

MEMO

TO Mark J Wejkszner, P.E. *M.W. 8/9/2023*
Program Manager
Air Quality Program

From: Neal J Elko *NJE 8/9/2023*
Application Manager
Air Quality Program

Through: Raymond Kempa, P.E. *R.K. 8/9/23*
Environmental Engineering Manager
Air Quality Program

DATE 8/8/2023

RE BEFESA Zinc US Inc
TV Operating Permit No. 13-00001
Palmerton Borough, Carbon County

Procedural History

As part of the Reasonably Available Control Technology (RACT) regulations codified at 25 Pa. Code §§ 129.111—129.115 (relating to additional RACT requirements for major sources of NO_x and VOCs for the 2015 ozone NAAQS) (RACT III), the Pennsylvania Department of Environmental Protection (Department) has established a method under § 129.114(i) (relating to alternative RACT proposal and petition for alternative compliance schedule) for an applicant to demonstrate that the alternative RACT compliance requirements incorporated under § 129.99 (relating to alternative RACT proposal and petition for alternative compliance schedule) (RACT II) for a source that commenced operation on or before October 24, 2016, and which remain in force in the applicable operating permit continue to be RACT under RACT III as long as no modifications or changes were made to the source after October 24, 2016. The date of October 24, 2016, is the date specified in § 129.99(i)(1) by which written RACT proposals to address the 1997 and 2008 8-hour ozone National Ambient Air Quality Standards (NAAQS) were due to the Department or the appropriate approved local air pollution control agency from the owner or operator of an air contamination source located at a major NO_x emitting facility or a major VOC emitting facility subject to § 129.96(a) or (b) (relating to applicability).

The procedures to demonstrate that RACT II is RACT III are specified in § 129.114(i)(1)(i), 129.114(i)(1)(ii) and 129.114(i)(2), that is, subsection (i), paragraphs (1) and (2). An applicant may submit an analysis, certified by the responsible official, that the RACT II permit requirements remain RACT for RACT III by following the procedures established under subsection (i), paragraphs (1) and (2).

Paragraph (1) establishes cost effectiveness thresholds of \$7,500 per ton of NO_x emissions reduced and \$12,000 per ton of VOC emissions reduced as “screening level values” to determine the amount of analysis and due diligence that the applicant shall perform if there is no new pollutant specific air cleaning device, air pollution control technology or technique available at the time of submittal of the analysis. Paragraph (1) has two subparagraphs.

Subparagraph (i) under paragraph (1) specifies that the applicant that evaluates and determines that there is no new pollutant specific air cleaning device, air pollution control technology or technique available at the time of submittal of the analysis and that each technically feasible air cleaning device, air pollution control technology or technique evaluated for the alternative RACT requirement or RACT emission limitation approved by the Department (or appropriate approved local air pollution control agency) under § 129.99(e) had a cost effectiveness equal to or greater than \$7,500 per ton of NO_x emissions reduced or \$12,000 per ton of VOC emissions reduced shall include the following information in the analysis:

- A statement that explains how the owner or operator determined that there is no new pollutant specific air cleaning device, air pollution control technology or technique available.
- A list of the technically feasible air cleaning devices, air pollution control technologies or techniques previously evaluated under RACT II.
- A summary of the economic feasibility analysis performed for each technically feasible air cleaning device, air pollution control technology or technique in the previous bullet and the cost effectiveness of each technically feasible air cleaning device, air pollution control technology or technique as submitted previously under RACT II.
- A statement that an evaluation of each economic feasibility analysis summarized in the previous bullet demonstrates that the cost effectiveness remains equal to or greater than \$7,500 per ton of NO_x emissions reduced or \$12,000 per ton of VOC emissions reduced.

