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Project Summary

Proceedings: 1993 SO_2 Control Symposium

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This report compiles over 100 papers presented at the 1993 Sulfur Dioxide (SO_2) Control Symposium held in Boston, MA, August 24-27, 1993. Papers in this symposium covered a wide range of topics: industry's strategies for dealing with the Clean Air Act Amendments of 1990, including Phase I strategies, the emission allowance trading system, and retrofit construction; additives, materials, and operating issues for wet flue gas desulfurization (FGD); clean coal demonstration programs; the effect of FGD systems on air toxics; dry FGD technologies of spray drying and furnace sorbent injection; applied SO_2 control research results and emerging acid rain control technologies; and waste disposal issues. Papers covered results obtained from full-scale demonstration/operation to pilot- and bench-scale work.

This Project Summary was developed by EPA's Air and Energy Engineering Research Laboratory, Research Triangle Park, NC, to highlight key topics on SO_2 control. Full documentation of the report of the same title is available (see Project Report ordering information at back).

Introduction

The symposium was jointly sponsored by the Air and Energy Engineering Research Laboratory, U.S. Environmental Protection Agency (AEERL/EPA), the Electric Power Research Institute (EPRI), and the U.S. Department of Energy (DOE). It is held approximately every 18 months to transfer technical information from laboratory research, pilot-scale tests, and field demonstrations on technologies for reduction of SO_2 emissions from fossil fuel combustion. This symposium was held in Boston, MA, August 24-27, 1993. The proceedings from the symposium are available in four volumes, covering over 100 papers in 13 technical sessions:

Session	Subject Area
1	Clean Air Act Regulatory Strategies
2	Phase I Designs
3A	Additives for High Efficiency FGD
3B	Materials for FGD
4A	Clean Coal Demonstrations
4B	Applied Research
5A	Dry FGD Technologies
5B	Wet FGD Process Issues (Part I)
6A	Air Toxics Removal in FGD Systems
6B	Wet FGD Process Issues (Part II)
7	Poster Papers
8A	Emerging Technologies
8B	Waste Utilization and Disposal

Clean Air Act Regulatory Strategies

Four papers comprised the introductory session, Session 1, to the symposium. The first paper presented the potential synergies and conflicts that have arisen between the acid rain provisions of the Clean Air Act Amendments of 1990 (CAAA) and the other titles involving hazardous air pollutants. These conflicts may lead to inefficient decisions by utilities as their risk-averse posture and the structure of the CAAA discourage integrated deci-

sions in reaching the goals of all titles of the CAAA. Another paper presented a model based on four utilities' data that estimates key factors regarding the SO_2 allowance trading system. An interactive multidimensional analysis for risk assessment was described by 1) a risk-based methodology for setting detection limits for field testing and 2) a framework for analyzing health risks from mercury emissions. The last paper of the session described the Clean Air Technology, Workstation™*, a tool for determining the economics of methods for systemwide emission reduction. This system allows commercial and emerging technologies to be evaluated and allows users to vary system parameters of unit configurations, technologies, and fuels.

Phase I Designs

This session (Session 2) contained eight papers that discussed system designs for meeting Phase I requirements of the CAAA. Wet lime or limestone FGD systems were or will be installed or retrofitted by Indiana Power & Light Company, Tennessee Valley Authority (TVA), the Conemaugh Station owners, Kentucky Utilities (with fuel switching), Henderson Municipal Power and Light, Navajo Generating Station, and PSI Energy Inc. Guidelines for economics decisions, design, and retrofit concerns for duct injection systems were also presented.

Additives for High Efficiency FGD

Wet FGD systems' SO_2 removal can often be improved by use of additives. In this session (Session 3A), papers were presented discussing the effect of organic acid additives (dibasic acid, formate) on pilot- and full-scale facilities both in terms of SO_2 removal and solids disposal properties. A model was developed and tied into EPRI's FGD Process Integration and Simulation Model (FGDPRISM) that estimates consumption rates of dibasic acid and formate ion in wet limestone FGD systems. A new ammonia-based process on a pilot plant using ammonium sulfate liquor for SO_2 absorption was described. The process produces high purity ammonium sulfate crystals with market value.

Materials for FGD

Eight papers in Session 3B covered topics related to materials of construction for FGD systems. Topics covered included economics, comparative technical performance, and design considerations. Structural materials and coatings used in ducts, towers, stacks, sumps, tanks, and pumps were discussed for a PSI Energy, Inc., unit. An EPRI research program investigating a wide variety of construction materials for FGD systems was presented with feedback from operating FGD plants. Finally, a failure analysis of FGD materials from 33 different investigations was reported, showing that 31% of failures resulted from quality control breakdown and 27% resulted from inadequate material selection.

Clean Coal Demonstrations

Results from DOE's Clean Coal Technology program were presented for eight implementations in Session 4A. Bechtel's Confined Zone Dispersion Technology, Pure Air's demonstration at the Bailly Generating Station, Ohio Edison's SNOX technology, the Passamaquoddy Technology, L.P. potassium or sodium process, Babcock & Wilcox's SO_x -NO_x-ROx BOx™ (SNRB) process, the Chiyoda CT-121 project at Georgia Power's Plant Yates (Unit #1), Tampella Power Corporation's LIFAC sorbent injection technology, and the Air Pol, Inc., demonstration of Gas Suspension Absorption FGD were all discussed in papers from this session.

