KOOGLER & ASSOCIATES
ENVIRONMENTAL SERVICES
4014 NW THIRTEENTH STREET
GAINESVILLE, FLORIDA 32609
352/377-5822 ▪ FAX/377-7158

187-06-10
May 22, 2006

RECEIVED
MAY 24 2006
BUREAU OF AIR REGULATION

Trina Vielhauer and Al Linero
FDEP
Twin Towers Office Bldg
2600 Blair Stone Road, MS 5500
Tallahassee, FL 32399-2400

Subject: ***Florida Rock Industries***
Thompson S. Baker Cement Plant
Permit Application to Install SNCR on Kiln 1

Dear Trina/Al:

Enclosed are four copies of an air construction permit application (FDEP Form No. 62-210.900(1)) requesting approval to install a Selective Non-Catalytic Reduction System on Kiln 1.

Included in the application package is a report outlining the scope of the application and providing the rationale for the requested project.

I will contact you within a week of your receipt of the application to see if there are any questions or comments. If questions or comments arise prior to my contact, please do not hesitate to contact me at 352-377-5822 or jkoogler@kooglerassociates.com.

Very truly yours,

KOOGLER & ASSOCIATES, INC.

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

JBK/lt

Encl.

cc: Mr. Gary Sauer
Mr. Chris Horner
Mr. Henry Gotsch

Department of Environmental Protection

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MAY 24 2006
BUREAU OF AIR REGULATION

Division of Air Resource Management

APPLICATION FOR AIR PERMIT - LONG FORM

I. APPLICATION INFORMATION

Air Construction Permit – Use this form to apply for any air construction permit at a facility operating under a federally enforceable state air operation permit (FESOP) or Title V air permit. Also use this form to apply for an air construction permit:

- For a proposed project subject to prevention of significant deterioration (PSD) review, nonattainment area (NAA) new source review, or maximum achievable control technology (MACT) review; or
- Where the applicant proposes to assume a restriction on the potential emissions of one or more pollutants to escape a federal program requirement such as PSD review, NAA new source review, Title V, or MACT; or
- Where the applicant proposes to establish, revise, or renew a plantwide applicability limit (PAL).

Air Operation Permit – Use this form to apply for:

- An initial federally enforceable state air operation permit (FESOP); or
- An initial/revised/renewal Title V air operation permit.

Air Construction Permit & Title V Air Operation Permit (Concurrent Processing Option) – Use this form to apply for both an air construction permit and a revised or renewal Title V air operation permit incorporating the proposed project.

To ensure accuracy, please see form instructions.

Identification of Facility

1. Facility Owner/Company Name: **Florida Rock Industries, Inc.**	
2. Site Name: **Thompson S. Baker Cement Plant – Newberry**	
3. Facility Identification Number: **0010087**	
4. Facility Location... Street Address or Other Locator: **4000 NW CR 235** City: **Newberry** County: **Alachua** Zip Code: **32669**	
5. Relocatable Facility? ☐ Yes ☒ No	6. Existing Title V Permitted Facility? ☒ Yes ☐ No

Application Contact

1. Application Contact Name: **John B. Koogler, Ph. D., P.E.**
2. Application Contact Mailing Address... Organization/Firm: **Koogler & Associates, Inc.** Street Address: **4014 NW 13th Street** City: **Gainesville** State: **Florida** Zip Code: **32609**
3. Application Contact Telephone Numbers... Telephone: **(352) 377-5822** ext. Fax: **(352) 377-7158**
4. Application Contact Email Address: jkoogler@koogleraccociates.com

Application Processing Information (DEP Use)

1. Date of Receipt of Application: 5/24/06	3. PSD Number (if applicable):
2. Project Number(s): 0010087-031-AC	4. Siting Number (if applicable):

APPLICATION INFORMATION

Purpose of Application

This application for air permit is submitted to obtain: (Check one)

Air Construction Permit

- [x] Air construction permit.
- [ ] Air construction permit to establish, revise, or renew a plantwide applicability limit (PAL).
- [ ] Air construction permit to establish, revise, or renew a plantwide applicability limit (PAL), and separate air construction permit to authorize construction or modification of one or more emissions units covered by the PAL.

Air Operation Permit

- [ ] Initial Title V air operation permit.
- [ ] Title V air operation permit revision.
- [ ] Title V air operation permit renewal.
- [ ] Initial federally enforceable state air operation permit (FESOP) where professional engineer (PE) certification is required.
- [ ] Initial federally enforceable state air operation permit (FESOP) where professional engineer (PE) certification is not required.

Air Construction Permit and Revised/Renewal Title V Air Operation Permit (Concurrent Processing)

- [ ] Air construction permit and Title V permit revision, incorporating the proposed project.
- [ ] Air construction permit and Title V permit renewal, incorporating the proposed project.

Note: By checking one of the above two boxes, you, the applicant, are requesting concurrent processing pursuant to Rule 62-213.405, F.A.C. In such case, you must also check the following box:

- [ ] I hereby request that the department waive the processing time requirements of the air construction permit to accommodate the processing time frames of the Title V air operation permit.

Application Comment

Application to install a Selective non-Catalytic Reduction (SNCR) system on Kiln No. 1 (EU-003). Details are provided in Attachment 1, hereto.

APPLICATION INFORMATION

Scope of Application

Emissions Unit ID Number	Description of Emissions Unit	Air Permit Type	Air Permit Proc. Fee
003	No. 1 Kiln System	ACM1	NA

Application Processing Fee

Check one: ☐ Attached - Amount: $______________ ☒ Not Applicable

APPLICATION INFORMATION

Owner/Authorized Representative Statement

Complete if applying for an air construction permit or an initial FESOP.

1.	Owner/Authorized Representative Name : **Chris Horner, Plant Manager**
2.	Owner/Authorized Representative Mailing Address... Organization/Firm: **Florida Rock Industries, Inc.** Street Address: **4000 NW CR 235** City: **Newberry** State: **Florida** Zip Code: **32669**
3.	Owner/Authorized Representative Telephone Numbers... Telephone: **353-474-4722 Ext 130** **Fax: 352-472-2449**
4.	Owner/Authorized Representative Email Address: chrish@flarock.com
5.	Owner/Authorized Representative Statement: *I, the undersigned, am the owner or authorized representative of the facility addressed in this air permit application. I hereby certify, based on information and belief formed after reasonable inquiry, that the statements made in this application are true, accurate and complete and that, to the best of my knowledge, any estimates of emissions reported in this application are based upon reasonable techniques for calculating emissions. The air pollutant emissions units and air pollution control equipment described in this application will be operated and maintained so as to comply with all applicable standards for control of air pollutant emissions found in the statutes of the State of Florida and rules of the Department of Environmental Protection and revisions thereof and all other requirements identified in this application to which the facility is subject. I understand that a permit, if granted by the department, cannot be transferred without authorization from the department, and I will promptly notify the department upon sale or legal transfer of the facility or any permitted emissions unit.* [signature] Signature 5/23/06 Date

APPLICATION INFORMATION

Application Responsible Official Certification

Complete if applying for an initial/revised/renewal Title V permit or concurrent processing of an air construction permit and a revised/renewal Title V permit. If there are multiple responsible officials, the "application responsible official" need not be the "primary responsible official."

1. Application Responsible Official Name: **Not Applicable**	
2. Application Responsible Official Qualification (Check one or more of the following options, as applicable): ☐ For a corporation, the president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation, or a duly authorized representative of such person if the representative is responsible for the overall operation of one or more manufacturing, production, or operating facilities applying for or subject to a permit under Chapter 62-213, F.A.C. ☐ For a partnership or sole proprietorship, a general partner or the proprietor, respectively. ☐ For a municipality, county, state, federal, or other public agency, either a principal executive officer or ranking elected official. ☐ The designated representative at an Acid Rain source.	
3. Application Responsible Official Mailing Address... Organization/Firm: Street Address: City: State: Zip Code:	
4. Application Responsible Official Telephone Numbers... Telephone:	
5. Application Responsible Official Email Address:	
6. Application Responsible Official Certification: *I, the undersigned, am a responsible official of the Title V source addressed in this air permit application. I hereby certify, based on information and belief formed after reasonable inquiry, that the statements made in this application are true, accurate and complete and that, to the best of my knowledge, any estimates of emissions reported in this application are based upon reasonable techniques for calculating emissions. The air pollutant emissions units and air pollution control equipment described in this application will be operated and maintained so as to comply with all applicable standards for control of air pollutant emissions found in the statutes of the State of Florida and rules of the Department of Environmental Protection and revisions thereof and all other applicable requirements identified in this application to which the Title V source is subject. I understand that a permit, if granted by the department, cannot be transferred without authorization from the department, and I will promptly notify the department upon sale or legal transfer of the facility or any permitted emissions unit. Finally, I certify that the facility and each emissions unit are in compliance with all applicable requirements to which they are subject, except as identified in compliance plan(s) submitted with this application.* Signature Date	

APPLICATION INFORMATION

Professional Engineer Certification

1.	Professional Engineer Name: **John B. Koogler** Registration Number: **12925**
2.	Professional Engineer Mailing Address... Organization/Firm: **Koogler & Associates, Inc.** Street Address: **4014 NW 13th Street** City: **Gainesville** State: **Florida** Zip Code: **32609**
3.	Professional Engineer Telephone Numbers... Telephone: **(352) 377-5822** ext. Fax: **(352) 377-7158**
4.	Professional Engineer Email Address: jkoogler@kooglerassociates.com
5.	Professional Engineer Statement: *I, the undersigned, hereby certify, except as particularly noted herein*, that:* *(1) To the best of my knowledge, there is reasonable assurance that the air pollutant emissions unit(s) and the air pollution control equipment described in this application for air permit, when properly operated and maintained, will comply with all applicable standards for control of air pollutant emissions found in the Florida Statutes and rules of the Department of Environmental Protection; and* *(2) To the best of my knowledge, any emission estimates reported or relied on in this application are true, accurate, and complete and are either based upon reasonable techniques available for calculating emissions or, for emission estimates of hazardous air pollutants not regulated for an emissions unit addressed in this application, based solely upon the materials, information and calculations submitted with this application.* *(3) If the purpose of this application is to obtain a Title V air operation permit (check here ☐, if so), I further certify that each emissions unit described in this application for air permit, when properly operated and maintained, will comply with the applicable requirements identified in this application to which the unit is subject, except those emissions units for which a compliance plan and schedule is submitted with this application.* *(4) If the purpose of this application is to obtain an air construction permit (check here ☒, if so) or concurrently process and obtain an air construction permit and a Title V air operation permit revision or renewal for one or more proposed new or modified emissions units (check here ☐, if so), I further certify that the engineering features of each such emissions unit described in this application have been designed or examined by me or individuals under my direct supervision and found to be in conformity with sound engineering principles applicable to the control of emissions of the air pollutants characterized in this application.* *(5) If the purpose of this application is to obtain an initial air operation permit or operation permit revision or renewal for one or more newly constructed or modified emissions units (check here ☐, if so), I further certify that, with the exception of any changes detailed as part of this application, each such emissions unit has been constructed or modified in substantial accordance with the information given in the corresponding application for air construction permit and with all provisions contained in such permit.* [signature] 5/22/2006 Signature Date (seal)

* Attach any exception to certification statement.

II. FACILITY INFORMATION

A. GENERAL FACILITY INFORMATION

Facility Location and Type

1. Facility UTM Coordinates... Zone **17** East (km) **346.4** North (km) **3285.7**		2. Facility Latitude/Longitude Latitude (DD/MM/SS) **29/41/37** Longitude (DD/MM/SS) **82/35/11**	
3. Governmental Facility Code: **0**	4. Facility Status Code: **A**	5. Facility Major Group SIC Code: **32**	6. Facility SIC(s): **3241**
7. Facility Comment:			

Facility Contact

1. Facility Contact Name: **Henry Gotsch, Environmental Manager**
2. Facility Contact Mailing Address... Organization/Firm: **Florida Rock Industries, Inc.** Street Address: **4000 NW County Road 235 / P.O. Box 459** City: **Newberry** State: **Florida** Zip Code: **32669**
3. Facility Contact Telephone Numbers: Telephone: **(352) 472-4722 Ext 121.** Fax: **(352) 472-2449**
4. Facility Contact Email Address: hgotsch@flarock.com

Facility Primary Responsible Official

Complete if an "application responsible official" is identified in Section I. that is not the facility "primary responsible official."

1. Facility Primary Responsible Official Name: **Not applicable**
2. Facility Primary Responsible Official Mailing Address... Organization/Firm: Street Address: City: State: Zip Code:
3. Facility Primary Responsible Official Telephone Numbers... Telephone: ( ) - ext. Fax: ( ) -
4. Facility Primary Responsible Official Email Address:

FACILITY INFORMATION

Facility Regulatory Classifications

Check all that would apply *following* completion of all projects and implementation of all other changes proposed in this application for air permit. Refer to instructions to distinguish between a "major source" and a "synthetic minor source."

