ENVIRONMENTAL CONSIDERATIONS AND PERMITTING

USE OF PETROLEUM COKE AS SUPPLEMENTAL FUEL IN LIME KILNS

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Environmental Considerations and Permitting

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Introduction

The pulp and paper industry continues to come under pressure to improve financial performance in the face of increasing energy costs for fuel oil and natural gas. Fuel is the primary cost in the operation of a lime kiln. Presently, for a 1,000-ton-per-day (tpd) bleached pulp mill, the fuel cost for a lime kiln can be $2.6 million per year. At current natural gas and oil prices, there are economic benefits for using petroleum coke (pet coke) for part of the fuel requirements in lime kilns.

Pet coke is a by-product of the upgrading of the heaviest petroleum fractions (e.g., residual fuel oil) to more valuable lighter products in coking units. Pet coke is used as a raw material in metals manufacturing, is commonly burned in cement kilns around the world, and is currently being fired in three lime kilns at pulp mills in the southeastern U. S. It is a solid fuel requiring pulverization prior to combustion. It has a sulfur content higher than natural gas and fuel oil and burns more intensely than natural gas and oil.

A bleached pulp mill can realize potential savings by utilizing alternative fuel sources at the lime kiln. For example, using pet coke in a lime kiln could save a 1,000-tpd bleached pulp mill more than $800,000 per year in fuel costs. The Parton Group identified these cost savings, as well as considered the economic and process implications for burning pet coke in a lime kiln in their report *Considerations in the Use of Petroleum Coke as a Supplemental Fuel in Lime Reburning Kilns*. Although, economic gains can be realized by using pet coke, an increase in air emissions may be the environmental tradeoff. This paper considers whether the increased air emissions would trigger additional permitting and environmental regulations.

The pulp and paper industry is currently subject to many environmental regulations to control air emissions from the facility, and the use of pet coke in the lime kiln combustion process does have the potential to trigger additional air quality regulations. Based on the emission estimates in this report, switching from 100% natural gas to 75% pet coke and 25% natural gas as a fuel in a lime kiln would result in the following:

- Prevention of Significant Deterioration (PSD) regulations would not be triggered for a 1,000-tpd bleached pulp mill (based on actual operations of 350 days and using AP-42 factors for actual emissions). The net emissions increase for each of the criteria pollutants, when modifying the lime kiln to combust 75% pet coke and 25% natural gas, is below the significant net emissions increase threshold level for attainment areas.

- The National Emission Standards for Hazardous Air Pollutants (NESHAPs) requirement for a new source would not be triggered because modifying a lime kiln to burn pet coke is not considered a modification or a new source under the NESHAPs requirements.
- The NESHAPs requirements (effective March 2004) for existing sources would apply, but these requirements will apply regardless if a fuel switch occurs.
- New Source Performance Standards (NSPS) may be triggered if the hourly emission rates of particulate matter (PM) or total reduced sulfur (TRS) increases. This paper is based on the assumption that the existing lime kilns (1) have the necessary control equipment to achieve the NSPS PM emission standards (as there is an existing PM standard under the NESHAPs requirements) and (2) will most likely be able to meet the NSPS TRS requirements using existing current operational controls. If NSPS for TRS is triggered, then continuous emission monitoring (CEM) and monitoring of percent oxygen (0_2) discharged would be required.
- State permitting would require air toxic modeling, but the air toxics from a pet coke lime kiln are insignificant (less than one ton) and, therefore, should not cause any issues with permitting.
- Some areas may be reclassified as nonattainment in the near future, which would affect permit applications that have not been approved or finalized prior to the reclassification.

This report has been prepared assuming the following conditions: 75% pet coke and 25% natural gas burned at a lime kiln to support a 1,000-tpd bleached pulp mill. The particulate emissions would be controlled with a wet scrubber or an electrostatic precipitator (ESP) with a control efficiency of 99%, and the sulfur removal of the system would be 99.5%. Pet coke has a heating value of 28 million British thermal units (MMBtu) per ton of pet coke and a sulfur content of 6%.

Background

The production of kraft paper products from wood can be divided into three process areas: (1) pulping of wood chips, (2) chemical recovery, and (3) product forming (including bleaching).

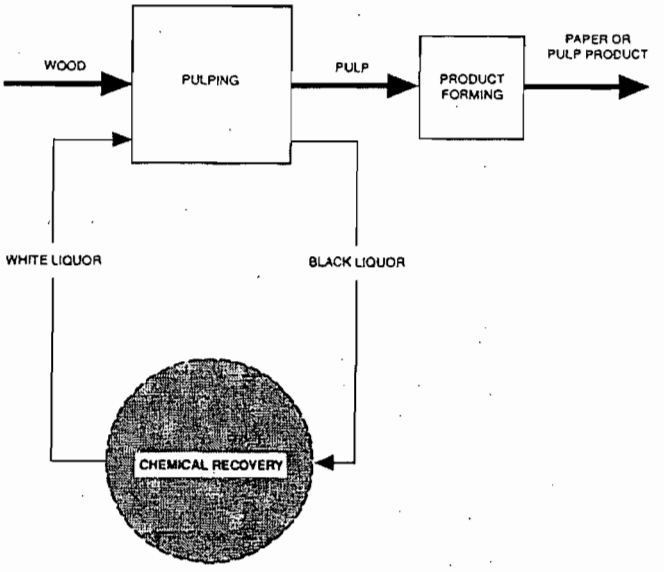


Figure 1. Pulp and Paper Process

As described in the Parton Group report, spent black liquor from the pulp mill is concentrated in multiple effect evaporators and is burned in the recovery boiler. The dissolved organics combust while the inorganic chemicals in the black liquor melt and form a pool of smelt in the bottom of the boiler. The smelt flows out into an agitated smelt-dissolving tank where the inorganic chemicals are dissolved to form green liquor.

Staged combustion in the recovery boiler keeps the lower portion of the furnace under reducing conditions, converting the sodium-sulfur compounds to sodium sulfide, one of the active cooking chemicals. The remainder of sodium is converted to sodium carbonate. To reuse the liquor for cooking, the sodium carbonate must be converted to sodium hydroxide, the other active cooking chemical.

To convert the sodium carbonate, calcium oxide is introduced into the green liquor in the slaker. The products of this chemical process are sodium hydroxide (caustic) and calcium carbonate (lime mud). The product solution is called white liquor.

The lime mud is separated from the white liquor by decantation or filtration, and the mud is washed to remove the residual white liquor. The lime mud is then heated (reburned) in the lime kiln, and the calcium carbonate is reconverted to calcium oxide.

Both the cooking liquor and the lime circulate within the pulp mill. Any elements introduced from the use of pet coke will circulate in either the liquor or solids circuits until purged or would be emitted from the lime kiln exhaust stack.

Air Quality Regulatory Requirements

Air permitting is the means through which regulatory agencies combine all applicable state, federal, and local requirements associated with a source of air pollution into one legal and enforceable document. When a new source is constructed or a facility needs to make a modification to its existing source, thereby potentially increasing impacts to air quality, air permitting is typically necessary. In the case of converting a lime kiln to burn pet coke (a modification), an air permit is required because the kiln was not originally designed to burn pet coke. The following sections discuss the potential air quality permitting issues related to converting from burning 100% natural gas to burning 75% pet coke and 25% natural gas at a 1,000-tpd bleached pulp mill's lime kiln.

Federal Regulations and Permitting Requirements

Modifying the lime kiln at a pulp mill to burn pet coke may trigger the following federal rules:

- PSD requirements under Title 40 Code of Federal Regulations (CFR) 52;
- NSPS under Title 40 CFR 60; and
- NESHAPs under Title 40 CFR 63.

Nonattainment new source review (NSR) may also be triggered if a facility is located in an area that exceeds the National Ambient Air Quality Standards (NAAQS) set by the United States Environmental Protection Agency (USEPA).

New Source Review

Major stationary sources of air pollution and major modifications to major stationary sources are required by the Clean Air Act to obtain an NSR air pollution permit before commencing construction. The NSR process is required whether the major source or modification is planned for an area where the NAAQS are exceeded (nonattainment areas) for one or more criteria pollutants or an area where air quality is acceptable (attainment and unclassifiable areas). PSD permits are required for sources in attainment areas, while nonattainment NSR permits are required for sources

located in nonattainment areas. A source may have to meet both PSD and nonattainment NSR permitting requirements if the source is in an area classified as attainment for some pollutants and nonattainment for others. The PSD and nonattainment NSR requirements are pollutant specific. Only those pollutants that exceed PSD or nonattainment NSR emission thresholds are subject to PSD or nonattainment NSR permitting requirements.

Prevention of Significant Deterioration

No source or modification subject to PSD review may be constructed without a permit. To obtain a PSD permit, an applicant must:

- Apply the best available control technology (BACT);
- Conduct an ambient air quality analysis;
- Analyze impacts to soils, vegetation, and visibility;
- Not adversely impact a Class I area (Class I areas include national parks, national wilderness areas, and tribal areas); and
- Undergo adequate public participation.

