Illinois Environmental Protection Agency
Bureau of Air, Permit Section
Springfield, Illinois

Project Summary for a Construction Permit Application from Archer Daniels Midland Company for Changes to the Lysine Manufacturing Department at Its Manufacturing Complex, in Decatur Illinois

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I. INTRODUCTION

Archer Daniels Midland Company ("ADM") has requested a construction permit for various changes to the Lysine Manufacturing Department at its Decatur complex. ADM makes lysine from dextrose for use as a supplement in animal feed. The changes would increase ADM's lysine manufacturing capacity.

The Illinois EPA has reviewed the application and has made preliminary determinations that the application meets applicable requirements. Accordingly, the Illinois EPA has prepared a draft of the air pollution control construction permit that it would propose to issue. However, before issuing the construction permit, the Illinois EPA is holding a public comment period to receive comments on the proposed issuance of the permit and the terms and conditions of the draft permit.

II. PROJECT DESCRIPTION

Lysine is an essential amino acid produced by ADM as a nutritional supplement for animal feeds. ADM manufactures lysine via fermentation of dextrose. ADM's Lysine Department uses fermentation to convert dextrose, which is produced in ADM's corn plant, to lysine. Fermentation is a biological process in which a selected microorganism is used under managed process conditions to convert an appropriate feedstock to a desired product[1]. The conversion of dextrose to lysine takes places in a number of fermentation tanks, which are operated on a batch basis. After each batch is completed, the broth from the fermentation tanks is then refined by various process equipment to reduce its water content and make a concentrated liquid lysine product. A portion of the concentrated liquid lysine is processed in steam-heated spray dryers and packaged for sale as a dry lysine product.

The fermentation of dextrose to produce lysine generates an off-gas stream that is rich in carbon dioxide (CO_2). This off-gas stream also contains low concentrations of volatile organic compounds (VOC), for example, ethanol[2]. Small amounts of VOC are also emitted from the downstream drying and dry material handling operations. The drying and handling of dry lysine emits particulate matter (PM). These PM emissions are controlled by various filters or baghouses.

The proposed project would include changes to the Lysine Department to increase its capacity to approximately 450,000 tons of lysine per year. The service of certain existing emission units would be changed for

[1] The most common example of fermentation is production of alcohol, in which a brewer's yeast is used to convert sugar or carbohydrate to alcohol.

[2] The vent system for fermentation tanks in ADM's BioProducts facility serves fermentation tanks for a number of products other than lysine. Due to the volume of air flow from the tanks, which conduct aerobic fermentation, and the potential for foam to form on the surface of the liquid, the off-gas streams go to a common header that serves a number of process water scrubbers before being released to the atmosphere. The design of these scrubbers is such that they have minimal impact on VOC emissions from the various fermentation processes. Accordingly, the emissions from lysine fermentation are determined based upon "uncontrolled" emissions, as present in the exhaust from the fermentation tanks. In addition these water scrubbers are not considered emission control equipment as they are neither designed to nor relied upon to reduce emissions.

lysine production. Certain existing units in the Lysine Department would be modified and certain new equipment would also be constructed.

The project would also involve increases in the operation of the boilers in ADM's existing Cogeneration Plant to supply the additional steam needed by the Lysine Department. The Cogeneration Plant has nine coal-fired fluidized bed boilers, Boilers 1 through 9. Emissions of the boilers are controlled with good combustion practices (carbon monoxide (CO) and VOC) and the fluidized beds (sulfur dioxide or SO_2) SO_2) and by selective noncatalytic reduction (nitrogen oxides or NOx) and baghouses (particulate matter or PM). These boilers would not be modified as part of this project. In this regard, this permit would not authorize physical changes to these boilers or provide for increases in emissions over permitted levels as set by the construction permits for these boilers, Permits 85060030, 94020006 and 97050097.

III. PROJECT EMISSIONS

The project would increase in emissions of VOC, PM and CO_2 resulting from the Lysine Department. The project would be accompanied by increases in emissions of VOC, PM, NOx, SO_2, and CO_2 and other GHG from the existing Cogeneration Plant.

The maximum increases in emissions of different pollutants that are expected to result from this project, as would be provided for by the draft permit, are summarized below. The actual increases in emissions will be less than the permitted emissions to the extent that the Department would operate at less than its maximum capacity and control equipment normally operates to achieve emission rates that are lower than the applicable standards and limits.