1. ☐ Small Business Stationary Source	☒ Unknown
2. ☐ Synthetic Non-Title V Source	
3. ☒ Title V Source	
4. ☒ Major Source of Air Pollutants, Other than Hazardous Air Pollutants (HAPs)	
5. ☐ Synthetic Minor Source of Air Pollutants, Other than HAPs	
6. ☒ Major Source of Hazardous Air Pollutants (HAPs)	
7. ☐ Synthetic Minor Source of HAPs	
8. ☒ One or More Emissions Units Subject to NSPS (40 CFR Part 60)	
9. ☐ One or More Emissions Units Subject to Emission Guidelines (40 CFR Part 60)	
10. ☒ One or More Emissions Units Subject to NESHAP (40 CFR Part 61 or Part 63)	
11. ☐ Title V Source Solely by EPA Designation (40 CFR 70.3(a)(5))	
12. Facility Regulatory Classifications Comment: **Field 6: Presumed major for HAPs.** **Field 8: NSPS Subpart F superseded by NESHAP Subpart LLL; NSPS Subpart OOO and NSPS Subpart Y apply to certain affected facilities.** **Field 10: Subject to applicable provisions of NESHAP Subpart LLL.**	

FACILITY INFORMATION

List of Pollutants Emitted by Facility

1. Pollutant Emitted	2. Pollutant Classification	3. Emissions Cap [Y or N]?
PM	**A**	**N**
PM10	**A**	**N**
NOX	**A**	**N**
SO2	**A**	**N**
CO	**A**	**N**
VOC	**A**	**N**
DIOX	**B**	**N**
H114	**B**	**N**
SAM	**B**	**N**

FACILITY INFORMATION

B. EMISSIONS CAPS

Facility-Wide or Multi-Unit Emissions Caps

1. Pollutant Subject to Emissions Cap	2. Facility Wide Cap [Y or N]? (all units)	3. Emissions Unit ID No.s Under Cap (if not all units)	4. Hourly Cap (lb/hr)	5. Annual Cap (ton/yr)	6. Basis for Emissions Cap
Not applicable					

7. Facility-Wide or Multi-Unit Emissions Cap Comment:

C. FACILITY ADDITIONAL INFORMATION

Additional Requirements for All Applications, Except as Otherwise Stated

1.	Facility Plot Plan: (Required for all permit applications, except Title V air operation permit revision applications if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) ☐ Attached, Document ID:__________ ☒ Previously Submitted, Date: 11/2004
2.	Process Flow Diagram(s): (Required for all permit applications, except Title V air operation permit revision applications if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) ☐ Attached, Document ID:__________ ☒ Previously Submitted, Date: 11/2004
3.	Precautions to Prevent Emissions of Unconfined Particulate Matter: (Required for all permit applications, except Title V air operation permit revision applications if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) ☐ Attached, Document ID:__________ ☒ Previously Submitted, Date: 11/2004

Additional Requirements for Air Construction Permit Applications

1.	Area Map Showing Facility Location: ☐ Attached, Document ID:__________ ☒ Not Applicable (existing permitted facility)
2.	Description of Proposed Construction, Modification, or Plant wide Applicability Limit (PAL): ☐ Attached, Document ID: **Attach 1**
3.	Rule Applicability Analysis: ☐ Attached, Document ID: **NA**
4.	List of Exempt Emissions Units (Rule 62-210.300(3), F.A.C.): ☐ Attached, Document ID:__________ ☒ Not Applicable (no exempt units at facility)
5.	Fugitive Emissions Identification: ☐ Attached, Document ID:__________ ☒ Not Applicable
6.	Air Quality Analysis (Rule 62-212.400(7), F.A.C.): ☐ Attached, Document ID:__________ ☒ Not Applicable
7.	Source Impact Analysis (Rule 62-212.400(5), F.A.C.): ☐ Attached, Document ID:__________ ☒ Not Applicable
8.	Air Quality Impact since 1977 (Rule 62-212.400(4)(e), F.A.C.): ☐ Attached, Document ID:__________ ☒ Not Applicable
9.	Additional Impact Analyses (Rules 62-212.400(8) and 62-212.500(4)(e), F.A.C.): ☐ Attached, Document ID:__________ ☒ Not Applicable
10.	Alternative Analysis Requirement (Rule 62-212.500(4)(g), F.A.C.): ☐ Attached, Document ID:__________ ☒ Not Applicable

FACILITY INFORMATION

Additional Requirements for FESOP Applications

1. List of Exempt Emissions Units (Rule 62-210.300(3)(a) or (b)1., F.A.C.): ☐ Attached, Document ID:________ ☒ Not Applicable (no exempt units at facility)

Additional Requirements for Title V Air Operation Permit Applications

1. List of Insignificant Activities (Required for initial/renewal applications only): ☐ Attached, Document ID:________ ☒ Not Applicable (revision application)
2. Identification of Applicable Requirements (Required for initial/renewal applications, and for revision applications if this information would be changed as a result of the revision being sought): ☐ Attached, Document ID:________ ☒ Not Applicable (revision application with no change in applicable requirements)
3. Compliance Report and Plan (Required for all initial/revision/renewal applications): ☐ Attached, Document ID:________ Note: A compliance plan must be submitted for each emissions unit that is not in compliance with all applicable requirements at the time of application and/or at any time during application processing. The department must be notified of any changes in compliance status during application processing.
4. List of Equipment/Activities Regulated under Title VI (If applicable, required for initial/renewal applications only): ☐ Attached, Document ID:________ ☐ Equipment/Activities On site but Not Required to be Individually Listed ☒ Not Applicable
5. Verification of Risk Management Plan Submission to EPA (If applicable, required for initial/renewal applications only) : ☐ Attached, Document ID:__________ ☒ Not Applicable
6. Requested Changes to Current Title V Air Operation Permit: ☐ Attached, Document ID:__________ ☒ Not Applicable

Additional Requirements Comment

III. EMISSIONS UNIT INFORMATION

Title V Air Operation Permit Application - For Title V air operation permitting only, emissions units are classified as regulated, unregulated, or insignificant. If this is an application for Title V air operation permit, a separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each regulated and unregulated emissions unit addressed in this application for air permit. Some of the subsections comprising the Emissions Unit Information Section of the form are optional for unregulated emissions units. Each such subsection is appropriately marked. Insignificant emissions units are required to be listed at Section II, Subsection C.

Air Construction Permit or FESOP Application - For air construction permitting or federally enforceable state air operation permitting, emissions units are classified as either subject to air permitting or exempt from air permitting. The concept of an "unregulated emissions unit" does not apply. If this is an application for air construction permit or FESOP, a separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each emissions unit subject to air permitting addressed in this application for air permit. Emissions units exempt from air permitting are required to be listed at Section II, Subsection C.

Air Construction Permit and Revised/Renewal Title V Air Operation Permit Application – Where this application is used to apply for both an air construction permit and a revised/renewal Title V air operation permit, each emissions unit is classified as either subject to air permitting or exempt from air permitting for air construction permitting purposes and as regulated, unregulated, or insignificant for Title V air operation permitting purposes. **The air construction permitting classification must be used to complete the Emissions Unit Information Section of this application for air permit.** A separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each emissions unit subject to air permitting addressed in this application for air permit. Emissions units exempt from air construction permitting and insignificant emissions units are required to be listed at Section II, Subsection C.

If submitting the application form in hard copy, the number of this Emissions Unit Information Section and the total number of Emissions Unit Information Sections submitted as part of this application must be indicated in the space provided at the top of each page.

A. GENERAL EMISSIONS UNIT INFORMATION

Title V Air Operation Permit Emissions Unit Classification

1. Regulated or Unregulated Emissions Unit? (Check one, if applying for an initial, revised or renewal Title V air operation permit. Skip this item if applying for an air construction permit or FESOP only.)

   [X] The emissions unit addressed in this Emissions Unit Information Section is a regulated emissions unit.

   [ ] The emissions unit addressed in this Emissions Unit Information Section is an unregulated emissions unit.

Emissions Unit Description and Status

1. Type of Emissions Unit Addressed in this Section: (Check one)

   [X] This Emissions Unit Information Section addresses, as a single emissions unit, a single process or production unit, or activity, which produces one or more air pollutants and which has at least one definable emission point (stack or vent).

   [ ] This Emissions Unit Information Section addresses, as a single emissions unit, a group of process or production units and activities which has at least one definable emission point (stack or vent) but may also produce fugitive emissions.

   [ ] This Emissions Unit Information Section addresses, as a single emissions unit, one or more process or production units and activities which produce fugitive emissions only.

2. Description of Emissions Unit Addressed in this Section: **Existing 2650 tpd (clinker) Kiln No. 1 that includes a 156 foot rotary kiln, a 25,300 cu. foot multi-stage combustion (MSC) calciner and a four-stage preheater. Fuels include coal, petroleum coke, WTDF, propane, natural gas, No. 2 fuel oil and flyash at a maximum heat input rate of 364 mmBTU/hr. PM emissions are controlled by an ESP.**

3. Emissions Unit Identification Number: **EU-003**

4. Emissions Unit Status Code: **A**	5. Commence Construction Date: **N/A**	6. Initial Startup Date: **12/1999**	7. Emissions Unit Major Group SIC Code: **32**	8. Acid Rain Unit? [ ] Yes [X] No

9. Package Unit:
   Manufacturer: **N/A** Model Number:

10. Generator Nameplate Rating: MW

11. Emissions Unit Comment: **Application is to install SNCR. The kiln feed rate and clinker production rate are not affected nor are the fuel types or heat input rate. There are no emission rate changes associated with this project. This application therefore addresses only matters that could be affected by SNCR.**

Emissions Unit Control Equipment

1. Control Equipment/Method(s) Description: **Electrostatic Precipitator – High Efficiency** **Selective Non-Catalytic Reduction (SNCR)**
2. Control Device or Method Code(s): **010, 107**

B. EMISSIONS UNIT CAPACITY INFORMATION

(Optional for unregulated emissions units.)

Emissions Unit Operating Capacity and Schedule

1. Maximum Process or Throughput Rate: **191.4 tph, peak hourly preheater feed rate**	
2. Maximum Production Rate: **115.0 tph, peak hourly clinker production rate**	
3. Maximum Heat Input Rate: million Btu/hr **364.0 mmBTU/hr**	
4. Maximum Incineration Rate: pounds/hr **N/A** tons/day	
5. Requested Maximum Operating Schedule: hours/day **24** weeks/year **52**	days/week **7** hours/year **8760**
6. Operating Capacity/Schedule Comment: **Clinker Production:** **115.0 tph, max hourly, 110.3 tph, 24-hr rolling average and 800,000 tpy** **Preheater Feed:** **191.4 tph, max hourly, 183.4 tph, 24-hr rolling average and 1,331,000 tpy** **Clinker production is determined from preheater feed**	

C. EMISSION POINT (STACK/VENT) INFORMATION
(Optional for unregulated emissions units.)

Emission Point Description and Type

1. Identification of Point on Plot Plan or Flow Diagram: **E-21**	2. Emission Point Type Code: **1**

3. Descriptions of Emission Points Comprising this Emissions Unit for VE Tracking:

E-21 Kiln No. 1/Raw Mill Stack

4. ID Numbers or Descriptions of Emission Units with this Emission Point in Common:
EU-002; Raw Mill and Raw Mill Auxiliary Heater discharge through E-21

5. Discharge Type Code: **V**	6. Stack Height: Feet **250**	7. Exit Diameter: Feet **9.42**
8. Exit Temperature: °F **215**	9. Actual Volumetric Flow Rate: Acfm **225,000**	10. Water Vapor: % **12**

11. Maximum Dry Standard Flow Rate: Dscfm **155,000**	12. Nonstack Emission Point Height: Feet **N/A**
13. Emission Point UTM Coordinates... Zone: East (km): North (km):	14. Emission Point Latitude/Longitude... Latitude (DD/MM/SS) Longitude (DD/MM/SS)

15. Emission Point Comment:

EMISSIONS UNIT INFORMATION
Section [1] of [1] Kiln No. 1 EU-003

D. SEGMENT (PROCESS/FUEL) INFORMATION

Segment Description and Rate: Segment __ of __

1. Segment Description (Process/Fuel Type): **Note: All Process and Fuel Segments are unchanged.**		
2. Source Classification Code (SCC):	3. SCC Units:	
4. Maximum Hourly Rate:	5. Maximum Annual Rate:	6. Estimated Annual Activity Factor:
7. Maximum % Sulfur:	8. Maximum % Ash:	9. Million Btu per SCC Unit:
10. Segment Comment:		

Segment Description and Rate: Segment __ of __

1. Segment Description (Process/Fuel Type): **N/A**		
2. Source Classification Code (SCC):	3. SCC Units:	
4. Maximum Hourly Rate:	5. Maximum Annual Rate:	6. Estimated Annual Activity Factor:
7. Maximum % Sulfur:	8. Maximum % Ash:	9. Million Btu per SCC Unit:
10. Segment Comment:		

E. EMISSIONS UNIT POLLUTANTS

List of Pollutants Emitted by Emissions Unit

1. Pollutant Emitted	2. Primary Control Device Code	3. Secondary Control Device Code	4. Pollutant Regulatory Code
PM	010	None	EL
PM10	010	None	EL
SO2	None	None	EL
NOx	107	None	EL
CO	None	None	EL
VOC	None	None	EL
SAM	None	None	EL
DIOX	None	None	EL
H114	None	None	EL

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL, FUGITIVE, AND ACTUAL EMISSIONS

(Optional for unregulated emissions units.)

