement companies in Michigan and one in Illinois have mentioned these proposed state fugitive dust regulations as being too restrictive and costly. One company indicated that if the regulations go into effect, the grinding of cement clinker at its plant might become unfeasible. A second company indicated that the fugitive dust regulations would substantially reduce its ability to store the product in preparation for the peak shipping season. A third company indicated that the main source of fugitive dust in the vicinity of the plant was an interstate highway to which little or no control was applied, while plant procedures included daily sweeping or watering of streets.

In summary, the companies did not indicate that production would be directly affected by the proposed fugitive dust regulations, but they believe that the expense of the regulations does not justify the intended result.

Allegations have been made that EPA did not perform an adequate economic impact analysis when the New Source Performance Standards (NSPS) for cement plants were promulgated.[4] The EPA has also been criticized for its policy of treating regulations in the "aggregate" (rather than studying their application to each specific industry) in an effort to eliminate unnecessary costs.[5] The issue behind these allegations, however--the cost-effectiveness of the environmental regulations for the cement industry--is complex and cannot be discussed within the scope of this report.

It is true that environmental regulations are raising the threshold for an adequate return on investment (ROI) for a new cement plant (see Section 4.3.2.2), and that operating and maintenance costs for control equipment are increasing. These factors are apparently influencing the decision of cement companies in Region V not to expand production capabilities, as evidenced by the 12 plants in this survey that cited the high costs of pollution control. Only one plant however gave any estimate of annual cost, and stated that maintenance of cyclones, ESP's and fabric filters, accounted for 2 percent of the price of cement. The prospect of even stricter control requirements in the industry raises the concern that the costs will be increased further for new plants.

The problem increased cost of building and maintaining pollution control devices in the cement industry is one shared by other industries, and these additional costs are passed along to the consumer in the form of higher cement prices. These prices will probably need to be significantly higher in future years to return the investment that the companies will make to expand their capacity.

4.3.2.2 Low Return on Investment--

Eleven plants cited a low return on investment as one of the reasons for not expanding production. This item is related to the high cost of complying with emission regulations, mostly for air.

The economic outlook for building new cement plants is not encouraging. A recent report by Merrill Lynch, Pierce, Fenner and Smith Inc.[6] estimates from industry sources that the capital spending requirement for new cement plant is $110 to $132/Mg ($100 to $120/ton) of clinker. At a selling price of $55 to $66/Mg ($50 to $60/ton), this translates into a capital turnover of 0.5 and, therefore, an average net margin of 20 percent to generate an ROI of 10 percent. Historically, the cement industry has not seen 20 percent net margins even during cyclical peaks.[6]

The minimum plant size for economical operation is believed to be 544,260 to 725,080 Mg (600,000 to 800,000 tons/yr).[6] At a capital cost of 60 to 80 million dollars, this scale is reportedly beyond the financial capability of all but the largest producers. This situation may change in coming years as cement prices rise. However, a number of small cement companies have already been acquired by larger companies with much greater financial capability to invest in expansion when conditions are appropriate.[6]

Some cement companies have expressed the fear that expansion will produce an oversupply, but this seem unlikely in view of the plant closings projected for the next few years.

Dust collection is estimated to account for 18.75 percent of an 80 million dollar investment for a new 827,000 Mg (750,000 ton) plant.[6] The figure is misleading, however, because many of the collectors recovery product from exhaust streams, and as a result, increase product yields. This recovery balances some of the capital investment and operating costs for dust control.

Two companies in Region V indicated that pollution control accounts for 15 percent of their capital investment in a new plant, and a third company stated that in general, the cost of pollution control equipment could be as high as 25 percent of the capital investment for a new plant. Another company stated that the cost of retrofitting pollution control equipment could exceed

25 percent of the value of an existing plant in some cases. The Portland Cement Association conducted an informal survey among its member in 1978 and found that air pollution control only is estimated to account for 10 percent of the capital cost of a new plant. No additional recent data on the economics of pollution control in the cement industry were located in the literature.

Most of the increased capacity of recent years is from expansion of existing plants (in Region V, the only company presently expanding is increasing existing plant capacity). This form of expansion is more readily justified than the building of new plants, especially if it is part of a modernization program that can significantly reduce fuel consumption. The reduction in direct costs results in returns on incremental spending of 15 to 20 percent.[6]

In summary although inadequate return on investment is often cited as a deterrent against expansion in the cement industry, the situation is likely to improve as cement prices rise.[6] Acquisition of small plants by larger companies may also provide relief by bringing greater financial capabilities. Additional incentives may also be needed to stimulate expansion, depending on the growth of demand.

4.3.2.3 Delays in Obtaining Permits/Increase in Construction Lead Time--

Delays in obtaining permits were cited by 10 plants in Region V as having an effect on expansion capability. The current regulations and procedures are believed to add significantly to the lead time for expansion, especially in a nonattainment area, where control considerations for a new plant are complex and costly. The regulations are viewed by the cement industry as a deterrent to expansion.

Some of the cement companies in Region V stated that it would take up to 2 years to obtain all of the necessary permits for a new plant. This increases construction lead time to about 4 years, and prevents the industry from reporting quickly to shortages. In addition, some companies expressed the concern that they cannot predict what the future definition and scope of environmental regulations will be. The rules keep changing and getting stricter.

Companies must receive approval from the state environmental control agency and from U.S. EPA to modify, reconstruct, or build new facilities. Figure 4-3 shows the permit procedure for Ohio, which usually takes about 3 months. The EPA Best Available Control Technology (BACT) and Prevention of Significant Deterioration (PSD) reviews cannot take more than 12 months, according to law. The National Pollutant Discharge Elimination System (NPDES) water permit is usually reviewed at the same time and may take up to 3 months. Likewise, delays are not usually encountered in obtaining solid waste permits for new cement plants. Lead times for obtaining a permit in a nonattainment area may be longer because of the presence of emission offsets rules with other industries. In some cases, the construction of a new cement plant may not be possible (mentioned by 5 plants).

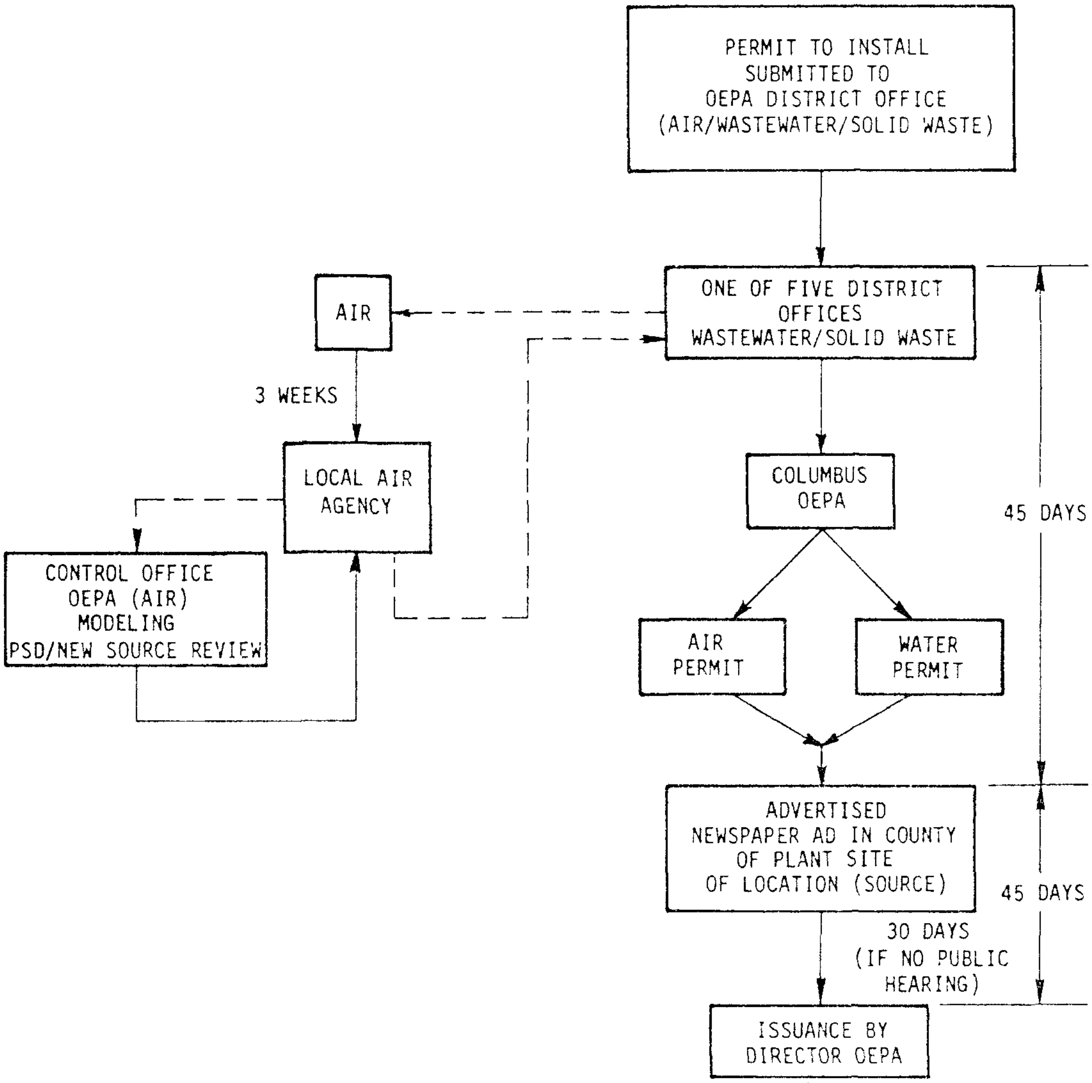

Figure 4-3. Permit process for state of Ohio.

We reviewed a list of the times it took for various entities (including cement plants) to obtain Federal EPA approval (PSD/BACT). These PSD/BACT determinations were made before the more restrictive PSD regulations took effect in June 1978. For cement plants we found no elapsed times greater than 8 months, but we were not able to determine whether the approval was for a portion of a cement plant or for an entirely new facility. Indications are, however, that time for review of PSD/BACT permits does not vary significanly whether a single process or an entire plant is involved.

Delays in permit approval are usually caused by incomplete information on the applications that are submitted, or by insufficient personnel in the state and Federal agencies responsible for processing them. Another cause may be public hearings, which may result in objections from environmental groups, for example, to building a plant as proposed. They may consequently file a lawsuit. The number of steps involved in permit approval, combined with the delays that can occur at various stages, may increase lead time to 2 years in some cases, however, the norm is 1 year or less.

In any event, the streamlining and clarification of cement plant regulations and permit procedures shorten the lead time for new plant construction. These measures would also allow the cement industry to respond more rapidly to changing demands, with the confidence that the environmental regulations will not change midstream through the project.

4.3.3 Other Factors Affecting the Cement Shortage In General

The survey elicited comments about two other factors that have affected the cement shortage: excessive demand for cement and the retirement of plants without replacement; which is discussed in the following section.

4.3.3.1 Retirement of Cement Plants--

The closing number of cement plants is one factor cited by five of the companies surveyed in Region V as contributing to the present cement shortage. Those plants that were closed in the last 3 or 4 years and not replaced by new capacity can be assumed to have had the greatest effect on the cement shortage. Table 4-4 lists the plants in Region V that were closed since 1975 and their capacities.

Although environmental regulations were not given as the only reason for the plant closings, many companies believe that the regulations accelerate the retirement of older, obsolete plants. No problem arises when the loss in production is compensated for by the building of new plants. In the last 4 years, however, four plants and parts of two others have been closed in Region V and not replaced. Similar closures have occurred throughout the nation during this time.