A PSD permit is necessary for a major modification to an existing major source. A major modification is generally a physical change or a change in the method of operation of a major stationary source that would result in a significant net emissions increase of any regulated pollutant. In determining if a proposed increase would result in a significant net increase, several detailed calculations must be performed. The significant emissions net increase number is pollutant specific, as shown in the table below:

Pollutant	Significant Emissions Net Increase Threshold level (tons per year)
Carbon monoxide	100 tpy
Nitrogen oxides	40 tpy
Sulfur dioxide	40 tpy
PM	25 tpy
PM_{10}	15 tpy
Ozone	40 tpy of volatile organic compounds (VOCs)
Hydrogen Sulfide (H_2S)	10 tpy
TRS (including H_2S)	10 tpy
Reduced sulfur compounds (including H_2S)	10 tpy

To determine whether a net emissions increase will result, the following equation is used:

Net Emissions Change	=	Emissions increases associated with the proposed modification	-	Source-wide creditable contemporaneous emissions decreases	+	Source-wide creditable contemporaneous emissions increases

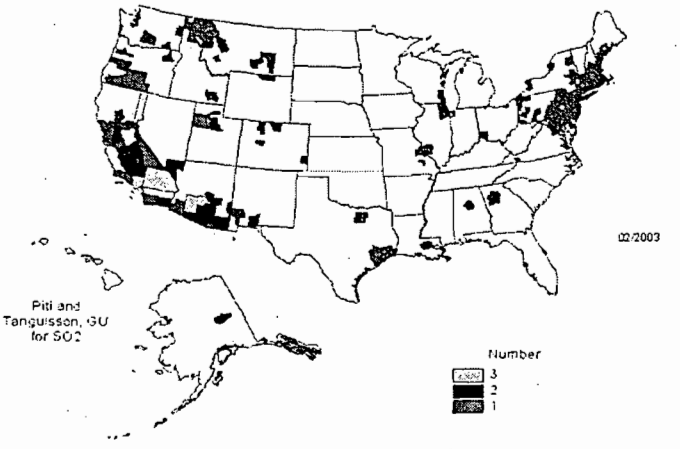
The net emissions change is based on the potential emissions increase from the proposed modification (combustion of pet coke) minus any actual emissions that would be decreased (in this case, the reduction of actual emissions from the natural gas burned at the lime kiln), plus any emissions increases (such as an increase in production that would increase the potential emissions from other processes).

The emissions estimates associated with modifying a natural gas fired lime kiln at a 1,000-tpd bleached pulp mill to combust 75% pet coke and 25% natural gas indicate the net emissions increase for each of the criteria pollutants are below the significant emissions net increase threshold levels for attainment areas (see page 15). Thus, no PSD permits are required; however, a minor source (state-only construction) permit would be required.

Nonattainment New Source Review

The permitting requirements for major new sources or major modifications located in nonattainment areas differ from the PSD permitting requirements for attainment areas. The significant emissions net increase threshold level for pollutants in nonattainment areas is lower than the levels established for attainment areas (projects with emission increases above the threshold levels are defined as major modifications). The emissions control requirement for a major modification in a nonattainment area is the lowest achievable emission rate (LAER), which is more stringent than the BACT emission control requirement required for attainment areas. The facility must also obtain emissions reductions (offsets) of the nonattainment pollutant from other sources that impact the same area as the proposed source. Facilities typically purchase emission offsets from other companies that have curtailed production or have shut down operations. The applicant must also certify that all other sources owned by the applicant in the State are complying with all applicable requirements of the Clean Air Act. Areas that are considered nonattainment for one or more pollutants are shaded in the map below[1]. Current nonattainment areas are identified in Appendix A.

Number of Pollutants By County Designated Nonattainment



[1] The NAAQS for ozone are currently being lowered, and there is a new standard being developed for PM under 2.5 microns ($PM_{2.5}$). Therefore, some current attainment areas may be reclassified as nonattainment areas in the near future.

A facility located in one of these nonattainment areas needs to assess whether converting to pet coke is a feasible option based on the permitting requirements for that area. For example, a mill located in Atlanta will have area-specific requirements that are different from the requirements for a mill located in Dallas, even though both mills are located in non-attainment areas.

New Source Performance Standards

Title 40 CFR 60, Subpart BB - *Standards of Performance for Kraft Pulp Mills* applies to kraft pulp mills constructed or modified after September 24, 1976 and includes the following sources: digester system, brown stock washer system, multiple-effect evaporator system, recovery furnace, smelt-dissolving tank, lime kiln, and condensate stripper system. If the lime kiln was being modified to burn pet coke, then the NSPS requirements would only be triggered for the lime kiln process, not for other processes at the facility.

The NSPS includes standards for both PM and TRS. The standards for PM include the following for the lime kiln:

- For natural gas use: 0.15 grams per dry standard cubic meter (g/dscm) (0.066 grains per dry standard cubic foot [gr/dscf]) corrected to 10% O_2, when gaseous fossil fuel is burned.
- For fuel oil and pet coke usage: 0.30 g/dscm (0.13 gr/dscf) corrected to 10% O_2, when liquid fossil fuel is burned.

When petroleum coke and gaseous fossil fuel are fired simultaneously in any combination, some states may allow a particulate emissions limit (in gr/dscf at 10% O_2) to be determined by prorating the natural gas and pet coke emission limits. This is an alternative to the more restrictive limit of 0.066 gr/dscf that is required when natural gas is burned. The prorated emission rate can be determined by the following equation:

$$PS_{PM} = \frac{Y(0.066) + Z(0.13)}{Y + Z}$$

Where: PS_{PM} is the prorated standard for PM when firing natural gas and pet coke simultaneously, in gr/dscf at 10% oxygen;

Y is the percentage of total heat input from natural gas; and

Z is the percentage of total heat input derived from pet coke.

Using the assumption of 75% total heat input from pet coke and 25% total heat input from natural gas, the PS_{PM} would be 0.114 gr/dscf.

The TRS standard for the lime kiln is 8 parts per million (ppm) by volume on a dry basis, corrected to 10% O_2. For a lime kiln that is modified, CEM systems are required to monitor and record the concentration of TRS emissions on a dry basis and the percent O_2 by volume on a dry basis in the gases discharged into the atmosphere from any lime kiln.

NSPS is triggered if a modification occurs where the hourly emission rates of PM or TRS increase. If the hourly emission rate (kilograms per hour [kg/hour]) for PM or TRS does not increase, then that standard does not apply. In other words, if only the hourly PM emission rate increases and not the TRS emission rate, then the mill is subject only to the NSPS PM emission standard and not the TRS emission standard.

National Emission Standards of Hazardous Air Pollutants

National Emission Standards for Hazardous Air Pollutants for Chemical Recovery Combustion Sources at Kraft, Soda, Sulfite, and Stand-Alone Semichemical Pulp Mills (Title 40 CFR 63 Subpart MM) requires that existing kraft or soda pulp mills comply with the requirements shown in the following table.

Summary of Promulgated Standards[a]

Subcategory	Emission point	HAP metals standard		Alternate HAP metals standard ("bubble")		Gaseous organic HAP standard	
		Existing	New	Existing	New	Existing	New
Kraft and soda	Recovery furnaces	PM ≤ 0.10 g/dscm (0.044 gr/dscf) at 8% oxygen	PM ≤ 0.034 g/dscm (0.015 gr/dscf) at 8% oxygen	Mill-specific PM emission limit (kg/Mg (lb/ton) BLS) based on calculated value of the sum of the individual emissions limits for recovery furnaces, SDT, and lime kilns. See equation 1 in §63.865(a)(1) of the final rule.	No "bubble" alternate standard for new sources	No standard	Gaseous organic HAP ≤ 0.012 kg/Mg (0.025 lb/ton) BLS (as measured by methanol)
	SDT	PM ≤ 0.10 g/dscm (0.20 lb/ton) BLS	PM ≤ 0.06 g/dscm (0.012 lb/ton) BLS			No standard[b]	No standard[b]
	Lime kilns	PM ≤ 0.15 g/dscm (0.064 gr/dscf) at 10% oxygen	PM ≤ 0.023 g/dscm (0.01 gr/dscf) at 10% oxygen			No standard[b]	No standard[b]
Sulfite	Sulfite combustion units	PM ≤ 0.092 g/dscm (0.040 gr/dscf) at 8% oxygen	PM ≤ 0.046 g/dscm (0.020 gr/dscf) at 8% oxygen	Not applicable	Not applicable	No standard[b]	No standard[b]
Stand-alone semi-chemical	Semi-chemical combustion units	No standard	No standard	Not applicable	Not applicable	Gaseous organic HAP ≤ 1.49 kg/Mg (2.97 lb/ton) BLS (as measured by THC) or 90% reduction	Gaseous organic HAP ≤ 1.49 kg/Mg (2.97 lb/ton) BLS (as measured by THC) or 90% reduction

[a] g/dscm= grams per standard cubic meter, gr/dscf = grains per standard cubic foot, kg/Mg = kilograms per megagram, lb/ton = pounds per ton, BLS = black liquor solids, and THC = total hydrocarbons

[b] Emissions of gaseous organic HAP from these sources are regulated as part of the NESHAP for noncombustion sources at pulp and paper mills.

