I. INTRODUCTION

PQ Corporation (PQ) is proposing to construct a sodium silicate manufacturing at the previously owned Anchor Glass facility in Gurnee, Illinois. The facility will be designed to produce 600 tons per day of sodium silicate.

The proposed project will require the modification of the two existing glass melting furnaces previously operated by Anchor Glass for the purpose of manufacturing the sodium silicate product.

II. PROJECT DESCRIPTION

Overview - The PQ Corporation=s Chicago silicate plant will use sand and soda ash as raw materials and fuse them in a furnace to produce solid sodium silicate. This solid sodium silicate may be transferred from storage silos and sold as a product in rail cars or further processed by dissolving with water in a pressure vessel to produce liquid sodium silicate. The liquid sodium silicate is stored in storage tanks and shipped to customers in trucks and rail cars.

The solid products are categorized by the ratio (xSiO2:Na2O). The liquid products are categorized by ratio and solid content (% dissolved solids).

The chemical reaction which described the manufacturing process is:

x Si02 x y Na2C03 = x Si02:yNa20 + y CO2
(sand) (soda ash) (sodium silicate)

Sand and soda ash are delivered as raw materials in rail cars. Each are unloaded through common unloading equipment. The raw materials are dropped from the rail car into the underground Raw Material Unloading Conveyor (C-101), elevated through two bucket elevators (BE-101, BE-102) and fed into the Raw Material Storage Bin
(T-101A/B) through a rotating feed device (MS-101).

The storage bin is a 20 compartment bin which holds the sand and soda ash.

All of the unloading equipment is sealed and vented to the Batch House Dust Collector (F-101) which collects any dust and deposits it into the process. The dust collector uses a blower (B-101) to pull the dust into the dust collector.

Feedstock to the furnace is called BATCH. This powder is the correct mixture of sand and soda ash to produce the desired final product ratio.

Batch is produced by individually weighing the sand and soda ash in the Raw Material Weight Hopper (T-102). Raw materials is conveyed through individual vibratory feeders from the selected compartments to the weigh hopper. The batch is conveyed from the weigh hopper through the Batch Belt Conveyor (C-103) and the Batch Elevator
(BE-103) to the Batch Weigh Check Tank (T-203) where it=s weight is checked before mixing.

Material is mixed batchwise in the Batch Mixer (M-103). It is discharged batchwise to the Transporter Surge Bin (T-201). The Transporter Bin Vent (F-201) vents the hopper as the material is dumped into it. The Transporter Blower (B-201) pulls the vented air through the filter bags and vents to the atmosphere.

Material is transferred from this area of the facility to the furnace area by the dense phase transport system. The Pneumatic Batch Transporter (C-201) is filled batchwise from the hopper and batch is transported by high pressure low volume air in a plug flow manner to the Charger Feed Hopper (T-202). The transporting air is vented through the Batch Bin Vent (F-202). The feed hopper holds approximately 1 hour surge of material. Batch is continuously fed from this hopper to the furnace.

III. PROJECT EMISSIONS

Emissions of nitrogen oxides (NO_x) and carbon monoxide (CO) are generated by the combustion of natural gas in the furnaces and boiler. When firing No. 2 or No. 6 fuel oil in the furnaces and boilers, SO_2 emissions will be generated during combustion. Furnace design minimizes NO_x and CO emissions.

Emissions of particulate matter in the furnaces are created by the vaporization of the raw material and from unmelted raw materials. Emissions of particulate matter from the furnace will be indirectly controlled via batch wetting of the input feed materials. Other particulate matter emissions throughout the processing units will be adequately controlled by dust collectors.

The potential emissions from the proposed operation of the sodium silicate furnaces and boilers are given below, based on continuous operation at the maximum production rate of sodium silicate.

