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October 1, 2010

Attention EPA Docket Center, EPA West (Air Docket)
Attention Docket ID No. EPA–HQ–OAR–2009–0491
U.S. Environmental Protection Agency
Mail Code: 2822T
1200 Pennsylvania Avenue, NW.
Washington, DC 20460

Re: Comments on U.S. EPA August 2, 2010 proposed "Federal Implementation Plans To Reduce Interstate Transport of Fine Particulate Matter and Ozone" ("Proposed Transport Rule") [75 FR 45210].

This letter is a supplement to the comments filed by Ohio EPA on October 1, 2010. The enclosed documents were used to support comment No.7 related to the need for Prevention of Significant Deterioration permits for the installation of sulfur dioxide scrubbers.

Please contact me at 644-614-2270 if you have any questions.

Sincerely,

Robert Hodanbosi

Robert F. Hodanbosi, Chief
Division of Air Pollution Control

CO$_2$ Emissions from Installation of SO$_2$ Scrubber

Example: Alabama Gaston Plant

SO$_2$ Emissions for 2009 = 102,980 tons/yr [1]

Assume a 95% SO$_2$ Control Efficient Scrubber

$102{,}980 \frac{\text{tons } SO_2}{\text{yr}} \times 0.95 = 97{,}831 \frac{\text{tons}}{\text{yr}}$ SO$_2$ controlled

From a study of the installation of a SO$_2$ scrubber on a process line for a primary aluminum smelter [2]

$1{,}893 \frac{\text{Lb } SO_2}{\text{HR}}$ (INLET) $- 95 \frac{\text{Lb } SO_2}{\text{HR}}$ (OUTLET) = 1798 Lb/HR SO$_2$ CONTROLLED

For every lb of SO$_2$ controlled, CO$_2$ is released.

Increase in CO$_2$ emissions:

$3751 \frac{\text{Lb } CO_2}{\text{Hr}} - 2479 \frac{\text{Lb } CO_2}{\text{Hr}} = 1272 \frac{\text{Lb } CO_2}{\text{Hr}}$ increase

BH
10/1/10

As a fraction of SO_2 controlled:

1272 $\frac{Lb\ CO_2}{Hr}$ increase / 1798 Lb SO_2 / Hr controlled

or 0.707 lb CO_2 / lb SO_2 controlled

For the example case if Gatson installed a SO_2 scrubber, the increase would be:

97,831 $\frac{\text{tons } SO_2 \text{ controlled}}{Yr}$ x $\frac{0.707 \text{ lb } CO_2 \text{ increase}}{\text{lb } SO_2 \text{ controlled}}$

= 69,166 $\frac{\text{Tons } CO_2}{Yr}$ increase from chemical reaction in scrubber

Increases in CO_2 emissions from scrubber operation:

From U.S. EPA - parasitic load is between 0.7% to 2.3%.[3]

From Clean Air Markets - FGD systems typically require between 2-3% energy consumption of the plant[4]

For purposes of example, assume 2.0% additional load

2009 Gatson CO_2 emissions = 8,859,466 tons CO_2 / Yr[1]

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$8{,}859{,}466 \frac{\text{tons } CO_2}{\text{Yr}} \times 0.02 = 171{,}189 \frac{\text{tons } CO_2}{\text{Yr}}$ increase

Total increase equals:

$69{,}166 \frac{\text{Tons } CO_2}{\text{Yr}}$ (from scrubber reaction)

$+171{,}189 \frac{\text{tons } CO_2}{\text{Yr}}$ (from parasitic load increase)

$240{,}355 \frac{\text{tons } CO_2}{\text{Yr}}$ increase

This increase does not take into account that a well controlled facility may be operated at higher capacities in order for the utility to meet the overall budgets of the transport rule. Also attached is a document that illustrates the chemical reactions in an SO_2 scrubber.[5]

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10/1/10

①

Clean Air Markets - Data and Maps

Emissions

Facility Level Emissions Quick Report

Your query will return data for 949 facilities and 3322 units.