Source: Federal Register, Vol. 66, No. 9, Friday, January 12, 2001

As the table indicates, an existing mill must comply with the following individual limits:

- Non direct contact evaporator (NDCE) recovery furnace/direct contact evaporator (DCE) recovery furnace - Reduce outlet PM emissions to 0.044 gr/dscf at 8% O_2
- Smelt Dissolving Tank (SDT) - Reduce outlet PM emissions to 0.20 pounds per ton (lb/ton) black liquor solids (BLS)
- Lime kiln- Reduce outlet PM emissions to 0.15 g/dscm (0.064 gr/dscf) at 10% O_2

Under the NESHAPs regulations for existing mills, all lime kilns equipped with an ESP must install, calibrate, maintain, and operate a continuous opacity monitoring system. All lime kilns equipped with a wet scrubber must install, calibrate, maintain, and operate a continuous monitoring system that can be used to determine and record the pressure drop across the scrubber and the scrubbing liquid flow to meet the NESHAPs monitoring requirements.

The NESHAPs regulations for existing mills allow a mill to comply with a PM bubble compliance alternative that is a mill-specific PM limit (lb/ton BLS) based on the calculated value of the sum of the individual emission limits for recovery furnaces, SDTs, and lime kilns. This mill-specific bubble limit is calculated based on the proposed emission limits for each affected source and mill-specific gas flow rates and process rates.

Mills that choose to comply with the NESHAPs standard using the proposed bubble compliance alternative are required to submit preliminary emission limits to the applicable permitting authority for approval for each existing recovery furnace, SDT, and lime kiln at the mill. Before the preliminary PM emission limits are approved, the mill is required to submit documentation demonstrating that if the preliminary emission limits for each emission source are met, the entire group of affected sources would be in compliance with the mill-wide allowable emission level. The allowable emission level would be determined from the applicable bubble equation using the reference concentrations and reference emission rates for each emission source and source-specific factors for exhaust gas flow rates and process rates. When approved by the applicable permitting authority, the emission limits would be incorporated into the operating permit for the mill. The PM emission limits from the mill-specific bubble limit would need to be modified to include the conversion of a lime kiln to burning pet coke.

The proposed bubble compliance alternative would not be applicable to new sources. All new affected sources at kraft pulp mills would be required to meet the individual emission limitations set for those sources. Also, mills subject to the NSPS requirements for kraft pulp mills would be required to continue to meet the PM emission limits of NSPS, regardless of which option they choose for complying with the NESHAP standard.

The conversion of a lime kiln to burning pet coke is not considered a "new source" under the NESHAPs regulations. Under Subpart A of Title 40 CFR 63, "new source" means "any affected source the construction or reconstruction of which is commenced after the Administrator first proposes a relevant emission standard under this part establishing an emission standard applicable to such source." As the lime kiln would not be newly constructed, because it would be constructed before the applicable NESHAPs standard was proposed, it is considered a reconstruction. The definition for Reconstruction, in Title 40 CFR 63 Subpart A is as follows:

> "Unless otherwise defined in a relevant standard, means the replacement of components of an affected or a previously nonaffected source to such an extent that:
>
> (1) The **fixed capital cost of the new components exceeds 50 percent** of the fixed capital cost that would be required to construct a comparable new source; and
>
> (2) It is technologically and economically feasible for the reconstructed source to meet the relevant standard(s) established by the Administrator (or a State) pursuant to section 112 of the Act. Upon reconstruction, an affected source, or a stationary source that becomes an affected source, is subject to relevant standards for new sources, including compliance dates, irrespective of any change in emissions of hazardous air pollutants from that source."

The estimated cost of a burner plus a fan, silo, and associated loading and unloading equipment required to facilitate the transportation and combustion of pet coke would be about $2.5 million, and the estimated cost of a new lime kiln is $30 million[2].

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[2] Costs are based on an estimate from the DTE Energy Services Development Department.

As the capital costs of the burner reconstruction is less than 50% of a new lime kiln, this modification would not be considered a reconstruction and, therefore, not be regulated under the new source requirements under the NESHAPs regulations. Thus, conversion of the lime kiln to burn pet coke does not introduce new NESHAPs regulations or alter a mill's requirement to comply with NESHAPs as an existing source. The mill will be regulated under the existing source NESHAPs requirements of either the source-specific limit or can continue under the PM bubble compliance alternative.

Potential Emission Increases Using Pet Coke

To determine if a source will trigger PSD permitting, the potential to emit for the source must be calculated. The potential to emit is the maximum capacity of a stationary source given its physical and operational design to emit a pollutant. Potential to emit is an emission estimation method used to determine future emissions, which are then compared to actual emissions. The difference between potential and actual emissions is used to determine if a significant net increase in emissions will occur.

As detailed in the Parton's Group paper, 285 tpd of reburned lime are required for a 1,000-tpd bleached pulp mill. The fuel requirement for the lime kiln is approximately 6 million MMBtu per ton of lime. The resulting fuel demand for the kiln that serves the 1,000-tpd pulp mill is

285 tpd lime x 6 MMBtu/ton = 1,710 MMBtu/day

The following calculations identify the fuel requirements for a lime kiln burning 75% pet coke and 25% natural gas at a 1,000-tpd bleached pulp mill, given a heating value of 28 MMBtu per ton of pet coke:

1,710 MMBtu/day x 1 ton pet coke/28 MMBtu x 75% = 45 tpd pet coke

1,710 MMBtu/day x 1 ft^3 natural gas/1,000 Btu x 25% = 427,000 cubic feet per day (ft^3/day) natural gas

Using these fuel requirements and the following assumptions and emission factors, we are able to calculate potential emission increases.

- The particulate emissions would be controlled with a wet scrubber or an ESP with a control efficiency of 99%.

- The sulfur removal of the system would be 99.5%.
- Pet coke has a sulfur content of 6%.
- Calculations in this paper for actual emissions from a lime kiln are based on an actual operating schedule of 350 days per year and the potential to emit is based on 365 days per year[3]. Actual emissions from current operating lime kilns can vary from these calculations based on several factors such as process differences, operating schedule, and add-on control removal efficiency.

Emissions were calculated using emissions factors described below:

- Lime kiln emission factors are from the United States Environmental Protection Agency's (USEPA's) *AP-42, Fifth Edition, Wood Products Industry, Chapter 10.2, Chemical Wood Pulping.* These emission factors are used to estimate the emissions associated with a lime kiln burning natural gas and include emissions generated by the lime kiln process, as well as those generated by the combustion of natural gas.
- Pet coke emission factors are from the USEPA's *Emission Inventory Improvement Program* (EIIP)*; Volume II: Chapter 14, Uncontrolled Emission Factor Listing for Criteria Air Pollutants, July, 2001.* These emission factors are fuel specific for commercial and institutional external combustion boilers; however, in the absence of available lime kiln-specific data, they are appropriate for use in this comparison. The EIIP emissions factors are used to calculate the emissions of sulfer dioxide (SO_2) and PM generated by the combustion of pet coke. The combustion of natural gas generates a negligible amount of SO_2 and PM. Therefore, to estimate the total potential to emit emissions, SO_2 and PM emissions from combusting pet coke in a lime kiln are added to the AP-42 factors for lime kilns.

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3 Under the PSD regulations, current actual emissions are compared to the proposed potential emissions to determine an emissions increase. On December 31, 2002, the USEPA reformed the PSD program. Under the reformed program, the proposed emissions increases can be calculated using other methods such as comparing current actual emissions to proposed actual emissions. However, most states have not yet implemented the reformed PSD program and continue to operate under the old program. In this paper, PSD applicability is based on the comparison of actual emissions to potential emissions because it is the most conservative method of comparison.

- The emissions factors for carbon monoxide (CO) and nitrous oxides (NOx) from a lime kiln burning a combination of pet coke/natural gas were obtained from a burner manufacturer. These emission factors are based on 80% pet coke being combusted with 20% natural gas. These factors are considered appropriate for this comparison because they take into account flame temperature and size, which are different in a lime kiln than in a boiler. In addition, the emissions from combustion vary greatly depending on flame temperature and size. CO and NOx are not emitted from the lime kiln process; they are only emitted during the combustion of fuels (natural gas or pet coke). Therefore, the addition of AP-42 factors and EIIP factors is not required to estimate the total potential-to-emit emissions.
- VOC emissions from a pet coke lime kiln are calculated by adding the VOC emissions from the lime kiln process and the VOC emissions from the combustions of pet coke and natural gas. The VOC emissions from a lime kiln burning a combination of pet coke/natural gas were calculated using an emission factor from a burner manufacturer and the AP-42 emission factor for the lime kiln process burning 100% natural gas. VOC emissions are produced from the lime kiln process and natural gas and pet coke combustion. There is no method to accurately determine the percentage of VOCs from natural gas combustion in the lime kiln, so the potential to emit from a pet coke lime kiln is very conservative.