Contaminant	Furnace 1 and 2 Emissions	Boiler Emissions	Total
Nitrogen Oxides	547.5	10.5	558.0
Particulate Matter	63.6	0.3	63.9
Carbon Monoxide	15.3	16.2	36.0

The net increase in emissions will be less than the above, considering representative operation of the furnaces for previous years. The existing furnace emissions are evaluated based on the rate at which these furnace actually emitted during a representative two year period which is calendar year 1993 and 1994 prior to shutdown. The altered furnace operations are evaluated at their potential to emit. In particular, the net emissions decrease for particulate matter is 32.9 tons per year. This decrease is obviously less than the significant emission increase level for particulate matter. Overall, the changes in the emissions in tons per year are as tabulated below.

Actual Emissions Potential Emissions (tons per year)

	Before Project (Old Plant)	After Project (Altered Plant)	Net Change
NO_x	549.1	558.0	+ 8.9
PM	105.2	72.3	- 32.9

IV. APPLICABLE REGULATIONS

A. Board Emission Standards

All emission sources in Illinois must comply with Illinois Pollution Control Board Emission standards. The Board=s emission standards represent the minimum requirements for sources in Illinois. The Board=s emission standards in 35 Ill. Adm. Code Part 212 address particulate matter emissions from the operation of these sodium silicate manufacturing furnaces.

B. Additional Requirements for Major Sources

Construction of a major new source or a significant increase in emissions at an existing major source is subject to further regulatory requirements. The particular regulations that apply depend upon the air quality status of the area in which the project is located. This project is in an area classified as attainment so the federal rules for Prevention of Significant Deterioration of Air Quality (PSD), 40 CFR 52.21, could apply. Significant emission levels are listed in the chart below.

PSD Significance Levels (Tons/Year)

Pollutant	Significance Level
Particulate Matter (PM10)	15
Sulfur Dioxide	40
Nitrogen Oxide	40
Carbon Monoxide	100

This project is subject to PSD for NO_x because emissions of NO_x are more than the major source threshold emission level of 250 tons/year. Emissions of particulate matter from this facility will not exceed the levels previously attained by Anchor Glass. Therefore, the project will not qualify as significant for particulate matter, as well as for any other pollutants.

The PSD rules, which were intended to preserve clean air, require: 1) an Aemission limit@ on new or modified equipment which represents Best Available Control Technology (BACT), 2) an air quality assessment of the impact of new emissions, and 3) an analysis of impacts on soils, vegetation, and visibility. The Illinois EPA has been delegated authority by USEPA to administer the PSD program in Illinois.

V. BEST AVAILABLE CONTROL TECHNOLOGY (BACT)

A. Introduction:

A. . .an emission limitation based on the maximum degree of reduction . . .which the permitting authority, on a
case-by-case basis, taking into account energy, environmental and other costs, determines is achievable . . .@.

BACT is generally set by a ATop Down Procedure.@ In this procedure, the most stringent control requirement in practice elsewhere is assumed to constitute BACT for a particulate project, unless the impacts associated with the control requirements are shown to be excessive. This approach has generally been followed by the Illinois EPA.

B. Discussion:

Nitrogen Oxides - Based on available data, the following technologies were reviewed as possible control options for NO_x: 1) low NO_x burners/low excess air, 2) oxygen enrichment/oxygen firing, 3) electric boost, 4) selective catalytic reduction, 5) selective noncatalytic reduction, and 6) furnace design optimization.

Furnace design optimization in combination with combustion efficiency as proposed by PQ are the NO_x control measures used on a furnace used to manufacture sodium silicate. Add-on control devices have not been used on these furnaces.

Low Excess Air/Low NO_x Burners - Modifications to existing burners include the use of low excess air and changing air/fuel contacting. Low excess air is designed to reduce the oxygen concentration in the flame zone and therefore reduce the NO_x formation. This is a feasible technology showing a 28 percent reduction in two glass furnaces as shown in EPA=s Alternate Control Techniques Document - NO_x Emissions from Glass Manufacturing. PQ expects a reduction of approximately 15 percent.