Subparagraph (ii) under paragraph (1) specifies that the applicant that evaluates and determines that there is no new pollutant specific air cleaning device, air pollution control technology or technique available at the time of submittal of the analysis and that each technically feasible air cleaning device, air pollution control technology or technique evaluated for the alternative RACT requirement or RACT emission limitation approved by the Department (or appropriate approved local air pollution control agency) under § 129.99(e) had a cost effectiveness less than \$7,500 per ton of NO_x emissions reduced or \$12,000 per ton of VOC emissions reduced shall include the following information in the analysis:

- A statement that explains how the owner or operator determined that there is no new pollutant specific air cleaning device, air pollution control technology or technique available.
- A list of the technically feasible air cleaning devices, air pollution control technologies or techniques previously evaluated under RACT II.
- A summary of the economic feasibility analysis performed for each technically feasible air cleaning device, air pollution control technology or technique in the previous bullet and the cost effectiveness of each technically feasible air cleaning device, air pollution control technology or technique as submitted previously under RACT II.
- A statement that an evaluation of each economic feasibility analysis summarized in the previous bullet demonstrates that the cost effectiveness remains less than \$7,500 per ton of NO_x emissions reduced or \$12,000 per ton of VOC emissions reduced.
- A new economic feasibility analysis for each technically feasible air cleaning device, air pollution control technology or technique.

Paragraph (2) establishes the procedures that the applicant that evaluates and determines that there is a new or upgraded pollutant specific air cleaning device, air pollution control technology or technique available at the time of submittal of the analysis shall follow.

- Perform a technical feasibility analysis and an economic feasibility analysis in accordance with § 129.92(b) (relating to RACT proposal requirements).

- Submit that analysis to the Department (or appropriate approved local air pollution control agency) for review and approval.

The applicant shall also provide additional information requested by the Department (or appropriate approved local air pollution control agency) that may be necessary for the evaluation of the analysis submitted under § 129.114(i).

Facility details

Befesa Zinc US Inc. operates a high-temperature metals recovery plant located at 900 Delaware Avenue, Palmerton, Carbon County, Pennsylvania (the "Facility"). The Facility uses four kilns (identified in the Facility's Title V permit 13-00001 as Kilns 1,2,5 and 6 respectively) to extract metal byproducts from raw materials through a high-temperature exothermic reaction process.

Since the submittal of the RACT II analysis, Kiln #6 has been decommissioned and Kiln #1 has discontinued operation in the calcining mode. The three operating Kilns #1, #2 and #5 only operate in the Waelzing Mode. In the Waelzing process, zinc bearing materials are reduced in a rotary kiln using carbon (coke or coal) and supplemented with natural gas to form an elemental zinc vapor that is then later oxidized to form Crude Zinc Oxide (CZO). The CZO is then collected in a fabric filter that is classified as a product collector. A by-product from this recycling process is known as Iron Rich Material (IRM) that is also used in a number of applications.

The facility has potential to emit VOC emissions less than 50 tons per year (tpy); therefore, is classified as a minor VOC facility under the RACT III rule, and hence is exempted from this rule for VOC emission sources. Potential NOx emissions exceed 100 tpy, subjecting the NOx sources at the facility to the RACT III NOx requirements. There are no new emission sources or changes to existing sources after October 24, 2016.

The EPA approved RACT II case-by-case RACT requirements for the facility on January 26, 2022 in 87 FR 3934.

The applicant submitted their RACT II equals RACT III proposal on December 28, 2022. Revisions were submitted on May 19, 2023.

List of sources(s) subject to § 129.114(i) - RACT II determination assures compliance with RACT III requirements

TABLE 1 - Sources

Source ID	Source Name	RACT III provision*
149	Waelzing Kiln #1	129.114(i)(1)(i)
150	Waelzing Kiln #2	129.114(i)(1)(i)
152	Waelzing Kiln #5	129.114(i)(1)(i)

The RACT II determination/requirements can be found in the attached RACT II review memo and at the following link:

[EPA Approved Pennsylvania Source-Specific Requirements | US EPA](#)

RACT III analysis performed by the Department (or appropriate approved local air pollution control agency) under § 129.114(j)(1):

In Befesa's RACT III submittal, the facility re-evaluated the RACT II determinations and have concluded that there are no new technologies that can further reduce the NO_x emissions from the three operating kilns. To this extent the following technologies were evaluated:

