EPA U.S. Environmental Protection Agency
Office of Research and Development
Industrial Environmental Research Laboratory
Research Triangle Park, North Carolina 27711
EPA-600/7-78-052a
March 1978

EPA INDUSTRIAL BOILER FGD SURVEY: First Quarter 1978

Interagency
Energy-Environment
Research and Development
Program Report

RESEARCH REPORTING SERIES

Research reports of the Office of Research and Development, U.S. Environmental Protection Agency, have been grouped into nine series. These nine broad categories were established to facilitate further development and application of environmental technology. Elimination of traditional grouping was consciously planned to foster technology transfer and a maximum interface in related fields. The nine series are:

1. Environmental Health Effects Research
2. Environmental Protection Technology
3. Ecological Research
4. Environmental Monitoring
5. Socioeconomic Environmental Studies
6. Scientific and Technical Assessment Reports (STAR)
7. Interagency Energy-Environment Research and Development
8. "Special" Reports
9. Miscellaneous Reports

This report has been assigned to the INTERAGENCY ENERGY-ENVIRONMENT RESEARCH AND DEVELOPMENT series. Reports in this series result from the effort funded under the 17-agency Federal Energy/Environment Research and Development Program. These studies relate to EPA's mission to protect the public health and welfare from adverse effects of pollutants associated with energy systems. The goal of the Program is to assure the rapid development of domestic energy supplies in an environmentally-compatible manner by providing the necessary environmental data and control technology. Investigations include analyses of the transport of energy-related pollutants and their health and ecological effects; assessments of, and development of, control technologies for energy systems; and integrated assessments of a wide range of energy-related environmental issues.

EPA REVIEW NOTICE

This report has been reviewed by the participating Federal Agencies, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Government, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.

EPA-600/7-78-052a
March 1978

EPA INDUSTRIAL BOILER FGD SURVEY: First Quarter 1978

by

J. Tuttle, A. Patkar,
and N. Gregory

PEDCo Environmental, Inc.
11499 Chester Road
Cincinnati, Ohio 45246

Contract No. 68-02-2603
Task 4
Program Element No. EHE624

EPA Project Officer: J. David Mobley

Industrial Environmental Research Laboratory
Office of Energy, Minerals and Industry
Research Triangle Park, N.C. 27711

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Research and Development
Washington, D.C. 20460

TABLE OF CONTENTS

SECTION		PAGE
1	INTRODUCTION	1
2	EXECUTIVE SUMMARY	3
3	LIST OF INDUSTRIAL BOILERS WITH FGD SYSTEMS	10
4	SUMMARY OF FGD SYSTEMS	13
5	LIST OF VENDORS OF FGD SYSTEMS	25
6	NUMBER AND TOTAL CAPACITY OF FGD SYSTEMS	29
7	STARTUP DATE OF FGD SYSTEMS	30
8	SUMMARY OF OPERATIONAL FGD SYSTEMS	31
9	SUMMARY OF UNDER CONSTRUCTION FGD SYSTEMS	35
10	SUMMARY OF PLANNED FGD SYSTEMS	36
11	SUMMARY OF WASTE AND BY-PRODUCT DISPOSAL PRACTICES FOR FGD SYSTEMS	37
12	DESCRIPTION OF OPERATIONAL FGD SYSTEMS	42
13	DESIGN INFORMATION FOR UNDER CONSTRUCTION FGD SYSTEMS	133
14	DESIGN INFORMATION FOR PLANNED FGD SYSTEMS	144
15	DESCRIPTION OF FGD SYSTEMS NOT OPERATING OR TERMINATED	147

SECTION 1

INTRODUCTION

THIS REPORT ADDRESSES THE APPLICATION OF FLUE GAS DESULFURIZATION (FGD) TECHNOLOGY TO INDUSTRIAL BOILERS. THE NEED FOR SUCH A DOCUMENT HAS ARISEN AS A RESULT OF THE INCREASED INTEREST IN THE CONTROL OF SULFUR DIOXIDE (SO_2) EMISSIONS. IN 1975 AN INITIAL SURVEY DEMONSTRATED THAT THE INDUSTRIAL (I.E., NONUTILITY) SECTOR WAS BECOMING MORE DEEPLY INVOLVED IN SO_2 CONTROL, A DIRECT RESULT OF GENERALLY MORE STRINGENT EMISSION CODES. EPA'S INDUSTRIAL ENVIRONMENTAL RESEARCH LABORATORY IN RESEARCH TRIANGLE PARK THEN INITIATED A MORE DETAILED SURVEY, ONE WHICH WOULD GENERALLY FOLLOW THE FORMAT OF THE WELL-ESTABLISHED EPA UTILITY BOILER FGD SURVEY. INFORMATION WAS OBTAINED FOR APPROXIMATELY 70 SO_2 CONTROL SYSTEMS, 25 OF WHICH WERE AT INDUSTRIAL BOILER SITES, AND THE REST OF WHICH WERE AT PULPING OPERATIONS, CHEMICAL PROCESSES, AND METALS PROCESSING OPERATIONS. THE RESULTS FROM THAT SURVEY WERE PUBLISHED IN A REPORT TITLED "SURVEY REPORT ON SO_2 CONTROL SYSTEMS FOR NONUTILITY COMBUSTION AND PROCESS SOURCES - MAY 1977."

AS A RESULT OF THE FAVORABLE RESPONSE TO THIS REPORT, INDUSTRIAL ENVIRONMENTAL RESEARCH LABORATORY DECIDED TO ESTABLISH A PERIODICALLY UPDATED ENGINEERING APPLICATION/INFORMATION TRANSFER PROGRAM ADDRESSING INDUSTRIAL SO_2 CONTROL TECHNOLOGY.

THE FIRST PRODUCT WAS A SEVEN-VOLUME, 900-PAGE REPORT TITLED "SUMMARY REPORT ON SO_2 CONTROL SYSTEMS FOR INDUSTRIAL COMBUSTION AND PROCESS SOURCES - DECEMBER 1977." THIS DOCUMENT REPORTED ON SO_2 CONTROL SYSTEMS IN TEN SOURCE CATEGORIES AT OVER 200 INDUSTRIAL SITES IN THE UNITED STATES. THOSE TEN CATEGORIES WERE AS FOLLOWS:

- INDUSTRIAL BOILERS
- PULP AND PAPER PROCESSES
- CLAUS PROCESSES
- SULFURIC ACID PLANTS
- COPPER, LEAD, AND ZINC SMELTERS
- METALLIC MINERALS PROCESSING

- NONMETALLIC MINERALS PROCESSING
- IRON AND STEEL PROCESSES
- FOUNDRIES AND CUPOLAS
- MISCELLANEOUS PROCESSES

THE CURRENT REPORT ADDRESSES ONLY INDUSTRIAL BOILER APPLICATIONS OF FGD TECHNOLOGY. THE OTHER SOURCE CATEGORIES WILL NOT BE INCLUDED IN FUTURE SURVEY WORK FOR THE INDUSTRIAL ENVIRONMENTAL RESEARCH LABORATORY, ALTHOUGH THEY MAY BE CONTINUED UNDER OTHER AUSPICES. THE CURRENT REPORT REPRESENTS AN EXPANSION OVER THE INFORMATION PRESENTED IN THE DECEMBER 1977 REPORT, WITH RESPECT TO BOTH THE AMOUNT OF INFORMATION PRESENTED PER INSTALLATION AND THE NUMBER OF INSTALLATIONS INCLUDED.

THE INFORMATION IN THIS REPORT WILL BE UPDATED FOUR TIMES PER YEAR. ANYONE DESIRING TO RECEIVE FREE UPDATED VERSIONS OF THIS REPORT MAY REQUEST THE ADDITION OF HIS OR HER NAME TO THE MAILING LIST. THIS MAY BE DONE BY CONTACTING THE EPA PROJECT OFFICER OR THE CONTRACTOR.

SECTION 2

EXECUTIVE SUMMARY

THE FIRST FULL-SCALE UNITED STATES APPLICATION OF FLUE GAS DESULFURIZATION (FGD) TECHNOLOGY TO INDUSTRIAL BOILERS WAS AT A GENERAL MOTOR'S PLANT IN ST. LOUIS, MISSOURI WHERE TWO SYSTEMS WERE INSTALLED ON TWO COAL-FIRED BOILERS IN 1972. IN THIS 1ST QUARTER 1978 REPORT, DATA IS PRESENTED ON 135 OPERATIONAL FGD SYSTEMS AT 34 PLANT SITES, CONTROLLING SO_2 EMISSIONS FROM 145 BOILERS. FGD UNITS AT NINE PLANTS ARE KNOWN TO BE UNDER CONSTRUCTION OR IN SOME STAGE OF PLANNING. THE TOTAL COVERAGE OF THIS REPORT IS THEREFORE 42 PLANT SITES AS SUMMARIZED IN TABLE I.

TABLE I

NUMBER AND TOTAL ACFM OF INDUSTRIAL BOILER FGD SYSTEMS

STATUS	NO. OF PLANT SITES	CAPACITY ACFM (THOUSANDS)
OPERATIONAL	34	5,232
UNDER CONSTRUCTION	5	1,636
PLANNING		
CONTRACT	2	488
LETTER OF INTENT	0	0
REQUESTING/EVALUATING BIDS	1	300
CONSIDERING FGD	0	0
TOTAL	42	7,656

THE REPORT CONTAINS THIRTEEN TABLES FOR DATA PRESENTATION AS LISTED BELOW:

CONTENT OF TABLES
INDUSTRIAL BOILER FGD SURVEY

SUMMARY SECTIONS

1 SUMMARY LIST OF SO_2 CONTROL SYSTEMS

A SUMMARY OF ALL THE INSTALLATIONS BY NAME, LOCATION, START-UP DATE, AND CURRENT STATUS.

2 STATUS OF SO_2 CONTROL SYSTEMS

A BRIEF SUMMARY OF THE SOURCE CHARACTERISTICS, THE CONTROL PROCESS AND CONTROL SYSTEM SUPPLIER, AND INFORMATION ON RECENT SYSTEM PERFORMANCE.

3 SUMMARY OF SO_2 CONTROL SYSTEMS BY VENDOR

A LIST OF THE CONTROL SYSTEMS SUPPLIED BY EACH SYSTEM VENDOR OR MANUFACTURER.

4 NUMBER AND TOTAL CAPACITY OF SO_2 CONTROL SYSTEMS

A SUMMARY OF SYSTEMS BY OPERATIONAL STATUS, NUMBER OF UNITS IN EACH STATUS, AND VOLUME OF THE EXHAUST STREAM (ACFM) BEING CONTROLLED.

5 SUMMARY OF SO_2 CONTROL SYSTEMS BY START-UP DATE

6 SUMMARY OF OPERATIONAL SO_2 CONTROL SYSTEMS

7 SUMMARY OF SO_2 CONTROL SYSTEMS UNDER CONSTRUCTION

8 SUMMARY OF PLANNED SO_2 CONTROL SYSTEMS

9 SUMMARY OF WASTE AND BY-PRODUCT DISPOSAL PRACTICES FOR SO_2 CONTROL SYSTEMS

DETAILED SECTIONS

10 PERFORMANCE DESCRIPTIONS OF OPERATIONAL SO_2 CONTROL SYSTEMS

AN IN-DEPTH DATA PRESENTATION FOR THE OPERATIONAL CONTROL SYSTEMS. THIS SECTION PRESENTS BACKGROUND INFORMATION, OPERATING PARAMETERS, DESIGN INFORMATION, START-UP PROBLEMS AND SOLUTIONS, OPERATING EXPERIENCE, WASTE AND BY-PRODUCT DISPOSAL PRACTICES, AND IN SHORT, ALL RELEVANT INFORMATION AVAILABLE CONCERNING FGD OPERATIONS AT THE VARIOUS INSTALLATIONS.

11 DESIGN DESCRIPTIONS OF SO_2 CONTROL SYSTEMS UNDER CONSTRUCTION

SAME AS SECTION 10, FOR CONTROL SYSTEMS UNDER CONSTRUCTION.

12 DESIGN DESCRIPTIONS OF SO2 CONTROL SYSTEMS IN THE PLANNING STAGES

SAME AS SECTION 10, FOR PLANNED CONTROL SYSTEMS.

13 PERFORMANCE DESCRIPTIONS OF SO2 CONTROL SYSTEMS TERMINATED/INDEFINITELY DOWN

SAME AS SECTION 10 FOR CONTROL SYSTEMS WHERE OPERATIONS HAVE BEEN TERMINATED OR INDEFINITELY SHUTDOWN.

SOME HIGHLIGHTS FROM THE CURRENT INDUSTRIAL BOILER FGD SURVEY ARE OUTLINED BELOW:

ALYESKA PIPELINE SERVICE CO. STARTED-UP OIL FLOW AND SO_2 CONTROL OPERATIONS AT THE VALDEZ TERMINAL OF THE ALASKA PIPELINE IN LATE JUNE-EARLY JULY 1977. THIS FMC SODIUM HYDROXIDE-BASED SYSTEM IS AN INTERESTING APPLICATION IN THAT WHILE, IN A STRICT SENSE, IT IS CONTROLLING SO_2 EMISSIONS, ITS PRIMARY FUNCTION IS THAT OF A GAS CONDITIONING UNIT. THE FGD SYSTEM TREATS COMBUSTION GASES FROM A BOILER WHOSE PRIMARY PURPOSE IS THE SUPPLY OF A WARM BLANKET GAS FOR THE OIL IN THE MASSIVE OIL STORAGE TANKS. OIL LEVELS FLUCTUATE IN THE TANKS AS A FUNCTION OF OIL FLOWING IN FROM THE PIPELINE AND FLOWING OUT TO TRANSPORT SHIPPING IN PORT VALDEZ. THE BOILER SUPPLIES A VARIABLE QUANTITY OF WARM AIR TO THE TANKS AS THE LEVELS VARY AND ALL AIR IS TREATED BY THE FGD SYSTEM. THIS CONTROL SYSTEM IS REMOVING SO_2 GENERATED IN THE FIRING OF 0.03 PERCENT TO 0.1 PERCENT SULFUR OIL.

CATERPILLAR TRACTOR CO. REPORTED THE FOLLOWING ITEMS CONCERNING FGD OPERATIONS ON HIGH SULFUR (3.2 PERCENT) ILLINOIS COAL:

AT THE JOLIET, ILLINOIS PLANT, FGD OPERATIONS BEGAN ON TWO COAL-FIRED BOILERS IN OCTOBER 1974. SO_2 CONTROL IS EFFECTED BY TWO DILUTE-MODE DUAL ALKALI (SODA ASH/PEBBLE LIME) SCRUBBING SYSTEMS SUPPLIED BY ZURN INDUSTRIES. IN GENERAL, AVAILABILITY INDEX VALUES HAVE AVERAGED 80 TO 85 PERCENT. SO_2 REMOVAL EFFICIENCY IS GREATER THAN 90 PERCENT AND MORE THAN ADEQUATE TO MEET THE REGULATION OF 1.8 LBS. SO_2 PER 10^6 BTU. HOWEVER, THE UNITS ARE NOT SATISFYING THE PARTICULATE EMISSION REGULATIONS. POSSIBLE SOLUTIONS TO THIS PROBLEM ARE CURRENTLY BEING INVESTIGATED. THE FOLLOWING PROBLEMS AND SOLUTIONS ARE SOME OF THOSE WHICH HAVE BEEN REPORTED BY PLANT PERSONNEL:

- PH PROBES SCALING (IMPROVED BY INCORPORATING FRESH WATER FLUSHING)
- LOUVRE DAMPERS REQUIRING REPLACEMENT BY GUILLOTINE DAMPERS
- CORROSION ATTACK DOWNSTREAM OF SCRUBBERS (REHEAT NOW BEING CONSIDERED)
- PLUGGED VACUUM FILTER BELTS
- LINING DAMAGE IN BLEED-OFF PUMPS CAUSED BY SOLIDS IN BLEED-OFF LINES (CORRECTED BY THE INSTALLATION OF SCREENS AND LEVEL CONTROLS IN THE SCRUBBERS)
- UNRELIABILITY OF SO_2 MONITORING EQUIPMENT
- UNRELIABILITY OF RECIRCULATION LINE FLOW SENSOR (REPLACED BY AN ULTRASONIC FLOW SENSOR)
- INADEQUATE COLD WEATHER PROTECTION

AT THE MOSSVILLE, ILLINOIS PLANT, FGD OPERATIONS ON THREE COAL-FIRED BOILERS BEGAN IN OCTOBER 1975, AND A FOURTH BOILER CAME ON-LINE IN JUNE 1977 WITH FGD BYPASS UNTIL OCTOBER 1977. FMC ENVIRONMENTAL EQUIPMENT DIV. DESIGNED, INSTALLED, AND OPERATED THESE SYSTEMS UNTIL JUNE 1976. AT THAT TIME, CATERPILLAR PERSONNEL TOOK OVER THE OPERATION OF THE SYSTEMS. THE FOUR SEPARATE SCRUBBING TRAINS UTILIZE VENTURI SCRUBBERS IN CONCENTRATED-MODE DUAL ALKALI SO_2 CONTROL STRATEGY. THE TWO LARGE BOILERS

(EACH AT 150,000 LBS/HR STEAM) HAVE HAD MECHANICAL COLLECTORS INSTALLED AHEAD OF THE VENTURIS, AND THE TWO SMALL BOILERS (EACH AT 80,000 LBS/HR STEAM) OPERATE WITH PARTICULATE PRECOLLECTION. THE FLYASH HAS CAUSED EROSION PROBLEMS IN THE SCRUBBER LOOP. CATERPILLAR REPORTS THAT MOSSVILLE FGD OPERATIONS HAVE AVERAGED 80 TO 85 PERCENT AVAILABILITY. SIMILAR TO JOLIET, SO_2 REMOVAL AT MOSSVILLE HAS BEEN ADEQUATE AT GREATER THAN 90 PERCENT, BUT THE SCRUBBERS HAVE NOT YET BEEN SATISFACTORY WITH RESPECT TO PARTICULATE CONTROL. THE FOLLOWING PROBLEM AREAS HAVE BEEN REPORTED BY PLANT PERSONNEL:

- OVERSIZED SLURRY PUMPS
- LOW SEAL WATER PRESSURE ALLOWING LEAKAGE OF PROCESS LIQUOR
- NOZZLE EROSION IN THE SCRUBBERS
- SWITCH OVER FROM LOUVRE TO GUILLOTINE DAMPERS
- SLUDGE HANDLING
- PLUGGING IN MOST OF THE PIPING
- INADEQUATE COLD WEATHER PROTECTION

AT THE FIRESTONE TIRE AND RUBBER CO. IN POTTSTOWN, PENNSYLVANIA, A 14,000 ACFM FMC DUAL ALKALI DEMONSTRATION TEST ON HIGH SULFUR (2.5 TO 3.0 PERCENT) COAL HAS BEEN UNDERWAY SINCE JANUARY 1975. THE UNIT HAS BEEN DEMONSTRATING GREATER THAN 90 PERCENT SO_2 REMOVAL AND AVAILABILITY INDEX VALUES OF 94 PERCENT. FLYASH AND SO_2 ARE COLLECTED SIMULTANEOUSLY IN A VENTURI SCRUBBER, AND THE SCRUBBER SLUDGE IS DEWATERED AND LANDFILLED.

THE FMC SODA ASH PLANT IN GREEN RIVER, WYOMING HAS BEEN OPERATING TWO FMC SODIUM BASED ONCE THROUGH FGD SYSTEMS SINCE MAY 1976. PARTICULATE CONTROL IS EFFECTED BY A PRECEDING ESP; DESIGN SO_2 REMOVAL EFFICIENCY IS 95 PERCENT. LINER PROBLEMS IN THE ABSORBER MODULES AND PROBLEMS WITH PH MONITORING HAVE OCCURRED OVER THE SUMMER.

GENERAL MOTORS IS CURRENTLY OPERATING FGD SYSTEMS AT FIVE INSTALLATIONS AROUND THE UNITED STATES. ALL OF THESE SYSTEMS USE SODIUM HYDROXIDE OR SODA ASH FOR SO_2 CONTROL, WITH SLAKED LIME REGENERATION BEING IMPLEMENTED AT THE PARMA STEAM PLANT, NEAR CLEVELAND, OHIO. THE INSTALLATIONS ARE AS FOLLOWS:

- GENERAL MOTORS CHEVROLET MOTOR DIVISION, TONOWANDA, NEW YORK. THERE ARE FOUR SEPARATE FGD SYSTEMS CONTROLLING EMISSIONS FROM FOUR COAL-FIRED (1.3 PERCENT SULFUR) BOILERS. STARTUP OCCURRED IN JUNE 1975. THE SYSTEM EMPLOYS SODIUM HYDROXIDE FOR ALKALI MAKEUP AND REMOVES 90 TO 95 PERCENT OF THE INLET SO_2.

- GENERAL MOTORS, ST. LOUIS, MISSOURI. THERE ARE TWO SEPARATE FGD SYSTEMS CONTROLLING EMISSIONS FROM TWO COAL-FIRED (3.2 PERCENT SULFUR) BOILERS. STARTUP OCCURRED IN 1972. THE SYSTEM USES SODIUM HYDROXIDE MAKEUP AND EFFECTS 90+ PERCENT SO_2 REMOVAL.

- GENERAL MOTORS, CHEVEROLET TRANSMISSION PLANT, PARMA, OHIO. THERE IS ONE DUAL ALKALI (SODA ASH/SLAKED LIME) FGD SYSTEM CONTROLLING EMISSIONS FROM FOUR COAL-FIRED (2.5 PERCENT SULFUR) BOILERS. STARTUP OCCURRED IN MARCH 1974. THE SO_2 REMOVAL EFFICIENCY IS 90 PERCENT.

- GENERAL MOTORS TRUCK & COACH PLANT, PONTIAC, MICHIGAN. THERE ARE TWO SEPARATE FGD SYSTEMS CONTROLLING EMISSIONS FROM TWO COAL-FIRED (0.84 PERCENT SULFUR) BOILERS. THE SCRUBBERS WERE INSTALLED PRIMARILY FOR PARTICULATE CONTROL, BUT SIGNIFICANT SO_2 REMOVAL OCCURS AS A RESULT OF THE ADDITION OF SODIUM HYDROXIDE. STARTUP OCCURRED IN APRIL 1976.

- GENERAL MOTORS/DELCO MORAINE, DAYTON, OHIO. THERE ARE TWO SEPARATE FGD SYSTEMS CONTROLLING EMISSIONS FROM TWO COAL-FIRED (1 PERCENT SULFUR) BOILERS. STARTUP OCCURRED IN SEPTEMBER 1974. THE SYSTEM USES SODIUM HYDROXIDE MAKEUP.

GREAT WESTERN SUGAR HAS BEEN OPERATING PARTICULATE/SO_2 CONTROL SYSTEMS SINCE LATE 1972. CURRENTLY THERE ARE SEVEN PLANT SITES WITH OPERATIONAL CONTROL SYSTEMS, ONE SITE UNDER CONSTRUCTION, AND ONE THAT HAS BEEN PERMANENTLY SHUTDOWN. TWO BASIC SO_2 REMOVAL TECHNOLOGIES ARE BEING EMPLOYED. ONE IS A ONCE-THROUGH APPROACH WHICH USES CONDENSATE WATER FROM THE SUGAR PRODUCTION PROCESS. THIS WATER HAS A SIGNIFICANT AMMONIA CONTENT (PH = 8.7) THEREBY EFFECTING SO_2 CONTROL. THIS TECHNOLOGY IS BEING

EMPLOYED AT THE SIX WESTERN OPERATIONAL PLANT SITES. THE OTHER APPROACH BEING IMPLEMENTED AT TWO PLANTS IN OHIO USES SODIUM CARBONATE MAKE-UP FOR THE CONTROL OF SULFUR DIOXIDE EMISSIONS FROM THE COMBUSTION OF 3 PERCENT SULFUR COAL. SCRUBBING LIQUOR IS RECIRCULATED AND A BLEED-OFF STREAM IS TREATED AND THEN DISCHARGED TO CITY SEWERS. OPERATIONAL EXPERIENCE IS REPORTED TO BE PROBLEM-FREE AT ALL OPERATIONAL SYSTEMS.

KERR-MCGEE CHEMICAL CORPORATION IS PLANNING AN APRIL 1978 START-UP OF A NEW 1.3 MILLION TON PER YEAR SODA ASH PLANT IN TRONA, CALIFORNIA. APRIL WILL ALSO MARK THE START-UP OF FGD OPERATIONS AT THE ON-SITE POWER PLANT, CONSISTING OF TWO 32-MW COKE-, COAL-, AND OIL-FIRED BOILERS GENERATING BOTH ELECTRICITY AND PROCESS STEAM. FLY ASH WILL BE COLLECTED BY PRECEDING COLD-SIDE ESP'S AND SO_2 REMOVAL WILL TAKE PLACE IN COMBUSTION ENGINEERING CARBON STEEL MODULES WITH FIBERGLASS REINFORCED PLASTIC (FRP) LINERS. THE TWO FLUE-GAS SCRUBBERS WILL USE PROCESS END-LIQUOR TO CONTROL SO_2 EMISSIONS.

THE MEAD PAPERBOARD CO. IN STEVENSON, ALABAMA HAS BEEN OPERATING A HIGH-SULFUR OIL FGD APPLICATION SINCE 1975. FLUE GAS FROM TWO BOILERS FLOWS INTO A COMMON DUCT AND INTO AN AIRPOL INDUSTRIES SCRUBBER MODULE CONSISTING OF THREE BUBBLE CAP TRAYS. A SODIUM CARBONATE SOLUTION EFFECTS AN SO_2 REMOVAL OF 95 PERCENT, AND THE GAS EXITS THROUGH A FIBERGLASS STACK. A BLEED STREAM OF THE SODIUM SOLUTION FORMED IN THE SCRUBBER OPERATIONS IS PIPED TO THE ON-SITE PULPING OPERATION. THE SCRUBBER LINER HAS PROVEN TO BE A PROBLEM. THE ORIGINAL GLASS-FLAKE LINER WAS REPLACED BY A CARPENTER 20 LINER, WHICH WAS APPARENTLY NOT PROPERLY INSTALLED.

AT ST. JOE MINERALS CORPORATION IN MONACA, PENNSYLVANIA (NEAR PITTSBURG), CONSTRUCTION IS UNDERWAY ON THE BUREAU OF MINES CITRATE PROCESS REGENERABLE SCRUBBER SYSTEM. THE SODIUM CITRATE FGD OPERATIONS WILL CONTROL SO_2 EMISSIONS FROM THE 60-MW COAL-FIRED ELECTRIC POWER GENERATING UNIT FIRING 3.0 PERCENT SULFUR COAL. THE REGENERABLE SYSTEM WILL PRODUCE ELEMENTAL SULFUR. OPERATIONS AT THIS RETROFIT APPLICATION ARE SCHEDULED TO STARTUP IN OCTOBER 1978.

TEXASGULF INC. HAS BEEN OPERATING AN EMISSIONS CONTROL SYSTEM AT GRANGER, WYOMING SINCE SEPTEMBER 1976. TWO SCRUBBING SYSTEMS TREAT THE FLUE GAS FROM TWO 30-MW (EQUIVALENT) BOILERS. THE SCRUBBING LIQUOR, 30 PERCENT SODA ASH BY WEIGHT, IS RECIRCULATED WITH A CONSTANT BLEED-OFF. HOLDING THE CONTROL PH AT 6 TO 6.5 CAUSED CORROSION IN THE MILD STEEL RECIRCULATING LINES, WHICH WERE REPLACED WITH FIBERGLASS PIPE. TROUBLE-FREE OPERATIONS HAVE BEEN REPORTED DURING RECENT MONTHS.

SECTION 3

LIST OF INDUSTRIAL BOILERS WITH FGD SYSTEMS

INSTALLATION NAME	LOCATION	START-UP DATE	STATUS
ALYESKA PIPELINE SERVICE CO.	VALDEZ, ALASKA	6-77	1
AMERICAN THREAD	MARION, NORTH CAROLINA	0-73	1
ARCO/POLYMERS	MONACA, PENNSYLVANIA	12-80	5
ARMCO STEEL	MIDDLETOWN, OHIO	0-75	1
CANTON TEXTILES	CANTON, GEORGIA	6-74	1
CARBORUNDUM ABRASIVES	BUFFALO, NEW YORK	0- 0	3
C TERPILLAR TRACTOR CO.	EAST PEORIA, ILLINOIS	3-78	2
CATERPILLAR TRACTOR CO.	JOLIET, ILLINOIS	9-74	1
CATERPILLAR TRACTOR CO.	MAPLETON, ILLINOIS	10-78	2
CATERPILLAR TRACTOR CO.	MORTON, ILLINOIS	1-78	1
CATERPILLAR TRACTOR CO.	MOSSVILLE, ILLINOIS	10-75	1
CHEVRON OIL COMPANY	BAKERSFIELD, CALIFORNIA	7-78	3
FIRESTONE TIRE AND RUBBER CO.	POTTSTOWN, PENNSYLVANIA	1-75	1
FMC (SODA ASH PLANT)	GREEN RIVER, WYOMING	5-76	1
GENERAL MOTORS CHEV. MOTOR DIV	TONOWANDA, NEW YORK	6-75	1
GENERAL MOTORS CORPORATION	ST. LOUIS, MISSOURI	0-72	1
GENERAL MOTORS PARMA	PARMA, OHIO	3-74	1
GENERAL MOTORS TRUCK & COACH	PONTIAC, MICHIGAN	4-76	1
GENERAL MOTORS/DELCO MORAINE	DAYTON, OHIO	9-74	1

STATUS CODES -
- 0 - STATUS NOT DEFINED
- 1 - OPERATIONAL
- 2 - CONSTRUCTIONAL
- 3 - PLANNED-CONTRACT AWARDED
- 4 - PLANNED-LETTER OF INTENT SIGNED
- 5 - PLANNED-REQUESTING/EVALUATING BIDS
- 6 - PLANNED-CONSIDERING SO_2 CONTROLS
- 7 - TERMINATED OR INDEFINITELY SHUT DOWN

SECTION 3

LIST OF INDUSTRIAL BOILERS WITH FGD SYSTEMS

INSTALLATION NAME	LOCATION	START-UP DATE	STATUS
GEORGIA-PACIFIC PAPER CO.	CROSSETT, ARKANSAS	0-75	1
GREAT SOUTHERN PAPER CO.	CEDAR SPRINGS, GEORGIA	0-75	1
GREAT WESTERN SUGAR	BILLINGS, MONTANA	10-77	1
GREAT WESTERN SUGAR	FINDLAY, OHIO	10-74	1
GREAT WESTERN SUGAR	FORT MORGAN, COLORADO	10-76	1
GREAT WESTERN SUGAR	FREEMONT,OHIO	10-78	2
GREAT WESTERN SUGAR	GERING, NEBRASKA	10-75	1
GREAT WESTERN SUGAR	GREELEY, COLORADO	10-75	1
GREAT WESTERN SUGAR	LONGMONT, COLORADO	10-73	7
GREAT WESTERN SUGAR	LOVELAND, COLORADO	10-73	1
GREAT WESTERN SUGAR	SCOTTS BLUFF, NEBRASKA	10-75	1
HARRIS MINING CO.	SPRUCE PINE, NORTH CAROLINA	0-73	7
ITT RAYONIER, INC.	FERNANDINA BEACH, FLORIDA	0-75	1
KERR-MCGEE CHEMICAL CORP.	TRONA, CALIFORNIA	4-78	2
MEAD PAPERBOARD CO.	STEVENSON, ALABAMA	0-75	1
MINN-DAK FARMER'S COOPERATIVE	WAHPETON, NORTH DAKOTA	6-77	1
MOBIL OIL COMPANY	SAN ARDO, CALIFORNIA	0-74	1
NCR-APPLETON	ROARING SPRINGS, PENNSYLVANIA	6-77	1
NEKOOSA PAPERS, INC.	ASHDOWN, ARKANSAS	2-76	1

STATUS CODES -
- 0 - STATUS NOT DEFINED
- 1 - OPERATIONAL
- 2 - CONSTRUCTIONAL
- 3 - PLANNED-CONTRACT AWARDED
- 4 - PLANNED-LETTER OF INTENT SIGNED
- 5 - PLANNED-REQUESTING/EVALUATING BIDS
- 6 - PLANNED-CONSIDERING SO_2 CONTROLS
- 7 - TERMINATED OR INDEFINITELY SHUT DOWN

SECTION 3

LIST OF INDUSTRIAL BOILERS WITH FGD SYSTEMS

INSTALLATION NAME	LOCATION	START-UP DATE	STATUS
QUALITY MILLS, INC.	MT. AIRY, NORTH CAROLINA	5-70	7
RICKENBACKER AIR FORCE BASE	COLUMBUS, OHIO	3-76	1
SHELLER GLOBE CORP.	NORFOLK, VIRGINIA	0-75	1
ST. JOE MINERALS CORP.	MONACA, PENNSYLVANIA	10-78	2
ST. REGIS PAPER CO.	CANTONMENT, FLORIDA	0-73	1
TEXACO INCORPORATED	SAN ARDO, CALIFORNIA	0-74	1
TEXASGULF	GRANGER, WYOMING	9-76	1
TRANSCO TEXTILES, INC.	AUGUSTA, GEORGIA	3-75	7
U.S. GYPSUM CORP.	OAKMONT, PENNSYLVANIA	0- 0	7

STATUS CODES -

0 - STATUS NOT DEFINED
1 - OPERATIONAL
2 - CONSTRUCTIONAL
3 - PLANNED-CONTRACT AWARDED
4 - PLANNED-LETTER OF INTENT SIGNED
5 - PLANNED-REQUESTING/EVALUATING BIDS
6 - PLANNED-CONSIDERING SO2 CONTROLS
7 - TERMINATED OR INDEFINITELY SHUT DOWN

SECTION 4

SUMMARY OF FGD SYSTEMS

COMPANY INFORMATION	CURRENT PERIOD
ALYESKA PIPELINE SERVICE CO. VALDEZ, ALASKA FMC ENVIRONMENTAL EQUIPMENT FUEL OIL (.03 - .1% SULFUR) 50,000 SCFM @ 70 F (DESIGN MAX) START-UP 6/77 SODIUM SCRUBBING STATUS - OPERATIONAL	THE ALYESKA FGD SYSTEM IS UNIQUE IN THAT IT WAS NOT INSTALLED PRIMARILY FOR CONTROL OF EMISSIONS, BUT TO TREAT GAS USED IN THE OIL STORAGE TANKS. OPERATIONS FOR THE PERIOD SEPTEMBER THRU JANUARY WERE NEARLY PROBLEM-FREE. THERE HAS BEEN NO DOWNTIME ATTRIBUTABLE TO THE SO2 REMOVAL SYSTEM. RECENT MEASUREMENTS INDICATE SO2 REMOVAL TO BE BETTER THAN 95%.
AMERICAN THREAD MARION, NORTH CAROLINA W.W. SLY MANUFACTURING CO. COAL (.99 PERCENT SULFUR, 7 PERCENT ASH) 60,000 ACFM @ 400 DEGREES F START-UP 0/73 SODIUM HYDROXIDE ADDITION STATUS - OPERATIONAL	THE FGD INSTALLATION CONSISTS OF TWO SEPARATE SCRUBBING UNITS OPERATING ON TWO COAL-FIRED BOILERS FOR THE REMOVAL OF PARTICULATES AND SULFUR DIOXIDE. THE FGD UNITS HAVE BEEN IN SERVICE SINCE 1973. CORROSION OF I.D. FANS, STACK AND PIPING HAS BEEN THE MAIN PROBLEM. I.D. FAN VIBRATIONS HAVE CAUSED SEVERE STRAIN IN PIPING.
ARCO/POLYMERS MONACA, PENNSYLVANIA NOT SELECTED COAL (3.5% SULFUR) 300,000 SCFM @ 70 F (TOTAL - 3 BOILERS) START-UP 12/80 NOT SELECTED STATUS - PLANNED-REQUESTING/EVALUATING BIDS	ARCO POLYMERS IS PLANNING TO PURCHASE A FGD SYSTEM FOR THE FLUE GASES FROM THEIR THREE IDENTICAL BOILERS (EACH 300,000 LBS/HR STEAM AT 700 PSIG & 700 F). WHILE OTHER PROCESSES ARE REPORTEDLY BEING CONSIDERED, THE TWO PRIMARY FGD PROCESS CANDIDATES ARE THE WELLMAN-LORD PROCESS AND THE FMC DOUBLE ALKALI PROCESS. A FINAL DECISION ON AWARD OF CONTRACT IS EXPECTED IN MAY 1978.
ARMCO STEEL MIDDLETOWN, OHIO KOCH ENGINEERING COAL (0.8% SULFUR* 9% ASH* 14,000 BTU/LB) 280,000 ACFM @ 425 F (TOTAL - 2 BOILERS) START-UP 0/75 LIME SCRUBBING STATUS - OPERATIONAL	THIS CONTROL SYSTEM SERVES TWO MULTI-RETORT UNDERFEED STOKER, COAL-FIRED BOILERS EACH WITH A CAPACITY OF 100,000 LBS/HR STEAM. EARLIER BOILER PROBLEMS (HIGH EXCESS AIR) HAVE BEEN GENERALLY RECTIFIED BY A RETROFITTED BOILER CONTROL SYSTEM. RECENT OPERATIONS HAVE BEEN PROBLEM-FREE ALTHOUGH IN MID-FEBRUARY 1978 THE SCRUBBER HAS BEEN TEMPORARILY SHUTDOWN AS A RESULT OF THE COAL-STRIKE RELATED POWER SHORTAGE IN OHIO.

