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Director

DAQP-062-21

July 27, 2021

Paul Pederson
Ash Grove Cement Company
Hwy 132 6 Miles E
Leamington, Utah 84638
paul.pederson@ashgrove.com

Dear Mr. Pederson,

The DAQ has received your four-factor analyses for the Ash Grove Cement Company prepared for the second planning period of Utah's Regional Haze State Implementation Plan. Enclosed is an engineering review of each analysis outlining some outstanding issues for you to be aware of. Please provide us with amendments or reasoning for these issues by **August 31st, 2021**. If you have any questions, please contact John Jenks at jjenks@utah.gov or (385) 306-6510.

Sincerely,

Chelsea Cancino
Environmental Scientist

RNC:CC:GS:jf

Regional Haze – Second Planning Period
SIP Evaluation Report:

Ash Grove Cement Company

Utah Division of Air Quality

July 30, 2021

SIP EVALUATION REPORT

Ash Grove Cement Company

1.0 Introduction

The following is part of the Technical Support Documentation for the Second Planning Period of the Regional Haze SIP (aka the Visibility SIP). This document specifically serves as an evaluation of the Ash Grove Cement Company facility.

1.1 Facility Identification

Name: Ash Grove Cement Company
Address: Hwy. 132, Leamington, Utah 84638
Owner/Operator: Ash Grove Cement Company
UTM coordinates: 4,379,850 m Northing, 397,000 m Easting, Zone 12

1.2 Facility Process Summary

Ash Grove Cement Company (Ash Grove) operates the Leamington Cement Plant. This plant has been in operation since 1981. At the Leamington cement plant, cement is produced when inorganic raw materials, primarily limestone (quarried on site), are correctly proportioned, ground and mixed, and then fed into a rotating kiln. The kiln alters the materials and recombines them into small stones called cement clinker. The clinker is cooled and ground with gypsum and additional limestone into a fine powdered cement. The final product is stored on site for later shipping. The major sources of air emissions are from the combustion of fuels for the kiln operation, from the kiln, and from the clinker cooling process.

1.3 Facility Criteria Air Pollutant Emissions Sources

The source consists of the following emission units:

- Unit Designation: Kiln 1
  Kiln 1 has the following installed:
  SNCR for NOx control; NOx, CO, Total Hydrocarbons (VOC), and Oxygen (O2) CEMS on main stack; Mercury (Hg) CEMS or integrated sorbent trap monitoring system on main stack; TSP (PM) Continuous Parametric Monitoring System (CPMS) on main kiln and clinker cooler stack.

1.4 Facility Current Potential to Emit

The current PTE values for Ash Grove, as established by the most recent NSR permit issued to the source (DAQE-AN103030029-19) are as follows:

Table 2: Current Potential to Emit

Pollutant	Potential to Emit (Tons/Year)
SO_2	192.50
NO_x	1347.20

2.0 Four Factor Review Methodology

Each source reviewed in this second planning period submitted a report on the available control technologies for SO2 and NOx emission reductions and the application of each technology to that facility. The information on available controls should consider the following four factors when analyzing the possible emission reductions:

1. Factor 1 – The Costs of Compliance
2. Factor 2 – Time Necessary for Compliance
3. Factor 3 – Energy and Non-Air Quality Environmental Impacts of Compliance
4. Factor 4 – Remaining Useful Life of the Source

Although not specifically required, the recommended approach was to follow a step-wise review of possible emission reduction options in a "top-down" fashion similar to U.S. EPA's guidelines for review of BART or Best Available Retrofit Technology (as found in 40 CFR 51, Section 308 amendments, pub. July 5, 2005). The steps involved are as follows:

Step 1. Identify all available retrofit control technologies
Step 2. Eliminate technically infeasible control technologies
Step 3. Evaluate the control effectiveness of remaining control technologies
Step 4. Evaluate impacts and document results

The process is inherently similar to that used in selecting BACT (Best Available Control Technology) under the NSR/PSD (Title I) permitting program. UDAQ evaluated the submissions from each source following the methodology outlined above. Where a particular submission may have differed from the recommended process, UDAQ will make note, and provide additional information as necessary.

