Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

AP42 Section:	11.3
Reference:	26
Title:	BIA HF Research Program Stack Testing Results (and Individual Stack Test Data Sheets), Center for Engineering Ceramic Manufacturing, Clemson University, Anderson, SC, November, 1995.

AP-42 Section 11.3
Reference 26
Report Sect. 4
Reference 23

Center For Engineering Ceramic Manufacturing
Clemson University
100 Clemson Research Blvd.
Anderson, SC 29625 USA

Research Report

Title: BIA HF Research Program Stack Testing Results

Date: November, 1995

Executive Summary

Stack tests were conducted by the Center during 1994 and 1995 as one Task of the BIA Funded "Hydrogen Fluoride Research Program". Tests were run by Center personnel subsequent to training which included EPA's stack testing training programs. Hydrogen fluoride, SOx, and particulate matter were determined by EPA Methods 26A, 8, and 2 respectively. Analytical work on capture solutions was by Armstrong Environmental.

The average emission of HF from gas kilns was 0.38 lb/ton (4 plants), and the average SOx emission was 0.28 lb/ton (1 plant). The stack particulate matter (PM) in one test was 0.17 lb/ton for a gas fired plant with sawdust added to the body.

Denis A. Brosnan, PE
SC Registration No. 13888

Table 1: Center Stack Test Data

Plant (fuel)	Date	Run	% Isokinetic	HF lb/hr.	Rate tons/hr.	HF Emission Factor lb/ton	Other Data Species	lb/hr.	lb/t
Boral #5	11/8/95	Avg.	NA	16.7	19.71	0.847	PM	3.38	0.17
Augusta, GA									
(gas/saw dust in body)									
Boral (Formerly Bickerstaff)		1	NA	3.293	12.848	0.256	SOx	3.765	0.293
Phenix City		2	NA	3.490	12.848	0.272	SOx	3.485	0.271
(gas)		3	NA	1.959	12.848	0.152	SOx	3.394	0.264
Average						0.227			0.276
Boral (Formerly Isenhour)		1	NA	6.54	22.8	0.287			
Salisbury, NC		2	NA	6.78	22.8	0.297			
(sawdust)		3	NA	6.01	22.8	0.264			
Average						0.283			
Endicott		1	NA	1.34	5.92	0.226			
Fairbury, Nebraska		2	NA	1.44	5.92	0.243			
Average						0.234			
Redlands (KF)	10/12/93	1	NA	7.60	10.94	0.695			
E. Windsor Hill, CT		2	NA	6.19	10.94	0.566			
(gas)		3	NA	6.85	10.94	0.626			
Average						0.629			
Richtex #4	12/20/94	2	96.7	4.58	11.27	0.406			
Columbia, SC									
(gas)		3	94.9	5.41	11.27	0.480			
Richtex #4 (Test Series 2)		1	NA	4.76	11.27	0.422			
(gas)		2	NA	5.46	11.27	0.484			
		3	NA	4.62	11.27	0.410			
Average Richtex #4						0.430 ← incorrect			
Richtex #2		1	NA	1.95	11.05	0.176			
(coal)		2	NA	2.18	11.05	0.197			
		3	NA	2.43	11.05	0.220			
Average						0.198			
Richtex #4	12/19/94	1	94.3	2.69*	11.27	0.239			
(gas)		3	97.2	2.56*	11.27	0.227			

Avg for 5 runs = 0.4404
3 runs = 0.439

* Special Test
To Reduce HF

Appendix

Recommended Practice For Brick Industry Compliance Monitoring Using Mass Balance Techniques

September, 1995

I. Introduction

The purpose of this "Recommended Practice" is to provide a method for the brick industry to establish air emissions levels and demonstrate compliance with state or federal emissions criteria including permitted emissions levels. The method explained herein is intended for use in determining emissions of hydrogen fluoride (HF) or sulfur oxides ("SO_X") in brick manufacturing. Trace quantities of HF are found in stack gases from kilns used in brick manufacturing due to the isomorphous substitution of trace quantities of fluorine atoms for hydroxyl radicals in clay crystals which are liberated on dehydroxylation or breakdown of clay crystals as the brick are exposed to temperatures in the general area of ~930 - 1800°F during the firing process in the kiln. Sulfur emissions can arise from decomposition of sulfate compounds or other sulfur sources in the raw material during heating in the kiln or from combustion of fuels.

The method has been developed by Clemson University in response to a two year study funded by the Brick Institute of America during the time period of December, 1992, through the present. The study has included (1) development of the mass balance method including the "pyrohydrolysis test" to determine fluorine content of raw materials and fired brick, (2) correlation activities between mass balance estimates and stack tests using EPA stack testing methods, and (3) development of novel chemical additions to reduce emissions by retaining certain acid gas forming species in the fired brick product. More information on methods is available in the "References" given below.

Mass balance, i.e. net fluorine/sulfur loss as the difference between fluorine/sulfur content of dried and fired brick, represents an economical and reliable method of emissions determination. It is a method used in Germany under the "TA-Luft" German Federal Regulations for Air Emissions.

This Recommended Practice includes (1) an initial production test and (2) methods for continued compliance monitoring. Recognizing the fact that brick plants typically use between two and eight raw materials, the Practice provides for actual testing on the number of brick mixes (i.e. discrete products, brands, or codes) representing the largest 25% of the plants production. Emissions for the remaining production are calculated from the fluorine content of the raw materials used in the mix. Further details and statistical sampling methods are elucidated in the Practice.

II. Test Methods

1. Prior to Initial Production Test

Purpose: Establish ranges expected by testing one specimen of each raw material and by determining mass balance on one specimen each of all products included in the top 25% of the plant's production volume.

Raw materials: One sample is to be provided each for total sulfur and HF both by mass balance. The sample is to be provided by running a quantity of that raw material through the plant grinding system so as to achieve a homogenized specimen. The minimum quantity to be run through the grinding system will be 10% of the hourly capacity of the grinding system (i.e. 25 ton sample if the capacity is 250 tons/hr.). The output of the grinding system will be placed in a sample pile which is to be rendered level to a depth of approximately 24" using mobile equipment. Two clean 5 gallon plastic pails will be filled by shoveling prepared raw material from the center of the leveled sample pile. One pail is to be provided to each test vendor for fluorine content or sulfur content tests. The vendor will use standard sample reduction techniques to obtain an appropriately sized specimen from the material in the plastic pail.
(Suggested vendors: Clemson University for fluorine content; Mission Clay or McCreath for Total Sulfur)

Dried/fired product: One specimen each is to be provided for products included in the top 25% of production volume. Each specimen will be based on one dried brick sample split in half with one half fired in a top set position with the dried companion saved for testing. If both fluorine and sulfur mass balance tests are desired, the dried and fired companion samples will be further divided in half so as to provide companion samples of dried and fired product for both determinations. Companion samples are to be sent to Clemson University for mass balance for potential HF emissions. The manufacturer will obtain total sulfur using a vendor of their selection.

Time Period: It is anticipated that this test period may involve at least one month after receipt of specimens by the vendors.

2. Initial Production Test

Purpose: Establish initial emissions levels and provide for a correlation between single top set fired samples and a statistically designed whole car experiment. Note that single top set specimens will be used in continued compliance monitoring. An optional purpose of this test is to provide a correlation between the mass balance and stack tests if it is deemed appropriate by the following criteria:

(1) No stack testing data is available from the last 10 years of operation of this plant.
(2) The raw materials used in the plant have changed by mining location or in geologic character so as to suggest that prior stack testing data is inappropriate for current use.
(3) The kiln(s) used in the plant have been substantially altered or replaced since the last stack test was obtained.

The manufacturer will be required to certify that a stack test is required or is inappropriate based on the three criteria given above.

Test Criteria: The manufacturer will schedule a production test for each of the products included in the top 25% of production volume. A statistically designed test matrix for sampling one kiln car will be provided with companion mass balance samples drawn from side to side and top to bottom of the setting. The sampling scheme will be arranged as followed:

(1) The number of samples will be computed using 95% confidence limits for test data based on the "Student's t-Test" as determined by using the test vendor's standard deviation for the test method being employed. The minimum number of companion samples for either fluorine or sulfur tests will be three.

(2) A grid will be made of a kiln car profile from top to bottom and side to side with numbers assigned to each grid position. Sample positions will be selected based on use of a random number table. The manufacturer will be allowed to manually obtain the dried companion sample from the automatically set car subsequent to drying. The manufacturer will side track the test car after firing and manually remove the fired companion samples. The sampling will include at least one top set specimen. The companion samples will be further divided in half, if necessary, in the event that both fluorine and sulfur tests are to be obtained. Each sample pair will be sent to the test vendor. **As an alternative to use of a statistically designed test matrix for sampling one car, the manufacturer will be allowed to select samples by an experienced person with knowledge of a particular kiln's variations and their effect on product properties such as cold water absorption.**

Time Period: It is anticipated that this test period may involve at least one month after receipt of specimens from the vendors.

3. Continued Compliance Monitoring

Purpose: Establish compliance during the initial year and subsequent years.

Test Criteria: For a period of one year, the manufacturer will obtain one sample of companion dried and fired product (the latter from a top set position) per quarter for the products made in that quarter which are included in the top 25% of production volume. Fluorine and sulfur emissions will be determined by the mass balance method by the appropriate test vendors.