The combined capacity of the six plants was about 1,890,400 Mg (2,084,000 tons). This lost production represents 13 percent of the total current capacity. The effect of these closures on the shortage in Region V is difficult to assess, because some of the cement produced in the last 2 years was shipped out of the

TABLE 4-4. CEMENT PLANTS CLOSED WITHOUT REPLACEMENT IN U.S. EPA REGION V, 1975 THROUGH 1978

State	Plant name and location	Annual capacity, Mg (tons)	Year closed	Comments
Michigan	National Gypsum, Alpena	454,000 (500,000)	1976	Twelve kilns shut down permanently because of high cost of equipping them with environmental controls.
Minnesota	U.S. Steel: Universal Atlas Duluth	191,000 (210,000)	1975	Voluntarily closed by U.S. Steel; plant never had operating permit, and many operations were not in compliance with state environmental regulations. Intermix Corporation applied for permit to reopen plant in 1977: permit denied because of inadequate planned pollution control and financial capability.
Ohio	Flintkote Co.: Diamond Kosmos C.E., Middlebranch	408,000 (450,000)	1976	Closed primarily because of cost of complying with environmental regulations; SME Cement, Inc., is reopening two of the four kilns; 1000 of 1500 tons/day are being regained.
	U.S. Steel: Universal Atlas, Fairborn	404,000 (445,000)	1975	Closed primarily because of increase in raw material costs; cost of complying with environmental regulations compounded the problem.
	PPG Industries: Columbia Cement Barberton	227,000 (250,000)	1976	Built 1959; price of byproduct limestone from soda ash plant became too expensive; soda ash plant closed because of cost of complying with water pollution regulations.
Wisconsin	Marquette Cement Co., Milwaukee	208,000 (229,000)	1975	Land not available for settling pond to comply with water pollution discharge regulations for scrubber; additional air pollution control equipment not economically justified.

region to areas of earlier shortages. It is clear, however, that the production from these six plants could have eased the present shortage.

The owners of the plants cited the difficulties to comply with environmental regulations as having an influence on the decision to close the plants; for four plants, it was given as the main reason. The regulations have apparently had an effect on cement production in Region V by causing these four older plants, with marginal control equipment, to close prematurely. According to the owners, the cost of compliance could not be justified.

Control agencies are not allowed sufficient flexibility in most cases, to adapt regulations to older plants that may be marginally out of compliance but could continue to operate profitably for several more years. An example is given in Section 5, however, of a plant that could have been granted a variance by control agencies and remained in operation.

Personnel at EPA in Region V surveyed the six state environmental control agencies about cement plant shutdowns in their jurisdictions. Agencies in Illinois, Indiana, and Michigan reported that their regulations had not caused any plants to shut down in the last 4 or 5 years. The Michigan agency reported two shutdowns early in the 1970's that involved noncompliance with air pollution regulations. It did not report the shutdown of 12 kilns at National Gypsum Company in Alpena in 1976 (capacity of

500,000 tons/yr). The company reported that these kilns were retired because it was not economical to equip them with the required control equipment.

The Ohio agency reported three shutdowns in the past 4 years but did not comment about their effect on the present shortage. Problems with raw materials were the main reason for closing two of these plants, but companies cited environmental regulations as contributing factors. The third plant was closed because of the expense of complying with air pollution regulations, but another company is reopening two-thirds of the capacity of the old plant. Grinding of some clinker began in July 1978, and 1 kiln was on line during the first quarter of 1979.

The Wisconsin control agency reported one plant shutdown in 1975. Because this happened 4 years ago, it is not believed to have had an impact on the present shortage.

The Minnesota agency reported that the only plant in that state closed in 1975 because it could not meet environmental regulations. An attempt by another company to reopen the plant in 1977 was denied because the State decided that the company could not comply, technically or economically, with environmental regulations.

In general, the state environmental agencies indicated their belief that state regulations have not had a significant impact on the cement shortage.

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SECTION 5

CASE HISTORIES

This section presents brief case histories of the two plants in Region V that experienced a significant loss in cement production during 1978. Each case history focuses on the causes for the loss, on company efforts to remedy the problems, and on the outlook for increased production in the future.

A third case history is presented on the events surrounding the decision of a company to close its cement plant in Region V.

5.1 CASE HISTORY NO. 1

This company manufactures portland and brixment cement. Portland cement is produced by kilns No. 1 and 2, and a third kiln is used for brixment cement. In 1977 the company shut down three kilns, which were built in the 1950's, in response to a state compliance order. These kilns became uneconomical to operate with the required controls.

The No. 1 kiln is a 152 m (500-ft) conventional unit that began operating in 1973. Main exhaust is controlled by a Fuller-Draco baghouse and clinker cooler exhaust is controlled by an American Air Filter baghouse. The No. 2 kiln is equipped with a four-stage preheater for drying and preheating the raw feed before firing in the kiln. A water spray conditioning tower is used on the main kiln exhaust during kiln-only operation. Particulate emissions from this kiln and from the raw mill are controlled by an eight-section Koppers electrostatic precipitator (ESP). A portion of the No. 2 kiln exhaust gas is ducted to a separate Koppers ESP to control alkali buildup in the final product. Dust from this second ESP is discarded, while the dust from the other control devices is recycled to the process. Clinker cooler exhaust is controlled by a Rexnard gravel-bed filter.

The company produces a proprietary masonry cement (containing no additives) from natural limestone rock in the brixment cement kiln. The main exhaust of the brixment kiln is controlled by a Lurgi ESP, and exhaust from the clinker cooler is controlled by a baghouse.

5.1.1 Operating Problems

The most recent problem occurred when the ESP on No. 2 kiln main exhaust malfunctioned, causing both portland cement kilns to shut down. Examination of the interior of the ESP showed that a number of plates had been warped. There was no evidence of heat damage, and the operators suspect that an explosion occurred. The malfunction was sudden, happening right after a shutdown of the raw mill. The kiln discharge is equipped with an O_2 and CO monitor; the O_2 monitor was not operating when the malfunction occurred, and it is not known whether the CO monitor was operating.

The company expects replacement plates to be delivered quickly, but the two portland cement kilns will be shut down completely for at least 3 weeks while the ESP is rebuilt. The plant is now operating the raw mill at one-third capacity to provide feed for kiln No. 1. Four of the eight ESP sections are able to operate partially, but opacity is very high. A variance has been obtained from the state to allow operations to continue in this manner until the shut down for repair.

The total loss in production from this incident will probably approach 90,710 Mg (100,000 tons) of clinker, which is about 8 percent of the annual design capacity of the plant.

Before this incident, production loss from malfunction of control equipment had been insignificant. Other problems which resulted in a 50 percent loss in production in 1978, are summarized below.

5.1.1.1 Materials Handling--

During the winter of 1977-78, problems arose when the limestone pile froze over the feeders and the clay pile turned to mud when it rained. Materials that could be extracted also froze in the flap gates of the roller mill. The company spent $100,000 for an extra feeder outside the limestone pile, and also built a roof over part of the clay pile, covering 13,610 Mg (15,000 tons) to make handling easier during inclement weather.

Another problem in materials handling occurred this past winter when two of the four rolls used in the grinding mill developed cracks. Two new ones were flown in from West Germany, but one of the new rolls recently broke apart. The plant is now operating on only two rolls; however only one kiln is being used. Four new rolls are on order.

5.1.1.2 Coal Silo Failure/Fan Problems--

The severe weather problems of the winter of 1977-78 were followed by two major catastrophes in the spring of 1978. First, the bottom cone of the coal silo fell out and crushed electrical and other equipment under it. Second, the fluid drives for the preheater and mill vent fans failed because operators did not restart the cooling water system when other equipment was restarted after a power failure.

The combination of the severe winter and these two process malfunctions prevented the company from building up a product inventory and kept production behind for the rest of 1978. Control equipment malfunctions did not affect production significantly in 1978.

5.1.2 Environmental Regulations

Company officials say that they feel overwhelmed with the multitude of environmental regulations and the rate at which they are changing: they have trouble keeping up and are experiencing a significant increase in operating costs. For example, the U.S. EPA recently asked the company to install a continuous opacity monitor on the stack of the No. 2 kiln exhaust. The company is spending $40,000 to install the necessary equipment. The monitor is required because excessive emissions occur during transition from mill-plus-kiln to kiln-only operating modes, and vice versa.

The company says that the automatic controls for the system make these excessive emissions unavoidable, and that they are kept as short as possible.

Another example the company cites is efforts by the state to impose stricter regulations on the No. 1 kiln and clinker cooler because the plant is in a nonattainment area.

New fugitive dust regulations are being proposed by the state. If implemented, they will require the company to spend considerable capital for compliance.

Water pollution regulations have not had as much impact as those for air pollution, but they have increased operating costs.

5.2 CASE HISTORY NO. 2

This company manufactures portland and masonry cement. Two conventional kilns, built in 1957, were extensively modernized in 1975 and converted to preheater kilns measuring 3.4 m by 56 m (11 ft by 190 ft). The preheater kilns were intended to offset the loss of capacity that occurred when 14 older kilns were shut down in the early 1970's. The capacity of the two conventional kilns was increased 15 percent when the preheaters were installed.

Raw materials (limestone, clay, and boiler slag) are fed into a roller mill for crushing and drying; they are them conveyed and classified and put into storage silos. When the material leaves the silos it is weighed and discharged into a four-stage preheater kiln, where it is heated to 760°C (1400°F) by direct contact with kiln gases. The partially calcined feed then enters the sloping kilns.

The two kiln main exhausts are controlled by Koppers ESP's. In the normal mode, exhaust gases from the kilns pass through the preheaters and the roller mill before entering the ESP's. In the bypass mode (roller mill shutdown), the exhaust gases first go through a conditioning tower with water sprays where the temperature is reduced from 316° to 149°C (600° to 300°F). They then enter the ESP's at about 104°C (220°F). A portion of kiln off-gases (alkali bypass) are withdrawn continuously and exhausted through a separate Swindel-Dresser ESP. The clinker coolers are controlled with a Rexnard gravel-bed filter.

The design capacity of this plant is 540,632 Mg (596,000 tons) of cement. In 1978, however, production was about 50 percent of design, or 263,422 Mg (290,400 tons). The problems causing the loss in production, efforts to remedy them, and the outlook for increased production in the future are discussed in the following sections.

5.2.1 Operating Problems

5.2.1.1 Bypass Mode (Kiln Only)--

Exhaust gas from each kiln is passed through a conditioning tower with water sprays. Each tower has three 0.6 l/s (9 gal/min) sprays for a total of 0.2 l/s (27 gal/min). Problems with the conditioning towers account for about 75 percent of the loss of production. The main problem is plugging, caused either by loss of air pressure, misdirection of water spray, or plugging of spray nozzles.

A misdirected spray, for example, will cause water to run down the side of the tower and will eventually plug or partially plug the bottom discharge duct of the tower. When it is a partial plug, operators can either shut down or reduce gas flow (and, consequently, kiln production). A complete plug of the tower discharge requires a shutdown and a crew of 10 people working 8 to 10 hours to dig out the plug. The situation has improved somewhat in the last 3 months after positive shutoff dampers were installed downstream of each conditioning tower, thus allowing operators to isolate each tower separately. Before the dampers were installed, a problem with one tower would cause both towers to be shutdown.

The other problem with the conditioning towers is plugging of spray nozzles, which causes a reduction in waterflow. This increases the gas temperature at the inlet to the ESP's and degrades their performance. Operators must then cut back gas flow and, as a result, production. Optimum temperature range for the ESP's is 82° to 104°C (180° to 220°F). Operators have developed a decompression chamber with a slide gate, into which they can pull the spray nozzles for repair during operation of the conditioning towers. The slide gates, however, will not work well after the spray nozzles are removed five or eight times, and the tower must be shut down periodically to clean the slide gates.