PSD Netting Analysis for a Pet Coke Lime Kiln[1]

Pollutant	Natural Gas Lime Kiln[2] Estimated Actual Emissions (Tons per Year)	Pet Coke Lime Kiln[1] Estimated Potential to Emit (Tons per Year)	Net Increase (Tons per Year)	PSD Significance Threshold (Tons per Year)	PSD Triggered?
TRS as S	5.25	5.48	0.23	10	No
SO_2	52.5	64.4	11.9	40	No
PM	87.5	91.8	4.3	15	No
NOx	175	202.8	27.8	40	No
CO	17.5	18.7	1.2	100	No
VOCs (Total Hydrocarbons)	5.25	9.18	3.93	40	No
CO_2	35,192	57,788	22,596	---	--

[1] Pet coke lime kiln refers to a lime kiln burning 75% pet coke and 25% natural gas.

[2] Natural gas lime kiln refers to a lime kiln burning 100% natural gas.

Total Reduced Sulfur Emissions

The USEPA's AP-42 factor for total reduced sulfur from a lime kiln burning natural gas is 0.03 pounds of TRS per ton of lime. The actual emissions from a lime kiln burning natural gas are calculated in the following equation:

Actual Emissions Estimate from Natural Gas Lime Kiln

$$\frac{1{,}000 \text{ tons pulp}}{\text{day}} \times \frac{0.03 \text{ lbs TRS}}{\text{ton pulp}} \times \frac{350 \text{ days}}{\text{year}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = 5.25 \text{ tpy of TRS}$$

To determine the potential to emit of TRS from a lime kiln burning pet coke and natural gas together, the same emission factor of 0.03 lbs TRS/ton of lime is used because the additional sulfur from the pet coke will be converted to SO_2 or anhydrite ($CaSO_4$)[4]. The emission factor for TRS is multiplied by the maximum number of days to determine the potential to emit, as shown in the equation below:

Potential to Emit from a Pet Coke Lime Kiln

$$\frac{1{,}000 \text{ tons pulp}}{\text{day}} \times \frac{0.03 \text{ lbs TRS}}{\text{ton pulp}} \times \frac{365 \text{ days}}{\text{year}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = 5.48 \text{ tpy of TRS}$$

Based on these estimations, the net increase in TRS (the difference in the potential to emit from a pet coke lime kiln minus actual emissions estimate from a natural gas lime kiln for PSD purposes) is 0.23 tpy and is the shown in the equation below:

Net Increase

5.48 tpy of TRS – 5.25 tpy of TRS = 0.23 tpy of TRS

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4 When burning pet coke in the kiln, the sulfur in the pet coke is converted to SO_2. Most of the SO_2 is absorbed by the lime in the kiln forming $CaSO_4$. Anhydrite is a solid and will not be emitted to the air. Therefore, any additional sulfur generated from combusting pet coke in the lime kiln will be converted to SO_2 or $CaSO_4$.

The net increase is below the significant emissions net increase threshold level of 10 tpy, and therefore, the PSD permitting requirements will not be triggered.

Sulfur Dioxide Emissions

The estimated actual emissions of SO_2 from an existing lime kiln burning natural gas is 52.5 tons per year. This is using the USEPA's AP-42 lime kiln emissions factor of 0.3 pounds SO_2/ton pulp and would be calculated as follows:

Actual Emissions Estimate from Natural Gas Lime Kiln

$$\frac{1{,}000 \text{ tons pulp}}{\text{day}} \times \frac{0.3 \text{ lbs } SO_2}{\text{ton pulp}} \times \frac{350 \text{ days}}{\text{year}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = 52.5 \text{ tpy of } SO_2$$

Based on process knowledge, the SO_2 emissions from the combustion of natural gas are negligible. Additional SO_2 emissions are introduced from the burning of pet coke and were calculated using the EIIP's emission factor for pet coke combustion, assuming 6% pet coke sulfur content and 99.5% removal efficiency. The EIIP's pet coke combustion emission factor of 39S lb/ton pet coke (where S is % sulfur) was used in this calculation.

Potential to Emit from Lime Kiln

$$\frac{1{,}000 \text{ tons pulp}}{\text{day}} \times \frac{0.3 \text{ lbs } SO_2}{\text{ton pulp}} \times \frac{365 \text{ days}}{\text{year}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = 54.8 \text{ tpy of } SO_2$$

Potential to Emit from Pet Coke Combustion

$$\frac{45 \text{ tons pet coke}}{\text{day}} \times \frac{(39 \times 6) \text{ lbs } SO_2}{\text{ton pet coke}} \times \frac{365 \text{ days}}{\text{year}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} \times (1 - 0.995) = 9.6 \text{ tpy of } SO_2$$

The potential to emit for SO_2 from a lime kiln burning pet coke would be:

Potential to Emit from Pet Coke Lime Kiln

$$54.8 \text{ tpy } SO_{2(\text{emissions from lime kiln})} + 9.6 \text{ tpy } SO_{2(\text{emissions from pet coke combustion})} = 64.4 \text{ tpy of } SO_2$$

Based on these estimations, the net increase in SO_2 would be 11.9 tpy, as expressed below:

Net Increase

64.4 tpy of SO_2 – 52.5 tpy of SO_2 = 11.9 tpy of SO_2

The net increase is below the significant emissions net increase threshold level of 40 tpy, and therefore, PSD permitting requirements will not be triggered.

Particulate Matter Emissions

The PM emissions calculations assume (1) PM control of 99% with add-on controls of either a wet scrubber or an ESP, and (2) the additional PM from the burning of pet coke would be adequately controlled by a wet scrubber or ESP and would remain below the NSPS and NESHAPs for existing sources.

The PM emissions for a natural gas fired lime kiln were calculated using the USEPA's AP-42 emission factor for a lime kiln with a wet scrubber or ESP.

Actual Emissions Estimate from Natural Gas Lime Kiln

$$\frac{1{,}000 \text{ tons pulp}}{\text{day}} \times \frac{0.5 \text{ lbs PM}}{\text{ton pulp}} \times \frac{350 \text{ days}}{\text{year}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = 87.5 \text{ tpy of PM}$$

Natural gas combustion produces negligible PM emissions, so the potential to emit from a pet coke lime kiln is the potential to emit from the lime kiln process and the potential to emit from pet coke combustion. Additional PM emissions generated during the burning of pet coke were calculated using the EIIP's emission factor for pet coke combustion.

Potential to Emit from Natural Gas Lime Kiln

$$\frac{1{,}000 \text{ tons pulp}}{\text{day}} \times \frac{0.5 \text{ lbs PM}}{\text{ton pulp}} \times \frac{365 \text{ days}}{\text{year}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = 91.3 \text{ tpy of PM}$$

Potential to Emit from Pet Coke Combustion

$$\frac{45 \text{ tons pet coke}}{\text{day}} \times \frac{3.5 \text{ lbs PM}}{\text{ton pet coke}} \times \frac{365 \text{ days}}{\text{year}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} \times (1 - 99\%) = 0.3 \text{ tpy of PM}$$

Potential to Emit from Pet Coke Lime Kiln

$$91.3 \text{ tpy } PM_{(\text{emissions from natural gas lime kiln})} + 0.3 \text{ tpy } PM_{(\text{emissions from pet coke combustion})} = 91.6 \text{ tpy of PM}$$

Additional PM emissions generated from using pet coke at the facility occur from the delivery and storage of pet coke. The delivery of pet coke to the facility by trucks would result in additional PM emissions due to unpaved roads inside facility boundaries. Potential PM emissions from unpaved roads were calculated using the USEPA's AP-42 emissions factor for PM_{10}. Assuming four delivery trucks daily driving a total of 0.5 mile per round trip and 95% control efficiency (from watering); the estimated emissions are 0.11 tpy PM.

Storage of pet coke at the facility has the potential to increase PM emissions. Potential PM emissions were calculated using the USEPA's AP-42 PM emission factor (for coke handling/ production) of 0.006 lb PM/ton coke (0.003 kilograms per megagram [kg/Mg] coke).

Potential to Emit from Pet Coke Handling/Storage

$$\frac{45 \text{ tons pet coke}}{\text{day}} \times \frac{0.006 \text{ lbs PM}}{\text{ton pet coke}} \times \frac{365 \text{ days}}{\text{year}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = 0.05 \text{ tpy PM}$$

Therefore, the total PM emissions for a pet coke lime kiln are calculated as follows:

$$0.3_{\text{petcoke}} + 91.3_{\text{process}} + 0.05_{\text{handling/storage}} + 0.11_{\text{roads}} = 91.8 \text{ tpy of PM}$$

Based on these estimations, the net increase in PM would be 4.3 tpy and is expressed below:

Net Increase

91.8 tpy of PM – 87.5 tpy of PM = 4.3 tpy of PM

The net increase is below the significant emissions net increase threshold level of 15 tpy; therefore, PSD permitting requirements will not be triggered.

