KOOGLER & ASSOCIATES
ENVIRONMENTAL SERVICES
4014 NW THIRTEENTH STREET
GAINESVILLE, FLORIDA 32609
904/377-5822 ▪ FAX 377-7158

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Division of Air
Resources Management

Mr. John Reynolds
Florida Department of
Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Subject: RACT Analysis For Nitrogen Oxides
Rinker Materials Corporation
Cement Kilns 1 and 2
FDER Permit No. A013-172954

Dear Mr. Reynolds:

This is in reference to a Reasonably Available Control Technology (RACT) analysis for the emissions of nitrogen oxides from the cement kilns at the Rinker facility in Miami, Dade County, Florida.

RACT REQUIREMENT

The amendments to Rule 17-296, of the Florida Administrative Code (FAC), associated with the Clean Air Act Amendments of 1990, apply new requirements for RACT for existing major sources of volatile organic compounds (VOCs) and nitrogen oxides (NOx) located in Florida's moderate ozone nonattainment areas. These areas include Dade, Broward, and Palm Beach Counties. FDER is expecting to implement a procedure for determining appropriate RACT for the affected sources, on a case-by-case basis, in accordance with Rule 17-296.570a, FAC.

Rinker's cement kilns emit more than 100 tons per year of NOx and are therefore subject to the RACT determination requirements.

NITROGEN OXIDES GENERATION & CONTROL

Nitrogen oxides are formed in the combustion process by the oxidation of nitrogen in the fuels (fuel NOx) and in the combustion air (thermal NOx). Fuel NOx is created by the oxidation of the volatilized nitrogen in the fuel. Thermal NOx is formed from the reaction between oxygen and nitrogen in the combustion air at combustion temperatures. Formation of thermal NOx depends on the flame temperature, residence time, combustion pressure, and air-to-fuel ratio in the combustion zone. The design and operation of the combustion system dictates these conditions.

NOx emissions can be lowered by lowering combustion temperatures and reducing combustion air. These measures, however, increase the generation of carbon monoxide. Sources for which post combustion controls, or add-on controls have been recommended include municipal waste combustors, industrial and utility boilers, glass furnaces, and gas turbines. The add-on controls used in the above applications typically consist of Selective Catalytic Reduction (SCR) and Selective Non-Catalytic Reduction (SNCR) technologies. As add-on controls have not been recommended for, nor demonstrated on cement kilns, the following discussion on RACT is limited to combustion control technology.

NOx EMISSION RATE COMPARISONS

The range of NOx emissions for cement kilns according to the BACT/LAER Clearinghouse (a listing of sources whose NOx emission rates were determined in accordance with the guidelines for Best Available Control Technology and Lowest Achievable Emission Rate) is about 4 to 10 lbs/ton clinker. While the BACT and LAER review criteria is far more stringent than for RACT, the NOx emission range indicates the NOx emission levels to which new or modified cement kilns have been restricted.

A comparison of the NOx emission rates of existing cement kilns indicates a range of about 3 to 34 lbs/ton of clinker.

Rinker's current permit, No. A013-172954 (issued 3-1-90, expires 1-15-95), does not limit the emissions of nitrogen oxides from the cement kilns. Also, the permit does not require any NOx testing. As a result, only limited NOx emission data, obtained from performance tests, is available on the kilns. The average NOx emissions are around 1000 pounds per hour. At a clinker production rate of 55 tons per hour, the emission factor is about 18 lbs/ton clinker.

Rinker's cement kiln NOx emission rates compare favorably with the emission range of existing kilns (3 to 34 lbs/ton clinker). However, if the current NOx emission rates were to be reduced, several combustion alternatives would need to be evaluated.

In comparing the NOx emission rates of different kilns, there are certain considerations to be aware of. Cement can be manufactured using a wet process, as in the case of Rinker, or a dry process. In the wet process, the kiln feed can either be a slurry (30% to 40% moisture) or a wet filtrate (about 20% moisture). The wet raw feed requires a longer residence time in the kiln and a greater fuel input per ton of product than in the dry process.

In the dry process, the raw feed contains less than 1% moisture. Furthermore, the dry process can incorporate a preheater system resulting in about 50% less fuel requirement than a wet process. With a greater fuel and combustion air requirement than the dry process, the wet process has the potential for greater NOx emissions.

Another consideration in comparing NOx emissions from different kilns is the quantity of primary combustion air fed to the kiln. Kilns that are direct-fired, as in the case of Rinker, emit a greater amount of NOx than kilns which are indirect-fired.