a. Combustion Controls

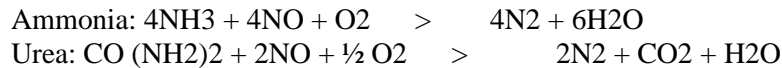
In the Waelz Kiln, the burner is used to pre-heat the kiln during startup until a temperature of 650 - 700°C (1202°F - 1292°F) is achieved in the kiln. The burner is also used periodically in the Waelz Kilns during their operation in order to maintain a kiln discharge temperature at around 1050 -1100°C (1922°F - 2012°F). Heat input from the Waelz Kiln burners is not required to continuously maintain kiln temperatures since kiln temperature is inherently maintained from the heat balance resulting from the reaction of coke and zinc bearing feed materials within the kiln. There are two principal mechanisms for NO_x formation in the kilns, including "fuel" NO_x and "thermal" NO_x. Fuel NO_x, which results from the presence of nitrogen in fuel sources, can result from oxidation of gas used to fire the kilns, and oxidation of coke/coal fed to the kiln. Natural gas consumed at the burner contains little nitrogen, if any, therefore fuel NO_x formation from natural gas consumption at the burner is negligible. Coke/coal contains nitrogen that when oxidized is a source for fuel NO_x formation. Thermal NO_x formation results from oxidation of atmospheric nitrogen contained in the gas-air mixture at temperatures above 1982°C (3599°F) at the burner flame. The factors influencing thermal NO_x formation include temperature, air to fuel ratio, and residence time within the combustion zone. The cumulative time of burner use in each Waelz kiln for start-up and routine temperature maintenance (trimming) is less than 2000 hours per year, with most of the burner hours from trimming use. Trimming occurs for brief periods of time and uses about 30% of the maximum thermal capacity while start-ups typically occur over a period of 16 to 24 hours and use 50 - 100% burner thermal capacity.

The kiln burners at Palmerton are operated in a fuel rich mode which produces a shorter and more luminous flame resulting in a reduced rate of potential NO_x generation during fuel combustion.

Burners at the facility are maintained and operated in accordance with manufacturer's recommendations. In addition, good operating practices for Waelzing Kiln operations are practiced by Befesa at this location.

b. Selective Non-Catalytic Reduction (SNCR)

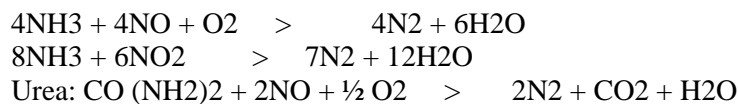
Selective non-catalytic reduction (SNCR) involves the direct injection of ammonia (NH₃) or urea (CO (NH₂)₂) in the flue gas stream where temperatures are approximately 1500°F to 1900°F. The ammonia or urea reacts with the NO_x in the flue gas to produce N₂ and water vapor. The NO_x reduction reactions in an SNCR system are driven by the thermal decomposition of ammonia or urea and the subsequent reduction of NO_x. SNCR systems do not employ a catalyst to promote these reactions. Typical reactions in the SNCR application are as follows:



Flue gas temperatures at the point of reagent injection can greatly affect NOx removal efficiencies and the quantity of NH3 that will pass through the SNCR un-reacted. This is known as ammonia slip. At temperatures below the desired operating range, the NOx reduction reactions diminish and un-reacted NH3 emissions increase. Above the desired temperature range, NH3 is oxidized to NOx resulting in the low NOx reduction efficiencies. Mixing of the reactant and flue gas within the reaction zone is also an important factor in SNCR performance. The SNCR system must be designed to deliver the reagent in the proper temperature window and allow sufficient residence time of the reagent and the flue gas in the temperature window. In addition to temperature, mixing, residence time, and other factors influence the performance of a SNCR system. Although you may be able to find the right temperatures prior to the product collector any ammonia slip would have a detrimental impact on the CZO collected in the product collectors. For this reason, the use of SNCR is not technically feasible. After an evaluation this is still the case and we have determined that SNCR remains not technically feasible for RACT III.

c. Selective Catalytic Reduction

Selective Catalytic Reduction (SCR) involves injecting ammonia into the flue gas in the presence of a catalyst to reduce NOx to N2 and water. The overall SCR reactions are shown as follows:



The performance of an SCR system is influenced by several factors, including flue gas temperature, SCR inlet NOx concentration, catalyst surface area, volume and age of catalyst, and the acceptable amount of slip. The function of the catalyst is to lower the activation energy of the NOx decomposition reaction and thus allow for the reduction at a lower temperature than required for SNCR. The optimal temperature range depends upon the type of catalyst used but is typically between 550°F and 950°F. Below this range sulfate can form from the sulfur in the flue gas, resulting in catalyst deactivation. If used above the optimum temperature, the catalyst will deteriorate quickly and not achieve desired controls. The only possible location for SCR control would be following the product collectors since ammonia slip prior to the collector would contaminate the product. The exhaust temperatures following the product collectors are significantly lower (approximately 300°F) than what would be required for effective NOx control. Likewise, a stack re-heat system is not feasible and would emit more emissions than it would control. To this extent we have determined and reaffirm that the use of SCR is not technically feasible.