Nitrous Oxides, Carbon Monoxide and Volatile Organic Compounds Emissions

NOx, CO, and VOC emissions factors for pet coke combustion in a lime kiln were obtained from a burner manufacturer. The burner manufacturer's emission factors are based on 80% pet coke being combusted with 20% natural gas. This information was uses a slightly different fuel split ratio (80% pet coke, 20% natural gas) than our

assumption of 75% pet coke and 25% natural gas. However, we believe (1) the burner manufacturer data to be appropriate and (2) the 5% difference in fuel use assumption will not make a material difference in our estimates. Therefore, the potential to emit calculations from these factors will be higher than 75% pet coke being combusted with 25% natural gas. Emission factors for NOx, CO, and VOCs are shown in the table below:

Expected Emissions, Pet Coke Firing Lime Recovery Kiln Burners [1,2]

Constituent	80% Pet Coke[3]/20% Natural Gas
NOx	0.65 lb/MMBtu
CO	0.06 lb/MMBtu
VOC	0.012 lb/MMBtu

1. The above are the contribution from the burner.
2. Secondary air temperature of 750 F.
3. Pet coke with heating value of 14,800 Btu/lb and nitrogen content of 1.5% by weight, dry.

NOx Emissions

Typical NOx from a lime kiln at a 1,000-tpd pulp mill burning natural gas is 175 tpy. This is using the USEPA's AP-42 emission factor of 1 pound NOx/ton pulp and is calculated below:

Actual Emissions Estimate from Natural Gas Lime Kiln

$$\frac{1{,}000 \text{ tons pulp}}{\text{day}} \times \frac{1 \text{ lbs NOx}}{\text{ton pulp}} \times \frac{350 \text{ days}}{\text{year}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = 175 \text{ tpy NOx}$$

The majority of the NOx emissions is from the combustion of natural gas, not the lime kiln process itself. For example, NOx emissions from lime kilns used in cement manufacturing are higher when burning natural gas than when burning coal or oil. According to the AP-42, Chapter 11.6 on lime kilns at cement manufacturing, "Oxides of nitrogen are generated during fuel combustion by oxidation of chemically-bound

nitrogen in the fuel and by thermal fixation of nitrogen in the combustion air. As flame temperature increases, the amount of thermally generated NOx increases. Fuel use affects the quantity and type of NOx generated. For example, in the kiln, natural gas combustion with a high flame temperature and low fuel nitrogen generates a larger quantity of NOx than does oil or coal, which have higher fuel nitrogen but which burn with lower flame temperatures." Conversely, NOx emissions from natural gas combustion in boilers are much lower than NOx emissions from combustion in lime kilns due to the lower flame temperatures.

Potential NOx emissions from a lime kiln burning a pet coke/natural gas mix of 80% pet coke and 20% would be 202.8 tpy and expressed as follows:

Potential to Emit from Pet Coke Lime Kiln

$$\frac{1{,}710\ \text{MMBtu}}{\text{day}} \times \frac{0.65\ \text{lbs NOx}}{\text{MMBtu}} \times \frac{365\ \text{days}}{\text{year}} \times \frac{1\ \text{ton}}{2{,}000\ \text{lbs}} = 202.8\ \text{tpy NOx}$$

Based on these estimations, the net increase in NOx would be 27.8 tpy and is expressed below:

Net Increase

202.8 tpy of NOx – 175.0 tpy of NOx = 27.8 tpy of NOx

Because the increase in NOx emissions are below the significant emissions net increase threshold level of 40 tpy, PSD permitting requirements will not be triggered.

Carbon Monoxide Emissions

Typical CO from a lime kiln burning natural gas is 17.5 tpy. This is using the USEPA's AP-42 emission factor of 0.1 pound CO/ton pulp and is calculated:

Actual Emissions Estimate from Natural Gas Lime Kiln

$$\frac{1{,}000\ \text{tons pulp}}{\text{day}} \times \frac{0.1\ \text{lbs CO}}{\text{ton pulp}} \times \frac{350\ \text{days}}{\text{year}} \times \frac{1\ \text{ton}}{2{,}000\ \text{lbs}} = 17.5\ \text{tpy CO}$$

The majority of the CO emissions is from the combustion of natural gas, not the lime kiln process itself. Potential CO emissions from a lime kiln burning 80% pet coke and 20% natural gas would be 18.7 tpy. The emissions are calculated as follows:

Potential to Emit from Pet Coke Lime Kiln

$$\frac{1{,}710\text{MMBtu}}{\text{day}} \times \frac{0.06\text{ lbs CO}}{\text{MMBtu}} \times \frac{365\text{ days}}{\text{year}} \times \frac{1\text{ ton}}{2{,}000\text{ lbs}} = 18.7\text{ tpy CO}$$

Based on these estimations, the net increase in CO would be 1.2 tpy and is expressed below:

Net Increase

18.7 tpy of CO – 17.5 tpy of CO = 1.2 tpy of CO

Because the increase in CO emissions is below the significant emissions net increase threshold level of 100 tpy, PSD permitting requirements will not be triggered.

Volatile Organic Compound Emissions

The USEPA's AP-42 emission factor for a typical natural gas burning lime kiln is 0.03 pounds VOC/ton pulp (using the USEPA's AP-42 factors for methyl mercaptan, dimethyl sulfide, and dimethyl disulfide with efficient mud washing, optimal kiln operation, and added caustic in scrubbing water). The emissions are calculated as follows:

Actual Emissions Estimate from Natural Gas Lime Kiln

$$\frac{1{,}000\text{ tons pulp}}{\text{day}} \times \frac{0.03\text{ lbs VOC}}{\text{ton pulp}} \times \frac{350\text{ days}}{\text{year}} \times \frac{1\text{ ton}}{2{,}000\text{ lbs}} = 5.25\text{ tpy of VOC}$$

To calculate the VOC emissions from a lime kiln burning 80% pet coke and 20% natural gas, the emission factor for VOCs from a burner manufacturer is used and then added to the VOCs from the process.

Potential to Emit from Lime Kiln

$$\frac{1{,}000\text{ tons pulp}}{\text{day}} \times \frac{0.03\text{ lbs VOC}}{\text{ton pulp}} \times \frac{365\text{ days}}{\text{year}} \times \frac{1\text{ ton}}{2{,}000\text{ lbs}} = 5.48\text{ tpy of VOC}$$

Potential to Emit from Pet Coke Combustion

$$\frac{0.012 \text{ lb VOC}}{\text{MMBtu}} \times \frac{1{,}710\text{MMBtu}}{\text{day}} \times \frac{365 \text{ days}}{\text{year}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = 3.7 \text{ tpy of VOC}$$

Potential to Emit from a Pet Coke Lime Kiln

5.48 tpy of $VOC_{\text{Lime Kiln Process}}$ + 3.7 tpy of $VOC_{\text{Pet Coke Combustion}}$ = 9.18 tpy of VOC

Based on these estimations, the total potential to emit from the pet coke lime kiln would be 9.18 tpy of VOCs. The net increase of VOC emissions is 3.93 tpy and is expressed below:

Net Increase

9.18 tpy of VOC – 5.48 tpy of VOC = 3.93 tpy of VOC

Because the increase in VOC emissions is below the significant emissions net increase threshold level of 40 tpy, PSD permitting requirements will not be triggered.

Carbon Dioxide Emissions

A CO_2 emission factor for both natural gas and pet coke was calculated based on the heating value and carbon content weight percent of the fuel. The calculated emission factors for natural gas and pet coke are 117.6 pounds CO_2/MMBtu and 207.7 pounds CO_2/MMBtu, respectively. Using the calculated emission factors, CO_2 emissions were calculated. Based on these calculations, the typical CO_2 emissions from a lime kiln burning natural gas are 35,192 tpy. The emissions are calculated as follows:

Estimated Actual Emissions from Natural Gas Lime Kiln

$$\frac{117.6 \text{ lb } CO_2}{\text{MMBtu}} \times \frac{1{,}710\text{MMBtu}}{\text{day}} \times \frac{350 \text{ days}}{\text{year}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = 35{,}192 \text{ tpy of } CO_2$$

The CO_2 emissions from a lime kiln burning 75% pet coke and 25% natural gas would be 57,788 tpy CO_2 and is expressed in the following equations:

Potential to Emit from Pet Coke Combustion

$$\frac{207.7 \text{ lb } CO_2}{\text{MMBtu}} \times \left(75\% \times \frac{1{,}710\text{MMBtu}}{\text{day}}\right) \times \frac{365 \text{ days}}{\text{year}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = 48{,}613 \text{ tpy of } CO_2$$

Potential to Emit from Natural Gas Combustion

$$\frac{117.6 \text{ lb } CO_2}{\text{MMBtu}} \times \left(25\% \times \frac{1{,}710 \text{MMBtu}}{\text{day}} \right) \times \frac{365 \text{ days}}{\text{year}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = 9{,}175 \text{ tpy of } CO_2$$

Potential to Emit from Pet Coke Lime Kiln

$$48{,}613 \text{ tpy of } CO_2 \text{ (pet coke)} + 9{,}175 \text{ tpy } CO_2 \text{ (natural gas)} = 57{,}788 \text{ tpy of } CO_2$$

Based on these calculations, the net increase in CO_2 is 22,596 tpy CO_2. This is a net increase of 64%; however, CO_2 emissions are not currently regulated.