5.2.1.2 Normal Mode--

When the plant is operating in the bypass mode and the roller mill is activated, the mill fan picks up deposited dust and purges it from the system. This causes a temporary increase in grain loading to the ESP's. As the system stabilizes, the stack temperature drops from around 104°C (220°F) to about 82°C (180°F), and moisture increases. Depending on the initial stack temperature, however, it may take five or more starts of the mill to stay within the 40 percent opacity regulation for the first 6 minutes. If the initial stack temperature is 93°C (200°F) or less, it may only take one or two starts; at temperatures over 93°C, it takes progressively more starts. If the initial temperature is over 104°C, the operators may elect not to start the mill until the system has been inspected.

Operators have sometimes spent as long as 8 hours trying to start the mill without exceeding the 40 percent opacity regulation. If they cannot achieve clear stacks after repeated mill starts, they begin looking for problems in the conditioning towers or ESP's. About 95 percent of the opacity violations come from mill starts, and the company says that many of the violations are for opacities that exceed the limit by only a few percentage points. Malfunctions of the roller mill itself, however, are estimated to account for about 70 percent of lost production; malfunctions of the ESP contribute only about 5 percent.

5.2.2 Environmental Regulations

Production is severely affected by attempts to comply with the 40 percent opacity regulation. Company officials say that they have changed their philosophy--from the goal of production to that of meeting the opacity regulation. Examination of the problem reveals that most of the trouble stems from the conditioning towers. According to the company, if the towers had been sized larger many of the problems could have been averted. Evidence also suggests that officials at EPA Region V recommended that fabric filters be used instead of the conditioning towers and ESP's. The company responds that it had no idea so many problems would arise with the existing system, and that recent modifications have not been successful. The company believes, however, that EPA has been reasonable in its enforcement efforts.

In light of these problems, the company is naturally concerned about changes in state regulations that will lower the limit for opacity to 20 percent over a 6-minute period. Officials say they could never meet a 20 percent opacity regulation, and would be forced to close. They hope to be exempted from this regulation.

5.2.2.1 Future Outlook--

Several improvements have been added to the system in the last 9 months. The ESP for the alkali bypass system has been rebuilt. About 18 months ago, this ESP was not working properly. A number of modifications (most involving gas flow distribution) markedly improved the performance of the ESP, which is now in compliance. A $200,000 fine was levied against the company because of opacity violations from this source.

Maintenance of the entire system has been improved. Ten people (four full time) now maintain the conditioning towers and ESP's; they keep records on their maintenance tasks, and a quarterly report is sent to EPA. Level alarms have been installed on the ESP hoppers for the kiln main exhaust. The company reports a reduction in the time it takes to clean out a conditioning tower.

The company hopes to move production closer to rated capacity, but it does not believe that the plant can reach full production with present operating procedures.

5.3 CASE HISTORY NO. 3

The following is a brief account of the series of events that led to the decision of a cement company in Region V to close its facility. The information was provided by the company and is based on correspondence and meetings between company officials and state and county pollution control officials.

In the early 1970's, with the advent of new, stricter air pollution laws, the ESP on the rotary kiln at this plant was no longer adequate. The precipitator had a design efficiency of 98 percent and fully met this operating efficiency. In an effort to comply with the stricter regulations, the company modified a dehumidifier chamber into a wet scrubber to be used for particulate removal after the precipitator. This combination of controls enabled kiln operation to meet the county air pollution code of 0.2 Kg/1000 Kg (0.2 lb/1000 lb) of gas. The scrubber used water from an adjacent canal, and the scrubber effluent was discharged back into the canal.

The use of canal water, however, created a conflict with U.S. EPA regulations. The suspended solids content of the discharge water was in excess of state National Pollutant Discharge Elimination System (NPDES) requirements that limited solids in wastewater to a maximum of 50 ppm. The company complained that, in many instances, the water from the canal already had a content of 180 ppm suspended solids before being used for particulate removal.

To avoid this problem with the scrubber water, the company undertook in 1973 an extensive ESP modification and rebuilding program at a cost of $500,000. Despite these efforts to increase efficiency from 98 percent to over 99 percent, the ESP was still unable to meet the air emission codes alone. The scrubber was reactivated in October 1974, with the hopes that an agreement could be reached with control agencies to solve the water pollution problem. In January 1975, the company applied for a variance to its water discharge permit, including a request that the limitation on the suspended solids content of the discharged scrubber effluent be changed to 200 ppm (maximum of 250 ppm per day). In response, agency personnel requested that the company build a settling pond. The company, however, had no available land site.

The company concluded that the only way to solve the water pollution dilemma was to grant the variance or install other air pollution control equipment, at a cost of $700,000, that would eliminate the need for the wet scrubber. During those years, however, the cement industry was suffering from an economic depression, and the company believed that spending another $700,000 with no guarantee that the plant would then be in compliance was totally impractical. The company notified the pollution control agencies that it would be forced to close the plant if the requested variance was not granted. The plant continued to be under daily scrutiny by enforcement officials, and the company said that since there was no sign, that a variance would be granted the production of cement ceased in April 1975. More than 70 employees were laid off, and a yearly supply of 200,000 tons of cement was lost. The company stated that after the plant had closed it was notified that the variance for the suspended solids content in the discharge permit would be granted until July 30, 1978.

The annual production rate at this plant was 174,160 Mg (192,000 tons) of cement for 1974, and a projected 207,725 Mg (229,000 tons) for 1975.

The misunderstanding between the company and enforcement officials should not have happened. A substantial amount of cement production was lost as a result. The fact remains, however, that a compromise can be reached between a company and enforcement officials if emissions at a plant are not too far in excess of the limits. In this case, the plant was in compliance with the air pollution regulations. The levels of suspended solids discharged from the scrubber were only slightly higher than in the water taken from the source.

APPENDIX A

NEW SOURCE PERFORMANCE STANDARDS CEMENT PLANTS

Subpart F—Standards of Performance for Portland Cement Plants

§ 60.60 Applicability and designation of affected facility.

[42 FR 37936, July 25, 1977]

(a) The provisions of this subpart are applicable to the following affected facilities in portland cement plants: kiln, clinker cooler, raw mill system, finish mill system, raw mill dryer, raw material storage, clinker storage, finished product storage, conveyor transfer points, bagging and bulk loading and unloading systems.

(b) Any facility under paragraph (a) of this section that commences construction or modification after August 17, 1971, is subject to the requirements of this subpart.

§ 60.61 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Portland cement plant" means any facility manufacturing portland cement by either the wet or dry process.

§ 60.62 Standard for particulate matter.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any kiln any gases which:

(1) Contain particulate matter in excess of 0.15 kg per metric ton of feed (dry basis) to the kiln (0.30 lb per ton).

(2) Exhibit greater than 20 percent opacity.

[39 FR 39872, November 12, 1974]

(b) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any clinker cooler any gases which:

(1) Contain particulate matter in excess of 0.050 kg per metric ton of feed (dry basis) to the kiln (0.10 lb per ton).

(2) Exhibit 10 percent opacity, or greater.

(c) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any affected facility other than the kiln and clinker cooler any gases which exhibit 10 percent opacity, or greater.

(d) [Deleted].

[39 FR 20790, June 14, 1974; 40 FR 36250, October 6, 1975]

§ 60.63 Monitoring of operations.

(a) The owner or operator of any portland cement plant subject to the provisions of this part shall record the daily production rates and kiln feed rates.

[39 FR 20790, June 14, 1974]

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 7414).)

§ 60.64 Test methods and procedures.

(a) The reference methods in Appendix A to this part, except as provided for in § 60.8(b), shall be used to determine compliance with the standards prescribed in § 60.62 as follows:

(1) Method 5 for the concentration of particulate matter and the associated moisture content;

(2) Method 1 for sample and velocity traverses;

(3) Method 2 for velocity and volumetric flow rate; and

(4) Method 3 for gas analysis.

(b) For Method 5, the minimum sampling time and minimum sample volume for each run, except when process variables or other factors justify otherwise to the satisfaction of the Administrator, shall be as follows:

(1) 60 minutes and 0.85 dscm (30.0 dscf) for the kiln.

(2) 60 minutes and 1.15 dscm (40.6 dscf) for the clinker cooler.

(c) Total kiln feed rate (except fuels), expressed in metric tons per hour on a dry basis, shall be determined during each testing period by suitable methods; and shall be confirmed by a material balance over the production system.

(d) For each run, particulate matter emissions, expressed in g/metric ton of kiln feed, shall be determined by dividing the emission rate in g/hr by the kiln feed rate. The emission rate shall be determined by the equation, $g/hr = Q_s \times c$, where Q_s = volumetric flow rate of the total effluent in dscm/hr as determined in accordance with paragraph (a)(3) of this section, and c = particulate concentration in g/dscm as determined in accordance with paragraph (a)(1) of this section.

[39 FR 20790, June 14, 1974]

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 7414))

STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES (Continued)

Source category	Affected facility	Pollutant	Emission level	Monitoring requirement
Subpart F - Portland Cement Plants				
Proposed/effective 8/17/71 (36 FR 15704)	Kiln	Particulate Opacity	0.30 lb/ton 20%	No requirement No requirement
Promulgated 12/23/71 (36 FR 24876)	Clinker cooler	Particulate Opacity	0.10 lb/ton 10%	No requirement No requirement
Revised 6/14/74 (39 FR 20790) 11/12/74 (39 FR 39874) 10/6/75 (40 FR 46250) 7/25/77 (42 FR 37936) 8/17/77 (42 FR 41424)	Fugitive emission points	Opacity	10%	No requirement Daily production and feed kiln rates

APPENDIX B

STATE IMPLEMENTATION PLAN REGULATIONS
U.S. EPA REGION V

(3) Portland Cement Manufacturing Processes. Rules 203(a) and 203(c) shall not apply to the kilns and coolers of portland cement manufacturing processes.

(A) The kilns and clinker coolers of existing portland cement manufacturing processes shall comply with the emission standards and limitations of Rule 203(b).

Rule 203: Particulate Emission Standards and Limitations.

(a) Particulate Emission Standards and Limitations for New Process Emission Sources.

Except as further provided in this Rule 203, no person shall cause or allow the emission of particulate matter into the atmosphere in any one hour period from any new process emission source which, either alone or in combination with the emission of particulate matter from all other similar new process emission sources at a plant or premises, exceeds the allowable emission rates specified in Table 2.1 (Table II-A*) and in Figure 2.1 (Figure II-B*).

(b) Particulate Emission Standards and Limitations for Existing Process Emission Sources.

Except as further provided in this Rule 203, no person shall cause or allow the emission of particulate matter into the atmosphere in any one hour period from any existing process emission source which, either alone or in combination with the emission of particulate matter from all other similar new or existing process emission sources at a plant or premises, exceeds the allowable emission rates specified in Table 2.2 (Table II-C*) and in Figure 2.2 (Figure II-D*).

(c) Compliance by Existing Process Emission Sources. Except as otherwise provided in this Rule 203 every existing process emission source that is not in compliance with paragraph (b) of this Rule 203 as of the effective date of Part 2 of this Chapter, shall comply with paragraph (a) of this Rule 203, unless both the following conditions are met.