Modifying the air fuel contacting includes: changing the contact angle between the gas and combustion air, varying the air and gas velocities, and altering the location of the gas injection (underport or overport). The results of modifying these parameters is a Along and lazy@ luminous flame, thus reducing the peak flame temperature and gas residence time at peak temperatures. This essentially creates a low NO_x Burner. The burners are sealed to prevent the infiltration of excess air at the flame. PQ has used this application in other sodium silicate furnaces along with a video camera to visually monitor the flame pattern.

Low NO_x Burners (LNB) are a viable option to be used in this application. LNB are designed to achieve a staging effect internally. The air and fuel flow fields are partitioned and controlled to achieve the desired air/fuel ratio. LNB

typically have longer flames and reduce the peak flame temperature, thus reducing the amount of thermal NO_x formed. A NO_x reduction of 30 to 40 percent can be achieved using this system. This is essentially producing the same effect as modifying the air/fuel contacting.

Oxygen Enrichment and Oxygen Firing - These techniques minimize NO_x using oxygen rather than air for combustion, so that nitrogen is not present to be converted to NO_x (air is 79% nitrogen). To date, oxy-firing has not been successfully scaled to meet larger furnace size applications employed in sodium silicate production. These techniques have only been used on small container glass furnaces. Oxy-firing has not been demonstrated as technically feasible or available for the sodium silicate furnaces.

Electric Boost - Electric boost is a process modification which substitutes electricity for some of the thermal energy combustion, thereby reducing the NO_x formation rate. This technology has been used in container glass furnaces, but not in sodium silicate furnaces because of product quality and other manufacturing considerations. Improper design or application of electric boosting may severely impact quality and process yields. Other problems associated with attempting to apply electric boost to sodium silicate furnaces include inefficiency, cost, and reduced refractory and furnace life. Furthermore, NO_x emissions from fossil fuels used to produce the electricity for application of electric boosting may exceed NO_x emissions from a conventional natural gas fired furnace, resulting in an overall emissions increase. Accordingly electric boost is not considered a feasible control measure for NO_x.

Selective catalytic reduction (SCR) - SCR uses a chemical reaction to remove NO_x and a reagent, e.g. ammonia (NH3) as it passes through a porous bed or screen impregnated with catalyst, changes NO_x back to N_2. This reaction takes place at a temperature of 700EF or above. SCR is not a demonstrated technology for control of NO_x emissions from sodium silicate manufacturing furnaces. This option is not considered technically feasible for controlling NO_x from these furnaces.

Selective non-catalytic reduction (SNCR) - SNCR also involves injection of a reactant, but without the use of a catalyst. The effectiveness of this method is dependent on individual NO_x concentration, residence time, mixing and on the temperature.

The sodium silicate manufacturing requirements at the proposed facility require flue gas temperatures that are incompatible with single reagent ammonia or urea based SNCR systems. At the inlet to the primary regenerator, a heat recovery system, the flue gas is roughly 2700EF. At the primary regenerator outlet, the peak flue gas temperature is roughly 1350EF. It is generally considered that the temperature of the gas must be in the range of 1600EF to 2000EF, to be suitable for SNCR

operation. In the proposed facility, the ideal single reagent SNCR reaction temperature window occurs in the primary regenerator. As the furnaces age, the temperatures will change from startup conditions. The aging process causes the ideal SNCR temperature widow to move to a different area in the primary regenerator. Injection of the reagent at increasingly non-ideal temperature will result in inefficient NO_x reduction due to ammonia slip. In ammonia slip, the temperature window is not ideal and so the ammonia does not react as efficiently and is exhausted out of the stack. Also, the layout of the primary and secondary regenerators at the proposed facility are of a layout which precludes the contact of the ammonia or urea reagent with all the flue gas from wall mounted nozzle injectors, limiting reaction efficiency.