In direct-fired kilns using coal, air which sweeps the coal mill conveys the coal directly to the kiln and is also the source of primary combustion air. As a large amount of air is required to adequately sweep the coal mill, the quantity of primary combustion air tends to be high (about 28% of total air supply) resulting in higher NOx emissions.

In indirect-fired kilns using coal, the air which sweeps the coal mill conveys the coal to a bin and exhausts through a dust collector. The dust collector deposits the coal into a bin from which it is mechanically or pneumatically fed to the kiln. The primary air to the kiln in this case is far lower (about 8% of total air supply) and results in lower NOx emissions.

While information for a detailed analysis of various combustion methods is not available at this time, the following discussion outlines Rinker's current combustion practice and also some of the alternative combustion methods which can be considered for reducing NOx emissions from the kilns.

CURRENT OPERATION

Rinker operates two wet process, direct-fired cement kilns. Coal is air swept from the coal mills to the kilns. This firing configuration results in about 28% of the total combustion air supply from primary air, 66% from secondary air, and 6% from tertiary air. The system is operated with 15% excess air (see Figure 1). The heat input requirement is about 5.2 MMBtu per ton clinker.

NOx EMISSION REDUCTION ALTERNATIVES

1. Retrofit Existing Direct-fired System

For the retrofit of the existing direct-fired system, a special recirculation valve can be used after the primary air fan to recirculate a portion (approximately 20 percent) of the coal mill exhaust air back to the mill inlet (see Figure 2). Based on 20 percent recirculation as indicated by a vendor, the present primary air volume can be reduced from 28 percent to approximately 23 percent. Although a reduction in NOx emissions is expected, it is not possible to accurately quantify the reduction.

However, there is a drawback. The retrofit would still require the operation of one mill for each kiln even though Rinker is planning to replace part of the coal with whole tires and possibly natural gas in the future. At that time, both coal mills would have to operate at about half of their present capacity resulting in reduced process efficiency. Another point of concern is the potential risk of coal dust settlement in the ductwork and the burner pipe after the primary air fan due to inadequate air flow resulting from the reduction of the primary air volume. These issues have to be reviewed in greater detail prior to making any decision on the coal mill retrofit with a recirculating valve. A preliminary cost estimate of such a retrofit is in the order of $100,000.

2. <u>Conversion to Semi-direct Firing</u>

Semi-direct firing, as shown in Figure 3, can operate with a high mill exhaust air recirculation rate thus reducing the primary air volume to the kiln burner significantly resulting in reduced NOx emissions. Depending on the feed moisture of the coal, a vendor estimates that this system can operate at around 15% primary air.

The major drawback of this system is that it relies on a high collecting efficiency of a cyclone to clean the recirculating air prior to re-entering the coal mill. A high concentration of coal dust re-entering the coal mill poses a high risk of fire in the mill. An operational drawback of this system is that the primary air flow to the kiln is always influenced by the raw coal conditions which make the kiln operation very unstable and therefore cannot be recommended.

3. <u>Burner Modification</u>

A burner modification can also help to reduce the NOx emissions. The present burner can be modified to allow simultaneous oil firing in the middle of the coal flame. By making the center of the flame more fuel rich, the ratio of the current primary air to fuel can be reduced resulting in a reduction in NOx emissions.

Without a detailed study, it is not possible to define the optimum fuel rates necessary to achieve adequate NOx emission reduction. The operation of the coal mills at a lower load will result in a reduced process efficiency. A preliminary cost estimate of burner modification, without considering fuel costs, is in the range of $800,000.

4. Conversion to Indirect Coal Firing

A conversion of the present system to an indirect-fired system would consist of an arrangement as shown in Figure 4. Both existing coal mills would be converted to an indirect-fired system. The dedusting of the mills would be done by two individual sets of dust collectors. Normally one dust collector would be operating while the other one is on standby. The standby dust collector would only be required when both coal mills have to be operated due to lack of the secondary fuels.

The pulverized coal from both bagfilters would be collected and transported to a surge bin from which it would be fed separately to each kiln burner via coal feeders. The design of the coal feeder would be such that it could operate at 50 to 100 percent of the coal requirements for each kiln when the substitute fuels are used.

As the existing kiln burners are not designed as combi-burner for coal/gas/oil firing and are not suitable for converted indirect coal firing, it would be necessary to replace the present burners with new high efficiency kiln burners designed to operate with low primary air requirements. The estimated cost of converting the present system to an indirect-fired system is in the range of $3,000,000. This cost does not include fuel costs, utility costs, maintenance costs, or production loss costs resulting from plant shutdown for the modification.