Potential, Estimated Fugitive, and Baseline & Projected Actual Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **NOx**	2. Total Percent Efficiency of Control: **0-50%**
3. Potential Emissions: **271 lb/hour** **980 tons/year**	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): **N/A** to tons/year	
6. Emission Factor: **2.45 lb/ton clinker** Reference: **BACT**	7. Emissions Method Code: **0**
8.a. Baseline Actual Emissions (if required): **N/A** tons/year	8.b. Baseline 24-month Period: **N/A** From: To:
9.a. Projected Actual Emissions (if required): **N/A** tons/year	9.b. Projected Monitoring Period: **N/A** ☐ 5 years ☐ 10 years

10. Calculation of Emissions:

Hourly: 2.45 lb/ton x 110.3 tph = 271 lb/hr NOx
Annual: 2.45 lb/ton x 800,000 tpy/2000 lb/ton = 980 tpy

11. Potential, Fugitive, and Actual Emissions Comment:

F2. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION - ALLOWABLE EMISSIONS

Complete if the pollutant identified in Subsection F1 is or would be subject to a numerical emissions limitation.

Allowable Emissions Allowable Emissions **1** of **1** **NOx**

1. Basis for Allowable Emissions Code: **OTHER**	2. Future Effective Date of Allowable Emissions: **N/A**
3. Allowable Emissions and Units: **2.45 lb/ton clinker**	4. Equivalent Allowable Emissions: **271.0 lb/hour** **980 tons/year**
5. Method of Compliance: **CEMS**	
6. Allowable Emissions Comment (Description of Operating Method): **Hourly and annual emissions from Permit 0010087-006-AC**	

Allowable Emissions Allowable Emissions __ of __

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units:	4. Equivalent Allowable Emissions: lb/hour tons/year
5. Method of Compliance:	
6. Allowable Emissions Comment (Description of Operating Method):	

H. CONTINUOUS MONITOR INFORMATION

Complete if this emissions unit is or would be subject to continuous monitoring.

Continuous Monitoring System: Continuous Monitor **1** of **1**

1. Parameter Code: **EM**	2. Pollutant(s): **SO2/NOx**
3. CMS Requirement: ☐ Rule [x] Other	
4. Monitor Information... Manufacturer: **Sick AG Environmental Monitoring** Model Number: **GM31-3** Serial Number: **8040 8002**	
5. Installation Date: **12/2000**	6. Performance Specification Test Date: **July, 2005 - Annual RATA**
7. Continuous Monitor Comment: **CEMS required by BACT for NOx**	

Continuous Monitoring System: Continuous Monitor ___ of ___

1. Parameter Code:	2. Pollutant(s):
3. CMS Requirement: ☐ Rule ☐ Other	
4. Monitor Information... Manufacturer: Model Number: Serial Number:	
5. Installation Date:	6. Performance Specification Test Date:
7. Continuous Monitor Comment:	

I. EMISSIONS UNIT ADDITIONAL INFORMATION

Additional Requirements for All Applications, Except as Otherwise Stated

1. Process Flow Diagram (Required for all permit applications, except Title V air operation permit revision applications if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) ☐ Attached, Document ID: ________ [x] Previously Submitted, Date **11/2004**
2. Fuel Analysis or Specification (Required for all permit applications, except Title V air operation permit revision applications if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) ☐ Attached, Document ID: ________ [x] Previously Submitted, Date **11/2004**
3. Detailed Description of Control Equipment (Required for all permit applications, except Title V air operation permit revision applications if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) [x] Attached, Document ID: **Attach. 1** ☐ Previously Submitted, Date ________
4. Procedures for Startup and Shutdown (Required for all operation permit applications, except Title V air operation permit revision applications if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) ☐ Attached, Document ID: ________ ☐ Previously Submitted, Date ________ [x] Not Applicable (construction application)
5. Operation and Maintenance Plan (Required for all permit applications, except Title V air operation permit revision applications if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought) ☐ Attached, Document ID: ________ ☐ Previously Submitted, Date ________ [x] Not Applicable

6. Compliance Demonstration Reports/Records

☐ Attached, Document ID: __________

Test Date(s)/Pollutant(s) Tested: ____

____

☐ Previously Submitted, Date: ________

Test Date(s)/Pollutant(s) Tested: ____

____

☐ To be Submitted, Date (if known): __________

Test Date(s)/Pollutant(s) Tested: ____

____

☒ Not Applicable

Note: For FESOP applications, all required compliance demonstration records/reports must be submitted at the time of application. For Title V air operation permit applications, all required compliance demonstration reports/records must be submitted at the time of application, or a compliance plan must be submitted at the time of application.

7. Other Information Required by Rule or Statute

☐ Attached, Document ID: __________ ☒ Not Applicable

Additional Requirements for Air Construction Permit Applications

1. Control Technology Review and Analysis (Rules 62-212.400(10) and 62-212.500(7), F.A.C.; 40 CFR 63.43(d) and (e)) ☐ Attached, Document ID: ______	☒ Not Applicable
2. Good Engineering Practice Stack Height Analysis (Rule 62-212.400(4)(d), F.A.C., and Rule 62-212.500(4)(f), F.A.C.) ☐ Attached, Document ID: ______	☒ Not Applicable
3. Description of Stack Sampling Facilities (Required for proposed new stack sampling facilities only) ☐ Attached, Document ID: ______	☒ Not Applicable

Additional Requirements for Title V Air Operation Permit Applications - NA

1. Identification of Applicable Requirements ☐ Attached, Document ID: ______	
2. Compliance Assurance Monitoring ☐ Attached, Document ID: ______	☐ Not Applicable
3. Alternative Methods of Operation ☐ Attached, Document ID: ______	☐ Not Applicable
4. Alternative Modes of Operation (Emissions Trading) ☐ Attached, Document ID: ______	☐ Not Applicable

5. Acid Rain Part Application
   - ☐ Certificate of Representation (EPA Form No. 7610-1)
     - ☐ Copy Attached, Document ID:_
   - ☐ Acid Rain Part (Form No. 62-210.900(1)(a))
     - ☐ Attached, Document ID:______ ☐ Previously Submitted, Date:______
   - ☐ Repowering Extension Plan (Form No. 62-210.900(1)(a)1.)
     - ☐ Attached, Document ID:______ ☐ Previously Submitted, Date:______
   - ☐ New Unit Exemption (Form No. 62-210.900(1)(a)2.)
     - ☐ Attached, Document ID:______ ☐ Previously Submitted, Date:______
   - ☐ Retired Unit Exemption (Form No. 62-210.900(1)(a)3.)
     - ☐ Attached, Document ID:______ ☐ Previously Submitted, Date:______
   - ☐ Phase II NOx Compliance Plan (Form No. 62-210.900(1)(a)4.)
     - ☐ Attached, Document ID:______ ☐ Previously Submitted, Date:______
   - ☐ Phase II NOx Averaging Plan (Form No. 62-210.900(1)(a)5.)
     - ☐ Attached, Document ID:______ ☐ Previously Submitted, Date:______
   - ☐ Not Applicable

Additional Requirements Comment

Attachment 1

Scope of Application and Information in Support of Application

KOOGLER & ASSOCIATES INC
ENVIRONMENTAL SERVICES

SCOPE OF APPLICATION

Florida Rock Industries (FRI) operates the Thompson S. Baker Portland cement plant in Alachua County, Florida. The plant is on County Road 235 approximately 2.5 miles northeast of Newberry, Florida. The company has one operating Portland cement production line (Line 1) and was recently permitted to construct a second line (Line 2).

The purpose of this application is to request the installation of Selective Non-Catalytic Reduction (SNCR) on Line 1. Currently, Line 1 has a NOx emission limit of 2.45 pounds per ton of clinker (30-day average). The NOx emission limit is among the lowest permitted NOx emission limits for operating Portland cement plants in the U.S. This limit is met through plant design which incorporates multi-stage combustion and by controlling plant operating parameters.

FRI conducted SNCR tests on Line 1 during the period December 6-11, 2004. The purpose of these tests was to determine the efficacy of SNCR for Line 2 which was being permitted at that time. In addition to the tests demonstrating that the technology was quite effective for controlling NOx emissions, FRI found that by operating the multi-stage combustion system on Kiln 1 under less severe reducing conditions, kiln operations were improved and the potential for plugging in the riser duct/preheater/calciner sections of the plant were reduced. These same results were experienced and reported by Suwannee American Cement, and as a result of favorable SNCR tests conducted by Suwannee American, that company elected to retrofit their existing Kiln No. 1 with SNCR.

The Line 2 permitted by Florida Rock in July 2005 is permitted with SNCR and by this application, FRI is requesting approval to retrofit existing Line 1 with SNCR. The purpose of this retrofit is to allow greater flexibility in plant operations while maintaining compliance with the existing NOx emission limiting standard of 2.45 pounds per ton of clinker, 30-day rolling average. The rationale for this request is discussed in detail in subsequent sections of this Report.

SELECTIVE NON-CATALYTIC REDUCTION FOR LINE 1

When Line 1 was originally permitted in December 1996, the permitted NOx emission limit was 2.80 pounds per ton of clinker, 30-day rolling average, and the clinker production rate was 2300 tons per day. In December 2002, FRI received Permit 0010087-006-AC from FDEP authorizing a production rate increase to 2650 tons per day of clinker. Concurrent with this rate increase was a reduction in the NOx emission limit to 2.45 pounds per ton of clinker, 30-day rolling average. This limit was established so there would be no increase in actual/permitted NOx emissions associated with the production rate increase.

Subsequent to December, 2002, FRI has demonstrated that the NOx emission limit of 2.45 pounds per ton of clinker is achievable through the use of multi-stage combustion which was a design feature of Line 1 and by controlling plant operating parameters.

In 2004, FRI developed plans for the construction of a second production line at the Thompson S. Baker Cement Plant. During the preparation of the permit application for the second line, FRI requested authorization from FDEP for a trial period to evaluate SNCR technology by temporarily installing a SNCR system on Line 1. The authority was granted by Permit 0010087-011-AC issued on November 8, 2004.

Following the same line of reason and for the same purpose, Suwannee American Cement also requested authorization to evaluate SNCR and was granted approval by Permit 1210465-013-AC issued on November 2, 2004. The SNCR testing at Suwannee American Cement (SAC) took place during the period November 8-29, 2004 and the testing at FRI took place during the period December 6-11, 2004. The results of both tests were submitted to FDEP. A copy of the FRI report is included as Attachment A.

The tests at both FRI and SAC demonstrated that SNCR was effective in reducing NOx emissions with minimal ammonia slip. The FRI experience (Attachment A) shows

NOx reductions ranging from 6-82 percent with ammonia/NOx mole ratios ranging from 0.1-1.0. The tests conducted at FRI were conducted both with and without tire derived fuel used as a supplemental fuel.

The actual ammonia injection rates during the FRI tests ranged from 75-600 liters per hour of 10 percent aqua-ammonia. Ammonia slip was observed only when the raw mill was not operating. The peak ammonia concentration in the kiln stack was in the order of 40 ppm.

During the test period, FRI operated for a 16-hour period with a variable ammonia injection rate, maintaining a NOx emission rate of 1.8 pounds per ton of clinker. This limited test demonstrated NOx emissions could be controlled at a set emission rate through a feedback system that automatically varied the ammonia injection rate based on the signal from the NOx CEMS. During this period of the test, the ammonia injection rate ranged from 200-400 liters per hour of 10 percent aqua-ammonia.

The SNCR testing at SAC covered a longer period of time and specifically, a longer period of time (approximately nine days) when the kiln operated a set NOx emission rate maintained by varying the ammonia injection rate. In the case of the SAC tests, the ammonia was injected as 19 percent aqua-ammonia.

The results of the testing at the two plants demonstrated that by operating the kilns under less severe reducing conditions in the riser duct and calciner, the stability of kiln operations was increased. By increasing the oxygen concentration at the kiln exit to 2-3 percent, the kiln operations were more stable and build-up (due to sulfur deposition) was reduced in the riser duct and calciner.

The only drawbacks to SNCR noted during the test periods at the two plants were a possible increase in CO emissions and the aforementioned ammonia slip. Regarding CO emissions, it is expected that once operating experience is gained with SNCR, the higher oxygen levels at the kiln exit will result in lower CO levels at the kiln exit and no measurable change in CO emissions at the kiln stack. As a result, the CO emission limit of 2.50 pounds per ton of clinker for the FRI Line 1 will remain unchanged and actual emissions are not expected to change.

The other disadvantage noted during the two tests was the fact that ammonia slip occurred when the raw mills were not operating. The maximum observed ammonia concentrations in the two stacks were in the range of 40-50 ppm. It is expected that if the mole ratio of ammonia/NOx is maintained below 1.0, ammonia slip will be minimized.

The other factor to consider with SNCR is a failure of the ammonia injection equipment. If this occurs, there will be short-term NOx emissions that exceed the limit of 2.45 pounds per ton of clinker. However, when averaged over the 30-day rolling average period for this limit, no change in emissions is expected.

As stated previously, the installation of the SNCR system at FRI is for purposes of stabilizing kiln operations and providing greater flexibility in operating the kiln. The SNCR installation is not for achieving compliance with the presently permitted NOx emission limit nor is the installation proposed as a means of increasing production. FRI operated at a clinker production factor of 90.2 percent for the period 2004-2005, and at a factor of 94.1 percent during 2003. Any change in clinker production will be based strictly on product demand.