Permitted Annual Emissions Increase from the Project (Tons/Year)

Pollutant	PM[a]	PM_{10}[b]	$PM_{2.5}$[c]	NO_x[d]	SO_2[d]	CO[d]	VOM	GHG
Lysine Department	17.4	9.1	5.4	-	-	-	82.4	156,068
Cogeneration Plant	7.2	5.7	3.8	41.1	153.0	17.3	0.4	108,450
Total	24.6	14.8	9.2	41.1	153.0	17.3	82.8	264,518

Notes:
a. Particulate matter including condensable particulate as measured by USEPA Method 202.
b. PM_{10} including condensable particulate as measured by USEPA Method 202.
c. $PM_{2.5}$ including condensable particulate as measured by USEPA Method 202.
d. Increase in emissions associated with increase coal usage at existing coal fired boilers.

IV. APPLICABLE EMISSION STANDARDS

The application shows that the proposed project will readily comply with applicable state and federal emission standards, including the emission standards of the State of Illinois (35 Illinois Administrative Code: Subtitle B) and applicable federal emission standards adopted by the United States EPA (40 CFR Part 60 and 40 CFR Part 63).

The Lysine Department is not a major source for emissions of hazardous air pollutants (HAPs). HAPs will make up at most a fraction of the VOC emissions. Accordingly, the potential emissions from this Department are and will be less than 10 tons of an individual HAP (e.g., acetaldehyde), and will be less than 25 tons in aggregate for total HAPs. Therefore, this Department is not subject to National Emission Standards for Hazardous Air Pollutants, adopted by USEPA under 40 CFR 63. This project is also not subject to review under Section 112(g) of the federal Clean Air Act as a major modification for emissions of HAPs.

V. APPLICABILITY OF PREVENTION OF SIGNIFICANT DETERIORATION (PSD)

Since ADM's existing Decatur complex is already a major source of emissions, the criterion for whether the proposed project is considered a major modification under the federal rules for Prevention of Significant Deterioration (PSD), 40 CFR 52.21, is whether the increases emissions from the project for one or more pollutants regulated by PSD would qualify as significant, as defined by the PSD rules. The project meets this criterion for VOC, NOx, SO_2 and GHG with increases in permitted annual emissions that are each greater than the PSD significant emission rate. The project is therefore potentially subject to the substantive requirements of the PSD rules for these pollutants. The increases in emissions of PM and CO from the project are not significant so that PSD does not apply for these pollutants.

The substantive requirement of the PSD rules that potentially apply to a major project for a pollutant are: 1) A case-by-case determination of Best Available Control Technology (BACT), 2) An ambient air quality impact analysis to confirm that the project would not cause or contribute to a violation of the National Ambient Air Quality Standard(s) (NAAQS) or applicable PSD increment(s); and 3) An assessment of the impacts on soils, vegetation and visibility.

Although the CO_2 emissions from the Lysine Department would increase with this project, with a projected increase of about 160,000 tons of CO_2 per year, the substantive requirements of PSD are not applicable to these emissions. This is because USEPA has deferred applicability of PSD to biogenic CO_2 emissions (i.e., CO_2 emissions from bioenergy and other biogenic stationary sources) until July 21, 2014. The CO_2 emitted from the lysine fermentation process is considered biogenic because the feedstock, dextrose, is made from corn.[3]

[3] In its application, ADM included an analysis of Best Available Control Technology (BACT) for the CO_2 emissions from the lysine fermentation process, as would have been required if its CO_2

Although the project would increase emissions of NOx, SO_2 and greenhouse gases (CO_2) from ADM's Cogeneration Plant, the boilers at this plant would not be subject to a case-by-case determination of BACT for these pollutants under the PSD rules. This is because the boilers would not undergo any physical modifications. This permit also does not provide for increases in emissions over permitted levels as set by the applicable PSD permits for these boilers.[4] Accordingly, the boilers are only subject to the substantive requirements of PSD other than the BACT requirement.

VI. BEST AVAILABLE CONTROL TECHNOLOGY (BACT)

I. Introduction

To address the BACT requirements of the PSD rules for the new and modified units in the Lysine Department, ADM submitted a "top-down" BACT demonstration in its application reflecting its judgment as to the emission control technologies and associated emission limits that should be considered BACT under the PSD rules. This demonstration addressed the VOC emissions from new and modified units, since VOC is the only pollutant which they emit that is subject to PSD.

