EVALUATION OF NITROGEN DEPOSITION AT CHASSAHOWITZKA CLASS I AREA

FLORIDA ROCK INDUSTRIES, INC.
BROOKSVILLE CEMENT PLANT
US 98 at BRITTLE ROAD
HERNANDO COUNTY, FLORIDA

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INTRODUCTION

Florida Rock Industries, Inc. proposes to construct a Portland cement plant near Brooksville, Hernando County, Florida. The proposed project is less than 50 kilometers (km) from Chassahowitzka Class I area, and all portions of the Class I area are less than 50 km from the proposed source. The project will be subject to Prevention of Significant Deterioration (PSD) review, which includes an impact analysis in the Class I area for particulate matter (PM10), sulfur dioxide (SO_2) and nitrogen oxides (NOx). Additionally, the U.S. Fish and Wildlife Service (FWS) is requesting an analysis of nitrogen deposition.

The deposition analysis has been performed in substantial accordance with the document *Interim Guidance for Deposition Analyses For PSD Permit Applicants Near Chassahowitzka National Wildlife Refuge* (U.S. Fish and Wildlife Service, Air Quality Branch, March 2000).

CONCERN THRESHOLD

The U.S. Fish and Wildlife Service (FWS) has established a concern threshold for nitrogen deposition in Chassahowitzka NWR. The FWS defines the concern threshold as a significant increase in nitrogen deposition over the background deposition rate. The current total inorganic nitrogen (NH_4 plus NO_3) deposition rate to Chassahowitzka NWR is approximately five kilograms per hectare per year (kg/ha/yr). This estimate is derived from the two years of National Atmospheric Deposition Program (NADP) data now available for Chassahowitzka NWR, 1997-1998. For this period, average inorganic nitrogen wet deposition is approximately 2.6 kg/ha/yr. Assuming that dry deposition equals wet deposition, total inorganic nitrogen deposition is approximately five kg/ha/yr (Note: FWS recognizes that dry deposition may not always equal wet deposition; however, FWS considers this to be the best available estimate at present.) FWS considers a significant increase in deposition to equal four percent or more of the background total deposition. Four percent is the same value proposed by the Environmental Protection Agency (EPA) to evaluate significant contributions to Class I PSD air quality increments. Using this significance value and a background deposition rate of five kg/ha/yr, an additional nitrogen deposition of 0.2 kg/ha/yr of inorganic nitrogen would be considered significant by the FWS.

The wet deposition rate provided by the National Atmospheric Deposition Program for the Chassahowitzka site is for inorganic nitrogen expressed in terms of kilograms per hectare (kg/ha) as nitrogen[1]. It follows that the concern threshold of 0.2 kg/ha/yr of additional inorganic nitrogen is expressed in terms of nitrogen. Therefore, the deposition rate calculated in the deposition analysis will be expressed in terms of kg/ha/yr as nitrogen.

<u>NITROGEN OXIDES CONCENTRATIONS</u>

To evaluate contributions to deposition, the ISCST model (version 00101) was used to obtain the concentration of nitrogen oxides (NOx) at Chassahowitzka. A receptor list of 151 receptors at Chassahowitzka was prepared, and the mathematical average NOx concentrations for all receptors were determined for each of the five years of meteorological data. The greatest annual average impact of FRI NOx emissions was with 1991 meteorological data and was 0.11521 $\mu g/m^3$.

As the source is less than 50 kilometers from all receptors in the Class I area, the Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 1 modeling guidance was used with the EPA ISCST model, to determine nitrogen deposition.

DEPOSITION VELOCITY

Deposition velocities for nitric acid (HNO_3) were obtained from the Clean Air Status and Trends Network (CASTNET). A value of 1.222838 cm/sec (0.01222838 m/sec), which is the average of 43 samples from the Florida CASTNET site in Sumatra, Florida, was selected as the deposition velocity for HNO_3. This value is consistent with a value of 1.283854 cm/sec averaged from 1907 samples from over 70 monitoring stations across the United States[2]. This value is also consistent with a dry deposition for HNO_3 provided in the *Mercury Study Report to Congress*. The average deposition velocity from this reference for the agricultural land-use category, averaged over all seasons and atmospheric stability categories, is 1.24 cm/sec[3].