Trace Elements

Trace elements will also be emitted from a lime kiln burning pet coke. The estimated potential to emit values from burning pet coke shown in the table below are based on concentrations of trace metals provided in the "PPM" column. The controlled emissions are based on 99% removal efficiency. This removal efficiency is achieved through a combination of trace elements being removed during the lime kiln process itself and the use of PM control devices.

Potential to Emit of Trace Elements from a Pet Coke Lime Kiln

Pet Coke Analysis	PPM	Uncontrolled Potential to Emit (lbs/year)	Controlled Potential to Emit (lbs/year)
Arsenic	0.3	9.9	0.10
Beryllium	1.5	49.5	0.50
Cadmium	0.1	3.3	0.03
Chromium	-	-	-
Copper	3.5	115	1.15
Fluorine	11	361	3.62
Iron	425	13,961	139.62
Lead	0.6	19.7	0.20
Manganese	2.4	78.8	0.79
Mercury	0.001	0.03	-

Pet Coke Analysis	PPM	Uncontrolled Potential to Emit (lbs/year)	Controlled Potential to Emit (lbs/year)
Nickel	350	11,498	114.98
Selenium	2.0	66	0.66
Silica	300	9,855	98.55
Sodium	200	6,570	65.70
Vanadium	700	22,995	229.95

State Requirements

States typically have additional requirements for PM, SO_2, and TRS emissions for new, modified, and reconstructed lime kilns. Most states also regulate air toxic emissions from pulp mills as well.

Air Quality Regulations for Selected States

For the purpose of this paper and based on DTE's request, air quality regulations of Louisiana, Arkansas, Mississippi, and Texas were selected for review and a permitting process comparison. The following table summarizes the air quality requirements for these four states; the state requirements are in addition to the applicable federal requirements.

State	PM Requirements	SO2 Requirements	TRS/H2S Requirements	Permitting Process Time
Louisiana	1 pound PM/ton pulp	No additional state applicable requirement	20 ppm TRS	6 to 9 months
Arkansas	No additional state applicable requirement	No additional state applicable requirement	No additional state applicable requirement	2 to 3 months
Mississippi	No additional state applicable requirement	No additional state applicable requirement	No additional state applicable requirement	6 to 9 months
Texas	No additional state applicable requirement	3.0 lb SO2/MMBtu	20 ppm H_2S	6 to 9 months

These states also have varying levels of air toxics regulations. The regulations, however, tend to limit the concentration of air toxics at the pulp mill fence line and, thus, do not directly regulate emissions from specific equipment in the chemical recovery area of the mill. Each of the four states' air quality requirements are further discussed in the following paragraphs.

Louisiana Air Quality Regulations

Louisiana regulates wood pulping in Title 33, Part III, Chapter 23, Subchapter A § 2301 *Control of Emissions from the Chemical Wood Pulping Industry.*

> "1. Particulate Emissions. Emission of particulate matter shall not exceed the following limits.
>
> c. For lime kilns, not more than 1.0 pound per equivalent pulp ton, (0.5 kilograms per equivalent pulp metric ton).
>
> 3. Total Reduced Sulfur Emissions. Emissions of Total Reduced Sulfur (TRS) from existing sources specified below shall not exceed the following limits:
>
> d. lime kilns, corrected to 10 percent oxygen by volume, 20 ppm"

Arkansas Air Quality Regulations

Arkansas currently does not have any applicable air quality regulations for PM, SO2, or TRS.

Mississippi Air Quality Regulations

Mississippi also regulates new kraft pulping mills as follows: "Kraft Pulping Mills. All sources shall minimize gaseous and particulate emission by use of modern equipment, devices, maintenance, and operating practices in accordance with best current technology. In no case shall emissions exceed the limits set forth in any applicable Federal Standard of Performance for New Stationary Sources."

Texas Air Quality Regulations

Texas regulates emissions of TRS under Title 30 Texas Administrative Code Chapter 112 (30 TAC Chapter §112.51)

"3. For lime kilns: 20 ppm TRS, as H2S on a dry basis, corrected to 10% oxygen"

Sulfur dioxide emissions are regulated under 30 TAC Chapter 112, § 112.8 - Control of Sulfur Dioxide.

"a. Except as provided in subsection (b) of this section, no person may cause, suffer, allow, or permit emissions of sulfur dioxide (SO_2) from any solid fossil fuel-fired steam generator to exceed 3.0 pounds per million Btu (MMBtu) heat input averaged over a three-hour period.

b. No person may cause, suffer, allow, or permit emissions of SO_2 from any solid fossil fuel-fired steam generator located in Milam County, which began operation prior to January 1, 1955, to exceed 4.0 pounds per MMBtu heat input averaged over a three-hour period.

c. Except as provided in subsection (d) of this section, beginning September 30, 1994, solid fossil fuel-fired steam generators of greater than 250 MMBtu heat input per hour which are equipped with SO_2 control equipment shall be equipped with a continuous emissions monitoring system (CEMS) for SO_2. The CEMS shall be installed, calibrated, and operated as specified in 40 Code of Federal Regulations Part 51, Appendix P, hereby incorporated by reference."

Permitting Timelines and Expediting Methods

In general, the time required to obtain a non-PSD (minor source) permit modification from Louisiana, Mississippi, and Texas is approximately six to nine months, with Arkansas' current turnaround time being less than six months. Arkansas permit engineers indicated their typical turnaround for non-PSD permits currently is approximately 60 to 90 days (two to three months).

A description of the permit review time frames and methods to expedite permit reviews are listed below for Louisiana, Arkansas, Mississippi, and Texas.

Louisiana

Agency:	Louisiana Department of Environmental Quality (LDEQ)
Contact:	Kermit Whittenburg, Permit Engineer (225-765-0195)

The typical permit turnaround time from the time the permit application is deemed technically complete to permit issuance is approximately 6 to 9 months. This turnaround time is based on the assumption that the emissions do not exceed the PSD significance levels. The LDEQ has a general operating permit (GOP) program that, if applicable, can reduce the review time by 30 days because no public notice period is required. However, based on the level of emissions increase expected, it does not appear that this modification will fit under the GOP program. The LDEQ has an internal expediting system that utilizes a series of red flags to track these permits. To expedite review of a permit application, the company must initially request this expedited review from the LDEQ permit engineer.

Arkansas

Agency:	Arkansas Department of Environmental Quality (ADEQ)
Contact:	Tom Rheaume (501-682-0762)

The typical permit turnaround time from the time the permit application is deemed technically complete to permit issuance is approximately two to three months. This turnaround time is based on the assumption that the emissions do not exceed the PSD significance levels.

Based on a conversation with Cecil Harrell, Permit Engineer, several permit engineers are available to review permit applications on an expedited schedule. The ADEQ can also authorize pilot testing without the full permit application being approved and the permit issued to the company. A pilot test can be authorized based on submitting general permit and emission information.

Mississippi

Agency:	Mississippi Department of Environmental Quality (MDEQ)
Contact:	Sharon Vinson (601-961-5693)

The typical permit turnaround time from the time the permit application is deemed technically complete to permit issuance is approximately six to nine months. This turnaround time is based on the assumption that the emissions do not exceed the PSD significance levels.

To expedite review of a permit application in Mississippi, the MDEQ recommends a pre-application meeting to discuss the project schedule and importance to the company

and community and to request an expedited review. The MDEQ did indicate that permit modifications take priority over general permit renewal applications.

Texas

Agency:	Texas Commission on Environmental Quality (TCEQ)
Contact:	Wesley Smith (512-239-6143)

The typical permit turnaround time from the time the permit application is deemed technically complete to permit issuance is approximately six to nine months. This turnaround time is based on the assumption that the emissions do not exceed the PSD significance levels.

To expedite review of a permit application in Texas, the TCEQ recommends a pre-application meeting to discuss the project schedule, expected emissions, and importance to the company and community and to request an expedited review. The TCEQ has a GOP program and Permit By Rule (PBR); however, based on the level of emissions increase expected, it does not appear that this modification will fit under either of these programs. The GOP program can reduce review time by eliminating the 30-day public notice period. The PBR regulation consists of the standard exemptions previously utilized by this agency and its predecessor agencies (i.e., TACB, TNRCC).

Conclusions

The following conclusions were reached as result of this study:

- For sources located in attainment areas, the permitting requirements and potential air quality regulations that may be triggered by modifying an existing lime kiln to combust pet coke rather that natural gas are minimal and should not be considered a roadblock when considering alternative fuels. Based on the calculations performed for this paper, the increased emissions of TRS, SO2, PM, NOx, CO, VOCs, and CO2 resulting from a switch to a 75% pet coke and 25% natural gas fuel source would remain below the significant emissions net increase threshold level and, therefore, would trigger state-only and possibly NSPS regulations.
- PSD permitting requirements will likely not be triggered from the potential emission increases associated with the fuel switch.
- The NESHAPs for a new source would not be triggered because modifying a lime kiln to burn pet coke is not considered a modification or a new source under the

NESHAPs requirements. The NESHAPs requirements for existing sources that will become effective March 2004 would apply, but these requirements would apply regardless if a fuel switch occurs.