You specified: **Year(s):** 2009 **Program:** CAIRSO2

FILTER results by clicking on the Filter Data bar.
PRINT THIS PAGE using the buttons below.
DOWNLOAD ALL DATA using the buttons below (download is limited to 100,000 rows).
SORT results by clicking on a column name (once=ascending, twice=descending).

There are data caveats associated with the data you have requested. Click the Download Caveats to download the caveats. Click Here to jump to data caveats relevant to this page displayed in a table below.

New Quick Report | Print This Page | Download All Data | Report Definitions | Download All Caveats

Filter Data (Expand this toolbar to filter your results.)

1 2 3 4 5 6 Next 4 Pages Last (949 records in 10 pages of 100 records)

State	Facility Name	Facility ID (ORISPL)	Year	Program (s)	# of Months Reported	SO_2 Tons	NO_x Tons	CO_2 Tons	Heat Input (mmBtu)
AL	AMEA Sylacauga Plant	56018	2009	CAIRSO2	12	0.0	2.1	3,064.2	51,949
AL	Barry	3	2009	CAIRSO2	12	37,109.3	8,4[illegible]0.9	11,424,863.8	[illegible]759
AL	Calhoun Power Company I, LLC	55409	2009	CAIRSO2	12	1.2	29.6	72,907.9	1,164,122
AL	Charles R Lowman	56	2009	CAIRSO2	12	5,645.0	3,193.0	3,496,782.4	34,081,753
AL	Colbert	47	2009	CAIRSO2	12	16,524.6	4,424.5	3,242,688.4	31,534,029
AL	Decatur Energy Center	55292	2009	CAIRSO2	12	7.4	108.6	1,466,904.2	24,683,416
AL	Discover	55138	2009	CAIRSO2	12	0.0	1.6		8,248
AL	E B Harris Generating Plant	7897	2009	CAIRSO2	12	6.9	160.3	1,363,345.8	22,940,966
AL	E C Gaston	26	2009	CAIRSO2	12	102,980.3	10,292.3	8,859,466.1	86,349,614
AL	Gadsden	7	2009	CAIRSO2	12	3,925.8	795.3	365,722.4	3,697,799
AL	Gorgas	8	2009	CAIRSO2	12	5,027.7	5,373.4	5,695,993.9	55,516,562
AL	Greene County	10	2009	CAIRSO2	12	31,604.5	4,379.6	2,606,753.7	26,034,535
AL	Hog Bayou Energy Center	55241	2009	CAIRSO2	12	0.6	15.0	122,357.4	2,058,742
AL	James H Miller Jr	6002	2009	CAIRSO2	12	62,241.0	7,929.2	21,929,157.0	209,144,368
AL	McIntosh (7063)	7063	2009	CAIRSO2	12	0.1	17.3	18,263.5	307,320
AL	McWilliams	533	2009	CAIRSO2	12	5.2	125.4	1,026,631.0	17,273,214
AL	Morgan Energy Center	55293	2009	CAIRSO2	12	9.3	123.1	1,839,149.3	30,947,100
AL	Plant H. Allen	7710	2009	CAIRSO2	12	15.4	279.4	3,054,122.6	51,391,560

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Data Caveats

HATCH™

Alcoa Primary Metals
USA

Pre-Feasibility Report

SO2 Scrubbing for the INTALCO Primary Aluminum Smelter

H-325640
2
November 5, 2007

Project Report

PR325640.10001
Rev. 2, Page 1

November 5, 2007

Alcoa Primary Metals
SO2 Scrubbing for the INTALCO Primary Aluminum Smelter

DISTRIBUTION

Alcoa	Hatch
Michael Palazzolo	Martin Desmeules
James Schon	Don Wilson
	Stephan Broek

Pre-Feasibility Report

Table of Contents

GAS (lb/hr)	Fumes from one potroom	Fumes from 6 potrooms	Oxidation air	Clean gases	
N2	1,025,647	6,153,884	4,514	6,158,398	
O2	285,454	1,712,725	1,368	1,713,645	
CO2	413	2,479	3	3,751	
H2O	25,375	152,251	82	324,134	
H20 (l)	-	-	-	653	
SO2	316	1,893	-	95	
SO3	-	-	-	-	
HCl	-	-	-	-	
HF	5	32	-	1	
Particulate	5	32	-	11	
Mass flow (lb/hr)	1,337,216	8,023,295	5,967	8,200,687	
Volume flow (ACFM)	369,114	2,214,685	1,365	1,984,246	
Volume flow (SCFM)	302,481	1,814,887	1,343	1,877,773	
Temperature (°F)	189	189	77	98	
Pressure (Inch WG)	407.7	407.7	405.3	405.3	