3.0 Analysis for SO2 Emission Reductions

Foremost, Ash Grove identified a baseline emission value of 8.0 tons/year as the starting point for all SO2 evaluations. Baseline annual emissions for SO2 were calculated based on stack test data and annual production levels. The calculations were not provided as part of the four factor analysis submission, but generally match the actual emissions inventory submitted by the company to DAQ on an annual basis.

Ash Grove followed the recommended approach, using a top-down style methodology for its analysis.

<u>Step 1:</u>

Ash Grove identified Fuel Substitution, Semi-Dry Scrubbing and Wet Scrubbing as possible controls for SO2 emissions.

Fuel substitution, although a feasible technology, is somewhat limited by Ash Grove's existing permit structure – which already allows for the use of alternative fuels, and the nature of the cement kiln itself – which is somewhat inherently self-scrubbing of fuel-based SO2 emissions.

Both Semi-Dry and Wet Scrubbing are tail pipe (i.e. stack-based) control systems, using a reactor vessel that mixes the exhaust stream with an alkaline reagent (typically lime or a similar product) in a slurry or liquid form. The reagent is captured either as waste liquid or as particulate, while the exhaust gas is released to the main stack.

Step 2:

Ash Grove eliminated all three identified controls in this step, by stating that all three controls were designed for sources with inherently higher emissions of SO2 on a tons/year actuals basis. DAQ disagrees with this approach, as all three controls are technically feasible and can be applied for control of SO2 emissions. Whether the application of such controls should be applied is properly left until Step 4. For details on Ash Grove's findings, analysis and conclusions, please see the Ash Grove Four Factor Analysis page 5-3.

Step 3:

Under the Ash Grove approach, no ranking of the three identified systems is possible, as none would have advanced to this step. DAQ agrees that the level of further emission reduction possible through application of any of these systems is negligible and therefore, ranking of the three systems is academic.

Step 4:

DAQ agrees with Ash Grove's conclusion for SO2 emission controls. Given the inherently low level of actual SO2 emissions on an annual basis, the application of either fuel switching or add-on emission controls would have little to no impact on total SO2 emissions. DAQ does recommend a revisit of Ash Grove's annual PTE estimation given the seeming disparity between the two values.

4.0 Analysis for NOx Emission Reductions

As with SO2 emissions, Ash Grove identified a baseline emission value as the starting point for all NOx emission evaluations. NOx actual annual emissions were set at 1,198 tons/year. Baseline emissions of NOx are based on CEMS data. The CEM data was also provided as part of the four factor analysis submission, but matched the actual emissions inventory submitted by the company to DAQ.

Ash Grove followed the recommended approach, using a top-down style methodology for its analysis.

Step 1:

Ash Grove identified only three retrofit technologies for the control of NOx emissions at the Leamington plant: low-NOx burners (LNB), selective non-catalytic reduction (SNCR) and selective catalytic reduction (SCR). All three control systems are technically feasible, with both LNB and SNCR being currently installed on the kiln.

DAQ has identified additional controls beyond those provided by Ash Grove; however, none are technically feasible and have been eliminated from further consideration. For informational purposes, these additional controls were:

- fuel switching and SNCR optimization, eliminated based on requirement to switch primarily to higher sulfur coal-based fuels;
- kiln modification, eliminated as the Ash Grove plant is already a pre-heater/pre-calciner type

kiln;

- kiln optimization, including: kiln feed uniformity, elimination of air infiltration, improvements in thermal efficiency, and returning kiln dust to the process – eliminated as Ash Grove undertakes these processes regularly, and additional benefit would be difficult to quantify
- Cemstar Process, eliminated as it requires the introduction of steel or blast furnace slag – this changes the chemical composition of the resulting cement, and is difficult/expensive to obtain/transport