Regarding compliance with the NOx emission limiting standard, FRI has demonstrated over the past three plus years (December 2002-May 2006) that this limit can be (and has been) achieved on a continuous basis. FRI will continue to operate at NOx emission levels (lb/ton clinker) that are in the range in which the plant has operated since December 2002. The installation of the SNCR system will not result in any change in NOx emissions and hence, the emission limit (pounds per ton of clinker) and the mass emission rate (tons per year) will remain unchanged for NOx; and for other regulated pollutants.

Based on the results of the tests conducted at FRI and SAC in November-December 2004, FRI will inject the ammonia between the calciner and the lowest stage cyclone in the preheater. The ammonia will be injected just prior to the gases entering the cyclone; thus allowing as much time as possible after the introduction of tertiary combustion air for the burn-out of CO. This injection location is consistent with the experience of SAC and the experience that Krupp-Polysius has had at other plants. This injection location is also consistent with information provided in a recent paper by Horton, Linero and Miller.[1]

Aqua-ammonia will be used as the source of ammonia. It is anticipated that a 10-19 percent ammonia solution will be utilized. To expedite the installation of the SNCR system, FRI is considering the temporary use of a Polysius system, or equivalent, identical/similar to the system used during the December, 2004 SNCR tests. That system is described in Attachment D.

In the permanent SNCR system, the ammonia will be stored in a double-walled tank having the capacity to handle 110 percent of the tank volume. The tank capacity will be approximately 10,000-15,000 gallons and the tank will be equipped with overfill and leak alarms as well as a level detection system. The tank and associated equipment will be pressure rated and will have means to ensure the vapors from the tank are not vented to the atmosphere. The ammonia will be delivered from the tank to the SNCR system by a dual pump system. This will ensure ammonia delivery even with the failure of one of the pumps. The system will be automated through the existing plant control system, including the NOx CEMS in the Line 1 kiln stack.

[1] *Use of SNCR to Control Emissions of Oxides of Nitrogen from Cement Plants*, presented at IEEE Conference, Dallas, Texas, April 2006.

Attachment A
FRI SNCR Test Report

KOOGLER & ASSOCIATES INC
ENVIRONMENTAL SERVICES

SELECTIVE NON-CATALYTIC REDUCTION TEST REPORT

FLORIDA ROCK INDUSTRIES, INC.
Thompson S. Baker Cement Plant

Facility ID: 0010087
Newberry, Florida

Test Date: December 6-11, 2004
Report Date: February 2, 2005

Koogler & Associates, Inc.
4014 N.W. 13th Street
Gainesville, Florida 32609
(352) 377-5822

187-04-16

KOOGLER & ASSOCIATES
ENVIRONMENTAL SERVICES

To the best of my knowledge, all test data and plant operating data are true and correct and the conclusions presented herein are representative of the data reported.

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

State of Florida
Registration No. 12925

2/2/05

Date

KOOGLER & ASSOCIATES
ENVIRONMENTAL SERVICES

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KOEGLER & ASSOCIATES
ENVIRONMENTAL SERVICES

1.0 INTRODUCTION

Florida Rock Industries, Inc. (FRI) operates the Thompson S. Baker Portland cement plant on CR 235, approximately 3.5 miles north of the city center of Newberry, Florida. The plant is a modern preheater/precalciner Portland cement plant designed by the Polysius Corporation. The plant has a permitted clinker production rate of 2650 tons per day and currently operates under FDEP Permit 0010087-009-AV.

On November 8, 2004 the Florida Department of Environmental Protection (FDEP) issued Air Construction Permit 0010087-011-AC to FRI authorizing tests to assess the viability of Selective Non-Catalytic Reduction (SNCR) for the control of NOx emissions from the cement kiln. These tests were conducted during the period December 6-11, 2004. The Polysius Corporation designed the tests, supplied the equipment for the injection of ammonia and provided personnel to operate the equipment. Additionally, Polysius monitored and reported the ammonia injection rates and the stack gas concentrations of NO and oxygen. FRI personnel were responsible for operating the plant, reporting plant operating data and operating continuous emissions monitors for NOx, SO2, total hydrocarbons, and stack gas flow located in the kiln/raw mill stack. Koogler and Associates, Inc. was the engineer of record for the tests and monitored ammonia and carbon monoxide in the kiln/raw mill stack.

The purpose of the testing was to evaluate the effectiveness of SNCR for NOx reduction. The ammonia used for the tests was a 10 percent (by weight) ammonia/water solution. This solution was injected into the calciner just before the Stage I cyclone (the bottom cyclone) of the preheater. This injection point was selected by Polysius based on experience at other plants. Ammonia was injected at various rates defined by the molar ratio of ammonia to uncontrolled NOx (NO + NO_2) measured in the kiln/raw mill stack. The NOx reductions measured in the kiln/raw mill stack are reported as a function of these molar ratios. The ammonia injection tests were conducted with and without the firing of whole-tire derived fuel at the kiln inlet. The tests demonstrated NOx reduction efficiencies in the range of 6-82 percent with molar ratios in the range of 0.1-1.0.

Additionally, ammonia was injected at varying rates for approximately a 16-hour period to maintain a set stack gas NOx concentration of about 130 ppm (v/v); equivalent to about 1.8 pounds of NOx per ton of clinker. This test demonstrated that a relatively constant NOx stack gas concentration can be maintained with an SNCR system by varying the injection rate of ammonia.

Finally, this report includes a cost estimate for the operation of an SNCR system at the FRI Thompson S. Baker Cement Plant based on the results of this test program.

2.0 THE SNCR PROCESS

The bases of the SNCR process are reactions between ammonia (NH_3) and NO and ammonia and NO_2. In these reactions, the NO and NO_2 are chemically reduced to elemental nitrogen. The governing reactions are as follows:

$$2\ NO + 2\ NH_3 + \frac{1}{2}\ O_2 \rightarrow 2\ N_2 + 3\ H_2O$$

$$6\ NO_2 + 8\ NH_3 \rightarrow 7\ N_2 + 12\ H_2O$$

These reactions take place without the aid of a catalyst and are highly temperature dependent. With the injection of aqua ammonia (an ammonia/water solution), the optimum reaction temperature is approximately 950°C (1750°F). For urea injection, the optimum temperature is in the range of 1000°C (1830°F). For temperatures significantly below these optimum temperatures, some of the ammonia is unreacted and ends up in the raw materials or as ammonia in the stack gas. At temperatures significantly above the temperatures, the ammonia will react with oxygen, increasing the concentrations of NO and NO_2 (referred to as collectively herein as NOx).

The actual reaction between ammonia and NOx first involves the reaction of ammonia with OH^* radicals to produce the NH_2* radical and water. The NH_2*

then reacts with NOx to produce the elemental nitrogen and water as shown in the above equations.

Because of this intermediate reaction, another factor to take into consideration is the presence of carbon monoxide (CO) in the gas stream into which the ammonia is injected. The oxidation of CO to CO_2 involves the same OH^* radicals that react with ammonia to produce the $NH_2{}^*$ radical. Thus, if CO is present, there are competing reactions between the CO and NH_3 for the OH^* radicals and both the oxidation of CO and the creation of $NH_2{}^*$ radicals suffer.

For SNCR to be effective, therefore, there must be enough residence time in the precalciner between the injection of tertiary combustion air and the injection of ammonia for the CO to be substantially oxidized. Considering these factors, Polysius has found that the most favorable point of ammonia injection at this Multi-Stage Combustion (MSC) plant is just prior to the Stage I cyclone of the preheater.

Polysius has found that because of the aforementioned competing reactions between CO and NH_3 for OH^* radicals, the presence of unoxidized carbon monoxide at the point of ammonia injection will result in an increase in carbon monoxide emissions. Polysius has reported (*Latest Developments in NOx Reduction Technology in the Cement Industry*, R. M. Erpelding, Polysius A.G.-

Germany, Cement Plant Environmental Handbook, 2003) that at a molar ratio of ammonia to NOx of 0.8, CO emissions will increase in the range of 0.3-1.0 pounds per ton of clinker. At a molar ratio of 1.0, the CO increase will be in the range of 0.5-1.5 pounds per ton of clinker.

3.0 SNCR TEST EQUIPMENT

Polysius supplied the equipment necessary for injecting the aqua ammonia. For the test at FRI, a 10 percent (by weight) ammonia in water solution was delivered by tank truck. The specific gravity of the solution was 0.9582.

The Polysius equipment consisted of three components; a control panel, the pump station and the injectors. The aqua ammonia was delivered from the tank truck through a 20 stage centrifugal pump and a series of controllers to the injectors at a pressure in the range of 150-220 psig (10-15 bars). Four injector nozzles were placed at 90 degrees to one another in the wall of a circular cross section of the precalciner just upstream of the Stage I cyclone of the preheater. Each injector nozzle created a flat fan-shaped distribution with an aperture angle of 60 degrees. The flat, thin spray of aqua ammonia maximized the interface between the reagent and the gas stream, optimizing the reaction between ammonia and NOx. One to four nozzles were used during the test period depending upon the ammonia injection rate.

The entire system was controlled with a control panel designed to maintain a constant ammonia injection rate or to vary the ammonia injection rate in order to maintain a constant stack gas NOx concentration.

The Polysius controller recorded NO in the stack gas (ppm, dry), stack gas oxygen (volume percent, dry), kiln feed (tons per hour provided by FRI), stack gas flow (from the FRI continuous monitoring system), and the ammonia injection rate, and other operating variables.

4.0 MONITORING

Ammonia injection at varying set molar ratios and ammonia injection at a variable rate to maintain a set stack gas NOx concentration was conducted during the period 0800 hours on December 9, 2004 and 2400 hours on December 10, 2004. During this period of time, there were two periods of disruption in kiln feed (See Figure 1). Ammonia injection tests were not conducted during these periods.

During the periods of testing, the kiln feed rate ranged from 165-175 tons per hour and averaged approximately 170 tons per hour (approximately 102 tph of clinker). During this period of time, the kiln and calciner were both fired with coal. Testing was conducted for about a one hour period between 0800-0900 hours on December 9 while whole-tire derived fuel was fired at the kiln inlet and again between 1400-2400 hours on December 10, 2004 with the firing of tire derived fuel. The tire firing rate typically averages about one ton per hour and provides about seven percent of the total heat input to the pyroprocessing system.

FRI was responsible for monitoring the kiln feed rate, the fuel firing rates, clinker production rate, and stack gas parameters including NOx, SO_2, total hydrocarbons, flow rate and temperature. The stack gas monitoring was conducted with continuous monitors permanently installed in the FRI kiln/raw mill stack. These monitors have been previously certified in accordance with the requirements of 40 CFR 60, Appendices B and F. The FRI NOx data were used for the analyses presented herein.

Polysius was responsible for the ammonia injection and the monitoring of parameters associated with this injection. These parameters included the ammonia injection rate and stack gas concentration of NO, O_2, and CO. The NO, O_2, and CO were measured on a dry basis in a bypass stream from the Koogler and Associates monitors.

Koogler and Associates was responsible as the engineer of record for the testing and monitored ammonia and CO in the stack. The ammonia was monitored continually in accordance with the general procedures of EPA Method 320 (the FTIR method) and CO was measured in accordance with the general procedures of EPA Method 10. Both methods are described in 40 CFR 60, Appendix A. The CO monitored in accordance with Method 10 was used for the analyses reported herein.

The extractive stack gas monitoring (NH_3 and CO) and the continuous in-stack gas monitoring were conducted in the 112-inch diameter, 241-foot high kiln/raw mill stack. The sampling ports are located 15.7 diameters downstream from the point where gases enter the stack and 5.4 diameters below the top of the stack.

5.0 DESCRIPTION OF TESTS

The purpose of the SNCR tests was two fold. First, the NOx (expressed as NO_2) control efficiency was determined as a function of the molar ratio of ammonia to uncontrolled NOx and secondly, a test was conducted with variable ammonia/NOx molar ratios to see if a set stack gas NOx concentration could be maintained.

In both cases, the ammonia was injected into the calciner just prior to the Stage I cyclone of the preheater. At this point, the average temperature during the test period was 862°C (1580°F) and the average pressure was -15 millibars (approximately -6 in. H_20).

For the NOx reduction tests, ammonia was introduced for discrete periods of time ranging from approximately 30-60 minutes. During each injection period, the ammonia injection rate was held constant at a predetermined NH_3/NOx molar ratio. The molar ratios ranged from approximately 0.1-1.0. Tests were conducted with whole-tire derived fuel fired at the inlet of the kiln and again with no whole-tire derived fuel being used.

Before and after each ammonia injection period, the uncontrolled NOx (expressed as NO_2) concentrations were measured in the stack gas. The uncontrolled NOx emission rate for each NH_3 injection period (expressed as pound per ton of clinker) was calculated as the average of the uncontrolled NOx emission rates before and after each injection period. From these data, the NOx reduction for each test period was calculated as:

$$\text{NOx Reduction (\%)} = (NOx_{uncontrolled} - NOx_{controlled}) \times 100 / NOx_{uncontrolled}$$

The molar ratio of ammonia to NOx was calculated as the molar injection rate of ammonia (moles per hour) divided by the uncontrolled NOx emission rate (moles per hour). The molar injection rate of ammonia was based on a 10 percent (by weight) solution of ammonia in water. The specific gravity of this solution was 0.9582. The molar injection rate of ammonia is expressed as moles of NH_3 per hour.