Emissions Calculation:

A. The emissions calculation for any singular product will be made as follows:

Emissions (lb/ton) = Mass Balance Data (lb/ton) X Factor 1 X Factor 2

where:

Factor 1 = correlation factor between top set brick and whole car average emissions.

Factor 2 = correlation factor between mass balance determination and stack test.

B. For products falling outside the category of the top 25% of production volume, the emissions will be estimated using the data for each raw material in the mix for that product in the following manner:

Emissions (lb/ton) = Content in Mix X Average Loss Factor X Factor 1 X Factor 2

where:

Content in mix = content of fluorine or sulfur estimated from the fraction of raw material in each mix times the content (fraction) of the species of interest in that raw material and expressed as lb/ton of production volume.

Average Loss Factor = Fraction of fluorine or sulfur species lost in firing in a particular plant calculated from the loss by mass balance for that species for each of the products included in the top 25% of production volume expressed as a numerical average times 100.

Factors 1 and 2 = as defined above.

Note: Data for fluorine or sulfur on any raw material or dried product is to be converted to a fired weight bases before use in any mass balance calculation or use as "Content in Mix" as defined above. The conversion is made as follows:

$$\text{S or F (weight percent, fired weight basis)} = \frac{\text{S or F Content (dried weight basis)}}{[1 - (\text{Loss On Ignition} \times 100)]}$$

Loss On Ignition is defined as the percentage of weight loss on exposure of a dried specimen of raw material or formed product fired to 1832°F until a constant weight is achieved.

C. The total emissions for any time period will be calculated from the emission factors for each product as determined above as multiplied by the production volume for each product and expressed as a sum for a particular species that was emitted.

Subsequent Test Years: Testing schedules beyond year one of compliance testing will be determined based on results of the initial year's activity.

4. References/Reference Methods

"Hydrogen Fluoride Emissions In Ceramic Manufacturing," Denis A. Brosnan and John P. Sanders, Journal of the Canadian Ceramic Society, 63 (4) 4-9 (1994).

"Monitoring For Hydrogen Fluoride Emissions In Ceramic Manufacturing," Ceramic Industry Magazine, 143 (1) 38 - 40 (1994).

"Technology and Regulatory Consequences of Fluorine Emissions In Ceramic Manufacturing," American Ceramic Society Bulletin, 71 (12) 1798-1802 (1992).

"Correlation of Laboratory Measurements and Field Measurements of Fluoride Emission In Ceramic Manufacturing," John Sanders and Denis A. Brosnan, The American Ceramic Society Annual Meeting, Indianapolis, Paper S-8-94, April 27, 1994.

Brick Institute of America THE NATIONAL AUTHORITY ON BRICK CONSTRUCTION

April 11, 1996

Mr. Ron Meyers
U.S. Environmental Protection Agency
Office of Air Qualilty Planning and Standards
Emission Factor and Inventory Group
Research Triangle Park, NC 27711

Dear Ron:

Enclosed are the stack test results conducted by the Center for Engineering Ceramic Manufacturing at Clemson University during 1994 and 1995 at 8 brick plants. You may contact Dr. Denis Brosnan directly if you have any questions or want more specifics regarding these tests. We hope this information will be helpful in revising AP-42 for brick manufacturing.

On another matter, the brick industry would like to meet with you and James Crowder in Emission Standards. Ms. Susan Fairchild Zapata of Mr. Crowder's office visited a brick plant in North Carolina and mentioned that it might be appropriate to combine the cromium refractory industry with the clay brick industry for air emission regulatory purposes. We would like to discuss this matter and also the presumptive MACT process and its relevance, if any, to our industry.

11490 Commerce Park Drive, Reston, Virginia 22091-1525 Phone: 703-620-0010 Fax: 703-620-3928

Our representatives for such a meeting would be Walt Banyas of General Shale Products Corporation, Dr. Denis Brosnan of Clemson University and myself. We'd like to offer the following dates for a meeting at your offices:

1st choice	-	July 16
2nd choice	-	July 15
3rd choice	-	sometime the week of July 8-12

I'll call you next week to see if you can arrange to meet with us.

Very truly yours,

Nelson

Nelson J. Cooney
President

NJC:cb

Enclosure

copy to: Walt Banyas
Dr. Denis Brosnan

CLEMSON
UNIVERSITY

August 6, 1996

Mr. Ronald E. Meyers
Environmental Protection Agency
Technical Support Division
Office of Air Quality and Standards
79 T. W. Alexander Boulevard
4201 Building, MS-14
Research Triangle Park, NC 27711

Re: Preliminary Test Reports From The Brick Institute of America (BIA) Hydrogen Fluoride Research Program

Dear Ron:

Following our meeting at RTP on July 15, 1996, I have assembled Preliminary Test Reports for most of the sites where BIA has provided emissions data to you in the past. This data was obtained in a program where Clemson University students performed research and earned degrees. The stack test supervisor was Barry Ellis who completed EPA's stack testing school in California. Analytical work was performed by Armstrong Environmental of Dallas, TX.

I regret that I do not have complete information in some of the reports. These files have survived two office moves, and Mr. Ellis left our employment in 1994. In addition, data was not available in my files for tests at Richtex Corporation in 1994, conducted under the supervision of Mr. Warren Brown, who left our employment in 1995.

Thank you for the opportunity to assist EPA in efforts to improve emissions factor information for the brick industry.

With best regards,

Denis A. Brosnan

Denis A. Brosnan, Ph.D, PE
Professor and Director

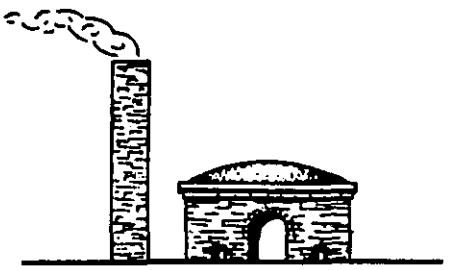
c: Mr. Walt Banyas, General Shale Products Corporation
Mr. Nelson Cooney, Brick Institute of America

/dab

CENTER FOR ENGINEERING CERAMIC MANUFACTURING
College of Engineering & Science 100 Clemson Blvd. · Anderson, SC 29625
864.656.1094 FAX 864.656.1095

Preliminary Stack Test Report

The Center For Engineering
Ceramic Manufacturing
Clemson University
Clemson, SC



Member:	Endicott Clay Products Fairbury, NE
Test Dates:	July 6-8, 1993
Tests Performed:	Method 13B
Test Supervisor:	Barry Ellis
Test Helper:	John Clayton
Analytical Contractor:	Armstrong Environmental

Note: Stack tests were performed as a part of the Hydrogen Fluoride Research Program sponsored by the Brick Institute of America. This research program involved Clemson University students in pursuit of undergraduate and Graduate degrees in Ceramic Engineering.

Endicott Clay Product
EPA Method 13B Result
(Total Fluorides)

Vm(std)	61.70538
Vwc =	4.42458
Vwsg(std	0.619551
Bws =	0.076804
Md =	28.968
Ms =	28.12561
AVG Vs =	56.97539
Qs =	1061930
Fl- ppmdv =	28.27664
PMR FL- lb/hr =	1.395133
Fl- tons/yr =	6.110682

Endicot method 13B

RUN 2

Vm(std)	81.66818	
Vwc =	5.6484	
Vwsg(std	0.777032	
Bws =	0.072939	
Md =	28.968	
Ms =	28.16801	
AVG Vs =	54.59708	
Qs =	1335438	
PMR =	0	lb/hr
PMR =	0	tons/yr
Fl- ppmdv =	219.4531	
PMR FL- lb/hr =	1.444954	
Fl- tons/yr =	6.328898	

Endicot method 13

RUN 1

Vm(std)	41.74257	
Vwc =	3.20076	
Vwsg(std	0.46207	
Bws =	0.080669	
Md =	28.968	
Ms =	28.08322	
AVG Vs =	59.3537	
Qs =	788421.6	
PMR =	0	lb/hr
PMR =	0	tons/yr
Fl- ppmdv =	346.0797	
PMR FL- lb/hr =	1.345312	
Fl- tons/yr =	5.892467	

Armstrong Environmental, Inc.

4747 Irving Boulevard, #204 • Dallas, Texas 75247 • (214) 631-0021 • FAX (214) 905-0634

July 30, 1993

College of Engineering
Center for Engineering Ceramic Manufacturing
B13 Olin Hall, Box 340908
Clemson University
Clemson, SC 29634-0908

Attn: Barry Ellis

Subject: Brick Kiln Exhaust Fluoride Analysis
Armstrong Environmental, Inc. Project W-1394-93

Dear Barry:

Analysis was performed on the samples sent from your facility following USEPA Method 13B for Fluorides. Results indicate the following:

Sample	Fl-, ug/ml	Total Fl-, mg
R13B Blank	0	--
E13B Blank	0.4	--
R13B Run 1	130	105.95
R13B Run 2	117	122.38
R13B Run 3	120	104.40
E13B Run 1	158	32.308
E13B Run 2&3	164	80.164

It was decided to run the samples through the IC to see what the concentrations really were. Results indicate the following:

Sample	F-	HF	Cl-	HCl	SO4	
	ug/ml	mg	ug/ml	mg	ug/ml	mg
R13B-1	160.1	136.48	9.71	6.57	ND	ND
R13B-2	121.8	134.16	10.67	9.21	32.66	34.17
R13B-3	158.98	145.59	11.27	8.41	26.98	23.47
E13B-1	249.9	53.87	76.73	15.79	160.9	32.98
E13B-2	254.1	130.89	50.68	24.62	162.4	79.60
R13B-Bl	0	--	1.87	--	0	--
E13B-Bl	0.3	--	1.81	--	0	--

The above were the only anions detected, although a small amount of nitrates was visible on the chromatogram, the peak too small to integrate.