Based on information on similar facilities which use an indirect-fired system, the NOx emission rates can be expected to be around 10 lbs/ton of clinker. While the indirect-fired system is capable of significant NOx emission reduction, a detailed evaluation of the impact of such a conversion on the overall process would be necessary.

PROPOSED ACTION

Although the NOx emissions from the cement kilns at the Rinker facility of about 18 lbs/ton of clinker are within the emission range of existing cement kilns in the country, Rinker is willing to take action to reduce the NOx emissions. However, given the nature and cost of modifications necessary to reduce NOx emissions, a detailed evaluation of the various emission reduction alternatives is warranted.

Rinker proposes to evaluate the above alternatives and any other alternatives suggested by FDER. Upon completion of the evaluation of the alternatives, Rinker's proposal will be submitted to FDER. If the evaluation process should take longer than six months, an interim status report will be submitted to FDER at the end of the six months.

The implementation of the alternative selected will involve project financing, any air permitting requirements, vendor bid evaluation, necessary construction, system debugging, and any compliance or performance tests for the kilns.

If you have any questions, please do not hesitate to give me a call.

Very truly yours,

KOOGLER & ASSOCIATES

John B. Koogler, Ph.D., P.E.

JBK:PAR:wa

c: Mr. Michael Vardeman, Rinker

<u>FIGURE 1</u>

DIRECT FIRING CONFIGURATION & RETROFIT

RINKER MATERIALS CORPORATION
DADE COUNTY, FLORIDA

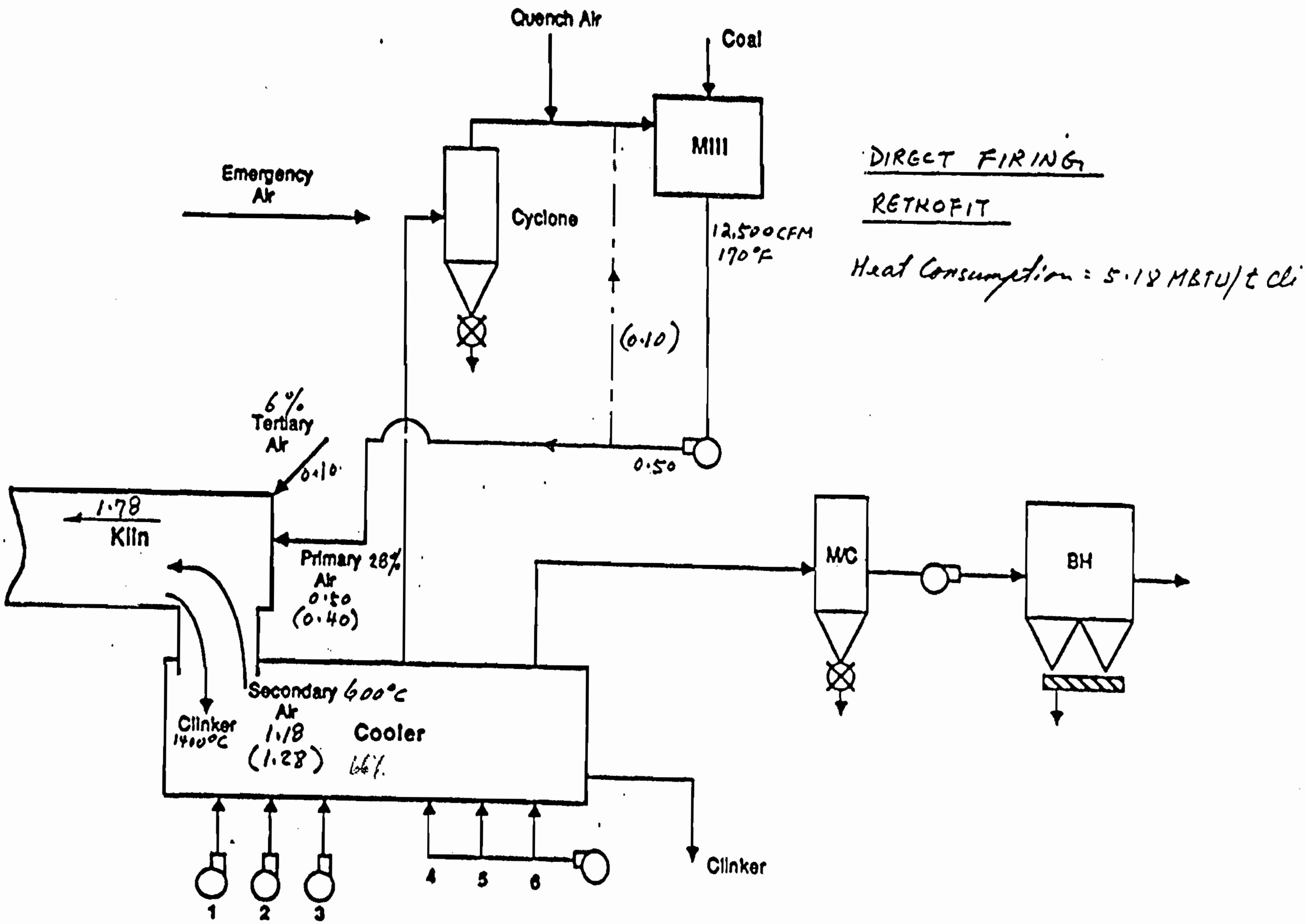
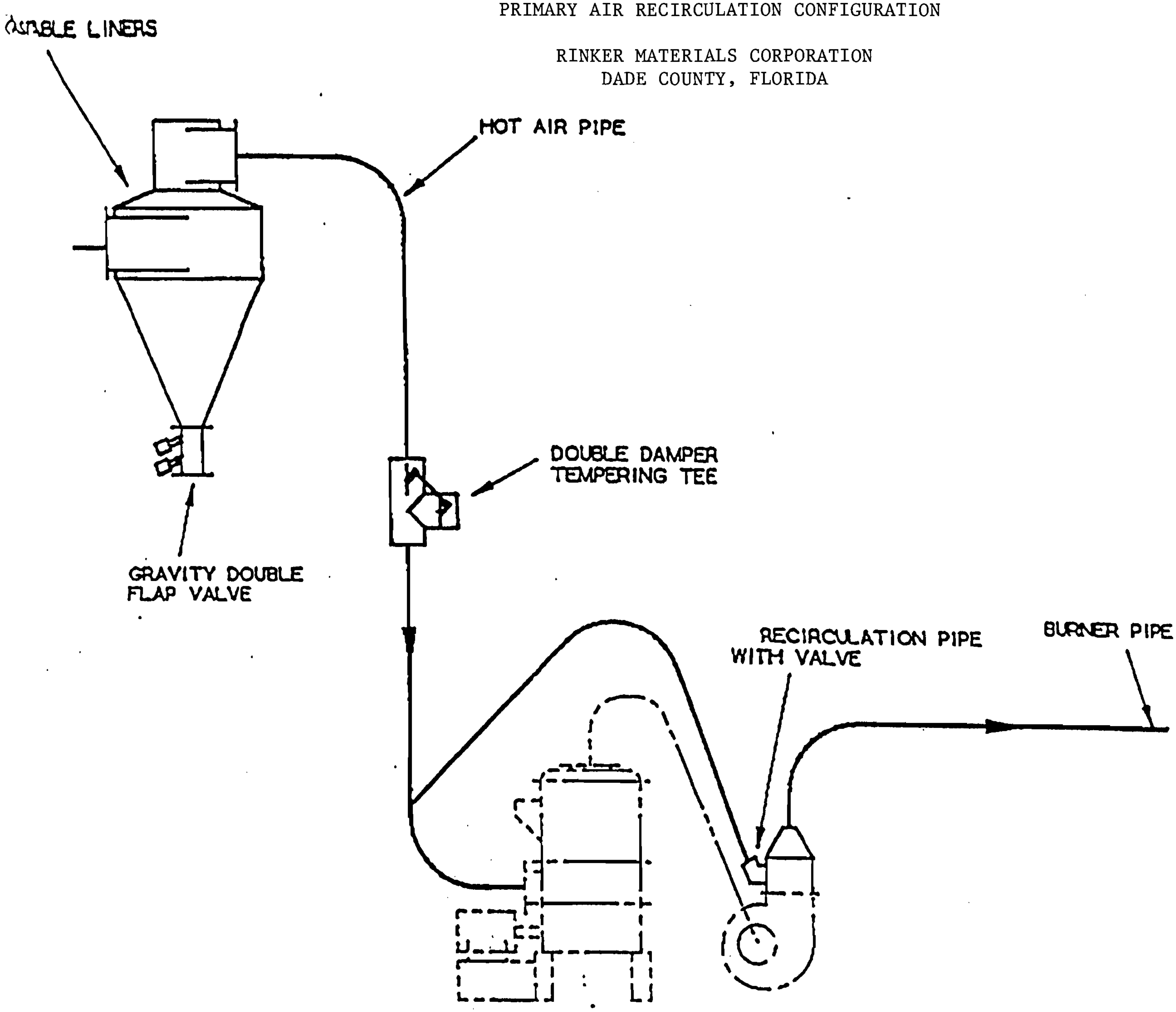