The Illinois EPA has reviewed the material submitted by ADM and made its independent determination of BACT. In addition to the material submitted by ADM, the Illinois EPA's determination of BACT relies upon its general knowledge of the types of operations at the proposed plant. As explained below, the Illinois EPA concurred with ADM's assessment.

II. BACT for the Fermentation Process

The control technologies that are commonly used to control VOC emissions from fermentation tanks are wet scrubbing and oxidation. As such, both wet scrubbing and oxidation are technically feasible control options for reducing VOC emissions from the lysine fermentation tanks.

In wet scrubbing, VOC is absorbed from a gas stream by contact with water, generally in a packed tower. Relatively large volumes of water are necessary to achieve high control efficiencies on dilute streams such as a lysine fermentation vent. For this reason, a practical upper limit on wet scrubbing efficiency for a dilute VOC stream such as a lysine fermenter vent is 80%. Wet scrubbing for VOC control is generally most effective on high-concentration ethanol fermentation vent streams where the ethanol can be collected and recovered to the process.

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emissions were subject to PSD. However, this analysis is no longer relevant because USEPA has amended the PSD rules, deferring applicability of PSD to biogenic CO_2 for three years.

[4] Under the PSD rules, 40 CFR 52.21(j)(3), the BACT requirement of the PSD rules does not apply to existing units that are not being modified.

In oxidation or afterburner technology, combustion is used to control VOC emissions. There are several types of oxidation systems but all employ heat to destroy VOC, reducing it to CO_2 and water. For streams with low VOC concentrations such as a lysine fermentation vent, natural gas or other supplemental fuel must be combusted to raise the gas stream's temperature to the range in which the VOC will be oxidized. Although the types of systems can vary, oxidation systems can all readily achieve at least 90 percent control, with control efficiencies of up to 99 percent achievable under ideal applications. For non-catalytic or thermal oxidation, these technologies function by raising the temperature of the gas stream being treated to between 1,400 and 1,600°F for about 1 to 2 seconds. Given sufficient mixing, this time-temperature condition usually results in high destruction efficiency of most VOC. Secondary pollutants can be produced by thermal oxidation, including NOx, CO, and CO_2. For catalytic oxidation, similar control efficiencies are achieved at lower temperatures with combustion facilitated by a catalyst bed. However, the gas stream must still be heated using supplemental fuel to the operating temperature range of the catalyst. In ADM's experience, the cost difference between thermal and catalytic oxidation is not significant and very similar; therefore, ADM believes that a review of catalytic oxidation was effectively covered by ADM's review of thermal oxidation technology.

Both oxidation and wet scrubbing are technically feasible control options for VOC emissions from the lysine fermentation tanks, with oxidation being the top performing technology. To demonstrate that neither of these technologies should be required as BACT, ADM evaluated the economic (cost), energy, and environmental impacts of controlling lysine fermentation with thermal oxidization and wet scrubbing.

Thermal oxidation with regenerative heat recovery, would have a very high cost impact, approximately $56,000 per ton of VOC controlled. This high cost occurs because VOC is present in low concentrations in the off-gas stream. Even with very effective recovery of heat, substantial qualities of supplemental fuel, i.e.; natural gas would be required for effective oxidation. Based on this assessment, the Illinois EPA concludes that the high cost of thermal oxidation does not justify the VOC reductions that could be attained by using this technology. Thermal oxidation would only become cost-effective if the concentration of VOC in the off-gas were much higher. This is not practical because of the intrinsic nature of lysine fermentation, which is an aerobic process in which VOC is only present as an incidental byproduct of the biological fermentation process. The circumstances would be similar for catalytic oxidation. This is because similar quantities of fuel would be needed since heat recovery would not be effective at the lower operational temperature of a catalytic oxidizer.

Use of wet scrubbing for lysine fermentation would have an even higher cost impact, over $75,000 per ton of VOC controlled. In addition, this wet scrubbing would consume significant water resources needing nearly two billion gallons of water per year to achieve 80% VOC control. Based on this assessment, Illinois EPA also concludes that wet scrubbing has excessive impacts and should not be considered as the basis for a BACT.