We are pleased to have been of service to Clemson University.

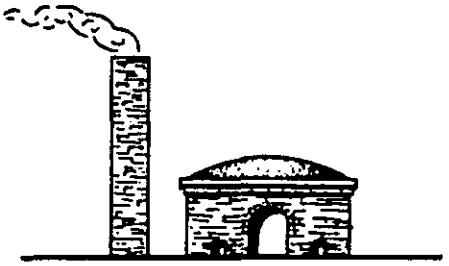
Submitted by:
Armstrong Environmental, Inc.

Tom Armstrong
President

TA/os

Preliminary Stack Test Report

The Center For Engineering
Ceramic Manufacturing
Clemson University
Clemson, SC



Member:	Boral Bricks, Inc. Isenhour Division Salisbury, NC
Test Dates:	July 6-8, 1993
Tests Performed:	Methods 5, 8, and 26
Test Supervisor:	Barry Ellis
Test Helper:	John Clayton
Analytical Contractor:	Armstrong Environmental

Note: Stack tests were performed as a part of the Hydrogen Fluoride Research Program sponsored by the Brick Institute of America. This research program involved Clemson University students in pursuit of undergraduate and Graduate degrees in Ceramic Engineering.

ISENHOUR

HYDROGEN FLUORIDE EMMISSIONS

SOURCE	RUN #	1	2	3	AVERAGE
E1	lb/hr	2.18128	2.520923	2.31276	2.338321
E2	lb/hr	1.013956		2.672959	1.843457
SD	lb/hr	2.510522	2.408865	1.851604	2.256997

AVERAGE lb/hr = 6.438775
tons/yr = 28.20184

HYDROGEN CHLORIDE EMMISSIONS

SOURCE	RUN #	1	2	3	AVERAGE
E1	lb/hr	0.605371	0.704477	0.59468	0.634843
E2	lb/hr	0.238239		0.840104	0.539172
SD	lb/hr	0.141652	0.115515	0.127738	0.128302

AVERAGE lb/hr = 1.302316
tons/yr = 5.704143

SULFUR EMMISSIONS (SO2 and SO3 COMBINED)

SOURCE	RUN #	1	2	3	AVERAGE
E1	lb/hr	3.547609	3.603798	3.573952	3.57512
E2	lb/hr	6.370995	6.31138	7.004926	6.562434
SD	lb/hr	3.752206	3.060849	3.316309	3.376455

AVERAGE lb/hr = 13.51401
tons/yr = 59.19136

*** NOTE ***
SO3 is considered to be ten percent (10%) of total sulfur emmissions.

PARTICULATE EMMISSIONS

SOURCE	RUN #	1	2	3	AVERAGE
E1	lb/hr	2.073392	3.317225	3.573952	2.98819
E2	lb/hr	3.963942	6.444239	4.532475	4.980219
SD	lb/hr	18.20771	16.82326	13.33171	16.12089

AVERAGE lb/hr = 24.0893

tons/yr = 105.5111

DEFINITION OF TERMS

Vm(std) = Standard Volume Metered

Vwc = H2O Collected in Impingers in Standard Cubic Feet

Vwsg(std) = H2O Collected in Silica Gel in Standard Cubic Feet

Bws = Moisture Content of Stack Gas

Md = Dry Molecular Weight of Stack Gas

Ms = Wet Molecular Weight of Stack Gas

AVG Vs = Average Stack Gas Velocity

dscf = Dry Standard Cubic Feet

Qs = Average Stack Gas Velocity (dscf/hr)

PMR = Pollutant Mass Rate

ppmdv = HF- Parts Per Million Dry Volume

FINAL RESULTS

Company: Isenhour

Method: 26

Location: E1

Date:

Run #	1	2	3	AVERAGE	S DEVIATI
Vm(std) =	31.68023	32.15732	31.7031	31.84688	0.219711
Vwc =	2.54178	2.066373	2.560608	2.389587	0.228676
Vwsg(std) =	0.363055	0.485645	0.46207	0.436923	0.053112
Bws =	0.083991	0.073525	0.087044	0.08152	0.005789
Md =	29.42	29.42	29.42	29.42	0
Ms =	28.46082	28.58034	28.42596	28.48904	0.06611
AVG Vs =	30.72188	35.57918	37.45407	34.58504	2.836876
Qs =	410918.1	479726.4	491476.2	460706.9	35531.27
PMR =	0	0	0	0	0
PMR =	0	0	0	0	0
Fl- ppmdv =	107.6633	106.5805	95.44203	103.2286	5.523647
PMR FL- lb/hr =	2.18128	2.520923	2.31276	2.338321	0.139832
Fl- tons/yr =	9.554004	11.04164	10.12989	10.24184	0.612463
Cl- ppmdv =	16.01153	15.96025	13.15066	15.04081	1.336702
Cl- lb/hr =	0.605371	0.704477	0.59468	0.634843	0.049432
Cl- tons/yr =	2.651524	3.085609	2.6047	2.780611	0.216512

Company: Isenhour
Method: 5-8
Location: E1
Date: 11/30/93

Run #	1	2	3	AVERAGE	S DEVIATI
Vm(std) =	33.98628	39.09825	40.59953	37.89468	2.830803
Vwc =	2.54178	2.066373	2.560608	2.389587	0.228676
Vwsg(std)	0.363065	0.485645	0.46207	0.436927	0.053107
Bws =	0.083991	0.073525	0.087044	0.08152	0.005789
Md =	29.42	29.42	29.42	29.42	0
Ms =	28.46082	28.58034	28.42596	28.48904	0.06611
AVG Vs =	30.53457	35.6388	37.44871	34.54069	2.927535
Qs =	413064.4	479042.7	491536.1	461214.4	34427.08
PMR =	2.073392	2.358023	4.214902	2.882106	0.949566
PMR =	9.081458	10.32814	18.46127	12.62362	4.159098
SO2, ppmdv =	48.57805	41.61613	43.73549	44.64322	2.913768
SO2, lb/hr =	3.335932	3.314325	3.573952	3.40807	0.117628
SO2, ton/yr =	14.61138	14.51675	15.65391	14.92734	0.515209
SO3, ppmdv =	2.466441	2.876709	0	1.78105	1.270481
SO3, lb/hr =	0.211678	0.286323	0	0.166	0.121271
SO3, ton/yr =	0.927148	1.254095	0	0.727081	0.531168
Total SOx =	3.547609	3.600649	3.573952	3.57407	0.021653
	15.53853	15.77084	15.65391	15.65443	0.094842

FINAL RESULTS

Company: ISENHOUR

Method: 26

Location: E2

Date: 11/29/93

Run #	1	2	3	AVERAGE	S DEVIATI
Vm(std) =	33.62646		33.95003	33.78824	0.161784
Vwc =	0.240057		1.219113	0.729585	0.489528
Vwsg(std) =	0.42435		0.49036	0.457355	0.033005
Bws =	0.019376		0.047939	0.033657	0.014282
Md =	29.34		29.34	29.34	0
Ms =	29.12028		28.79637	28.95833	0.161953
AVG Vs =	92.95776		98.01192	95.48484	2.527079
Qs =	1755459		1667162	1711310	44148.53
PMR =	0		0	0	0
PMR =	0		0	0	0
Fl- ppmdv =	11.71494		32.51818	22.11656	10.40162
PMR FL- lb/hr =	1.013956		2.672959	1.843457	0.829502
Fl- tons/yr =	4.441126		11.70756	8.074343	3.633217
Cl- ppmdv =	1.474991		5.476736	3.475863	2.000872
Cl- lb/hr =	0.238239		0.840104	0.539172	0.300932
Cl- tons/yr =	1.043488		3.679655	2.361571	1.318083

Company: ISENHOUR
Method: 5-8
Location: E2
Date: 12/2/93

Run #	1	2	3	AVERAGE	S DEVIATI
Vm(std) =	33.56848	33.58908	32.71906	33.29221	0.405363
Vwc =	0.240057	1.087317	1.219113	0.848829	0.433816
Vwsg(std)	0.4986	0.43378	0.49036	0.474247	0.028811
Bws =	0.019376	0.041914	0.047939	0.036409	0.012293
Md =	29.34	29.34	29.34	29.34	0
Ms =	29.12028	28.8647	28.79637	28.92712	0.139406
AVG Vs =	96.99805	97.43279	99.93707	98.12264	1.295218
Qs =	1692975	1669423	1639764	1667388	21770.88
PMR =	3.963942	6.444239	4.532475	4.980219	1.060919
PMR =	17.36207	28.22577	19.85224	21.81336	4.646826
SO2, ppmdv =	21.01621	20.29268	24.35836	21.88908	1.770852
SO2, lb/hr =	5.91513	5.63203	6.640316	6.062492	0.424615
SO2, ton/yr =	25.90827	24.66829	29.08459	26.55372	1.859814
SO3, ppmdv =	1.295984	1.958578	1.070189	1.441584	0.377013
SO3, lb/hr =	0.455865	0.67935	0.36461	0.499942	0.132218
SO3, ton/yr =	1.99669	2.975553	1.596991	2.189744	0.579115
Total SOx =	6.370995	6.31138	7.004926	6.562434	0.313834
	27.90496	27.64385	30.68158	28.74346	1.374594