6.0 TEST RESULTS

The results derived from the SNCR testing at FRI are divided into three sections; NOx control as a function of ammonia injection rate, factors associated with carbon monoxide and ammonia emissions and the estimated cost of operating an SNCR system at FRI.

6.1 NOx Control Efficiency

The control of NOx from the kiln/raw mill stack is defined as a function of the uncontrolled emissions and the controlled emissions as defined in Section 5.0. The uncontrolled emissions are based on NOx data collected immediately before and immediately following periods of ammonia injection. During the time periods used for determining uncontrolled NOx emissions, no ammonia was being injected. The controlled emissions were measured and calculated based on data collected during each period of ammonia injection.

The controlled and uncontrolled NOx emissions, expressed both as pounds per ton of clinker and pound-moles (of NO_2) per hour for each period of ammonia injection are summarized in Table 1. One set of data was collected while tire derived fuel was fired at the kiln inlet and the second set of data was collected with no tire derived fuel being burned.

The ammonia injection rate was varied from approximately 75-600 liters per hour during the NOx control efficiency test period. Ammonia was injected at six discrete flow rates while tire derived fuel was being used and six discrete flow rates when no tire derived fuel was being used. The time periods of ammonia injection typically ranged from 30-60 minutes.

The injection rates of ammonia were calculated in terms of moles per hour based on the injection rate of the ten percent aqua ammonia solution (liters per hour), a solution specific gravity of 0.9582 and the molecular weight of ammonia (NH_3; m.w. = 17.

The molar ratio of ammonia to NOx was calculated for each period based on the ammonia injection rate (moles per hour) and the uncontrolled NOx emission rate (moles per hour). The data summarized in Table 1 show that the molar ratios for the two test periods combined ranged from approximately 0.1-1.0.

The NOx control efficiencies range from about seven percent with a molar ratio of 0.09 (with no tire derived fuel) to about 82 percent with a molar ratio of 1.04 (with no tire derived fuel). The control efficiencies with tire derived fuel ranged from about 34-68 percent with molar ratios ranging from 0.12-0.64. The control efficiency data are also shown in graphical form in Figure 2.

It will be noted from the data presented in Figure 2 that the apparent NOx control efficiency is greater when tires are used as a supplemental fuel than when tires are not used. This is particularly true at the lower molar ratios; i.e., between 0.1 and 0.6. At molar ratios of 0.6 and above, the control efficiencies tend to converge.

The difference in control efficiencies with and without tire derived fuel is not readily explained. Looking at the data in Table 1, it will be noted that in general, the uncontrolled NOx emissions during tests without tire derived fuel were greater than the uncontrolled NOx emissions when tire derived fuel was being burned. This would indicate a higher oxygen level at the kiln exit (resulting in higher uncontrolled NOx emissions) when no tire derived fuel was used. This higher oxygen level and the fact that oxygen was not consumed by the combustion of tire derived fuel, would have a tendency to lower CO levels in the calciner and result in a more efficient reaction between ammonia and NOx (See Section 2.0). The control efficiency data are contrary to this.

The data presented in Figures 3 and 4 are the time dependent NOx emission rates, carbon monoxide emission rates, and ammonia injection rates for the SNCR tests when tire derived fuel was being burned (Figure 3a-3c) and when no tire derived fuel was being burned (Figure 4). These data confirm that when the highest uncontrolled NOx emissions occurred (the lower molar ratio injections with no tire derived fuel), the CO emissions were lowest (approximately 10 pound-moles per hour). As the uncontrolled NOx emissions decreased (again with no tire derived) the CO emissions increased to approximately 20 pound-moles per hour. This higher CO emissions rate was typical of most of the ammonia injection periods when tire derived fuel was fired (Figures 3a-3c). Again, the lower levels of CO would indicate the reaction between ammonia and NOx should be more efficient. As stated previously, the data in Figure 2 do not support this.

For purposes of evaluating the effectiveness of SNCR for NOx control under the variable conditions of this cement plant, it is probably best to use the relationship between ammonia injection and NOx control represented by the combined data set shown in Figure 2.

The molar injection of ammonia (pound-moles per hour) is compared with the reduction in NOx in the stack gas (pound-moles per hour) in Figure 5. Again, these data show an apparent greater reduction when tire derived fuel was being burned than when tire derived fuel was not being burned. Again, it is probably best to use the combined data set to represent the functioning of SNCR at this cement plant.

These data show that stack gas NOx is reduced by approximately 0.8 pound-moles with the injection of 1.0 pound-mole of ammonia. The data further show that this relationship is linear over the injection rates tested (molar ratios between 0.1 and 1.0). This indicates an ammonia utilization efficiency of about 80 percent.

The other part of the NOx control efficiency tests was to set a stack gas NOx concentration and to maintain this concentration over an extended period of time by varying the ammonia injection rate. This was done for an approximate 16-hour period between 1800 hours on December 9 and 1000 hours on December 10, 2004. The ammonia injection rate (liters per hour) and the stack gas NOx concentration (ppm) for this period of time are presented in Figure 6. These data show (for the limited period of this test) that it is possible to maintain a relatively constant NOx emission rate by varying the ammonia injection rate.

For the period, the stack gas NOx concentration averaged approximately 130 ppm (equivalent to an NOx emission rate of 1.80 pounds per ton of clinker). The ammonia injection rate for the period ranged from approximately 200-400 liters per hour (equivalent to molar ratios of NH_3/NOx of 0.35-0.70).

6.2 Carbon Monoxide and Ammonia Emissions

Carbon monoxide and ammonia concentrations were measured in the kiln/raw mill stack during the SNCR test period in accordance with the general procedures of EPA Methods 10 and 320, respectively.

6.2.1 Carbon Monoxide Emissions

The carbon monoxide emissions (pound-mole per hour) are presented graphically in Figures 3 and 4 for periods when tire derived fuel was fired and periods when no tire derived fuel was fired. During the period when tire derived fuel was fired (Figure 3a-c) the CO emissions were generally quite variable and no trend between ammonia injection and CO emissions is discernible. During the period when no tire derived fuel was fired (Figure 4) the CO emissions were more stable; especially during the first part of the test period. From these data, a trend of increased CO emissions is observed when ammonia was injected. This is consistent with previous Polysius observations and the reactions between ammonia, CO, and NOx discussed in Section 2.0.

Until more experience is gathered defining the relationship between CO emissions and the injection of ammonia, FRI is comfortable with the CO emission limit proposed in the Air Construction Permit Application for Line No. 2 of 3.6 pounds of CO per ton of clinker.

6.2.2 Ammonia Emissions

The continuous monitoring of ammonia in the kiln/raw mill stack demonstrated that during most periods of time when the raw mill was operating, very little to no ammonia was observed in the stack gas. When the raw mill was not operating, however, the ammonia concentration in the stack gas peaked at approximately 40 ppm (v/v) (See Figure 7a-7b).

This indicates that the unreacted ammonia is absorbed in the raw materials in the raw mill and recirculated until such time that the raw mill shuts down. With the raw mill down, some of the absorbed ammonia is purged from the system.

Due to the limited period of time over which the SNCR tests were conducted at FRI (six days), no definitive conclusion can be reached regarding long-term ammonia emissions during the operation of an SNCR system.

It appears that long term, an ammonia equilibrium would be reached in the plant and that some ammonia slip may occur even with the raw mill running. The majority of the unreacted ammonia would more than likely still be purged during periods when the raw mill is not operating. The long-term effect of ammonia emissions can only be determined with the continuous operation of an SNCR system.

6.3 SNCR Cost Estimate

The SNCR system is relatively easy to install and operate compared with other add-on NOx control systems. Additionally, the operational costs (reagent, variable operating cost, and capital return) are relatively low compared with other systems and the SNCR system offers considerable operating flexibility.

In general, an SNCR system would include:

- an ammonia storage tank,
- a redundant pumping system,
- a control system,
- a set of injectors, and
- the necessary piping.

The system can be installed in a relatively short period of time with minimal plant downtime.

Based on data provided by Polysius and others, the basic fixed costs associated with an SNCR system for the FRI plant are approximately 0.20 dollars per ton of clinker.

The operating cost can vary considerably depending on the source of ammonia and the ammonia injection rate. For purposes of this report, the ammonia considered was a 10 percent aqua ammonia solution at a delivered cost of $145 per ton of solution ($1,450 per ton of ammonia).

The cost data developed from data collected during the SNCR test period at FRI are presented in Figure 8. These data show the costs of an SNCR system (operating cost plus capital recovery) to reduce NOx emissions from a range of uncontrolled emission rates to a range of targeted controlled emission rates. For example, to reduce NOx emissions from 3.5 pounds per ton of clinker (uncontrolled) to 2.0 pounds per ton of clinker (controlled), the cost would be about 0.60 dollars per ton of clinker.

7.0 CONCLUSION

The six-day SNCR test at FRI demonstrated the apparent feasibility of SNCR for controlling NOx emissions from the FRI cement plant. NOx emissions were reduced between 7 and 82 percent with ammonia injected at molar ratios between 0.1 and 1.0. Limited testing also demonstrated that a relatively constant NOx level can be maintained in the kiln/raw mill stack gas by varying the ammonia injection rate.

Factors that could not be totally evaluated because of the short duration of the tests include the long-term ammonia equilibrium in the kiln/raw mill system and the effect of this equilibrium on ammonia emissions both during periods with the raw mill operating and with the raw mill not operating. Other factors that could not be fully evaluated are the long-term effect of ammonia on overall plant operations and the product quality and the effect of operating an SNCR system while using tire derived fuel.

The tests did demonstrate that SNCR is effective for controlling NOx emissions during normal plant operations. Because of the temperature dependency of the reactions associated with SNCR, it is apparent that SNCR will not be effective during plant startups and during periods of plant upset. There will also be periods of downtime for the SNCR system. During periods of startup, plant malfunction and SNCR system downtime, NOx emissions can be controlled using best operating practices and Multi-Stage Combustion.

Table 1. Summary of NOx Control Efficiency Data

Test Condition	Uncontrolled NOx (as NO2)		Controlled NOx (as NO2)		NH3 as NH3	Molar Ratio (NH3/NOx)	NOx Reduction (%)
	(lb/ton Cl)	(lb-mol/hr)	(lb/ton cl)	(lb-mol/hr)	(lb-mol/hr)		lb/ton Cl basis
With Tires	3.10	6.83	2.05	4.63	0.84	0.12	33.9
	2.86	6.03	1.76	3.76	1.14	0.19	38.5
	3.17	7.02	2.07	4.62	1.78	0.25	34.7
	3.20	7.08	1.96	4.34	2.42	0.34	38.8
	3.28	7.34	1.52	3.43	3.73	0.51	53.7
	3.32	7.47	1.06	2.36	4.75	0.64	68.1
Without Tires	4.46	9.54	4.17	9.01	0.88	0.09	6.5
	4.21	9.00	3.46	7.88	1.85	0.21	17.8
	3.74	8.01	2.64	6.09	2.78	0.35	29.4
	3.59	7.68	1.90	4.10	3.64	0.47	47.1
	3.55	7.63	0.87	1.84	6.10	0.80	75.5
	3.17	6.91	0.58	1.26	7.19	1.04	81.7