d. Other Control Technologies

After a review of current available technologies, it was determined that no additional controls have been developed since the RACT II evaluation. Additionally, a review of the RACT/BACT/LAER Clearing House (RBLCH) does not identify any post combustion controls being used on rotary kilns. An internet review by the facility and the Department on potential NOx controls for rotary kilns suggest that combustion practices as applied by Befesa in Palmerton are the best methods to minimize NOx emissions.

Determination

Based on the above evaluation, the facility has looked at 25 PA Code 129.114(i) and made the following determinations.

- a. The only available control technology is the use of low NOx burners which are already being employed on the three operating Waelzing Kilns. All other available control technologies, specifically SNCR and SCR have been determined not to be technically feasible. A review of literature has not identified any additional technologies that can be applied at this location.
- b. Regarding control costs, because add on controls are not technically feasible and have been determined not to be technically feasible, an economic analysis is not required.

Independent searches by the Department on Google, the BACT/RACT/LAER Clearinghouse and similar facilities performing the same operation as BEFESA for this type of source generated no additional add on controls for Waelzing operations on rotary kilns.

TABLE 2 - Feasibility Analysis for NOx Control Technologies:

Control Technology	Technical Feasibility	Economic Feasibility	Cost for Technically Feasible controls (\$/ton)
Source ID 149: Waelzing Kiln #1			
Low NOx burners operated in accordance with manufacturers recommendation and good operating practices	Feasible	Installed	N/A
SNCR	Infeasible	N/A	N/A
SCR	Infeasible	N/A	N/A
Source ID 150: Waelzing Kiln #2			
Low NOx burners operated in accordance with manufacturers recommendation and good operating practices	Feasible	Installed	N/A
SNCR	Infeasible	N/A	N/A
SCR	Infeasible	N/A	N/A
Source ID 152: Waelzing Kiln #5			
Low NOx burners operated in accordance with manufacturers recommendation and good operating practices	Feasible	Installed	N/A
SNCR	Infeasible	N/A	N/A
SCR	Infeasible	N/A	N/A

TABLE 3 - Proposed RACT III NOx Limits

Source	Source ID	RACT III NOx emission limit (lbs/hr)
Waelzing Kiln #1	149	8.2
Waelzing Kiln #2	150	9.9
Waelzing Kiln #5	152	12.3

Sources Exempt from RACT

Sources with a potential to emit of one (1) tpy or less of NO_x are exempt from the RACT III NO_x related requirements, in accordance with 25 Pa Code 129.111(c). The KILN #2 - ID FAN EMERGENCY DRIVE ENGINES (Source ID 101), the KILN #5 - ID FAN EMERGENCY DRIVE ENGINES (Source ID 102) and KILN #1 - EMERGENCY GENERATOR (Source ID 103) have potential emissions of NO_x less than one (1) tpy. As such, these sources are exempt from NO_x RACT requirements and do not require further assessment.

Public discussion

No discussions occurred with the EPA, the company, or the public after the company submitted the RACT II is RACT III proposal application.

Conclusion

The Department has analyzed Befesa Zinc US Inc. proposal for considering RACT II requirements as RACT III and performed independent analysis. Based on the information provided by the applicant of the facility and independently verified by the Department, the Department determines that the RACT II requirements satisfy the RACT III requirements. The RACT III requirements are identical to the RACT II requirements and are as stringent as RACT II.

cc: NERO, TV Operating Permit 13-00001
EPA Region 3

COMMONWEALTH OF PENNSYLVANIA
Department of Environmental Protection
RACT II Review Memo

SUBJECT: Title V Operating Permit Review Memo (Modification – RACT II)
Horsehead Corporation (AZR)
Palmerton Borough, Carbon County
Application No. 13-00001

To: Mark J Wejkszner, PE *MJW*
Program Manager
Air Quality Program

From: Neal J Elko *NJE*
Air Quality Program

Through: Raymond Kempa, PE *RK*
Environmental Group Manager
Air Quality Program

On October 25, 2016, the Department received an application for a Modification to address PADEP's RACT II regulations to the existing TVOP, number 13-00001, for the Horsehead Corporation.