Company: ISENHOUR
Method: 26
Location: SAWDUST DRYER
Date: 11/30/93

Run #	1	2	3	AVERAGE	S DEVIATI
Vm(std) =	32.23021	33.13638	33.13968	32.83542	0.427951
Vwc =	4.245714	4.160988	3.445524	3.950742	0.358914
Vwsg(std) =	0.39606	0.40549	0.485645	0.429065	0.040193
Bws =	0.125889	0.121118	0.106045	0.117684	0.008457
Md =	28.82667	28.82	28.82667	28.82444	0.003143
Ms =	27.46371	27.50951	27.67856	27.55059	0.092396
AVG Vs =	98.25636	96.27933	72.89511	89.1436	11.51773
Qs =	1169982	1157490	897265.5	1074912	125718.7
PMR =	0	0	0	0	0
PMR =	0	0	0	0	0
Fl- ppmdv =	43.52078	42.20918	41.85418	42.52805	0.716772
PMR FL- lb/hr =	2.510522	2.408865	1.851604	2.256997	0.289645
Fl- tons/yr =	10.99609	10.55083	8.110027	9.885648	1.268644
Cl- ppmdv =	1.315862	1.084642	1.547269	1.315924	0.188867
Cl- lb/hr =	0.141652	0.115515	0.127738	0.128302	0.010678
Cl- tons/yr =	0.620436	0.505954	0.559493	0.561961	0.04677

Company: ISENHOUR
Method: 5-8
Location: SAWDUST DRYER
Date: 12/2/93

Run #	1	2	3	AVERAGE	S DEVIATI
Vm(std) =	33.98628	39.03469	40.59953	37.8735	2.82194
Vwc =	4.245714	4.160988	3.445524	3.950742	0.358914
Vwsg(std)	8	0.40549	0.485645	2.963712	3.561344
Bws =	0.125889	0.121118	0.106045	0.117684	0.008457
Md =	29.42	29.42	29.42	29.42	0
Ms =	27.98235	28.03684	28.20897	28.07605	0.096583
AVG Vs =	117.8197	116.9079	71.94746	102.225	21.41271
Qs =	983737.9	962610.5	890262.7	945537	40025.21
PMR =	18.20771	16.82326	13.33171	16.12089	2.051638
PMR =	79.74975	73.6859	58.39289	70.60951	8.986175
SO2, ppmdv =	21.46018	17.97129	15.25353	18.22833	2.540366
SO2, lb/hr =	3.509717	2.876002	2.257604	2.881108	0.511186
SO2, ton/yr =	15.37256	12.59689	9.888306	12.61925	2.238993
	0	0	0		
SO3, ppmdv =	1.186389	0.92422	5.723616	2.611409	2.203264
SO3, lb/hr =	0.24249	0.184847	1.058705	0.495347	0.399049
SO3, ton/yr =	1.062104	0.80963	4.637128	2.169621	1.747833
	0	0	0		
Total SOx =	3.752206	3.060849	3.316309	3.376455	0.285432
	16.43466	13.40652	14.52543	14.78887	1.250191

Armstrong Environmental, Inc.

7715 Sovereign Row • Dallas, TX 75247 • (214) 631-0021 • Fax (214) 905-0634

DATE:

PAGES:
(Including cover sheet)
3

TO: Barry Ellis

FROM: Jeff Lovett

RE:

COMMENTS: If you have any questions give me a call.

Armstrong Environmental, Inc.

7715 Sovereign Row • Dallas, TX 75247 • (214) 631-0021 • Fax (214) 905-0634

DATE:

PAGES:
(Including cover sheet)
2

TO: Barry Ellis

FROM: Jeff Lovett

RE:

COMMENTS: Correct page #2 of last fax

J.

	SO3	SO2	Particulate mg
I5-8Imp1R1E1	7.9	---	38.4
I5-8Imp2-3R1E1	---	124.5	
I5-8Imp1R2E1	10.6	---	45.8
I5-8Imps2-3R2E1	---	122.7	
I5-8Imp1,2,3R3E1	---	133.9	111.4
I5-8ImpsR1E2	4.1	---	24.2
I5-8Imps2-3R1E2	---	53.2	
I5-8Imp1R2E2	6.2	---	24.2
I5-8Imps2-3R2E2	---	51.4	
I5-8Imp1R3E2	3.3	---	14.2
I5-8Imps2-3R3E2	---	60.1	
I5-8Imp1R15D	3.8	---	57.6
I5-8Imps2-3R15D	---	55.0	
I5-8Imp1R25D	3.4	---	45.4
I5-8Imps2-3R25D	---	52.9	
I5-8Imp1R35D	21.9	---	44.4
I5-8Imps2-3R35D	---	46.7	

detection limit - 0.0002 mg

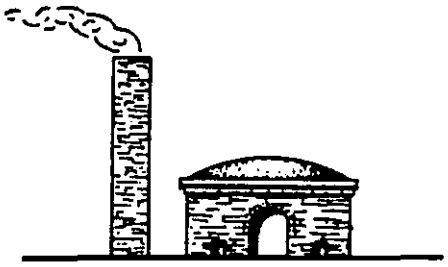
We are pleased to have been of service to Clemson University. If you have any questions please give me a call at the above number.

Submitted by:
Armstrong Environmental, Inc.

Jeff Lovett
Project Manager
JL/jl

Preliminary Stack Test Report

The Center For Engineering
Ceramic Manufacturing
Clemson University
Clemson, SC



Member:	Boral Bricks, Inc. Biskerstaff Division Phenic City, AL
Test Dates:	February 10-11, 1993
Tests Performed:	Methods 8, 13B, and 26
Test Supervisor:	Barry Ellis
Test Helper:	Plant Personnel
Analytical Contractor:	Armstrong Environmental

Note: Stack tests were performed as a part of the Hydrogen Fluoride Research Program sponsored by the Brick Institute of America. This research program involved Clemson University students in pursuit of undergraduate and Graduate degrees in Ceramic Engineering.

FINAL RESULTS
Company: Bickerstaff
Method: 26A

Run #	1	2	3	AVERAGE
Vm(std) =	46.172195	45.47231	45.14799	45.597499
Vwc =	4.674051	4.052727	3.930345	4.219041
Vwsg(std) =	0.532795	0.495075	0.410205	0.4793583
Bws =	0.1013418	0.0909195	0.0877082	0.0933232
Md =	29.08	29.08	29.08	29.08
Ms =	27.957133	28.072612	28.108193	28.045979
AVG Vs =	55.623916	55.004411	55.337698	55.322008
Qs =	737859.63	735695.54	731736.9	735097.35
PMR =	0	0	0	0
PMR =	0	0	0	0
Fl- ppmdv =	85.995895	91.410139	51.579583	76.328539
PMR FL- lb/hr =	3.1285266	3.3157431	1.860892	2.7683872
Fl- tons/yr =	13.702946	14.522955	8.1507069	12.125536
Cl- ppmdv =	20.942463	23.14067	11.111059	18.398064
Cl- lb/hr =	1.4217885	1.5664175	0.7480729	1.2454263
Cl- tons/yr =	6.2274336	6.8609088	3.2765591	5.4549672

FINAL RESULTS
Company: Bickerstaff
Method: 8

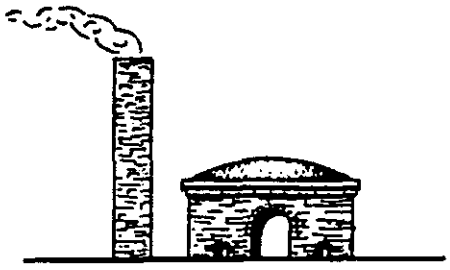
Run #	1	2	3	AVERAGE
Vm(std) =	31.395116	32.044288	31.420944	31.620116
Vwc =		0	0	0
Vwsg(std) =		0	0	0
Bws =	0.0933232	0.0933232	0.0933232	0.0933232
Md =	29.08	29.08	29.08	29.08
Ms =	28.045979	28.045979	28.045979	28.045979
AVG Vs =	55.239175	53.000176	55.167869	54.469073
Qs =	736559.47	762984.12	737370.27	745637.95
SO2, ppmdv =	25.596754	22.429677	22.959056	23.661829
SO2, lb/hr =	3.1343826	2.8451018	2.814485	2.9313232
SO2, ton/yr =	13.728596	12.461546	12.327444	12.839195
SO3, ppmdv =	4.1233013	4.0397691	3.7822142	3.9817616
SO3, lb/hr =	0.6310143	0.6404104	0.5794528	0.6169592
SO3, ton/yr =	2.7638427	2.8049975	2.5380033	2.7022811
Total SOx =	3.7653969	3.4855122	3.3939378	3.5482823
ton/yr =	16.492438	15.266544	14.865448	15.541477

FINAL RESULTS
Company: Bickerstaff
Method: 13B

Run #	1	2	3	AVERAGE
Vm(std) =	44.962377	44.581556	44.876267	44.806733
Vwc =	0	0	0	0
Vwsg(std) =	0	0	0	0
Bws =	0.0933232	0.0933232	0.0933232	0.0933232
Md =	29.08	29.08	29.08	29.08
Ms =	28.045979	28.045979	28.045979	28.045979
AVG Vs =	55.127967	55.706925	55.729853	55.521582
Qs =	737825.01	731287.82	731031.51	733381.45
PMR =	0	0	0	0
PMR =	0	0	0	0
Fl- ppmdv =	136.84345	133.23763	126.34663	132.14257
PMR FL- lb/hr =	4.9781245	4.804007	4.5539488	4.7786934
Fl- tons/yr =	21.804185	21.04155	19.946296	20.930677

Preliminary Stack Test Report

The Center For Engineering
Ceramic Manufacturing
Clemson University
Clemson, SC



Member:	Redlands Brick K-F Division East Winsdor, CT
Test Dates:	8/31/93 - 9/1/93
Tests Performed:	Methods 5,8, and 26
Test Supervisor:	Barry Ellis
Test Helper:	Plant Personnel
Analytical Contractor:	Armstrong Environmental

Note: Stack tests were performed as a part of the Hydrogen Fluoride Research Program sponsored by the Brick Institute of America. This research program involved Clemson University students in pursuit of undergraduate and Graduate degrees in Ceramic Engineering.