Figure 1

Kiln Operating Rate During SNCR Tests

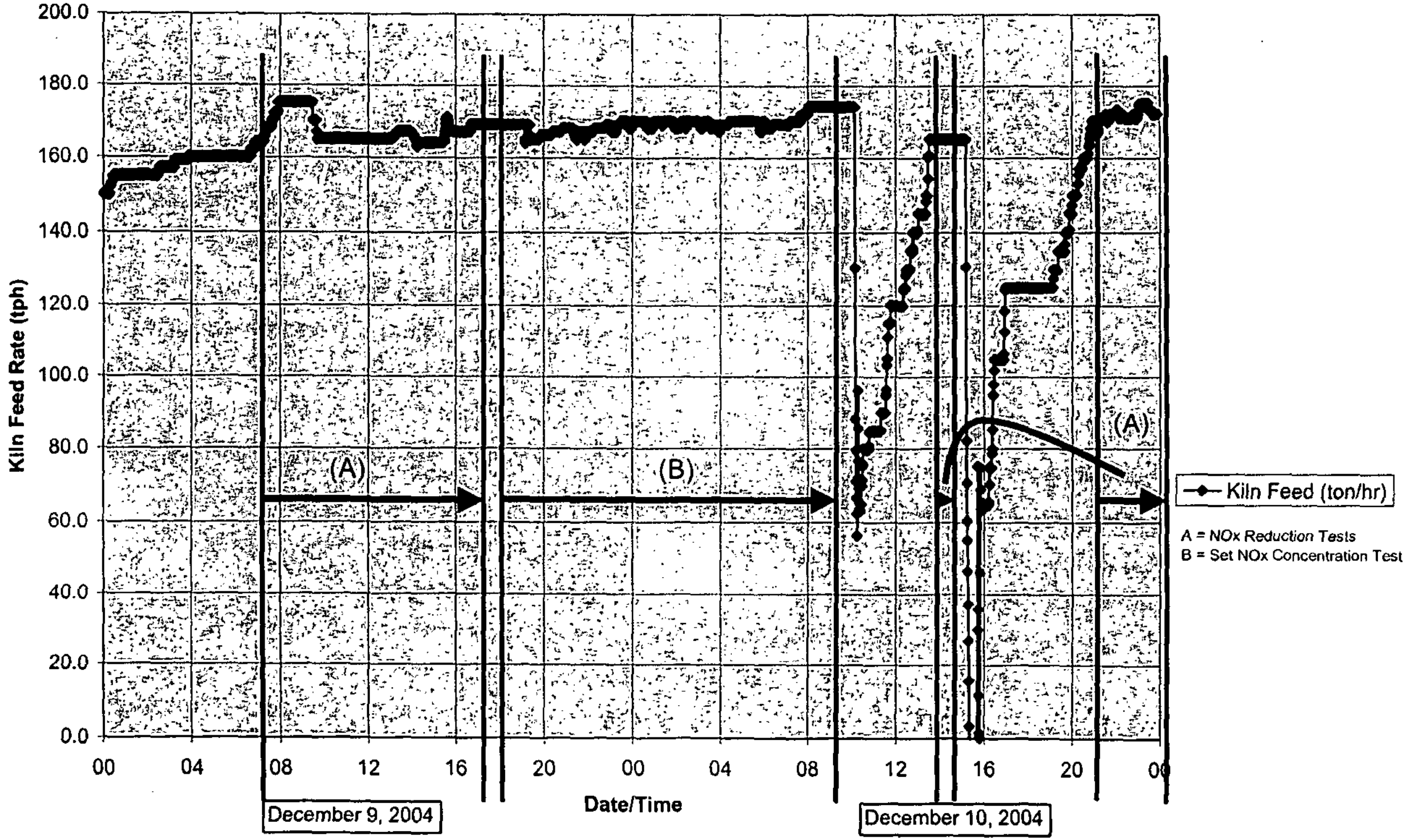


Figure 2

NOx Control Efficiency as a Function of NH3/NOx Molar Ratio

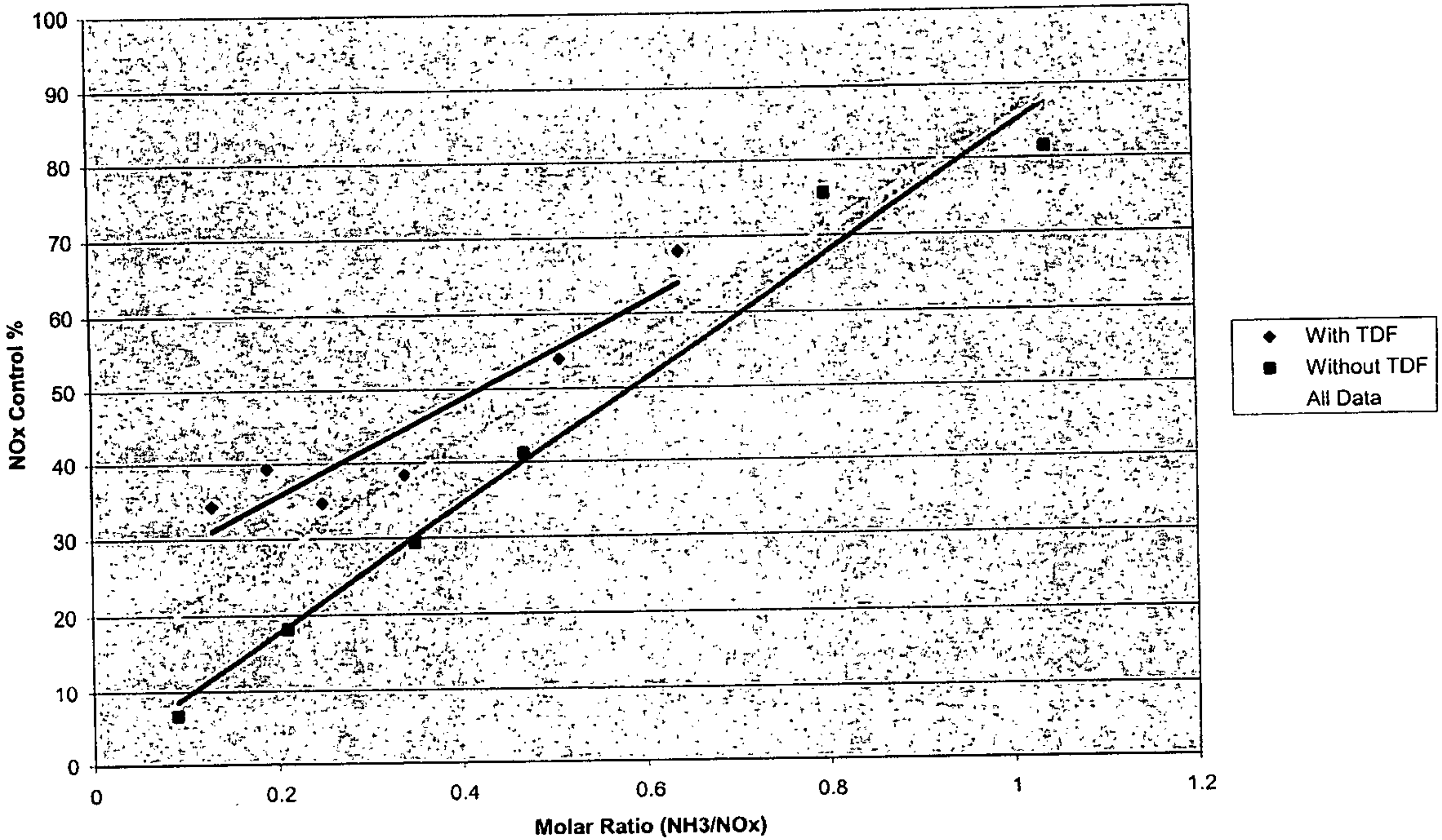
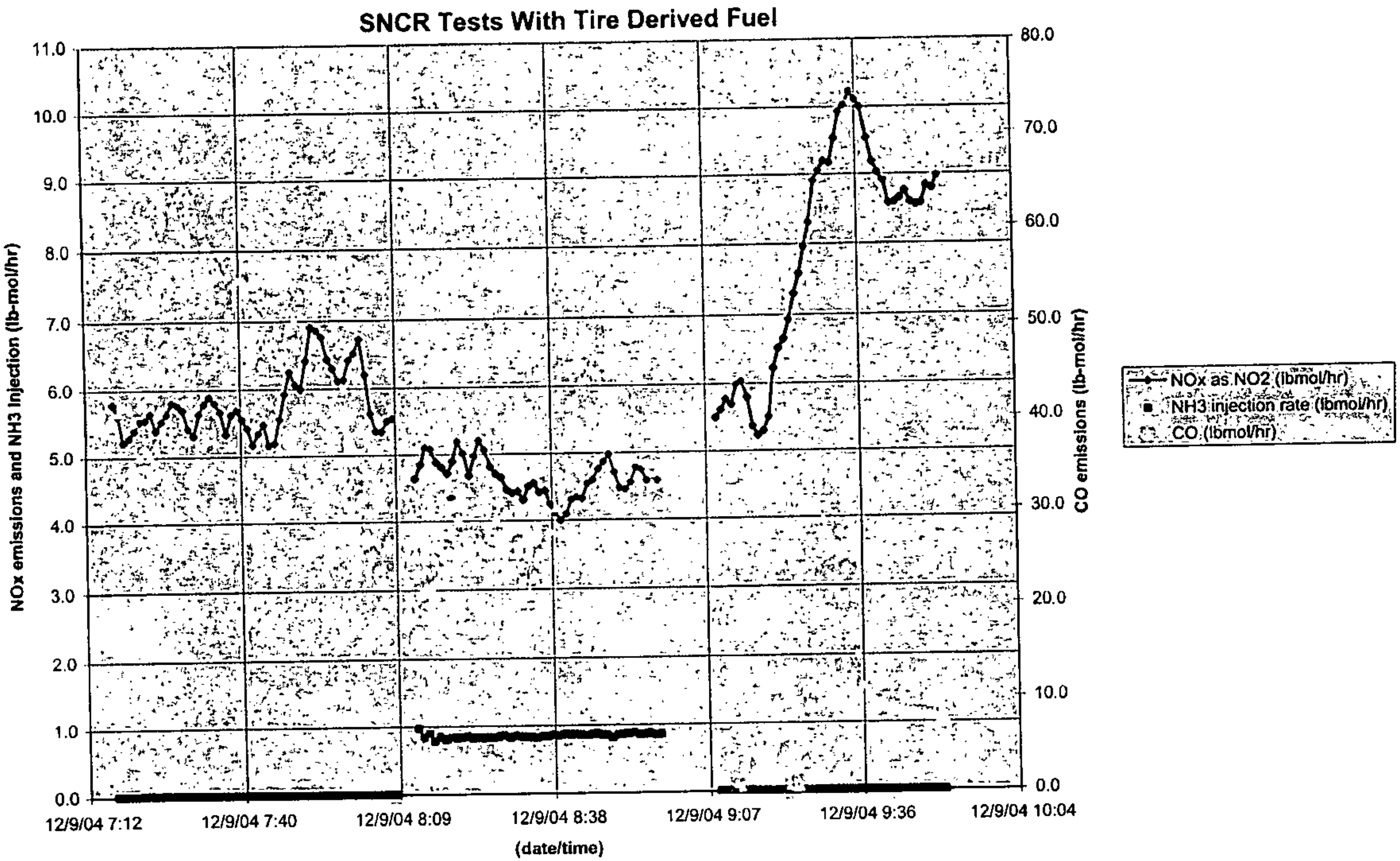


Figure 3a



SNCR Tests With Tire Derived Fuel
NOx emissions and NH3 Injection (lb-mol/hr)
CO emissions (lb-mol/hr)
(date/time)
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
12/9/04 7:12
12/9/04 7:40
12/9/04 8:09
12/9/04 8:38
12/9/04 9:07
12/9/04 9:36
12/9/04 10:04
NOx as NO2 (lbmol/hr)
NH3 injection rate (lbmol/hr)
CO (lbmol/hr)

Figure 3b

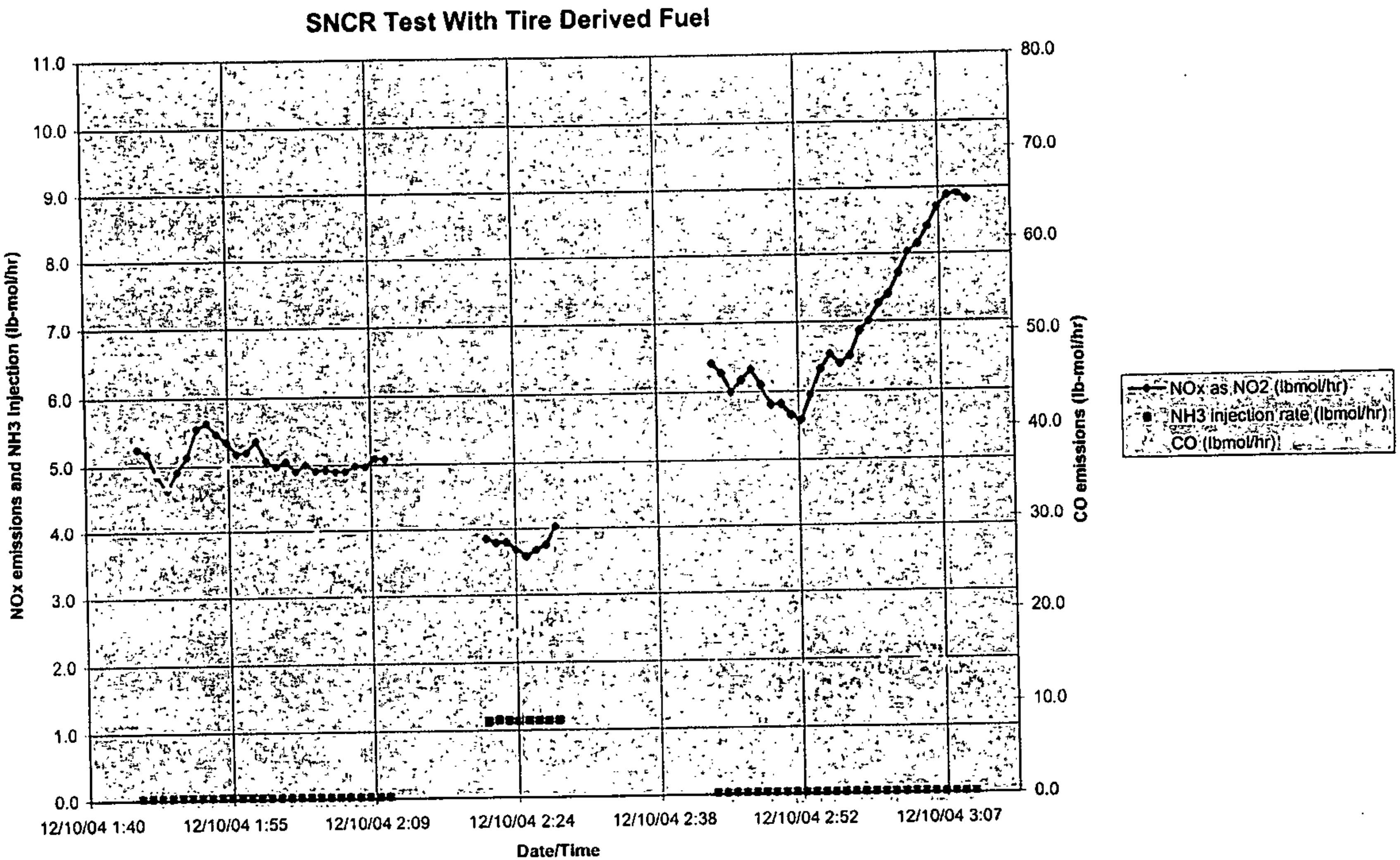

SNCR Test With Tire Derived Fuel
NOx emissions and NH3 Injection (lb-mol/hr)
CO emissions (lb-mol/hr)
Date/Time
12/10/04 1:40
12/10/04 1:55
12/10/04 2:09
12/10/04 2:24
12/10/04 2:38
12/10/04 2:52
12/10/04 3:07
NOx as NO2 (lbmol/hr)
NH3 injection rate (lbmol/hr)
CO (lbmol/hr)

