CF Industries, Inc.
Plant City Phosphate Complex
PSD-FL-339/0570005-019-AC
Hillsborough County

The project proposed by CF Industries, Inc. will increase the permitted production rate of the existing "C" and "D" Sulfuric Acid Plants (SAPs) from 2,600 to 2,750 tons per day. Several improvements to increase production capacity of the "C" and "D" SAPs are proposed, including:

- Replacement of potassium or sodium promoted vanadium catalyst with installation of cesium promoted vanadium catalyst;
- Replacement of the "C" SAP final and drying absorption tower packing with low pressure drop packing;
- Installation of a new tube side bypass on the No.3 cold gas heat exchanger;
- Installation of a bypass around the superheater/economizer, replacement of the existing No. 1 cross flow hot gas heat exchanger with a low pressure drop radial heat exchanger; and
- Installation of onsite oxygen generation, storage, and injection equipment suitable.

To accommodate the increase in sulfuric acid production, CF Industries is also requesting an increase in the maximum throughput rate of the Molten Sulfur Storage and Handling System from 930,750 tons per year (TPY) to 965,388 TPY. There will be no physical changes to the Molten Sulfur Storage and Handling System as part of this project. Only the permitted annual throughput rate will increase.

The proposed modification will result in a significant increase in emissions of sulfur dioxide (SO_2), sulfuric acid mist (SAM) and nitrogen oxides (NOx). The project is subject to Prevention of Significant Deterioration (PSD) review in accordance with Rule 62-212.400, Florida Administrative Code (F.A.C.). A Best Available Control Technology (BACT) determination is part of the review required by Rules 62-212.400 and 62-296, FAC. Descriptions of the process, project, air quality effects, and rule applicability are given in the Technical Evaluation and Preliminary Determination, accompanying the Department's Intent to Issue.

DATE OF RECEIPT OF COMPLETE BACT APPLICATION:

Original application received on January 22, 2004. BACT application was complete on April 20, 2004.

BACT DETERMINATION PROCEDURE:

In accordance with Chapter 62-212, F.A.C., this BACT determination is based on the maximum degree of reduction of each pollutant emitted which the Department of Environmental Protection (Department), on a case by case basis, taking into account energy, environmental and economic impacts, and other costs, determines what is achievable through application of production processes and available methods, systems, and techniques. In addition, the regulations state that, in making the BACT determination, the Department shall give consideration to the following:

- Any Environmental Protection Agency determination of BACT pursuant to Section 169, and any emission limitation contained in 40 CFR Part 60 - Standards of Performance for New Stationary Sources or 40 CFR Part 61 and 63 - National Emission Standards for Hazardous Air Pollutants.
- All scientific, engineering, and technical material and other information available to the Department.
- The emission limiting standards or BACT determination of any other state.
- The social and economic impact of the application of such technology.

The EPA currently stresses that BACT should be determined using the "top-down" approach.
The first step in this approach is to determine, for the emission unit in question, the most stringent control available for a similar or identical emission unit or emission unit category. If it is shown that this level of control is technically or economically unfeasible for the emission unit in question, then the next most stringent level of control is determined and similarly evaluated. This process continues until the BACT level under consideration cannot be eliminated by any substantial or unique technical, environmental, or economic objections.

The air pollutant emissions from this facility can be grouped into categories based upon the control equipment and techniques that are available to control emissions from these emission units. Using this approach, the emissions can be classified as indicated below:

- ***Combustion Products*** (SO_2, NOx, PM). Controlled generally by good combustion of clean fuels.
- ***Products of Incomplete Combustion*** (CO, VOC). Controlled generally by proper combustion.

Grouping the pollutants in this manner facilitates the BACT analysis because it enables the equipment available to control the type or group of pollutants emitted and the corresponding energy, economic, and environmental impacts to be examined on a common basis.

Although all of the pollutants addressed in the BACT analysis may be subject to a specific emission limiting standard as a result of PSD review, the control of "non-regulated" air pollutants is considered in imposing a more stringent BACT limit on a "regulated" pollutant (i.e., PM, SO_2, H_2SO_4, fluorides, etc.), if a reduction in "non-regulated" air pollutants can be directly attributed to the control device selected as BACT for the abatement of the "regulated" pollutants.

BACT EMISSION LIMITS PROPOSED BY APPLICANT:

The applicant proposed the following emission limits from the "C" and "D" sulfuric acid plants.