LIQUID / SOLIDS (lb/hr)	Absorber recycle	Absorber bleed	pH loop	Hydroclone overflow	Hydroclone underflow
Liquid	30,849,560	78,847	25,708	46,671	6,467
Solids	5,444,040	13,914	4,537	4,086	5,291
Total	36,293,600	92,761	30,245	50,757	11,759
Solids concentration	15	15	15	8	45
Density (SG)	1.10	1.10	1.10	1.05	1.34
Flow (GPM)	66,050	169	55	96	18

LIQUID / SOLIDS (lb/hr)	Vacuum filter feed	Filter wash water	Rinse water	Filtrate	Gypsum
Liquid	6,467	-	10,530	16,068	929
Solids	5,291	-	-	26	5,265
Total	11,759	-	10,530	16,095	6,194
Solids concentration	45	-	-	0.2	85
Density (SG)	1.34	1.00	1.00	1.01	1.50
Flow (GPM)	18	-	21	32	-

LIQUID / SOLIDS (lb/hr)	Limestone	Process water	Limestone slurry to absorber		
Liquid	-	9,757	9,757		
Solids	3,252	-	3,252		
Total	3,252	9,757	13,009		
Solids concentration	100	-	25		
Density (SG)	2.80	1.00	1.19		
Flow (GPM)	-	-	-		

LIQUID / SOLIDS (lb/hr)	Process water intake	Water to absorber	Water to limestone preparation	Water to gypsum dewatering	Water for oxidation air cooling
Liquid	174,362	152,973	9,757	10,530	1,102
Solids	-	-	-	-	-
Total	174,362	152,973	9,757	10,530	1,102
Solids concentration	-	-	-	-	-
Density (SG)	1.00	1.00	1.00	1.00	1.00
Flow (GPM)	348	306	19	21	2

(3)

NCEE

NATIONAL CENTER FOR ENVIRONMENTAL ECONOMICS

Policy Innovation Impacts on Scrubber Electricity Usage

Ian Lange and Allen Bellas

Working Paper Series

Working Paper # 06-01
April, 2006

U.S. Environmental Protection Agency
National Center for Environmental Economics
1200 Pennsylvania Avenue, NW (MC 1809)
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http://www.epa.gov/economics

Policy Innovation Impacts on Scrubber Electricity Usage

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Policy Innovation Impacts on Scrubber Electricity Usage*

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Abstract
The introduction of scrubbers as a means of controlling sulfur dioxide pollution from stationary sources coincided with the implementation of the Clean Air Act of 1970. Since that time, there have been many policy changes affecting the electricity generation industry. These changes may be characterized as moving from direct regulation toward market-based incentives, both in deregulation or restructuring of power markets and adoption of market-based environmental regulation. These changes provide natural experiments for investigating whether the form of regulation can alter the rate of technological progress. Previous literature (Popp 2003, Lange and Bellas 2005) is mixed on whether advancements as a result of the switch to market-based environmental incentives have led to lower costs. This paper extends this literature by analyzing changes in scrubbers' use of electricity (also known as parasitic load) in relation to regulatory policy regimes. Results show that restructured electricity markets have led to a considerable (30-45%) decrease in parasitic load. Conversely, the change to a cap-and-trade system for sulfur dioxide has not led to a decrease.

*The views expressed in this paper are those of the authors and do not necessarily reflect those of the Environmental Protection Agency. The authors would like to thank Nathaniel Keohane and Carl Pasurka for their helpful conversations and suggestions.