METHOD 26

	Fluoride		Chloride	
Run #	lb/hr	tons/yr	lb/hr	tons/yr
1	7.59516	33.2668	3.219268	14.1004
2	6.193272	27.12653	2.503449	10.96511
3	6.850484	30.00512	2.839212	12.43575
AVERAGE	6.879638	30.13282	2.853977	12.50042
Std. dev	0.57269	2.508381	0.292418	1.280793

METHOD 8

	SO2		SO3	
Run #	lb/hr	tons/yr	lb/hr	tons/yr
1	7.157904	31.35162	0.273202	1.196627
2	7.504624	32.87025	0.613026	2.685054
3	6.598077	28.89958	0.356653	1.562139
AVERAGE	7.086868	31.04048	0.414294	1.814607
Std. dev	0.37349	1.635884	0.144596	0.633329

AVERAGE TOTAL SOx = 7.501162 lb/hr
32.85509 ton/yr

22

Method 26 Calculations

Area of stack (ft squared)		12.56664
total # of traverse points		24
Test Time Minutes		41.3
AVG Stack Temp DEG F		396.75
stack absolute pressure	-0.63	30.85368
Barometric Pressure		30.9
Squre root of Delta P AVG		0.703841
%CO2		2
%O2		19.5
%N2 + %CO		78.5
Moisture Collecte (ml or g)		
Imp 1		31.4
Imp 2		0
Imp 3		0
Imp 4		0
Silica gel gain		4.8
Area of nozzle (ft squared)		
AVG Delta H		2.5
AVG Meter temp deg F		100.625
Dry gas meter correction factor		1
Volume metered		30.215
Particulate weight		
Total Fl-, mg		6.78
Fl-, ug/ml		

METHOD 2

	Fluoride		Chloride	
Run #	lb/hr	tons/yr	lb/hr	tons/yr
1	7.59516	33.2668	3.219268	14.1004
2	6.193272	27.12653	2.503449	10.96511
3	6.850484	30.00512	2.839212	12.43575
AVERAGE	6.879638	30.13282	2.853977	12.50042
Std. dev	0.57269	2.508381	0.292418	1.280793

METHOD 8

	SO2		SO3	
Run #	lb/hr	tons/yr	lb/hr	tons/yr
1	7.157904	31.35162	0.273202	1.196627
2	7.504624	32.87025	0.613026	2.685054
3	6.598077	28.89958	0.356653	1.562139
AVERAGE	7.086868	31.04048	0.414294	1.814607
Std. dev	0.37349	1.635884	0.144596	0.633329

AVERAGE TOTAL SOx = 7.501162 lb/hr
32.85509 ton/yr

Armstrong Environmental, Inc.

7715 Sovereign Row • Dallas, TX 75247 • (214) 631-0021 • Fax (214) 905-0634

October 11, 1993

College of Engineering
Center for Engineering Ceramic Manufacturing
B13 Olin Hall, Box 340908
Calhoun Drive
Clemson University
Clemson, SC 29634-0908

Attn: Barry Ellis

Subject: Air Quality Testing Sample Analysis
Armstrong Environmental, Inc. Project W-1394-93

Dear Barry:
The sample analysis you requested was performed following USEPA Title 40: Method 8 and 26 specifications. Results indicate the following:

	Total mg	
Sample	F-	Cl-
KFM26R1imps1-2	78.80	33.40
KFM26R1imps3-4	N/D	N/D
KFM26R2imps1C	5.7	1.90
KFM26R2imps2	55.9	23.0
KFM26R2imps3-4	N/D	N/D
KFM26R3imps1-2	67.8	28.1
KFM26R3imps3-4	N/D	N/D
	SO3	SO2
KFM5/8R1imp1	3.0	---
KFM5/8R1imps2-3	---	78.6
KFM5/8R2imp1	6.2	---
KFM5/8R2imps2-3	---	75.9
KFM5/8R3imp1	3.8	---
KFM5/8R3imps2-3	---	70.3

N/D detection limit - 0.0002 mg

We are pleased to have been of service to Clemson University. If you have any questions please give me a call at the above number.

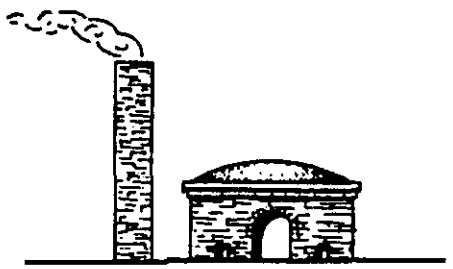
Submitted by:
Armstrong Environmental, Inc.

Jeff Lovett

Jeff Lovett
Project Manager
JL/jl

Preliminary Stack Test Report

The Center For Engineering
Ceramic Manufacturing
Clemson University
Clemson, SC



Member:	Richtex Corporation Plant 4, Columbia, SC
Test Dates:	6/15/93-6/18/93
Tests Performed:	Method 13B
Test Supervisor:	Barry Ellis
Test Helper:	Chuck Overmann
Analytical Contractor:	Armstrong Environmental

Note: Stack tests were performed as a part of the Hydrogen Fluoride Research Program sponsored by the Brick Institute of America. This research program involved Clemson University students in pursuit of undergraduate and Graduate degrees in Ceramic Engineering.

College of Engineering
CENTER FOR ENGINEERING CERAMIC MANUFACTURING

CLEMSON UNIVERSITY

Date: 8-17-93
To: Mr. Mitch Wells
From: Barry N. Ellis
Subject: HF Test Results

The results from the total fluoride test (6-15 through 6-18) have been completed and are listed below.

Run#	lbs/hr	tons/yr	%Isokinetic
1	4.76	20.8	114
2	5.46	23.9	115
3	4.62	20.2	116
AVERAGE	4.95	21.6	115

Please note that all three runs were over isokinetic. This suggests that the actual releases could be less than what is shown above. Please contact me if you have any questions or comments.

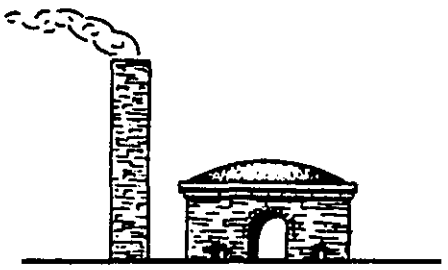
Sincerely

Barry N. Ellis

B13 OLIN HALL • BOX 340908 • CLEMSON, SOUTH CAROLINA 29634-0908, USA • TELEPHONE 803/656-1094 • FAX 803/656-1095

Preliminary Stack Test Report

The Center For Engineering
Ceramic Manufacturing
Clemson University
Clemson, SC



Member:	Boral Bricks, Inc. Plant 5, Augusta, GA
Test Dates:	November 7-8, 1994
Tests Performed:	Methods 5,8, and 26A
Test Supervisor:	Barry Ellis
Test Helper:	John P. Lloyd
Analytical Contractor:	Armstrong Environmental

Note: Stack tests were performed as a part of the Hydrogen Fluoride Research Program sponsored by the Brick Institute of America. This research program involved Clemson University students in pursuit of undergraduate and Graduate degrees in Ceramic Engineering.

Armstrong Environmental, Inc.

7715 Sovereign Row • Dallas, TX 75247 • (214) 631-0021 • Fax (214) 905-0634

DATE: Dec. 13, 1994

PAGES: 15
(Including cover sheet)

TO: John Lloyd
The Ceramic Center

FROM: Jeff Lovett

RE: Air Quality Testing Sample Analysis

COMMENTS:

December 13, 1994

College of Engineering
Center for Engineering Ceramic Manufacturing
B13 Olin Hall, Box 340908
Calhoun Drive
Clemson University
Clemson, SC 29634-0908

Attn: John Lloyd

Subject: Air Quality Testing Sample Analysis
Armstrong Environmental, Inc. Project W-1394-94

Dear Mr. Lloyd

The sample analysis you requested was performed using USEPA Title 40 Methodology and specifications. Results indicate the following:

	Total mg	
Sample	SO3	SO2
R1M5/8	32.55	96.28
R2M5/8	24.30	99.03
R3M5/8	26.59	99.94
Blanks		
80% IPA	0.006 mg/ml	
H2O2	0.028 mg/ml	
Detection Limit	0.006 mg/ml	

	F-	Cl-
R4M26	85.8	42.9
R5M26	75.9	38.1
R6M26	82.1	40.4
Blanks		
H2O	N/D	N/D
H2SO4	N/D	N/D
NaOH	N/D	N/D

Detection Limit 0.2 ug/ml

We are pleased to have been of service to Clemson University. If you have any questions please give me a call.