LNBs reduce the amount of NOx initially formed in the flame. The principle of all LNBs is the same: stepwise or staged combustion and localized exhaust gas recirculation (i.e., at the flame). LNBs are designed to reduce flame turbulence delay fuel/air mixing and establish fuel-rich zones for initial combustion. The longer, less intense flames reduce thermal NOx formation by lowering flame temperatures. Control of air turbulence and speed is often controlled via mixing air fans. Some of the burner designs produce a low-pressure zone at the burner center by injecting fuel at high velocities along the burner edges. Such a low-pressure zone tends to recirculate hot combustion gas which is retrieved through an internal reverse flow zone around the extension of the burner centerline. The recirculated combustion gas is deficient in oxygen thus producing the effect of flue gas recirculation. Reducing the oxygen content of the primary air creates a fuel-rich combustion zone that then generates a reducing atmosphere for combustion. Due to fuel-rich conditions and lack of available oxygen formation of thermal NOx and fuel NOx are minimized. The Leamington facility has already installed a LNB on the kiln and has demonstrated compliance with a federally enforceable NOx emission rate of 2.8 lbs/ton clinker (30-day rolling average).

SCR is an exhaust gas treatment process in which ammonia (NH3) is injected into the exhaust gas upstream of a catalyst bed. On the catalyst surface, NH3 and nitric oxide (NO) or nitrogen dioxide (NO2) react to form diatomic nitrogen and water. The overall chemical reactions can be expressed as follows:

$4NO + 4NH3 + O2 \rightarrow 4N2 + 6H2O$
$2NO2 + 4NH3 + O2 \rightarrow 3N3 + 6HzO$

When operated within the optimum temperature range of 500ºF to 800ºF, the reaction can result in removal efficiencies between 70 and 90 percent. The rate of NOx removal increases with temperature up to a maximum removal rate at a temperature between 700ºF and 750ºF. As the temperature increases above the optimum temperature, the NOx removal efficiency begins to decrease. SCR use in the cement industry is incredibly limited with only a handful of uses in Europe and one instance, i.e the Joppa Cement Plant operated by LaFargeHolcim in the United States.

In SNCR systems a reagent is injected into the flue gas within an appropriate temperature window. The NOx and reagent (ammonia or urea) react to form nitrogen and water. A typical SNCR system consists of reagent storage, multi-level reagent-injection equipment, and associated control instrumentation. The SNCR reagent storage and handling systems are similar to those for SCR systems.

Like SCR, SNCR uses ammonia or a solution of urea to reduce NOx through a similar chemical reaction.
$2NO+4NH3+2O2 \rightarrow N2+6H2O$

SNCR requires a higher temperature range than SCR often between 1,600ºF and 1,900ºF due to the lack of a catalyst to lower the activation energies of the reactions.

The Leamington facility has already installed a SNCR system on the kiln and has demonstrated compliance with a federally enforceable NOx emission rate of 2.8 lbs/ton clinker (30 day rolling average).

Step 2:

Ash Grove did not evaluate further the control options of LNB or SNCR as these two control systems have already been installed at the Leamington plant. Although the source could have evaluated more efficient/improved versions of either/both systems, the source did not supply any additional data on these options.

For SCR, Ash Grove supplied information on an SCR’s temperature requirements, ammonia slip, and the catalyst fouling possibilities. Ash Grove reached the conclusion that SCR is not widely available for use with cement kilns, in large part because the site-specificity limits the commercial availability of systems. Therefore, neither high-dust nor clean-side SCR's were considered technically feasible.

Step 3:

Step 3 of the top-down control review is to rank the technically feasible options in order of effectiveness. All technically feasible control options, LNB and SNCR, have already been installed by the Leamington facility.

Step 4:

Ash Grove believes that reasonable progress compliant controls are already in place. Ash Grove's actual NOx emission level of 1198 tpy is adequate and the Leamington facility does not propose any change to their current limit of 2.8 lbs/ton clinker on a 30-day rolling average basis.

DAQ agrees with Ash Grove’s conclusion for NOx emission controls. Although some additional information should be supplied on potential improvements in efficiency to the existing SNCR system, DAQ does not recommend any changes to the existing level of control at this time.

5.0 Conclusion

Although some additional information should be supplied by the source regarding SNCR efficiency, the Leamington Cement Plant appears to be adequately controlled at this time for purposes of the Second Planning Period.