POLLUTANT	EMISSION LIMIT (lb/hr)	LIMIT BASIS (lb/ton H2SO4)	CONTROL TECHNOLOGY
SO_2	441	3.5; 24-hr basis 3.85; 3-hr basis	Double Absorption Process
SAM	11	0.10	Fiber Mist Eliminators
NOx	16	0.14	Good Combustion Practice

The applicant has proposed to use the existing double absorption process and incorporation of cesium promoted catalyst in the entire 4th pass of the converter to achieve the proposed limits for the sulfuric acid plants.

BACT POLLUTANT ANALYSIS

The process by which sulfuric acid is produced is the same process by which SO_2 and sulfuric acid emissions are controlled.

The SAPs utilize double absorption technology. Molten sulfur with physical characteristics much like fuel oil sulfur is burned in a furnace with dried atmospheric oxygen to produce SO_2. The SO_2 is catalytically oxidized to sulfur trioxide (SO_3) over a bed of vanadium pentoxide. The SO_3 is then absorbed in a recirculating stream of sulfuric acid (H_2SO_4) to produce additional H2SO4.

The remaining SO_2, not previously oxidized, is passed over a final converter bed of catalyst and the SO_3 produced is then absorbed in H_2SO_4 in a second absorber. SO_2 and sulfuric acid mist emissions result from the process, as well as a small amount of NOx.

The control equipment for the SAPs consists of two systems in series. The first system is integral to the H_2SO_4 production process and is the double contact process where the converted SO_3 emissions from the sulfur combustion are absorbed by water in a tower. This process is at least 99 percent efficient at absorbing SO_3. This system is considered process equipment and not considered control equipment. The second system is a high-velocity mist eliminator, which causes moisture (droplets containing sulfuric acid mist) from the double-contact process to be removed from the air stream by impingement. This process is at least 90 percent efficient at removing SAM from the air stream and, therefore, recovering the product.

The proposed project includes an increase in the production rate of the existing "C" and "D" SAPs to 2,750 tons per day, each. It involves upgrading and/or replacement of plant equipment to accomplish the production increases, as described in the permit application. The primary improvement will be the incorporation of cesium promoted vanadium catalyst into the 4th pass of the converter (beds 4a and 4b).

Cesium promotion allows operation at lower temperature and thus a more complete approach to equilibrium in the final pass (i.e. more SO_2 gets converted to SO_3). The particular formulations available in recent years have optimized shapes that are basically hollow cylinders with ribbed sides. They have star, daisy, or asterisk shapes when viewed from the end. They also have greater vanadium concentration than conventional catalysts.

The result is that installation of this catalyst allows greater production due to lower operating pressure and temperature, and higher activity. If production is not increased, the catalyst allows for lower emissions. Emissions increase on a lb/hr basis and on a lb/ton of product basis. Therefore a lb/ton limit directly affects maximum production.

In a modification for the purpose of increasing production, a balance is required so that the benefits of the more effective catalyst do not accrue only to production or only to lower emissions which would defeat the purpose of the modification.

According to the applicant, "C" SAP will undergo turnaround initially in the first week of June 2004. CF Industries, Inc. has selected Haldor Topsoe to provide the cesium promoted catalyst for "C" SAP. The cesium catalyst product is a VK69 12mm daisy design product. In quoting from a letter from Haldor Topsoe to the applicant dated April 7, 2004, "Our modeling indicates that with 165,000 liters of VK69 cesium catalyst installed in the 4A and 4B converter beds the emissions at the start of run immediately after a turnaround would be 3.12 lbs of SO_2 per ton of acid produced and after 3 years at the end of a turnaround cycle the emissions would be 3.43 lbs of SO_2 per ton of acid produced".

Based on this analysis, the Department has reasonable assurance that the "C" SAP can meet a ***BACT limit of 3.5 lbs of SO_2 per ton of 100% acid, 3-hour rolling average***. This is less than the present NSPS based limit of 4 lb/ton applicable to the "C" SAP.

According to the applicant the "D" SAP will be undergoing turnaround in the fall of 2004. They have requested that they should be given the option of utilizing other catalyst vendors and products if those vendors can guarantee equal or better performance than the Haldor Topsoe product. The Department has no objection to that request, as long as the applicant installs 165,000 liters of cesium promoted catalyst in the 4th pass of the "D" SAP converter and meets the same ***BACT limit of 3.5 lbs of SO_2 per ton of 100% acid, 3-hour rolling average***.