(1) The source is in compliance, as of the effective date of Part 2 of this Chapter, with the term and conditions of a variance granted by the Pollution Control Board, or, within sixty (60) days of the effective date of this Chapter, the source is the subject of a variance petition filed with the Pollution Control Board, which variance is subsequently granted by the Board, and,

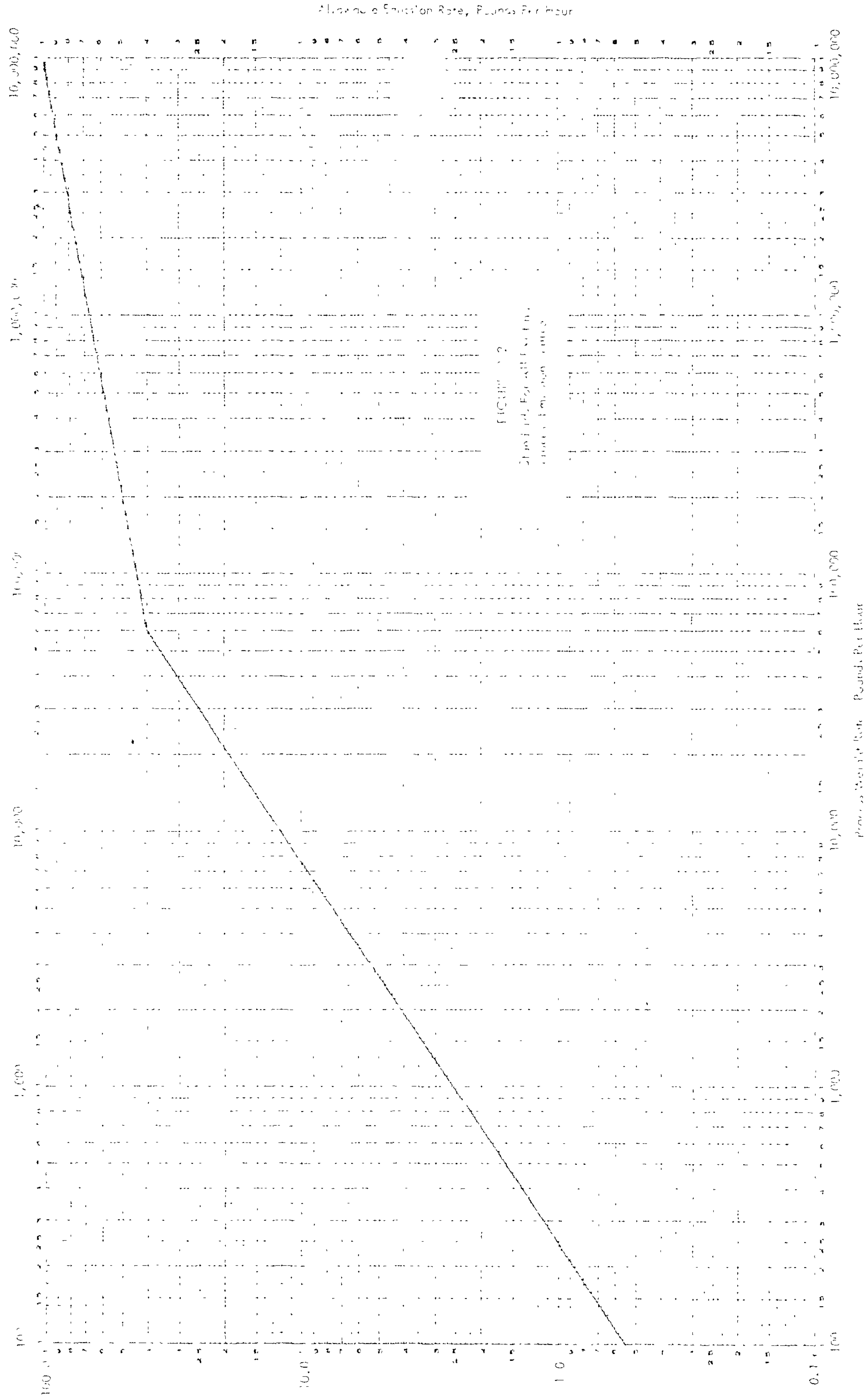
(2) As of the effective date of Part 2 of this Chapter, construction has commenced on equipment or modifications sufficient to achieve compliance with paragraph (b) of this Rule 203.

*This is an Agency interpretation for this printing of the Rules adopted by the Pollution Control Board. These numbers are for reference purposes only.

TABLE 2.2 (II-C*)
STANDARDS FOR EXISTING PROCESS EMISSION SOURCES

Process Weight Rate Pounds Per Hour	Process Weight Rate Tons Per Hour	Allowable Emission Rate Pounds Per Hour
100	0.05	0.55
200	0.10	0.87
400	0.20	1.40
600	0.30	1.83
800	0.40	2.22
1,000	0.50	2.58
1,500	0.75	3.38
2,000	1.00	4.10
4,000	2.00	6.52
6,000	3.00	8.56
8,000	4.00	10.40
10,000	5.00	12.00
20,000	10.00	19.20
30,000	15.00	25.20
40,000	20.00	30.50
50,000	25.00	35.40
60,000	30.00	40.00
70,000	35.00	41.30
80,000	40.00	42.50
90,000	45.00	43.60
100,000	50.00	44.60
200,000	100.00	51.20
300,000	150.00	55.40
400,000	200.00	58.60
500,000	250.00	61.00
600,000	300.00	63.10
700,000	350.00	64.90
800,000	400.00	66.20
900,000	450.00	67.70
1,000,000	500.00	69.00

* This is an Agency interpretation for this printing of the Rules adopted by the Pollution Control Board. These numbers are for reference purposes only.


Allowable Emission Rate, Pounds Per Hour
Process Weight Rate, Pounds Per Hour
10,000,000
1,000,000
100,000
10,000
1,000
100
100.0
10.0
1.0
0.1

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B) The kilns and clinker coolers at new portland cement manufacturing processes shall comply with the following emission standards and limitations

(i) No person shall cause or allow the emission of particulate matter into the atmosphere from any such kiln to exceed 0.3 pounds per ton of feed to the kiln.

(ii) No person shall cause or allow the emission of particulate matter into the atmosphere from any such clinker cooler to exceed 0.1 pounds per ton of feed to the kiln.

INDIANA
REGULATION APC-5
Process Operations

No person shall operate any process so as to produce, cause, suffer or allow particulate matter to be emitted in excess of the amount shown in the following table. Exceptions are combustion for indirect heating, incinerators, open burning, existing cement kilns, existing catalytic cracking units, and existing foundries.

Allowable Rate of Emission Based on Process Weight Rate[1]

Process Weight Rate Lbs/Hr	Process Weight Rate Tons/Hr	Rate of Emission Lbs/Hr	Process Weight Rate Lbs/Hr	Process Weight Rate Tons/Hr	Rate of Emission Lbs/Hr
100	0.05	0.551	16,000	8.00	16.5
200	0.10	0.877	18,000	9.00	17.9
400	0.20	1.40	20,000	10.00	19.2
600	0.30	1.83	30,000	15.00	25.2
800	0.40	2.22	40,000	20.00	30.5
1,000	0.50	2.58	50,000	25.00	35.4
1,500	0.75	3.38	60,000	30.00	40.0
2,000	1.00	4.10	70,000	35.00	41.3
2,500	1.25	4.76	80,000	40.00	42.5
3,000	1.50	5.38	90,000	45.00	43.6
3,500	1.75	5.96	100,000	50.00	44.6
4,000	2.00	6.52	120,000	60.00	46.3
5,000	2.50	7.58	140,000	70.00	47.8
6,000	3.00	8.56	160,000	80.00	49.0
7,000	3.50	9.49	200,000	100.00	51.2
8,000	4.00	10.40	1,000,000	500.00	69.0
9,000	4.50	11.20	2,000,000	1,000.00	77.6
10,000	5.00	12.00	6,000,000	3,000.00	92.7
12,000	6.00	13.60			

When the process weight exceeds 200 tons/hour, the maximum allowable emission may exceed that shown in the table, provided the concentration of particulate matter in the discharge gases to the atmosphere is less than 0.10 pounds per 1,000 pounds of gases at standard conditions.

Existing cement manufacturing operations equipped with electrostatic precipitators, bag filters, or equivalent gas-cleaning devices shall be allowed to discharge concentrations of particulate matter in accordance with $E=8.6\ P^{0.67}$ below 30 tons per hour of process weight and $E=15.0\ P^{0.5}$ over 30 tons per hour of process weight.

Existing petroleum catalytic cracking units equipped with cyclone separators, electrostatic precipitators, or other gas-cleaning systems shall recover 99.97% or more of the circulating catalyst or total gas-borne particulate

[1] Interpolation of the data in this table for process weight rates up to 60,000 lbs/hr shall be accomplished by use of the equation $E=4.10\ P^{0.67}$, and interpolation and extrapolation of the data for process weight rates in excess of 60,000 lbs/hr shall be accomplished by use of the equation $E=55.0\ P^{0.11}-40$, where E=rate of emission in lbs/hr and P=process weight in tons/hr.

Promulgated December 6, 1968.

R 336.44. Emission of particulate matter.

Rule 44. It is unlawful for a person to cause or allow the emission of particulate matter from any source in excess of:

(a) The maximum allowable emission rate listed in Table 1.

(b) The maximum allowable emission rate listed by the commission on its own initiative or by application. A new listed value shall be based upon the control results achievable with the application of the best technically feasible, practical equipment available. This applies only to sources not assigned a specific emission limit in Table 1.

(c) The maximum allowable emission rate specified as a condition of a permit to install or a permit to operate.

(d) The maximum allowable emission rate specified in a voluntary agreement, performance contract, stipulation, or an order of the commission.

(e) The maximum allowable emission rate as determined by Table 2 for sources not covered in subdivisions (a) to (d).

TABLE 1.

PARTICULATE MATTER EMISSION SCHEDULE

Source	Capacity Rating in Pounds Steam Per Hr	Maximum Allowable Emission at Operating Conditions (lbs particulate per 1000 lbs gas)
A. Fuel Burning Equipment		
1. Pulverized coal (Includes cyclone furnace)	0 - 1,000,000	See Figure 1 for maximum emission limit
	over 1,000,000	Apply to commission for specific emission limit

2. Other modes of firing coal (other than pulverized)	0 - 100,000	0.65
	100,000 - 300,000	0.65 - 0.15 [illegible]
	over - 300,000	apply to commission for specific emission limit
3. Wood (saw dust, shavings, bark and other) where heat input of wood fuel > 75% of total heat input		0.50
All other combination fuel burning equipment which uses wood as 1 of the fuels	Apply to commission for specific emission limit	
B. Incinerator	Rating in Lbs Waste Per Hour	
1. Residential, apartments, commercial and industrial [illegible]	0 - 100	0.65
	over 100	0.30
2. Municipal	All	0.30
3. Pathological		0.20
4. [illegible]		0.20
C. Steel Manufacturing		
1. Open hearth furnaces		0.10
2. Basic oxygen furnaces		0.10
3. Electric furnaces		0.10
4. Sintering plants		0.20
5. Blast furnaces		0.15
6. Heating and reheating furnaces		0.30
D. Ferrous Cupola Operations	Total Plant Melt Rate in Tons Hr	
1. Production cupolas	0 - 10	0.40
	10 - 20	0.25
	over 20	0.15
2. Jobbing cupolas		[illegible]
3. [illegible]		0.30
4. [illegible]		[illegible]
E. Chemical Lime Manufacture Kilns		0.20
F. Asphalt Paving Plants		[illegible]
G. Cement Manufacture		
Up to 15,000 barrels per day kiln capacity		
1. Kiln - wet or dry process		0.25
2. Clinker cooler		0.30
3. Grinding, crushing and other material handling		0.15

Note: A maximum allowable emission listing shall be applied for to the commission for all kiln installations which will result in a total plant kiln capacity in excess of 15,000 barrels of cement per day.