Figure 3c

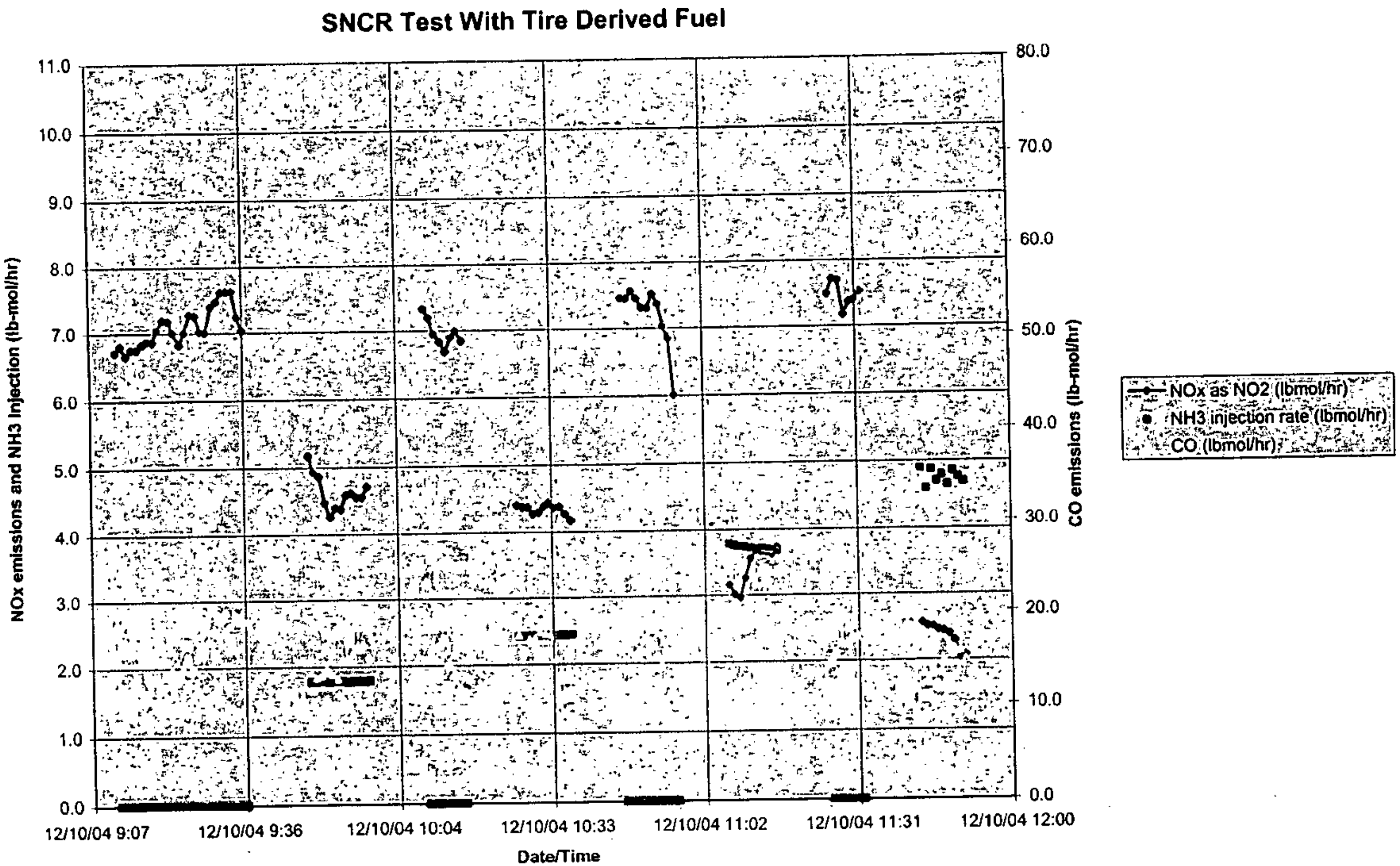

SNCR Test With Tire Derived Fuel
NOx emissions and NH3 Injection (lb-mol/hr)
CO emissions (lb-mol/hr)
Date/Time
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
12/10/04 9:07
12/10/04 9:36
12/10/04 10:04
12/10/04 10:33
12/10/04 11:02
12/10/04 11:31
12/10/04 12:00
NOx as NO2 (lbmol/hr)
NH3 injection rate (lbmol/hr)
CO (lbmol/hr)

Figure 4

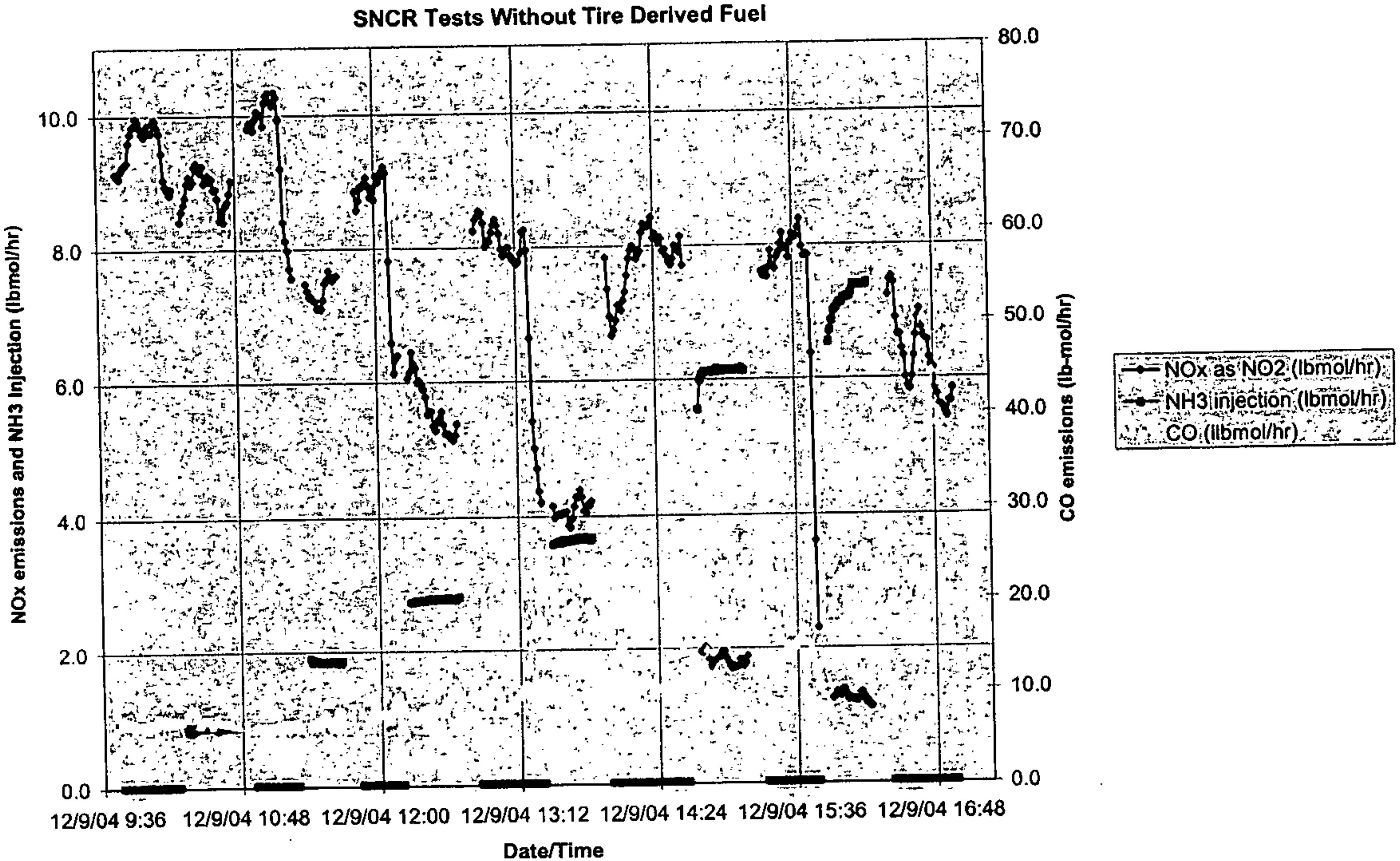

SNCR Tests Without Tire Derived Fuel
NOx emissions and NH3 Injection (lbmol/hr)
CO emissions (lb-mol/hr)
0.0
2.0
4.0
6.0
8.0
10.0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
12/9/04 9:36
12/9/04 10:48
12/9/04 12:00
12/9/04 13:12
12/9/04 14:24
12/9/04 15:36
12/9/04 16:48
Date/Time
NOx as NO2 (lbmol/hr)
NH3 injection (lbmol/hr)
CO (lbmol/hr)