- NSPS may be triggered if the hourly PM or TRS emission rate increases. This paper is based on the assumption that the existing lime kilns (1) have the necessary control equipment to achieve the NSPS PM emission standards (as there is an existing PM standard under the NESHAPs requirements) and (2) will most likely be able to meet the NSPS TRS requirements using existing current operational controls. Continuous emission monitoring of TRS emissions and monitoring of percent O_2 discharged would also be required if NSPS is triggered.
- State permitting may require air toxic modeling, but the air toxics from a pet coke lime kiln are insignificant and, therefore, should not cause any issues with permitting. Some areas may be reclassified as nonattainment in the near future, which would affect permit applications that have not been approved or finalized prior to the reclassification.
- The use of pet coke fuel should be considered in light of each mill's current operating conditions, actual emissions, and local requirements (especially in an non attainment area). However, based on the emission calculations in this paper, the cost advantages of converting to pet coke outweigh the minor permitting requirements needed for the conversion.

ARCADIS

Appendix A

EPA Green Book

Criteria Pollutant Area Summary Report

As of August 27, 2003

State: Simple Name Pollutant	Nonattainment Area Name	Population (1000s)	Number of Counties	Classification
AK: Anchorage				
CO	Anchorage, AK	255	1	Serious
PM-10	Eagle River, AK	195	1	Moderate
AK: Fairbanks				
CO	Fairbanks, AK	39	1	Serious
AK: Juneau				
PM-10	Juneau, AK	14	1	Moderate
AL: Birmingham				
Ozone	Birmingham, AL	805	2	Marginal
AZ: Ajo				
PM-10	Ajo (Pima County), AZ	8	1	Moderate
SO2	Ajo (Pima County), AZ	8	1	Primary
AZ: Douglas (Cochise County)				
PM-10	Douglas (Cochise County), AZ	16	1	Moderate
SO2	Douglas (Cochise County), AZ	16	1	Primary
AZ: Hayden/Miami				
PM-10	Hayden/Miami, AZ	4	2	Moderate
SO2	Hayden (Pinal County), AZ	2	1	Primary
SO2	Miami (Gila County), AZ	2	1	Primary
AZ: Morenci				
SO2	Morenci (Greenlee County), AZ	9	1	Primary
AZ: Nogales				

Criteria Pollutant Area Summary Report

As of August 27, 2003

State: Simple Name / Pollutant	Nonattainment Area Name	Population (1000s)	Number of Counties	Classification
PM-10	Nogales, AZ	25	1	Moderate
AZ: Paul Spur (Cochise County)				
PM-10	Paul Spur, AZ	1	1	Moderate
AZ: Phoenix				
CO	Phoenix, AZ	3,029	1	Serious
Ozone	Phoenix, AZ	3,029	1	Serious
PM-10	Phoenix, AZ	3,112	2	Serious
AZ: Rillito (Pima County)				
PM-10	Rillito, AZ	1	1	Moderate
AZ: San Manuel				
SO2	San Manual (Pinal County), AZ	8	1	Primary
AZ: Yuma				
PM-10	Yuma, AZ	82	1	Moderate
CA: Chico				
Ozone	Chico, CA	203	1	Section 185A
CA: Imperial County				
Ozone	Imperial Co, CA	142	1	Section 185A
PM-10	Imperial Valley, CA	120	1	Moderate
CA: Los Angeles-South Coast Air Basin				
CO	Los Angeles South Coast Air Basin, CA	14,551	4	Serious
Ozone	Los Angeles South Coast Air Basin, CA	14,551	4	Extreme
PM-10	Los Angeles South Coast Air Basin, CA	14,551	4	Serious
CA: Mono County				
PM-10	Mono Basin, CA	0	1	Moderate
CA: Owens Valley				
PM-10	Owens Valley, CA	7	1	Serious
CA: Sacramento Metro				
Ozone	Sacramento Metro, CA	1,978	6	Severe-15
PM-10	Sacramento Co, CA	1,223	1	Moderate
CA: San Francisco-Bay Area				
Ozone	San Francisco Bay Area, CA	6,542	9	Other
CA: San Joaquin Valley				
Ozone	East Kern Co, CA	111	1	Serious
Ozone	San Joaquin Valley, CA	3,191	8	Severe-15
PM-10	San Joaquin Valley, CA	3,080	7	Serious
CA: Searles Valley				
PM-10	Coso Junction, CA	7	1	Moderate
PM-10	Trona, CA	4	1	Moderate

Criteria Pollutant Area Summary Report

As of August 27, 2003

State: Simple Name Pollutant Nonattainment Area Name	Population (1000s)	Number of Counties	Classification
CA: Southeast Desert Modified AQMA			
Ozone Southeast Desert Modified AQMA, CA	1,024	3	Severe-17
PM-10 Coachella Valley, CA	225	1	Serious
PM-10 San Bernardino Co, CA	199	1	Moderate
CA: Ventura County			
Ozone Ventura Co, CA	753	1	Severe-15*
CA: Yuba City			
Ozone Yuba City, CA	114	2	Section 185A
CO: Fort Collins			
CO Fort Collins, CO	143	1	Moderate <= 12.7ppm
CO: Lamar			
PM-10 Lamar, CO	9	1	Moderate
CO: Steamboat Springs			
PM-10 Steamboat Springs	10	1	Moderate
CT: Greater Connecticut			
Ozone Greater Connecticut, CT	2,532	8	Serious
PM-10 New Haven Co, CT	124	1	Moderate
DC-MD-VA: Washington			
Ozone Washington, DC-MD-VA	4,545	16	Severe-15
DE: Sussex County			
Ozone Sussex Co, DE	157	1	Marginal
GA: Atlanta			
Ozone Atlanta, GA	3,699	13	Serious
GU: Piti Power Plant			
SO2 Piti, GU	1	1	Primary
GU: Tanguisson Power Plant			
SO2 Tanguisson, GU	1	1	Primary
ID: Bonner County (Sandpoint)			
PM-10 Bonner Co (Sandpoint), ID	37	1	Moderate
ID: Pocatello			
PM-10 Portneuf Valley, ID	66	2	Moderate
PM-10 Fort Hall Reservation, ID	1	2	Moderate
ID: Shoshone County			
PM-10 Shoshone Co, ID	10	1	Moderate
PM-10 Pinehurst, ID	2	1	Moderate
IL-IN: Chicago-Gary-Lake County			
Ozone Chicago-Gary-Lake County, IL-IN	8,758	10	Severe-17
PM-10 Lyons Twsp., IL	109	1	Moderate

Criteria Pollutant Area Summary Report

As of August 27, 2003

State: Simple Name / Pollutant	Nonattainment Area Name	Population (1000s)	Number of Counties	Classification
PM-10	Southeast Chicago, IL	3	1	Moderate
SO2	Lake County, IN	485	1	Primary
LA: Baton Rouge				
Ozone	Baton Rouge, LA	636	5	Severe-15
MA: Springfield (W. Mass)				
Ozone	Springfield (Western MA), MA	815	4	Serious
MA-NH: Boston-Lawrence-Worcester (E. Mass)				
Ozone	Boston-Lawrence-Worcester (E. MA), MA-NH	5,883	12	Serious
MD: Baltimore				
Ozone	Baltimore, MD	2,512	6	Severe-15
MD: Kent County and Queen Anne's County				
Ozone	Kent & Queen Anne's Co.s, MD	60	2	Marginal
ME: Knox County and Lincoln County				
Ozone	Knox & Lincoln Co.s, ME	73	2	Moderate*
ME: Lewiston-Auburn				
Ozone	Lewiston-Auburn, ME	221	2	Moderate*
ME: Portland				
Ozone	Portland, ME	488	3	Moderate
MO: Liberty and Arcadia (Iron County)				
Lead	Iron County (part); Liberty and Arcadia, MO	6	1	
MO-IL: St. Louis				
Lead	Jefferson County (part); Herculaneum, MO	2	1	
MT: Billings/Laurel				
SO2	Laurel Area (Yellowstone County), MT	6	1	Primary
MT: Butte				
PM-10	Butte, MT	35	1	Moderate
MT: Columbia Falls (Flathead County)				
PM-10	Columbia Falls, MT	4	1	Moderate
MT: East Helena				
Lead	East Helena Area (Lewis and Clark Co.), MT	2	1	
SO2	East Helena Area (Lewis and Clark Co.), MT	2	1	Primary, Secondary
MT: Kalispell (Flathead County)				
PM-10	Kalispell, MT	15	1	Moderate
MT: Lame Deer				
PM-10	Lame Deer, MT	1	1	Moderate
MT: Libby				
PM-10	Libby, MT	3	1	Moderate
MT: Missoula				