H. Iron Ore Pelletizing	Gas Flow Rate SCFM	
Grate kilns and traveling grates	Greater than 600,000	Apply to commission for specific commission limit
	300,000 to 600,000	0.10
	100,000 to 300,000	0.15
	less than 100,000	0.20

APC 5 Standards of Performance for Industrial Process Equipment

(a) Definitions As used in this regulation, the following words shall have the meanings defined herein

(1) "Collection efficiency" means the percent of the total amount of particulate matter entering the control equipment which is removed from the exhaust stream by the control equipment and is calculated by the following equation:

$$\text{collection efficiency} = \frac{100(A-B)}{A}$$

Where

A = the amount (grams or pounds) or the concentration (gr SCF) of particulate matter entering the collection equipment

B = the amount (grams or pounds) or the concentration (gr SCF) of particulate matter leaving the control equipment

(2) "Industrial process equipment" means any equipment, apparatus, or device embracing chemical, industrial or manufacturing facilities such as ovens, mixing kettles, heating and reheating furnaces, kilns, stills, dryers, roasters, and equipment used in connection therewith, and all other methods or forms of manufacturing or processing that may emit any air contaminant such as smoke, odor, particulate matter, or gaseous matter Industrial process equipment is an "affected facility." An emission facility may consist of more than one unit of industrial process equipment

(3) "Process weight" means the total weight in a given time period of all materials introduced into any industrial process equipment that may cause any emission of particulate matter Solid fuels charged are considered as part of the process weight but liquid and gaseous fuels and combustion air are not For a cyclical or batch operation the process weight per hour is derived by dividing the total process weight by the number of hours in one complete operation from the beginning of any given process to the completion thereof excluding any time during which the equipment is idle For a continuous operation, the process weight per hour is derived by dividing the process weight for a typical period of time

(b) Applicability This regulation shall apply to industrial process equipment for which a standard of performance has not been promulgated in a specific regulation

(c) Standards of Performance for Pre 1969 Industrial Process Equipment

(1) No owner or operator of any industrial process equipment which was in operation before July 9, 1969 shall cause to be discharged into the atmosphere from the industrial process equipment any gases which

(aa) In any one hour contain particulate matter in excess of the amount permitted in Table 1 for the allocated process weight, provided that the owner or operator shall not be required to reduce the particulate matter emission below the concentration permitted in Table 2 for the appropriate source gas volume, provided further that regardless of the mass emission permitted by Table 1, the owner or operator shall not be permitted to emit particulate matter in a concentration in excess of 0.30 grains per standard cubic foot of exhaust gas, or

(bb) Exhibit greater than 20 percent opacity, except that a maximum of 60 percent opacity shall be permissible for 4 minutes in any 60 minute period and a *maximum of 40 percent opacity shall be permissible for 4* additional minutes in any 60 minute period.

(2) The owner or operator of any industrial process equipment which was in operation before July 9, 1969, which has control equipment with a collection efficiency of not less than 99 percent by weight shall be considered in compliance with the requirements of subsection (c)(1)(aa) of this regulation

(3) The owner or operator of any industrial process equipment which was in operation before July 9, 1969, which is located outside the Minneapolis-St. Paul Air Quality Control Region and the City of Duluth, which is located not less than one-fourth mile from any residence or public roadway, and which has control equipment with a collection efficiency of not less than 85 percent by weight, and the operation of the entire emission facility does not cause a violation of the ambient air quality standards, shall be considered in compliance with the requirements of subsection (c)(1)(aa) of this regulation

(d) Standards of Performance for Post 1969 Industrial Process Equipment

(1) No owner or operator of any industrial process equipment which was not in operation before July 9, 1969, shall cause to be discharged into the atmosphere from the industrial process equipment any gases which:

(aa) In any one hour contain particulate matter in excess of the amount permitted in Table 1 for the allocated process weight, provided that the owner or operator shall not be required to reduce the particulate matter emission below the concentration permitted in Table 2 for the appropriate source gas volume, provided that regardless of the mass emission permitted by Table 1, the owner or operator shall not be permitted to emit particulate matter in a concentration in excess of 0.30 grains per standard cubic foot of exhaust gas, or

(bb) Exhibit greater than 20 percent opacity

(2) The owner or operator of any industrial process equipment which was not in operation before July 9, 1969 which has control equipment with a collection efficiency of not less than 99.7 percent by weight shall be considered in compliance with the requirements of subsection (d)(1)(aa) of this regulation

(3) The owner or operator of any industrial process equipment which was in operation after July 9, 1969, which is located outside the Minneapolis-St Paul Air Quality Control Region and the City of Duluth, which is located not less than one-fourth mile from any residence or public roadway, and which has control equipment with a collection efficiency of not less than 85 percent by weight, and the operation of the entire emission facility does not cause a violation of the ambient air quality standards shall be considered in compliance with the requirements of subsection (d)(1)(aa) of this regulation.

(e) Performance Test Methods Unless another method is approved by the Agency, any owner or operator required to submit performance tests for any industrial process equipment shall utilize the following test methods

(1) Method 1 for sample and velocity traverses,

(2) Method 2 for velocity and volumetric flow rate.

(3) Method 3 for gas analysis.

(4) Method 5 for the concentration of particulate matter and associated moisture content,

(5) Method 9 for visual determination of the opacity of emissions from stationary sources

(f) Performance Test Procedures In the event that emissions from any industrial process equipment contain organic vapors which condense at standard conditions of temperature and pressure, the following changes in Method 5 for determining particulate emissions shall be made

(1) Paragraph 4 2 (Sample Recovery) in Method 5 is amended to read as follows

4 2 Sample Recovery Exercise care in moving the collection train from the test site to the sample recovery area so as to minimize the loss of collected sample or the gain of extraneous particulate matter Set aside a portion of the acetone and water used in the sample recovery as a blank for analysis Place the samples in containers as follows

Container #1 Remove the filter from its holder, place in this container, and seal

Container #2 Place loose particulate matter and water and acetone washings from all sample-exposed surfaces preceding the filter paper in this container and seal. The probe and nozzle should be scrubbed with a stiff brush and distilled water, followed by an acetone rinse If these solvents do not do a good cleaning job, an adequate solvent must be found and used Use a razor blade or rubber policeman to loosen adhering particles if necessary

Container #3 Measure the volume of water from the first three impingers and place the water in this container Place water rinsings of all sample-exposed surfaces between the filter and fourth impinger in this container prior to sealing

Container #4 Transfer the silica gel from the fourth impinger to the original container and seal Use a rubber policeman as an aid in removing silica gel from the impinger

Container #5 Thoroughly rinse all sample-exposed surfaces between the filter paper and fourth impinger with acetone, place the washings in this container and seal

(2) Paragraph 4 3 (Analysis) in Method 5 is amended to read as follows

4 3 Analysis Record the data required on the example sheet shown in figure 5-3 Handle each sample container as follows

Container #1 Transfer the filter and any loose particulate matter from the sample container to a tared glass weighing dish, desiccate and dry to a constant weight Report results to the nearest 0 5 mg

Container #2 Transfer the washings to a tared beaker and evaporate to dryness at ambient temperature and pressure Desiccate and dry to a constant weight Weigh to the nearest 0 5 mg

Container #3 Extract organic particulate from the impinger solution with three 25 ml portions of chloroform. Complete the extraction with three 25 ml portions of ethyl ether Combine the ether and chloroform extracts transfer to a tared beaker and evaporate at 70°F until no solvent remains Desiccate dry to a constant weight, and report the results to the nearest 0 5 mg

Container #4 Weigh the spent silica gel and report to the nearest gram

Container #5 Transfer the acetone washings to a tared beaker and evaporate to dryness at ambient temperature and pressure Desiccate, dry to a constant weight and report the results to the nearest 0 5 mg

TABLE 1

Process Weight Rate (lbs/hr)	Emission Rate (lbs/hr)
50	0 08
100	0 55
500	1 53
1,000	2 25
5,000	6 34
10,000	9 73
20,000	14 99
60 000	29 60
80,000	31 19
120,000	33 28
160,000	34 85
200 000	36.11
400,000	40 35
1,000 000	46 72

Interpolation of the data in Table 1 for the process weight rates up to 60 000 lbs/hr shall be accomplished by the use of the equation.

$$E = 3.59P^{0.62}$$

$$P \leq 30 \text{ tons/hr}$$

and interpolation and extrapolation of the data for process weight rates in excess of 60,000 lbs/hr shall be accomplished by use of the equation:

$$E = 17.31P^{0.16}$$

$$P > 30 \text{ tons/hr.}$$

Where E = Emissions in pounds per hour

P = Process weight rate in tons per hour

TABLE 2

(5)

Source Gas Volume, SCFM[a]	Concentration GR/SCF[b]	Source Gas Volume, SCFM[a]	Concentration GR/SCF[b]
7,000 or less	0 100	140,000	0 038
8,000	0 096	160,000	0 036
9,000	0 092	180,000	0 035
10,000	0 089	200,000	0 034
20 000	0 071	300,000	0 030
30,000	0 062	400,000	0 027
40 000	0 057	500 000	0 025
50,000	0 053	600 000	0 024
60,000	0 050	800,000	0 021
80,000	0 045	1 000 000 or more	0 020
100,000	0 042		
120,000	0 040		

[a] Standard cubic feet per minute

[b] Grains per standard cubic foot

APC 22 Standards of Performance for Portland Cement Plants

(a) Portland Cement Plant. As used in this regulation "portland cement plant" means any facility manufacturing portland cement by either the wet or dry process.

(b) Standards of Performance for Existing Portland Cement Plants.

(1) No owner or operator of an existing portland cement plant shall cause or allow the discharge into the atmosphere any gases which:

(aa) Contain particulate matter in excess of the limits established by Minnesota Regulation APC 5; [illegible]

(bb) Exhibit greater than 20 percent opacity, except that a maximum of 40 percent opacity shall be permissible for not more than 4 minutes in any 30 minutes period and a maximum of 60 percent opacity shall be permissible for not more than 4 minutes in any 60 minute period.

(2) The requirements of this section are applicable to the kiln, the clinker cooler, the raw mill system, the raw mill dryer, raw material storage, the finish mill system, clinker storage, finished product storage, conveyor transfer points, and bagging and bulk loading and unloading systems.

(c) Standards of Performance for New Portland Cement Plants.

(1) No owner or operator of a new portland cement plant shall cause or allow the discharge into the atmosphere from the kiln any gases which:

(aa) Contain particulate matter in excess of 0.15 kilogram per metric ton (0.30 pound per ton) of feed (dry basis) to the kiln, or

(bb) Exhibit greater than 2[illegible] percent opacity.

(2) No owner or operator of a new portland cement plant shall cause or allow the discharge into the atmosphere from the clinker cooler any gases which:

(aa) Contain particulate matter in excess of 0.050 kg per metric ton of feed (dry basis) to the kiln [illegible] lb per ton, or

(bb) Exhibit greater than [illegible] percent opacity.

(3) No owner or operator of a new portland cement plant shall cause or allow the discharge into the atmosphere from the raw mill system, the raw mill dryer, raw mill storage, the finish mill system, clinker storage, finished product storage, conveyor transfer points, or the bagging and bulk loading and unloading systems any gases which exhibit greater than 10 percent opacity.

(d) Monitoring of Operations. The owner or operator of any portland cement plant shall record the daily production rates and kiln feed rates.

(e) Performance Test Methods. Unless another method is approved by the Agency, an owner or operator required to conduct performance tests for a portland cement plant shall utilize the following test methods:

(1) Method 5 for the concentration of particulate matter and the associated moisture content.

(2) Method 1 for sample and velocity traverses.

(3) Method 2 for velocity and volumetric flow rate.

(4) Method 3 for gas analysis.

(5) Method 9 for visual determination of opacity.

(f) Performance Test Procedures.

(1) In testing for the concentration of particulate matter and the associated moisture content, the minimum sampling time and minimum sample volume for each run, except when [illegible] are approved by the Agency, shall be as follows:

(aa) 60 minutes and 20 [illegible] for the kiln.

(bb) [illegible] 40.6 [illegible] 15 [illegible] for the clinker cooler.

(2) Total kiln feed rate (except fuels), expressed in tons per hour on a dry basis, shall be determined during each testing period by a method approved by the Agency and shall be confirmed by a material balance over the production system.

(3) For each run, particulate matter emissions, expressed in pounds per ton of kiln feed, shall be determined by dividing the emission rate in pounds per hour by the kiln feed rate. The emission rate shall be determined by the equation lb/hr = $Q_s \times c$, where Q_s = volumetric flow rate of the total effluent in dscf/hr as determined in accordance with subsection (e)(3), and c = particulate concentration in lb/dscf as determined in accordance with subsection (e)(1).