FIGURE 2

PRIMARY AIR RECIRCULATION CONFIGURATION

RINKER MATERIALS CORPORATION
DADE COUNTY, FLORIDA



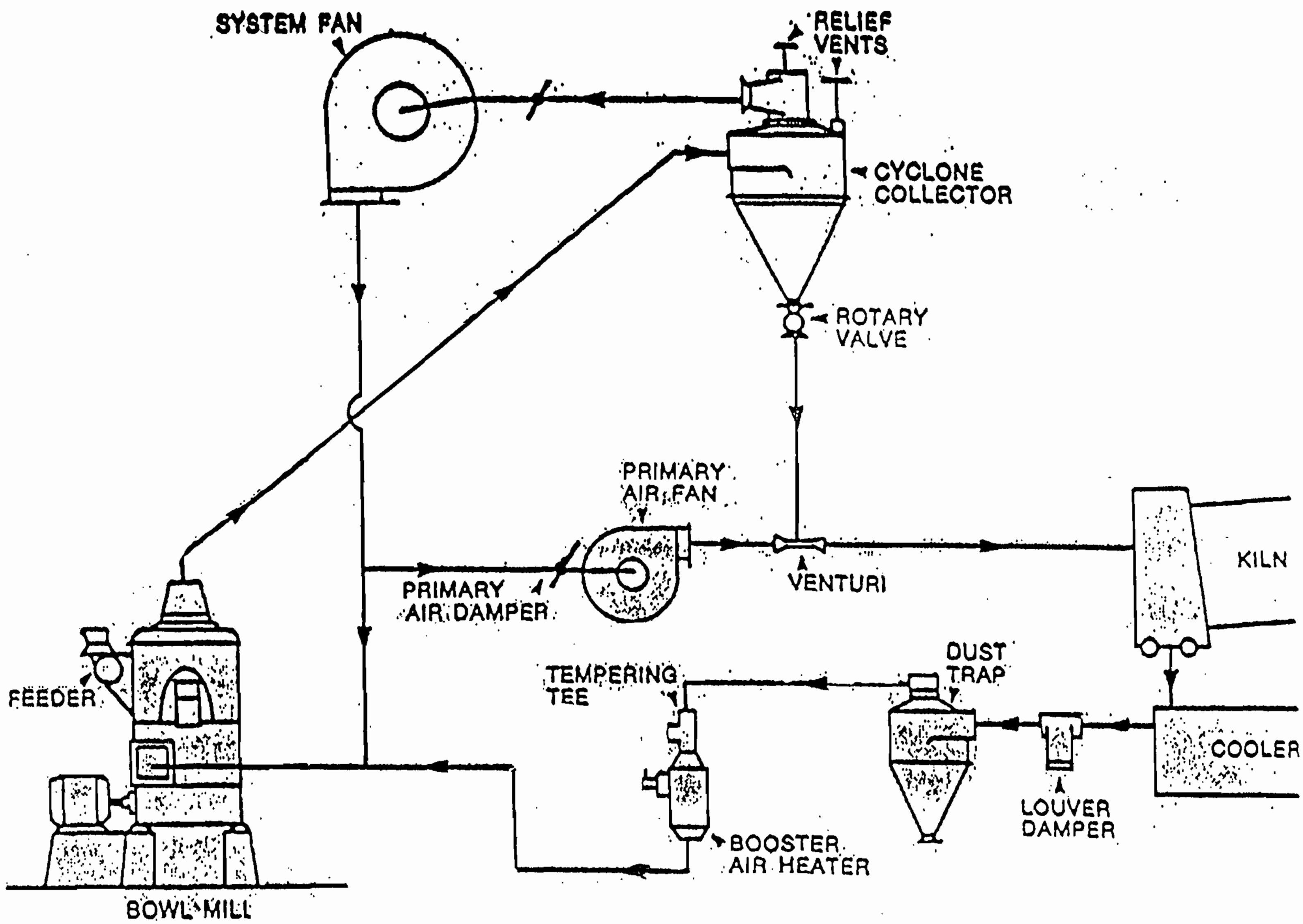


FIGURE 3

Semi-Direct Fired System—Low Moisture Coal

RINKER MATERIALS CORPORATION
DADE COUNTY, FLORIDA

FIGURE 4

INDIRECT FIRING CONFIGURATION

RINKER MATERIALS CORPORATION
DADE COUNTY, FLORIDA