SECTION 4

SUMMARY OF FGD SYSTEMS

COMPANY INFORMATION	CURRENT PERIOD
CANTON TEXTILES CANTON, GEORGIA FMC ENVIRONMENTAL EQUIPMENT INTERRUPTIBLE NATURAL GAS* COAL (0.8% SULFUR) 42,000 ACFM START-UP 6/74 SODIUM SCRUBBING- WASTE STREAM STATUS - OPERATIONAL	AT CANTON TEXTILES THE CONTROL SYSTEM CONSISTS OF AN FMC MEDIUM ENERGY VENTURI SCRUBBER AND UTILIZES A CAUSTIC WASTE STREAM FOR SO2 REMOVAL. THE UNIT HAS BEEN IN OPERATION SINCE JUNE OF 1974. CANTON AGAIN REPORTED NO OPERATIONAL PROBLEMS DURING THIS REPORT PERIOD. COAL FIRING WAS RE-STARTED IN MID-OCTOBER 1977.
CARBORUNDUM ABRASIVES BUFFALO, NEW YORK CARBORUNDUM ENVIR. SYS. LTD. COAL (2% S AVERAGE, 3.2% S DESIGN MAX) 38,000 ACFM @ 350 F START-UP 0/ 0 LIME SCRUBBING STATUS - PLANNED-CONTRACT AWARDED	NO DEFINITE PLANS HAVE BEEN MADE FOR THE CONTROL OF SO2 EMISSIONS FROM THIS BOILER. THE FUTURE OF THE CONTROL SYSTEM WILL BE DETERMINED BY A REGULATORY AGENCY DECISION EXPECTED NEAR THE END OF 1978. THE CURRENTLY OPERATING VENTURI (L/G = 10) CONTROLS ONLY PARTICULATE, BUT TIE-INS HAVE BEEN PROVIDED FOR A LIME SCRUBBING SYSTEM USING A 6-STAGE SPRAY TOWER FOR SO2 CONTROL.
CATERPILLAR TRACTOR CO. EAST PEORIA, ILLINOIS FMC ENVIRONMENTAL EQUIPMENT COAL (3.2% SULFUR) 360,000 ACFM START-UP 3/78 DOUBLE ALKALI (CONCENTRATED) STATUS - CONSTRUCTION	THE FGD SYSTEM IS STILL UNDER CONSTRUCTION. FMC CONCENTRATED MODE DOUBLE ALKALI SYSTEMS WILL REMOVE SO2 EMISSIONS FROM 4 COAL-FIRED BOILERS. A SEPARATE SCRUBBER WILL TREAT THE GASES FROM EACH BOILER. START-UP IS CURRENTLY SCHEDULED FOR MARCH 1978.
CATERPILLAR TRACTOR CO. JOLIET, ILLINOIS ZURN INDUSTRIES COAL (3.2% SULFUR)* 9.65 T/HR FEED 90,000 ACFM (TOTAL - 2 BOILERS) START-UP 9/74 DOUBLE ALKALI (DILUTE) STATUS - OPERATIONAL	THE FGD SYSTEM CONSISTS OF AN INDEPENDENT SCRUBBING TRAIN ON EACH OF TWO COAL-FIRED BOILERS. THESE BOILERS HAVE BEEN OPERATIONAL EACH HEAT SEASON SINCE OCTOBER 1974. SINCE THAT DATE, SCRUBBER AVAILABILITY HAS BEEN AVERAGING 80-85%. OPERATIONS IN THE CURRENT HEAT SEASON HAVE BEEN IMPROVED BY THE SYSTEM MODIFICATIONS OF SUMMER 1977.

SECTION 4

SUMMARY OF FGD SYSTEMS

COMPANY INFORMATION	CURRENT PERIOD
CATERPILLAR TRACTOR CO. MAPLETON, ILLINOIS FMC ENVIRONMENTAL EQUIPMENT COAL (3.2% SULFUR) 360,000 ACFM START-UP 10/78 DOUBLE ALKALI (CONCENTRATED) STATUS - CONSTRUCTION	AT THE CATERPILLAR MAPLETON PLANT, FMC CONCENTRATED MODE DUAL ALKALI TECHNOLOGY WILL BE UTILIZED TO CONTROL SO_2 EMISSIONS. THREE SCRUBBER SYSTEMS WILL CONTROL EMISSIONS FROM THREE COAL-FIRED BOILERS. CONSTRUCTION DELAYS, PRIMARILY ON THE STEAM GENERATION SIDE HAVE DELAYED SYSTEM START-UP BACK TO THE 1978-79 HEAT SEASON.
CATERPILLAR TRACTOR CO. MORTON, ILLINOIS ZURN INDUSTRIES COAL (3.2% SULFUR) 70,000 ACFM (TOTAL - 2 BOILERS) START-UP 1/78 DOUBLE ALKALI (DILUTE) STATUS - OPERATIONAL	THE CATERPILLAR MORTON PLANT UTILIZES ZURN INDUSTRIES' DILUTE MODE DOUBLE ALKALI TECHNOLOGY TO CONTROL EMISSIONS FROM THE STEAM PLANT. FGD SYSTEM START-UP OCCURRED AT THE BEGINNING OF 1978. CURRENTLY THE VENDOR IS TRAINING THE BOILER OPERATORS ON HOW TO OPERATE AND MAINTAIN THE EMISSIONS CONTROL SYSTEM. THERE HAVE BEEN NO MAJOR PROBLEMS SINCE START-UP.
CATERPILLAR TRACTOR CO. MOSSVILLE, ILLINOIS FMC ENVIRONMENTAL EQUIPMENT COAL (3.2% SULFUR) 240,000 ACFM START-UP 10/75 DOUBLE ALKALI (CONCENTRATED) STATUS - OPERATIONAL	THE CATERPILLAR MOSSVILLE PLANT HAS UTILIZED AN FMC CONCENTRATED MODE FGD SYSTEM EACH HEATING SEASON SINCE OCTOBER 1975. THERE ARE FOUR COAL-FIRED BOILERS EACH BEING TREATED BY A SEPARATE SCRUBBING TRAIN. OVERALL AVAILABILITY HAS BEEN 80-85%. OPERATIONS FOR THE 1977-78 HEAT SEASON HAVE BEEN MARKED BY SOME PROBLEMS, BUT DETAILS ARE NOT YET AVAILABLE.
CHEVRON OIL COMPANY BAKERSFIELD, CALIFORNIA KOCH ENGINEERING OIL (1.3% SULFUR) 450,000 ACFM @ 500 F (TOTAL-18 BOILERS) START-UP 7/78 SODIUM SCRUBBING STATUS - PLANNED-CONTRACT AWARDED	CHEVRON IS AWAITING A REGULATORY BOARD DECISION AS TO WHETHER THE ERECTION OF THESE PROPOSED STEAM GENERATORS AND ACCOMPANYING FGD SYSTEMS WILL BE APPROVED. IF CHEVRON RECEIVES A GO-AHEAD FROM THE REGULATORY BOARD, THE COMPANY PLANS TO USE PROPRIETARY SCRUBBING STRATEGY IN MODULES FABRICATED BY KOCH ENGINEERING.

SECTION 4

SUMMARY OF FGD SYSTEMS

COMPANY INFORMATION	CURRENT PERIOD
FIRESTONE TIRE AND RUBBER CO. POTTSTOWN, PENNSYLVANIA FMC ENVIRONMENTAL EQUIPMENT 2.5-3.0% SULFUR COAL 14,000 ACFM START-UP 1/75 DOUBLE ALKALI (CONCENTRATED) STATUS - OPERATIONAL	THE FGD SYSTEM AT FIRESTONE-POTTSTOWN CONSISTS OF AN FMC DOUBLE ALKALI DUAL THROAT VENTURI SCRUBBER. THIS SO2 CONTROL SYSTEM WAS BUILT AS A DEMONSTRATION PROJECT FUNDED BY FIRESTONE. THE SYSTEM OPERATED WITH AN AVAILABILITY VALUE OF 91% IN THE FALL QUARTER OF 1977. . THE MAJOR PROBLEM AREA IS EROSION OF FAN AND SPRAY NOZZLES BY FLYASH. THIS EQUIPMENT WILL BE REDESIGNED.
FMC (SODA ASH PLANT) GREEN RIVER, WYOMING FMC ENVIRONMENTAL EQUIPMENT COAL (1% SULFUR* 5% ASH* 10,000 BTU/LB) 660,000 ACFM @ 320 F (TOTAL - 2 BOILERS) START-UP 5/76 SODIUM SCRUBBING STATUS - OPERATIONAL	THE FGD SYSTEM CONSISTS OF TWO FMC SODIUM SCRUBBING UNITS TO REMOVE SULFUR DIOXIDE AND PARTICULATE MATTER FROM THE FLUE GAS OF TWO BOILERS. SCRUBBER CORROSION HAS BEEN A PROBLEM. PLANT PERSONNEL FELT THAT THE LINING WAS IMPROPERLY APPLIED. FOAMING AND SEDIMENTATION HAS OCCURED IN THE SCRUBBER DUE TO IMPURITIES IN THE LIQUOR.
GENERAL MOTORS CHEV. MOTOR DIV TONOWANDA, NEW YORK FMC ENVIRONMENTAL EQUIPMENT COAL (1.3% S* 9% ASH* 12,500 BTU/LB) 132,700 SCFM @ 70 F (TOTAL - 4 BOILERS) START-UP 6/75 SODIUM SCRUBBING STATUS - OPERATIONAL	THE FGD SYSTEM CONSISTS OF FOUR GM SODIUM SCRUBBING UNITS FOR THE REMOVAL OF PARTICULATES AND SULFUR DIOXIDE FROM FOUR COAL-FIRED BOILERS. THE SCRUBBERS ARE EQUIPPED WITH VENTURI SCRUBBERS FOR PARTICULATE REMOVAL. UNSTABLE PH CONTROL, PIPE EROSION AND STACK CORRISION ARE MAIN PROBLEM AREAS. REPLACEMENT OF CONTROL SENSORS, PIPING AND RELINING OF STACK ARE THE CORRECTIVE ACTIONS.
GENERAL MOTORS CORPORATION ST. LOUIS, MISSOURI A.D. LITTLE COAL (3.2% SULFUR* 10% ASH) 100,000 ACFM @ 370 F START-UP 0/72 SODIUM SCRUBBING STATUS - OPERATIONAL	THIS SO2 CONTROL SYSTEM CONSISTS OF TWO GM DESIGNED SODIUM SCRUBBING UNITS OPERABLE ON TWO OF FOUR COAL-FIRED BOILERS. DURING THIS REPORT PERIOD, STACK CORROSION HAS BEEN THE MAIN PROBLEM. PLANS ARE BEING MADE TO RELINE THE STACK IN THE NEAR FUTURE. THE SYSTEM IS PROVIDED WITH BYPASS AND 60 F REHEAT.

SECTION 4

SUMMARY OF FGD SYSTEMS

COMPANY INFORMATION	CURRENT PERIOD
GENERAL MOTORS PARMA PARMA, OHIO GM ENVIRONMENTAL COAL (2.5% SULFUR* 7.1% ASH* 13,350 BTU/LB) 128,400 SCFM @ 70 F (TOTAL - 4 BOILERS) START-UP 3/74 DOUBLE ALKALI (DILUTE) STATUS - OPERATIONAL	THE FGD SYSTEM CONSISTS OF A GM DESIGN DOUBLE ALKALI SCRUBBER OPERATIONAL ON 4 BOILERS. THE SCRUBBERS HANDLE A TOTAL 240,000 ACFM OF FLUE GAS. THE SCRUBBERS HAVE BEEN OPERATIONAL SINCE MARCH 1974. THE SYSTEM DEVELOPED MIST ELIMINATOR PROBLEMS DURING THIS REPORT PERIOD. AT THE TIME OF THIS REPORT, A SATISFACTORY SOLUTION HAD NOT YET BEEN FOUND.
GENERAL MOTORS TRUCK & COACH PONTIAC, MICHIGAN PEABODY ENGINEERING COAL (0.84% SULFUR* 8.5% ASH* 12,500 BTU/LB) 107,300 SCFM @ 70 F (TOTAL - 2 BOILERS) START-UP 4/76 SODIUM SCRUBBING STATUS - OPERATIONAL	THE SCRUBBER SYSTEM CONSISTS OF TWO G.M. SODIUM UNITS FOR THE REMOVAL OF FLYASH AND SULFUR DIOXIDE FROM THE FLUE GAS OF TWO COAL-FIRED BOILERS. PLANT HAS BEEN EXPERIENCING FLYASH ABRASION IN PUMPS AND PIPING.
GENERAL MOTORS/DELCO MORAINE DAYTON, OHIO ENTOLETER, INC. COAL (0.7-1.3% SULFUR* 5-9.5% ASH* 13,400 BTU/LB) 55,440 SCFM @ 70 F (TOTAL - 2 BOILERS) START-UP 9/74 SODIUM SCRUBBING STATUS - OPERATIONAL	THE FGD SYSTEM CONSISTS OF TWO GM SODIUM SCRUBBING UNITS ON 2 COAL-FIRED BOILERS. THE UNITS HAVE BEEN OPERATIONAL SINCE SEPTEMBER 1974. THE SCRUBBERS REMOVE SULFUR DIOXIDE AND PARTICULATE MATTER FROM A TOTAL GAS VOLUME OF 45,000 ACFM AT 400 DEGREES F. AVERAGE OPERABILITY OF THE SYSTEM IS 95%.
GEORGIA-PACIFIC PAPER CO. CROSSETT, ARKANSAS AIRPOL INDUSTRIES BARK AND OIL OR COAL (1% - 1.5 % SULFUR)* 62 T/HR 320,000 ACFM @ 310 F START-UP 0/75 CAUSTIC WASTE STREAM STATUS - OPERATIONAL	THE FGD SYSTEM CONSISTS OF AN AIR-POL CAUSTIC SCRUBBING UNIT TO REMOVE SULFUR DIOXIDE AND PARTICULATE MATTER FROM THE FLUE GAS OF A COAL/BARK OR OIL/BARK POWER BOILER. PROBLEMS HAVE BEEN ENCOUNTERED WITH THE FIBERGLASS LININGS IN THE SCRUBBER. THE SYSTEM IS PRECEDED BY CYCLONES FOR PARTICULATE REMOVAL. NO REHEAT IS PROVIDED ON THE SYSTEM AND MATERIALS ARE HOLDING UP WELL WITH NO CORROSION OR ABRASION PROBLEMS. FIBERGLASS LININGS IN THE SCRUBBER ARE REPLACED AS THEY FAIL.

SECTION 4

SUMMARY OF FGD SYSTEMS

COMPANY INFORMATION	CURRENT PERIOD
GREAT SOUTHERN PAPER CO. CEDAR SPRINGS, GEORGIA AIRPOL INDUSTRIES BARK AND COAL OR OIL (1.0%-2.0% SULFUR) 700,000 ACFM* TOTAL - 2 SCRUBBERS START-UP 0/75 CAUSTIC WASTE STREAM STATUS - OPERATIONAL	THE FGD SYSTEM CONSISTS OF TWO AIR-POL CAUSTIC SCRUBBERS TO CONTROL PARTICULATE AND SULFUR DI-OXIDE FROM TWO POWER BOILERS. THE PRIMARY FUEL IS BARK/COAL (BARK/OIL IS FIRED OCCASIONALLY.) THE FOLLOWING PROBLEMS HAVE BEEN ENCOUNTERED* EROSION AND PLUGGAGE OF THE PH PROBES, INTERNAL WEAR ON PUMPS, AND EROSION IN THE RECIRCULATION LINES OF THE POWER BOILER SCRUBBER. THE PLANT IS IN THE PROCESS OF CHANGING THE PH CONTROL AND MOVING THE PROBES.
GREAT WESTERN SUGAR BILLINGS, MONTANA GREAT WESTERN SUGAR COAL (0.7% SULFUR) 60,000 SCFM @ 70 F START-UP 10/77 AMMONIA-LADEN PROCESS WATER STATUS - OPERATIONAL	GREAT WESTERN SUGAR USES CONDENSATE PROCESS WATER PRIMARILY FOR PARTICULATE CONTROL. THE WATER HAS A HIGH PH (8.7) BUT THE SYSTEM HAS A LOW SO2 REMOVAL BECAUSE THE WATER IS INTRODUCED THROUGH PIPES RATHER THAN SPRAY NOZZLES.
GREAT WESTERN SUGAR FINDLAY, OHIO GREAT WESTERN SUGAR COAL (3% SULFUR) 15,000 SCFM @ 70 F (TOTAL - 2 BOILERS) START-UP 10/74 SODIUM CARBONATE STATUS - OPERATIONAL	PARTICULATE AND SO2 EMISSIONS WILL BE CONTROLLED BY A SCRUBBER/ABSORBER MODULE OF PROPRIETARY DESIGN. THE FLUE GAS IS GENERATED BY TWO 720 BOILER HP UNITS. SCRUBBING OPERATIONS BEGAN IN OCTOBER 1974.
GREAT WESTERN SUGAR FORT MORGAN, COLORADO GREAT WESTERN SUGAR COAL (0.5% SULFUR) 50,000 SCFM @ 70 F START-UP 10/76 AMMONIA-LADEN PROCESS WATER STATUS - OPERATIONAL	GREAT WESTERN SUGAR USES CONDENSATE PROCESS WATER PRIMARILY FOR PARTICULATE CONTROL. THE WATER HAS A HIGH PH (8.7) BUT THE SYSTEM HAS A LOW SO2 REMOVAL BECAUSE THE WATER IS INTRODUCED THROUGH PIPES RATHER THAN SPRAY NOZZLES.

SECTION 4

SUMMARY OF FGD SYSTEMS

COMPANY INFORMATION	CURRENT PERIOD
GREAT WESTERN SUGAR FREEMONT,OHIO GREAT WESTERN SUGAR COAL (3% SULFUR) 40,000 SCFM @ 70 F (TOTAL - 2 BOILERS) START-UP 10/78 SODIUM CARBONATE STATUS - CONSTRUCTION	PARTICULATE AND SO2 EMISSIONS WILL BE CONTROLLED BY A SCRUBBER/ABSORBER MODULE OF PROPRIETARY DESIGN. THE FLUE GAS IS GENERATED BY TWO UNION BOILERS, EACH RATED @ 70,000 LB/HR STEAM. STARTUP IS SCHEDULED FOR OCTOBER 1978.
GREAT WESTERN SUGAR GERING, NEBRASKA GREAT WESTERN SUGAR COAL (0.7% SULFUR) 50,000 SCFM @ 70 F START-UP 10/75 AMMONIA-LADEN PROCESS WATER STATUS - OPERATIONAL	GREAT WESTERN SUGAR USES CONDENSATE PROCESS WATER PRIMARILY FOR PARTICULATE CONTROL. THE WATER HAS A HIGH PH (8.7) BUT THE SYSTEM HAS A LOW SO2 REMOVAL BECAUSE THE WATER IS INTRODUCED THROUGH PIPES RATHER THAN SPRAY NOZZLES.
GREAT WESTERN SUGAR GREELEY, COLORADO GREAT WESTERN SUGAR COAL (0.6% SULFUR) 25,000 SCFM @ 70 F START-UP 10/75 AMMONIA-LADEN PROCESS WATER STATUS - OPERATIONAL	GREAT WESTERN SUGAR USES CONDENSATE PROCESS WATER PRIMARILY FOR PARTICULATE CONTROL. THE WATER HAS A HIGH PH (8.7) BUT THE SYSTEM HAS A LOW SO2 REMOVAL BECAUSE THE WATER IS INTRODUCED THROUGH PIPES RATHER THAN SPRAY NOZZLES.
GREAT WESTERN SUGAR LONGMONT, COLORADO GREAT WESTERN SUGAR COAL (0.7% SULFUR) START-UP 10/73 AMMONIA-LADEN PROCESS WATER STATUS - TERMINATED OR INDEFINITELY SHUT DOWN	SUGAR PRODUCTION AND ALL PLANT OPERATIONS HAVE BEEN TERMINATED AT THE LONGMONT PLANT.

SECTION 4

SUMMARY OF FGD SYSTEMS

COMPANY INFORMATION	CURRENT PERIOD
GREAT WESTERN SUGAR LOVELAND, COLORADO GREAT WESTERN SUGAR COAL (0.6%-0.7% SULFUR) 50,000 SCFM @ 70 F START-UP 10/73 AMMONIA-LADEN PROCESS WATER STATUS - OPERATIONAL	GREAT WESTERN SUGAR USES CONDENSATE PROCESS WATER PRIMARILY FOR PARTICULATE CONTROL. THE WATER HAS A HIGH PH (8.7) BUT THE SYSTEM HAS A LOW SO2 REMOVAL BECAUSE THE WATER IS INTRODUCED THROUGH PIPES RATHER THAN SPRAY NOZZLES.
GREAT WESTERN SUGAR SCOTTS BLUFF, NEBRASKA GREAT WESTERN SUGAR COAL (0.6%-0.7% SULFUR) 60,000 SCFM @ 70 F START-UP 10/75 AMMONIA-LADEN PROCESS WATER STATUS - OPERATIONAL	GREAT WESTERN SUGAR USES CONDENSATE PROCESS WATER PRIMARILY FOR PARTICULATE CONTROL. THE WATER HAS A HIGH PH (8.7) BUT THE SYSTEM HAS A LOW SO2 REMOVAL BECAUSE THE WATER IS INTRODUCED THROUGH PIPES RATHER THAN SPRAY NOZZLES.
HARRIS MINING CO. SPRUCE PINE, NORTH CAROLINA W.W. SLY MANUFACTURING CO. COAL (0.8% SULFUR, 5% ASH) START-UP 0/73 WATER SCRUBBING (NA,NH3 OPTN.) STATUS - TERMINATED OR INDEFINITELY SHUT DOWN	THE FGD SYSTEM CONSISTS OF A W.W. SLY IMPINJET SCRUBBER CURRENTLY BEING USED STRICTLY AS A PARTICULATE CONTROL DEVICE. THE SYSTEM HAS THE CAPABILITY OF SCRUBBING WITH AMMONIA OR CAUSTIC IF NECESSARY. HOWEVER, AS LONG AS CURRENT LOW-SULFUR COAL SUPPLIES LAST, THERE IS NO NEED FOR SO2 CONTROLS.
ITT RAYONIER, INC. FERNANDINA BEACH, FLORIDA AIRPOL INDUSTRIES BARK AND OIL (2% - 2.5% SULFUR) 344,000 ACFM @ 446 F (TOTAL - 2 BOILERS) START-UP 0/75 CAUSTIC SCRUBBING STATUS - OPERATIONAL	AT FERNANDINA BEACH, ITT RAYONIER FIRES BARK AND OIL IN TWO OF THE FOUR PROCESS STEAM BOILERS. PARTICULATE AND SO2 EMISSIONS ARE CONTROLLED IN TWO AIRPOL SCRUBBING TRAINS. SPENT CAUSTIC IS NORMALLY USED FOR SO2 CONTROL. CURRENTLY HOWEVER, CONDENSATE STEAM IS BEING USED FOR SCRUBBING PURPOSES AND THE SPENT CAUSTIC IS BEING MARKETED.

SECTION 4

SUMMARY OF FGD SYSTEMS

COMPANY INFORMATION	CURRENT PERIOD
KERR-MCGEE CHEMICAL CORP. TRONA, CALIFORNIA COMBUSTION EQUIPMENT ASSOC. COKE, COAL, OIL (0.5% - 5% SULFUR) 726,000 ACFM @ 320 DEGREES F START-UP 4/78 SODIUM SCRUBBING STATUS - CONSTRUCTION	THE FGD SYSTEM CONSISTS OF A COMBUSTION EQUIPMENT (CEA) SODA ASH SCRUBBING SYSTEM WHICH REMOVES FLY-ASH AND SULFUR DIOXIDE FROM THE FLUE GAS OF TWO COAL FIRED BOILERS. MAJOR CONSTRUCTION IS COMPLETE AND PRECOMMISSIONING ACTIVITIES ARE UNDERWAY. EXPECTED STARTUP DATE IS APRIL 1, 1978.
MEAD PAPERBOARD CO. STEVENSON, ALABAMA AIRPOL INDUSTRIES OIL (1.5% - 3% SULFUR) 173,000 ACFM @ 450 F START-UP 0/75 SODIUM SCRUBBING STATUS - OPERATIONAL	AIRPOL INDUSTRIES HAS SUPPLIED A PARTICULATE AND SO_2 CONTROL SYSTEM FOR THE TWO OIL-FIRED BOILERS AT THIS MEAD PULP MILL. SODIUM CARBONATE SCRUBBING SOLUTION EFFECTS SO_2 REMOVAL OF ABOUT 95%. RECENT MODIFICATIONS HAVE INCLUDED A NEW RUBBER LINER IN THE SCRUBBER MODULE, AND THE INSTALLATION OF ADDITIONAL SPRAY NOZZLES.
MINN-DAK FARMER'S COOPERATIVE WAHPETON, NORTH DAKOTA KOCH ENGINEERING LIGNITE (1.0 PERCENT SULFUR) 250,000 ACFM @ 350 F - TOTAL TWO BOILERS START-UP 6/77 AMMONIA SCRUBBING STATUS - OPERATIONAL	KOCH ENGINEERING HAS SUPPLIED TWO AMMONIA-BASED SO_2 CONTROL SYSTEMS FOR THESE COAL-FIRED BOILERS. ORIGINAL DESIGN USED LIME SLURRY, BUT EXCESSIVE PLUGGING AND SCALING BROUGHT ABOUT THE SWITCH TO AMMONIA.
MOBIL OIL COMPANY SAN ARDO, CALIFORNIA MOBIL OIL COMPANY OIL (2% - 2.25% SULFUR) 304,000 ACFM @ 270 F START-UP 0/74 SODIUM SCRUBBING STATUS - OPERATIONAL	MOBIL OPERATES 28 SMALL STEAM GENERATORS AT THEIR OIL FIELDS IN SAN ARDO, CALIFORNIA. EACH OF THESE STEAM GENERATORS HAS ITS OWN SO_2 CONTROL SYSTEM UTILIZING CAUSTIC AND ALKALINE OIL FIELD WASTEWATER. PRIMARY PROBLEMS HAVE BEEN CORROSION OF STAINLESS STEEL COMPONENTS DUE TO HIGH CHLORIDE CONTENT.

SECTION 4

SUMMARY OF FGD SYSTEMS

COMPANY INFORMATION	CURRENT PERIOD
NCR-APPLETON ROARING SPRINGS, PENNSYLVANIA AIRPOL INDUSTRIES COAL (2% - 3% SULFUR) 85,000 ACFM @ 400 F START-UP 6/77 SODIUM SCRUBBING STATUS - OPERATIONAL	THIS NEW BOILER, RATED AT 12 MW (EQUIVALENT), WAS SUPPLIED WITH AN EMISSION CONTROL SYSTEM BY AIRPOL INDUSTRIES. THE SODIUM-BASED CHEMISTRY UTILIZES SODIUM HYDROXIDE FOR SO2 REMOVAL, ALTHOUGH NO GUARANTEE WAS MADE WITH RESPECT TO SO2 REMOVAL. BOILER-RELATED PROBLEMS HAVE DELAYED ACCEPTANCE TESTS ALTHOUGH START-UP OCCURED IN JUNE 1977.
NEKOOSA PAPERS, INC. ASHDOWN, ARKANSAS AIRPOL INDUSTRIES COAL (1%-1.5% SULFUR)* 27 TON/HR 325,000 ACFM @ 355 F START-UP 2/76 AIR POL CAUSTIC SCRUBBING STATUS - OPERATIONAL	THE FGD SYSTEM CONSISTS OF TWO AIR-POL CAUSTIC SCRUBBERS WHICH REMOVE FLYASH AND SULFUR DIOXIDE FROM THE FLUE GAS OF A STEAM BOILER FIRED WITH COAL OR FUEL OIL. SOME SOLIDS DEPOSITS ON THE PH PROBES ARE CAUSING SOME PROBLEMS. FLOW METERS HAVE BEEN INSTALLED TO GAIN MORE PH CONTROL IN THE SYSTEM.
QUALITY MILLS, INC. MT. AIRY, NORTH CAROLINA COMMERCIAL FABRICATION & MACH. FUEL OIL START-UP 5/70 WATER SCRUBBING STATUS - TERMINATED OR INDEFINITELY SHUT DOWN	THIS SMALL INDUSTRIAL BOILER UTILIZED A COMMERICAL FABRICATION AND MACHINE (CFM) SCRUB-AIR SYSTEM TO CONTROL EMISSIONS FROM THE COAL-FIRED BOILER FROM MAY 1970 TO DECEMBER 1973. AT THAT TIME THEY CONVERTED TO FIRING LOW-SULFUR OIL, REMOVING THE NEED TO CONTROL EMISSIONS.
RICKENBACKER AIR FORCE BASE COLUMBUS, OHIO RESEARCH-COTTRELL/BAHCO COAL (3.6% SULFUR) 50,000 SCFM @ 70 F START-UP 3/76 LIMESTONE SCRUBBING STATUS - OPERATIONAL	THIS RESEARCH-COTTRELL/BAHCO LIME FGD UNIT WAS FIRST PLACED IN SERVICE MARCH 11, 1976. THE SYSTEM WAS SWITCHED OVER TO LIMESTONE IN APRIL 1977, AND HAS REMAINED IN THAT OPERATING MODE TO DATE. THE NEW OHIO CODE REQUIRES A LESS STRINGENT SO2 REMOVAL EFFICIENCY AND THE PLANT IS NOW RUNNING A STOICHIOMETRIC RATIO OF ABOUT 0.75. AVAILABILITY HAS BEEN 95% SINCE AUGUST 1977.

SECTION 4

SUMMARY OF FGD SYSTEMS

COMPANY INFORMATION	CURRENT PERIOD
SHELLER GLOBE CORP. NORFOLK, VIRGINIA W.W. SLY MANUFACTURING CO. COAL (LESS THAN 1% SULFUR, 6% ASH, 13,200 BTU/LB) 8,000 SCFM @ 70 F START-UP 0/75 SODIUM HYDROXIDE STATUS - OPERATIONAL	AFTER SYSTEM RESTART IN OCTOBER 1977, THERE HAVE BEEN NO PROBLEMS RESULTING FROM EITHER BOILER OR SCRUBBER OPERATIONS. THE PLANT IS CURRENTLY AWAITING CERTIFICATION FROM VIRGINIA EPA.
ST. JOE MINERALS CORP. MONACA, PENNSYLVANIA BUREAU OF MINES COAL (3.0% SULFUR, 11000 BTU/LB) 150,000 ACFM START-UP 10/78 CITRATE PROCESS STATUS - CONSTRUCTION	CONSTRUCTION CONTINUES ON THE CITRATE PROCESS SCRUBBING SYSTEM WHICH WILL CONTROL SO_2 EMISSIONS FROM A 60-MW COAL-FIRED POWER GENERATING UNIT AT ST. JOE MINERALS. START-UP IS SCHEDULED FOR OCTOBER 1978. THE REGENERABLE FGD SYSTEM WILL PRODUCE ELEMENTAL SULFUR AS A BY-PRODUCT.
ST. REGIS PAPER CO. CANTONMENT, FLORIDA AIRPOL INDUSTRIES INTERRUPTIBLE NATURAL GAS* BARK & OIL (2%-3% S) 175,000 ACFM START-UP 0/73 CAUSTIC SCRUBBING STATUS - OPERATIONAL	THE FGD SYSTEM CONSISTS OF AN AIR-POL CAUSTIC SCRUBBING SYSTEM TO REMOVE PARTICULATES AND SULFUR DIOXIDE FROM THE FLUE GAS OF A BARK BOILER FIRING INTERRUPTIBLE NATURAL GAS AND OIL. PROBLEMS WITH VALVES PLUGGING AND FIBERS CLOGGING MIST ELIMINATOR HAVE BEEN INVESTIGATED AND A DECISION WAS MADE TO CHANGE THE MAKE-UP WATER SOURCE.
TEXACO INCORPORATED SAN ARDO, CALIFORNIA CEILCOTE CO. OIL (2 PERCENT SULFUR) 18,100 ACFM @ 460 F START-UP 0/74 SODIUM SCRUBBING STATUS - OPERATIONAL	THE FGD SYSTEM CONSISTS OF A HORIZONTAL,PACKED-BED TYPE SCRUBBER FOR THE FLUE GAS OF OIL FIRED BOILERS. THE BOILERS PRODUCE STEAM WHICH IS USED TO FACILITATE OIL FLOW FROM THE OIL WELLS. THERE ARE SEVERAL SCRUBBERS ON-SITE ALTHOUGH THE EXACT SITUATION HAS NOT YET BEEN REPORTED.

SECTION 4

SUMMARY OF FGD SYSTEMS

COMPANY INFORMATION	CURRENT PERIOD
TEXASGULF GRANGER, WYOMING SWEMCO INC. COAL (0.8% SULFUR* 7% ASH* 10,500 BTU/LB) 140,000 SCFM @ 70 F (TOTAL - 2 BOILERS) START-UP 9/76 SODIUM SCRUBBING STATUS - OPERATIONAL	THIS SODIUM CARBONATE FGD SYSTEM WAS DESIGNED BY SWEMCO, INC. OF NEW YORK. SO2 CONTROL OCCURS IN THE QUENCHER AND THE SIEVE-TRAY ABSORBER MODULE. AN INTERESTING FEATURE IS AN INTERNAL DAMPER WHICH ALLOWS A 4 TO 1 TURNDOWN RATIO. INITIAL PROBLEMS INCLUDED PLUGGING CAUSED BY FLYASH CARRYOVER FROM THE ESP. MILD STEEL PIPING IN THE RECIRCULATING LINES WAS SEVERELY CORRODED BY THE SLIGHTLY ACIDIC SCRUBBING LIQUOR.
TRANSCO TEXTILES, INC. AUGUSTA, GEORGIA FMC ENVIRONMENTAL EQUIPMENT FUEL OIL (2% MAX. SULFUR) 50,000 ACFM START-UP 3/75 SODIUM SCRUBBING STATUS - TERMINATED OR INDEFINITELY SHUT DOWN	THE FGD OPERATIONS HAVE BEEN TERMINATED FOR AN INDEFINITE PERIOD. THE PLANT BURNS NUMBER 6 FUEL OIL AND THE SULFUR DIOXIDE EMISSIONS ARE 50% OF THE EXISTING REGULATIONS. THE BOILER IS RATED AT 20 MW (EQUIVALENT) AND PRODUCES 150,000 LBS/HR STEAM. WHEN OPERATIONAL, THE SCRUBBER SYSTEM HAD FLUE GAS VOLUME OF 50,000 ACFM AT 140 DEGREES F. SYSTEM START-UP OCCURRED IN MARCH 1975 AND SCRUBBER OPERATIONS WERE TERMINATED LATER IN THE SAME YEAR. A DEC. 1977 CHECK REVEALS THAT THE FGD SYSTEM IS STILL TERMINATED AND THERE ARE CURRENTLY NO PLANS TO INITIATE OPERATIONS.
U.S. GYPSUM CORP. OAKMONT, PENNSYLVANIA AIRPOL INDUSTRIES COAL START-UP 0/ 0 DOUBLE ALKALI (DILUTE) STATUS - TERMINATED OR INDEFINITELY SHUT DOWN	AN AIRPOL DOUBLE ALKALI SCRUBBING SYSTEM IS ON-SITE, INSTALLED, AND READY FOR OPERATIONS. HOWEVER, US GYPSUM DECIDED NOT TO INITIATE PRODUCTION AT THIS FACILITY. A DEC. 1977 CHECK REVEALED THAT THE SITUATION IS UNCHANGED, I.E., THE STEAM PLANT WAS NEVER STARTED.