Keywords: Market-based regulation, Electricity deregulation, Scrubbers
Subject Area: Costs of Pollution Control (17), Electric Power (34), Environmental Policy (52)

I. Background

Most proponents of market-based regulation point to the incentives for cost savings as an important justification for their use. When pollution (in the case of environmental policy) or electricity (in the case of generation policy) is priced at the margin, plants act to minimize the cost of producing a certain level of output. Many coal-fired power plants have flue gas desulfurization units (also known as scrubbers) to control the release of sulfur dioxide, and to a lesser extent, mercury. Scrubbers draw electricity from the plant, known as parasitic load, which is estimated to be between 0.7% and 2.3% of total generation (Keohane, 2006 and EPA, 2000). This load would be valued at approximately $2.0 million per scrubber, annually, at $0.05/KWh. Färe et al (2004) show the parasitic load does vary substantially from plant to plant. While market-based environmental regulation may have spurred reductions in scrubber electricity consumption to better compete with other abatement options, a similar argument can be made for restructured (or deregulated) electricity markets in that they allow a generator to profit from any savings in parasitic load. Concurrently, both changes have provided plants incentives for energy saving innovation in their use of scrubbers. This paper tests the hypothesis that these market-based regulations have reduced scrubber electricity use.

Electricity Market Regulation

Until the early 1990s, power plants generally operated as regulated monopolies. States, through public utility commissions (PUCs), allowed firms (both investor-owned and municipal) to build power plants and provide electricity to the grid sufficient to meet demand.[1] In return, firms were allowed to earn a specified rate of return on the cost of

[1] Federal projects like the Tennessee Valley Authority were not subject to state level regulation.

4

COAL-FIRED POWER PLANT HEAT RATE REDUCTIONS

SL-009597

FINAL REPORT

JANUARY 22, 2009

PROJECT 12301-001

PREPARED BY

Sargent & Lundy LLC

55 East Monroe Street • Chicago, IL 60603-5780 USA • 312-269-2000
www.sargentlundy.com

5. EMISSIONS CONTROL TECHNOLOGIES

To meet environmental regulations, it has been regular practice for plant operators to implement emissions control technologies. Among the typical technologies used in the industry are the three discussed in this section of the report:

- FGD system
- Particulate control system, e.g., electrostatic precipitators (ESP)
- SCR system

These types of control technologies can consume relatively large amounts of auxiliary power. For example, a wet FGD system typically requires 2-3% of the gross electrical output of a plant when the unit is combusting a high-sulfur coal. In addition to general auxiliary power required to operate the apparatus, optimal performance may not be realized due to natural wear on the system, inadequate maintenance, inefficient operation practices, and/or poor operating conditions. Small adjustments or modifications can be made to these systems to alleviate a portion of the electrical requirements necessary to accommodate these inefficiencies. Generally, FGD systems and ESPs are technologies that can be modified to have the greatest impact on power consumption, while concurrently meeting emissions collection requirements.[Refs. 20, 25]

The modifications to SCR systems generally entail optimizations to reduce flue gas pressure drops. Some optimizations may be realized in the extensive ductwork usually involved with SCR retrofits and in other cases, lower pressure drop catalysts are developed by vendors. In lesser amounts, auxiliary power may be reduced by changes in the vaporization or mixing scheme of the SCR system.

5.1 FGD SYSTEM

Areas and means of potential improvement within an older FGD system are:

- Removal of venturi throat
- Improved flow distribution to lower the pressure drop across FGD
- Spray header operation
- Use of VFDs

Clean Coal Technologies
Wet scrubbers for SO2 control

Wet scrubbers are the most widely used FGD technology for SO2 control throughout the world. Calcium-, sodium- and ammonium-based sorbents have been used in a slurry mixture, which is injected into a specially designed vessel to react with the SO2 in the flue gas. The preferred sorbent in operating wet scrubbers is limestone followed by lime. These are favoured because of their availability and relative low cost. The overall chemical reaction, which occurs with a limestone or lime sorbent, can be expressed in a simple form as:

$$SO_2 + CaCO_3 = CaSO_3 + CO_2$$

In practice, air in the flue gas causes some oxidation and the final reaction product is a wet mixture of calcium sulphate and calcium sulphite (sludge). A forced oxidation step, in situ or ex situ (in the scrubber or in a separate reaction chamber) involving the injection of air produces the saleable by-product, gypsum, by the following reaction:

$$SO_2 + CaCO_3 + 1/2O_2 + 2H_2O = CaSO_4.2H_2O + CO_2$$

Waste water treatment is required in wet scrubbing systems.