Figure 5

NOx Reduction and Ammonia Injection

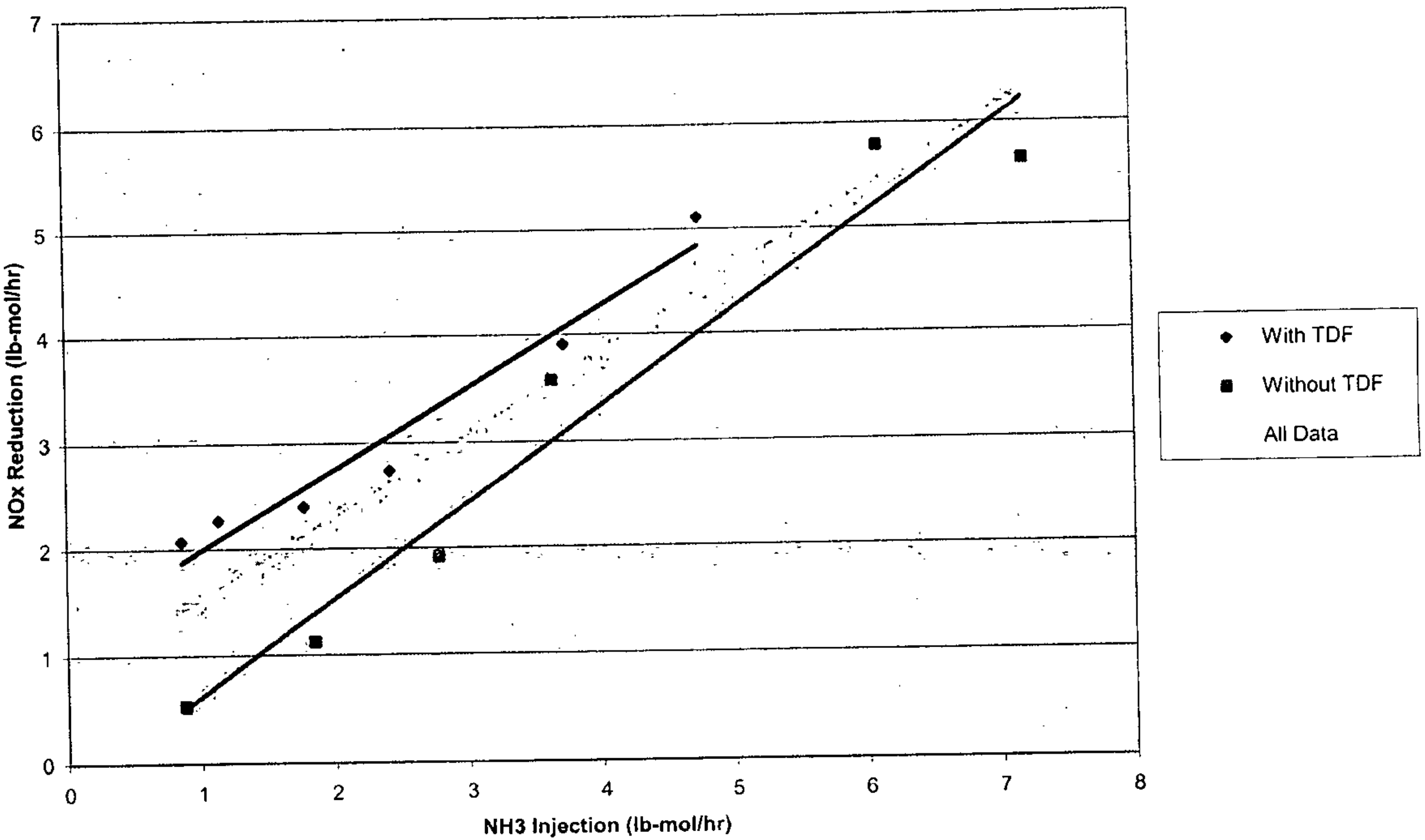


Figure 6

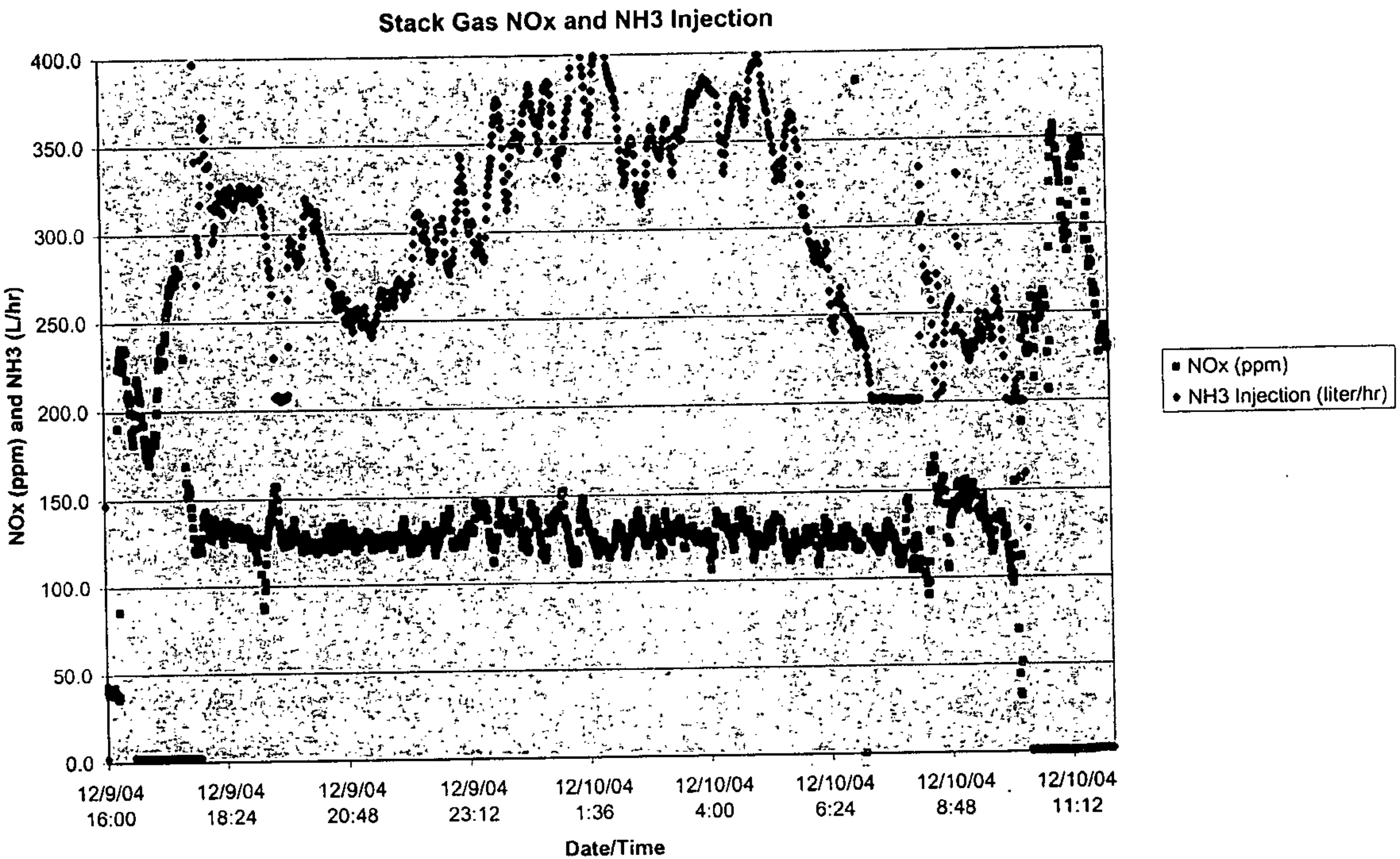
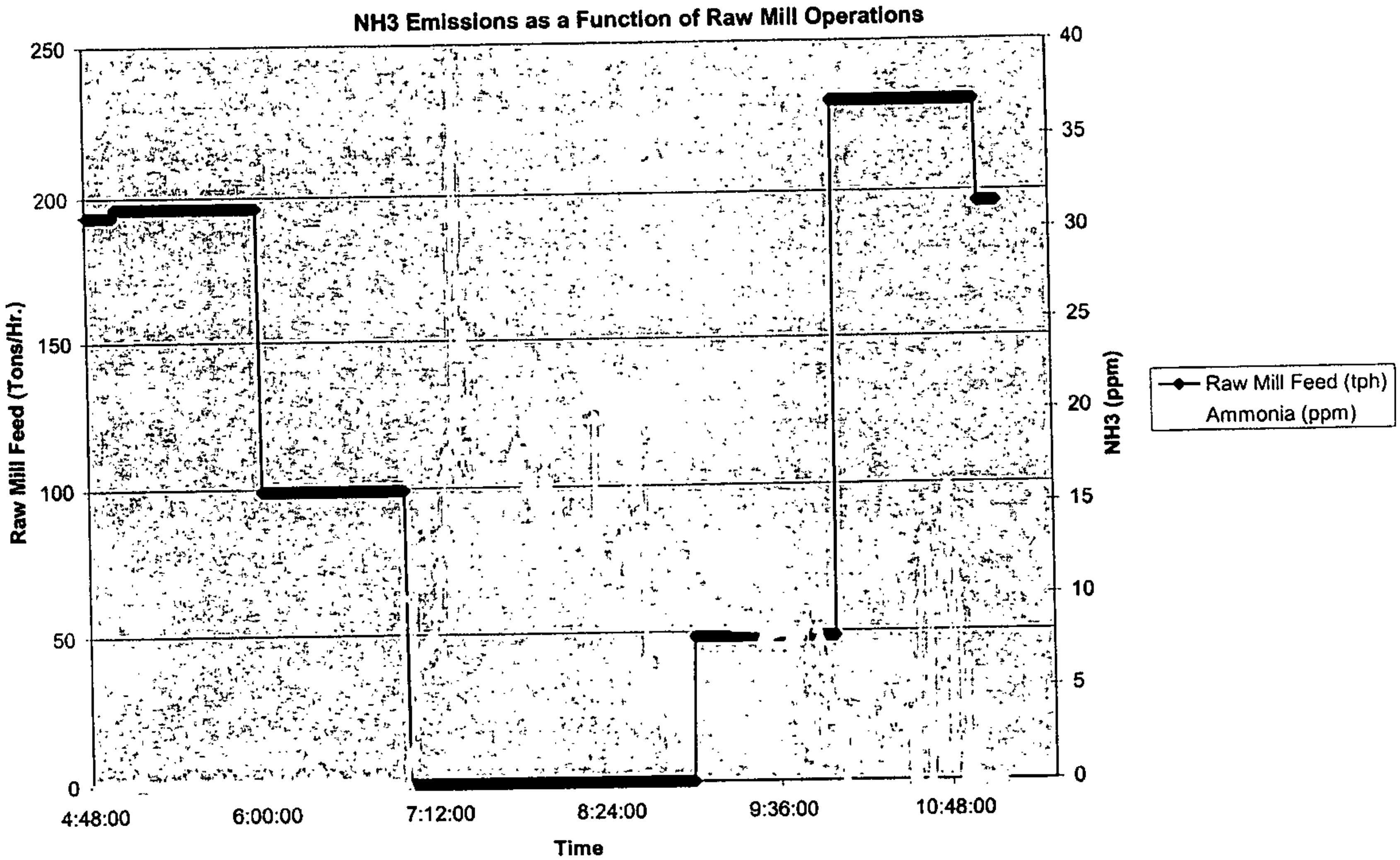

Stack Gas NOx and NH3 Injection
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
NOx (ppm) and NH3 (L/hr)
12/9/04 16:00
12/9/04 18:24
12/9/04 20:48
12/9/04 23:12
12/10/04 1:36
12/10/04 4:00
12/10/04 6:24
12/10/04 8:48
12/10/04 11:12
Date/Time
NOx (ppm)
NH3 Injection (liter/hr)

Figure 7a



NH3 Emissions as a Function of Raw Mill Operations
250
200
150
100
50
0
Raw Mill Feed (Tons/Hr.)
40
35
30
25
20
15
10
5
0
NH3 (ppm)
4:48:00
6:00:00
7:12:00
8:24:00
9:36:00
10:48:00
Time
Raw Mill Feed (tph)
Ammonia (ppm)

Figure 7b

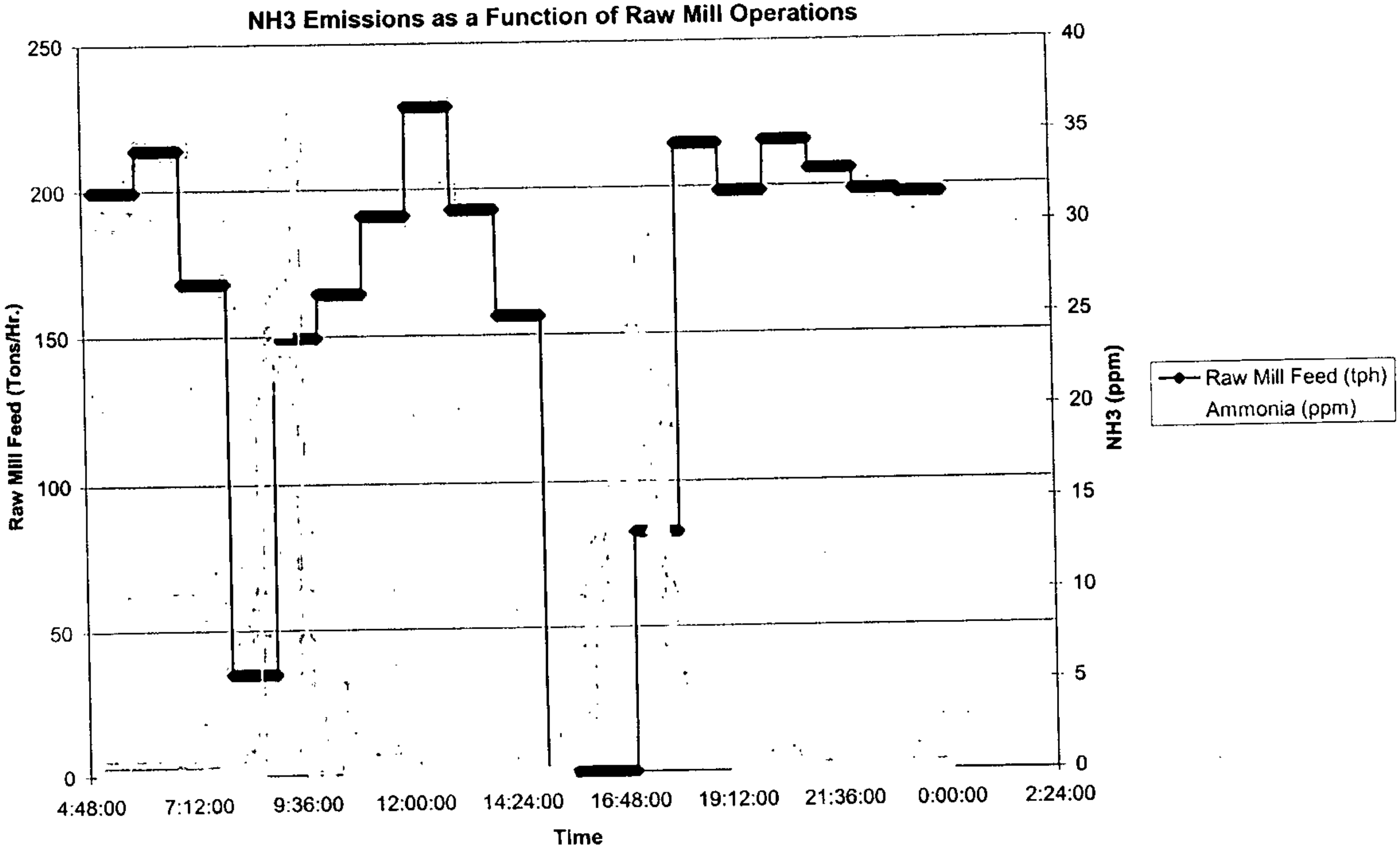

NH3 Emissions as a Function of Raw Mill Operations
250
200
150
100
50
0
Raw Mill Feed (Tons/Hr.)
40
35
30
25
20
15
10
5
0
NH3 (ppm)
4:48:00
7:12:00
9:36:00
12:00:00
14:24:00
16:48:00
19:12:00
21:36:00
0:00:00
2:24:00
Time
Raw Mill Feed (tph)
Ammonia (ppm)

Figure 8
Cost Per Ton of Clinker to Reduce NOx from an Uncontrolled Emission Rate to a Target Rate