OHIO

AP-3-07. Control of visible air contaminants from stationary sources.

(A) Emission limitation.

(1) No person shall discharge into the atmosphere from any single source of emission whatsoever any air contaminant of a shade or density equal to or darker than that designated as No. 1 on the Ringelmann Chart or 20 percent opacity, except as set forth in subsection (A) (2) and section (B) of this regulation.

(2) A person may discharge into the atmosphere from any single source of emission for a period or periods aggregating not more than three minutes in any sixty minutes or for a period of time deemed necessary by the Board, air contaminants of a shade or density not darker than No. 3 on the Ringelmann Chart or 60 percent opacity.

(B) Uncombined water.

It shall be deemed not to be a violation of this regulation where the presence of uncombined water is the only reason for failure of an emission to meet the requirements of this regulation.

(Adopted January 28, 1972; effective February 15, 1972.)

AP-3-09. Restriction of emission of fugitive dust and gases.

(A) No person shall cause or permit any materials to be handled, transported, or stored, or a building or its appurtenances or a road to be used, constructed, altered, repaired, or demolished without taking reasonable precautions to prevent particulate matter from becoming airborne. Such reasonable precautions shall include, but not be limited to, the following:

(1) Use, where possible, water or chemicals for control of dust in the demolition of existing buildings or structures, construction operations, the grading of roads or the clearing of land,

(2) Application of asphalt, oil, water, or suitable chemicals on dirt roads, material stockpiles, and other surfaces which can create airborne dusts,

(3) Installation and use of hoods, fans, and control equipment to enclose, contain, capture and vent the handling of dusty materials. Adequate containment methods shall be employed during sandblasting or other similar operations,

(4) Covering, at all times when in motion, open bodied vehicles transporting materials likely to become airborne,

(5) Conduct of agricultural practices such as

AP-3-12. Restriction of emission of particulate matter from industrial processes.

(A) General provisions.

(1) This regulation applies to any operation, process, or activity from which particulate matter is emitted except (a) the burning of fuel for the primary purpose of producing heat or power by indirect heating in which the products of combustion do not come into direct contact with process materials, (b) the burning of refuse, and (c) the processing of salvageable material by burning.

(2) Emission restriction requirements for sources not exempted under subsection (A) (1) above are specified in Figure II and in Table I. Figure II relates Uncontrolled Mass Rate of Emission (abscissa) to maximum allowable mass rate of emission (ordinate). Table I relates process weight of materials introduced into any specific process that may cause any emission of particulate matter to maximum allowable mass rate of emission. Table I shall apply in Priority I Regions where the Uncontrolled Mass Rate of Emission cannot be ascertained and where an emission factor characterization for the process is unknown. Curve P-1 of Figure II shall apply in Priority I Regions where the Process Weight Rate cannot be ascertained. In all cases, the more stringent of the two requirements shall apply where both are termed applicable.

(3) Compliance with the limits specified in section (B) of this regulation shall be determined by sampling and other measurements made at the air contamination source or sources prior to the point at which air contaminants are emitted to the atmosphere. The uncontrolled mass rate of emission may be determined by sampling in the stack upstream from the inlet of the control equipment. Estimating techniques approved by the Board may be substituted for the above required source testing.

(4) Emission tests relating to this regulation shall be made following the standards in the American Society of Mechanical Engineers Power Test Codes 11 – PTC-27 dated 1957 and entitled, "Determining Dust Concentrations in a Gas Stream", or as modified by the Board to suit specific sampling needs or conditions.

(5) For purposes of Figure II, the total uncontrolled mass rate of emission from all similar process units at a plant, such units being united either physically or operationally, or otherwise located in close proximity to each other, shall be used for determining the maximum allowable mass rate of emission of particulate matter that passes through a stack or stacks.

(6) For purposes of Table I, process weight per hour is the total weight of all materials introduced into any single, specific process that may cause any emission of particulate matter. Solid fuels charged will be considered as part of the process weight, but liquid and gaseous fuels and combustion air will not. For a cyclical or batch operation, the process weight per hour will be derived by dividing the total process weight by the number of hours in one complete operation from the beginning of any given process to the completion thereof, excluding any time during which the equipment is idle. For a continuous operation, the process weight per hour will be derived by dividing the process weight for a typical period of time.

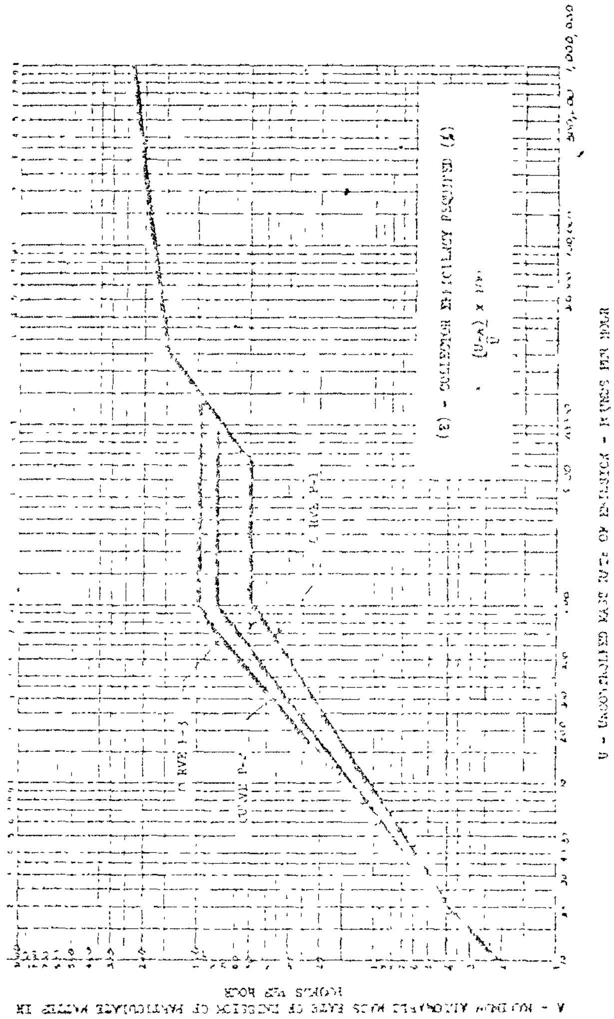

TABLE I

ALLOWABLE RATE OF EMISSION BASED ON PROCESS WEIGHT RATE

PROCESS WEIGHT RATE		RATE OF EMISSION	PROCESS WEIGHT RATE		RATE OF EMISSION
Lb/Hr	Tons/Hr	Lb/Hr	Lb/Hr	Tons/Hr	Lb/Hr
100	0.05	0.551	16,000	8.00	16.5
200	0.10	0.877	18,000	9.00	17.9
400	0.20	1.40	20,000	10	19.2
600	0.30	1.83	30,000	15.	25.2
800	0.40	2.22	40,000	20	30.5
1,000	0.50	2.58	50,000	25.	35.4
1,500	0.75	3.38	60,000	30.	40.0
2,000	1.00	4.10	70,000	35.	41.3
2,500	1.25	4.76	80,000	40	42.5
3,000	1.50	5.38	90,000	45	43.6
3,500	1.75	5.96	100,000	50	44.6
4,000	2.00	6.52	120,000	60	46.3
5,000	2.50	7.58	140,000	70	47.8
6,000	3.00	8.56	160,000	80	49.0
7,000	3.50	9.49	200,000	100.	51.2
8,000	4.00	10.4	1,000,000	500.	69.0
9,000	4.50	11.2	2,000,000	1,000.	77.6
10,000	5.00	12.0	6,000,000	3,000	92.7
12,000	6.00	13.6			

(B) Emission limitations

(1) No person shall cause, suffer, allow, or permit the emission of particulate matter in any one hour from any source in excess of the amount shown in the following Figure II.

(2) All persons located within air quality control regions classified as Priority I Regions shall attain or exceed, as soon as practicable, but no later than July 1, 1975, that degree of emission reduction specified by Curve P-1 of Figure II or by Table I whichever is applicable under subsection (A) (2).

(3) All persons located within air quality control regions classified as Priority II Regions shall attain or exceed, as soon as practicable, but no later than July 1, 1975, that degree of emission reduction specified by Curve P-2 of Figure II.

Interpolation of the data in this table for process weight rates up to 60,000 lb/hr shall be accomplished by use of the equation $E = 4.10 P^{0.67}$, and interpolation of the data for process weight rates in excess of 60,000 lb/hr shall be accomplished by use of the equation $E = 55.0 P^{0.11} - 40$, where E = rate of emission in lb/hr and P = Process weight rate in ton/hr.

(4) All persons located within air quality control regions classified as Priority III Regions shall attain or exceed, as soon as practicable, but no later than July 1, 1975, that degree of emission reduction specified by Curve P-3 of Figure II.

(5) All persons located within air quality control regions classified as Priority II or III Regions shall attain or exceed, no later than July 1, 1978, that degree of emission reduction specified by Curve P-1 of Figure II or by Table I.

(Adopted January 28, 1972, effective February 15, 1972.)

NR 154.11 Control of particulate emissions. (1) GENERAL LIMITATIONS. No person shall cause, suffer, allow, or permit particulate matter to be emitted into the ambient air which substantially contributes to exceeding of an air standard, or creates air pollution.

(2) FUGITIVE DUST. No person shall cause, suffer, allow, or permit any materials to be handled, transported, or stored without taking precautions to prevent particulate matter from becoming air-borne. Nor shall a person allow a structure, a parking lot or a road to be used, constructed, altered, repaired, sand blasted or demolished without taking such precautions. Such precautions shall include, but not be limited to.

(a) Use, where possible, of water or chemicals for control of dust in the demolition of existing buildings or structures, or construction operations.

(b) Application of asphalt, oil, water, suitable chemicals, or plastic covering on dirt roads, material stockpiles, and other surfaces which can create airborne dust, provided such application does not create a hydrocarbon, odor, or water pollution problem.

(c) Installation and use of hoods, fans, and air cleaning devices to enclose and vent the areas where dusty materials are handled.

(d) Covering or securing of materials likely to become airborne while being moved on public roads, railroads, or navigable waters.

(e) Conduct of agricultural practices such as tilling of land or application of fertilizers in such manner as not to create air pollution.

(f) The paving or maintenance of roadways or parking lots so as not to create air pollution.

(3) PARTICULATE EMISSION LIMITS FOR PROCESSES. No person shall cause, suffer, allow, or permit the emission of particulate matter to the ambient air from a direct or portable source involving a process in excess of one of the following limitations:

(a) All direct and portable sources on which construction or modification is commenced after April 1, 1972 shall meet the emission limits of this paragraph.

1. Direct or portable sources other than those specified in (3) (a) 2. of this section, emissions in excess of:

a. Any process not otherwise covered by paragraph (3) (a) of this section, emissions calculated by the use of the equation, $E = 3.59\ P^{0.62}$ for process weight rates up to 60,000 pounds per hour; by use of the equation $E = 17.31\ P^{0.16}$ for process weight rates of 60,000 pounds per hour or more; (E is the allowable emissions in pounds per hour and P is the process weight rate in tons per hour,) or in concentrations greater than those listed in section NR 154.11 (3) (b), whichever is more restrictive. Some examples of these calculations are given in the following table.

Process Weight Rate (Lbs/Hr)	Emission Rate (Lbs/Hr)
50	0.36
100	0.56
500	1.52
1,000	2.33
5,000	6.33
10,000	9.74
20,000	14.96
60,000	29.57
80,000	31.23
120,000	33.33
160,000	34.90
200,000	36.15
400,000	40.41
1,000,000	46.79

b. Cement kilns: 0.30 pounds of particulate per ton of feed to the kiln.

c. Cement clinker coolers: 0.10 pounds of particulate per ton of feed to the kiln.