This application is to address the RACT II regulations found in 25 Pa. Code §§ 129.96-100.

Administrative/Notifications

Application Received:	October 25, 2016
GIF:	October 25, 2016
Compliance History:	October 25, 2016
Site Location:	900 Delaware Avenue, Palmerton, PA 18071
Coordination involvement:	None Required
Application Fee:	\$750.00, received with application.
Municipal Notification:	Submitted with the application package on November 3, 2016.

Introduction

Horsehead Corporation-Palmerton (Palmerton) is currently operating the Palmerton facility under a Title V Operating Permit Number 13-00001 that was issued by PA DEP on March 25, 2014 and has a permit term running through March 25, 2019.

Based on a review of the Title V Permit the facility is a **major source of NO_x emissions. VOC emissions were found to be under 50 TPY through stack testing and the company is taking limits to stay under the 50 TPY threshold.** Since the facility was in operation prior to July 20, 2012 it is subject to the RACT II requirements. To this extent, Palmerton has reviewed all existing sources at the facility and is submitting this Title V Modification to address the RACT II requirements

in 25 Pa. Code Sections 129.96 through 129.99. The following Table is a compilation of the NO_x sources at the facility and their potential for evaluation under the RACT II.

Table 1: Facility NO_x Emission Sources and RACT II Evaluation

Source	Source ID	Capacity/Throughputs	Subject to NO _x RACT II Evaluation (NO _x emissions > 1 ton)
Kiln #2 -ID Fan Emergency Drive	101	5.1 MMBtu/hr.	N
Kiln #5 -ID Fan Emergency Drive	102	5.1 MMBtu/hr.	N
Kiln #1 Emergency Generator	103	12.0 MMBtu/hr.	N
Kiln #1- Waelzing / Calcining System	149	15 TPH (Waelzing) 12.5 TPH (Calcining)	Y
Kiln #2 - Waelzing System	150	17.5 TPH (Waelzing)	Y
Kiln #5 - Waelzing System	152	22.5 TPH (Waelzing)	Y
Kiln #6 - Calcining System	153	23 TPH (Calcining)	Y
(2) Induction Melting Furnaces (Metal Powder Production)	173	1.0 Tons/hr.	N
Atomizing Furnace (Metal Powder Production)	175	0.9 Tons/hr.	N
Screen & Packing (Metal Powder Production)	176	0.9 Tons/hr.	N
PD Rail Car Unloading	213		N
CZO Unloading System	214		N
#2 Electrical Furnace & Atomizer (Zinc Powder)	219	2,000 lbs/hr.	N
#3 Electrical Furnace & Atomizer (Zinc Powder)	220	2,000 lbs/hr.	N
Lead Concentrate Pneumatic Conveyor	230		N
EAF Dust Collector Transfer Systems	231		N
Feed Hopper Loading	233		N
EAF Dust Unloading/Storage Conveyor Transfer Systems	234		N
EAF Dust Railcar Unloading	235		N
Truck Sweep Station/Material Conveyor Transfer (Bldg 60B Pickup)	236		N
Lead Concentrate Sack Packer	237		N

F2 Kiln Discharge Area Fugitive Dust	238		N
F1 Kiln Discharge Area Fugitive Dust	239		N
Material Stockpiles Wind Erosion - Fugitive Dusts	242		N
Roadway Usage - Fugitive Dusts	244		N
Kiln Feed Conveying System	245		N
Pneumatic Material Handling	246		N
Calcine Kiln Feed Receiving Bin	248		N

RACT Evaluation

The Horsehead Palmerton facility is a **major source of NOx emissions**. Based on a review of available information for the facility four sources at the facility were identified to have NOx emissions above 1 ton per year (tpy), and require NOx RACT II evaluation. Other plant sources were determined to have NOx emissions below 1 ton per year (tpy) and are not subject to a RACT evaluation.