CALCULATION OF NITROGEN DEPOSITION FOR LEVEL I ANALYSIS

Deposition rates of total nitrogen were calculated in substantial accordance with the procedures found on page 5-6 of the IWAQM Phase 1 document. The final deposition rate is expressed as kilograms of total inorganic nitrogen per hectare per year (kg/ha/yr). A Level I approach for depositional impacts assumes that concentrations of NOx are deposited as HNO_3. Since the steady-state, Gaussian plume models do not actually remove any mass from the plume, when run in their recommended dispersion modes, this will provide a conservative deposition estimate, as all NOx is assumed to reach the Class I area.

The step-by-step procedure for determining nitrogen deposition is as follows:

1. Run appropriate model for Level I analysis; the ISCST model (Version 00101) to determine the average NOx concentrations in the Class I area.

2. Assume no conversion NOx to other species (i.e., assume all NOx is emitted as NO_2).

3. Convert the NO_2 concentration to an HNO_3 concentration by multiplying the concentration of NO_2 ($\mu g/m^3$), by the ratio of the molecular weights of the secondary species (HNO_3) to the primary species (NO_2). The molecular weights of NO_2 and HNO_3 are 46 and 63. Thus multiplying the concentration of NO_2 ($\mu g/m^3$) by 1.37 will yield the concentration of HNO_3 ($\mu g/m^3$), as follows:

   0.11521 $\mu g/m^3$ of NO_2 (annual average) X 1.37 = 0.15784 $\mu g/m^3$ of HNO_3

4. The averaging times for nitrogen deposition will generally require a long-term value (annual). Since the Level I model produces average values, they must be converted to total rates. Multiply the concentration of HNO_3 by the number of seconds in the averaging time of interest to obtain a total rate (i.e., 3.1536×10^7 seconds/year).

$0.15784\ \mu g/m^3$ of HNO_3 X 3.1536×10^7 seconds/year = $4.9776 \times 10^6\ \mu g\text{-}sec/m^3/yr$

5. Multiply the result by the deposition velocity for HNO_3 (0.01222838 m/sec). This will result in a deposition value in units of $\mu g/m^2/yr$.

$4.9776 \times 10^6\ \mu g\text{-}sec/m^3\text{-}yr$ X 0.01222838 m/sec = $6.0868 \times 10^4\ \mu g/m^2/yr$

6. To convert to kg/hectare, multiply the result by 1×10^{-5}.

$6.0868 \times 10^4\ \mu g/m^2/yr$ X 1×10^{-5} = 0.60868 kg/ha/yr as HNO_3

7. To convert to inorganic nitrogen as expressed in terms of kg/ha/yr as nitrogen, multiply the deposition rate of HNO_3 by the ratio of the molecular weights of nitrogen to the secondary species (HNO_3). The molecular weights of N and HNO_3 are 14 and 63. Thus multiplying the deposition of HNO_3 (kg/ha/yr) by 0.22 will yield the deposition of inorganic nitrogen expressed in terms of kg/ha/yr as nitrogen.

0.60868 kg/ha/yr as HNO_3 X 0.22 = **0.13 kg/ha/yr as N**

CONCLUSION

As the deposition rate of additional inorganic nitrogen resulting from the source is less than the level of concern of 0.2 kg/ha/yr established by FWS, no adverse impacts to this air quality related value (AQRV) are expected.

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[1] e-mail from Bob Larson, NADP-UIUC, May 31, 2000.
[2] Clean Air Status and Trends Network (CASTNET), http://www.epa.gov/acidrain/castnet/, May 31, 2000.
[3] Mercury Study Report to Congress, Table 4-3, December 1997.