2. Direct or portable sources specified hereunder on which construction or modification is commenced after February 1, 1975, emissions in excess of:

a. Asphalt concrete plants (any combination of the following: dryers, systems for screening, handling, storing, and weighing hot aggregate; systems for loading, transferring, and storing mineral filler; systems for mixing asphalt concrete; and the loading, transfer, and storage systems associated with emission control systems): 0.04 grains per dry cubic foot at standard conditions (90 milligrams per dry cubic meter at standard conditions).

b. Petroleum refineries (fluid catalytic cracking unit catalyst regenerators or fluid catalytic cracking unit incinerator-waste heat boilers):

i. 1.0 pound per 1,000 pounds (1.0 kilogram per 1,000 kilograms) of coke burn-off in the catalyst regenerator.

ii. In those instances in which auxiliary liquid or solid fossil fuels are burned in the fluid catalytic cracking unit incinerator-waste heat boiler, particulate matter in excess of that permitted by paragraph (4) (a) 1.e.i. of this section may be emitted to the atmosphere, except that the incremental rate of particulate emissions shall not exceed 0.10 pounds per million BTU (0.18 grams per million calories) of heat input attributable to such liquid or solid fuel.

c. Secondary lead smelters (blast or cupola furnaces and reverberatory furnaces): 0.022 grains per dry cubic foot at standard conditions (50 milligrams per dry cubic meter at standard conditions).

d. Secondary brass and bronze ingot production plants (reverberatory furnaces of 2,205 pounds or greater production capacity): 0.022 grains per dry cubic foot at standard conditions (50 milligrams per dry cubic meter at standard conditions).

e. Iron and steel plants (basic oxygen process furnaces): 0.022 grains per dry cubic foot at standard conditions (50 milligrams per dry cubic meter at standard conditions).

(b) All direct and portable sources on which construction or modification was commenced on or before April 1, 1972 shall meet the emission limits of this paragraph.

1. Direct or portable sources specified hereunder, emissions in excess of:

a. Cupolas: 0.45 pounds of particulate matter per 1,000 pounds of gas.

b. Electric arc or induction furnaces: 0.1 pounds of particulate matter per 1,000 pounds of gas.

c. Open hearth furnaces: 0.2 pounds of particulate matter per 1,000 pounds of gas.

d. Basic oxygen furnaces: 0.1 pounds of particulate matter per 1,000 pounds of gas.

e. Sintering plants: 0.2 pounds of particulate matter per 1,000 pounds of gas.

f. Air melting furnaces: 0.3 pounds of particulate matter per 1,000 pounds of gas.

g. Heating or preheating furnaces: 0.3 pounds of particulate matter per 1,000 pounds of gas.

h. Blast furnaces: 0.2 pounds of particulate matter per 1,000 pounds of gas.

i. Asphalt, concrete, or aggregate mix plants: 0.3 pounds of particulate matter per 1,000 pounds of gas.

j. Cement kilns: 0.2 pounds of particulate matter per 1,000 pounds of gas.

k. Lime kilns: 0.2 pounds of particulate matter per 1,000 pounds of gas.

l. Cement clinker coolers: 0.3 pounds of particulate matter per 1,000 pounds of gas.

m. Grinding, drying, mixing, conveying, sizing, or blending: 0.2 pounds of particulate matter per 1,000 pounds of gas.

n. Grain processing or handling: 0.4 pounds of particulate matter per 1,000 pounds of gas.

o. Any other process not enumerated: 0.4 pounds of particulate matter per 1,000 pounds of gas.

APPENDIX C

ENVIRONMENTAL PROTECTION AGENCY
EFFLUENT GUIDELINES AND STANDARDS FOR CEMENT MANUFACTURING

ENVIRONMENTAL PROTECTION AGENCY
EFFLUENT GUIDELINES AND STANDARDS FOR CEMENT MANUFACTURING

(40 CFR 411, 39 FR 6590, February 20, 1974, Amended by 40 FR 6432, February 11, 1975; 42 FR 10681, February 23, 1977)

Title 40—Protection of the Environment

CHAPTER I—ENVIRONMENTAL PROTECTION AGENCY

SUBCHAPTER N—EFFLUENT GUIDELINES AND STANDARDS

PART 411—CEMENT MANUFACTURING POINT SOURCE CATEGORY

Effluent Limitations Guidelines

Subpart A—Nonleaching Subcategory

§ 411.10 Applicability; description of the nonleaching subcategory.

The provisions of this subpart are applicable to discharges resulting from the process in which several mineral ingredients (limestone or other natural sources of calcium carbonate, silica, alumina, and iron together with gypsum) are used in the manufacturing of cement and in which kiln dust is not contracted with water as an integral part of the process and water is not used in wet scrubbers to control kiln stack emissions.

§ 411.11 Specialized definitions.

For the purpose of this subpart:

(a) Except as provided below, the general definitions, abbreviations and methods of analysis set forth in 40 CFR Part 401 shall apply to this subpart.

§ 411.12 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available.

In establishing the limitations set forth in this section, EPA took into account all information it was able to collect, develop and solicit with respect to factors (such as age and size of plant, raw materials, manufacturing processes, products produced, treatment technology available, energy requirements and costs) which can affect the industry subcategorization and effluent levels established. It is, however, possible that data which would affect these limitations have not been available and, as a result, these limitations should be adjusted for certain plants in this industry. An individual discharger or other interested person may submit evidence to the Regional Administrator (or to the State, if the State has the authority to issue NPDES permits) that factors relating to the equipment or facilities involved, the process applied, or other such factors related to such discharger are fundamentally different from the factors considered in the establishment of the guidelines. On the basis of such evidence or other available information, the Regional Administrator (or the State) will make a written finding that such factors are or are not fundamentally different for that facility compared to those specified in the Development Document. If such fundamentally different factors are found to exist, the Regional Administrator or the State shall establish for the discharger effluent limitations in the NPDES permit either more or less stringent than the limitations established herein, to the extent dictated by such fundamentally different factors. Such limitations must be approved by the Administrator of the Environmental Protection Agency. The Administrator may approve or disapprove such limitations, specify other limitations, or initiate proceedings to revise these regulations.

The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best practicable control technology currently available:

Effluent characteristic	Effluent limitations (maximum for any 1 day)
	Metric units (kilograms per 1,000 kg of product)
TSS	0.005
Temperature (heat)	Not to exceed 3° C rise above inlet temperature.
pH	Within the range 6.0 to 9.0.
	English units (pounds per 1,000 lb of product)
TSS	0.005
Temperature (heat)	Not to exceed 3° C rise above inlet temperature.
pH	Within the range 6.0 to 9.0.

§ 411.13 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best available technology economically achievable.

The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best available technology economically achievable:

Effluent characteristic	Effluent limitations (maximum for any 1 day)
	Metric units (kilograms per 1,000 kg of product)
TSS	0.005
Temperature (heat)	Not to exceed 3° C rise above inlet temperature.
pH	Within the range 6.0 to 9.0.
	English units (pounds per 1,000 lb of product)
TSS	0.005
Temperature (heat)	Not to exceed 3° C rise above inlet temperature.
pH	Within the range 6.0 to 9.0.

§ 411.14 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the nonleaching subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property	Pretreatment standard
pH	No limitation.
Temperature (heat)	Do.
TSS	Do.

[40 FR 6432, February 11, 1975]

§ 411.15 Standards of performance for new sources.

The following standards of performance establish the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged by a new source subject to the provisions of this subpart.

Effluent characteristic	Effluent limitations (maximum for any 1 day)
	Metric units (kilograms per 1,000 kg of product)
TSS	0.005
Temperature (heat)	Not to exceed 3° C rise above inlet temperature.
pH	Within the range 6.0 to 9.0.
	English units (pounds per 1,000 lb of product)
TSS	0.005
Temperature (heat)	Not to exceed 3° C rise above inlet temperature.
pH	Within the range 6.0 to 9.0.

§ 411.16 Pretreatment standards for new sources.

The pretreatment standards under section 307(c) of the Act for a source within the nonleaching subcategory, which is a user of a publicly owned treatment works (and which would be a new source subject to section 306 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, § 128.133 of this title shall be amended to read as follows:

"In addition to the prohibitions set forth in 40 CFR 128.131, the pretreatment standard for incompatible pollutants introduced into a publicly owned treatment works shall be the standard of performance for new sources specified in 40 CFR 411.15, provided that, if the publicly owned treatment works which receives the pollutants is committed, in its NPDES permit, to remove a specified percentage of any incompatible pollutant, the pretreatment standard applicable to users of such treatment works shall, except in the case of standards providing for no discharge of pollutants, be correspondingly reduced in stringency for that pollutant."

Subpart B—Leaching Subcategory

§ 411.20 Applicability; description of the leaching subcategory.

The provisions of this subpart are applicable to discharges resulting from the process in which several mineral ingredients (limestone or other natural sources of calcium carbonate, silica, alumina, and iron) together with gypsum are used in the manufacturing of cement and in which kiln dust is contacted with water as an integral part of the process or water is used in wet scrubbers to control kiln stack emissions.

§ 411.21 Specialized definitions.

For the purpose of this subpart:

(a) Except as provided below, the general definitions, abbreviations and methods of analysis set forth in 40 CFR Part 401 shall apply to this subpart.

§ 411.22 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available.

In establishing the limitations set forth in this section, EPA took into account all information it was able to collect, develop and solicit with respect to factors (such as age and size of plant, raw materials, manufacturing processes, products produced, treatment technology available, energy requirements and costs) which can affect the industry subcategorization and effluent levels established. It is, however, possible that data which would affect these limitations have not been available and, as a result, these limitations should be adjusted for certain plants in this industry. An individual discharger or other interested person may submit evidence to the Regional Administrator (or to the State, if the State has the authority to issue NPDES permits) that factors relating to the equipment or facilities involved, the process applied, or other such factors related to such discharger are fundamentally different from the factors considered in the establishment of the guidelines. On the basis of such evidence or other available information, the Regional Administrator (or the State) will make a written finding that such factors are or are not fundamentally different for that facility compared to those specified in the Development Document. If such fundamentally different factors are found to exist, the Regional Administrator or the State shall establish for the discharger effluent limitations in the NPDES permit either more or less stringent than the limitations established herein, to the extent dictated by such fundamentally different factors. Such limitations must be approved by the Administrator of the Environmental Protection Agency. The Administrator may approve or disapprove such limitations, specify other limitations, or initiate proceedings to revise these regulations.

The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best practicable control technology currently available:

Effluent characteristic	Effluent limitations (maximum for any 1 day)
	Metric units (kg/kkg of dust leached)
TSS	0.4
Temperature (heat)	Not to exceed 3° C rise above inlet temperature.
pH	Within the range 6.0 to 9.0.
	English units (lb/1,000 lb of dust leached)
TSS	0.4
Temperature (heat)	Not to exceed 3° C rise above inlet temperature.
pH	Within the range 6.0 to 9.0.

§ 411.23 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best available technology economically achievable.

The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best available technology economically achievable:

Effluent characteristic	Effluent limitations (maximum for any 1 day)
	Metric units (kg/kkg of dust leached)
TSS	0.4
Temperature (heat)	Not to exceed 3° C rise above inlet temperature.
pH	Within the range 6.0 to 9.0.
	English units (lb/1,000 lb of dust leached)
TSS	0.4
Temperature (heat)	Not to exceed 3° C rise above inlet temperature.
pH	Within the range 6.0 to 9.0.

§ 411.24 Pretreatment standards for existing sources.

The pretreatment standard under section 307(b) of the Act for a source within the leaching subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.

[40 FR 6432, February 11, 1975]

§ 411.25 Standards of performance for new sources.