Applied Research

This session (4B) covered research-oriented topics in eight papers. A paper from University of Lund, Sweden, reviewed the limits and potential of furnace sorbent injection, finding that small particles (< 3 m) with sufficient mixing can achieve 95% SO_2 removal at a residence time of 2s and at a calcium/sulfur ratio of 2/1. The application of gas-phase ionic chemistry for pollution control was discussed, including a look at the equipment, experimental results, applications, and costs. Work from the Universidad de Cantabria, Spain, was presented on kinetic modeling of the low temperature, humidified reaction of hydrated lime in an FGD system. Production of the ADVAnced siliCATE (ADVACATE) sorbent utilizing fly ash was examined, where researchers at the University of Texas at Austin related batch- and flow-reactor-derived sorbents and found that grinding the ash dramatically increased the reaction rate. Researchers at Lawrence Berkeley Laboratory presented development of a catalyst capable of >90% sulfur yield for a process that would catalytically reduce SO_2 to elemental sulfur. The University of Kentucky and TVA presented results on pilot scale tests of a circulating bed absorption system, covering effects of stoichiometry, gas temperature, fuel chloride, gas residence time, and total sulfur capture. The University of Cincinnati's work on sorbents for spray dryers slurried fly ashes with quicklime and determined reactivity, suggesting that the compressive strength of the material may be a reactivity indicator. Other work at the university studied the economizer temperature reactivity of injected calcium hydroxide and dolomitic hydroxide sorbents.

Dry FGD Technologies

Several varieties of dry sorbent systems for FGD were covered in eight papers in Session 5A. Furnace sorbent injection (FSI) processes were discussed in papers on full-scale results. A paper by Combustion Engineering, Inc., Virginia Power Company (VPC), and EPA discussed optimization (in progress) of the combined SO_2/NO_x demonstration at VPC's Yorktown Power Station. A combined SO_2/NO_x retrofit program at the Bastardo power plant in Italy was discussed. Combining gas reburning with FSI (GR-SI), a Clean Coal Technology Round I demonstration project was discussed, along with results from an earlier project. An overview of supported sorbents technology (magnesia or lime coated on vermiculite or perlite substrates) and demonstration results was presented. Pilot-scale work on spray dryers with fabric filters achieving 95% SO_2 removal was discussed for medium- and high-sulfur coals. The final three papers presented commercial operating results for dry FGD technologies in Canada, Japan, and Germany.

Wet FGD Process Issues (Part I)

This session (5B) contained seven papers on various issues related to wet FGD processes. Several papers compared and discussed inhibited and fully oxidized operating modes of wet lime and limestone FGD systems. Topics of operating guidelines for cyclic FGD systems, high efficiency pilot plant results, control of a limestone grind circuit, design of mist eliminators, and economics of chloride removal were covered.

Air Toxics Removal in FGD Systems

With the passage of the CAAA, control of toxic or hazardous air pollutant emissions may become an issue of concern for facilities burning fossil fuels. Eight papers in this session (6A) covered various topics related to air toxics control and the interrelationship with control of SO_2. EPRI's program on reviewing air toxics literature

* Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

coupled with its pilot wet FGD tests for mercury removal were presented. Other topics included the ability of available control technologies to deal with organic and metallic pollutants; performance of three spray dryer pilot plants at removal of mercury, selenium, and boron; reduction of submicrometer metal emissions of arsenic, selenium, mercury, and antimony by FSI; performance of SNRB versus electrostatic precipitators for collection of air toxics; effect of a semi-dry FGD system in Germany to remove heavy metals; and the use of Fourier Transform Infrared technology as a continuous emission monitor. The session closed with a summary of research needs in air toxics determined from a workshop sponsored by EPRI and DOE.

Wet FGD Process Issues (Part II)

This session (6B) continued papers on this topic started in Session 5B. Seven papers were presented, covering development of a plume opacity engineering workbook, reduction of sulfur trioxide by sorbent injection to lower plume opacity, optimization of the FGD system at the Bruce Mansfield Plant, the magnesium-enhanced lime scrubber at the Zimmer Generating Station, development of a clear liquor scrubbing process, development of a test facility for studying wet scrubber fluid mechanics, and an update on FGDPRISM. The last paper in this session discussed the European view of FGD applications and new advances and topics in flue gas cleaning systems.

Poster Papers

Session 7 included 19 papers that were also presented as posters at a special session. These papers covered a variety of subjects, encompassing the major topics of the symposium. The poster papers included a mixture of field demonstration and pilot- and bench-scale reports on both wet and dry FGD processes, multipollutant control processes, foreign and domestic authors, and modeling efforts.

Emerging Technologies

Seven papers were presented in Session 8A on developments in new FGD processes. They included a report on a moving limestone bed process, pilot plant results of several new technologies, ADVACATE studies at a TVA plant, demonstration of a sodium-based scrubber and membrane separation for sulfur recovery, and optimization of the Advanced Coolside technology, which uses sorbent injection and flue gas humidification.

Waste Utilization and Disposal

The last session of the symposium, Session 8B, included seven papers on topics including economics of FGD waste disposal, use of FGD waste as a saleable gypsum product, application of FGD wastes to agricultural production, waste stabilization, and use of FGD as a component of a landfill liner.

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The complete report, entitled "Proceedings: 1993 SO_2 Control Symposium," consists of four volumes:

Volume I (Order No. PB95-179222, Cost: $52.00, subject to change) consists of Sessions 1, 2, 3A, and 3B.

Volume II (Order No. PB95-179230, Cost: $52.00, subject to change) consists of Sessions 4A, 4B, and 5A.

Volume III (Order No. PB95-179248, Cost: $44.50, subject to change) consists of Sessions 5B, 6A, and 6B.

Volume IV (Order No. PB95-179255, Cost: $61.00, subject to change) consists of Sessions 7, 8A, and 8B.

The complete set, consisting of all four volumes, can be ordered using Order No. PB95-179214. The cost is $178.50 (subject to change).

All documents will be available only from

National Technical Information Service
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