In an effort to determine the performance of an acid plant utilizing cesium promoted catalyst in the entire 4th pass of a converter, the Department will require the applicant to provide continuous emission monitor results on a quarterly basis for three years (turnaround cycle) for both "C" and "D" SAPs. The data can be presented in a graphical representation against time, indicating the production rate as well as 3-hour rolling averages of SO_2 emissions. This requirement will be included as a specific condition in the permit. The data can be used by the Department for any future SO_2 BACT determinations of sulfuric acid plants.

Recent SAM compliance test data for "C" and "D" SAPs indicates that the average SAM emissions are between 0.03 and 0.05 lb/ton. These SAM levels are less than the proposed allowable emissions of 0.10 lb/ton for the "C" and "D" SAPs. For reference the present limit is 0.15 lb SAM/ton in accordance with the NSPS for sulfuric acid plants. High efficiency mist eliminators will be used to achieve the BACT emission limit for SAM.

The applicant accepted the NOx emission limit of 0.12 lb/ton of acid produced. This is the current BACT limit established for other acid plants. The Department agrees with the applicant that continued use of good combustion practices is considered BACT for NOx.

Control options involving production of by-products or wastes have been rejected as BACT. There is no indication that add-on control methods are competitive with process improvements that result in production of additional sulfuric acid. Recovery of sulfuric acid mist is an economic necessity as well as an environmental requirement.

BACT DETERMINATION BY THE DEPARTMENT:

Based on the information provided by the applicant, the above analysis and other information available to the Department, the following emission limits are established employing the top-down BACT approach.

The proposed BACT for SO_2 for the "C" and "D" SAPs is the current double-absorption system with the addition of 165,000 liters of Haldor Topsoe cesium catalyst in the 4th pass of the "C" SAP converter and equivalent cesium catalyst that guarantees equal or better performance than Topsoe's product for the "D" SAP. The proposed BACT limit for "C" and "D" SAP is 3.5 lbs of SO_2 per ton of 100% H_2SO_4, 3-hour rolling average.

This determination is applicable only to the present project and does not represent a BACT determination for a greenfield site or a new unit at a brownfield site. Such a new project would have to consider all process options and a thorough cost-effectiveness evaluation on the basis of cost per ton of SO_2 removed.

The proposed BACT for SAM emissions is the use of high-efficiency mist eliminators. The proposed emission limit for the "C" and "D" SAP is 0.10 lbs of SAM per ton of 100% H_2SO_4. The proposed emission limit is reasonable based on previous BACT determinations, and is consistent with currently established BACT, based on recent PSD permits.

The proposed BACT for NOx emissions is the continued use of good combustion practices. The proposed NOx emission limit is 0.12 lbs of NOx per ton of 100% H_2SO_4.

POLLUTANT	EMISSION LIMIT (lb/hr)	LIMIT BASIS (lb/ton H2SO4)	CONTROL TECHNOLOGY
SO_2	401	3.5 3-hr rolling average	Double Absorption Process, cesium-promoted vanadium catalyst in the entire 4th bed.
SAM	11	0.10	Fiber Mist Eliminators
NOx	14	0.12	Good Combustion Practice

COMPLIANCE:

Compliance with the sulfur dioxide emission limit (3.5 lb/ton, 3-hour rolling average) shall be demonstrated with a certified continuous emission monitor. Start-up excess emissions shall be permitted for three hours for the sulfuric acid plants as endorsed in an agreement titled "Best Operational Start-Up Practices for Sulfuric Acid Plants", which is attached as Appendix A of the permit.

Annual compliance testing with the sulfur dioxide, sulfuric acid mist and nitrogen oxides limits shall be demonstrated using EPA Reference Methods 1, 2, 3, 4, 6C, 7E, 8 and 9 as appropriate, and contained in 40 CFR 60, Appendix A.
Tallahassee, Florida 32399-2400

DETAILS OF THE ANALYSIS MAY BE OBTAINED BY CONTACTING:

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Recommended By:

Trina L. Vielhauer, Chief
Bureau of Air Regulation

June 1, 2004
Date:

Approved By:

Michael G. Cooke, Director
Division of Air Resources Management

June 1, 2004
Date:

Note: *A copy of the original BACT Determination document can be found with the project file for Permit No. PSD-FL-339/0570005-019-AC.*