The USEPA's RACT, BACT, and LAER Clearinghouse (database) does not include any determinations specifically for VOC emissions from lysine fermentation. Nearly all of the determinations for fermentation in the database are for ethanol fermentation operations. These operations differ significantly from lysine fermentation. The VOC concentration, as carbon, in the off-gas from ethanol fermentation is on the order of 20,000 or 30,000 ppmv and add-on control has been required as BACT. By contrast, the concentration of VOC, as carbon, in the exhaust from ADM's lysine fermentation tanks will be orders of magnitude lower, no more than 50 ppmv. As discussed above, with this low concentration in the exhaust stream, the cost impacts for use of add-on control for VOC emissions would be excessive.

This determination is consistent with a 2006 BACT determination in the database for the fermentation operation at ADM's Polymers Plant in Clinton, Iowa. This is the only determination in the database for a fermentation process with comparable levels of VOC in the exhaust from the fermentation tanks. The VOC BACT determination for this operation did not require use of add-on control and the VOC BACT limit was set at 40 ppmv, as carbon, 30-day average.

Based on these considerations, the VOC BACT limit for the modified fermentation operation at the Lysine Department is proposed to be set at 50 ppmv, as carbon, dry basis, averaged over the batch cycle, determined in the exhaust ductwork from the fermentation tanks, at the inlet to the header serving the process water scrubbers. This limit would be consistent with the demonstrated level of VOC in the exhaust from fermentation to produce lysine, which is a different process than "polymer fermentation." In addition, this limit is proposed to generally apply as a as a batch average, rather than a 30-day average. For purpose of emission testing to confirm compliance with this limit, when quantitative measurements of emissions would be made, VOC emissions would be determined as an average over at least three fermentation batch cycles.[5]

III. BACT for Drying and Other Downstream Operations

However, due to lower concentration for the dryers and dry material handling units than the concentration present at the fermentation tanks, the addition of control is considered cost

[5] If one set of measurements was not completed or determined to be flawed, compliance could be determined from the average of two batch cycles, as generally provided by 40 CFR 60.11(f).

prohibitive even when added to process vent for BACT analysis. BACT is set at "Trivial" levels of emissions, consistent with ADM's projections, at which add-on control is not appropriate.

Based on these considerations, the BACT limit for VOC emissions from each dryer is proposed to be set at 1.0 lb/hr, on a 3-hour average.

The VOC emissions from each affected handling unit shall be negligible Based on these considerations, the BACT limit for VOC emissions from each new dry material handling unit is proposed to be set at 0.1 lb/hr or 10 ppmvd, whichever is greater, on a 3-hour average.

VII. AIR QUALITY ANALYSIS

I. Introduction

An ambient air quality analysis was conducted by ADM to assess the impact of the emissions of the proposed project. 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. Air quality standards have been established for NO_2 and SO_2. In addition, VOC and NOx are precursors to the formation of ozone in the atmosphere, and USEPA has adopted an ambient air quality standard for ozone.[6] The environmental consulting firm RTP Environmental Associates of Raleigh, North Carolina performed the air quality modeling on behalf of ADM. Based on this modeling and accompanying review by the Illinois EPA, the air quality impact analysis for the proposed project is acceptable.

II. Air Quality Analysis for NO_2 and SO_2

The starting point for determining the extent of the modeling necessary for the proposed project was evaluating whether the project would have a "significant impact" for NO_2 or SO2. The PSD rules identify Significant Impact Levels (SIL), which represent thresholds triggering a need for more detailed modeling.

The increase in NOx and SO_2 emissions from this project are due to the increase in output from ADM's existing cogeneration plant. Initial air quality modeling of the increase in emissions due to this project was conducted by the consultant for NO_2 and SO_2. This modeling was performed to demonstrate that the significant impact level (SIL) for each averaging period for NO_2 and SO_2 would not be exceeded as shown below.

[6] USEPA's has not adopted air quality standards for GHG. In addition, GHG emissions pose concerns for air quality on a global level, through global warming and climate change. Accordingly, USEPA has not developed modeling tools to address GHG emissions in PSD permitting.

Full load operation, as well as reduced loads of 75% and 50%, was modeled for the worst case boiler flue emissions. The following table summarizes the maximum impacts predicted by the model.

Significant Impact Modeling for NO_2 and SO_2 ($\mu g/m^3$)

Pollutant	Averaging Period	Maximum Concentration	PSD de minimis Concentration	National Ambient Air Quality Standard (NAAQS)
NO_2	1 Hour	1.51	7.56	188
NO_2	Annual	0.023	1.0	100
SO_2	1 Hour	5.607	7.84	196
SO_2	3 Hour	4.865	25.0	1,300
SO_2	24 Hour	1.759	5.0	-
SO_2	Annual	0.084	1.0	-

* The 1-hour significant impact levels were calculated as 4% of the 1-hour NO2 NAAQS; USEPA) and 4% of the 1-hour SO_2 standard. Both 1-hour SIL's are converted from ppb to ug/m3 to facilitate the comparison with modeled values.