However, a dual reagent (with an additive like hydrogen) SNCR system could be conceivable since the peak 1350EF primary regenerator exit flue gas temperature is still above 1300EF at the end of the heat recovery cycle. But, since this is a dynamic, cyclic regenerative furnace, there is only a portion of the firing cycle time that the primary regenerator exit flue gas temperature is above the 1300EF to attempt any NO_x reduction with a H2 + NH3 dual reagent SNCR control technology. If any fleeting NO_x reduction were expectable for this portion of time, when averaged over the entire firing cycle time, the resulting NO_x reduction would most likely be below the 30% listed by the USEPA for single reagent based SNCR systems. Furthermore, since the 1350EF temperature is at the bottom of the 1300 to 1600EF range, the amount of H2 and NH3 injection required would be high, even if a NO_x reduction could be affected. The resultant potential for ammonia slip and particulate emissions would be exacerbated, and excessive costs for all the equipment and expense of hydrogen handling and extra ammonia could be expected. Reports of NO_x emission reduction and commercial operating experience with dual reagent NH3 + H2 based SNCR systems are not available.

SNCR control technology is not technically feasible for the new furnace because projected average flue gas temperatures for the furnace are wide ranging and will be below the critical SNCR temperature window of 1700E-1850EF for operating effectiveness.

To summarize, the predicted average flue gas temperatures for the altered furnaces preclude the successful use of SNCR control technology, both as a single control option or in combination with the furnace design optimization. Therefore, the Illinois EPA believes that SNCR technology is not BACT for the furnaces.

Furnace Design - Furnace design has been shown to be an effective and available NO_x control technology for sodium silicate manufacturing furnaces. Updated technologies are employed to assist the transfer of heat from the burner flames to the sodium silicate bed beneath them, and to keep that heat

available for heating and reacting the components of the batch. By reducing the heat losses, heat input is reduced.

Heat input in a sodium silicate furnace is from the combustion of fuel, which results in the formation of majority of the NO_x emissions. By reducing the heat input while making sodium silicate, the NO_x emissions are reduced.

Furnace design was selected as BACT in the most recent BACT determination for a flat glass furnace in 1991. For this American Flat Glass, Menominee, Wisconsin facility, BACT was based on furnace insulation and fuel-efficient burners, on a 550 ton/day furnace, to achieve NO_x emission rate of 400 lbs/hour, equivalent to 17.5 lbs NO_x/ton of glass produced. The 600 ton/day furnace now proposed by PQ is designed to comply with NO_x emissions of 5.0 lbs/ton sodium silicate produced. The proposed furnace incorporates advances in design that enable the furnace to heat the same amount of sodium silicate even more efficiently and with less NO_x emissions.

Furnace Design Optimization is a proven, available control technique for reducing NO_x emissions in regenerative sodium silicate manufacturing furnaces. This technology is considered as a viable BACT control technology for application at the proposed facility.

C. <u>BACT Determination</u>:

Nitrogen Oxides

The Illinois EPA has determined that RACT for NO_x emissions continues to be a limit of 6.0 lbs/ton of sodium silicate produced by the furnaces. The design of the furnaces and the use of low NO_x burners and low excess air technologies limits nitrogen oxide emissions and will be used to meet this limit.

VI. AIR QUALITY ANALYSIS

A. <u>Introduction</u>

The previous discussion addressed emissions and emission standards. Emissions are the quantity of pollutants emitted by a source, as they are released to the atmosphere from a stack. Standards are set limiting the amount of these emissions primarily as a means to address the quality of air. The quality of air as we breath it or as pollutants and animals experience it, is known as ambient air quality. Ambient air quality considers the emissions from a particular source after they have dispersed following release from a stack, been added to the background level of pollutants in the air entering the region, and joined with the pollutants emitted from other nearby sources.

The concern for pollutants in ambient air is typically expressed in terms of the concentration of the pollutant in the air. One form of this expression is parts per million. A more common specific form is microgram per cubic meter, i.e., a millionth of a gram in a cube of air one meter on a side.