SECTION 5

LIST OF VENDORS OF FGD SYSTEMS

VENDOR	INSTALLATION NAME / LOCATION	CONTROL SYSTEM PROCESS
A.D. LITTLE	GENERAL MOTORS CORPORATION ST. LOUIS, MISSOURI	SODIUM SCRUBBING
AIRPOL INDUSTRIES	GEORGIA-PACIFIC PAPER CO. CROSSETT, ARKANSAS	CAUSTIC WASTE STREAM
	GREAT SOUTHERN PAPER CO. CEDAR SPRINGS, GEORGIA	CAUSTIC WASTE STREAM
	ITT RAYONIER, INC. FERNANDINA BEACH, FLORIDA	CAUSTIC SCRUBBING
	MEAD PAPERBOARD CO. STEVENSON, ALABAMA	SODIUM SCRUBBING
	NCR-APPLETON ROARING SPRINGS, PENNSYLVANIA	SODIUM SCRUBBING
	NEKOOSA PAPERS, INC. ASHDOWN, ARKANSAS	AIR POL CAUSTIC SCRUBBING
	ST. REGIS PAPER CO. CANTONMENT, FLORIDA	CAUSTIC SCRUBBING
	U.S. GYPSUM CORP. OAKMONT, PENNSYLVANIA	DOUBLE ALKALI (DILUTE)
BUREAU OF MINES	ST. JOE MINERALS CORP. MONACA, PENNSYLVANIA	CITRATE PROCESS
CARBORUNDUM ENVIR. SYS. LTD.	CARBORUNDUM ABRASIVES BUFFALO, NEW YORK	LIME SCRUBBING
CEILCOTE CO.	TEXACO INCORPORATED SAN ARDO, CALIFORNIA	SODIUM SCRUBBING
COMBUSTION EQUIPMENT ASSOC.	KERR-MCGEE CHEMICAL CORP. TRONA, CALIFORNIA	SODIUM SCRUBBING
COMMERCIAL FABRICATION & MACH.	QUALITY MILLS, INC. MT. AIRY, NORTH CAROLINA	WATER SCRUBBING
ENTOLETER, INC.	GENERAL MOTORS/DELCO MORAINE DAYTON, OHIO	SODIUM SCRUBBING

SECTION 5

LIST OF VENDORS OF FGD SYSTEMS

VENDOR	INSTALLATION NAME / LOCATION	CONTROL SYSTEM PROCESS
FMC ENVIRONMENTAL EQUIPMENT	ALYESKA PIPELINE SERVICE CO. VALDEZ, ALASKA	SODIUM SCRUBBING
	CANTON TEXTILES CANTON, GEORGIA	SODIUM SCRUBBING- WASTE STREAM
	CATERPILLAR TRACTOR CO. MAPLETON, ILLINOIS	DOUBLE ALKALI (CONCENTRATED)
	CATERPILLAR TRACTOR CO. EAST PEORIA, ILLINOIS	DOUBLE ALKALI (CONCENTRATED)
	CATERPILLAR TRACTOR CO. MOSSVILLE, ILLINOIS	DOUBLE ALKALI (CONCENTRATED)
	FIRESTONE TIRE AND RUBBER CO. POTTSTOWN, PENNSYLVANIA	DOUBLE ALKALI (CONCENTRATED)
	FMC (SODA ASH PLANT) GREEN RIVER, WYOMING	SODIUM SCRUBBING
	GENERAL MOTORS CHEV. MOTOR DIV TONOWANDA, NEW YORK	SODIUM SCRUBBING
	TRANSCO TEXTILES, INC. AUGUSTA, GEORGIA	SODIUM SCRUBBING
GM ENVIRONMENTAL	GENERAL MOTORS PARMA PARMA, OHIO	DOUBLE ALKALI (DILUTE)
GREAT WESTERN SUGAR	GREAT WESTERN SUGAR SCOTTS BLUFF, NEBRASKA	AMMONIA-LADEN PROCESS WATER
	GREAT WESTERN SUGAR LOVELAND, COLORADO	AMMONIA-LADEN PROCESS WATER
	GREAT WESTERN SUGAR BILLINGS, MONTANA	AMMONIA-LADEN PROCESS WATER
	GREAT WESTERN SUGAR GREELEY, COLORADO	AMMONIA-LADEN PROCESS WATER
	GREAT WESTERN SUGAR GERING, NEBRASKA	AMMONIA-LADEN PROCESS WATER

SECTION 5

LIST OF VENDORS OF FGD SYSTEMS

VENDOR	INSTALLATION NAME / LOCATION	CONTROL SYSTEM PROCESS
GREAT WESTERN SUGAR	GREAT WESTERN SUGAR FREEMONT,OHIO	SODIUM CARBONATE
	GREAT WESTERN SUGAR FORT MORGAN, COLORADO	AMMONIA-LADEN PROCESS WATER
	GREAT WESTERN SUGAR FINDLAY, OHIO	SODIUM CARBONATE
	GREAT WESTERN SUGAR LONGMONT, COLORADO	AMMONIA-LADEN PROCESS WATER
KOCH ENGINEERING	ARMCO STEEL MIDDLETOWN, OHIO	LIME SCRUBBING
	CHEVRON OIL COMPANY BAKERSFIELD, CALIFORNIA	SODIUM SCRUBBING
	MINN-DAK FARMER'S COOPERATIVE WAHPETON, NORTH DAKOTA	AMMONIA SCRUBBING
MOBIL OIL COMPANY	MOBIL OIL COMPANY SAN ARDO, CALIFORNIA	SODIUM SCRUBBING
NOT SELECTED	ARCO/POLYMERS MONACA, PENNSYLVANIA	NOT SELECTED
PEABODY ENGINEERING	GENERAL MOTORS TRUCK & COACH PONTIAC, MICHIGAN	SODIUM SCRUBBING
RESEARCH-COTTRELL/BAHCO	RICKENBACKER AIR FORCE BASE COLUMBUS, OHIO	LIMESTONE SCRUBBING
SWEMCO INC.	TEXASGULF GRANGER, WYOMING	SODIUM SCRUBBING
W.W. SLY MANUFACTURING CO.	AMERICAN THREAD MARION, NORTH CAROLINA	SODIUM HYDROXIDE ADDITION
	HARRIS MINING CO. SPRUCE PINE, NORTH CAROLINA	WATER SCRUBBING (NA,NH3 OPTN.)
	SHELLER GLOBE CORP. NORFOLK, VIRGINIA	SODIUM HYDROXIDE

SECTION 5

LIST OF VENDORS OF FGD SYSTEMS

VENDOR	INSTALLATION NAME / LOCATION	CONTROL SYSTEM PROCESS
ZURN INDUSTRIES	CATERPILLAR TRACTOR CO. MORTON, ILLINOIS	DOUBLE ALKALI (DILUTE)
	CATERPILLAR TRACTOR CO. JOLIET, ILLINOIS	DOUBLE ALKALI (DILUTE)

SECTION 6

NUMBER AND TOTAL CAPACITY OF FGD SYSTEMS

STATUS	NO. OF UNITS	CAPACITY ACFM	NO. OF UNITS ACFM NOT KNOWN
OPERATIONAL	34	5231940.	0
UNDER CONSTRUCTION	5	1636000.	0
PLANNING			
CONTRACT AWARDED	2	488000.	0
LETTER OF INTENT	0	0.	0
REQUESTING/EVALUATION BIDS	1	300000.	0
CONSIDER ONLY	0	0.	0
TOTAL	42	7655940.	0

SECTION 7

STARTUP DATE OF FGD SYSTEMS

YEAR	UNITS	ACFM	NO. OF UNITS ACFM UNKNOWN
1972	1	100000.	0
1973	3	285000.	0
1974	7	652940.	0
1975	12	2346700.	0
1976	6	1332300.	0
1977	4	445000.	0
1978	7	2156000.	0
1980	1	300000.	0
UNDEFINED	1	38000.	0
TOTAL	42	7655940.	0

SECTION 8

SUMMARY OF OPERATIONAL FGD SYSTEMS

COMPANY/LOCATION	NEW/ RETROFIT	SIZE UNIT (ACFM)	PROCESS/VENDOR	MO/YR
ALYESKA PIPELINE SERVICE CO. VALDEZ, ALASKA SOURCE CHARACTERISTICS -FUEL OIL (.03 - .1% SULFUR)	NEW	50,000	SODIUM SCRUBBING FMC ENVIRONMENTAL EQUIPMENT	6/77
AMERICAN THREAD MARION, NORTH CAROLINA SOURCE CHARACTERISTICS -COAL (.99 PERCENT SULFUR, 7 PERCENT ASH)	RETROFIT	60,000	SODIUM HYDROXIDE ADDITION W.W. SLY MANUFACTURING CO.	0/73
ARMCO STEEL MIDDLETOWN, OHIO SOURCE CHARACTERISTICS -COAL (0.8% SULFUR* 9% ASH* 14,000 BTU/LB)	RETROFIT	280,000	LIME SCRUBBING KOCH ENGINEERING	0/75
CANTON TEXTILES CANTON, GEORGIA SOURCE CHARACTERISTICS -INTERRUPTIBLE NATURAL GAS* COAL (0.8% SULFUR)	RETROFIT	42,000	SODIUM SCRUBBING- WASTE STREAM FMC ENVIRONMENTAL EQUIPMENT	6/74
CATERPILLAR TRACTOR CO. JOLIET, ILLINOIS SOURCE CHARACTERISTICS -COAL (3.2% SULFUR)* 9.65 T/HR FEED	RETROFIT	90,000	DOUBLE ALKALI (DILUTE) ZURN INDUSTRIES	9/74
CATERPILLAR TRACTOR CO. MOSSVILLE, ILLINOIS SOURCE CHARACTERISTICS -COAL (3.2% SULFUR)	1NEW, 3RETROFIT	240,000	DOUBLE ALKALI (CONCENTRATED) FMC ENVIRONMENTAL EQUIPMENT	10/75
CATERPILLAR TRACTOR CO. MORTON, ILLINOIS SOURCE CHARACTERISTICS -COAL (3.2% SULFUR)	RETROFIT	70,000	DOUBLE ALKALI (DILUTE) ZURN INDUSTRIES	1/78
FIRESTONE TIRE AND RUBBER CO. POTTSTOWN, PENNSYLVANIA SOURCE CHARACTERISTICS -2.5-3.0% SULFUR COAL	RETROFIT	14,000	DOUBLE ALKALI (CONCENTRATED) FMC ENVIRONMENTAL EQUIPMENT	1/75
FMC (SODA ASH PLANT) GREEN RIVER, WYOMING SOURCE CHARACTERISTICS -COAL (1% SULFUR* 5% ASH* 10,000 BTU/LB)	NEW	660,000	SODIUM SCRUBBING FMC ENVIRONMENTAL EQUIPMENT	5/76

SECTION 8

SUMMARY OF OPERATIONAL FGD SYSTEMS

COMPANY/LOCATION	NEW/ RETROFIT	SIZE UNIT (ACFM)	PROCESS/VENDOR	MO/YR
GENERAL MOTORS CHEV. MOTOR DIV TONOWANDA, NEW YORK SOURCE CHARACTERISTICS -COAL (1.3% S* 9% ASH* 12,500 BTU/LB)	RETROFIT	132,700	SODIUM SCRUBBING FMC ENVIRONMENTAL EQUIPMENT	6/75
GENERAL MOTORS CORPORATION ST. LOUIS, MISSOURI SOURCE CHARACTERISTICS -COAL (3.2% SULFUR* 10% ASH)	RETROFIT	100,000	SODIUM SCRUBBING A.D. LITTLE	0/72
GENERAL MOTORS PARMA PARMA, OHIO SOURCE CHARACTERISTICS -COAL (2.5% SULFUR* 7.1% ASH* 13,350 BTU/LB)	RETROFIT	128,400	DOUBLE ALKALI (DILUTE) GM ENVIRONMENTAL	3/74
GENERAL MOTORS TRUCK & COACH PONTIAC, MICHIGAN SOURCE CHARACTERISTICS -COAL (0.84% SULFUR* 8.5% ASH* 12,500 BTU/LB) ALSO WOOD, PAPER, AND CARDBOARD.	NEW	107,300	SODIUM SCRUBBING PEABODY ENGINEERING	4/76
GENERAL MOTORS/DELCO MORAINE DAYTON, OHIO SOURCE CHARACTERISTICS -COAL (0.7-1.3% SULFUR* 5-9.5% ASH* 13,400 BTU/LB)	RETROFIT	55,440	SODIUM SCRUBBING ENTOLETER, INC.	9/74
GEORGIA-PACIFIC PAPER CO. CROSSETT, ARKANSAS SOURCE CHARACTERISTICS -BARK AND OIL OR COAL (1% - 1.5 % SULFUR)* 62 T/HR BARK* 22 GPM OIL	NEW	320,000	CAUSTIC WASTE STREAM AIRPOL INDUSTRIES	0/75
GREAT SOUTHERN PAPER CO. CEDAR SPRINGS, GEORGIA SOURCE CHARACTERISTICS -BARK AND COAL OR OIL (1.0%-2.0% SULFUR)	RETROFIT	700,000	CAUSTIC WASTE STREAM AIRPOL INDUSTRIES	0/75
GREAT WESTERN SUGAR SCOTTS BLUFF, NEBRASKA SOURCE CHARACTERISTICS -COAL (0.6%-0.7% SULFUR)	RETROFIT	60,000	AMMONIA-LADEN PROCESS WATER GREAT WESTERN SUGAR	10/75

SECTION 8

SUMMARY OF OPERATIONAL FGD SYSTEMS

COMPANY/LOCATION	NEW/ RETROFIT	SIZE UNIT (ACFM)	PROCESS/VENDOR	MO/YR
GREAT WESTERN SUGAR GREELEY, COLORADO SOURCE CHARACTERISTICS -COAL (0.6% SULFUR)	RETROFIT	25,000	AMMONIA-LADEN PROCESS WATER GREAT WESTERN SUGAR	10/75
GREAT WESTERN SUGAR GERING, NEBRASKA SOURCE CHARACTERISTICS -COAL (0.7% SULFUR)	RETROFIT	50,000	AMMONIA-LADEN PROCESS WATER GREAT WESTERN SUGAR	10/75
GREAT WESTERN SUGAR LOVELAND, COLORADO SOURCE CHARACTERISTICS -COAL (0.6%-0.7% SULFUR)	RETROFIT	50,000	AMMONIA-LADEN PROCESS WATER GREAT WESTERN SUGAR	10/73
GREAT WESTERN SUGAR FORT MORGAN, COLORADO SOURCE CHARACTERISTICS -COAL (0.5% SULFUR)	RETROFIT	50,000	AMMONIA-LADEN PROCESS WATER GREAT WESTERN SUGAR	10/76
GREAT WESTERN SUGAR BILLINGS, MONTANA SOURCE CHARACTERISTICS -COAL (0.7% SULFUR)	RETROFIT	60,000	AMMONIA-LADEN PROCESS WATER GREAT WESTERN SUGAR	10/77
GREAT WESTERN SUGAR FINDLAY, OHIO SOURCE CHARACTERISTICS -COAL (3% SULFUR)	RETROFIT	15,000	SODIUM CARBONATE GREAT WESTERN SUGAR	10/74
ITT RAYONIER, INC. FERNANDINA BEACH, FLORIDA SOURCE CHARACTERISTICS -BARK AND OIL (2% - 2.5% SULFUR)	RETROFIT	344,000	CAUSTIC SCRUBBING AIRPOL INDUSTRIES	0/75
MEAD PAPERBOARD CO. STEVENSON, ALABAMA SOURCE CHARACTERISTICS -OIL (1.5% - 3% SULFUR)	NEW	173,000	SODIUM SCRUBBING AIRPOL INDUSTRIES	0/75
MINN-DAK FARMER'S COOPERATIVE WAHPETON, NORTH DAKOTA SOURCE CHARACTERISTICS -LIGNITE (1.0 PERCENT SULFUR)	RETROFIT	250,000	AMMONIA SCRUBBING KOCH ENGINEERING	6/77

SECTION 8

SUMMARY OF OPERATIONAL FGD SYSTEMS

COMPANY/LOCATION	NEW/ RETROFIT	SIZE UNIT (ACFM)	PROCESS/VENDOR	MO/YR
MOBIL OIL COMPANY SAN ARDO, CALIFORNIA SOURCE CHARACTERISTICS -OIL (2% - 2.25% SULFUR)	RETROFIT	304,000	SODIUM SCRUBBING MOBIL OIL COMPANY	0/74
NCR-APPLETON ROARING SPRINGS, PENNSYLVANIA SOURCE CHARACTERISTICS -COAL (2% - 3% SULFUR)	NEW	85,000	SODIUM SCRUBBING AIRPOL INDUSTRIES	6/77
NEKOOSA PAPERS, INC. ASHDOWN, ARKANSAS SOURCE CHARACTERISTICS -COAL (1%-1.5% SULFUR)* 27 TON/HR	NEW	325,000	AIR POL CAUSTIC SCRUBBING AIRPOL INDUSTRIES	2/76
RICKENBACKER AIR FORCE BASE COLUMBUS, OHIO SOURCE CHARACTERISTICS -COAL (3.6% SULFUR)	RETROFIT	50,000	LIMESTONE SCRUBBING RESEARCH-COTTRELL/BAHCO	3/76
SHELLER GLOBE CORP. NORFOLK, VIRGINIA SOURCE CHARACTERISTICS -COAL (LESS THAN 1% SULFUR, 6% ASH, 13,200 BTU/LB)	RETROFIT	8,000	SODIUM HYDROXIDE W.W. SLY MANUFACTURING CO.	0/75
ST. REGIS PAPER CO. CANTONMENT, FLORIDA SOURCE CHARACTERISTICS -INTERRUPTIBLE NATURAL GAS* BARK & OIL (2%-3% S)	RETROFIT	175,000	CAUSTIC SCRUBBING AIRPOL INDUSTRIES	0/73
TEXACO INCORPORATED SAN ARDO, CALIFORNIA SOURCE CHARACTERISTICS -OIL (2 PERCENT SULFUR)	RETROFIT	18,100	SODIUM SCRUBBING CEILCOTE CO.	0/74
TEXASGULF GRANGER, WYOMING SOURCE CHARACTERISTICS -COAL (0.8% SULFUR* 7% ASH* 10,500 BTU/LB)	NEW	140,000	SODIUM SCRUBBING SWEMCO INC.	9/76

SECTION 9

SUMMARY OF UNDER CONSTRUCTION FGD SYSTEMS

COMPANY/LOCATION	NEW/ RETROFIT	SIZE UNIT (ACFM)	PROCESS/VENDOR	MO/YR
CATERPILLAR TRACTOR CO. EAST PEORIA, ILLINOIS SOURCE CHARACTERISTICS -COAL (3.2% SULFUR)	2NEW, 2RETROFIT	360,000	DOUBLE ALKALI (CONCENTRATED) FMC ENVIRONMENTAL EQUIPMENT	3/78
CATERPILLAR TRACTOR CO. MAPLETON, ILLINOIS SOURCE CHARACTERISTICS -COAL (3.2% SULFUR)	NEW	360,000	DOUBLE ALKALI (CONCENTRATED) FMC ENVIRONMENTAL EQUIPMENT	10/78
GREAT WESTERN SUGAR FREEMONT,OHIO SOURCE CHARACTERISTICS -COAL (3% SULFUR)	RETROFIT	40,000	SODIUM CARBONATE GREAT WESTERN SUGAR	10/78
KERR-MCGEE CHEMICAL CORP. TRONA, CALIFORNIA SOURCE CHARACTERISTICS -COKE, COAL, OIL (0.5% - 5% SULFUR)	NEW	726,000	SODIUM SCRUBBING COMBUSTION EQUIPMENT ASSOC.	4/78
ST. JOE MINERALS CORP. MONACA, PENNSYLVANIA SOURCE CHARACTERISTICS -COAL (3.0% SULFUR, 11000 BTU/LB)	RETROFIT	150,000	CITRATE PROCESS BUREAU OF MINES	10/78

SECTION 10

SUMMARY OF PLANNED FGD SYSTEMS

COMPANY/LOCATION	NEW/ RETROFIT	SIZE UNIT (ACFM)	PROCESS/VENDOR	MO/YR
CARBORUNDUM ABRASIVES BUFFALO, NEW YORK SOURCE CHARACTERISTICS -COAL (2% S AVERAGE, 3.2% S DESIGN MAX)	RETROFIT	38,000	LIME SCRUBBING CARBORUNDUM ENVIR. SYS. LTD.	0/ 0
CHEVRON OIL COMPANY BAKERSFIELD, CALIFORNIA SOURCE CHARACTERISTICS -OIL (1.5% SULFUR)	RETROFIT	450,000	SODIUM SCRUBBING KOCH ENGINEERING	7/78
ARCO/POLYMERS MONACA, PENNSYLVANIA SOURCE CHARACTERISTICS -COAL (3.5% SULFUR)	RETROFIT	300,000	NOT SELECTED NOT SELECTED	12/80

SECTION 11

SUMMARY OF WASTE AND BY-PRODUCT DISPOSAL PRACTICES FOR FGD SYSTEMS

INSTALLATION NAME / LOCATION	STATUS/COMMENTS
ALKALINE SULFITE/BISULFITE RECYCLED TO PULP PROCESS	
MEAD PAPERBOARD CO. STEVENSON, ALABAMA	OPERATIONAL RECOVERED SOLUTION USED AS MAKE-UP TO COOKING LIQUOR IN PULP MILL.
NEKOOSA PAPERS, INC. ASHDOWN, ARKANSAS	OPERATIONAL SO2 RECOVERED FROM SODIUM SULFITE/SULFATE LIQUOR AND RECYCLED TO PULPING PROCESS.
DEWATERED SLURRY TO LANDFILL	
CATERPILLAR TRACTOR CO. MORTON, ILLINOIS	OPERATIONAL
CATERPILLAR TRACTOR CO. MOSSVILLE, ILLINOIS	OPERATIONAL 60+% SOLIDS (CASO4) SLUDGE DIRECTLY TO LANDFILL
CATERPILLAR TRACTOR CO. JOLIET, ILLINOIS	OPERATIONAL
CATERPILLAR TRACTOR CO. EAST PEORIA, ILLINOIS	CONSTRUCTION 60+% SOLIDS (CASO4) SLUDGE DIRECTLY TO LANDFILL
CATERPILLAR TRACTOR CO. MAPLETON, ILLINOIS	CONSTRUCTION 60+% SOLIDS (CASO4) SLUDGE DIRECTLY TO LANDFILL
FIRESTONE TIRE AND RUBBER CO. POTTSTOWN, PENNSYLVANIA	OPERATIONAL
GENERAL MOTORS CHEV. MOTOR DIV TONOWANDA, NEW YORK	OPERATIONAL FLY ASH AND NA2SO3/SO4 WASTE LIQUOR DEWATERED AND THEN TO SANITARY LANDFILL
GENERAL MOTORS PARMA PARMA, OHIO	OPERATIONAL 50 + % SOLIDS (CASO3/SO4) SLUDGE TO DRYING POND AND LANDFILL
GENERAL MOTORS TRUCK & COACH PONTIAC, MICHIGAN	OPERATIONAL 5% SOLIDS SLURRY DEWATERED AND TO LANDFILL

SECTION 11

SUMMARY OF WASTE AND BY-PRODUCT DISPOSAL PRACTICES FOR FGD SYSTEMS

INSTALLATION NAME / LOCATION	STATUS/COMMENTS
DEWATERED SLURRY TO LANDFILL	
U.S. GYPSUM CORP. OAKMONT, PENNSYLVANIA	TERMINATED OR INDEFINITELY SHUT DOWN SLUDGE TO POND FOR DRYING. THEN TO LANDFILL.
HOLDING POND FOR EVAPORATION	
AMERICAN THREAD MARION, NORTH CAROLINA	OPERATIONAL THE SODIUM SULFITE/SULFATE SLURRY IS PUMPED TO A RED CLAY LINED ASH BASIN. LEACHING OF SODIUM SULFITE IS NOT A PROBLEM DUE TO THE IMPERMEABLE NATURE OF THE RED CLAY LINER.
ARMCO STEEL MIDDLETOWN, OHIO	OPERATIONAL
FMC (SODA ASH PLANT) GREEN RIVER, WYOMING	OPERATIONAL NA2SO3/SO4 LIQUOR DISPOSED TO COLLECTION POND - NO PRIOR AERATION. LANDFILL IN THE FUTURE
KERR-MCGEE CHEMICAL CORP. TRONA, CALIFORNIA	CONSTRUCTION SCRUBBER EFFLUENT IS CLARIFIED AND THEN PUT INTO A MINERAL DEPOSIT.
MOBIL OIL COMPANY SAN ARDO, CALIFORNIA	OPERATIONAL
TEXASGULF GRANGER, WYOMING	OPERATIONAL
NON-FIXATED SLURRY TO LINED POND	
CANTON TEXTILES CANTON, GEORGIA	OPERATIONAL NA SO3/SO4 LIQUOR DISPOSED TO LINED HOLDING PONDS
RICKENBACKER AIR FORCE BASE COLUMBUS, OHIO	OPERATIONAL UNSTABILIZED CASO3/SO4 SLUDGE TO LINED POND

SECTION 11

SUMMARY OF WASTE AND BY-PRODUCT DISPOSAL PRACTICES FOR FGD SYSTEMS

INSTALLATION NAME / LOCATION	STATUS/COMMENTS
REGENERABLE - ELEMENTAL SULFUR PRODUCT	
ST. JOE MINERALS CORP. MONACA, PENNSYLVANIA	CONSTRUCTION
WASTEWATER TREATMENT AND DISCHARGE TO CITY SEWER	
CARBORUNDUM ABRASIVES BUFFALO, NEW YORK	PLANNED-CONTRACT AWARDED
GENERAL MOTORS CORPORATION ST. LOUIS, MISSOURI	OPERATIONAL NA2SO3 OXIDIZED TO NA2SO4, PH NEUTRALIZED AND DISCHARGED TO CITY SEWER SYSTEM
GENERAL MOTORS/DELCO MORAINE DAYTON, OHIO	OPERATIONAL NA2SO3/SO4 LIQUOR AT 35 GPM TO ON-SITE CLARIFICATION AND DEWATERING FACILITY
GEORGIA-PACIFIC PAPER CO. CROSSETT, ARKANSAS	OPERATIONAL
GREAT WESTERN SUGAR FINDLAY, OHIO	OPERATIONAL
GREAT WESTERN SUGAR FREEMONT,OHIO	CONSTRUCTION
NCR-APPLETON ROARING SPRINGS, PENNSYLVANIA	OPERATIONAL
QUALITY MILLS, INC. MT. AIRY, NORTH CAROLINA	TERMINATED OR INDEFINITELY SHUT DOWN SCRUBBING LIQUOR DISCHARGED TO NEUTRALIZATION POND
ST. REGIS PAPER CO. CANTONMENT, FLORIDA	OPERATIONAL SLUDGE IS DISCHARGED TO AN ON-SITE SEWAGE TREATMENT PLANT

SECTION 11

SUMMARY OF WASTE AND BY-PRODUCT DISPOSAL PRACTICES FOR FGD SYSTEMS

INSTALLATION NAME / LOCATION	STATUS/COMMENTS
WASTEWATER TREATMENT AND DISCHARGE TO RIVER	
GREAT SOUTHERN PAPER CO. CEDAR SPRINGS, GEORGIA	OPERATIONAL CLARIFICATION FOLLOWED BY PONDING AND DISCHARGE TO RIVER
GREAT WESTERN SUGAR LONGMONT, COLORADO	TERMINATED OR INDEFINITELY SHUT DOWN
GREAT WESTERN SUGAR LOVELAND, COLORADO	OPERATIONAL
GREAT WESTERN SUGAR SCOTTS BLUFF, NEBRASKA	OPERATIONAL
GREAT WESTERN SUGAR GREELLY, COLORADO	OPERATIONAL
GREAT WESTERN SUGAR GERING, NEBRASKA	OPERATIONAL
GREAT WESTERN SUGAR BILLINGS, MONTANA	OPERATIONAL
GREAT WESTERN SUGAR FORT MORGAN, COLORADO	OPERATIONAL
TRANSCO TEXTILES, INC. AUGUSTA, GEORGIA	TERMINATED OR INDEFINITELY SHUT DOWN NA2SO3/SO4 LIQUOR DISCHARGED TO A HOLDING POND
WASTEWATER TREATMENT	
ALYESKA PIPELINE SERVICE CO. VALDEZ, ALASKA	OPERATIONAL NA2SO3/HSO3 AERATED TO NA2SO4 AND TRANSFERRED TO WASTEWATER TREATMENT PLANT AT A RATE OF 10 GPM. IT IS MIXED WITH ABOUT 10,000 GPM OF BALLAST WATER FROM TANKERS IN PORT VALDEZ. CLEANED WATER IS THEN DISCHARGED INTO PORT VALDEZ.
MINN-DAK FARMER'S COOPERATIVE WAHPETON, NORTH DAKOTA	OPERATIONAL BLEED STREAM GOES TO AN ACTIVATED SLUDGE SYSTEM @ 160 GPM

SECTION 11

SUMMARY OF WASTE AND BY-PRODUCT DISPOSAL PRACTICES FOR FGD SYSTEMS

INSTALLATION NAME / LOCATION	STATUS/COMMENTS
OVERFLOW TO SEWER/SLUDGE TO LANDFILL	
SHELLER GLOBE CORP. NORFOLK, VIRGINIA	OPERATIONAL

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	ALYESKA PIPELINE SERVICE CO.
INSTALLATION LOCATION	VALDEZ, ALASKA
SOURCE CHARACTERISTICS	FUEL OIL (.03 - .1% SULFUR)
SOURCE RATING	50,000 SCFM @ 70 F (DESIGN MAX)
SOURCE CAPACITY	13 MW (EQUIVALENT)
CONTROL SYSTEM VENDOR	FMC ENVIRONMENTAL EQUIPMENT
CONTROL PROCESS	SODIUM SCRUBBING
NEW / RETROFIT	NEW
START-UP DATE	JUNE, 1977
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	96+% (150-160 PPM @ INLET)
PARTICULATE EFFICIENCY	PARTICULATE EMISSIONS MEET NSPS.
WATER MAKE-UP	10 GPM - OPEN LOOP
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT NA2SO3/HSO3 AERATED TO NA2SO4 AND TRANSFERRED TO WASTEWATER TREATMENT PLANT AT A RATE OF 10 GPM. IT IS MIXED WITH ABOUT 10,000 GPM OF BALLAST WATER FROM TANKERS IN PORT VALDEZ. CLEANED WATER IS THEN DISCHARGED INTO PORT VALDEZ.
CONTROL SYSTEM COST	PLANT PERSONNEL ARE NOT ABLE TO BREAK OUT FGD SYSTEM COSTS FROM OVERALL PIPELINE PROJECT COSTS.

OPERATIONAL EXPERIENCE

THE ALYESKA FGD SYSTEM IS UNIQUE IN THAT IT WAS NOT INSTALLED PRIMARILY FOR CONTROL OF EMISSIONS, BUT TO TREAT GAS USED IN THE OIL STORAGE TANKS. OPERATIONS FOR THE PERIOD SEPTEMBER THRU JANUARY WERE NEARLY PROBLEM-FREE. THERE HAS BEEN NO DOWNTIME ATTRIBUTABLE TO THE SO_2 REMOVAL SYSTEM. RECENT MEASUREMENTS INDICATE SO_2 REMOVAL TO BE BETTER THAN 95%.

BACKGROUND INFORMATION

ALYESKA PIPELINE SERVICE CO. - VALDEZ, ALASKA

AT THE VALDEZ TERMINAL OF THE ALASKAN OIL PIPELINE, ALYESKA PIPELINE SERVICE COMPANY OPERATES THE OIL STORAGE AND TRANSFER FACILITY. OIL FLOWING IN FROM THE PIPELINE IS TEMPORARILY STORED IN SEVERAL HUGE TANKS, THEN TRANSFERRED FROM THE TANKS TO OIL TANKER SHIPS IN NEARBY PORT VALDEZ. ALYESKA WANTED NEUTRAL BLANKET AIR FOR THE OIL STORAGE TANKS, A LOW OXYGEN CONTENT BEING PARTICULARLY DESIRABLE. IT WAS DETERMINED THAT ON-SITE BOILER FLUE GAS WOULD HAVE THE REQUIRED LOW OXYGEN CONTENT. CORROSION PREVENTION DICTATED THE NEED FOR SO_2 CONTROLS, I.E., THIS DEVICE WAS NOT INSTALLED TO MEET ANY EMISSIONS REGULATIONS. THE SO_2 REMOVAL APPROACH CHOSEN WAS A RECIRCULATING SODIUM-BASED CHEMISTRY DESIGNED AND FABRICATED BY FMC ENVIRONMENTAL EQUIPMENT DIVISION.

THE BOILERS WILL NOT OPERATE AT STEADY STATE CONDITIONS. THIS IS DUE TO THE FACT THAT WHEN OIL IS REMOVED FROM THE TANKS AT A FASTER RATE THAN IT IS BEING FED BY THE PIPELINE, AN ADDITIONAL INERT AIR BLANKET WILL BE NEEDED. THIS REQUIRES STEPPING UP THE BOILERS FROM THE NORMAL LEVEL OF PLANT POWER PRODUCTION TO RUN THE COMPRESSORS AND PRODUCE ADDITIONAL GAS FOR BLANKET PRODUCTION. IF THE TANKS ARE FILLING FASTER THAN THEY ARE BEING EMPTIED, THE AIR FORCED OUT BY THE INCOMING OIL WILL BE INCINERATED.

THE BOILER PLANT AT THE VALDEZ TERMINAL CONSISTS OF THREE 250 MM BTU/HR OIL-FIRED BOILERS, MANUFACTURED BY COMBUSTION-ENGINEERING. THE OIL BEING USED IN THE BOILERS PRODUCES A VERY LOW PARTICULATE GRAIN LOADING, AND HAS AN EXTREMELY LOW SULFUR CONTENT WHICH RANGES FROM 0.03% TO 0.1%. THERE IS NO PARTICULATE REMOVAL OTHER THAN WHAT OCCURS IN THE FMC SO_2 ABSORBER MODULE.

THE MAXIMUM DESIGN CAPACITY OF THE SCRUBBER MODULE IS 50,000 SCFM, WHICH REPRESENTS ABOUT 25% OF THE TOTAL FLUE GAS GENERATED. THE SO_2 CONTROL SYSTEM IS DESIGNED WITH 100% REDUNDANCY, I.E., THERE ARE TWO MODULES IN PARALLEL, ONLY ONE OF WHICH IS IN USE AT ANYTIME.

CAUSTIC (SODIUM HYDROXIDE) IS USED AS REAGENT MAKE-UP. DESIGN PH CONTROL WAS ABOUT 6.5, BUT OPERATIONS HAVE INDICATED THAT A HIGHER PH IS MORE DESIRABLE, SO CONTROL PH NOW EQUALS ABOUT 8.0. A BLEED STREAM OF SODIUM BISULFITE/SULFITE GOES TO AN AERATOR AT A RATE OF 10 GPM. AFTER COMPLETE

ALYESKA PIPELINE SERVICE CO. (CONTINUED)

OXIDATION TO NA_2SO_4, THE WASTE STREAM GOES TO A WASTEWATER TREATMENT AREA WHERE IT IS MIXED WITH 10,000 GPM OF BALLAST WATER FROM THE TANKERS IN THE PORT.

AT THE PRESENT TIME THERE ARE NO CONTINUOUS MONITORS FOR SO_2, BUT ALYESKA TESTS HAVE DEMONSTRATED ABOUT 5 PPM OF $SO_2/SO_3/SO_4$ AT THE OUTLET OF THE ABSORBER. SINCE INLET SO_2 CONCENTRATION RANGES FROM 150-160 PPM, THE SYSTEM IS REMOVING ABOUT 97 PERCENT OF THE INLET SULFUR OXIDES.

COMMENTS

3RD QUARTER-1977 CORROSION HAS OCCURED IN THE PIPING FOR THE WATER RECIRCULATION SYSTEM. AT THE TIME OF THIS REPORT, THE CAUSE IS UNKNOWN.

4TH QUARTER-1977 THE CONTROL SYSTEM HAS BEEN OPERATING NEARLY PROBLEM-FREE, WITH NO DOWNTIME BEING ASSIGNED TO THE SO_2 REMOVAL SYSTEM. THE CURRENT LOAD IS APPROXIMATELY 20% OF DESIGN CAPACITY. THIS IS A RESULT OF OIL FLOW BEING LOW AT PRESENT. THE CORROSION PROBLEM IN WET AREAS MAY BE DEALT WITH BY INTRODUCING NEUTRALIZING AMINE SPRAYS.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	AMERICAN THREAD
INSTALLATION LOCATION	MARION, NORTH CAROLINA
SOURCE CHARACTERISTICS	COAL (.99 PERCENT SULFUR, 7 PERCENT ASH)
SOURCE RATING	60,000 ACFM @ 400 DEGREES F (TOTAL - 2 BOILERS)
SOURCE CAPACITY	8 MW (EQUIVALENT)* TOTAL - TWO BOILERS
CONTROL SYSTEM VENDOR	W.W. SLY MANUFACTURING CO.
CONTROL PROCESS	SODIUM HYDROXIDE ADDITION
NEW / RETROFIT	RETROFIT
START-UP DATE	1973
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	90%
PARTICULATE EFFICIENCY	97%
SLUDGE OR BY-PRODUCT DISPOSAL	HOLDING POND FOR EVAPORATION THE SODIUM SULFITE/SULFATE SLURRY IS PUMPED TO A RED CLAY LINED ASH BASIN. LEACHING OF SODIUM SULFITE IS NOT A PROBLEM DUE TO THE IMPERMEABLE NATURE OF THE RED CLAY LINER.
OPERATIONAL EXPERIENCE	THE FGD INSTALLATION CONSISTS OF TWO SEPARATE SCRUBBING UNITS OPERATING ON TWO COAL-FIRED BOILERS FOR THE REMOVAL OF PARTICULATES AND SULFUR DIOXIDE. THE FGD UNITS HAVE BEEN IN SERVICE SINCE 1973. CORROSION OF I.D. FANS, STACK AND PIPING HAS BEEN THE MAIN PROBLEM. I.D. FAN VIBRATIONS HAVE CAUSED SEVERE STRAIN IN PIPING.