Table 2
Sources Subject to RACT

Source	Source ID	Actual Emissions (Lbs/hr.) NOx	Actual PTE (tpy) NOx	Emission Limits (Lbs/hr.) NOx	Emission Limits (TPY) NOx	Subject to RACT II Evaluation
Kiln #1- Waelzing / Calcining System	149	3.5 - Waelzing 2.6 - Calcining	15.33 - Waelzing 11.4 - Calcining	8.2 (Waelzing) 3.0 (Calcining)	35.92	Y
Kiln #2 - Waelzing System	150	4.6	20.15	9.9	43.36	Y
Kiln #5 - Waelzing System	152	9.1	39.85	12.3	53.87	Y
Kiln #6 - Calcining System	153	5.5 (1)	24.09 (1)	5.3	23.2	Y

Note 1: Stack Testing Results within margin of error ($\pm 10\%$)

Kilns #1, #2, #5 and #6 (Source numbers 149,150,152 and 153) - Four kilns are used for Waelzing and/or calcining at the Palmerton facility. Kilns 2 and 5 are used in the Waelzing mode, Kiln 6 is used for calcining, and Kiln 1 is a swing Kiln that is used in either Waelzing or calcining mode. All the kilns use natural gas as a fuel and are equipped with low NOx burners.

A. Waelzing - The Waelzing operation involves processing zinc containing materials (including electric arc furnace (EAF) dust) and other metal bearing materials to recover metal oxides, primary zinc oxide. The process involves recycling zinc bearing feed materials with carbon (coke or coal) in a rotary kiln. The chemical process involves reduction of zinc compounds to elemental zinc followed by oxidization of the vapor phase to Crude Zinc Oxide (CZO), also known as Waelz Oxide (WOX). The CZO is then collected in a fabric filter (baghouse), also referred to as a product collector. The bed load product from the high temperature metal recovery recycling process is Iron Rich Material (IRM) which also has a number of applications.

B. Calcining - In the calcining process, CZO which is produced from the Waelzing operation is refined in a rotary kiln by heating at a high temperature in an oxidizing atmosphere. No carbon material, is used in the calcining process. In calcining CZO, the lead, cadmium and chloride is vaporized and condensed as a solid particulate matter which is captured in the product collector. Product collected in the bag collector is lead concentrate (13 - 19% lead content) and the bed load product from the calcine kiln is zinc calcine (65 - 70% zinc content). These products are used as feed in zinc and lead metal production, respectively.

Typical stack temperatures and air volumes from the product collectors for each kiln are provided in the following table:

Table 3
Kiln Average Stack Test Exhaust Temperatures

Source	Source ID No.	Stack Temperature (°C)	Stack Flow Rate (ACFM)
Kiln #1	149	154 - 178	85,000
Kiln #2	150	161	150,000
Kiln #5	152	160	165,000
Kiln #6	153	130	90,000

RACT II Evaluation - Kilns #1, #2, #5 and #6 (Source numbers 149, 150, 152 and 153)

Because all 4 kilns have the potential to emit (PTE) NO_x that is greater than 5 tpy and there is not a presumptive RACT requirement in 25 Pa. Code 127.97, a case by case RACT analysis is required. Since all of the kilns are operated similarly with respect to NO_x emissions, the evaluation was conducted for all of the kilns. Since all kilns operate similarly, the same control technologies were evaluated for each kiln for controlling NO_x emissions

Evaluation of possible RACT II Technologies

Background

Only natural gas is used as fuel to fire the burners in the four kilns at the Palmerton facility. In the Waelz kiln the burner is used to pre-heat the kiln during startup until a temperature of 650 - 700°C (1202°F - 1292°F) is achieved in the kiln. The burner is also used periodically in the Waelz Kilns during their operation in order to maintain a kiln discharge temperature at around 1050 - 1100°C (1922°F - 2012°F). Heat input from the Waelz kiln burners is not required to continuously maintain kiln temperatures since kiln temperature is inherently maintained from the heat balance resulting from the reaction of coke and zinc bearing feed materials within the kiln.

There are two principal mechanisms for NO_x formation in the kilns, including "fuel" NO_x and "thermal" NO_x. Fuel NO_x, which results from the presence of nitrogen in fuel sources, can result from oxidation of gas used to fire the kilns, and oxidation of coke/coal fed to the kiln. Natural gas consumed at the burner contains little nitrogen, if any, therefore fuel NO_x formation from natural gas consumption at the burner is negligible. Coke/coal contains nitrogen that when oxidized is a source for fuel NO_x formation.