The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a new source subject to the provisions of this subpart:

Effluent characteristic	Effluent limitations (maximum for any 1 day)
	Metric units (kg/kkg of dust leached)
TSS	0.4
Temperature (heat)	Not to exceed 3° C rise above inlet temperature.
pH	Within the range 6.0 to 9.0.
	English units (lb/1,000 lb of dust leached)
TSS	0.4
Temperature (heat)	Not to exceed 3° C rise above inlet temperature.
pH	Within the range 6.0 to 9.0.

§ 411.26 Pretreatment standards for new sources.

The pretreatment standard under section 307(c) of the Act for a source within the leaching subcategory, which is a user of a publicly owned treatment works (and which would be a new source subject to section 306 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, § 128.133 of this title shall be amended to read as follows:

"In addition to the prohibitions set forth in 40 CFR 128.131, the pretreatment standard for incompatible pollutants introduced into a publicly owned treatment works shall be the standard of performance for new sources specified in 40 CFR 411.25, provided that, if the publicly owned treatment works which receives the pollutants is committed, in its NPDES permit, to remove a specified percentage of any incompatible pollutant, the pretreatment standard applicable to users of such treatment works shall, except in the case of standards providing for no discharge of pollutants, be correspondingly reduced in stringency for that pollutant."

Subpart C—Materials Storage Piles Runoff Subcategory

§ 411.30 Applicability; description of the materials storage piles runoff subcategory.

The provisions of this subpart are applicable to discharges resulting from the runoff of rainfall which derives from the storage of materials, including raw materials, intermediate products, finished products and waste materials which are used in or derived from the manufacture of cement under either subcategory A or subcategory B.

§ 411.31 Specialized definitions.

For the purpose of this subpart:

(a) Except as provided below, the general definitions, abbreviations and methods of analysis set forth in 40 CFR Part 401 shall apply to this subpart.

(b) The term "10 year, 24 hour rainfall event" shall mean a rainfall event with a probable recurrence interval of once in ten years as defined by the National Weather Service in Technical Paper No. 40, "Rainfall Frequency Atlas of the United States," May 1961, and subsequent amendments or equivalent regional or state rainfall probability information developed therefrom.

§ 411.32 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available.

In establishing the limitations set forth in this section, EPA took into account all information it was able to collect, develop and solicit with respect to factors (such as age and size of plant, raw materials, manufacturing processes, products produced, treatment technology available, energy requirements and costs) which can affect the industry subcategorization and effluent levels established. It is, however, possible that data which would affect these limitations have not been available and, as a result, these limitations should be adjusted for certain plants in this industry. An individual discharger or other interested person may submit evidence to the Regional Administrator (or to the State, if the State has the authority to issue NPDES permits) that factors relating to the equipment or facilities involved, the process applied, or other such factors related to such discharger are fundamentally different from the factors considered in the establishment of the guidelines. On the basis of such evidence or other available information, the Regional Administrator (or the State) will make a written finding that such factors are or are not fundamentally different for that facility compared to those specified in the Development Document. If such fundamentally different factors are found to exist, the Regional Administrator or the State shall establish for the discharger effluent limitations in the NPDES permit either more or less stringent than the limitations established herein, to the extent dictated by such fundamentally different factors. Such limitations must be approved by the Administrator of the Environmental Protection Agency. The Administrator may approve or disapprove such limitations, specify other limitations, or initiate proceedings to revise these regulations.

(a) Subject to the provisions of subparagraph (b) of this section, the following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best practicable control technology currently available.

Effluent characteristic	*Effluent limitations*
TSS	Not to exceed 50 mg/l.
pH	Within the range 6.0 to 9.0.

(b) Any untreated overflow from facilities designed, constructed and operated to treat the volume of runoff from materials storage piles which is associated with a 10 year, 24 hour rainfall event shall not be subject to the pH and TSS limitations stipulated in subparagraph (a), above.

§ 411.33 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best available technology economically achievable.

(a) Subject to the provisions of subparagraph (b) of this section the following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best practicable control technology currently available:

Effluent characteristic	*Effluent limitations*
TSS	Not to exceed 50 mg/l.
pH	Within the range 6.0 to 9.0.

(b) Any untreated overflow from facilities designed, constructed and operated to treat the volume of runoff from materials storage piles which results from a 10 year, 24 hour rainfall event shall not be subject to the pH and TSS limitations stipulated in subparagraph (a), above.

§ 411.34 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the materials storage piles runoff subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property	*Pretreatment standard*
pH	No limitation.
TSS	Do.

[40 FR 6432, February 11, 1975]

§ 411.35 Standards of performance for new sources.

(a) Subject to the provisions of paragraph (b) of this section the following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a new source subject to the provisions of this subpart:

Effluent characteristic	*Effluent limitations*
TSS	Not to exceed 50 mg/l.
pH	Within the range 6.0 to 9.0.

(b) Any overflow from facilities designed, constructed and operated to treat to the applicable limitation the precipitation and runoff resulting from a 10-year, 24-hour precipitation event shall not be subject to the limitations of this section.

[40 FR 10681, February 23, 1976]

§ 411.36 Pretreatment standards for new sources.

The pretreatment standards under section 307(c) of the Act for a source within the materials storage piles runoff subcategory, which is a user of a publicly owned treatment works (and which would be a new source subject to section 306 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, § 128.133 of this title shall be amended to read as follows:

"In addition to the prohibitions set forth in 40 CFR 128.131, the pretreatment standard for incompatible pollutants introduced into a publicly owned treatment works by a new source shall be the standard of performance for new sources specified in 40 CFR 411.35; provided that, if the publicly owned treatment works which receives the pollutants is committed, in its NPDES permit, to remove a specified percentage of any incompatible pollutant, the pretreatment standard applicable to users of such treatment works shall, except in the case of standards providing for no discharge of pollutants, be correspondingly reduced in stringency for that pollutant."

APPENDIX D

SURVEY FORM FOR CEMENT PLANTS IN U.S. EPA REGION V

CEMENT PLANTS
CHECK LIST
PEDCO PN 3470-1-D

1. General

a. Name of Company ______________________

Address ______________________

Telephone No. ______________________

Contact ______________ Title ______________

b. Initial startup date ______________________

2. Plant Data

a. Type of Process ____________ Wet _____ Dry _____

b. Capacity, tons or bbl/hr ______________________

c. Normal yearly operating hours ______________________

d. Fuel Used ______________________

e. Major Emission Points — Control Equipment

Kiln ______________

Clinker cooler ______________

Grinding mill ______________

Other ______________

3. Production Data

a. Can your plant meet current demand?

Yes _____ No _____

If no, explain ______________________

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____

b. Can you expand plant capacity?

Yes ______ No ______

Explain ____

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4. Environmental Regulations

a. Are environmental regulation impacts (plant closings, cost of control equipment, malfunction of control equipment, etc.) impacting on (1) current cement production, (2) installation of new plants or expansion of existing capacity? Explain

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5. Additional Comments

APPENDIX E

SUMMARY OF RESPONSES TO PEDCo SURVEY OF CEMENT PLANTS IN U.S. EPA REGION V

Plant No. 1: Environmental regulations cause a much longer lag time in plant construction because of the delays in obtaining permits.

- Plant cannot expand because it is a nonattainment area.
- Concern is expressed over proposed regulations for fugitive dust from stockpiles and roads.

Plant No. 2: Plant capacity cannot be expanded; however, no explanation is given. Other comments are the same as those for Plant No. 12.

Plant No. 3: Malfunction with pollution control equipment has caused 5 percent loss in production.

- Environmental restrictions caused the plant to be shut down.

Plant No. 4: Environmental regulations are not having a significant impact on current cement production; however, expansion of capacity could be seriously affected by the Clean Air Act Amendments of 1977. The plant is in a nonattainment area with respect to sulfur dioxide.

Plant No. 5: Current regulations have had minimal impact on production. Both EPA and the State of Indiana have been cooperative during periods of high demand.

- With respect to expansion of capacity, current regulations significantly add to lead time required to bring new capacity on stream.
- Meeting environmental considerations in a nonattainment area is costly and a major detriment to the industry.

Plant No. 6: During the last 10 years, five plants (other companies) have been shut down because of the high cost of equipment needed to bring plants into compliance with environmental regulations.

- Existing plant capacity could not be increased because the available capital was spent to bring plants into compliance with environmental regulations.

Plant No. 7: Three kilns that were installed in the 1950's were shut down in 1977 because of the costs of bringing them into compliance with air quality regulations and Federal energy objectives.

- In 1977, new suspension preheater kilns were installed to bring the plant into compliance; however, numerous startup and shakedown problems have severely limited production.

- New opacity and particulate emission regulations may restrict plant operation.

Plant No. [illegible]: Environmental regulations have not affected production at this plant, but operating costs have risen as a result of control equipment installed to maintain compliance.

- Plant is located in a nonattainment area and expansion would be limited by compliance with [illegible] requirements.

Plant No. [illegible]: The trial-and-error procedures needed to meet stack opacity limits, especially when changing from roller mill to roller mill bypass mode, have resulted in periodic long delays in startup.

- Production has to be curtailed or shut down during long-term violation of stack opacity.

- Complex permit procedures are required before construction of a new plant can be started. This greatly extends the time from authorization of funds to plant completion.

Plant No. 10: This plant is presently used as a grinding facility. Four of the five kilns were shut down in 1968 because of the costs of meeting air quality regulations. The remaining kiln is not presently used, although it meets environmental regulations.

- If proposed fugitive dust regulations in Michigan are passed, continued cement production may be uneconomical.

Plant No. 11: Environmental regulations have an impact on current cement production because they accelerate the closing of older, obsolete plants and add to the costs of continuing operations.

- Lead time for construction of new plants is about 3 years.
- Expansion of capacity cannot presently be justified economically because of the inadequate return on investment.

Plant No. 12: Large expansion [illegible]. Production has been interrupted during installation of major pollution control equipment.

- Regulations have caused some rescheduling of production and of moving products from one plant location to another. This has disrupted production schedules and added transportation costs.
- Investment in pollution control equipment has slowed expansion.

- Company wants to develop markets for cement kiln dust for a variety of uses: agricultural, road base stabilization, sludge stabilization, and sulfur scrubbing. This material has to be reclassified by EPA as nonhazardous, however, before markets can be developed.

Plant No. 13: Twelve kilns were permanently shut down due to high cost of equipping them with environmental controls.

Plant No. 14: Plant closings, malfunctions of control equipment, increased operating costs, reluctance of corporation to make any further investments, and long delays in obtaining air pollution permits have affected current and increased production.

Plant No. 15: Additional grinding facilities are needed to meet current demand, however, the required capital has been diverted to meet environmental regulations. About $500,000 will be spent each year for the next 5 years to keep up with environmental regulations.

- Use of low sulfur coal [illegible] higher than normal oxygen [illegible] production [illegible] reduce the problem.

- In the past 12 years, four plants have been closed (not in Region V) due to [illegible] environmental problems.

Plant No. 16: Environmental regulations have not affected current production or expansion of capacity.

Plant No. 17: It [illegible] to 3 years in some cases to obtain an operating permit.

- Government restrictions are trying to force a change over from wet to dry process for fuel conservation.

Plant No. 18: Ten percent of plant down time due to malfunction of control equipment.

- Plant closings due to high cost (more than 25% of net worth of plant) of retrofit emission control devices.
- Lag time due to delays in obtaining permits has curtailed new production.

Plant No. 20: Expansion is not economically justified for this plant. Other comments are the same as those for Plant No. 12.

Plant No. 21: Environmental regulations have not affected current production.

- Cost of environmental control equipment (as much as 25% of total investment) has severely influenced installation of new mills or expansion of existing capacity.

Plant No. [illegible]: Production is curtailed frequently during maintenance of dust control equipment. White cement market does not justify expansion.

Plant No. [illegible] [illegible] supply [illegible] expansion of plant capacity.

Plant No. [illegible]: This is a grinding facility; not enough clinker is available for expansion to be profitable.