BACKGROUND INFORMATION

AMERICAN THREAD MARION, NORTH CAROLINA

THE AMERICAN THREAD PLANT NEAR MARION, NORTH CAROLINA, SPECIALIZES IN THE DYEING AND FINISHING OF VARIOUS TYPES OF INDUSTRIAL SEWING THREADS AND RETAIL YARNS. STEAM AND HEAT FOR THE PLANT ARE PROVIDED BY TWO 4-MW (EQUIVALENT) COAL-FIRED BOILERS AND A 1-MW (EQUIVALENT) STANDBY OIL BURNER. THE SCRUBBER SYSTEMS AT THIS FACILITY WERE INSTALLED PRIMARILY FOR FLY ASH AND PARTICULATE CONTROL. THE ISSUE OF SULFUR DIOXIDE EMISSIONS DID NOT ENTER INTO THE DECISION TO INSTALL THE SCRUBBERS BECAUSE COAL SULFUR CONTENT MET STATE REGULATIONS.

THE BOILERS ARE EQUIPPED WITH CYCLONE PARTICULATE COLLECTORS WHICH PRECEDE THE SCRUBBER. THE SCRUBBING SYSTEM CONSISTS OF TWO W.W. SLY IMPINJET TYPE SCRUBBERS CONSTRUCTED OF 304 STAINLESS STEEL AND DESIGNED TO HANDLE APPROXIMATELY 30,000 ACFM @ 400 F. A DILUTE SODIUM HYDROXIDE SOLUTION FROM A MERCERIZING PROCESS IS USED IN THE RECIRCULATING SCRUBBER WATER. A PH OF 6.5 IS MAINTAINED.

UPON START UP IN LATE 1973, THE PH OF THE RIVER WATER USED AS SCRUBBING SOLUTION DROPPED TO APPROXIMATELY 2. THIS CAUSED CONSIDERABLE CORROSION PROBLEMS AND PROMPTED THE TIE-IN TO THE SODIUM HYDROXIDE WASTE STREAM FROM THE MERCERIZING PROCESS. A PH METER WAS INSTALLED TO INSURE THAT A PH OF 6.5 WAS MAINTAINED IN THE SCRUBBER RECIRCULATION TANK. ALL PIPING IN THE SCRUBBING SYSTEM WAS REMOVED AND REPLACED WITH POLYVINYL CHLORIDE (PVC) PIPE. DURING START UP AND LOW LOAD OPERATIONS, A LOSS OF BOILER DRAFT IS EXPERIENCED. AS A SOLUTION, THE PLANT OPERATOR OPENS AN ACCESS DOOR ON THE SCRUBBER DURING LOW LOAD OPERATIONS WHEN ADDITIONAL FLOW THROUGH THE SCRUBBER IS NEEDED. THE FLUE GASES HAVE A SCRUBBER BYPASS AND THE GASES ARE NOT REHEATED.

CORROSION PROBLEMS IN THE FAN IMPELLERS RESULT FROM THE HIGH ACID CONDITIONS EXISTING AT THE SCRUBBER OUTLET. FIBERGLASS REINFORCED PLASTIC LINED IMPELLERS WERE INSTALLED TO ALLEVIATE THE PROBLEM. BALANCING WEIGHTS ON THE IMPELLERS CORRODE AND FALL OFF CAUSING WEAR ON THE FAN SHAFT. THE VIBRATIONS OF FANS, CAUSED BY THE HEAVY 1 IN. FIBERGLASS LINING, RESULT IN CRACKING OF THE PVC PIPES. THE ACID MIST HAS CAUSED CORROSION ON EXTERNAL SURFACE OF THE EQUIPMENT. THE RECIRCULATING PUMPS, WHICH ARE RUBBER LINED, NEEDED IMPELLER REPLACEMENT IN LATE 1975. THE OUTLET DUCTWORK HAS A FIBERGLASS LINING. THE STACK, ORIGINALLY 304 SS, HAS BEEN REPLACED TOTALLY BY FIBERGLASS STRUCTURE.

AMERICAN THREAD (CONTINUED)

COMMENTS

4TH QUARTER-1977 THE SCRUBBER I.D. FANS HAVE BEEN THE MAJOR PROBLEM AREA. THE HEAVY FIBERGLASS LINING ON THE IMPELLERS HAS STOPPED CORROSION BUT CAUSED SEVERE VIBRATIONS RESULTING IN THE CRACKING OF PVC PIPING. THE INSTRUMENTATION LINES HAVE PLUGGED OCASSIONALLY. PLANT PERSONNEL FEEL THAT THE SCRUBBER I.D. FANS (40 HP) SHOULD BE REMOVED AND THE BOILER I.D. FANS, PRESENTLY 100 HP, BE REPLACED BY HIGHER CAPACITY FANS (150 HP). THE OPERABILITY OF THE SCRUBBERS HAS BEEN ABOUT 90 PERCENT DURING THIS PERIOD.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	ARMCO STEEL
INSTALLATION LOCATION	MIDDLETOWN, OHIO
SOURCE CHARACTERISTICS	COAL (0.8% SULFUR* 9% ASH* 14,000 BTU/LB)
SOURCE RATING	280,000 ACFM @ 425 F (TOTAL - 2 BOILERS)
	200,000 LB/HR STEAM (TOTAL)
CONTROL SYSTEM VENDOR	KOCH ENGINEERING
CONTROL PROCESS	LIME SCRUBBING
NEW / RETROFIT	RETROFIT
START-UP DATE	1975
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	NOT AVAILABLE
SLUDGE OR BY-PRODUCT DISPOSAL	HOLDING POND FOR EVAPORATION
OPERATIONAL EXPERIENCE	THIS CONTROL SYSTEM SERVES TWO MULTI-RETORT UNDERFEED STOKER, COAL-FIRED BOILERS EACH WITH A CAPACITY OF 100,000 LBS/HR STEAM. EARLIER BOILER PROBLEMS (HIGH EXCESS AIR) HAVE BEEN GENERALLY RECTIFIED BY A RETROFITTED BOILER CONTROL SYSTEM. RECENT OPERATIONS HAVE BEEN PROBLEM-FREE ALTHOUGH IN MID-FEBRUARY 1978 THE SCRUBBER HAS BEEN TEMPORARILY SHUTDOWN AS A RESULT OF THE COAL-STRIKE RELATED POWER SHORTAGE IN OHIO.

BACKGROUND INFORMATION

ARMCO STEEL-MIDDLETOWN, OHIO

THE SCRUBBER UNIT SERVES TWO MULTI-RETORT, UNDERFEED STOKER, COAL-FIRED BOILERS, EACH WITH A CAPACITY OF 100,000 LBS/HR STEAM. THE COAL BURNED IS TYPICALLY 0.7 TO 0.9 PERCENT SULFUR AND 8% TO 10% ASH. NORMALLY THE BOILERS ARE OPERATED IN THE WINTER MONTHS ONLY, HOWEVER FOR THE PAST TWO YEARS, OPERATIONS HAVE BEEN YEAR-ROUND WITH REDUCED CAPACITY DURING THE SUMMER. THE CONTROL SYSTEM CONSISTS OF A VARIABLE-THROAT VENTURI SCRUBBER WITH A PRESSURE DROP CONTROLLED ADJUSTABLE PLUG. IMMEDIATELY DOWNSTREAM FROM THE VENTURI IS AN ABSORBER MODULE 17 FEET IN DIAMETER WITH THREE GAS SCRUBBING TRAYS, A S-TYPE CHEVRON MIST ELIMINATOR AND A 106-INCH DIAMETER STUB STACK. THE SYSTEM IS DESIGNED TO HANDLE 140,000 ACFM AT 425 F AND 15 INCHES W.G. WITH AN OUTLET LOADING OF 0.02 GR PER SCFD. FRESH WATER IS SUPPLIED FROM CLARIFIED RIVER WATER AT THE RATE OF 1600 GPM TO THE TOP TRAY AND VENTURI THROAT. A LIME SLURRY IS ADDED IN A 10000 GALLON RECYCLE TANK WHICH HOLDS EFFLUENT FROM THE ABSORBER MODULE.

THE LARGEST PROBLEM AFFECTING SCRUBBER PERFORMANCE HAS BEEN CONTROL OF EXCESS AIR IN THE BOILERS. WITHOUT CONTROL, EXCESS AIR RESULTS IN 1.5 TO 3 TIMES THE SCRUBBER DESIGN FLOW RATE. THESE HIGH EXCESS AIR RATES ALSO RESULT IN THE PRESENCE OF UNBURNED CARBON WHICH COULD NOT BE SCRUBBED AND COMPOUNDED POOR PERFORMANCE. PROBLEMS WERE ALSO ENCOUNTERED WITH THE CHEVRON MIST ELIMINATOR WHICH IS MADE OF NOREL PLASTIC. IT WAS RATED AT 225 F WHICH WAS WELL ABOVE THE TEMPERATURE AT THAT LOCATION IN THE SYSTEM. HOWEVER, OVERLOOKED WAS THE FACT THAT NOREL IS CREEP SENSITIVE AT 20 DEGREES F ABOVE AMBIENT AND THE CHEVRONS FAILED WITHIN A FEW MONTHS. NEW CHEVRONS OF THE SAME MATERIAL ARE ALSO BEING DAMAGED. STAINLESS STEEL OR FIBERGLASS REINFORCED PLASTIC IS THE PREFERRED MATERIAL FOR THIS APPLICATION.

THE WATER SYSTEM WAS ORIGINALLY DESIGNED TO BE A RECIRCULATING SYSTEM. THE RECIRCULATED WATER HAD A SUSPENDED SOLIDS CONCENTRATION OF 40000-50000 MILLIGRAMS PER LITER AT THE VENTURI. ALL THE PIPING IN THIS SYSTEM WAS MILD STEEL AND WAS SEVERLY ABRADED CAUSING NUMEROUS LEAKS.

ARMCO STEEL-MIDDLETOWN, OHIO (CONTINUED)

THE SYSTEM HAS BEEN MODIFIED TO A ONCE-THROUGH OPERATION AND THE ABRASION HAS CEASED. SERIOUS ABRASION PROBLEMS WERE ALSO ENCOUNTERED IN 12-INCH STEEL PIPING CARRYING DIRTY WATER FROM THE TRAYS TO THE RECYCLE TANK AS WELL AS IN THE PUMPS. THE PROBLEM WAS SOLVED BY REPLACING THE PIPING WITH RUBBER HOSE, RUBBER LINED ELBOWS, AND RUBBER LINED PUMPS. IN ADDITION, PUMP SPEED WAS REDUCED FROM 1780 TO 1180 RPM AND FLANGED T-SECTIONS WERE INSTALLED ON THE SUCTION SIDE OF THE SLUDGE PUMPS AND RECIRCULATION PUMPS. THIS MATERIAL HAS WITHSTOOD ABRASION BETTER THAN ANY OTHER MATERIAL TRIED TO DATE.

A LIME BUILD UP PROBLEM WAS EXPECTED ON THE ABSORBER TRAYS AT LOW GAS FLOW RATES. THIS PROBLEM HAS NOT YET OCCURRED AT SUSTAINED PH LEVELS OF 6-6.5.

THE LIME SLURRY SYSTEM HAS ALSO PRESENTED A PROBLEM. CLOGGING OF THE LIME SLURRY LINE IS ATTRIBUTED TO ITS EXCESSIVE LENGTH. LIME ADDITION RATE IS A PROBLEM WHICH CAN BE RESOLVED WITH THE INSTALLATION OF A PROPORTIONAL LIME SLAKER.

COMMENTS

4TH QUARTER-1977 THE PLANT WAS NOT ABLE TO SUPPLY EXTENSIVE UPDATE INFORMATION FOR THIS REPORT PERIOD, ALTHOUGH REPORTED THAT RECENT OPERATIONS HAVE BEEN RELATIVELY PROBLEM-FREE. THE SCRUBBER IS DOWN IN FEBRUARY 1978 AS A RESULT OF THE POWER SHORTAGE OHIO IS EXPERIENCING.
PLANT HAS INDICATED THAT IT WILL SUPPLY MORE DETAILED INFORMATION FOR THE NEXT REPORT PERIOD.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	CANTON TEXTILES
INSTALLATION LOCATION	CANTON, GEORGIA
SOURCE CHARACTERISTICS	INTERRUPTIBLE NATURAL GAS* COAL (0.8% SULFUR)
SOURCE RATING	42,000 ACFM
SOURCE CAPACITY	10 MW (EQUIVALENT)
CONTROL SYSTEM VENDOR	FMC ENVIRONMENTAL EQUIPMENT
CONTROL PROCESS	SODIUM SCRUBBING- WASTE STREAM
NEW / RETROFIT	RETROFIT
START-UP DATE	JUNE, 1974
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	70% (1500 PPM @ INLET)
PARTICULATE EFFICIENCY	80% - 90% (5.92 LB/MM BTU AT INLET)
WATER MAKE-UP	OPEN LOOP
SLUDGE OR BY-PRODUCT DISPOSAL	NON-FIXATED SLURRY TO LINED POND NA SO3/SO4 LIQUOR DISPOSED TO LINED HOLDING PONDS
CONTROL SYSTEM COST	
CAPITAL	$ 74,000. CAPITAL COST IS FOR AN INSTALLED SYSTEM.
OPERATIONAL EXPERIENCE	AT CANTON TEXTILES THE CONTROL SYSTEM CONSISTS OF AN FMC MEDIUM ENERGY VENTURI SCRUBBER AND UTILIZES A CAUSTIC WASTE STREAM FOR SO2 REMOVAL. THE UNIT HAS BEEN IN OPERATION SINCE JUNE OF 1974. CANTON AGAIN REPORTED NO OPERATIONAL PROBLEMS DURING THIS REPORT PERIOD. COAL FIRING WAS RE-STARTED IN MID-OCTOBER 1977.

BACKGROUND INFORMATION

CANTON TEXTILES, CANTON, GEORGIA

CANTON TEXTILE MILLS IN CANTON, GEORGIA HAS A 10 MW (EQUIVALENT) COAL-FIRED STEAM BOILER WHICH IS NORMALLY USED DURING PERIODS OF INTERRUPTED NATURAL GAS SERVICE. THE BOILER IS A COMBUSTION ENGINEERING (C-E) VERTICAL UNIT EQUIPPED WITH A CYCLONIC DUST COLLECTOR. THE DUST COLLECTOR CAPTURES APPROXIMATELY 75 TO 100 POUNDS OF FLY ASH PER HOUR. THE TYPICAL COAL BURNED HAS A SULFUR CONTENT OF 0.8 PERCENT AND A RECEIVED HEAT VALUE OF 13,600 BTU PER POUND COAL. SULFUR DIOXIDE CONCENTRATION IN FLUE GAS IS 1500 PPM WITH A PARTICULATE LOADING OF 5.92 LB/MM BTU.

THE FGD SYSTEM CONSISTS OF A FMC MEDIUM ENERGY, VENTURI-TYPE SCRUBBER AND IS BASED ON A CONCENTRATED DOUBLE ALKALI SCRUBBING PROCESS. CAUSTIC DYEING WATER WASTE CONTAINING SODIUM HYDROXIDE AND SODIUM SULFATE WITH A PH OF APPROXIMATELY 11 TO 12 IS THE SCRUBBING LIQUOR. THE SCRUBBING LIQUID IS INJECTED INTO THE FLUE GAS STREAM THROUGH SPRAY NOZZLES AHEAD OF THE VENTURI THROAT. THE SCRUBBING LIQUID PASSES THROUGH THE SCRUBBER AND IS THEN TREATED WITH LIME OR LIMESTONE IN THE CHEMICAL REGENERATION SECTION OF THE SYSTEM. UPON REMOVAL OF THE INSOLUBLE COMPOUNDS RESULTING FROM THE REGENERATION PROCESS, THE WASTEWATER IS COLLECTED IN AN EQUALIZATION BASIN. DEPENDING ON THE DESIRED DEGREE OF NEUTRALIZATION, THE WASTEWATER IS THEN RECYCLED TO THE SCRUBBER OR PUMPED TO THE WASTEWATER TREATMENT FACILITY.

SEVERAL OPERATIONAL PROBLEMS WERE ENCOUNTERED UPON INITIAL STARTUP. A SEVERE PLUGGING PROBLEM WAS ENCOUNTERED IN SEVERAL PUMPS DUE TO THE PRESENCE OF COTTON FIBERS IN THE WASTEWATER. A SCREEN BASKET AROUND THE INITIAL SCRUBBER SYSTEM INTAKE PIPE IN THE DYE COLLECTION MANHOLE IS BEING USED TEMPORARILY UNTIL FURTHER INVESTIGATION IS COMPLETED. SURFACE-ACTIVE AGENTS IN THE DYEING WASTEWATERS WHICH PRODUCE FOAMING IN THE SCRUBBER PUMP WERE DETECTED AND A DEFOAMER ADDITIVE IS NOW INJECTED INTO THE SCRUBBER FEED FROM THE DYE RETENTION BASIN. FOULING OF THE PH PROBES AND SULFUR AND MIST GENERATION ARE OTHER PROBLEM AREAS THAT HAVE BEEN INVESTIGATED.

CANTON TEXTILES, CANTON, GEORGIA (CONTINUED)

COMMENTS

3RD QUARTER-1977 NO OPERATIONAL PROBLEMS WERE REPORTED DURING THIS SURVEY PERIOD. THE PLANT REPORTS THE SYSTEM IS WORKING SATISFACTORILY. THE PLANT HAS BEEN BURNING NATURAL GAS BUT EXPECTS TO RETURN TO COAL DURING THE HEATING SEASON (DECEMBER-MAY).

4TH QUARTER-1977 THE PLANT STARTED BURNING COAL AND OPERATING SCRUBBER 100 PERCENT OF THE TIME IN MID-OCTOBER. NO OPERATIONAL PROBLEMS HAVE BEEN ENCOUNTERED DURING THIS PERIOD.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	CATERPILLAR TRACTOR CO.
INSTALLATION LOCATION	JOLIET, ILLINOIS
SOURCE CHARACTERISTICS	COAL (3.2% SULFUR)* 9.65 T/HR FEED
SOURCE RATING	90,000 ACFM (TOTAL - 2 BOILERS)
SOURCE CAPACITY	18 MW (TOTAL - 2 BOILERS)
CONTROL SYSTEM VENDOR	ZURN INDUSTRIES
CONTROL PROCESS	DOUBLE ALKALI (DILUTE)
NEW / RETROFIT	RETROFIT
START-UP DATE	SEPTEMBER, 1974
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	90+%
PARTICULATE EFFICIENCY	NOT AVAILABLE
WATER MAKE-UP	0.5 GPM* CLOSED LOOP
SLUDGE OR BY-PRODUCT DISPOSAL	DEWATERED SLURRY TO LANDFILL
OPERATIONAL EXPERIENCE	THE FGD SYSTEM CONSISTS OF AN INDEPENDENT SCRUBBING TRAIN ON EACH OF TWO COAL-FIRED BOILERS. THESE BOILERS HAVE BEEN OPERATIONAL EACH HEAT SEASON SINCE OCTOBER 1974. SINCE THAT DATE, SCRUBBER AVAILABILITY HAS BEEN AVERAGING 80-85%. OPERATIONS IN THE CURRENT HEAT SEASON HAVE BEEN IMPROVED BY THE SYSTEM MODIFICATIONS OF SUMMER 1977.

BACKGROUND INFORMATION

CATERPILLAR TRACTOR CO., JOLIET, ILL.

THE JOLIET PLANT OPERATES TWO COAL-FIRED BOILERS RATED AT 100,000 AND 80,000 POUNDS OF STEAM PER HOUR. THESE BOILERS ARE ON LINE ONLY DURING WINTER MONTHS.

THE SCRUBBER SYSTEM ON EACH BOILER IS A ZURN DOUBLE ALKALI SCRUBBER CONSTRUCTED OF 316L STAINLESS STEEL. EACH SCRUBBER EXHAUSTS THROUGH A CARBON STEEL STACK. THE TOTAL FLUE GAS FLOW RATE IS 103,500 ACFM.

THE SCRUBBER UNITS ARE PRECEDED BY MECHANICAL COLLECTORS FOR PARTICULATE REMOVAL. THE ZURN SCRUBBER UTILIZES A DUSTRAXTOR MODULE FOR BOTH PARTICULATE AND SO2 CONTROL. SPENT SCRUBBING LIQUOR IS THEN PUMPED TO THE REGENERATION AREA WHERE LIME IS ADDED TO PRECIPITATE THE ABSORBED SULFUR IN CLARIFIERS. CLARIFIER UNDERFLOW IS DEWATERED BY VACUUM FILTERS AND THE SLUDGE PRODUCED IS READY FOR DISPOSAL AT A LANDFILL. CLARIFIER OVERFLOW IS RETURNED TO THE SCRUBBER AS REGENERATED SCRUBBING LIQUOR. SODA ASH IS ALSO ADDED TO THE REGENERATED LIQUOR TO REPLENISH SODIUM LOST IN THE SLUDGE. LIME AND SODA ASH ARE STORED IN OUTSIDE SILOS AND CONVEYED TO PROCESS USE POINTS PNEUMATICALLY. A CHEMICAL TREATMENT BUILDING WAS ERECTED TO HOUSE REGENERATION AND SLUDGE HANDLING EQUIPMENT.

COMMENTS

3RD QUARTER-1977 PROBLEMS OCCURED WHEN A TANK RAN DRY AND DAMAGED A PUMP. SOME PIPE PLUGGING PROBLEMS ALSO OCCURED AS A RESULT OF THE PUMP FAILURE.
PROBLEMS ARE INCURRED WITH THE VACUUM FILTERS. THE FILTER CLOTH LASTS ONLY 2 TO 3 WEEKS. NO SOLUTIONS HAVE BEEN FOUND BUT FILTER DESIGN MODIFICATIONS ARE BEING CONSIDERED.
THE UNITS WERE ULTRASONICALLY TESTED AND RESULTS SHOW THAT THE SYSTEMS ARE ON THE HIGH SIDE OF TOLERANCE LEVELS. A MINOR LEAK WAS DETECTED AS A RESULT OF A FAULTY WELD.

4TH QUARTER-1977 FGD SYSTEM RESTART OCCURRED AT THE BEGINNING OF THE HEATING SEASON. PLANT HAS INITIATED A PROCESS OF DETAILED RECORD KEEPING BUT IS STILL WORKING ON THE INTERNAL INFORMATION TRANSFER PROCESS. PLANT HAS INDICATED THAT A SUMMARY OF THESE RECORDS WILL BE AVAILABLE TO THIS REPORT IN THE NEAR FUTURE.

INSTALLATION NAME	CATERPILLAR TRACTOR CO.
INSTALLATION LOCATION	MORTON, ILLINOIS
SOURCE CHARACTERISTICS	COAL (3.2% SULFUR)
SOURCE RATING	70,000 ACFM (TOTAL - 2 BOILERS)
SOURCE CAPACITY	12 MW
CONTROL SYSTEM VENDOR	ZURN INDUSTRIES
CONTROL PROCESS	DOUBLE ALKALI (DILUTE)
NEW / RETROFIT	RETROFIT
START-UP DATE	JANUARY, 1978
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	NOT AVAILABLE
SLUDGE OR BY-PRODUCT DISPOSAL	DEWATERED SLURRY TO LANDFILL

OPERATIONAL EXPERIENCE

THE CATERPILLAR MORTON PLANT UTILIZES ZURN INDUSTRIES' DILUTE MODE DOUBLE ALKALI TECHNOLOGY TO CONTROL EMISSIONS FROM THE STEAM PLANT. FGD SYSTEM START-UP OCCURRED AT THE BEGINNING OF 1978. CURRENTLY THE VENDOR IS TRAINING THE BOILER OPERATORS ON HOW TO OPERATE AND MAINTAIN THE EMISSIONS CONTROL SYSTEM. THERE HAVE BEEN NO MAJOR PROBLEMS SINCE START-UP.

BACKGROUND INFORMATION

CATERPILLAR TRACTOR - MORTON, ILLINOIS

AT THE MORTON PLANT, A PARTS DISTRIBUTION CENTER, CATERPILLAR TRACTOR OPERATES A TWO-BOILER STEAM PLANT WHICH GENERATES STEAM EQUIVALENT TO ABOUT 12 MW. EMISSIONS ARE CONTROLLED BY A ZURN INDUSTRIES AIR QUALITY CONTROL SYSTEM CONSISTING OF A DUSTRAXTOR SCRUBBER IN WHICH PARTICULATE AND SO2 REMOVAL OCCUR SIMULTANEOUSLY. SULFUR DIOXIDE REMOVAL IS BROUGHT ABOUT BY THE USE OF ZURN DILUTE MODE, DOUBLE ALKALI FGD TECHNOLOGY. THE TWO BOILERS AND THE TWO SCRUBBING TRAINS AND MOST ANCILLARY EQUIPMENT ARE WITHIN THE BOILER HOUSE.

THE SYSTEM AT MORTON IS VERY SIMILAR TO THAT AT THE CATERPILLAR JOLIET PLANT, WHICH HAS BEEN OPERATING EACH HEATING SEASON SINCE OCTOBER 1974. WHENEVER POSSIBLE, PROBLEM AREAS AND SOLUTIONS IDENTIFIED IN JOLIET OPERATIONS HAVE BEEN IMPLEMENTED TO IMPROVE THE SYSTEM DESIGN AT MORTON. SPECIFIC AREAS IN WHICH MODIFICATIONS TO DESIGN HAVE BEEN MADE ARE WATER BALANCE, PUMPS, PH MONITORING, PIPING, LIME STORAGE, AND COLD WEATHER PROTECTION.

COMMENTS

1ST QUARTER-1978 SYSTEM START-UP OCCURRED AT THE BEGINNING OF JANUARY. INITIAL OPERATIONS HAVE BEEN PROBLEM FREE. THROUGH JANUARY AND PART OF FEBRUARY, ZURN PERSONNEL WILL BE TRAINING CATERPILLAR BOILER PLANT PERSONNEL IN THE OPERATION OF THE FGD SYSTEM.
CATERPILLAR'S OPERATING EXPERIENCES AT JOLIET AND MOSSVILLE HAVE SHOWN THAT EXISTING BOILER OPERATORS CAN BE EFFECTIVELY TRAINED TO OPERATE AND MAINTAIN FGD SYSTEMS.
CURRENT PLANS CALL FOR ACCEPTANCE TESTING IN THE SPRING, BUT THE COAL SITUATION MAY DELAY THE TEST PERIOD.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	CATERPILLAR TRACTOR CO.
INSTALLATION LOCATION	MOSSVILLE, ILLINOIS
SOURCE CHARACTERISTICS	COAL (3.2% SULFUR)
SOURCE RATING	240,000 ACFM
SOURCE CAPACITY	57 MW (TOTAL - 4 BOILERS)
CONTROL SYSTEM VENDOR	FMC ENVIRONMENTAL EQUIPMENT
CONTROL PROCESS	DOUBLE ALKALI (CONCENTRATED)
NEW / RETROFIT	1NEW, 3RETROFIT
START-UP DATE	OCTOBER, 1975
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	90+%
SLUDGE OR BY-PRODUCT DISPOSAL	DEWATERED SLURRY TO LANDFILL 60+% SOLIDS (CASO4) SLUDGE DIRECTLY TO LANDFILL

OPERATIONAL EXPERIENCE

THE CATERPILLAR MOSSVILLE PLANT HAS UTILIZED AN FMC CONCENTRATED MODE FGD SYSTEM EACH HEATING SEASON SINCE OCTOBER 1975. THERE ARE FOUR COAL-FIRED BOILERS EACH BEING TREATED BY A SEPARATE SCRUBBING TRAIN. OVERALL AVAILABILITY HAS BEEN 80-85%. OPERATIONS FOR THE 1977-78 HEAT SEASON HAVE BEEN MARKED BY SOME PROBLEMS, BUT DETAILS ARE NOT YET AVAILABLE.

BACKGROUND INFORMATION

CATERPILLAR TRACTOR-MOSSVILLE, ILLINOIS

AT THE MOSSVILLE PLANT, CATERPILLAR TRACTOR OPERATES A FOUR-BOILER STEAM PLANT. TWO OF THE BOILERS ARE RATED AT 150,000 LBS/HR STEAM AND TWO ARE RATED AT 80,000 LBS/HR STEAM. THE ENTIRE 4-UNIT PLANT IS ROUGHLY EQUIVALENT TO 50 MW OF ELECTRICAL GENERATING POWER. THE COAL FIRED IS HIGH-SULFUR (3.2%-4.0%) ILLINOIS COAL. THE FOURTH BOILER, AT 150,000 LBS/HR, BEGAN IN JUNE 1977 AND ITS FGD SYSTEM WAS BYPASSED UNTIL OCTOBER 1977.

FMC ENVIRONMENTAL EQUIPMENT DIVISION HAS SUPPLIED AN AIR QUALITY CONTROL SYSTEM CONSISTING OF A VENTURI SCRUBBER FOR PARTICULATE CONTROL AND AN ABSORBER MODULE FOR SO2 CONTROL. THE TWO 150,000 LB/HR BOILERS HAVE PRECEDING MECHANICAL COLLECTORS REMOVING ABOUT 90% OF THE INLET FLYASH. THE SCRUBBING TRAINS ON THE TWO SMALL BOILERS HAVE NO PRECEDING MECHANICAL COLLECTORS.

WHILE THE FLYASH IN THE FINAL FILTER CAKE PROVIDES ADDED MECHANICAL STABILITY, THE HIGH ASH CONTENT IN THE RECIRCULATING SLURRY CAUSED SEVERE EROSION/ABRASION PROBLEMS IN EARLY OPERATIONS. THE ORIGINALLY INSTALLED WEIR TYPE CONTROL VALVES HAVE BEEN REPLACED WITH SPOOL PIECES AND A CONSTANT VOLUME PUMPING SYSTEM. THERE WAS ALSO SIGNIFICANT WEAR IN THE VENTURI SCRUBBER BOTTOMS, WHICH WAS SOLVED BY THE INSTALLATION OF WEAR PLATES.

SEVERAL PROBLEM AREAS WERE IDENTIFIED AND DEALT WITH DURING THE TWO HEAT SEASONS PRIOR TO THE 1977-78 SEASON.

PUMPS - THE RUBBER-LINED SLURRY PUMPS WERE OVERSIZED WHICH CAUSED HIGH PIPE VELOCITIES AND ACCELERATED WEAR ON THE PUMP LININGS. THESE PUMPS WERE REVISED TO LOWER THEIR OUTPUT.

LOW SEAL WATER PRESSURE ALLOWED PROCESS LIQUOR TO GET INTO THE PUMP AND PACKING. ALL SEAL WATER IS NOW ONCE THROUGH AND SYSTEM PRESSURES HAVE BEEN ADJUSTED TO MAINTAIN SEAL WATER PRESSURE ABOVE PROCESS LIQUID PRESSURES.

SLUDGE HANDLING - SLUDGE IS TRANSPORTED FROM THE VACUUM FILTERS TO THE LOADING AREA ON A BELT

CONVEYOR. SEVERAL STRATEGIES, ALL INVOLVING SCRAPING OR PLOWING THE DEWATERED SLUDGE OFF THE BELT, RESULTED IN EXCESSIVE WEAR OF EITHER THE BELTS OR THE PLOWS.

THE PRESENT APPROACH SIMPLY DUMPS THE MATERIAL OFF THE END OF THE BELT INTO BINS. THE POSITION OF THE END OF THE BELT IS CHANGEABLE SO THAT EIGHT BINS CAN BE FILLED BEFORE THEY MUST BE EMPTIED. A FURTHER MODIFICATION HAS A DUAL POSITION CHUTE UNDER EACH BELT END POSITION, SO THAT A TOTAL OF 16 BINS CAN BE IN PLACE AT ONE TIME. SLUDGE BINS ARE THEN LOADED HYDRAULICALLY INTO TRUCKS AND HAULED TO THE SANITARY LANDFILL AREA. ANOTHER PROBLEM WAS COLD WEATHER ICING ON THE SLUDGE LOADING AREA, WHICH WAS SOLVED BY ENCLOSING THE AREA.

INSTRUMENTATION - ORIGINAL DESIGN PLANS CALLED FOR CONTROL BY THE MONITORING OF THE SO_3/SO_4 RATIO AND SODIUM ION CONCENTRATION. THE CONTROL RANGE WAS FOUND TO BE TOO SMALL AND THE PRESENT APPROACH IS PH CONTROL (6.5) AND CLEANING OF THE PROBES EVERY OTHER DAY.

ORIGINAL DESIGN DID NOT MONITOR SO_2 CONCENTRATION BUT A COMPLETE MONITOR SYSTEM WAS INSTALLED PRIOR TO THE 1977-78 SEASON.

PIPING - MODIFICATIONS HAVE BEEN MADE WHICH FACILITATE CLEANING OR SCHEDULED REPLACEMENT.

COMMENTS

4TH QUARTER-1977 CATERPILLAR HAS BEGUN A PROCEDURE OF DETAILED RECORD KEEPING, BUT THE FLOW OF INFORMATION IS NOT YET SUCH THAT IT IS AVAILABLE TO THIS REPORT.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	FIRESTONE TIRE AND RUBBER CO.
INSTALLATION LOCATION	POTTSTOWN, PENNSYLVANIA
SOURCE CHARACTERISTICS	2.5-3.0% SULFUR COAL
SOURCE RATING	14,000 ACFM
SOURCE CAPACITY	3 MW (EQUIVALENT)
CONTROL SYSTEM VENDOR	FMC ENVIRONMENTAL EQUIPMENT
CONTROL PROCESS	DOUBLE ALKALI (CONCENTRATED)
NEW / RETROFIT	RETROFIT
START-UP DATE	JANUARY, 1975
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	90% (1000 PPM AT INLET)
SLUDGE OR BY-PRODUCT DISPOSAL	DEWATERED SLURRY TO LANDFILL

OPERATIONAL EXPERIENCE

THE FGD SYSTEM AT FIRESTONE-POTTSTOWN CONSISTS OF AN FMC DOUBLE ALKALI DUAL THROAT VENTURI SCRUBBER. THIS SO2 CONTROL SYSTEM WAS BUILT AS A DEMONSTRATION PROJECT FUNDED BY FIRESTONE. THE SYSTEM OPERATED WITH AN AVAILABILITY VALUE OF 91% IN THE FALL QUARTER OF 1977. . THE MAJOR PROBLEM AREA IS EROSION OF FAN AND SPRAY NOZZLES BY FLYASH. THIS EQUIPMENT WILL BE REDESIGNED.

BACKGROUND INFORMATION

FIRESTONE TIRE-POTTSTOWN, PA.

THE FIRESTONE TIRE AND RUBBER CO. LOCATED IN POTTSTOWN, PENNSYLVANIA HAS BEEN OPERATING SINCE JANUARY 1975 AND IS A DEMONSTRATION-SCALE PLANT DESIGNED TO TEST THE FEASIBILITY OF FGD ON INDUSTRIAL BOILERS. THE UNIT IS DEMONSTRATING 90 PERCENT SO2 REMOVAL EFFICIENCIES WITH A SYSTEM AVAILABILITY OF 94 PERCENT AND A FLUE GAS CAPACITY OF 14,000 CFM OR EQUIVALENT OF 3.0 MW. THIS FLOW REPRESENTS APPROXIMATELY 1/3 THE TOTAL OUTPUT OF ONE 100,000 LB/HR STEAM BOILER. THE SULFUR DIOXIDE REGULATION THE PLANT IS 0.86 LBS/MILLION BTU OF HEAT OUTPUT.

THE PLANT IS USING THE CONCENTRATED DOUBLE ALKALI PROCESS PATENTED BY FMC CORPORATION. THE LOAD CAPACITY OF THE BOILER ON WHICH THE SCRUBBER IS OPERATING IS APPROXIMATELY 12 MW. IN OCTOBER 1976, THE BOILER WAS CONVERTED FROM BURNING RESIDUAL FUEL OIL (2.2% S) TO COAL (2.5-3.0% S).

THE VENTURI SCRUBBER IS SPRAYED WITH ALKALINE LIQUOR WHERE THE FLUE GAS ENTERS. THE FAN AND DAMPER UPSTREAM OF VENTURI CONTROL THE FLUE GAS FEED. SCRUBBING LIQUOR FLOWS FROM THE VENTURI TO THE BOTTOM OF CYCLONE DEMISTER AND THEN INTO THE RECIRCULATION TANK. DROPLETS OF SCRUBBING LIQUO ARE SPUN OUT IN THE CYCLONE AND RUN BACK DOWN IN THE RECIRCULATION TANK. THE SCRUBBING LIQUOR IS PARTLY RECIRCULATED TO THE VENTURI THUS COMPLETING THE SCRUBBING CYCLE. ACCUMULATION OF SOLUBLE SODIUM BISULFITE IS PREVENTED BY CONTINUOUSLY DRAWING OFF A SMALL STREAM OF SCRUBBER SOLUTION TO THE LIME REACTOR TANK WHERE THE SODIUM SULFITE REACTS WITH LIME TO FORM CALCIUM SULFITE AND SODIUM HYDROXIDE WHICH IS RECYLCED TO THE ABSORBER. CALCIUM SULFITE SLURRY IS TRANSFERRED TO THE ROTARY FILTER. THE FILTER CAKE FORMED (180 LBS/HR, 55 % SOLIDS) IS HAULED TO THE LANDFILL. THE WATER BALANCE IS MAINTAINED BY MAKING UP FOR THE LOSSES BY EVAPORATION AND IN THE FILTER CAKE.