III. Air Quality Analysis for Ozone

The air quality analyses for ozone conformed to the current guidance and requirements of the USEPA and the Illinois EPA. The analyses indicate that this project will not cause or contribute to a violation of the air quality standards or PSD increments. For ozone, the predicted impact was determined to not threaten compliance with the applicable ambient air quality standard.

The analysis for ozone was conducted using a screening method developed by USEPA for PSD permitting to address the historic one-hour ozone standard. The analysis confirms that the project will not cause a violation of the ozone air quality standard. For this purpose, information on current air quality for ozone in the region is available from an ambient monitoring station operated by the Illinois EPA in Decatur, Illinois. These data show that air quality in the region complies with the historic one-hour ozone standard.

With a VOC to NOx ratio of 2:1 and an increase of 83 tons/year of VOC, the predicted maximum 1-hour impact from this project is 0.013 ppm, as per USEPA's VOC/NOx Point Source Screening Tables (USEPA, 1988). When combined with the Decatur monitor 1-hour ozone design value of 0.082 ppm for the 2007-09 periods, a maximum predicted 1-hour ozone value of 0.095 ppm is produced, which is well under the former 1-hour standard of 0.12 ppm. The use of the VOC/NOx screening tables is a very conservative estimate of ozone producing potential, so additional analysis is not necessary.

IV. Impacts on Soil, Vegetation and Visibility

The application addresses the potential impact of the proposed project on soils, vegetation, and visibility. The assessment

concludes that the project would not adversely impact soil, vegetation or visibility. This is because the maximum air quality impact predicted for the project is de minimis, so that existing air quality should not be affected measurably by this project.

An additional impact analysis was also performed to determine potential air quality impacts on soils, vegetation, and visibility from this expansion. In regard to soils, even assuming that the annual average concentration maximum of NO2 and SO2 were entirely deposited onto the soil, a very trivial amount of acidification would occur. In regard to vegetation, threshold values for harm to vegetation, including crops and trees, are far above the peak concentrations that would result from this project. The impact from VOC upon vegetation was assessed by taking the screening method maximum impact for ozone (referenced above) and comparing it to USEPA vegetation screening levels. The predicted maximum ozone impact is well below the screening values for sensitive plant species. For visibility, the modeling guidelines relevant indicates that any source where the emissions of NO2 and SO_2 (in tons per year) divided by the distance (in kilometers) to the nearest Class I area (referred to as Q/D) is less than 10 will not cause or contribute to degradation of visibility at that Class I area. The distance from ADM to the nearest Class I area (Mingo National Wildlife Refuge) is about 330 kilometers, and the sum of NO2 and SO_2 emissions from the project is 194.1 tons per year. The Q/D value is 0.59, much less than the threshold of 10. This leads to the conclusion that this expansion will not cause or contribute to a degradation of visibility.

VIII. PERMIT CONDITIONS

The conditions of the permit would set forth the air pollution control requirements that the project must meet. These requirements include the applicable emission standards that apply to the project. They also include the measures that must be used and the emission limits that must be met as BACT for emissions of VOC from the modified Lysine Department.

The permit also establishes enforceable limits on the amount of VOC, NO_2 and SO_2 for which the project is permitted. In addition to annual limitations on emissions, the permit includes short-term emission limits and operational limits, as needed to provide practical enforceability of the annual emission limits. As previously noted, actual emissions associated with the project would be less than the permitted emissions to the extent that emission units operate at less than capacity and control equipment normally operates to achieve emission rates that are lower than the applicable standards and limitations.

The permit also establishes appropriate compliance procedures for the ongoing operation of the Lysine Department, including requirements for emission testing, required work practices, operational monitoring,

recordkeeping, and reporting. These measures are imposed to assure that the operation and emissions of the Department are appropriately tracked to confirm compliance with the various limitations and requirements established for individual emission units.

IX. REQUEST FOR COMMENTS

It is the Illinois EPA's preliminary determination that the proposed project meets applicable state and federal air pollution control requirements. The Illinois EPA is therefore proposing to issue a construction permit for the project.

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