Thermal NO_x formation results from oxidation of atmospheric nitrogen contained in the gas-air mixture at temperatures above 1982°C (3599°F) at the burner flame. The factors influencing thermal NO_x formation include temperature, air to fuel ratio, and residence time within the combustion zone.

The cumulative time of burner use in each Waelz kiln for start-up and routine temperature maintenance (trimming) is less than 2000 hours per year, with most of the burner hours from trimming use. Trimming occurs for brief periods of time and uses about 30% of the maximum thermal capacity of the

burner, while start-ups typically occur over a period of 16 to 24 hours and use 50 - 100% burner thermal capacity.

In the Calcine kilns, the gas fired burners are used for process heat input purposes during operation. The burners on the Calcine kilns are used at all times when the kiln is in operation.

The kiln burners at Palmerton are operated in a fuel rich mode which produces a shorter and more luminous flame resulting in a reduced rate of potential NOx generation during fuel combustion.

Step 1: Identification of a Potentially Feasible NOx Control Option

Potential NOx control options were identified based upon a review of available information. Control options with potential application to the proposed kilns, based on information presented above, are provided in the following Table.

Table 4
List of Potential NOx Control Options

Control Technology
Combustion Controls
<u>Selective Non-Catalytic Reduction</u>
Selective Catalytic Reduction

Step 2: Technical Feasibility of Potential Control Options

For technical feasibility evaluation purposes, control methods for NOx are discussed in two categories, including (1) combustion controls, and (2) post-combustion controls (selective non-catalytic reduction and selective catalytic reduction). Combustion controls reduce the amount of NOx that is generated in the combustion process, and post-combustion controls limit NOx emissions that enter the atmosphere after the combustion process.

Combustion Controls

Combustion controls address the rate of NOx formation in the combustion zone, and relate to several variables including the availability of free oxygen, the combustion temperature, and residence time. Combustion techniques designed to minimize the formation of NOx will reduce and/or minimize one or more of these variables.

The natural gas burner on all kilns at Palmerton is located at the base of the kilns, and air flow through the kilns is countercurrent to the movement of feed material. Gaseous emissions from the kilns exit at their respective product baghouse stacks.

Burners on kilns used for Waelzing on a full time basis each operate around 2000 hours per year (Kilns 2 and 5 full time and Kiln 1 part time), whereas burners on kilns for calcining (Kiln 6 full time and Kiln 1 part time) are used continuously while in operation. The Calcining kilns rely on the natural gas fired burners for heat supply to the operation, whereas the reaction of coke and zinc bearing material in feed supply to the Waelz kilns provides heat for the Waelz process.

Burners installed on all kilns at Palmerton are classified as low NOx burners. Burners at the facility are maintained and operated in accordance with manufacturer's recommendations. In addition, good operating practices for Waelzing and Calcining kiln operations are practiced by Horsehead at this location.

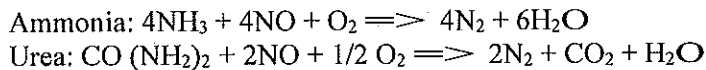
Post-Combustion Controls

Post-combustion controls for NOx with potential application to the rotary kilns at Palmerton are discussed below, including selective non-catalytic reduction and selective catalytic reduction.

Selective Non-Catalytic Reduction

Selective non-catalytic reduction (SNCR) involves the direct injection of ammonia (NH₃) or urea (CO (NH₂)₂) in the flue gas stream where temperatures are approximately 815°C to 1037°C (1500°F - 1900°F). The ammonia or urea reacts with the NO_x in the flue gas to produce N₂ and water vapor. The NO_x reduction reactions in an SNCR system are driven by the thermal decomposition of ammonia or urea and the subsequent reduction of NO_x. SNCR systems do not employ a catalyst to promote these reactions.

Typical reactions in the SNCR application are as follows:



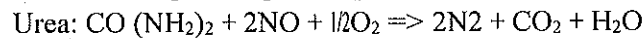
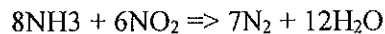
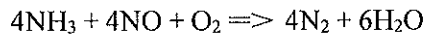
Flue gas temperatures at the point of reagent injection can greatly affect NOx removal efficiencies and the quantity of NH₃ that will pass through the SNCR un-reacted. This is known as ammonia slip. At temperatures below the desired operating range, NOx reduction reactions diminish and un-reacted NH₃ emissions increase. At temperatures above the desired temperature range, NH₃ is oxidized to NOx resulting in a contribution and increase to NOx emissions.