Criteria Pollutant Area Summary Report

As of August 27, 2003

State: Simple Name / Pollutant	Nonattainment Area Name	Population (1000s)	Number of Counties	Classification
CO	Missoula, MT	52	1	Moderate <= 12.7ppm
PM-10	Missoula, MT	52	1	Moderate
MT: Polson (Lake County)				
PM-10	Polson, MT	4	1	Moderate
MT: Ronan (Lake County)				
PM-10	Ronan, MT	3	1	Moderate
MT: Thompson Falls				
PM-10	Sanders County (part);Thompson Falls and vicinity,MT	1	1	Moderate
MT: Whitefish (Flathead County)				
PM-10	Flathead County; Whitefish and vicinity, MT	5	1	Moderate
NH: Cheshire County				
Ozone	Cheshire Co, NH	74	1	Incomplete Data
NH: Manchester				
Ozone	Manchester, NH	365	3	Marginal
NH: Portsmouth-Dover-Rochester				
Ozone	Portsmouth-Dover-Rochester, NH	192	2	Serious
NJ: Atlantic City				
Ozone	Atlantic City, NJ	355	2	Moderate
NM: Anthony				
PM-10	Anthony, NM	3	1	Moderate
NM: Grant County				
SO2	Grant Co, NM	31	1	Primary
NM: Sunland Park				
Ozone	Sunland Park, NM (New Area 1995)	10	1	Marginal
NV: Lake Tahoe Nevada				
CO	Lake Tahoe, NV	29	3	Not Classified
NV: Las Vegas				
CO	Las Vegas, NV	479	1	Serious
PM-10	Clark Co, NV	1,376	1	Serious
NV: Reno				
CO	Reno, NV	179	1	Moderate <= 12.7ppm
Ozone	Reno, NV	339	1	Marginal
PM-10	Washoe Co, NV	339	1	Serious
NY: Albany-Schenectady-Troy				
Ozone	Albany-Schenectady-Troy, NY	892	6	Marginal
NY: Buffalo-Niagara Falls				
Ozone	Buffalo-Niagara Falls, NY	1,170	2	Marginal

Criteria Pollutant Area Summary Report

As of August 27, 2003

State: Simple Name Pollutant Nonattainment Area Name	Population (1000s)	Number of Counties	Classification
NY: Essex County; Whiteface Mountain			
Ozone Essex Co, NY	0	1	Marginal RT
NY: Jefferson County			
Ozone Jefferson Co, NY	112	1	Marginal*
NY: Poughkeepsie			
Ozone Poughkeepsie, NY	600	3	Moderate
NY-NJ-CT: New York-N. New Jersey-Long Island			
Ozone New York-N. New Jersey-Long Island, NY-NJ-CT	19,171	24	Severe-17
PM-10 New York Co, NY	1,537	1	Moderate
OH: Cleveland-Akron-Lorain			
SO2 Cuyahoga Co, OH	1,095	1	Primary
OH: Toledo			
SO2 Lucas Co, OH	455	1	Primary
OH-KY: Cincinnati-Hamilton			
Ozone Cincinnati-Hamilton, OH-KY (OH Portion)	1,514	4	Moderate
OH-PA: Youngstown-Warren-Sharon			
Ozone Youngstown-Warren-Sharon, PA portion	120	1	Marginal
OR: Eugene-Springfield			
PM-10 Eugene-Springfield, OR	179	1	Moderate
OR: Grants Pass			
PM-10 Grants Pass, OR	21	1	Moderate
OR: Klamath Falls			
PM-10 Klamath Falls, OR	20	1	Moderate
OR: LaGrande			
PM-10 LaGrande, OR	12	1	Moderate
OR: Lakeview			
PM-10 Lake Co, OR	3	1	Moderate
OR: Medford			
PM-10 Medford-Ashland, OR	78	1	Moderate
OR: Oakridge			
PM-10 Lane Co, OR	3	1	Moderate
OR: Salem			
CO Salem, OR	135	2	Not Classified
Ozone Salem, OR	345	2	Incomplete Data
PA: Altoona			
Ozone Altoona, PA	129	1	Marginal
PA: Crawford County			
Ozone Crawford Co, PA	90	1	Incomplete Data

Criteria Pollutant Area Summary Report

As of August 27, 2003

State: Simple Name Pollutant	Nonattainment Area Name	Population (1000s)	Number of Counties	Classification
PA: Erie				
Ozone	Erie, PA	281	1	Marginal
PA: Franklin County				
Ozone	Franklin Co, PA	129	1	Incomplete Data
PA: Greene County				
Ozone	Greene Co, PA	41	1	Incomplete Data
PA: Harrisburg-Lebanon-Carlisle				
Ozone	Harrisburg-Lebanon-Carlisle, PA	629	4	Marginal
PA: Johnstown				
Ozone	Johnstown, PA	233	2	Marginal
PA: Juniata County				
Ozone	Juniata Co, PA	23	1	Incomplete Data
PA: Lancaster				
Ozone	Lancaster, PA	471	1	Marginal
PA: Lawrence County				
Ozone	Lawrence Co, PA	95	1	Incomplete Data
PA: Northumberland County				
Ozone	Northumberland Co, PA	95	1	Incomplete Data
PA: Pike County				
Ozone	Pike Co, PA	46	1	Incomplete Data
PA: Pittsburgh-Beaver Valley				
PM-10	Clairton & 4 Boroughs, PA	22	1	Moderate
SO2	Hazelwood, PA	406	1	Primary
SO2	Armstrong Co, PA	5	1	Primary
PA: Schuylkill County				
Ozone	Schuylkill Co, PA	150	1	Incomplete Data
PA: Scranton-Wilkes-Barre				
Ozone	Scranton-Wilkes-Barre, PA	763	5	Marginal
PA: Snyder County				
Ozone	Snyder Co, PA	38	1	Incomplete Data
PA: Susquehanna County				
Ozone	Susquehanna Co, PA	42	1	Incomplete Data
PA: Warren County				
Ozone	Warren Co, PA	44	1	Incomplete Data
SO2	Warren Co, PA	17	1	Primary, Secondary
SO2	Conewango Township (Warren County), PA	4	1	Primary
PA: Wayne County				
Ozone	Wayne Co, PA	48	1	Incomplete Data

Criteria Pollutant Area Summary Report

As of August 27, 2003

State: Simple Name Pollutant	Nonattainment Area Name	Population (1000s)	Number of Counties	Classification
PA: York				
Ozone	York, PA	473	2	Marginal
PA-DE-NJ-MD: Philadelphia-Wilmington-Trenton				
Ozone	Philadelphia-Wilmington-Trenton, PA-NJ-DE-MD	6,311	14	Severe-15
PA-NJ: Allentown-Bethlehem-Easton				
Ozone	Allentown-Bethlehem-Easton, PA-NJ	740	4	Marginal
SO2	Warren Co, NJ	102	1	Primary, Secondary
PR: Guaynabo County				
PM-10	Mun. of Guaynabo, PR	92	1	Moderate
RI: Providence (all of RI)				
Ozone	Providence (All RI), RI	1,048	5	Serious
TX: Beaumont-Port Arthur				
Ozone	Beaumont-Port Arthur, TX	385	3	Moderate
TX: Dallas-Fort Worth				
Ozone	Dallas-Fort Worth, TX	4,590	4	Serious
TX: El Paso				
CO	El Paso, TX	62	1	Moderate <= 12.7ppm
Ozone	El Paso, TX	680	1	Serious
PM-10	El Paso Co, TX	564	1	Moderate
TX: Houston-Galveston-Brazoria				
Ozone	Houston-Galveston-Brazoria, TX	4,670	8	Severe-17
UT: Ogden				
PM-10	Ogden, UT	77	1	Moderate
UT: Provo				
CO	Provo, UT	119	1	Moderate > 12.7ppm
PM-10	Utah Co, UT	369	1	Moderate
UT: Salt Lake City				
PM-10	Salt Lake Co, UT	898	1	Moderate
SO2	Salt Lake Co, UT	898	1	Primary, Secondary
UT: Tooele County				
SO2	Tooele Co, UT	41	1	Primary, Secondary
VA: Smyth County; White Top Mountain				
Ozone	Smyth Co, VA (White Top Mtn)	0	1	Marginal RT
WA: Spokane				
CO	Spokane, WA	323	1	Serious
PM-10	Spokane Co, WA	205	1	Moderate
WA: Wallula				
PM-10	Wallula, WA	0	1	Serious

Criteria Pollutant Area Summary Report

As of August 27, 2003

State: Simple Name Pollutant Nonattainment Area Name	Population (1000s)	Number of Counties	Classification
WA: Yakima			
PM-10 Yakima Co, WA	64	1	Moderate
WI: Milwaukee-Racine			
Ozone Milwaukee-Racine, WI	1,839	6	Severe-17
WV: Follansbee (Brooke County)			
PM-10 Follansbee, WV	3	1	Moderate
WV: New Manchester-Grant Mag. Dis (Hancock County)			
SO2 New Manchester-Grant Mag. Dis (Hancock), WV	9	1	Primary
WV: Weirton			
PM-10 Weirton, WV	15	2	Moderate
SO2 Weirton, WV	17	1	Primary, Secondary
WV-KY: Huntington-Ashland			
SO2 Boyd County (part), KY	50	1	Primary
WY: Sheridan			
PM-10 Sheridan, WY	16	1	Moderate

Note: The attainment status of Ada County (Boise), Idaho area for PM-10 is on hold pending the approval of a concent dec

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