DURING THE FIRST 12 MONTHS OF OPERATION THE SYSTEM EXPERIENCED UTILIZATION OF 94 PERCENT. ALL DOWNTIME WAS DUE TO COMPONENT FAILURE (PUMP PACKING) OR MAINTENANCE (FILTER CLOTH REPLACEMENT). NO SHUTDOWNS OCCURED DUE TO SCALING, PLUGGING OR RELATED PROBLEMS. DURING THE FALL QUARTER OF 1977, THE SYSTEM HAD AN AVAILABILITY OF 91 %. THE MAJOR PROBLEM AREA IS EROSION OF THE MILD STEEL FAN AND THE 316 SS SPRAY NOZZLES BY FLYASH. SOME CONTROL VALVES ARE ALSO ERODED. THE COMPONENTS WILL BY REDESIGNED AND REPLACED. THE PIPELINE FROM THE THICKENER TO THE FILTER GETS PLUGGED FREQUENTLY AND NEEDS CLEANING.

FIRESTONE TIRE - POTTSTOWN, PA (CONTINUED)

FMC CORP. AND NORTHWESTERN UNIVERSITY PERSONNEL ARE STUDYING THE LEACHING AND STRENGTH CHARACTERISTICS OF THE FILTER CAKE, WHEREAS UNITED ENGINEERS OF PHILADELPHIA ARE STUDYING THE OPERATING COST DATA OF THE UNIT. RESULTS OF NEITHER STUDY ARE YET AVAILABLE.

MON/YR	AVAILABILITY(%)	COMMENTS
JAN. 75 THRU SEP. 76		DURING THIS PERIOD THE BOILER BURNED RELATIVELY LOW SULFUR OIL. THE BOILER WAS CONVERTED TO BURN COAL (2.5-3.0 % S) FROM OCTOBER 1976 WHEN THE FLUE GAS SCRUBBING WAS STARTED.
OCT. 76 THRU SEP. 77	94	ALL DOWNTIME WAS DUE TO COMPONENT FAILURE OR MAINTENANCE. SHUTDOWNS OCCURED DUE TO SCALING, PLUGGING OR RELATED PROBLEMS.
OCT. 77 THRU DEC. 77	91	THE MAJOR PROBLEM AREA IS EROSION OF THE MILD STEEL F.D. FAN AND THE 316 SS SPRAY NOZZLES. THESE COMPONENTS WILL BE REDESIGNED. THICKENER UNDERFLOW PIPES REQUIRES FREQUENT CLEANING.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	FMC (SODA ASH PLANT)
INSTALLATION LOCATION	GREEN RIVER, WYOMING
SOURCE CHARACTERISTICS	COAL (1% SULFUR* 5% ASH* 10,000 BTU/LB)
SOURCE RATING	660,000 ACFM @ 320 F (TOTAL - 2 BOILERS)
SOURCE CAPACITY	200 MW (EQUIVALENT)* TOTAL
CONTROL SYSTEM VENDOR	FMC ENVIRONMENTAL EQUIPMENT
CONTROL PROCESS	SODIUM SCRUBBING
NEW / RETROFIT	NEW
START-UP DATE	MAY, 1976
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	95% (800 PPM AT INLET)
PARTICULATE EFFICIENCY	REMOVED BY PRECEDING ESP (99.5%)
WATER MAKE-UP	OPEN LOOP* L/G = 15-20 GAL/1000 ACF
SLUDGE OR BY-PRODUCT DISPOSAL	HOLDING POND FOR EVAPORATION NA2SO3/SO4 LIQUOR DISPOSED TO COLLECTION POND - NO PRIOR AERATION. LANDFILL IN THE FUTURE
CONTROL SYSTEM COST	
CAPITAL	$ 10.000 MILLION CAPITAL COST INCLUDES ESP

OPERATIONAL EXPERIENCE

THE FGD SYSTEM CONSISTS OF TWO FMC SODIUM SCRUBBING UNITS TO REMOVE SULFUR DIOXIDE AND PARTICULATE MATTER FROM THE FLUE GAS OF TWO BOILERS. SCRUBBER CORROSION HAS BEEN A PROBLEM. PLANT PERSONNEL FELT THAT THE LINING WAS IMPROPERLY APPLIED. FOAMING AND SEDIMENTATION HAS OCCURED IN THE SCRUBBER DUE TO IMPURITIES IN THE LIQUOR.

BACKGROUND INFORMATION

FMC SODA ASH PLANT - GREEN RIVER WYOMING

FMC CHEMICAL CORP. HAS A SODA ASH PLANT IN GREEN RIVER, WYOMING. THE PLANT HAS TWO COAL-FIRED POWER BOILERS WHICH BURN 1.1 PERCENT SULFUR COAL. THE FLUE GAS FROM EACH BOILER (330,000 ACFM AT 320 F) IS HEATED BY A HOTSIDE ESP WITH 288 PLATES AND A PARTICULATE REMOVAL EFFICIENCY OF 99.5 %.

THE FLUE GASES ARE SCRUBBED BY THE PLANT END-LIQUOR IN TWO SCRUBBERS, EACH WITH THREE PAIRS OF DISC-AND-DONUT TRAYS. THE SCRUBBERS AND THE DISCS ARE LINED WITH CEILCOTE 103 WHEREAS THE DONUT PARTS OF THE TRAYS ARE MADE FROM INCONEL 825. THE SCRUBBER LIQUOR IS MAINTAINED AT A PH OF 6.5 AND IS RECIRCULATED AT A RATE OF 10 - 15 GALLONS/1000 ACF OF FLUE GAS. A PART OF THE RECIRCULATING LIQUOR IS CONTINUOUSLY PURGED TO REMOVE SULFITES AND SULFATES FORMED BY THE REACTION OF SO_2 WITH SODA ASH. THE RECIRCULATING PUMPS AND THE RELATED PIPING IS RUBBER LINED. A MESH TYPE DEMISTER IS USED IN EACH SCRUBBER. THE GASES ARE REHEATED BY DIRECT FIRING OF NATURAL GAS AT THE EXIT OF THE SCRUBBERS. THE REHEATED FLUE GAS IS MIXED WITH BYPASSED GAS BEFORE GOING TO THE STACK AT ABOUT 160 F.

AUTOMATIC CONTROLS MAINTAIN SOLUTION LEVEL IN THE SCRUBBER BASIN. THE PRIMARY SOURCE OF WATER MAKE-UP IS PROCESS WASTEWATER WHICH IS CHANNELED TO A MAKE-UP TANK. IF MORE MAKE-UP IS REQUIRED, RIVER WATER IS TAPPED. THE SCRUBBER BLEED STREAM IS DISCHARGED TO A WASTE POND AT THE SITE. DAMPERS WITH REMOTE CONTROLS REGULATE THE FLOW OF OFF GAS THROUGH AND AROUND THE SCRUBBERS. APPROXIMATELY 50% OF TOTAL FLUE GAS IS RUN THROUGH THE SCRUBBERS.

COMMENTS

3RD QUARTER-1977 SOME PROBLEMS HAVE OCCURRED WITH THE SCRUBBER LINING AS A RESULT OF FAULTY INSTALLATION. THE POSSIBILITY OF RUNNING THE SYSTEM WITH NO REHEAT IS BEING INVESTIGATED.

4TH QUARTER-1977 THE SCRUBBERS HAVE CORRODED AS A RESULT OF FAULTY INSTALLATION OF THE LINING. THE IMPURITIES IN THE SCRUBBING LIQUOR CAUSE FOAMING AND SEDIMENTATION ON THE TRAP.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	GENERAL MOTORS CHEV. MOTOR DIV
INSTALLATION LOCATION	TONOWANDA, NEW YORK
SOURCE CHARACTERISTICS	COAL (1.3% S* 9% ASH* 12,500 BTU/LB)
SOURCE RATING	132,700 SCFM @ 70 F (TOTAL - 4 BOILERS)
	340,000 LB/HR STEAM (TOTAL)
SOURCE CAPACITY	32 MW (EQUIVALENT)* TOTAL
CONTROL SYSTEM VENDOR	FMC ENVIRONMENTAL EQUIPMENT
CONTROL PROCESS	SODIUM SCRUBBING
NEW / RETROFIT	RETROFIT
START-UP DATE	JUNE, 1975
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	90%-95% (1,000 PPM @ INLET)
PARTICULATE EFFICIENCY	90% (1.0 LB/MM BTU AT INLET)
WATER MAKE-UP	OPEN LOOP
SLUDGE OR BY-PRODUCT DISPOSAL	DEWATERED SLURRY TO LANDFILL
	FLY ASH AND NA2SO3/SO4 WASTE LIQUOR DEWATERED AND THEN TO SANITARY LANDFILL
CONTROL SYSTEM COST	
CAPITAL	$ 2.000 MILLION
	CAPITAL COST IS IN 1974 DOLLARS.

OPERATIONAL EXPERIENCE

THE FGD SYSTEM CONSISTS OF FOUR GM SODIUM SCRUBBING UNITS FOR THE REMOVAL OF PARTICULATES AND SULFUR DIOXIDE FROM FOUR COAL-FIRED BOILERS. THE SCRUBBERS ARE EQUIPPED WITH VENTURI SCRUBBERS FOR PARTICULATE REMOVAL. UNSTABLE PH CONTROL, PIPE EROSION AND STACK CORRISION ARE MAIN PROBLEM AREAS. REPLACEMENT OF CONTROL SENSORS, PIPING AND RELINING OF STACK ARE THE CORRECTIVE ACTIONS.

BACKGROUND INFORMATION

GENERAL MOTORS CORP., TONOWANDA, N.Y.

THE CHEVROLET DIVISION OF GENERAL MOTORS HAS A MOTOR PRODUCTION PLANT AT TONAWANDA, NEW YORK. THERE ARE 4 COAL-FIRED BOILERS AT THE FACILITY WHICH BURN 1.16 PERCENT SULFUR COAL WITH A HEATING VALUE OF 12,650 BTU/LB. THE TOTAL COAL FEED RATE IS 17 TONS/HR WHICH IS EQUIVALENT TO 412 MM BTU/HR OF HEAT INPUT OR 340,000 LBS/HR OF STEAM. THE BOILERS ARE RATED AT A TOTAL OF 32 MW.

ONE SCRUBBER HANDLES 39,000 ACFM AT 350 F WHEREAS EACH OF THE OTHER THREE 36,000 ACFM AT 406 F. THERE IS A CYCLONE BEFORE AND AFTER SCRUBBER FOR DUST COLLECTION AND MIST REMOVAL PURPOSES, RESPECTIVELY. THE VARIABLE THROAT VENTURI SCRUBBERS WERE SUPPLIED BY FMC CORP. THE PH OF RECYCLE SCRUBBER LIQUOR IS CONTROLLED AT 7.0 AND A L/G RATIO OF 20 GALLONS/1000 ACF IS USED. PRESSURE DROP ACROSS EACH SCRUBBER IS 10 IN. WG. CAUSTIC SODA IS ADDED TO THE SPENT LIQUOR IN A SEPARATE RECYCLE TANK. THE BLEED OFF RATE FROM THE RECYCLE TANK VARIES FROM 25 - 100 GPM. THE DISCHARGE CONTAINS FLYASH AND SODIUM SULFATE. THE FLYASH IS CONTROLLED AT LESS THAN 1% SUSPENDED SOLIDS. THE EFFLUENT IS DISCHARGED TO THE WASTE TREATMENT PLANT AFTER AERATION. THE AVERAGE INLET CONCENTRATIONS ARE 0.85 LB/MM BTU OF SO_2 AND 1 LB/MM BTU OF PARTICULATE. THE EFFICIENCY OF SO_2 REMOVAL IS 90% WHEREAS THAT OF PARTICULATE REMOVAL IS 80%-95%.

EACH SCRUBBER AND THE CYCLONIC DEMISTER IS MADE OF 316L SS. PLUME REHEAT IS NOT INCORPORATED IN THE SYSTEM. THE ENERGY REQUIREMENTS FOR THE SYSTEM ARE ABOUT 3 - 5 % OF THE FUEL BURNED. THE TOTAL CAPITAL COST FOR THE FGD SYSTEM WAS $2 MM IN 1974 DOLLARS. THE MAJOR PROBLEM AREAS HAVE BEEN PH CONTROL STABILITY AND RECYCLE PIPE EROSION. THE CONTROL SENSORS AND AUTOMATIC MODULATING MIXING VALVE WERE REPLACED FOR STABLE PH CONTROL WHEREAS THE STAINLESS STEEL PIPE IN RECYCLE LOOP WAS REPLACED BY CAST IRON ONE. CONDENSATION AFTER THE DEMISTER HAS CORRODED THE STACK LINING, WHICH WILL SHORTLY BE RELINED.

GENERAL MOTORS - TONOWANDA, NEW YORK (CONTINUED)

COMMENTS

3RD QUARTER-1977 AVERAGE OPERABILITY DURING THIS PERIOD WAS REPORTED TO BE 100%.

4TH QUARTER-1977 MAJOR PROBLEMS HAVE BEEN PH CONTROL AND RECYCLE PIPE EROSION. CONTROL SENSORS/MODULATING MIXER VALVE REPLACED FOR PH CONTROL AND CAST IRON PIPE WAS USED TO REPLACE SS RECYCLE PIPING. DURING NOV - DEC CONDENSATION FOLLOWING THE DEMISTER HAS CORRODED THE STACK LINING. A DECISION HAS BEEN MADE TO RELINE THE STACK.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	GENERAL MOTORS CORPORATION
INSTALLATION LOCATION	ST. LOUIS, MISSOURI
SOURCE CHARACTERISTICS	COAL (3.2% SULFUR* 10% ASH)
SOURCE RATING	100,000 ACFM @ 370 F
SOURCE CAPACITY	25 MW (TOTAL - 2 BOILERS)
CONTROL SYSTEM VENDOR	A.D. LITTLE
CONTROL PROCESS	SODIUM SCRUBBING
NEW / RETROFIT	RETROFIT
START-UP DATE	1972
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	90+% (2000 PPM @ INLET)
PARTICULATE EFFICIENCY	REMOVED BY PRECEDING CYCLONE AND ESP
WATER MAKE-UP	OPEN LOOP
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT AND DISCHARGE TO CITY SEWER NA2SO3 OXIDIZED TO NA2SO4, PH NEUTRALIZED AND DISCHARGED TO CITY SEWER SYSTEM
CONTROL SYSTEM COST	
CAPITAL	$773,000.
OPERATING	$172,000.
	CAPITAL COST IS IN 1972 DOLLARS

OPERATIONAL EXPERIENCE

THIS SO_2 CONTROL SYSTEM CONSISTS OF TWO GM DESIGNED SODIUM SCRUBBING UNITS OPERABLE ON TWO OF FOUR COAL-FIRED BOILERS. DURING THIS REPORT PERIOD, STACK CORROSION HAS BEEN THE MAIN PROBLEM. PLANS ARE BEING MADE TO RELINE THE STACK IN THE NEAR FUTURE. THE SYSTEM IS PROVIDED WITH BYPASS AND 60 F REHEAT.

BACKGROUND INFORMATION

GENERAL MOTORS CORP., ST. LOUIS, MO.

THE GENERAL MOTORS CORPORATION PLANT LOCATED IN ST. LOUIS, MISSOURI OPERATES 4 COAL-FIRED BOILERS. TWO BOILERS, WHICH ARE RATED AT A TOTAL OF 25 MW (EQUIVALENT) AND HAVE A TOTAL STEAM GENERATION CAPACITY OF 250,000 LB/HR, ARE EQUIPPED WITH SCRUBBERS. COAL COMPOSITION IS TYPICALLY 3.2% SULFUR AND 10% ASH. SULFUR DIOXIDE CONCENTRATION IS APPROXIMATELY 2100 PPM AT THE INLET TO EACH SCRUBBER. CYCLONES AND ESP'S ARE USED FOR PARTICULATE REMOVAL PRIOR TO SO2 REMOVAL IN A 3-STAGE IMPINGEMENT TOWER WITH A CHEVRON MIST ELIMINATOR. DIRECT REHEAT IS ACCOMPLISHED WITH STEAM COILS

THE FGD SYSTEM IS CONSTRUCTED OF 316L STAINLESS STEEL.

COMMENTS

3RD QUARTER-1977 AN OPERABILITY OF 100% WAS REPORTED DURING THE MAY-AUGUST PERIOD.

4TH QUARTER-1977 IN SPITE OF A CHEVRON DEMISTER AND 60 F REHEAT, THE STACK LINER IS EXPERIENCING CORROSION ATTACK. THE STACK WILL REQUIRE RELINING IN THE NEAR FUTURE.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	GENERAL MOTORS PARMA
INSTALLATION LOCATION	PARMA, OHIO
SOURCE CHARACTERISTICS	COAL (2.5% SULFUR* 7.1% ASH* 13,350 BTU/LB)
SOURCE RATING	128,400 SCFM @ 70 F (TOTAL - 4 BOILERS)
	320,000 LB/HR STEAM (TOTAL)
SOURCE CAPACITY	32 MW (EQUIVALENT)* TOTAL
CONTROL SYSTEM VENDOR	GM ENVIRONMENTAL
CONTROL PROCESS	DOUBLE ALKALI (DILUTE)
NEW / RETROFIT	RETROFIT
START-UP DATE	MARCH, 1974
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	90% (800-1300 PPM @ INLET)
PARTICULATE EFFICIENCY	83% (AT INLET* UNITS 1&2 - 1.75 LB/MIN* UNITS 3&4 - 1.22 LB/MIN)
WATER MAKE-UP	CLOSED LOOP
SLUDGE OR BY-PRODUCT DISPOSAL	DEWATERED SLURRY TO LANDFILL
	50 + % SOLIDS (CASO3/SO4) SLUDGE TO DRYING POND AND LANDFILL
CONTROL SYSTEM COST	
CAPITAL	$ 3.200 MILLION
	OPERATING COSTS ARE $643,500/YR @ 55,000 TPY OF COAL

OPERATIONAL EXPERIENCE

THE FGD SYSTEM CONSISTS OF A GM DESIGN DOUBLE ALKALI SCRUBBER OPERATIONAL ON 4 BOILERS. THE SCRUBBERS HANDLE A TOTAL 240,000 ACFM OF FLUE GAS. THE SCRUBBERS HAVE BEEN OPERATIONAL SINCE MARCH 1974. THE SYSTEM DEVELOPED MIST ELIMINATOR PROBLEMS DURING THIS REPORT PERIOD. AT THE TIME OF THIS REPORT, A SATISFACTORY SOLUTION HAD NOT YET BEEN FOUND.

BACKGROUND INFORMATION

GENERAL MOTORS - PARMA, OHIO

THE CHEVROLET PARMA PLANT OF GENERAL MOTORS IS LOCATED NEAR CLEVELAND, OHIO. THE PLANT HAS FOUR SPREADER-STOKER BOILERS FIRED BY TRAVELING GRATES, CAPABLE OF PRODUCING A TOTAL OF 320,000 LB/HR OF STEAM OR APPROXIMATELY 32 MW OF EQUIVALENT ELECTRICAL CAPACITY. THE COAL FIRED IN THESE UNITS ORIGINATES PRIMARILY FROM THE SOUTHEASTERN PORTION OF OHIO AND HAS THE FOLLOWING AVERAGE CHARACTERISTICS- HEAT CONTENT OF 11,300 BTU/LB, SULFUR CONTENT OF 1.7 TO 2.7 PERCENT, ASH CONTENT OF 6.8 TO 14.8 PERCENT, AND A TOTAL MOISTURE CONTENT OF 0.9 TO 7.8 PERCENT.

THE POWER BOILERS HAVE BEEN FITTED WITH AN EMISSION CONTROL SYSTEM CONSISTING OF MECHANICAL COLLECTORS UPSTREAM OF A DILUTE DOUBLE ALKALI SCRUBBING SYSTEM. THE FGD SYSTEM SCRUBBING MODULES WERE SUPPLIED BY KOCH ENGINEERING. INSTALLATION WAS COMPLETED ON FEBRUARY 28, 1974. THE SYSTEM CONSISTS OF FOUR SCRUBBERS OPERATING IN PARALLEL. EACH SCRUBBER CONTAINS THREE BUBBLE-CAP ABSORPTION TRAYS AND A MESH MIST ELIMINATOR. THE FLUE GAS RATE IS 61,500 ACFM AT 393 F FOR EACH OF THE FIRST TWO SCRUBBERS AND THE OUTLET TEMPERATURE IS 137 F. THE INLET SO2 CONCENTRATION IS 765 PPM. THE FLUE GAS FLOW RATE IS 58,600 ACFM AT 550 F FOR THE OTHER TWO SCRUBBERS AND THE OUTLET TEMPERATURE IS 152 F. THE INLET SO2 CONCENTRATION IS 720 PPM. THE OUTLET SO2 CONCENTRATION VARIES BETWEEN 76 - 36 PPM FOR THE SCRUBBERS.

THE SULFUR DIOXIDE CONTAINED IN THE BOILER FLUE GAS IS ABSORBED BY A REGENERATED CAUSTIC SOLUTION (0.1 MOLAR NAOH), FORMING A SOLUTION OF SOLUBLE SODIUM SALTS. THE SPENT CAUSTIC IS THEN REGENERATED BY REACTING THE SODIUM SALT SOLUTION WITH SLAKED LIME, RESULTING IN THE FORMATION OF CALCIUM SULFITE AND SULFATE SOLIDS, WHICH ARE SEPARATED OUT OF THE SOLUTION. NEXT, SODA ASH IS ADDED TO THE SOLUTION IN ORDER TO MAKE UP FOR SODIUM LOSSES AND MINIMIZE THE SCALE POTENTIAL FROM THE CALCIUM WHICH REMAINS IN SOLUTION. THE REGENERATED CAUSTIC FORMED IS THEN RECYCLED BACK TO THE SCRUBBER FOR ADDITIONAL SULFUR DIOXIDE REMOVAL. THE CALCIUM SALT AND FLY ASH SLUDGE WHICH RESULTS IS DEWATERED AND HAULED AWAY BY TRUCK TO AN OFF-SITE LANDFILL.

GENERAL MOTORS - PARMA, OHIO (CONTINUED)

EQUIPMENT SPECIFICATIONS

SCRUBBERS. EACH OF THE 4 SCRUBBERS IS 10.5 FT DIA X 22.5 FT HIGH X 11 GAUGE THICK AND CONTAINS 3 BUBBLE-CAP TRAYS. ALL THE SCRUBBERS AND TRAYS ARE MADE OF 316 L SS. THE SCRUBBERS HAVE A TURNDOWN RATIO OF 3 AND ALSO HAVE A BYPASS DUCT. THE L/G RATIO HAS A DESIGN VALUE OF 20 GALLONS/ACF BUT IT MAY BE VARIED DURING OPERATION. THE PRESSURE DROP ACROSS THE SCRUBBER RANGES BETWEEN 8-9 INCHES WG.

DEMISTERS. ORIGINAL 316 SS DEMISTERS WERE CORRODED DUE TO CONDENSATION AND ARE REPLACED BY FLEXI-MESH TYPE POLYPROPYLENE ONES.

RECYCLE TANKS/PUMPS. ALL THE 4 RECYCLE TANKS ARE MILD STEEL WITH TAR TYPE RESIN COATING. THE PUMPS (TOTAL 6, 2 SPARE) ARE CENTRIFIGALS WITH MILD STEEL CASING AND HAVE RUBBER LINING. THE PUMP MOTORS HAVE 40 H.P.

CHEMICAL MIX TANKS & AGITATORS. BOTH THE MIX TANKS ARE MILD STEEL WITH 5000 GALLONS CAPACITY. THE DESIGN RESIDENCE TIME IS 7 MINUTES. NEW AGITATORS ARE PROPELLER TYPE. THESE ARE SPECIALLY DESIGNED TO GIVE HIGHER FLOW RATE THROUGH THE BLADES. THE DRIVE RATINGS ARE 5 HP AND 45 RPM.

CLARIFIERS. BOTH THE CLARIFIERS (60 FT DIA X 14 FT LIQUID DEPTH) HAVE A CONICAL BOTTOM AND 300,000 GALLONS CAPACITY. THE DESIGN RETENTION LINE IS ABOUT 4 HOURS AT FLOW RATE OF 1200 GPM.

VACUUM FILTERS. BOTH THE VACUUM FILTERS HAVE 500 SQ. FT. SURFACE AREA WITH 10 FT DRUM DIAMETER. THE DRUM DRIVE SPEED IS 0.5 RPM MAXIMUM.

FILTRATE TANK/PUMPS. THE TANK (4 FT DIA X 7 FT HIGH) IS MILD STEEL AND HOLDS 660 GALLONS OF FILTRATE. THE PUMPS ARE MILD STEEL, CENTRIFIGAL AND HAVE A CAPACITY OF 300 GPM AT 15 FT. OF HEAD.

PROBLEMS AND SOLUTIONS

THE SYSTEM WAS STARTED UP ON FEBRUARY 28, 1974 AND BY APRIL 31 IT HAD OPERATED FOR 264 HOURS. THERE WERE TWO SCHEDULED SHUTDOWNS DURING THIS PERIOD FOR EQUIPMENT INSPECTION. THE SECOND SHUTDOWN REVEALED THAT SOLIDS WERE NOT BEING DISCHARGED FROM THE PRIMARY CLARIFIER RAPIDLY ENOUGH. AS A RESULT, THE CLARIFIER RAKE JAMMED. A PIPING CHANGE WAS MADE TO BLEND THE CAUSTIC FEED IN WITH THE RECYCLE LIQUOR. THIS HAS IMPROVED PERFORMANCE BUT NOT COMPLETELY ELIMINATED THE PROBLEM. PREMATURE CAKE CRACKING IN THE VACUUM FILTERS REQUIRED THE PRESENCE OF AN OPERATOR

DURING OPERATION. G.M. ANTICIPATES THAT THE CHANGE TO NYLON FROM POLYPROPYLENE WILL SOLVE THIS PROBLEM. CAKE WASHING TO REDUCE LOSSES WAS NOT INITIALLY SUCCESSFUL BECAUSE THE SPRAY WATER TENDED TO KNOCK THE CAKE OFF THE DRUM. ALTERATIONS IN SPRAY PATTERN AND OTHER MEASURES HAVE APPARENTLY SOLVED THIS PROBLEM. THERE HAS BEEN NO EVIDENCE OF CORROSION OR ABRASION IN THE PUMPS OR PIPING.

THE SYSTEM WAS SHUT DOWN FROM MAY 1 TO MAY 28, 1974, BECAUSE OF UNEXPECTED BUILDUP OF SOLIDS IN THE CLARIFIER, WITH SUBSEQUENT OVERFLOW INTO THE SCRUBBER. THE PROBLEM WAS SOLVED BY 1) USING A POLYMERIC FLOCCULATION AGENT TO ATTAIN BETTER SETTLING AND 2) WITHDRAWING SLUDGE FROM THE CLARIFIER AT MORE FREQUENT INTERVALS. SYSTEM AVAILABILITY TO THE BOILER WAS 87 PERCENT IN APRIL 1974, LESS THAN 10 PERCENT IN MAY, AND 100 PERCENT IN JUNE, JULY, AND AUGUST AFTER THE SYSTEM WAS RESTARTED. PLUGGING BY GYPSUM DEPOSITS IN THE OVERFLOW LINE BETWEEN THE CLARIFIERS AND IN THE LINE FROM CLARIFIER NO. 2 TO THE MIX TANKS WAS CORRECTED BY RELOCATING A CHEMICAL FEED LINE AND REPLACING SOME PIPING. THE SYSTEM WAS DOWN THROUGH JULY AND AUG. 1975 FOR REPLACEMENT OF GRAVITY FLOW LINES WITH AN OPEN FLUME THAT CAN BE EASILY CLEANED. ADDITIONAL MODIFICATIONS TO THE DESIGN AND OPERATION OF THE FGD SYSTEM HAVE CONTINUED. THE OPERABILITY INDEX FOR THE FGD SYSTEM HAS INCREASED SIGNIFICANTLY THROUGHOUT THE COURSE OF 1976. THE MAJOR PROBLEM AND SOLUTION AREAS, PLUS MODIFICATIONS IMPLEMENTED TO THE SYSTEM ARE HIGHLIGHTED BELOW IN THE SYSTEM PERFORMANCE TABLE.

GENERAL MOTORS - PARMA, OHIO (CONTINUED)

MONTH	OPERATION HOURS BOILER	FGD SYSTEM	OPERABILITY (%)	COMMENTS
JUN. 75				THE SYSTEM WAS RESTARTED AND PARTICULATE TESTS WERE CONDUCTED IN MAY. THE SYSTEM WAS SHUT DOWN DUE TO PLUGGED CHEMICAL FEED LINE TO THE CLARIFIERT AFTER RESTART, AROUND JUNE 10, THE SYSTEM WAS SHUTDOWN BECAUSE OF SIMILAR PLUGGING IN ANOTHER PART OF THELINE. UNIT RAN FOR ABOUT TWO WEEKS IN JUNE.
JUL. 75				FGD SYSTEM WAS DOWN IN JULY AND AUGUST FOR REPLACEMENT OF GRAVITY FLOW LINES WITH AN OPEN FLUME.
AUG. 75				
SEP. 75				FGD SYSTEM RESTARTED ON SEPTEMBER 8, AND OPERATED DURING THIS PERIOD AT AN AVAILABILITY FACTOR OF 80 PERCENT. *NOTE* THE FIGURES GIVEN FOR SEPTEMBER AND OCTOBER REPRESENT THE OPERATION HOURS FROM SEPTEMBER 8 TO NOVEMBER 9.
OCT. 75	2331	1848*	79	
NOV. 75				THE FGD SYSTEM OPERATED WELL DURING THE REPORT PERIOD EXCEPT FOR A SCHEDULED HOLIDAY SHUTDOWN FROM DECEMBER 23 TO JANUARY 4, 1976. BECAUSE OF PROBLEMS WITH SOLIDS AND SOLIDS CARRYOVER, G.M. CONDUCTED STREAM TEST DURING DECEMBER TO DETERMINE WHETHER SOLIDS CARRYOVER IS DUE TO A HIGH SOLIDS RECIRCULATION RATE. THE FGD SYSTEM WAS DOWN MOST OF DECEMBER BECAUSE OF THESE TEST, WHICH CAUSED THE LOW OPERABILITY FACTOR.
DEC. 75	2135	1250	59	

GENERAL MOTORS - PARMA, OHIO (CONTINUED)

MONTH	OPERATION HOURS BOILER	FGD SYSTEM	OPERABILITY (%)	COMMENTS
JAN. 76				G.M. HAS FOUND SOLIDS CONCENTRATION IN THE CLARIFIER
FEB. 76	2997	1196	40	TOO HIGH FOR EFFICIENT SYSTEM OPERATION. A.D. LITTLE IS SCHEDULED TO CONDUCT TESTS ON THE SYSTEM IN APRIL 76 AS PART OF AN EPA EVALUATION PROGRAM.
MAR. 76	1379	240	7	THE LOW OPERABILITY INDEX DURING THE MONTH OF MARCH RESULTED FROM EXTENSIVE MODIFICATIONS PERFORMED ON THE SYSTEM BY G.M. DURING THIS PERIOD THE SCRUBBER BLOWDOWN AND SCRUBBER FLOW INDICATION SYSTEM WAS REVISED.
APR. 76	1084	847	78	FROM APRIL 19 TO THE END OF THE MONTH THE SYSTEM WAS OPERABLE 100%. DURING THIS PERIOD ALL SYSTEM MODIFICATIONS WERE COMPLETED AND ALL MAJOR PROBLEM AREAS CORRECTED.
MAY 76	1149	1042	91	NO MAJOR PROBLEMS WERE ENCOUNTERED DURING THE REPORTING PERIOD.
JUN. 76	924	816	88	ONE SYSTEM UPSET OCCURRED DURING THE PERIOD DUE TO AN OPERATOR ERROR. BOILER HOURS WERE LOW IN JUNE BECAUSE OF LOW PROCESS DEMAND. THE SCRUBBING SYSTEM CHARACTERIZATION STUDY WAS CONCLUDED ON MAY 14, 1976.
JUL. 76	599	599	100	THE BOILER LOAD DEMAND WAS VERY LIGHT DURING THE REPORT
AUG. 76	715	715	100	MONTHS, REQUIRING ONLY ONE BOILER BEING CONTINUOUSLY ON LINE. THE SYSTEM WAS DOWN FOR A ONE-WEEK PERIOD BECAUSE OF THE ANNUAL PLANT INVENTORY.

GENERAL - PARMA, OHIO (CONTINUED)

MONTH	OPERATION HOURS BOILER	OPERATION HOURS FGD SYSTEM	OPERABILITY (%)	COMMENTS
				MODIFICATIONS TO THE OPERATION OF THE GAS SCRUBBING SYSTEM HAVE INCLUDED* ELIMINATION OF POLYMERIC ADDITION. ELIMINATION OF SLUDGE BLANKET FOR FILTRATION. HIGH PERCENT SULFATE CONCENTRATION IN THE FILTER CAKE. INCORPORATION OF PH CONTROLLER IN THE CHEMICAL MIX TANK REGULATING THE LIME FEED INTO SYSTEM. PH CONTROL SHOULD REDUCE THE STOICHIOMETRIC REQUIREMENTS FROM THE 1.25-1.50 RANGE DOWN TO 1.10-1.20.
SEP. 76	809	223	40	TWO BOILERS AND THEIR CORRESPONDING SCRUBBER MODULES WERE IN SERVICE DURING THE MONTH. OPERATION TIME WAS LODGED PRIMARY IN THE INITIAL PART OF THE MONTH. A NUMBER OF PROBLEMS WERE ENCOUNTERED, FORCING A SHUTDOWN THROUGHOUT THE REMAINDER OF THE MONTH. THESE INCLUDED* SOLIDS DEPOSITION AND PLUGGING OF THE CHEMICAL TANKS AND REACTORS, REQUIRING SHUTDOWN AND CLEAN-OUT. AGITATOR PROBLEMS. BOILER PROBLEMS. REPLACEMENT OF DEMISTER PADS.

GENERAL MOTORS - PARMA, OHIO (CONTINUED)

MONTH	OPERATION HOURS BOILER	FGD SYSTEM	OPERABILITY (%)	COMMENTS
OCT. 76	1174	734	63	THE SYSTEM WAS RETURNED TO SERVICE THE SECOND WEEK IN OCTOBER. TWO BOILERS AND THEIR CORRESPONDING SCRUBBERS WERE PUT BACK IN THE GAS STREAM. PROBLEMS ENCOUNTERED STEMMED PRIMARILY FROM A MECHANICAL COLLECTOR MALFUNCTION, RESULTING IN EXCESSIVE DUST LOADINGS IN THE MODULES AND EVENTUALLY CAUSING WIDESPREAD PLUGGING OF THE LOWER BUBBLE-CAPE TRAYS. SHUTDOWN AND CLEANOUT OF MODULES PLUS REPAIRS TO THE MECHANICAL COLLECTOR WERE REQUIRED. SYSTEM RESTART OCCURRED NOVEMBER 8. MAJOR MODIFICATIONS PERFORMED TO THE DOUBLE ALKALI SYSTEM DURING THE PERIOD INCLUDED THE INSTALLATION OF A GREAT LAKES PH MONITOR AND CONTROL UNIT FOR THE REGULATION OF LIME FEED TO THE REGENERATION REACTOR-CLARIFIER UNIT. THIS UNIT EMPLOYS A DIGITAL READOUT AND IS SCHEDULED FOR OPERATION SOMETIME IN NOVEMBER. SUPERIOR CRYSTAL GROWTH OF THE CALCIUM SULFITE/SULFATE SALTS HAS RESULTED BY RUNNING A SEEDING LINE BACK TO THE REACTOR-CLARIFIER UNIT.
NOV. 76	1321	787	60	DURING THE LATTER PART OF NOVEMBER AND EARLY DECEMBER, THE SCRUBBERS WERE TAKEN OUT OF THE FLUE GAS PATH BECAUSE OF CONTINUED SOILDS BUILDUP IN THE MIX TANK. IN ADDITION, SOME PIPING ARRANGEMENTS WERE MODIFIED AND
DEC. 76	1559	349	22	

GENERAL MOTORS - PARMA, OHIO (CONTINUED)

MONTH	OPERATION HOURS BOILER	FGD SYSTEM	OPERABILITY (%)	COMMENTS
				THE GEAR REDUCER IN THE MIX TANK HAD TO BE REPLACED. THE FGD FIGURES REPORTED FOR THE MONTH OF DECEMBER ARE NOT FULLY REPRESENTATIVE BECAUSE IT IS PART OF THE LOCAL UAW CONTRACT THAT ONLY UAW PERSONNEL CAN OPERATE THE FGD SYSTEM AND THEREFORE THE SCRUBBERS COULD NOT BE OPERATED.
JAN. 77	1852	607.5	32.8	TANK BROKE DOWN. THE AGITATORS ON BOTH THE TANKS WERE REPLACED BY NEW AND LONGER ONES.
FEB. 77	1462	891.8	61.0	THE PLANT WAS SHUTDOWN FOR SOME PERIOD DUE TO CUTBACK OF NATURAL GAS SUPPLY AND REQUEST TO CURTAIL ELECTRICAL CONSUMPTION.
APR. 77	1300	1158.3	89.1	NEW AGITATORS IN THE MIX TANKS. THESE ARE EXPECTED TO ALLEVIATE SOLIDS PLUGGAGE PROBLEMS.
MAY 77	1222	1118	91.5	BOILER HOURS ARE LESS DUE TO LOWER LOAD IN SUMMER.
JUN. 77	1180	1103	93.5	FGD SYSTEM HAS GIVEN VERY HIGH OPERABILITY.
JUL. 77	702	276	39.3	THE FGD SYSTEM WAS DOWN FOR A CONSIDERABLE PORTION OF THIS MONTH. THE CHEMICAL MIX TANK BLEED OFF LINES AND OTHER PIPING HAD TO BE CLEANED OF SEDIMENTED SOLIDS.
AUG. 77	755	678	89.8	DURING THIS LOW-LOAD PERIOD THE LIME FEED PUMP AND
SEP. 77	764	480	71.2	LIME FEED LINES WERE CLEANED. GENERALLY, EVERY SUMMER ANNUAL OVERHAUL IS CARRIED OUT.