Mixing of the reactant and flue gas within the reaction zone is also an important factor in SNCR performance. The SNCR system must be designed to deliver the reagent in required temperature window, and allow sufficient residence time of the reagent and the flue gas in the required (temperature) window. In addition to temperature, mixing, residence time, and other factors influence the performance of a SNCR system. Although a suitable temperature window located in the duct work may be present upstream from the product collector, the injection of urea or ammonia can have a detrimental effect on the product (WOX and Lead Concentrate). Because of the potential detrimental effect of ammonia on products, the use of SNCR to control NOx emissions at Palmerton is not technically feasible.

Selective Catalytic Reduction

Selective Catalytic Reduction (SCR) involves injecting ammonia into the flue gas in the presence of a catalyst to reduce NOx to N₂ and water.

The overall SCR reactions are shown as follows:



The performance of an SCR system is influenced by several factors including flue gas temperature, SCR inlet NOx concentration, catalyst surface area, volume and age of catalyst, and the acceptable amount of slip.

The function of the catalyst is to lower the activation energy of the NOx decomposition reaction and allow for reduction at a temperature that is less than that required for SNCR. The optimal temperature range depends primarily upon the type of catalyst used, and is typically between 260°C and 510°C (500°F - 950°F). Operation of the system below this temperature range can result in the formation of sulfate from sulfur in the flue gas, resulting in catalyst deactivation. Operation of the system above this temperature range, quickly deteriorate the catalyst, resulting in diminished control of NOx.

Exhaust temperatures from the product collectors are significantly lower than the required temperature for effective NOx control using SCR. Installation of a stack re-heat system is not feasible. Based on these circumstances, SCR is not technically feasible for the Waelz and Calcining Kiln processes.

The results of Step 2 of the NOx, BAT Analysis is summarized in Table 5 as follows:

Table 5
Technical Feasibility of Potential NO_x Control Technologies

Control Technology	In Service on Existing Waelzing or Calcining Kilns	In Service on other Rotary Kilns	Technically Feasible for the Horsehead Palmerton Facility
Low NOx burners operated in accordance with manufacturer's recommendation and good operating practices in the kiln when Waelzing or calcining.	Yes	Yes	Current Case
SNCR	No	No	No
SCR	No	No	No

Step 3: Rank of Technically Feasible NOx Control Options by Effectiveness

The control technologies for all four kilns are identified as being technically feasible for NOx control and are provided in Table 6.

**Table 6
Summary of Technically Feasible NOx Control
Technologies**

Control Technology	Technically Feasible
Low NOx Burners	Yes
Manufacturers Recommendations	Yes
Use of Good Operating Practices in the Kilns during Waelzing and Calcining	Yes

Steps 4 and 5: RACT Selection

Horsehead has determined that NOx RACT II for the rotary kilns is the operation of Low NOx Natural gas fired burners (when in operation) in accordance with manufacturer's recommendations and use of good operating practices for the Waelzing and Calcining Kilns.

It should also be noted that a review of the RACT/BACT/LAER Clearing House (RBLC) indicates that no post combustion controls are being used on rotary kilns.

The proposed NOx RACT limitations are the same as in the existing permits and are provided in Table 7.

**Table 7
RACT II Emission Limits**

SOURCE	SOURCE ID	RACT I NOx limit (lbs/hr)	RACT II limit (lbs/hr)
Kiln 1 (calcine)	149	3.0	3.0
Kiln 1 (Waelzing) ¹	149	n/a	8.2
Kiln 2 (Waelzing)	150	9.9	9.9
Kiln 3 (Waelzing)	151	8.8	Shut Down
Kiln 5 (Waelzing)	152	12.3	12.3
Kiln 6 (Calcine)	153	5.3	5.3

¹ Kiln 1 was modified to also run in the Waelzing mode in Plan Approval 13-308-104 issued on 2/27/2004.

The RACT I limit of 3.0 lbs/hr for kiln 1 is for calcine mode and still is in effect for RACT II. Kiln 1 in Waelzing mode is 8.2 lbs/hr. No backsliding has occurred.

Recommendation:

I recommend issuance of the operating permit modification to address the plan proposed by the company pursuant to the RACT II requirements found in 25 Pa. Code § 129.99.