Submitted by:
Armstrong Environmental, Inc.

Jeff Lovett
Project Manager
JL/jl

Method 6/8 Laboratory Analysis

Plant Clemson
Location Furnace #1 Ex
Train SOx

Location		Total Grams	Total Mg
R1 M5/8 Imp1	SO3	0.03255	32.55
Imp 2-3	SO2	0.096275	96.28
R2 M5/8 Imp1	SO3	0.024298	24.30
Imp 2-3	SO2	0.099026	99.03
R3 M5/8 Imp1	SO3	0.02659	26.59
Imp 2-3	SO2	0.099943	99.94
Blank H2O2	SO2	0.000138	0.14
Blank IPA	SO3	3.44E-05	0.03

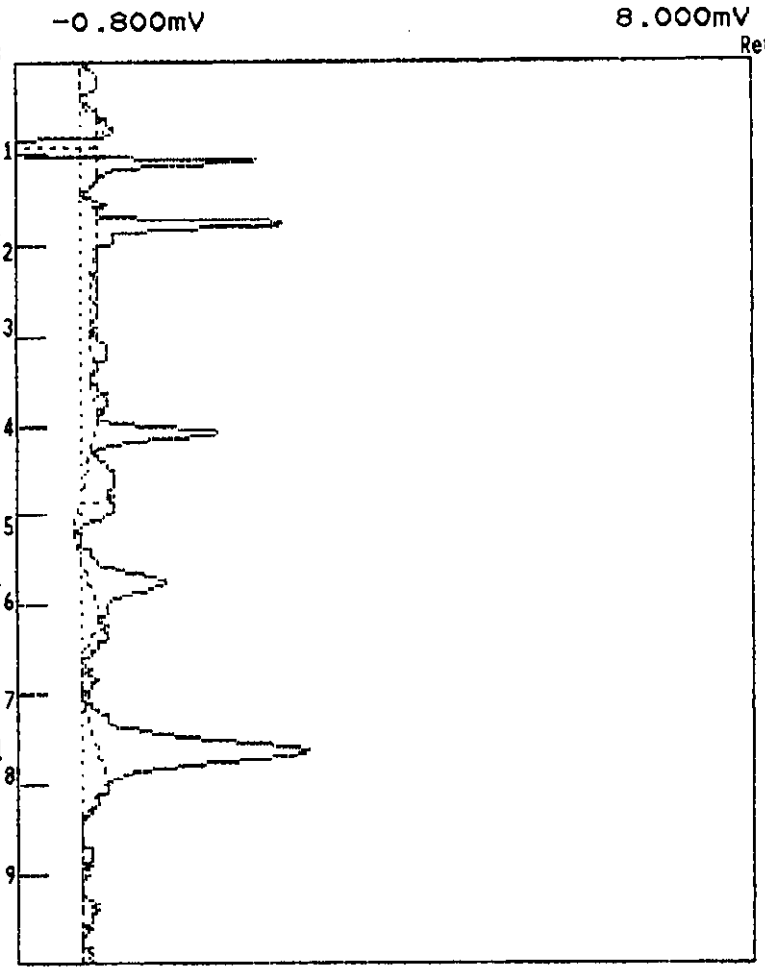
Location	Volume mls	Dilution	Titer			Avg Titer
R1 M5/8 Imp1	200	1	2.4	2.3	2.4	2.366667
Imp 2-3	500	1	3.5	3.5	3.5	3.5
R2 M5/8 Imp1	200	1	1.7	1.8	1.8	1.766667
Imp 2-3	500	1	3.6	3.6	3.6	3.6
R3 M5/8 Imp1	200	1	1.9	1.9	2	1.933333
Imp 2-3	500	1	3.6	3.7	3.6	3.633333
Blank H2O2	5	1	0.5	0.5	0.5	0.5
Blank IPA	5	1	0.1	0.1	0.1	0.1

Standarization Ba (ClO2)4

Titer			Avg Titer	Normality
11.6	11.7	11.6	11.63333	0.008595989

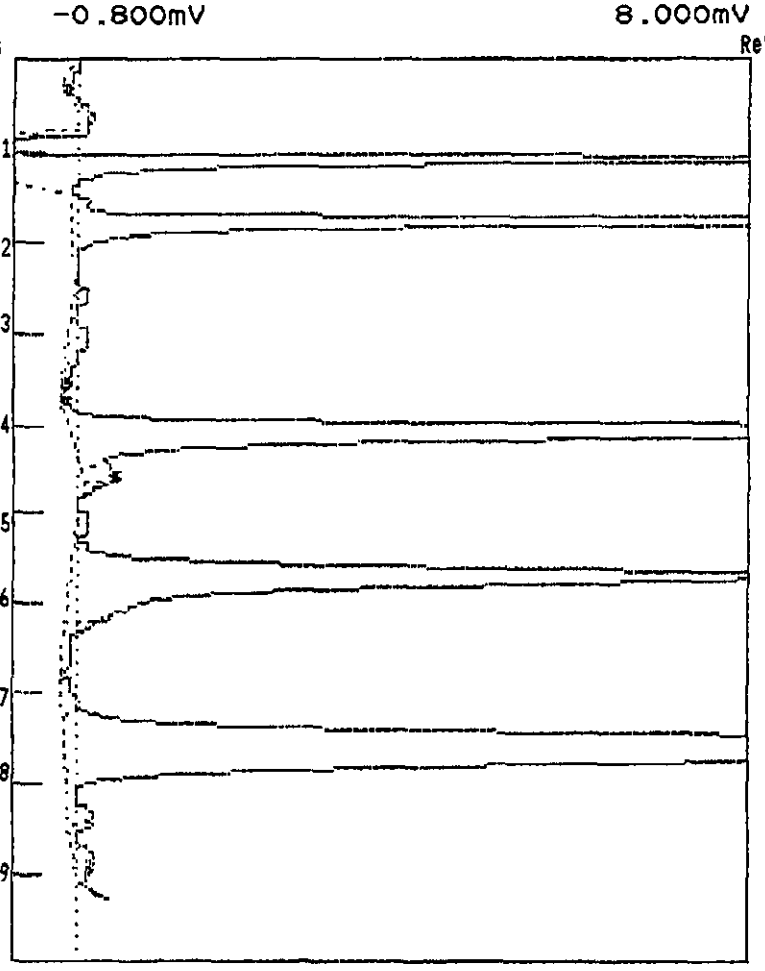
All titrations performed using 5 ml aliquot

Description : Channel 1
Conditions : 5 anion std
: 1/100
Date : 12/09/1994
Time : 14:49:48



Component	External	Units	Retention	Height	Area
Cl-	0.47	ug/ml	1.750	2.409	14.80 M
NO4-	0.79	ug/	4.075	1.538	14.28 M
PO4-	1.78	ug/ml	5.708	0.930	17.56 M
SO4	2.08	ug/ml	7.633	2.518	48.62 M

Description : Channel 1
Conditions : 5 anion std
: 1/10
Date : 12/09/1994
Time : 15:07:20



Component	External	Units	Retention	Height	Area
F-	2.00	ug/	1.075	19.173	122.94 M
Cl-	3.02	ug/ml	1.758	16.164	101.07 M
NO4-	10.34	ug/	4.050	15.510	162.35 M
PO4-	15.88	ug/ml	5.691	8.692	137.45 M
SO4	15.00	ug/ml	7.608	18.554	334.96 M

Armstrong Environmental, Inc.

7715 Sovereign Row • Dallas, TX 75247 • (214) 631-0021 • Fax (214) 905-0634

DATE: Dec. 13, 1994

PAGES: 15
(Including cover sheet)

TO: John Lloyd
The Ceramic Center

FROM: Jeff Lovett

RE: Air Quality Testing Sample Analysis

COMMENTS:

Method 6/8 Laboratory Analysis

Plant Clemson
Location Furnace #1 Ex
Train SOx

Location		Total Grams	Total Mg
R1 M5/8 Imp1	SO3	0.03255	32.55
Imp 2-3	SO2	0.096275	96.28
R2 M5/8 Imp1	SO3	0.024298	24.30
Imp 2-3	SO2	0.099026	99.03
R3 M5/8 Imp1	SO3	0.02659	26.59
Imp 2-3	SO2	0.099943	99.94
Blank H2O2	SO2	0.000138	0.14
Blank IPA	SO3	3.44E-05	0.03

Location	Volume mls	Dilution	Titer			Avg Titer
R1 M5/8 Imp1	200	1	2.4	2.3	2.4	2.366667
Imp 2-3	500	1	3.5	3.5	3.5	3.5
R2 M5/8 Imp1	200	1	1.7	1.8	1.8	1.766667
Imp 2-3	500	1	3.6	3.6	3.6	3.6
R3 M5/8 Imp1	200	1	1.9	1.9	2	1.933333
Imp 2-3	500	1	3.6	3.7	3.6	3.633333
Blank H2O2	5	1	0.5	0.5	0.5	0.5
Blank IPA	5	1	0.1	0.1	0.1	0.1