GENERAL MOTORS - PARMA, OHIO (CONTINUED)

MONTH	OPERATION HOURS BOILER	FGD SYSTEM	OPERABILITY (%)	COMMENTS
OCT. 77	1277	398	31.2	THE CHEMICAL MIX TANK AGITATORS WERE TOTALLY REDESIGNED AND REPLACED BY HIGH-C STEEL, PROPELLER TYPES. THE BLADES ARE SPECIFICALLY DESIGNED TO INCREASE THE FLOW THROUGH THE PROPELLERS, THUS INCREASING THE INTENSITY OF MIXING.
NOV. 77	1380	920	66.7	DUE TO THANKSGIVING HOLIDAYS IN NOVEMBER AND CHRISTMAS
DEC. 77	1790	968	54.1	AND NEW YEAR HOLIDAYS IN DECEMBER, THE FGD SYSTEM HAD LOWER OPERATION HOURS. SOME OF THE BOILERS HAD TO BE RUN FOR BUILDING MAINTENANCE.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	GENERAL MOTORS TRUCK & COACH
INSTALLATION LOCATION	PONTIAC, MICHIGAN
SOURCE CHARACTERISTICS	COAL (0.84% SULFUR* 8.5% ASH* 12,500 BTU/LB) ALSO WOOD, PAPER, AND CARDBOARD.
SOURCE RATING	107,300 SCFM @ 70 F (TOTAL - 2 BOILERS)
SOURCE CAPACITY	40 MW (EQUIVALENT)* TOTAL
CONTROL SYSTEM VENDOR	PEABODY ENGINEERING
CONTROL PROCESS	SODIUM SCRUBBING
NEW / RETROFIT	NEW
START-UP DATE	APRIL, 1976 SYSTEM OPERATED TWO MONTHS IN EARLY 1973.
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	NOT DETERMINED
PARTICULATE EFFICIENCY	85%
WATER MAKE-UP	50 GPM
SLUDGE OR BY-PRODUCT DISPOSAL	DEWATERED SLURRY TO LANDFILL 5% SOLIDS SLURRY DEWATERED AND TO LANDFILL
CONTROL SYSTEM COST	
CAPITAL	$600,000. CAPITAL COST IS IN 1972 DOLLARS
OPERATIONAL EXPERIENCE	THE SCRUBBER SYSTEM CONSISTS OF TWO G.M. SODIUM UNITS FOR THE REMOVAL OF FLYASH AND SULFUR DIOXIDE FROM THE FLUE GAS OF TWO COAL-FIRED BOILERS. PLANT HAS BEEN EXPERIENCING FLYASH ABRASION IN PUMPS AND PIPING.

BACKGROUND INFORMATION

G.M.C. TRUCK & COACH PLANT - PONTIAC, MICHIGAN

THE G.M.C. TRUCK AND COACH PLANT LOCATED AT PONTIAC, MICHIGAN OPERATES TWO G.M. SODIUM SCRUBBING SYSTEMS CONSTRUCTED BY PEABODY EQUIPMENT. TWO BOILERS ARE INVOLVED, NO. 6, RATED @ 150,000 LB/HR STEAM AND NO. 8, RATED @ 200,000 LB/HR STEAM. EMISSIONS FROM THESE TWO BOILERS ARE CONTROLLED BY MECHANICAL COLLECTORS AND THREE-STAGE TRAY SCRUBBERS. ALL SCRUBBER INTERNALS ARE 316L SS. THE MODULES WERE INSTALLED PRIMARILY FOR PARTICULATE CONTROL, BUT SIGNIFICANT SO2 CONTROL IS EFFECTED BY THE ADDITION OF SODIUM HYDROXIDE IN THE HOLD TANK. THE NEUTRALIZED SCRUBBER EFFLUENT IS THEN PUMPED TO A CLARIFIER AND RECYCLED TO THE SCRUBBERS. SCRUBBER EFFLUENT COMPRISES FLYASH, SODIUM SULFITE, BISULFITE, AND SULFATE. DEWATERED SLUDGE IS LANDFILLED. CONTROL OF PH AND WEAR ON MECHANICAL EQUIPMENT HANDLING THE FLY ASH SOLUTION WERE MAJOR START-UP PROBLEMS.

COMMENTS

3RD QUARTER-1977 SOME PROBLEMS WITH PUMPS EXIST. NO OTHER MAJOR DIFFICULTIES HAVE OCCURRED.

4TH QUARTER-1977 DURING THE SEPTEMBER-DECEMBER REPORT PERIOD, THE ONLY PROBLEMS REPORTED WERE FLYASH ABRASION IN THE PUMPS AND PIPING.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	GENERAL MOTORS/DELCO MORAINE
INSTALLATION LOCATION	DAYTON, OHIO
SOURCE CHARACTERISTICS	COAL (0.7-1.3% SULFUR* 5-9.5% ASH* 13,400 BTU/LB)
SOURCE RATING	55,440 SCFM @ 70 F (TOTAL - 2 BOILERS)
	120,000 LB/HR STEAM (TOTAL)
SOURCE CAPACITY	24 MW (EQUIVALENT)* TOTAL
CONTROL SYSTEM VENDOR	ENTOLETER, INC.
CONTROL PROCESS	SODIUM SCRUBBING
NEW / RETROFIT	RETROFIT
START-UP DATE	SEPTEMBER, 1974
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	80% (1.43 LB/MM BTU @ INLET)
PARTICULATE EFFICIENCY	85% (0.4 LB/MM BTU AT INLET)
WATER MAKE-UP	50 GPM
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT AND DISCHARGE TO CITY SEWER
	NA2SO3/SO4 LIQUOR AT 35 GPM TO ON-SITE CLARIFICATION AND DEWATERING FACILITY
CONTROL SYSTEM COST	
CAPITAL	$668,000.

OPERATIONAL EXPERIENCE

THE FGD SYSTEM CONSISTS OF TWO GM SODIUM SCRUBBING UNITS ON 2 COAL-FIRED BOILERS. THE UNITS HAVE BEEN OPERATIONAL SINCE SEPTEMBER 1974. THE SCRUBBERS REMOVE SULFUR DIOXIDE AND PARTICULATE MATTER FROM A TOTAL GAS VOLUME OF 45,000 ACFM AT 400 DEGREES F. AVERAGE OPERABILITY OF THE SYSTEM IS 95%.

BACKGROUND INFORMATION

G.M.C./DELCO MORAINE - DAYTON, OHIO

THE FGD SYSTEM AT THE G.M.C. DELCO MORAINE PLANT IN DAYTON, OHIO CONTROLS FLYASH AND SULFUR DIOXIDE EMISSIONS FROM TWO STOKER-FED, COAL-FIRED BABCOCK & WILCOX BOILERS INSTALLED IN 1954. THE BOILERS ARE RATED AT 60,000 LBS/HR STEAM AND BURN 3 TONS OF COAL PER HOUR MAXIMUM. THE SCRUBBERS ARE CONSTRUCTED OF 316L STAINLESS STEEL AND WERE DESIGNED TO HANDLE A TOTAL GAS FLOW RATE OF 45,000 ACFM AT A TEMPERATURE OF 400 DEGREES F.

SCRUBBER UNDERFLOW CONSISTS OF FLYASH AND SODIUM SULFITE/BISULFITE SOLUTION. THE SLUDGE IS PRODUCED AT 35 GPM AND IS PUMPED TO A WASTEWATER TREATMENT PLANT CLARIFIER WHERE THE SOLIDS ARE REMOVED AND EVENTUALLY FILTERED ALONG WITH THE WASTE TREATMENT SLUDGE. THIS SLUDGE IS THEN DISPOSED OF AT A SANITARY LANDFILL.

UPON START-UP, SEVERAL PROBLEMS WERE ENCOUNTERED. PARTICULATE BUILD-UP WOULD CAUSE PLUGGING OF THE RECYCLE TANK DRAIN AND WASTE SUMP PUMPS. THESE PROBLEMS WERE ALLEVIATED BY THE INSTALLATION OF AIR PURGE LINES. NUMEROUS PROBLEMS WERE ENCOUNTERED WITH DAMPERS AND THE DAMPER CONTROL SYSTEM. THREE SETS OF EXPANSION JOINTS WERE INSTALLED UNTIL EXPANSION JOINT PROBLEMS WERE SOLVED. FAN BEARINGS HAD TO BE REPLACED THREE TIMES. INSTRUMENTATION AND CONTROL PROBLEMS PROMPTED WIRING REVISIONS.

COMMENTS

4TH QUARTER-1975 A NEW EXPANSION JOINT WAS INSTALLED ON UNIT TWO. IN DECEMBER UNIT TWO HAD FAN PROBLEMS AND FAN BEARINGS WERE REPLACED. VANE CAGE CONTROL PROBLEMS WERE ENCOUNTERED AND NUMBER TWO FAN MOTOR GROUNDED.

1ST QUARTER-1976 PROBLEMS OCCURRED WITH THE FAN MOTOR BEARINGS IN UNIT NUMBER ONE, GAS FLOW WAS SWITCHED TO UNIT TWO.

2ND QUARTER-1976 UNIT ONE THREW A FAN BLADE AND A SWITCH WAS MADE TO SCRUBBER UNIT TWO. A NEW HEADER WAS INSTALLED FOR THE RECYCLE PUMPS.

G.M.C./DELCO MORAINE - DAYTON, OHIO (CONTINUED)

COMMENTS

3RD QUARTER-1976 VANES WERE REMOVED FROM RECYCLE TANKS.

2ND QUARTER-1977 CORROSION WAS DETECTED DOWNSTREAM OF MIST ELIMINATOR. AN EPOXY-COAL TAR RESIN WAS APPLIED TO ABATE THE CORROSION PROBLEM.

4TH QUARTER-1977 NO DETAILED UPDATE INFORMATION WAS MADE AVAILABLE FOR THIS REPORT PERIOD OTHER THAN THE FACT THAT THE CORROSION PROBLEM DOWNSTREAM OF THE MIST ELIMINATOR IS STILL PRESENT. PLANS ARE BEING MADE TO RELINE THE STACK.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	GEORGIA-PACIFIC PAPER CO.
INSTALLATION LOCATION	CROSSETT, ARKANSAS
SOURCE CHARACTERISTICS	BARK AND OIL OR COAL (1% - 1.5 % SULFUR)* 62 T/HR BARK* 22 GPM OIL
SOURCE RATING	320,000 ACFM @ 310 F
SOURCE CAPACITY	96 MW (EQUIVALENT)
CONTROL SYSTEM VENDOR	AIRPOL INDUSTRIES
CONTROL PROCESS	CAUSTIC WASTE STREAM
NEW / RETROFIT	NEW
START-UP DATE	1975
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	80% (500 PPM @ INLET)
PARTICULATE EFFICIENCY	90% (0.5 GR/SCF AT INLET)
WATER MAKE-UP	OPEN LOOP* SCRUBBED WITH 2,300 GPM *BLACK WATER* FROM PULP MILL.
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT AND DISCHARGE TO CITY SEWER
CONTROL SYSTEM COST	
CAPITAL	$275,000.

OPERATIONAL EXPERIENCE

THE FGD SYSTEM CONSISTS OF AN AIR-POL CAUSTIC SCRUBBING UNIT TO REMOVE SULFUR DIOXIDE AND PARTICULATE MATTER FROM THE FLUE GAS OF A COAL/BARK OR OIL/BARK POWER BOILER. PROBLEMS HAVE BEEN ENCOUNTERED WITH THE FIBERGLASS LININGS IN THE SCRUBBER. THE SYSTEM IS PRECEDED BY CYCLONES FOR PARTICULATE REMOVAL. NO REHEAT IS PROVIDED ON THE SYSTEM AND MATERIALS ARE HOLDING UP WELL WITH NO CORROSION OR ABRASION PROBLEMS. FIBERGLASS LININGS IN THE SCRUBBER ARE REPLACED AS THEY FAIL.

BACKGROUND INFORMATION

GEORGIA-PACIFIC PAPER CO. - CROSSETT, ARKANSAS

THE SCRUBBER SYSTEM AT GEORGIA-PACIFIC PAPER CO., CROSSETT, ARKANSAS REMOVES SO2 AND PARTICULATES FROM THE FLUE GAS GENERATED BY A BARK/OIL OR COAL-FIRED BOILER (COAL- 1.0-1.5 % SULFUR). THE BOILER IS RATED AT 100 MW (EQUIVALENT) AND PRODUCES 950,000 LB/HR STEAM. THE FLUE GAS RATE IS 320,000 ACFM AT 310 DEGREES F.

SO2 CONCENTRATION IN FLUE GAS IS 500 PPM WITH A PARTICULATE LOADING OF 0.5 GR/SCF. SCRUBBER WASTE WATER WITH AN AVERAGE PH OF 7.5 IS NEUTRALIZED AND DISCHARGED TO CITY SEWERS AT 2000 GPM. CYCLONES PRECEDE SCRUBBERS FOR PARTICULATE CONTROL.

COMMENTS

3RD QUARTER-1977 PLANT REPORTS SATISFACTORY OPERATION WITH NO MAJOR PROBLEMS. THE FIBERGLASS LININGS IN THE SCRUBBER FAIL FREQUENTLY AND ARE REPLACED AS THEY FAIL.

4TH QUARTER-1977 NO FIBERGLASS LINER FAILURE WAS DETECTED DURING THIS REPORT PERIOD. THE PLANT OPERATIONS WENT ON AS SCHEDULED WITH NO PROBLEMS ENCOUNTERED.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	GREAT SOUTHERN PAPER CO.
INSTALLATION LOCATION	CEDAR SPRINGS, GEORGIA
SOURCE CHARACTERISTICS	BARK AND COAL OR OIL (1.0%-2.0% SULFUR)
SOURCE RATING	700,000 ACFM* TOTAL - 2 SCRUBBERS
SOURCE CAPACITY	100 MW (EQUIVALENT)* TOTAL - 2 BOILERS
CONTROL SYSTEM VENDOR	AIRPOL INDUSTRIES
CONTROL PROCESS	CAUSTIC WASTE STREAM
NEW / RETROFIT	RETROFIT
START-UP DATE	1975
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	85%-90% (1,000 PPM AT INLET)
PARTICULATE EFFICIENCY	99.1% (DESIGN* 4.5 GR/SCF AT INLET)
WATER MAKE-UP	OPEN LOOP* 350 GPM-400 GPM PER SCRUBBER
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT AND DISCHARGE TO RIVER CLARIFICATION FOLLOWED BY PONDING AND DISCHARGE TO RIVER
CONTROL SYSTEM COST	
CAPITAL	$600,000. CAPITAL COST IS FOR 2 SCRUBBER MODULES

OPERATIONAL EXPERIENCE

THE FGD SYSTEM CONSISTS OF TWO AIR-POL CAUSTIC SCRUBBERS TO CONTROL PARTICULATE AND SULFUR DIOXIDE FROM TWO POWER BOILERS. THE PRIMARY FUEL IS BARK/COAL (BARK/OIL IS FIRED OCCASIONALLY.) THE FOLLOWING PROBLEMS HAVE BEEN ENCOUNTERED* EROSION AND PLUGGAGE OF THE PH PROBES, INTERNAL WEAR ON PUMPS, AND EROSION IN THE RECIRCULATION LINES OF THE POWER BOILER SCRUBBER. THE PLANT IS IN THE PROCESS OF CHANGING THE PH CONTROL AND MOVING THE PROBES.

BACKGROUND INFORMATION

GREAT SOUTHERN PAPER CEDAR SPRINGS, GA.

THE FGD SYSTEM AT GREAT SOUTHERN PAPER AT CEDAR SPRINGS, GEORGIA CONSISTS OF TWO AIRPOL SODIUM SCRUBBING TRAINS CONTROLLING EMISSIONS FROM TWO COAL-FIRED BOILERS, EACH RATED AT 50 MW (EQUIVALENT) AND EACH PRODUCING 500,000 LB/HR STEAM. THE FUELS FIRED IN THE BOILERS TYPICALLY HAVE THE FOLLOWING SULFUR CONTENTS* COAL - 1.5% , OIL - 1.5%, AND BARK - 2.0%.

THE STAINLESS STEEL SCRUBBERS HANDLE A COMBINED TOTAL OF 700,000 ACFM AT 425 DEGREES F. THE PRESSURE DROP ACROSS THE SCRUBBER IS APPROXIMATELY 7 INCHES W.G. WITH 85 TO 90% SULFUR DIOXIDE REMOVAL EFFICIENCY. THE SULFUR CONCENTRATION OF THE FLUE GAS IS 1000-1200 PPM AND-THE PARTICULATE LOADING IS 4.5 GR/SCFD.

THE SCRUBBER UNDERFLOW IS COMPOSED OF FLYASH AND SODIUM SULFITE/SULFATE SOLUTION. SOLIDS CONTENT (FLYASH) IS TYPICALLY 3 TO 5 % BY WEIGHT. SCRUBBER WASTE WATER WITH AN AVERAGE PH OF 4.5 IS PONDED AND CLARIFIED WATER IS RETURNED TO THE RIVER.

COMMENTS

4TH QUARTER-1977 THE EXPANSION JOINT BETWEEN THE EXISTING STACK AND SCRUBBER HAD TO BE REPLACED IN SEPTEMBER. SOME INTERNAL WEAR HAS BEEN DETECTED ON THE PUMPS DUE TO THE ASH CONTENT. EROSION AND PLUGGAGE PROBLEMS WITH THE PH PROBES HAVE BEEN ENCOUNTERED. THE PLANT IS IN THE PROCESS OF CHANGING THE CONTROL PH AND MOVING THE PROBES. TANKS AND NECESSARY EQUIPMENT TO CONTROL THE PROPER PH ARE EXPECTED TO BE COMPLETED IN A COUPLE OF MONTHS. SOME EROSION WAS DETECTED IN THE RECIRCULATION LINES OF THE POWER BOILER SCRUBBER. THE LINES AND SOME OF THE VALVES HAD TO BE REPLACED.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	GREAT WESTERN SUGAR
INSTALLATION LOCATION	BILLINGS, MONTANA
SOURCE CHARACTERISTICS	COAL (0.7% SULFUR)
SOURCE RATING	60,000 SCFM @ 70 F
CONTROL SYSTEM VENDOR	GREAT WESTERN SUGAR
CONTROL PROCESS	AMMONIA-LADEN PROCESS WATER
NEW / RETROFIT	RETROFIT
START-UP DATE	OCTOBER, 1977
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	35% (300-400 PPM @ INLET)
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT AND DISCHARGE TO RIVER
OPERATIONAL EXPERIENCE	GREAT WESTERN SUGAR USES CONDENSATE PROCESS WATER PRIMARILY FOR PARTICULATE CONTROL. THE WATER HAS A HIGH PH (8.7) BUT THE SYSTEM HAS A LOW SO2 REMOVAL BECAUSE THE WATER IS INTRODUCED THROUGH PIPES RATHER THAN SPRAY NOZZLES.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	GREAT WESTERN SUGAR
INSTALLATION LOCATION	FINDLAY, OHIO
SOURCE CHARACTERISTICS	COAL (3% SULFUR)
SOURCE RATING	15,000 SCFM @ 70 F (TOTAL - 2 BOILERS) 1400 BOILER HP (TOTAL - 2 BOILERS)
CONTROL SYSTEM VENDOR	GREAT WESTERN SUGAR
CONTROL PROCESS	SODIUM CARBONATE
NEW / RETROFIT	RETROFIT
START-UP DATE	OCTOBER, 1974
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT AND DISCHARGE TO CITY SEWER
OPERATIONAL EXPERIENCE	PARTICULATE AND SO2 EMISSIONS WILL BE CONTROLLED BY A SCRUBBER/ABSORBER MODULE OF PROPRIETARY DESIGN. THE FLUE GAS IS GENERATED BY TWO 720 BOILER HP UNITS. SCRUBBING OPERATIONS BEGAN IN OCTOBER 1974.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	GREAT WESTERN SUGAR
INSTALLATION LOCATION	FORT MORGAN, COLORADO
SOURCE CHARACTERISTICS	COAL (0.5% SULFUR)
SOURCE RATING	50,000 SCFM @ 70 F
CONTROL SYSTEM VENDOR	GREAT WESTERN SUGAR
CONTROL PROCESS	AMMONIA-LADEN PROCESS WATER
NEW / RETROFIT	RETROFIT
START-UP DATE	OCTOBER, 1976
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	35% (300-400 PPM @ INLET)
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT AND DISCHARGE TO RIVER
OPERATIONAL EXPERIENCE	GREAT WESTERN SUGAR USES CONDENSATE PROCESS WATER PRIMARILY FOR PARTICULATE CONTROL. THE WATER HAS A HIGH PH (8.7) BUT THE SYSTEM HAS A LOW SO2 REMOVAL BECAUSE THE WATER IS INTRODUCED THROUGH PIPES RATHER THAN SPRAY NOZZLES.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	GREAT WESTERN SUGAR
INSTALLATION LOCATION	GERING, NEBRASKA
SOURCE CHARACTERISTICS	COAL (0.7% SULFUR)
SOURCE RATING	50,000 SCFM @ 70 F
SOURCE CAPACITY	20.5 MW (TOTAL 1 - 15, 1 - 5.5 BOILER)
CONTROL SYSTEM VENDOR	GREAT WESTERN SUGAR
CONTROL PROCESS	AMMONIA-LADEN PROCESS WATER
NEW / RETROFIT	RETROFIT
START-UP DATE	OCTOBER, 1975
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	35% (300-400 PPM @ INLET)
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT AND DISCHARGE TO RIVER
OPERATIONAL EXPERIENCE	GREAT WESTERN SUGAR USES CONDENSATE PROCESS WATER PRIMARILY FOR PARTICULATE CONTROL. THE WATER HAS A HIGH PH (8.7) BUT THE SYSTEM HAS A LOW SO2 REMOVAL BECAUSE THE WATER IS INTRODUCED THROUGH PIPES RATHER THAN SPRAY NOZZLES.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	GREAT WESTERN SUGAR
INSTALLATION LOCATION	GREELEY, COLORADO
SOURCE CHARACTERISTICS	COAL (0.6% SULFUR)
SOURCE RATING	25,000 SCFM @ 70 F
CONTROL SYSTEM VENDOR	GREAT WESTERN SUGAR
CONTROL PROCESS	AMMONIA-LADEN PROCESS WATER
NEW / RETROFIT	RETROFIT
START-UP DATE	OCTOBER, 1975
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	35% (300-400 PPM @ INLET)
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT AND DISCHARGE TO RIVER
OPERATIONAL EXPERIENCE	GREAT WESTERN SUGAR USES CONDENSATE PROCESS WATER PRIMARILY FOR PARTICULATE CONTROL. THE WATER HAS A HIGH PH (8.7) BUT THE SYSTEM HAS A LOW SO2 REMOVAL BECAUSE THE WATER IS INTRODUCED THROUGH PIPES RATHER THAN SPRAY NOZZLES.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	GREAT WESTERN SUGAR
INSTALLATION LOCATION	LOVELAND, COLORADO
SOURCE CHARACTERISTICS	COAL (0.6%-0.7% SULFUR)
SOURCE RATING	50,000 SCFM @ 70 F
CONTROL SYSTEM VENDOR	GREAT WESTERN SUGAR
CONTROL PROCESS	AMMONIA-LADEN PROCESS WATER
NEW / RETROFIT	RETROFIT
START-UP DATE	OCTOBER, 1973
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	35% (300-400 PPM @ INLET)
WATER MAKE-UP	800 GPM (PROCESS CONDENSATE WATER, PH=8.7, L/G=8)
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT AND DISCHARGE TO RIVER
CONTROL SYSTEM COST	TOTAL INSTALLED COST FOR THE TWO SCRUBBERS, NEW BREECHING, I.D. FANS, AND WATER SYSTEM. (1972 DOLLARS)
OPERATIONAL EXPERIENCE	GREAT WESTERN SUGAR USES CONDENSATE PROCESS WATER PRIMARILY FOR PARTICULATE CONTROL. THE WATER HAS A HIGH PH (8.7) BUT THE SYSTEM HAS A LOW SO2 REMOVAL BECAUSE THE WATER IS INTRODUCED THROUGH PIPES RATHER THAN SPRAY NOZZLES.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	GREAT WESTERN SUGAR
INSTALLATION LOCATION	SCOTTS BLUFF, NEBRASKA
SOURCE CHARACTERISTICS	COAL (0.6%-0.7% SULFUR)
SOURCE RATING	60,000 SCFM @ 70 F
SOURCE CAPACITY	30 MW (TOTAL 2 - BOILERS)
CONTROL SYSTEM VENDOR	GREAT WESTERN SUGAR
CONTROL PROCESS	AMMONIA-LADEN PROCESS WATER
NEW / RETROFIT	RETROFIT
START-UP DATE	OCTOBER, 1975
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	35% (300-400 PPM @ INLET)
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT AND DISCHARGE TO RIVER
OPERATIONAL EXPERIENCE	GREAT WESTERN SUGAR USES CONDENSATE PROCESS WATER PRIMARILY FOR PARTICULATE CONTROL. THE WATER HAS A HIGH PH (8.7) BUT THE SYSTEM HAS A LOW SO2 REMOVAL BECAUSE THE WATER IS INTRODUCED THROUGH PIPES RATHER THAN SPRAY NOZZLES.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	ITT RAYONIER, INC.
INSTALLATION LOCATION	FERNANDINA BEACH, FLORIDA
SOURCE CHARACTERISTICS	BARK AND OIL (2% - 2.5% SULFUR)
SOURCE RATING	344,000 ACFM @ 446 F (TOTAL - 2 BOILERS)
SOURCE CAPACITY	120 MW (TOTAL - 4 BOILERS* EACH BARK BOILER HAS A SCRUBBER TRAIN) EQUIVALENT
CONTROL SYSTEM VENDOR	AIRPOL INDUSTRIES
CONTROL PROCESS	CAUSTIC SCRUBBING
NEW / RETROFIT	RETROFIT
START-UP DATE	1975
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	80% - 85% (1,200 PPM AT INLET)
PARTICULATE EFFICIENCY	97% (1.7 GR/SCF AT INLET)
WATER MAKE-UP	OPEN LOOP
SLUDGE OR BY-PRODUCT DISPOSAL	
CONTROL SYSTEM COST	
CAPITAL	$500,000. CAPITAL COST IS FOR 2 SCRUBBERS, DUCTWORK, AND STACKS
OPERATIONAL EXPERIENCE	AT FERNANDINA BEACH, ITT RAYONIER FIRES BARK AND OIL IN TWO OF THE FOUR PROCESS STEAM BOILERS. PARTICULATE AND SO2 EMISSIONS ARE CONTROLLED IN TWO AIRPOL SCRUBBING TRAINS. SPENT CAUSTIC IS NORMALLY USED FOR SO2 CONTROL. CURRENTLY HOWEVER, CONDENSATE STEAM IS BEING USED FOR SCRUBBING PURPOSES AND THE SPENT CAUSTIC IS BEING MARKETED.

BACKGROUND INFORMATION

ITT RAYONIER-FERNANDINA BEACH, FLORIDA

ITT RAYONIER OPERATES AN AMMONIUM-BASED SULFITE PULP MILL IN FERNANDINA BEACH, FLORIDA. THERE ARE FOUR PROCESS STEAM BOILERS OPERATING IN THE FOLLOWING MANNER*

NO. 1 - 100,000 LB/HR STEAM- FIRES FUEL OIL (NO. 6)

NO. 2 - 125,000 LB/HR STEAM- FIRES A COMBINATION OF BARK AND NO. 6 FUEL OIL

NO. 3 - SAME AS NO. 2

NO. 4 - 150,000 LB/HR STEAM- FIRES NO. 6 FUEL OIL

AIRPOL INDUSTRIES HAS SUPPLIED TWO SCRUBBING TRAINS, EACH TRAIN CONSISTING OF A VENTURI SCRUBBER FOLLOWED BY AN ABSORBER MODULE. FLUE GASES FROM BOILERS NO. 1 AND NO. 2 PASS THROUGH ONE TRAIN, AND THE GASES FROM NO. 3 AND NO. 4 PASS THROUGH THE OTHER TRAIN. THE SCRUBBING LIQUOR IS SPENT CAUSTIC FROM THE MIDDLE STAGE OF THE PULP BLEACHING OPERATION. PH IS MAINTAINED AT 5.5 TO 6.0.

OPERATING HISTORY

4TH QUARTER-1977 PLANT REPORTS THAT BOILERS NO. 2 AND 3 ARE CURRENTLY OPERATING AT REDUCED LOADS, EACH IN THE RANGE OF 75,000 - 90,000 LBS/HR STEAM. THE SPENT CAUSTIC IS CURRENTLY NOT BEING USED FOR SCRUBBING LIQUOR. ITT IS SELLING THE SPENT CAUSTIC TO KRAFT MILLS WHO USE IT FOR THEIR SODA BASE. CONDENSATE STEAM IS BEING RECYCLED AND USED FOR SCRUBBING PURPOSES. SOME EROSION HAS BEEN NOTED AT THE VENTURI THROAT.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	MEAD PAPERBOARD CO.
INSTALLATION LOCATION	STEVENSON, ALABAMA
SOURCE CHARACTERISTICS	OIL (1.5% - 3% SULFUR)
SOURCE RATING	173,000 ACFM @ 450 F
SOURCE CAPACITY	60 MW (EQUIVALENT)* TOTAL - TWO BOILERS
CONTROL SYSTEM VENDOR	AIRPOL INDUSTRIES
CONTROL PROCESS	SODIUM SCRUBBING
NEW / RETROFIT	NEW
START-UP DATE	1975
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	95% (2,000 PPM AT INLET)
PARTICULATE EFFICIENCY	90%
SLUDGE OR BY-PRODUCT DISPOSAL	ALKALINE SULFITE/BISULFITE RECYCLED TO PULP PROCESS RECOVERED SOLUTION USED AS MAKE-UP TO COOKING LIQUOR IN PULP MILL.
CONTROL SYSTEM COST	
CAPITAL	$100,000. CAPITAL COST IS FOR SCRUBBER.
OPERATIONAL EXPERIENCE	AIRPOL INDUSTRIES HAS SUPPLIED A PARTICULATE AND SO2 CONTROL SYSTEM FOR THE TWO OIL-FIRED BOILERS AT THIS MEAD PULP MILL. SODIUM CARBONATE SCRUBBING SOLUTION EFFECTS SO2 REMOVAL OF ABOUT 95%. RECENT MODIFICATIONS HAVE INCLUDED A NEW RUBBER LINER IN THE SCRUBBER MODULE, AND THE INSTALLATION OF ADDITIONAL SPRAY NOZZLES.

BACKGROUND INFORMATION

MEAD PAPERBOARD, STEVENSON, ALABAMA

THE MEAD PAPERBOARD COMPANY IN STEVENSON, ALABAMA, IS A NEUTRAL SULFITE PULP MILL WITH A 500 TON/DAY PULP PRODUCTION RATE. THE MILL HAS A CHEMICAL RECOVERY SYSTEM THAT ABSORBS SO2 FROM THE BILLERUD REACTOR. EFFLUENT FROM THE RECOVERY SYSTEM FLOWS BACK TO THE PULPING OPERATION. ELSEWHERE ON-SITE, AN AIRPOL INDUSTRIES ABSORBER TOWER CONTROLS PARTICULATE AND SO2 EMISSIONS FROM TWO OIL-FIRED (1.5% - 3.0% SULFUR) COMBUSTION-ENGINEERING PACKAGE BOILERS. FLUE GAS VOLUME INTO THE SCRUBBER SYSTEM IS ABOUT 175,000 ACFM @ 450 F. HOT GASES PASS THROUGH A STAINLESS STEEL VENTURI/QUENCH SECTION FOR COOLING AND INITIAL SO2 REMOVAL. THE FLUE GAS THEN ENTERS THE BOTTOM OF THE ABSORBER SECTION AND PASSES UP THROUGH THREE BUBBLE-CAP TRAYS. A SODIUM CARBONATE SOLUTION IS INTRODUCED THROUGH A BANK OF 1.5 INCH NOZZLES AND SPIN VANES. THE GAS EXITS THROUGH A FIBERGLASS STACK.

SCRUBBER EFFLUENT (600 GPM), MOSTLY SODIUM SULFITE, IS SENT TO THE MILLS PULPING OPERATIONS FOR EVENTUAL USE IN THE DIGESTERS. PH IS CONTROLLED AT 7.0-8.5 IN THE RECIRCULATION TANK.

THE SO2 SCRUBBING SYSTEM WAS DOWN FROM MARCH THROUGH JULY 1976 DUE TO ABRASION PROBLEMS. THE ABRASION WAS CAUSED PARTIALLY BY HIGH STREAM VELOCITY THROUGH THE EXISTENT VENTURI PARTICULATE SCRUBBER INTO THE SO2 SCRUBBER. SODIUM CARBONATE AND CARBON PARTICLES THAT HAD NOT GONE INTO SOLUTION ALSO WERE VERY ABRASIVE TO THE SO2 SCRUBBER LINING. IN ADDITION, THE ORIGINAL GLASS-FLAKED LINER (5 MM THICK) WAS EXPERIENCING STRESS CRACKING.

THE HIGH VELOCITIES INTRODUCED BY THE VENTURI WERE ELIMINATED BY REMOVING THE PARTICULATE VENTURI SECTION OF THE SYSTEM. THE GLASS-FLAKED LINING WAS PATCHED WITH $60,000 WORTH OF CARPENTER 20 LINER. THESE CORRECTIVE ACTIONS HELPED FOR A WHILE, BUT AS IT TURNED OUT, THE CARPENTER 20 WAS NOT INSTALLED PROPERLY AND SOLUTION WAS GETTING BETWEEN IT AND THE MILD STEEL SHELL. IT WAS FINALLY DECIDED TO INSTALL NEW RUBBER LINING INSIDE THE ENTIRE SCRUBBER, INCLUDING THE SPIN VANES, AT A COST OF $150,000. TO PREVENT ANY HEAT PROBLEMS, ADDITIONAL NOZZLES WERE INSTALLED. TO DATE, NO MAJOR PROBLEMS HAVE OCCURRED WITH THE RUBBER LINING.

COMMENTS

4TH QUARTER-1977 MINOR EMBRITTLEMENT, DUE TO LOCALIZED HIGH TEMPERATURE, HAS BEEN DETECTED ON THE LINING SURFACE, SOME METAL, NOZZLES, AND RUBBER HAVE BEEN REPLACED.

INSTALLATION NAME	MINN-DAK FARMER'S COOPERATIVE
INSTALLATION LOCATION	WAHPETON, NORTH DAKOTA
SOURCE CHARACTERISTICS	LIGNITE (1.0 PERCENT SULFUR)
SOURCE RATING	250,000 ACFM @ 350 F - TOTAL TWO BOILERS
SOURCE CAPACITY	TWO BOILERS, EACH @ 275,000 LBS/HR STEAM (250 PSIG - 455 F)
CONTROL SYSTEM VENDOR	KOCH ENGINEERING
CONTROL PROCESS	AMMONIA SCRUBBING
NEW / RETROFIT	RETROFIT
START-UP DATE	JUNE, 1977
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	TESTS TO DATE HAVE BEEN INCONCLUSIVE.
WATER MAKE-UP	200 GPM POND WATER
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT BLEED STREAM GOES TO AN ACTIVATED SLUDGE SYSTEM @ 160 GPM
CONTROL SYSTEM COST	TOTAL PURCHASE COST WAS $300,000 (1977)
OPERATIONAL EXPERIENCE	KOCH ENGINEERING HAS SUPPLIED TWO AMMONIA-BASED SO2 CONTROL SYSTEMS FOR THESE COAL-FIRED BOILERS. ORIGINAL DESIGN USED LIME SLURRY, BUT EXCESSIVE PLUGGING AND SCALING BROUGHT ABOUT THE SWITCH TO AMMONIA.

BACKGROUND INFORMATION

MINN-DAK FARMER'S COOP., WAHPETON, N.D.