The United States EPA has established standards which set limits on the level of pollution in the ambient air. These ambient air quality standards are based on a broad collection of scientific data to define levels of ambient air quality where adverse human health impacts and welfare impacts may occur. As part of the process of adopting air quality standards, the United States EPA compiles the various scientific information on impacts into a Acriteria@ document. Hence the pollutant for which legal air quality standards exist are known as criteria pollutants. Based upon the nature and effects of a pollutant, appropriate numerical limitation(s) and associated averaging times are set to protect against adverse impacts. For some pollutants several standards are set, for others a single standard may suffice.

Areas can be designated as attainment or nonattainment for criteria pollutants, based on the existing air quality. Locations can either have good air quality complying with the air quality standard for a pollutant, in which case the area is known as attainment. if the air quality standard is exceeded the area is known as nonattainment.

In attainment areas one wishes to generally preserve the existing clean air resource and prevent increases in emissions which would result in nonattainment. In a nonattainment area efforts must be taken to reduce emissions to come into attainment. An area can be attainment for one standard and nonattainment for another or comply with the long-term standard for a pollutant but violate the short-term standard.

Compliance with air quality standards is determined by two techniques -- monitoring and modeling. In monitoring, one actually samples the levels of pollutants in the air on a routine basis. This is particularly valuable as monitoring provides data on actual air quality, considering actual weather and source operation. The Illinois EPA operates a network of ambient monitoring stations across the State.

Monitoring is limited because one cannot operate monitors at all locations. One also cannot monitor to predict the effect of a future source which has not yet been built or to evaluate the effect of possible regulatory programs to reduce emissions. Modeling is used for these purposes. Modeling uses mathematical equations to predict ambient concentrations based on various factors, including the height of a stack, the velocity and temperature of exhaust gases, and weather data (speed, direction, and atmospheric mixing).

Modeling is usually performed by computer, allowing detailed estimates to be made of air quality impacts over a range of

weather data. Modeling techniques are well developed for essentially stable pollutants like particulate matter, NO_x, and CO, and can readily address the impact of individual sources. Modeling techniques for reactive pollutants, e.g., ozone, are more complex and have generally been developed for analysis of entire urban areas. They are not applicable to a single source with small amounts of emissions.

Air quality analysis is the process of predicting ambient concentrations in the area or as a result of a project and comparing the concentration to the air quality standard or other reference level. Air quality analysis uses a combination of monitoring data and modeling as appropriate.

B. Air Quality Analysis for PQ

An ambient air quality analysis was conducted by the consulting firm, JACA, on behalf of PQ to assess the impacts of its emissions of NO_x on ambient air quality. Under the PSD rules, this analysis must determine whether the proposed project will cause or contribute to a violation of any applicable air quality standard.

Modeling was done incorporating proposed new emissions and existing emission points at PQ and major stationary sources in surrounding areas. The analysis performed conforms to the guidance and requirements of the USEPA and the Illinois EPA. Background concentrations were added to modeled impact for NO_x National Ambient Air Quality Standard (NAAQS). The highest regional values from the particular averaging period of five years of Illinois EPA monitoring were used as background.

PQ has provided adequate information to determine that emissions from the furnaces, when altered, will not cause a violation of the relevant national Ambient Air Quality Standard (NAAQS).

VII. REQUEST FOR COMMENTS

It is the Illinois EPA=s preliminary determination that the project meets all applicable state and federal air pollution control requirements, subject to the conditions proposed in the draft permit. The Illinois EPA, therefore, is proposing to issue a permit for this project.

Comments are requested on this proposed action by the Illinois EPA and the proposed conditions of the draft permit.

Comments must be addressed to the Illinois Environmental Protection Agency, P.O. Box 19276, Springfield, Illinois, 92794-9276. If substantial public concern is shown in this matter, the Illinois EPA will consider holding a public hearing in accordance with 35 Ill. Adm. Code, Part 164.

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