Standarization Ba (ClO2)4

Titer			Avg Titer	Normality
11.6	11.7	11.6	11.63333	0.008595989

All titrations performed using 5 ml aliquot

December 13, 1994

College of Engineering
Center for Engineering Ceramic Manufacturing
B13 Olin Hall, Box 340908
Calhoun Drive
Clemson University
Clemson, SC 29634-0908

Attn: John Lloyd

Subject: Air Quality Testing Sample Analysis
Armstrong Environmental, Inc. Project W-1394-94

Dear Mr. Lloyd

The sample analysis you requested was performed using USEPA Title 40 Methodology and specifications. Results indicate the following:

	Total mg	
Sample	SO3	SO2
R1M5/8	32.55	96.28
R2M5/8	24.30	99.03
R3M5/8	26.59	99.94
Blanks		
80% IPA	0.006 mg/ml	
H2O2	0.028 mg/ml	
Detection Limit	0.006 mg/ml	

	F-	Cl-
R4M26	85.8	42.9
R5M26	75.9	38.1
R6M26	82.1	40.4
Blanks		
H2O	N/D	N/D
H2SO4	N/D	N/D
NaOH	N/D	N/D

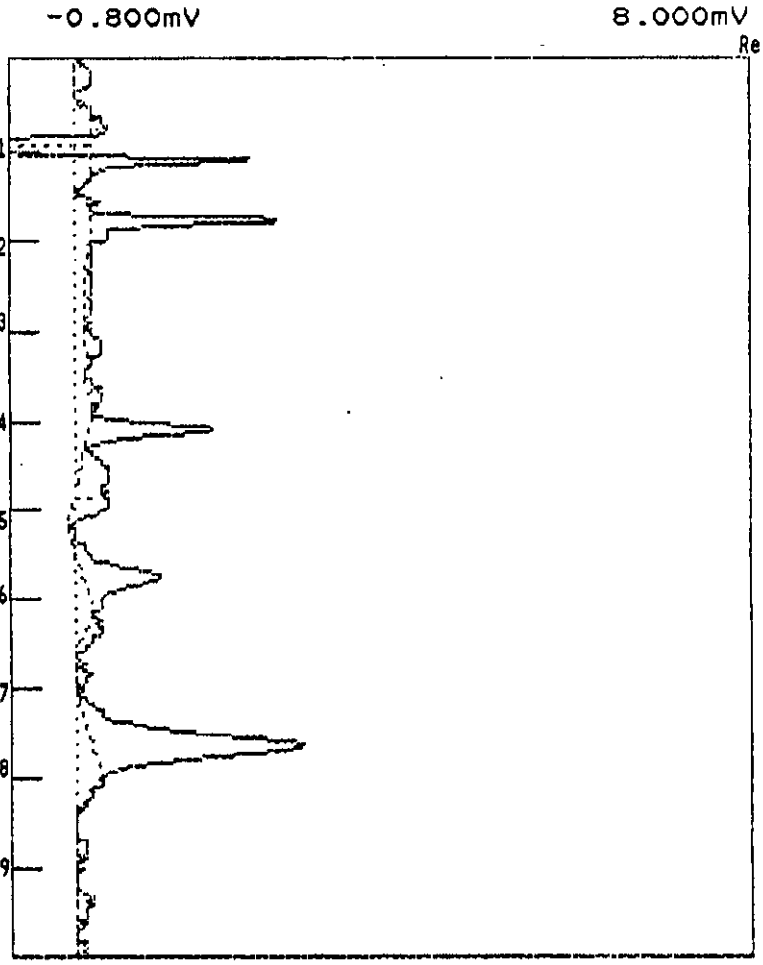
Detection Limit 0.2 ug/ml

We are pleased to have been of service to Clemson University. If you have any questions please give me a call.

Submitted by:
Armstrong Environmental, Inc.

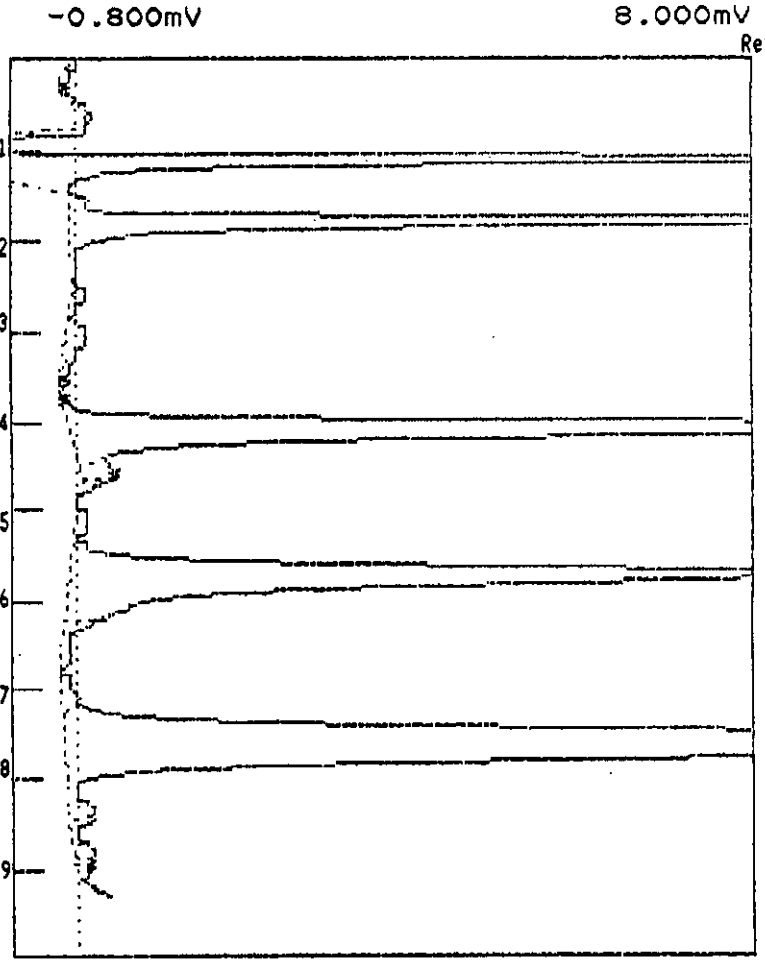
Jeff Lovett
Project Manager
JL/jl

Description : Channel 1
Conditions : 5 anion std
: 1/100
Date : 12/09/1994
Time : 14:49:48



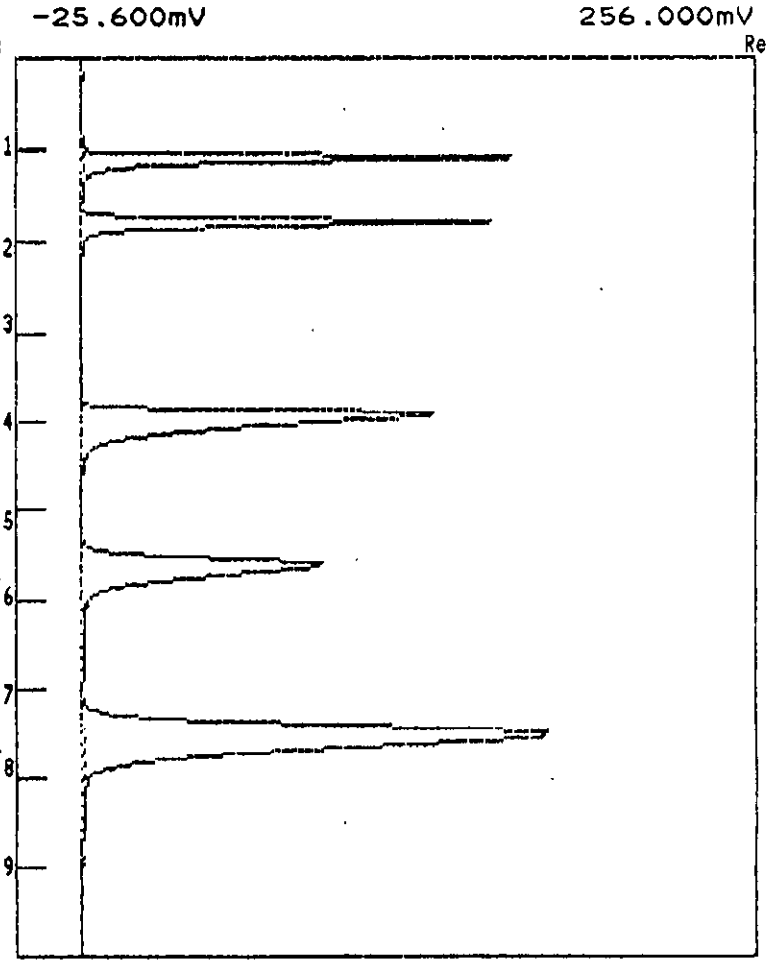
Component	External	Units	Retention	Height	Area
Cl-	0.47	ug/ml	1.750	2.409	14.80 M
NO4-	0.79	ug/	4.075	1.538	14.28 M
PO4-	1.78	ug/ml	5.708	0.930	17.56 M
SO4	2.08	ug/ml	7.633	2.518	48.62 M

Description : Channel 1
Conditions : 5 anion std
: 1/10
Date : 12/09/1994
Time : 15:07:20