MINN-DAK FARMER'S COOP. HAS A SUGAR FACTORY AT WAHPETON, NORTH DAKOTA. THERE ARE TWO BOILERS, EACH WITH A CAPACITY OF 275,000 LBS STEAM/HR AT 250 PSIG AND 455 F. THE FUEL BURNED IS 1% SULFUR LIGNITE. SULFUR DIOXIDE REMOVAL IS EFFECTED BY AMMONIA ADDITION TO THE RECIRCULATING SCRUBBER LIWUOR.

KOCH ENGINEERING HAS SUPPLIED TWO SCRUBBERS FOR THE BOILERS EACH OF WHICH GENERATES 125,000 ACFM OF FLUE GASES AT 350 F. THE SCRUBBER SYSTEMS WENT ONSTREAM IN JUNE 77. EACH SCRUBBER IS A VARIABLE THROAT VENTURI WITH OPEN ENDED PIPE INLETS FOR LIQUID AND WAS PRIMARLY DESIGNED FOR PARTICULATE CONTROL. THE SCRUBBER LIQUOR IS RECIRCULATED AT A RATE OF 800 GPM AND THE BLEED-OFF RATE GOING TO THE ACTIVATED SLUDGE SYSTEM IS 160 GPM. THE MAKEUP POND WATER FLOW RATE IS 200 GPM. THE PRESSURE DROP ACROSS A SCRUBBER IS 11 IN. WG. THERE IS ONE COMMON CHEVERON TYPE DEMISTER AND ONE STACK. THE INLET CONCENTRATION RANGES ARE 76-193 LBS/HR OF SO2 AND .3-.4 GR/SCF OF PARTICULATE. THE OUTLET CONCENTRATION RANGES ARE 10-37 LBS/HR AND .027-.038 GR/SCF RESPECTIVELY.

THE SCRUBBERS AND THE LIQUOR INLET PIPES ARE MADE OF 316L SS, THE DEMISTER AND STACK 316 SS AND THE RECIRCULATING PIPING OF FIBERGLASS. THE TOTAL PURCHASE COST OF THE EQUIPMENT WAS $300,000 IN 1977 DOLLARS. INITIALLY THE SYSTEM WAS DESIGNED TO USE A LIME SLURRY OF PH 10.0 AS THE SCRUBBING LIQUOR. HOWEVER, DURING THE FIRST SIX WEEKS OF OPERATION, NUMEROUS PLUGGING AND SCALING PROBLEMS OCCURRED. HENCE, THE PLANT PERSONNEL BEGAN USING POND WATER WITH SOME AMMONIA ADDITION IN EARLY 1978.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	MOBIL OIL COMPANY
INSTALLATION LOCATION	SAN ARDO, CALIFORNIA
SOURCE CHARACTERISTICS	OIL (2% - 2.25% SULFUR)
SOURCE RATING	304,000 ACFM @ 270 F 20 SCRUBBERS TREATING 8,000 ACFM EACH 8 SCRUBBERS TREATING 18,000 ACFM EACH
SOURCE CAPACITY	840 MM BTU/HR (60 MW EQUIVALENT)* TOTAL - 28 SCRUBBERS
CONTROL SYSTEM VENDOR	MOBIL OIL COMPANY
CONTROL PROCESS	SODIUM SCRUBBING
NEW / RETROFIT	RETROFIT
START-UP DATE	1974
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	90% (1500 PPM SO2 @ INLET)
WATER MAKE-UP	OIL FIELD WASTEWATER
SLUDGE OR BY-PRODUCT DISPOSAL	HOLDING POND FOR EVAPORATION
CONTROL SYSTEM COST	CAPITAL = $2,300,000 FOR 20 FGD SYSTEMS @ $65,000 EACH AND 8 FGD SYSTEMS @ $125,000 EACH. OPERATING COSTS ARE $500,000 YEARLY FOR 20 FGD SYSTEMS @ $15,000/YR EACH AND 8 SYSTEMS @ $25,000/YR EACH.

OPERATIONAL EXPERIENCE

MOBIL OPERATES 28 SMALL STEAM GENERATORS AT THEIR OIL FIELDS IN SAN ARDO, CALIFORNIA. EACH OF THESE STEAM GENERATORS HAS ITS OWN SO_2 CONTROL SYSTEM UTILIZING CAUSTIC AND ALKALINE OIL FIELD WASTEWATER. PRIMARY PROBLEMS HAVE BEEN CORROSION OF STAINLESS STEEL COMPONENTS DUE TO HIGH CHLORIDE CONTENT.

BACKGROUND INFORMATION

MOBIL OIL COMPANY, SAN ARDO, CALIFORNIA

THE MOBIL OIL COMPANY HAS AN OIL SITE IN SAN ARDO, CALIFORNIA WHERE 28 STEAM GENERATORS ARE USED TO FORCE OIL OUT OF THE WELL. THE FUEL USED IS CRUDE OIL WITH 2-2.25% SULFUR. EACH STEAM GENERATOR IS FOLLOWED BY AN INDIVIDUAL FGD SYSTEM INSTALLED SPECIFICALLY FOR SO2 CONTROL. THE UNITS EXPERIENCED STARTUP IN THE PERIOD FROM 1972 THROUGH 1974.

THERE ARE TWO SIZES OF STEAM GENERATORS- 22 MM BTU/HR (20 UNITS) AND 50 MM BTU/HR (8 UNITS). THE SMALL UNITS GENERATE 8,000, AND THE LARGE UNITS 18,000 SCFM OF THE FLUE GAS. THE GASES ARE SCRUBBED BY A LIQUOR CONSISTING OF NAOH AND ALKALINE OIL FIELD WASTEWATER (NA2CO3). THE PROCESS IS ONCE THROUGH AND PH VALUES OF 8.0 AND 6.0 ARE MAINTAINED AT THE INLET AND OUTLET OF THE SCRUBBERS, RESPECTIVELY. THE SPENT LIQUOR FROM THE BOTTOM OF THE SCRUBBERS IS DISPOSED OF IN THE WASTEWATER DISPOSAL ZONE. THERE IS NO RECYCLE FROM THE DISPOSAL ZONE SO THE SYSTEM OPERATES IN AN OPEN LOOP. THE LIQUID FLOW RATES TO THE TWO SIZES OF THE SCRUBBERS ARE 75 GPM AND 200 GPM. THE SCRUBBER SIZES ARE* 4 FT. DIAMETER X 20 FT. HIGH AND 6.5 FT. DIAMETER X 25 FT. HIGH. EACH SCRUBBER HAS THREE V-GRATE TYPE TRAYS. THE I.D. FANS ON EACH SCRUBBER EXPERIENCE 3-4 INCHES WG PRESSURE DROP. THE SO2 REMOVAL EFFICIENCY OF THE PROCESS IS 90 PERCENT WITH INLET SO2 CONCENTRATION OF 1500 PPM. CHEVRON-TYPE DEMISTERS ARE USED.

THE SCRUBBERS ARE 316 L SS AND THE TRAYS 316 SS. THE INLET DUCTWORK IS CS UP TO THE ECONOMIZER AND THEN 316 L SS. THE DOWNSTREAM DUCT IS HEAVY FIBERGLASS AND THE I.D. FANS ARE CS WITH 316 L SS LINING ON THE CASING. THE STACK IS FIBERGLASS. THE FLUE GASES ARE NOT REHEATED AND CANNOT BE BY-PASSED. THE MIST ELIMINATORS, ORIGINALLY 316 SS, HAVE BEEN LINED WITH PHENOLIC EPOXY RESIN TO COMBAT CORROSION. INADEQUATE MIST REMOVAL HAS ALSO RESULTED IN CORROSION OF THE I.D. FAN IMPELLER, BLADES, AND HUBS, WHICH NEED REPLACEMENT EVERY YEAR. THE HIGH CHLORIDE CONTENT OF WASTE WATER IS THE PRIMARY CAUSE OF PITTING OF SS MATERIAL.

THE SPENT LIQUOR IS INJECTED INTO A WASTEWATER WELL (LARGE WASTE WATER DISPOSAL ZONE).

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	NCR-APPLETON
INSTALLATION LOCATION	ROARING SPRINGS, PENNSYLVANIA
SOURCE CHARACTERISTICS	COAL (2% - 3% SULFUR)
SOURCE RATING	85,000 ACFM @ 400 F
SOURCE CAPACITY	12 MW (EQUIVALENT)
CONTROL SYSTEM VENDOR	AIRPOL INDUSTRIES
CONTROL PROCESS	SODIUM SCRUBBING
NEW / RETROFIT	NEW
START-UP DATE	JUNE, 1977
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	80% - 85%
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT AND DISCHARGE TO CITY SEWER

OPERATIONAL EXPERIENCE

THIS NEW BOILER, RATED AT 12 MW (EQUIVALENT), WAS SUPPLIED WITH AN EMISSION CONTROL SYSTEM BY AIRPOL INDUSTRIES. THE SODIUM-BASED CHEMISTRY UTILIZES SODIUM HYDROXIDE FOR SO2 REMOVAL, ALTHOUGH NO GUARANTEE WAS MADE WITH RESPECT TO SO2 REMOVAL. BOILER-RELATED PROBLEMS HAVE DELAYED ACCEPTANCE TESTS ALTHOUGH START-UP OCCURED IN JUNE 1977.

BACKGROUND INFORMATION

NCR-APPLETON - ROARING SPRING, PENNSYLVANIA

NCR-APPLETON RUNS A KRAFT PULP AND PAPER OPERATION IN ROARING SPRING, PENNSYLVANIA. PROCESS STEAM IS SUPPLIED BY A COAL-FIRED BOILER. THE COAL USED HAS A SULFUR CONTENT RANGING FROM 2% TO 3%. THE BOILER IS EQUIVALENT TO ABOUT 12 MW, GENERATING ABOUT 85,000 ACFM AT 400 F. THIS IS A NEW STEAM PLANT WHICH BEGAN PRODUCTION IN JUNE 1977. PARTICULATE AND SO2 EMISSIONS ARE CONTROLLED BY AN AIRPOL SCRUBBING SYSTEM CONSISTING OF A VENTURI FOLLOWED BY AN ABSORBER MODULE. SCRUBBER AND ABSORBER INTERNALS ARE LINED WITH AN ACID RESISTANT MATERIAL (CRUSHED AGGREGATE WITH EPOXY BINDER, RATED IN PH RANGE 1 TO 2). THE STACK IS FRP LINED.

SO2 REMOVAL AND CORROSION PREVENTION ARE IMPLEMENTED BY THE ADDITION OF CAUSTIC (SODIUM HYDROXIDE) TO THE RECYCLE TANK. PH CONTROL IS IN THE 5 TO 7 RANGE.

OPERATING HISTORY

4TH QUARTER-1977 SINCE START-UP IN JUNE 1977, THERE HAVE BEEN SOME MECHANICAL PROBLEMS RELATED TO BOILER OPERATION. THE COAL BEING FIRED IN THE STEAM GENERATOR IS NOT THE DESIGN COAL HAVING A LOWER HEAT VALVE AND HIGHER ASH CONTENT THAN PLANNED. THE SCRUBBER OPERATIONS ARE REPORTED BY THE VENDOR TO BE GOING FAIRLY WELL. THERE HAVE BEEN LINER PROBLEMS. THE UNIT HAS NOT BEEN THROUGH ACCEPTANCE TESTING BY THE INSTALLATION.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	NEKOOSA PAPERS, INC.
INSTALLATION LOCATION	ASHDOWN, ARKANSAS
SOURCE CHARACTERISTICS	COAL (1%-1.5% SULFUR)* 27 TON/HR
SOURCE RATING	325,000 ACFM @ 355 F
SOURCE CAPACITY	50 MW (EQUIVALENT)* DESIGN - 500,000 LB/HR STEAM
CONTROL SYSTEM VENDOR	AIRPOL INDUSTRIES
CONTROL PROCESS	AIR POL CAUSTIC SCRUBBING
NEW / RETROFIT	NEW
START-UP DATE	FEBRUARY, 1976
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	90+% (600 PPM @ INLET)
PARTICULATE EFFICIENCY	98% - 99% (1.42 GR/SCF AT INLET)
WATER MAKE-UP	OPEN LOOP
SLUDGE OR BY-PRODUCT DISPOSAL	ALKALINE SULFITE/BISULFITE RECYCLED TO PULP PROCESS SO2 RECOVERED FROM SODIUM SULFITE/SULFATE LIQUOR AND RE-CYCLED TO PULPING PROCESS.
CONTROL SYSTEM COST	
CAPITAL	$250,000. CAPITAL COST IS FOR SCRUBBER SYSTEM

OPERATIONAL EXPERIENCE

THE FGD SYSTEM CONSISTS OF TWO AIR-POL CAUSTIC SCRUBBERS WHICH REMOVE FLYASH AND SULFUR DIOXIDE FROM THE FLUE GAS OF A STEAM BOILER FIRED WITH COAL OR FUEL OIL. SOME SOLIDS DEPOSITS ON THE PH PROBES ARE CAUSING SOME PROBLEMS. FLOW METERS HAVE BEEN INSTALLED TO GAIN MORE PH CONTROL IN THE SYSTEM.

BACKGROUND INFORMATION

NEKOOSA-EDWARDS, INC., ASHDOWN, ARKANSAS

THE NEKOOSA-EDWARDS PAPER PULP MILL IN ASHDOWN, ARKANSAS HAS TWO AIRPOL SCRUBBERS ON A 50-MW EQUIVALENT STEAM BOILER FIRED WITH COAL OR FUEL OIL. THE VENTURI SCRUBBERS ARE DESIGNED TO REMOVE BOTH SULFUR DIOXIDE AND PARTICULATES. THE INTENT OF NEKOOSA-EDWARDS WAS TO MAKE, FROM THE SCRUBBER EFFLUENT, SALTCAKE WHICH WOULD BE USED AT THE MILL. THE COAL HAS 1-1.5% SULFUR AND A HEATING VALUE OF 12,000 BTU/LB. IT IS BURNED AT A RATE OF 27 TONS/HR.

THE SCRUBBER HANDLES 325,000 ACFM AT 355 DEGREES F. SCRUBBER INLET SO2 CONCENTRATION IS TYPICALLY 600 PPM WITH A PARTICULATE LOADING OF 1.42 GR/SCFM. RECIRCULATED WATER IS BLED OFF AT 150-250 GPM. REAGENT MAKE-UP AMOUNTS TO 12 LB/MIN OF SODIUM HYDROXIDE. SCRUBBER UNDERFLOW CONSISTS OF FLYASH AND A SOLUTION OF SODIUM SULFITE/SULFATE. THE ASH SLURRY GOES TO A SETTLING POND.

THE PREDOMINANT DIFFICULTIES WITH THE FGD SYSTEM HAVE BEEN TWO-FOLD. FIRST, THE PLANT HAS BEEN UNABLE TO DEVELOP AN ADEQUATE PH CONTROL MECHANISM. THE PH CONTROL SYSTEM MONITORS THE AMOUNT OF CAUSTIC AGENT, I.E., SODIUM HYDROXIDE, WHICH GOES INTO THE RECYCLE TANK, KEEPING THE PH OF THE SCRUBBER SOLUTION AT A NONCORROSIVE LEVEL. THE PLANT HAS BEEN PLAGUED WITH PROBLEMS IN OPERATING THE PH CONTROL SYSTEM AND HAS SUFFERED A GREAT DEAL OF CORROSION. THE SECOND PROBLEM CONCERNS THE CHEMICAL REGENERATION PORTION OF THE SYSTEM. THE INTENT OF THE PLANT WAS TO SEPARATE THE FLY ASH FROM THE SCRUBBER LIQUID AND TAKE THE SCRUBBER LIQUID THROUGH A SERIES OF EVAPORATORS WHERE SODIUM SULFATE, I.E., SALTCAKE, WOULD BE GENERATED. THE PLANT HAS BEEN UNABLE TO OPERATE THE FLY ASH SEPARATION SYSTEM PROPERLY, AND THERE IS NOT ENOUGH EVAPORATION CAPACITY FOR THE PLANT TO PROCESS THE SCRUBBER EFFLUENT AT FULL OPERATIONAL CAPACITY.

IN SPITE OF THE OPERATIONAL PROBLEMS, THE SULFUR DIOXIDE AND PARTICULATE REMOVAL EFFICIENCIES OF THE FGD SYSTEM ARE 90 AND 99 PERCENT, RESPECTIVELY, ACCORDING TO THE PLANT ENGINEER. THE WASTE PRODUCT FROM THE SCRUBBER IS NOT RECYCLED, AT PRESENT, AND IS PUMPED TO THE WASTEWATER TREATMENT PLANT. CLEANED WASTEWATER IS RETURNED TO THE RIVER.

NEKOOSA PAPERS - ASHDOWN, ARKANSAS (CONTINUED)

UPON STARTUP, PROBLEMS OCCURED WITH THE PIPING AND VALVES WHICH WERE CONSTRUCTED OF CARBON STEEL. THE CARBON STEEL SYSTEM WAS REMOVED AND REPLACED WITH STAINLESS STEEL VALVES AND PIPING. SOME PIPING LEAKS OCCURRED AND WERE REWELDED. SOME CORROSION OF DUCT DAMPERS OCCURED AND WERE RELIEVED BY ADJUSTING THE PH OF THE SCRUBBING LIQUOR. THE PH IS MAINTAINED BETWEEN 5.5 - 6.0.

THE SCRUBBER SYSTEM OPERATES WITHOUT REHEAT, EXHAUSTING TO A FIBERGLASS COATED STACK. PARTICULATES ARE CONTROLLED WITH CYCLONES AND TWO VARIABLE THROAT VENTURI SCRUBBERS WITH AN AVERAGE PRESSURE DROP OF 14 TO 16 INCHES w.G.

COMMENTS

3RD QUARTER-1977 NO MAJOR PROBLEMS HAVE BEEN REPORTED.
CORROSION PROBLEMS STILL EXIST AND PH CONTROL IS STILL A PROBLEM. FLOW METERS ARE BEING INSTALLED TO MONITOR SCRUBBER WATER.

4TH QUARTER-1977 TWO FLOW METERS HAVE BEEN INSTALLED AT EACH SCRUBBER, ONE AT THE THROAT INLETF OF THE VENTURI AND ONE AT THE THROAT. THE PLANT REPORTS THAT PH CONTROL IS STILL A PROBLEM. SOME PROBLEMS ARE BEING ENCOUNTERED WITH THE PH PROBES DUE TO THE CONSTANT FLOW OF LARGE AMOUNTS OF SOLIDS, AND SOLIDS DEPOSITS ON THE PROBES.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	RICKENBACKER AIR FORCE BASE
INSTALLATION LOCATION	COLUMBUS, OHIO
SOURCE CHARACTERISTICS	COAL (3.6% SULFUR)
SOURCE RATING	50,000 SCFM @ 70 F
SOURCE CAPACITY	20 MW (EQUIVALENT)
CONTROL SYSTEM VENDOR	RESEARCH-COTTRELL/BAHCO
CONTROL PROCESS	LIMESTONE SCRUBBING
NEW / RETROFIT	RETROFIT
START-UP DATE	MARCH, 1976
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	90% (AVERAGE)
PARTICULATE EFFICIENCY	98%
WATER MAKE-UP	OPEN LOOP - 2.5 GPM/MW (MAX)
SLUDGE OR BY-PRODUCT DISPOSAL	NON-FIXATED SLURRY TO LINED POND UNSTABILIZED CASO3/SO4 SLUDGE TO LINED POND
CONTROL SYSTEM COST	
CAPITAL	$ 2.200 MILLION FOR 1977, OPERATING COSTS WERE $5.92/TON COAL. THIS INCLUDES OPERATING AND MAINTENANCE LABOR AND PARTS. CAPITAL COST INCLUDES ADJACENT ELECTRICAL SUBSTATION, SLUDGE DISPOSAL, EXTERNAL FLUES, AND OTHER ATYPICAL EQUIPMENT.

OPERATIONAL EXPERIENCE

THIS RESEARCH-COTTRELL/BAHCO LIME FGD UNIT WAS FIRST PLACED IN SERVICE MARCH 11, 1976. THE SYSTEM WAS SWITCHED OVER TO LIMESTONE IN APRIL 1977, AND HAS REMAINED IN THAT OPERATING MODE TO DATE. THE NEW OHIO CODE REQUIRES A LESS STRINGENT SO2 REMOVAL EFFICIENCY AND THE PLANT IS NOW RUNNING A STOICHIOMETRIC RATIO OF ABOUT 0.75. AVAILABILITY HAS BEEN 95% SINCE AUGUST 1977.

BACKGROUND INFORMATION

RICKENBACKER AIR FORCE BASE-COLUMBUS, OHIO

IN 1971 RESEARCH-COTTRELL CONCLUDED AN AGREEMENT WITH A.B. BAHCO VENTILATION, ENKOPING SWEDEN. THIS CONTRACTUAL ARRANGEMENT ALLOWS RESEARCH-COTTRELL TO BE THE EXCLUSIVE LICENSEE OF THE BACHO SULFUR DIOXIDE SCRUBBING PROCESS IN THE UNITED STATES. TO DATE, THERE ARE 19 BACHO SULFUR DIOXIDE SCRUBBING SYSTEMS IN THE VARIOUS STAGES OF DEVELOPMENT THROUGHOUT THE WORLD. THE FIRST U.S. BACHO INSTALLATION HANDLES SEVEN STOKER-TYPE COAL-FIRED BOILERS AT THE RICKENBACKER AIR FORCE BASE IN COLUMBUS, OHIO. THREE BOILERS WERE PLACED IN SERVICE IN 1952 AND THE REMAINING FOUR IN 1954. THE UNITS FIRE A HIGH-SULFUR COAL, 3.6 PERCENT SULFUR, @ HIGH COMBUSTION AIR RATES, 150-160% EXCESS AIR.

THE RICKENBACKER EMISSION CONTROL SYSTEM CONSISTS ESSENTIALLY OF A MECHANICAL COLLECTOR, BACHO SCRUBBER TOWER, LIME STORAGE AND HANDLING SYSTEM, CLARIFIER, BOOSTER FAN AND ASSOCIATED DUCTWORK, PUMPS, CONTROLS, AND A SLUDGE DISPOSAL POND.

SOLID PARTICULATE AND SULFUR DIOXIDE-LADEN FLUE GAS TAKEN FROM EACH OF THE EXISTING SEVEN STACKS IS FED THROUGH A COMMON HEADER AND INTO A MECHANICAL COLLECTOR WHERE PRIMARY PARTICULATE REMOVAL TAKES PLACE. THE MECHANICAL COLLECTOR HAS A DESIGN REMOVAL EFFICIENCY OF 70 PERCENT AND WAS INSTALLED PRIMARILY TO REDUCE FAN WEAR. THE PARTLY CLEANED GAS THEN FLOWS INTO THE BACHO TONER WHERE ADDITIONAL PARTICULATE AND PRIMARY SULFUR DIOXIDE REMOVAL TAKES PLACE.

THE BACHO SCRUBBING VESSEL IS A VERTICAL TOWER CONSISTING OF TWO SCRUBBING STAGES. GAS FLOWS THROUGH THE TOWER WHERE IT IS CONTACTED WITH A LIME SLURRY SOLUTION. AFTER PASSING THROUGH THE FIRST SCRUBBING STAGE, ENTRAINED MOISTURE IS REMOVED BY A CYCLONIC TYPE MIST ELIMINATOR. THE GAS THEN PASSES THROUGH A SECOND SCRUBBING STAGE AND A SECOND CYCLONIC MIST ELIMINATOR. THE CLEANED GAS IS DISCHARGED TO THE ATMOSPHERE THROUGH A STACK MOUNTED DIRECTLY TO THE TOWER.

PEBBLE LIME IS EMPLOYED AS THE REAGENT IN THE SCRUBBING SYSTEM AND IS PREPARED BY SLAKING AND DISSOLUTION IN A MIX/HOLD TANK. THE SCRUBBING SLURRY IS THEN PUMPED TO THE ABSORBER WHERE IT IS CONTACTED WITH THE FLUE GAS IN A COUNTERCURRENT FASHION.

RICKENBACKER AIR FORCE BASE - COLUMBUS, OHIO (CONTINUED)

THE SPENT SCRUBBING SOLUTION IS DISCHARGED TO THE THICKENER WHERE THE WASTE SOLIDS SETTLE OUT. THICKENER OVERFLOW IS RETURNED TO THE MIX/HOLD TANK. THICKENER UNDERFLOW IS DISCHARGED TO A 5-ACRE HYPALON-LINED DISPOSAL POND. THIS POND IS LOCATED APPROXIMATELY 400 FEET FROM THE SCRUBBING TOWER. CLEAR WATER FROM THE POND IS RETURNED TO PROCESS AS SLAKING WATER.

THE SYSTEM WAS INITIALLY PLACED IN SERVICE MARCH 11, 1976. INITIAL OPERATION PROCEEDED IN AN OPEN WATER LOOP MODE BECAUSE THE THICKENER WAS NOT YET COMPLETELY INSTALLED. SULFUR DIOXIDE INLET CONCENTRATIONS WERE IN THE 1800 TO 2000 PPM RANGE. HIGH OXYGEN CONCENTRATIONS ALSO EXIST IN THE FLUE GAS BECAUSE THESE OLDER, INEFFICIENT BOILERS OPERATE AT 150 TO 160 PERCENT EXCESS AIR RATES. SULFUR DIOXIDE REMOVAL EFFICIENCY HAS BEEN IN THE LOW 90 PERCENT PLUS RANGE. LIME UTILIZATION HAS BEEN VERY GOOD. PROBLEMS ENCOUNTERED TO DATE HAVE BEEN PRIMARILY OF A MECHANICAL NATURE USUALLY ASSOCIATED WITH STARTUP. THE MAJOR PROBLEMS ARE ITEMIZED BELOW.

ELECTRICAL CIRCUITS AND SYSTEM CONTROL PANEL.

PUMP MALFUNCTION-SPARE PARTS SHIPMENT DELAY.

SEDIMENTATION BUILDUP IN THE SCRUBBER VESSEL (THIS WAS DUE PRIMARILY TO OPERATION AT HIGHER THAN DESIGN SOLIDS CONCENTRATION IN THE SCRUBBING SOLUTION BECAUSE THE THICKENER WAS NOT YET IN SERVICE PLUS GRIT GETTING THROUGH THE LIME SLAKER GRIT REMOVAL STEP).

FAMILIARIZATION OF THE OPERATING STAFF WITH THE MECHANICS OF THE PROCESS.

I.D. BOOSTER FAN PROBLEMS. ADDITIONAL BRACING, AND EPOXY GROUTING WAS REQUIRED TO STOP THE ELEVATED FAN CONCRETE SUPPORT FROM VIBRATING WHILE THE FAN WAS OPERATING.

OPERATING HISTORY

NOV. 76 TO JUN. 77

DOWNTIME WAS LESS THAN 5%. OPERATING PROBLEMS HAVE BEEN MECHANICAL AND CONTROL RATHER THAN PROCESS-RELATED. FAN-RELATED PROBLEMS ACCOUNTED FOR OVER 75% OF THE ACTUAL DOWNTIME. THIS RESULTED FROM EXCESSIVE FAN VIBRATIONS CAUSED BY BEARING, SUPPORT, AND INSTRUMENTATION DIFFICULTIES. IN APRIL 1977. THE FAN WHEEL DEVELOPED A CRACK IN THE RIM ATTRIBUTED TO FATIGUE FROM RESONANT VIBRATION. THE FAN WAS SENT BACK TO THE MANUFACTURER, AMERICAN STANDARD, WHO MADE THE REQUIRED MODIFICATIONS. THE ORIGINAL FAN WAS RADIAL BLADE WITH RIMS, AND A MAJOR MODIFICATION WAS CHOPPING THE RIMS OFF, THEREBY REDUCING THE DIAMETER. THE FAN WAS RETURNED IN EARLY MAY AND THE VIBRATION PROBLEM WAS SOLVED. OTHER OPERATIONS WERE RELATIVELY PROBLEM-FREE. THERE WERE NO CORROSION, EROSION, SCALING, OR PLUGGING PROBLEMS.

THE SYSTEM BEGAN RUNNING ON LIMESTONE IN APRIL, AS PART OF THE EPA TEST PROGRAM. LIMESTONE PERFORMED WELL, YIELDING ADEQUATE REMOVAL.

ON JUNE 3RD, THE STEAM PLANT WAS SHUTDOWN THE TIE-IN OF THE NEW NO. 8 BOILER, THIS UNIT REPLACED UNITS NO. 1 AND NO. 2, AND NO. 3 WILL BE ON STANDBY. TIE IN WAS COMPLETED IN JUNE.

AUG. 77

THE ARMS BROKE OFF IN THE 25-FOOT DIAMETER THICKENER TANK, CAUSING A 30-DAY DOWN PERIOD.

SEP. 77

A MAKE-UP WATER BOOSTER PUMP HAD TO BE REPLACED.

OCT. 77

THE MOTOR DRIVE ON THE SLAKER BELT HAD TO BE REPAIRED. ALTHOUGH THE SLAKER IS NO LONGER USED WITH THE LIMESTONE REAGENT, THE BELT IS USED TO CONVEY THE LIMESTONE TO THE DISSOLVING TANK.

RICKENBACKER AFB-COLUMBUS, OHIO (CONTINUED)

JAN. 78 IT HAS BEEN DISCOVERED THAT WITH A STOICHIOMETRIC RATIO OF 0.75 THE REQUIRED DEGREE OF SO2 REMOVAL CAN BE ACHIEVED. THE CURRENT REGULATION LIMITS EMISSIONS TO 2.2 LBS/MM BTU HEAT IMPUT. DURING THE JANUARY BLIZZARD, SOME FREEZE-UP PROBLEMS WERE ENCOUNTERED. OVERALL SYSTEM AVAILABILITY HAS BEEN ABOUT 95% SINCE AUGUST 1977.

A RECENT COST ANALYSIS INDICATED THAT 1977 SCRUBBER COSTS, EXCLUSIVE OF CAPITAL DEPRECIATION, WERE $5.92/TON OF COAL FOR 35,000 TONS/YR. THIS FIGURE REFLECTS OPERATING COSTS AND MAINTENANCE LABOR AND PARTS. THIS IS STILL CHEAPER THAN FIRING LOW-SULFUR COAL, WITH THE CURRENT SPREAD BETWEEN LOW-SULFUR AND HIGH-SULFUR COAL AT ABOUT $7/TON.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	SHELLER GLOBE CORP.
INSTALLATION LOCATION	NORFOLK, VIRGINIA
SOURCE CHARACTERISTICS	COAL (LESS THAN 1% SULFUR, 6% ASH, 13,200 BTU/LB)
SOURCE RATING	8,000 SCFM @ 70 F
CONTROL SYSTEM VENDOR	W.W. SLY MANUFACTURING CO.
CONTROL PROCESS	SODIUM HYDROXIDE
NEW / RETROFIT	RETROFIT
START-UP DATE	1975
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	NOT DETERMINED
PARTICULATE EFFICIENCY	NOT DETERMINED
SLUDGE OR BY-PRODUCT DISPOSAL	OVERFLOW TO SEWER/SLUDGE TO LANDFILL
OPERATIONAL EXPERIENCE	AFTER SYSTEM RESTART IN OCTOBER 1977, THERE HAVE BEEN NO PROBLEMS RESULTING FROM EITHER BOILER OR SCRUBBER OPERATIONS. THE PLANT IS CURRENTLY AWAITING CERTIFICATION FROM VIRGINIA EPA.

BACKGROUND INFORMATION

SHELLER GLOBE CORP., NORFOLK, VIRGINIA

IN NORFOLK, VIRGINIA, SHELLER GLOBE CORPORATION OPERATES THE MITCHELL SMITH DIVISION PLANT, WHERE THE PRIMARY PRODUCT IS CORK RUBBER GASKET MATERIAL. PROCESS (AUTOCLAVE) AND HEATING STEAM ARE SUPPLIED BY A BOILER RATED AT 350 BOILER HP (ABOUT 3.5 MW EQUIVALENT). STEAM CONDITIONS ARE 125 PSI AT 325 F. THE BOILER WAS ORIGINALLY ERECTED IN 1939, BUT UNDERWENT A COMPLETE OVERHAUL IN 1977. BOILER TUBES, REFRACTORY BRICK, GRATE, AND SOOT BLOWERS WERE REPLACED DURING THE OVERHAUL. THE BOILER FIRES COAL SUPPLIED BY GENERAL COAL - NOMINAL SIZE IS 1.25 X 0.25 INCHES. COAL CHARACTERISTICS ARE AS FOLLOWS* HHV=13,200 BTU/LB, ASH=6%, AND SULFUR IS LESS THAN 1%.

THE EMISSIONS CONTROL SYSTEM AT SHELLER GLOBE CONSISTS OF A W.W. SLY IMPINGJET SCRUBBER WHICH REMOVES PARTICULATE AND SO_2 FROM THE FLUE GAS. THE SYSTEM USES A SODIUM HYDROXIDE MAKE-UP FOR SO_2 CONTROL. RECYCLE TANK SUPERNATANT IS PH NEUTRALIZED AND IS DISCHARGED TO CITY SEWERS. FLYASH AND SEDIMENT ARE SUMPED OUT AND HAULED TO A SANITARY LANDFILL.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	ST. REGIS PAPER CO.
INSTALLATION LOCATION	CANTONMENT, FLORIDA
SOURCE CHARACTERISTICS	INTERRUPTIBLE NATURAL GAS* BARK & OIL (2%-3% S)
SOURCE RATING	175,000 ACFM
SOURCE CAPACITY	60 MW (EQUIVALENT)* DESIGN - 300,000 LB/HR STEAM
CONTROL SYSTEM VENDOR	AIRPOL INDUSTRIES
CONTROL PROCESS	CAUSTIC SCRUBBING
NEW / RETROFIT	RETROFIT
START-UP DATE	1973
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	80% - 90%
PARTICULATE EFFICIENCY	94.5% (400 LB/HR AT INLET)
WATER MAKE-UP	OPEN LOOP* 200 GPM-250 GPM SCRUBBING LIQUOR FEED
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT AND DISCHARGE TO CITY SEWER SLUDGE IS DISCHARGED TO AN ON-SITE SEWAGE TREATMENT PLANT
CONTROL SYSTEM COST	
CAPITAL	$100,000. CAPITAL COST IS FOR THE SCRUBBER ONLY
OPERATIONAL EXPERIENCE	THE FGD SYSTEM CONSISTS OF AN AIR-POL CAUSTIC SCRUBBING SYSTEM TO REMOVE PARTICULATES AND SULFUR DIOXIDE FROM THE FLUE GAS OF A BARK BOILER FIRING INTERRUPTIBLE NATURAL GAS AND OIL. PROBLEMS WITH VALVES PLUGGING AND FIBERS CLOGGING MIST ELIMINATOR HAVE BEEN INVESTIGATED AND A DECISION WAS MADE TO CHANGE THE MAKE-UP WATER SOURCE.

BACKGROUND INFORMATION

ST. REGIS PAPER CO. CANTONMENT, FLORIDA

THE SCRUBBER SYSTEM AT ST. REGIS PAPER LOCATED AT CANTONMENT, FLORIDA WAS MANUFACTURED BY AIRPOL. THE UNIT IS CONSTRUCTED OF 316 L STAINLESS STEEL AND HANDLES A TOTAL FLUE GAS VOLUME OF 175,000 ACFM. PARTICULATES ARE CONTROLLED WITH CYCLONES PRECEEDING THE SCRUBBER. SCRUBBER PRESSURE DROP IS APPROXIMATELY 20 INCHES W.G. WITH 80 TO 90% SULFUR DIOXIDE REMOVAL EFFICIENCY.

THE BOILER IS RATED AT 60 MW AND PRODUCES 300,000 LBS/HR STEAM. THE TYPICAL SULFUR CONTENT OF THE FUEL (OIL & BARK, NATURAL GAS) IS BETWEEN 2 AND 3%. SULFUR DIOXIDE CONCENTRATION IN THE SCRUBBER INLET IS APPROXIMATELY 500 PPM WITH A PARTICULATE LOADING OF 400 LBS/HR.

SCRUBBER UNDERFLOW CONSISTS OF ASH AND A SODIUM SULFITE/SULFATE SOLUTION. THE SLUDGE IS DISCHARGED TO AN ON-SITE SEWAGE TREATMENT PLANT.

COMMENTS

3RD QUARTER-1977 WOOD FIBERS FROM BARK WERE CLOGGING SEPARATORS AND CONTROL VALVES. INSPECTION WAS MADE AND SOLUTION TO PROBLEM IS BEING INVESTIGATED.

4TH QUARTER-1977 AFTER INVESTIGATION OF THE CLOGGING PROBLEM IT WAS DECIDED TO CHANGE THE MAKE-UP UP WATER SOURCE. WATER IS NOW OBTAINED FROM A CLEANER PORTION OF THE PROCESS LOOP.
PLANT REPORTS SATISFACTORY OPERATIONS WITH NO OTHER MAJOR PROBLEMS.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	TEXACO INCORPORATED
INSTALLATION LOCATION	SAN ARDO, CALIFORNIA
SOURCE CHARACTERISTICS	OIL (2 PERCENT SULFUR)
SOURCE RATING	18,100 ACFM @ 460 F THERE ARE MANY SCRUBBERS OF THIS APPROXIMATE SIZE AT THIS INSTALLATION. CURRENTLY, THE ACTUAL NUMBER OF SCRUBBING SYSTEMS HAS NOT BEEN REPORTED.
CONTROL SYSTEM VENDOR	CEILCOTE CO.
CONTROL PROCESS	SODIUM SCRUBBING
NEW / RETROFIT	RETROFIT
START-UP DATE	1974
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	
SLUDGE OR BY-PRODUCT DISPOSAL	HALF OF SCRUBBER UNDERFLOW IS RECIRCULATED, HALF GOES TO WASTEWATER DISPOSAL WELLS.
OPERATIONAL EXPERIENCE	THE FGD SYSTEM CONSISTS OF A HORIZONTAL,PACKED-BED TYPE SCRUBBER FOR THE FLUE GAS OF OIL FIRED BOILERS. THE BOILERS PRODUCE STEAM WHICH IS USED TO FACILITATE OIL FLOW FROM THE OIL WELLS. THERE ARE SEVERAL SCRUBBERS ON-SITE ALTHOUGH THE EXACT SITUATION HAS NOT YET BEEN REPORTED.