A variety of scrubber designs is available including:

- spray tower design where pump pressure and spray nozzles atomise the scrubbing liquid into the reaction chamber providing large particle surface area for efficient mass transfer;
- plate tower design where the gas is dispersed into bubbles, which also provides large sorbent surface area;
- impingement scrubber design where a vertical chamber incorporates perforated plates with openings that are partially covered by target plates. The plates are flooded with the sorbent slurry and the flue gas is accelerated upwards through the perforations. The flue gas and sorbent liquid make contact around the target plate, creating a turbulent frothing zone to provided the desired reaction contact;
- packed tower design where the flue gas flows upwards through a packing material counter-current to the sorbent which is introduced at the top of the packing through a distributor; and
- the fluidized packed tower design or turbulent contact absorber, which is similar to the packed tower, except that the packing is fluidized. The turbulence created keeps the packing material clean and improves the mass transfer between the flue gas and the slurry liquid.

In the simplest configuration in wet lime/limestone/gypsum scrubbers, all chemical reactions takes place in a single integrated absorber resulting in reduced capital cost and energy consumption. The integrated single tower system requires less space thus making it easier to retrofit in existing plants.

The absorber usually requires a rubber, stainless steel or nickel alloy lining as construction material to control corrosion and abrasion. Fibreglass scrubbers are also in operation.

Commercial wet scrubbing systems are available in many variations and proprietary designs. Systems currently in operation include:

- lime/limestone/sludge wet scrubbers;
- lime/limestone/gypsum wet scrubbers;
- wet lime, fly ash scrubbers; and

- Air staging for NOx control (overfire air and two-stage combustion)
- Bubbling fluidized bed combustion (BFBC) at atmospheric pressure
- Burner optimisation for NOx control (excess air control, burner fine tuning)
- Circulating fluidized bed combustion (CFBC) at atmospheric pressure
- Clean Coal Technologies - home
- Combined heat and power (CHP) - Cogeneration
- Combined SO2/NOx removal processes
- Cyclone fired wet bottom boilers
- Dry scrubbers
- Electrostatic precipitators (ESP)
- Fabric filters (baghouses)
- Flue gas desulfurization (FGD) for SO2 control
- Flue gas recirculation for NOx control
- Fluidised bed combustion (FBC)
- Fuel staging (burner out of service (boos), fuel biasing, reburning, or three-stage combustion)
- High Temperature High Pressure (HTHP) particulate control
- Integrated gasification combined cycle (IGCC)
- Low NOx burners
- Mechanical/inertial collectors (cyclones/multicyclones)
- NOx emissions abatement and control by flue gas treatment
- NOx emissions abatement and control by primary measures
- Particulate emissions control technologies
- Pressurized Circulating Fluidized Bed Combustion (PCFBC)
- Pressurized fluidized bed combustion (PFBC)
- Pulverised coal combustion (PCC)
- Regenerable processes for SO2 control
- Selective catalytic reduction (SCR) for NOx control
- Selective non-catalytic reduction (SNCR) for NOx control
- Sorbent injection systems for SO2 control
- Spray dry scrubbers for SO2 control

- other (including seawater, ammonia, caustic soda, sodium carbonate, potassium and magnesium hydroxide) wet scrubbers.

Wet scrubbers can achieve removal efficiencies as high as 99%. Wet scrubbers producing gypsum will overtake all other FGD technologies, especially with the increased cost of land filling in Europe and the introduction of increasingly stricter regulations regarding by-product disposal.

Click on the relevant text below for other FGD technologies:

- wet scrubbers
- spray dry scrubbers
- sorbent injection processes
- dry scrubbers
- regenerable systems
- combined SO2/NOx removal processes

Stoker boilers
Wet scrubbers for particulate control
Wet scrubbers for SO2 control