BACKGROUND INFORMATION

TEXACO, INC. - SAN ARDO, CALIFORNIA

TEXACO USES OIL-FIRED STEAM GENERATORS AT THE SAN ARDO, CALIFORNIA SITE TO FORCE OIL OUT OF THE WELL. THE OIL HAS A TYPICAL SULFUR CONTENT OF 1.7%.

A TYPICAL SCRUBBER HANDLES 18,000 ACFM AT 460 F AND HAS PLASTIC PACKINGS TO AVOID CORROSION OF INTERNALS. SODIUM HYDROXIDE SOLUTION IS USED AS SCRUBBING LIQUOR. THE SCRUBBER UNDERFLOW IS SPLIT WITH HALF BEING RECYCLED AND HALF DISPOSED OF IN WASTE WATER DISPOSAL WELLS.

COMMENTS

2ND QUARTER-1977 A PROBLEM OF AMMONIA CONDENSING ON SURROUNDING FOLIAGE EXISTS. THE PROBLEM IS UNDER INVESTIGATION BY TEXACO.

SECTION 12 - DESCRIPTION OF OPERATIONAL FGD SYSTEMS

INSTALLATION NAME	TEXASGULF
INSTALLATION LOCATION	GRANGER, WYOMING
SOURCE CHARACTERISTICS	COAL (0.8% SULFUR* 7% ASH* 10,500 BTU/LB)
SOURCE RATING	140,000 SCFM @ 70 F (TOTAL - 2 BOILERS) 600,000 LB/HR STEAM (TOTAL)
SOURCE CAPACITY	65 MW (EQUIVALENT)* TOTAL
CONTROL SYSTEM VENDOR	SWEMCO INC.
CONTROL PROCESS	SODIUM SCRUBBING
NEW / RETROFIT	NEW
START-UP DATE	SEPTEMBER, 1976
CONTROL SYSTEM STATUS	OPERATIONAL
SO2 EFFICIENCY	90+%
PARTICULATE EFFICIENCY	99.3% (HOT-SIDE ESP W/PRECEDING MECHANICAL COLLECTOR)
SLUDGE OR BY-PRODUCT DISPOSAL	HOLDING POND FOR EVAPORATION
OPERATIONAL EXPERIENCE	THIS SODIUM CARBONATE FGD SYSTEM WAS DESIGNED BY SWEMCO, INC. OF NEW YORK. SO2 CONTROL OCCURS IN THE QUENCHER AND THE SIEVE-TRAY ABSORBER MODULE. AN INTERESTING FEATURE IS AN INTERNAL DAMPER WHICH ALLOWS A 4 TO 1 TURNDOWN RATIO. INITIAL PROBLEMS INCLUDED PLUGGING CAUSED BY FLYASH CARRYOVER FROM THE ESP. MILD STEEL PIPING IN THE RECIRCULATING LINES WAS SEVERELY CORRODED BY THE SLIGHTLY ACIDIC SCRUBBING LIQUOR.

SECTION 13 - DESIGN INFORMATION FOR UNDER CONSTRUCTION FGD SYSTEMS

INSTALLATION NAME	CATERPILLAR TRACTOR CO.
INSTALLATION LOCATION	EAST PEORIA, ILLINOIS
SOURCE CHARACTERISTICS	COAL (3.2% SULFUR)
SOURCE RATING	360,000 ACFM
SOURCE CAPACITY	100 MW (TOTAL - 4 BOILERS)
CONTROL SYSTEM VENDOR	FMC ENVIRONMENTAL EQUIPMENT
CONTROL PROCESS	DOUBLE ALKALI (CONCENTRATED)
NEW / RETROFIT	2NEW, 2RETROFIT
START-UP DATE	MARCH, 1978
CONTROL SYSTEM STATUS	CONSTRUCTION
SO2 EFFICIENCY	90% (2,000 PPM @ INLET)
SLUDGE OR BY-PRODUCT DISPOSAL	DEWATERED SLURRY TO LANDFILL 60+% SOLIDS (CASO4) SLUDGE DIRECTLY TO LANDFILL
OPERATIONAL EXPERIENCE	THE FGD SYSTEM IS STILL UNDER CONSTRUCTION. FMC CONCENTRATED MODE DOUBLE ALKALI SYSTEMS WILL REMOVE SO2 EMISSIONS FROM 4 COAL-FIRED BOILERS. A SEPARATE SCRUBBER WILL TREAT THE GASES FROM EACH BOILER. START-UP IS CURRENTLY SCHEDULED FOR MARCH 1978.

BACKGROUND INFORMATION

CATERPILLER TRACTOR, EAST PEORIA, ILLINOIS

THE CATERPILLAR TRACTOR COMPANY PLANT LOCATED IN EAST PEORIA ILLINOIS HAS FOUR COAL FIRED BOILERS. TWO OF THE BOILERS ARE RATED AT 200,000 POUNDS OF STEAM PER HOUR AND THE REMAINING TWO ARE RATED AT 210,000 POUNDS OF STEAM PER HOUR. THE TOTAL BOILER CAPACITY IS ABOUT 100 MW (EQUIVALENT). MECHANICAL COLLECTORS ARE USED FOR FLY ASH CONTROL.

THE AIR QUALITY CONTROL SYSTEMS HAVE BEEN SUPPLIED BY FMC ENVIRONMENTAL EQUIPMENT DIVISION. THERE IS ONE SCRUBBER TRAIN FOR EACH OF THE FOUR BOILERS, AND THEY WILL EACH CONTROL BOTH PARTICULATE AND SO2 EMISSIONS FROM ABOUT 90,000 ACFM.

COMMENTS

4TH QUARTER-1977 STARTUP IS NOW SCHEDULED FOR MARCH 1978. CONSTRUCTION IS PROGRESSING SMOOTHLY.

SECTION 13 - DESIGN INFORMATION FOR UNDER CONSTRUCTION FGD SYSTEMS

INSTALLATION NAME	CATERPILLAR TRACTOR CO.
INSTALLATION LOCATION	MAPLETON, ILLINOIS
SOURCE CHARACTERISTICS	COAL (3.2% SULFUR)
SOURCE RATING	360,000 AFCM
SOURCE CAPACITY	100 MW (TOTAL - 3 BOILERS)
CONTROL SYSTEM VENDOR	FMC ENVIRONMENTAL EQUIPMENT
CONTROL PROCESS	DOUBLE ALKALI (CONCENTRATED)
NEW / RETROFIT	NEW
START-UP DATE	OCTOBER, 1978
CONTROL SYSTEM STATUS	CONSTRUCTION
SO2 EFFICIENCY	NOT AVAILABLE
SLUDGE OR BY-PRODUCT DISPOSAL	DEWATERED SLURRY TO LANDFILL 60+% SOLIDS (CASO4) SLUDGE DIRECTLY TO LANDFILL
OPERATIONAL EXPERIENCE	AT THE CATERPILLAR MAPLETON PLANT, FMC CONCENTRATED MODE DUAL ALKALI TECHNOLOGY WILL BE UTILIZED TO CONTROL SO2 EMISSIONS. THREE SCRUBBER SYSTEMS WILL CONTROL EMISSIONS FROM THREE COAL-FIRED BOILERS. CONSTRUCTION DELAYS, PRIMARILY ON THE STEAM GENERATION SIDE HAVE DELAYED SYSTEM START-UP BACK TO THE 1978-79 HEAT SEASON.

BACKGROUND INFORMATION

CATERPILLAR TRACTOR CO. MAPLETON, ILLINOIS

AT THE MAPLETON, ILLINOIS PLANT, CATERPILLAR TRACTOR IS INSTALLING A NEW BOILER PLANT WHICH WILL BE COMPLETED IN THE EARLY 1980'S. PLANS CALL FOR THE ERECTION OF EIGHT BOILERS, EACH RATED AT ABOUT 200,000 LBS/HR STEAM. THE TOTAL STEAM GENERATING CAPACITY WILL BE 1,650,000 LBS/HR STEAM. THREE OF THESE BOILERS WILL BE COMPLETED BY THE 1978-79 HEAT SEASON AND THE FLUE GAS FROM THESE BOILERS WILL BE TREATED IN AN FMC ENVIRONMENTAL EQUIPMENT DIVISION SCRUBBER SYSTEM. THE SYSTEM WILL CONTROL PARTICULATES IN A VENTURI SCRUBBER (MECHANICAL PRECOLLECTION 85-90%). A CONCENTRATED-MODE DUAL ALKALI CHEMISTRY WILL CONTROL SO2 EMISSIONS. THE FINAL CONTROL SYSTEM WILL CONSIST OF TWO SCRUBBING SYSTEMS, ONE TREATING GAS FROM FOUR OF THE BOILERS AND ONE TREATING GAS FROM THE OTHER FOUR.

COMMENTS

3RD QUARTER-1977 SYSTEM IS UNDER CONSTRUCTION. START-UP IS EXPECTED LATE IN THE FALL OF 1977.

4TH QUARTER-1977 CONSTRUCTION DELAYS ON THE STEAM GENERATIONS SIDE HAVE PUSHED PLANT START-UP BACK TO THE FALL OF 1978.

SECTION 13 - DESIGN INFORMATION FOR UNDER CONSTRUCTION FGD SYSTEMS

INSTALLATION NAME	GREAT WESTERN SUGAR
INSTALLATION LOCATION	FREEMONT,OHIO
SOURCE CHARACTERISTICS	COAL (3% SULFUR)
SOURCE RATING	40,000 SCFM @ 70 F (TOTAL - 2 BOILERS) 140,000 LB/HR STEAM (TOTAL - 2 BOILERS)
CONTROL SYSTEM VENDOR	GREAT WESTERN SUGAR
CONTROL PROCESS	SODIUM CARBONATE
NEW / RETROFIT	RETROFIT
START-UP DATE	OCTOBER, 1978
CONTROL SYSTEM STATUS	CONSTRUCTION
SO2 EFFICIENCY	
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT AND DISCHARGE TO CITY SEWER
OPERATIONAL EXPERIENCE	PARTICULATE AND SO2 EMISSIONS WILL BE CONTROLLED BY A SCRUBBER/ABSORBER MODULE OF PROPRIETARY DESIGN. THE FLUE GAS IS GENERATED BY TWO UNION BOILERS, EACH RATED @ 70,000 LB/HR STEAM. STARTUP IS SCHEDULED FOR OCTOBER 1978.

SECTION 13 - DESIGN INFORMATION FOR UNDER CONSTRUCTION FGD SYSTEMS

INSTALLATION NAME	KERR-MCGEE CHEMICAL CORP.
INSTALLATION LOCATION	TRONA, CALIFORNIA
SOURCE CHARACTERISTICS	COKE, COAL, OIL (0.5% - 5% SULFUR)
SOURCE RATING	726,000 ACFM @ 320 DEGREES F (TOTAL - 2 BOILERS)
SOURCE CAPACITY	64 MW (ELECTRIC POWER AND PROCESS STEAM) TOTAL - 2 BOILERS
CONTROL SYSTEM VENDOR	COMBUSTION EQUIPMENT ASSOC.
CONTROL PROCESS	SODIUM SCRUBBING
NEW / RETROFIT	NEW
START-UP DATE	APRIL, 1978
CONTROL SYSTEM STATUS	CONSTRUCTION
SO2 EFFICIENCY	98+% (AT MAXIMUM LOADING)
PARTICULATE EFFICIENCY	98.5% (COLLECTED BY PRECEDING ESP'S)
WATER MAKE-UP	OPEN LOOP* 125 GPM BURKITE SCRUBBING LIQUOR (47% NA2CO3 AND 41% NA2SO4)
SLUDGE OR BY-PRODUCT DISPOSAL	HOLDING POND FOR EVAPORATION SCRUBBER EFFLUENT IS CLARIFIED AND THEN PUT INTO A MINERAL DEPOSIT.
CONTROL SYSTEM COST	KERR-MCGEE SPENT $1.5 MM IN A PILOT PLANT FOR SEVERAL YEARS BEFORE AND DURING CONSTRUCTION OF THE NEW FACILITY. OUT OF THE $200 MM PROJECT COST, $22 MM IS FOR POLLUTION CONTROL EQUIPMENT, AND $16 MM OF THAT IS FOR POWER PLANT WITH ITS RELATED POLLUTION CONTROL APPARATUS.

OPERATIONAL EXPERIENCE

THE FGD SYSTEM CONSISTS OF A COMBUSTION EQUIPMENT (CEA) SODA ASH SCRUBBING SYSTEM WHICH REMOVES FLY-ASH AND SULFUR DIOXIDE FROM THE FLUE GAS OF TWO COAL FIRED BOILERS. MAJOR CONSTRUCTION IS COMPLETE AND PRECOMMISSIONING ACTIVITIES ARE UNDERWAY. EXPECTED STARTUP DATE IS APRIL 1, 1978.

BACKGROUND INFORMATION

KERR-MCGEE CHEMICAL CORP. TRONA, CALIFORNIA

KERR-MCGEE CHEMICAL CORP. HAS A NEW 1.3 MM TON/YR SODA ASH PLANT AT TRONA, CALIFORNIA. THE PLANT LOCATED ALONG THE SHORE OF SEARLES LAKE, IS THE LARGEST YET BUILT TO YIELD SODA ASH BY DIRECT CARBONATION OF BRINE AND IS EXPECTED TO ONSTREAM BY APRIL, 1978. THE PROCESSING INNOVATIONS, WHICH HAVE IMPROVED THE PLANT EFFICIENCY, INCLUDE CARBONATION UNDER 13.5 LB/SQ. IN. PRESSURE, USE OF A COAL-FIRED POWER PLANT, AND RECOVERY OF CO2 FROM THE FLUE GASES.

THE PLANT HAS TWO BOILERS, EACH RATED AT 32 MW, WHICH PRODUCE PROCESS STEAM AND ELECTRICITY. EACH BOILER PRODUCES 600,000 LBS/HR OF STEAM AT 1500 PSI AND BURNS A MIXTURE OF WESTERN COAL (0.7 PERCENT SULFUR) AND PETROLEUM COKE (1.5 PERCENT SULFUR). THE HIGH SULFUR COKE IS MIXED WITH THE COAL IN ORDER TO IMPROVE THE PARTICAL IONIZATION AND IN TURN FLY-ASH COLLECTION IN THE ESP WHICH OPERATES ON THE COLD SIDE OF THE PREHEATER AT 98.5 PERCENT EFFICIENCY AND 300 F. THE FLUE GAS FLOW RATE FROM EACH BOILER IS 363,000 ACFM AT 320 F AND MAY CONTAIN SO2 BETWEEN 335 TO 5985 PPM DEPENDING UPON THE FUEL. THE AIR POLLUTION REGULATIONS DICTATE THAT EACH BOILER MAY RELEASE NOT MORE THAN 10 LBS/HR PARTICULATE, 200 LBS/HR OF SO2 AND 140 LBS/HR OF NOX.

THE FLUE GASES ARE SCRUBBED BY THE END LIQUOR FROM THE SODA ASH PLANT IN TWO SCRUBBERS (30 FT DIA X 35 FT HIGH EACH) WHICH ARE MILD STEEL VESSELS WITH FLAKE LINING AND POLYPROPYLENE SIEVE TRAYS. THE TOP TRAY RECEIVES PLAIN WATER WHEREAS THE SECOND TRAY RECEIVES THE RECIRCULATING LIQUOR AT PH OF 6 - 6.5. THE SPENT LIQUOR FROM THE BOTTOM OF THE SCRUBBERS IS RECIRCULATED BY RUBBER LINED PUMPS TO A MILD STEEL SURGE TANK WHERE FRESH END-LIQUOR IS ADDED TO IT WITHOUT AGITATION. A BLEED OFF STREAM IS CONTINUOUSLY TAKEN BACK TO THE SALT PONDS.

THE BOILER I.D. FANS (1600 HP.) FORCE THE GASES THROUGH THE SCRUBBERS AND EXPERIENCE 6 IN. WG PRESSURE DROP. THE FANS HAVE MILD STEEL CASING. THE DOWNSTREAM DUCTWORK IS MILD STEEL WITH FLAKE

LINING WHEREAS THE STACK IS CONCRETE WITH FRP LINER. AMBIENT AIR IS HEATED IN AN EXTERNAL STEAM HEATER AND MIXED WITH THE EXIT FLUE GASES TO INCREASE THE TEMPERATURE FROM 125 F TO ABOUT 175 F. AT MAXIMUM LOADING, THE SCRUBBERS HAVE A SO_2 REMOVAL EFFICIENCY OF 98 PERCENT. THE SCRUBBED FLUE GASES WILL BE PROCESSED THROUGH TWO MONOETHANOLAMINE (MEA) PLANTS FOR EXTRACTION OF CO_2. EACH PLANT WILL PRODUCE 300 TONS/DAY OF CO_2 AND WILL BE THE MAIN SOURCE OF MAKEUP CO_2 IN THE CARBONATION PLANT.

COMMENTS

1ST QUARTER-1978 THE MAJOR CONSTRUCTION WORK IS OVER. PRECOMMISSIONING ACTIVITIES ARE UNDERWAY. THE PLANT IS EXPECTED TO GO ONSTREAM BY APRIL 1, 1978.

SECTION 13 - DESIGN INFORMATION FOR UNDER CONSTRUCTION FGD SYSTEMS

INSTALLATION NAME	ST. JOE MINERALS CORP.
INSTALLATION LOCATION	MONACA, PENNSYLVANIA
SOURCE CHARACTERISTICS	COAL (3.0% SULFUR, 11000 BTU/LB)
SOURCE RATING	150,000 ACFM
SOURCE CAPACITY	50 MW (DESIGN CAPACITY-ACTUAL ELECTRICAL POWER GENERATION)
CONTROL SYSTEM VENDOR	BUREAU OF MINES
CONTROL PROCESS	CITRATE PROCESS
NEW / RETROFIT	RETROFIT
START-UP DATE	OCTOBER, 1978
CONTROL SYSTEM STATUS	CONSTRUCTION
SO2 EFFICIENCY	
SLUDGE OR BY-PRODUCT DISPOSAL	REGENERABLE - ELEMENTAL SULFUR PRODUCT
CONTROL SYSTEM COST	
CAPITAL	$ 12.700 MILLION
OPERATIONAL EXPERIENCE	CONSTRUCTION CONTINUES ON THE CITRATE PROCESS SCRUBBING SYSTEM WHICH WILL CONTROL SO2 EMISSIONS FROM A 60-MW COAL-FIRED POWER GENERATING UNIT AT ST. JOE MINERALS. START-UP IS SCHEDULED FOR OCTOBER 1978. THE REGENERABLE FGD SYSTEM WILL PRODUCE ELEMENTAL SULFUR AS A BY-PRODUCT.

BACKGROUND INFORMATION

ST. JOE MINERALS - MONACA, PENNSYLVANIA

IN THE SUMMER OF 1977, CONSTRUCTION BEGAN AT MONACA, PA. ON A CITRATE PROCESS (BUREAU OF MINES) FGD SYSTEM FOR ONE OF THE TWO 60-MEGAWATT BOILERS OF THE GEORGE F. WEATON POWERPLANT USED BY ST. JOE MINERALS CORP. TO GENERATE ELECTRICITY FOR A ZINC SMELTER. IT IS THE FIRST SMALL COMMERCIAL SIZE EXPERIMENTAL CITRATE CONTROL SYSTEM BEING BUILT FOR SCRUBBING SULFUR DIOXIDE OUT OF COAL-FIRED POWERPLANT STACK GAS.

UNDER A $12.7 MILLION COST-SHARING AGREEMENT BETWEEN THE BUREAU AND ST. JOE, COSTS FOR TESTING THE CITRATE PROCESS FOR A FULL YEAR ARE BEING SHARED ABOUT 50-50. THE CITRATE PROCESS WAS DEVELOPED BY THE BUREAU IN THE 1960'S TO HELP CURB SULFUR DIOXIDE EMISSIONS FROM BASE METAL SMELTERS.

THE CITRATE PROCESS DERIVES ITS NAME FROM THE WATER SOLUTION OF SODIUM CITRATE AND CITRIC ACID USED TO ABSORB SO_2 CONTAINED IN THE FLUE GAS. ADDING HYDROGEN SULFIDE TO THE CITRATE-SO_2 SOLUTION PRECIPITATES SOLID ELEMENTAL SULFUR, WHICH IS EASY TO SHIP AND CAN BE SOLD TO HELP OFFSET COSTS, OR STORED WITHOUT CAUSING DETRIMENTAL EFFECTS ON THE ENVIRONMENT.

SECTION 14 - DESIGN INFORMATION FOR PLANNED FGD SYSTEMS

INSTALLATION NAME	ARCO/POLYMERS
INSTALLATION LOCATION	MONACA, PENNSYLVANIA
SOURCE CHARACTERISTICS	COAL (3.5% SULFUR)
SOURCE RATING	300,000 SCFM @ 70 F (TOTAL - 3 BOILERS) 900,000 LB/HR STEAM @ 700 PSIG AND 700 F
SOURCE CAPACITY	100 MW (EQUIVALENT)
CONTROL SYSTEM VENDOR	NOT SELECTED
CONTROL PROCESS	NOT SELECTED
NEW / RETROFIT	RETROFIT
START-UP DATE	DECEMBER, 1980
CONTROL SYSTEM STATUS	PLANNED-REQUESTING/EVALUATING BIDS
SO2 EFFICIENCY	90% (2,300 PPM @ INLET)
SLUDGE OR BY-PRODUCT DISPOSAL	IF A REGENERABLE PROCESS IS CHOSEN, PLANS ARE TO PRODUCE LIQUID SO2. IF DOUBLE ALKALI, A DEWATERED CASO4 LANDFILL FILTER CAKE WILL BE PRODUCED.
OPERATIONAL EXPERIENCE	ARCO POLYMERS IS PLANNING TO PURCHASE A FGD SYSTEM FOR THE FLUE GASES FROM THEIR THREE IDENTICAL BOILERS (EACH 300,000 LBS/HR STEAM AT 700 PSIG & 700 F). WHILE OTHER PROCESSES ARE REPORTEDLY BEING CONSIDERED, THE TWO PRIMARY FGD PROCESS CANDIDATES ARE THE WELLMAN-LORD PROCESS AND THE FMC DOUBLE ALKALI PROCESS. A FINAL DECISION ON AWARD OF CONTRACT IS EXPECTED IN MAY 1978.

SECTION 14 - DESIGN INFORMATION FOR PLANNED FGD SYSTEMS

INSTALLATION NAME	CARBORUNDUM ABRASIVES
INSTALLATION LOCATION	BUFFALO, NEW YORK
SOURCE CHARACTERISTICS	COAL (2% S AVERAGE, 3.2% S DESIGN MAX)
SOURCE RATING	38,000 ACFM @ 350 F 80,000 - 85,000 LBS/HR STEAM (PROCESS AND HEATING STEAM)
SOURCE CAPACITY	10 MW (EQUIVALENT)
CONTROL SYSTEM VENDOR	CARBORUNDUM ENVIR. SYS. LTD.
CONTROL PROCESS	LIME SCRUBBING
NEW / RETROFIT	RETROFIT
START-UP DATE	
CONTROL SYSTEM STATUS	PLANNED-CONTRACT AWARDED
SO2 EFFICIENCY	92%
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT AND DISCHARGE TO CITY SEWER
OPERATIONAL EXPERIENCE	NO DEFINITE PLANS HAVE BEEN MADE FOR THE CONTROL OF SO2 EMISSIONS FROM THIS BOILER. THE FUTURE OF THE CONTROL SYSTEM WILL BE DETERMINED BY A REGULATORY AGENCY DECISION EXPECTED NEAR THE END OF 1978. THE CURRENTLY OPERATING VENTURI (L/G = 10) CONTROLS ONLY PARTICULATE, BUT TIE-INS HAVE BEEN PROVIDED FOR A LIME SCRUBBING SYSTEM USING A 6-STAGE SPRAY TOWER FOR SO2 CONTROL.

SECTION 14 - DESIGN INFORMATION FOR PLANNED FGD SYSTEMS

INSTALLATION NAME	CHEVRON OIL COMPANY
INSTALLATION LOCATION	BAKERSFIELD, CALIFORNIA
SOURCE CHARACTERISTICS	OIL (1.5% SULFUR)
SOURCE RATING	450,000 ACFM @ 500 F (TOTAL-18 BOILERS) THERE WILL BE THREE ABSORBERS,EACH HANDLING FLUE GAS FROM SIX STEAM GENERATORS
CONTROL SYSTEM VENDOR	KOCH ENGINEERING
CONTROL PROCESS	SODIUM SCRUBBING
NEW / RETROFIT	RETROFIT
START-UP DATE	JULY, 1978
CONTROL SYSTEM STATUS	PLANNED-CONTRACT AWARDED
SO2 EFFICIENCY	90%
SLUDGE OR BY-PRODUCT DISPOSAL	
OPERATIONAL EXPERIENCE	CHEVRON IS AWAITING A REGULATORY BOARD DECISION AS TO WHETHER THE ERECTION OF THESE PROPOSED STEAM GENERATORS AND ACCOMPANYING FGD SYSTEMS WILL BE APPROVED. IF CHEVRON RECEIVES A GO-AHEAD FROM THE REGULATORY BOARD, THE COMPANY PLANS TO USE PROPRIETARY SCRUBBING STRATEGY IN MODULES FABRICATED BY KOCH ENGINEERING.

SECTION 15 - DESCRIPTION OF FGD SYSTEMS NOT OPERATING OR TERMINATED

INSTALLATION NAME	GREAT WESTERN SUGAR
INSTALLATION LOCATION	LONGMONT, COLORADO
SOURCE CHARACTERISTICS	COAL (0.7% SULFUR)
SOURCE RATING	
CONTROL SYSTEM VENDOR	GREAT WESTERN SUGAR
CONTROL PROCESS	AMMONIA-LADEN PROCESS WATER
NEW / RETROFIT	RETROFIT
START-UP DATE	OCTOBER, 1973
CONTROL SYSTEM STATUS	TERMINATED OR INDEFINITELY SHUT DOWN
SO2 EFFICIENCY	35% (300-400 PPM @ INLET)
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT AND DISCHARGE TO RIVER
OPERATIONAL EXPERIENCE	SUGAR PRODUCTION AND ALL PLANT OPERATIONS HAVE BEEN TERMINATED AT THE LONGMONT PLANT.

SECTION 15 - DESCRIPTION OF FGD SYSTEMS NOT OPERATING OR TERMINATED

INSTALLATION NAME	HARRIS MINING CO.
INSTALLATION LOCATION	SPRUCE PINE, NORTH CAROLINA
SOURCE CHARACTERISTICS	COAL (0.8% SULFUR, 5% ASH)
SOURCE RATING	
SOURCE CAPACITY	2 MW (EQUIVALENT)
CONTROL SYSTEM VENDOR	W.W. SLY MANUFACTURING CO.
CONTROL PROCESS	WATER SCRUBBING (NA,NH3 OPTN.)
NEW / RETROFIT	RETROFIT
START-UP DATE	1973
CONTROL SYSTEM STATUS	TERMINATED OR INDEFINITELY SHUT DOWN
SO2 EFFICIENCY	
PARTICULATE EFFICIENCY	96%
SLUDGE OR BY-PRODUCT DISPOSAL	
CONTROL SYSTEM COST	
CAPITAL	$ 15,000.
	CAPITAL COST INCLUDES INSTALLATION COST.
OPERATIONAL EXPERIENCE	THE FGD SYSTEM CONSISTS OF A W.W. SLY IMPINJET SCRUBBER CURRENTLY BEING USED STRICTLY AS A PARTICULATE CONTROL DEVICE. THE SYSTEM HAS THE CAPABILITY OF SCRUBBING WITH AMMONIA OR CAUSTIC IF NECESSARY. HOWEVER, AS LONG AS CURRENT LOW-SULFUR COAL SUPPLIES LAST, THERE IS NO NEED FOR SO2 CONTROLS.

BACKGROUND INFORMATION

HARRIS MINING SPRUCE PINE, N.C.

THE FGD SYSTEM AT THE HARRIS MINING COMPANY LOCATED AT SPRUCE PINE, NORTH CAROLINA REMOVES FLY-ASH AND SULFUR DIOXIDE FROM THE FLUE GAS OF A COAL FIRED BOILER. THE SCRUBBER IS A W.W. SLY IMPINGENT TYPE SCRUBBER CONSTRUCTED OF 304 STAINLESS STEEL. THE BOILER IS RATED 1.9 MW (EQUIVALENT 200 BOILER HORSEPOWER). COAL COMPOSITION IS TYPICALLY 0.8% SULFUR AND 5% ASH. PRIMARY INTEREST IN FLUE GAS SCRUBBING IS IN FLYASH REMOVAL AND NO TESTS FOR SULFUR DIOXIDE REMOVAL EFFICIENCY HAVE BEEN MADE.

COMMENTS

2ND QUARTER-1977 NO OPERATIONAL PROBLEMS HAVE BEEN REPORTED.

1ST QUARTER-1978 THIS PLANT HAS BEEN MOVED TO THE INACTIVE SYSTEMS FILE UNTIL SUCH TIME AS ACTUAL FGD OPERATIONS BEGIN. THE SCRUBBER IS EQUIPPED WITH ALKALI ADDITION CAPABILITY, BUT WITH THE LOW SULFUR COAL CURRENTLY BEING FIRED, NO ALKALI ADDITION OR PH CONTROL IS OCCURRING.

SECTION 15 - DESCRIPTION OF FGD SYSTEMS NOT OPERATING OR TERMINATED

INSTALLATION NAME	QUALITY MILLS, INC.
INSTALLATION LOCATION	MT. AIRY, NORTH CAROLINA
SOURCE CHARACTERISTICS	FUEL OIL
SOURCE RATING	
SOURCE CAPACITY	5 MW (EQUIVALENT)* TOTAL - THREE BOILERS 52,000 LB/HR STEAM
CONTROL SYSTEM VENDOR	COMMERCIAL FABRICATION & MACH.
CONTROL PROCESS	WATER SCRUBBING
NEW / RETROFIT	RETROFIT
START-UP DATE	MAY, 1970
CONTROL SYSTEM STATUS	TERMINATED OR INDEFINITELY SHUT DOWN
SO2 EFFICIENCY	47% (600-800 PPM @ INLET)
PARTICULATE EFFICIENCY	80%-95% (0.05-0.16 GRAIN/SCF @ INLET)
WATER MAKE-UP	40 GPM* OPEN LOOP
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT AND DISCHARGE TO CITY SEWER SCRUBBING LIQUOR DISCHARGED TO NEUTRALIZATION POND
CONTROL SYSTEM COST	
CAPITAL	$ 18,000.
OPERATIONAL EXPERIENCE	THIS SMALL INDUSTRIAL BOILER UTILIZED A COMMERICAL FABRICATION AND MACHINE (CFM) SCRUB-AIR SYSTEM TO CONTROL EMISSIONS FROM THE COAL-FIRED BOILER FROM MAY 1970 TO DECEMBER 1973. AT THAT TIME THEY CONVERTED TO FIRING LOW-SULFUR OIL, REMOVING THE NEED TO CONTROL EMISSIONS.

SECTION 15 - DESCRIPTION OF FGD SYSTEMS NOT OPERATING OR TERMINATED

INSTALLATION NAME	TRANSCO TEXTILES, INC.
INSTALLATION LOCATION	AUGUSTA, GEORGIA
SOURCE CHARACTERISTICS	FUEL OIL (2% MAX. SULFUR)
SOURCE RATING	50,000 ACFM
SOURCE CAPACITY	20 MW
CONTROL SYSTEM VENDOR	FMC ENVIRONMENTAL EQUIPMENT
CONTROL PROCESS	SODIUM SCRUBBING
NEW / RETROFIT	NEW
START-UP DATE	MARCH, 1975
CONTROL SYSTEM STATUS	TERMINATED OR INDEFINITELY SHUT DOWN
SO2 EFFICIENCY	80%-85% (610 LB/HR @ INLET)
WATER MAKE-UP	48 GPM* OPEN LOOP
SLUDGE OR BY-PRODUCT DISPOSAL	WASTEWATER TREATMENT AND DISCHARGE TO RIVER NA2SO3/SO4 LIQUOR DISCHARGED TO A HOLDING POND

OPERATIONAL EXPERIENCE

THE FGD OPERATIONS HAVE BEEN TERMINATED FOR AN INDEFINITE PERIOD. THE PLANT BURNS NUMBER 6 FUEL OIL AND THE SULFUR DIOXIDE EMISSIONS ARE 50% OF THE EXISTING REGULATIONS. THE BOILER IS RATED AT 20 MW (EQUIVALENT) AND PRODUCES 150,000 LBS/HR STEAM. WHEN OPERATIONAL, THE SCRUBBER SYSTEM HAD FLUE GAS VOLUME OF 50,000 ACFM AT 140 DEGREES F. SYSTEM START-UP OCCURRED IN MARCH 1975 AND SCRUBBER OPERATIONS WERE TERMINATED LATER IN THE SAME YEAR. A DEC. 1977 CHECK REVEALS THAT THE FGD SYSTEM IS STILL TERMINATED AND THERE ARE CURRENTLY NO PLANS TO INITIATE OPERATIONS.

SECTION 15 - DESCRIPTION OF FGD SYSTEMS NOT OPERATING OR TERMINATED

INSTALLATION NAME	U.S. GYPSUM CORP.
INSTALLATION LOCATION	OAKMONT, PENNSYLVANIA
SOURCE CHARACTERISTICS	COAL
SOURCE RATING	
SOURCE CAPACITY	19,300 SCFM (TOTAL - 4 BOILERS)
CONTROL SYSTEM VENDOR	AIRPOL INDUSTRIES
CONTROL PROCESS	DOUBLE ALKALI (DILUTE)
NEW / RETROFIT	NEW
START-UP DATE	
CONTROL SYSTEM STATUS	TERMINATED OR INDEFINITELY SHUT DOWN
SO2 EFFICIENCY	MEETS CODE
PARTICULATE EFFICIENCY	MEETS CODE
WATER MAKE-UP	10 GPM* CLOSED LOOP
SLUDGE OR BY-PRODUCT DISPOSAL	DEWATERED SLURRY TO LANDFILL SLUDGE TO POND FOR DRYING, THEN TO LANDFILL.
OPERATIONAL EXPERIENCE	AN AIRPOL DOUBLE ALKALI SCRUBBING SYSTEM IS ON-SITE, INSTALLED, AND READY FOR OPERATIONS. HOWEVER, US GYPSUM DECIDED NOT TO INITIATE PRODUCTION AT THIS FACILITY. A DEC. 1977 CHECK REVEALED THAT THE SITUATION IS UNCHANGED, I.E., THE STEAM PLANT WAS NEVER STARTED.

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-600/7-78-052a	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE EPA Industrial Boiler FGD Survey: First Quarter 1978		5. REPORT DATE March 1978
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) J. Tuttle, A. Patkar, and N. Gregory		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS PEDCo Environmental Inc. 11499 Chester Road Cincinnati, Ohio 45246		10. PROGRAM ELEMENT NO. EHE624
		11. CONTRACT/GRANT NO. 68-02-2603, Task 4
12. SPONSORING AGENCY NAME AND ADDRESS EPA, Office of Research and Development Industrial Environmental Research Laboratory Research Triangle Park, NC 27711		13. TYPE OF REPORT AND PERIOD COVERED Periodic; 4/77-3/78
		14. SPONSORING AGENCY CODE EPA/600/13

15. SUPPLEMENTARY NOTES IERL-RTP project officer is J. David Mobley, Mail Drop 61, 919/541-2915.

16. ABSTRACT The report presents detailed technical information concerning application of flue gas desulfurization (FGD) systems to industrial boilers. The information was obtained by a survey of plant personnel, control system vendors, regulatory agencies, and consulting engineering firms. The data is given in two types of tables: one gives summary information; the other, detailed information. Summary tables present information as a function of control process, control system vendor, disposal techniques, operation status, start-up date, and flue gas capacity. Detailed information includes: control system design, economics, operating experience, problems and solutions, waste disposal techniques, and maintenance practices.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Pollution	Pollution Control	13B
Flue Gases	Stationary Sources	21B
Desulfurization	Industrial Boilers	07A,07D
Boilers		13A
Waste Disposal		15E
Maintenance		

18. DISTRIBUTION STATEMENT Unlimited	19. SECURITY CLASS *(This Report)* Unclassified	21. NO. OF PAGES 157
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE

EPA Form 2220-1 (9-73)