Component	External	Units	Retention	Height	Area
F-	2.00	ug/	1.075	19.173	122.94 M
Cl-	3.02	ug/ml	1.758	16.164	101.07 M
NO4-	10.34	ug/	4.050	15.510	162.35 M
PO4-	15.88	ug/ml	5.691	8.692	137.45 M
SO4	15.00	ug/ml	7.608	18.554	334.96 M

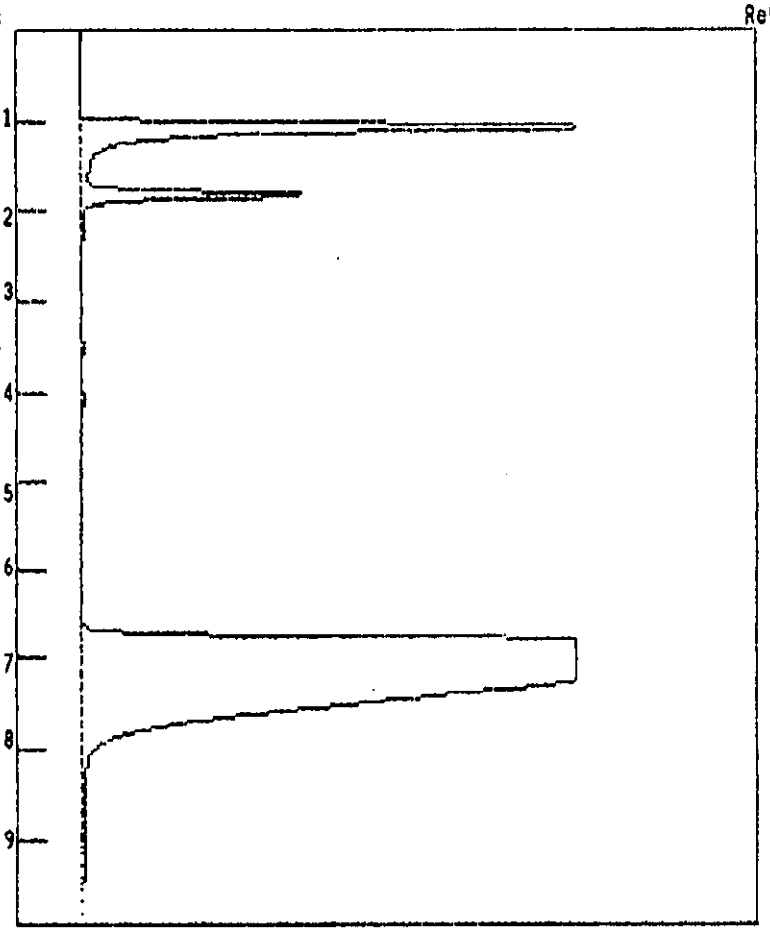
Description : Channel 1
Conditions : 5 anion std
Date : 12/09/1994
Time : 15:22:15



Component	External	Units	Retention	Height	Area
F-	20.01	ug/	1.066	165.712	865.33
Cl-	30.02	ug/ml	1.766	156.644	886.60
NO4-	100.03	ug/	3.916	134.384	1660.42
PO4-	150.06	ug/ml	5.600	91.434	1336.55
SO4	150.04	ug/ml	7.516	178.940	3207.75

Description : Channel 1
Conditions : Clemson
: M26
: vol 500 ml
: R4 Imps 1-2
Date : 12/09/1994
Time : 15:33:36

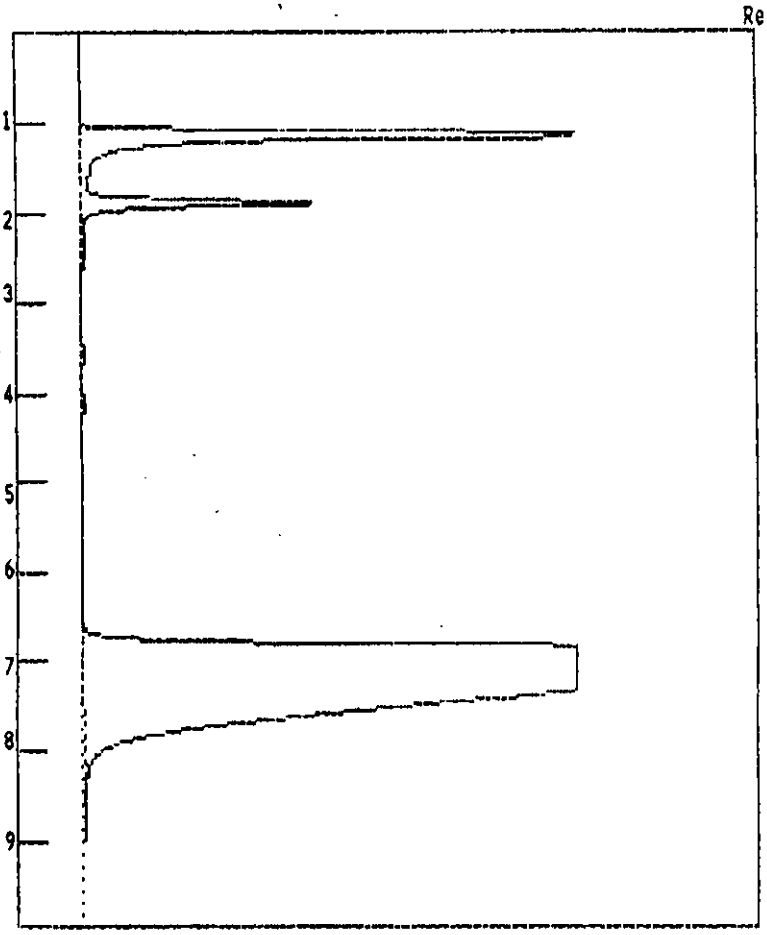
-102.400mV 1024.000mV



Component	External	Units		Retention	Height	Area
F- 80.9mg total	161.80	ug/	1	1.050	752.695	6711.14
Cl- 39.3 mg total	78.76	ug/ml	2	1.825	389.121	2304.41
(unknown)	N/A		3	2.800	1.001	11.59
Br-	2.73	ug/ml		3.525	3.428	36.17
NO4- 0.92mg total	1.85	ug/	4	4.083	2.873	28.85
			5			
			6			
(unknown)	N/A		7	6.808	750.986	36598.28
			8			
			9			

Description : Channel 1
Conditions : Clemson
: M26
: vol 500 ml
: R5 Imps 1-2
Date : 12/09/1994
Time : 16:03:06

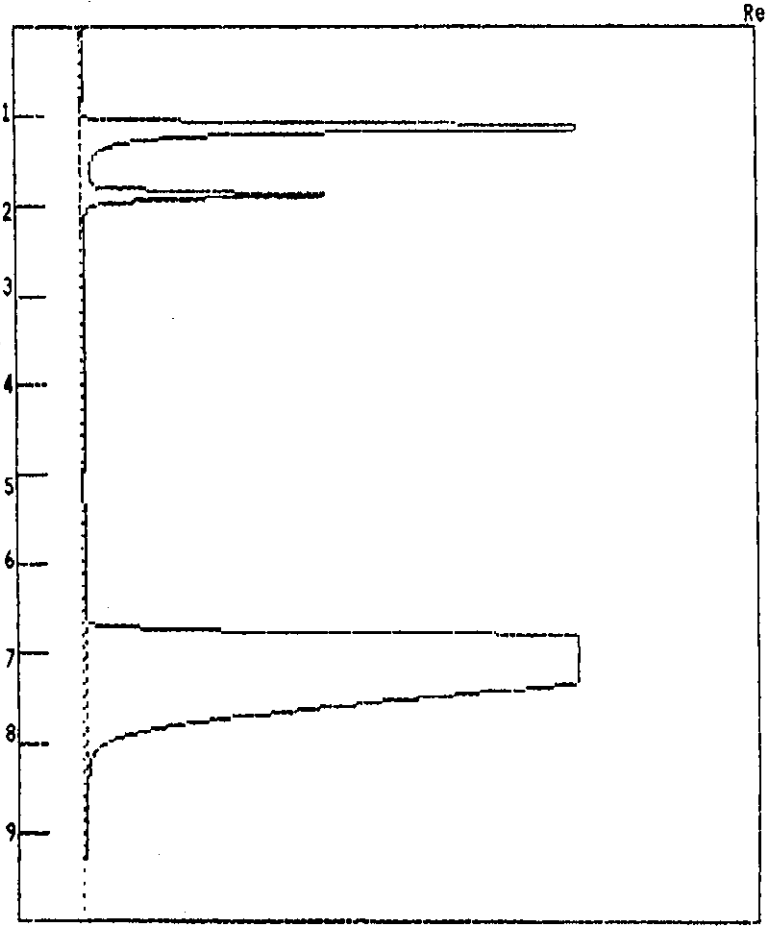
-102.400mV 1024.000mV



Component	External	Units	Retention	Height	Area
(unknown)	N/A		0.558	0.514	16.48
F- 75.0mg total	150.08	ug/ml	1.108	751.991	6227.88
Cl- 37.5 mg total	75.11	ug/ml	1.875	353.328	2198.41
Br-	2.08	ug/ml	3.550	3.053	27.52
NO4- 0.58mg total	1.16	ug/	4.108	1.708	18.15
(unknown)	N/A		6.833	750.384	37949.15

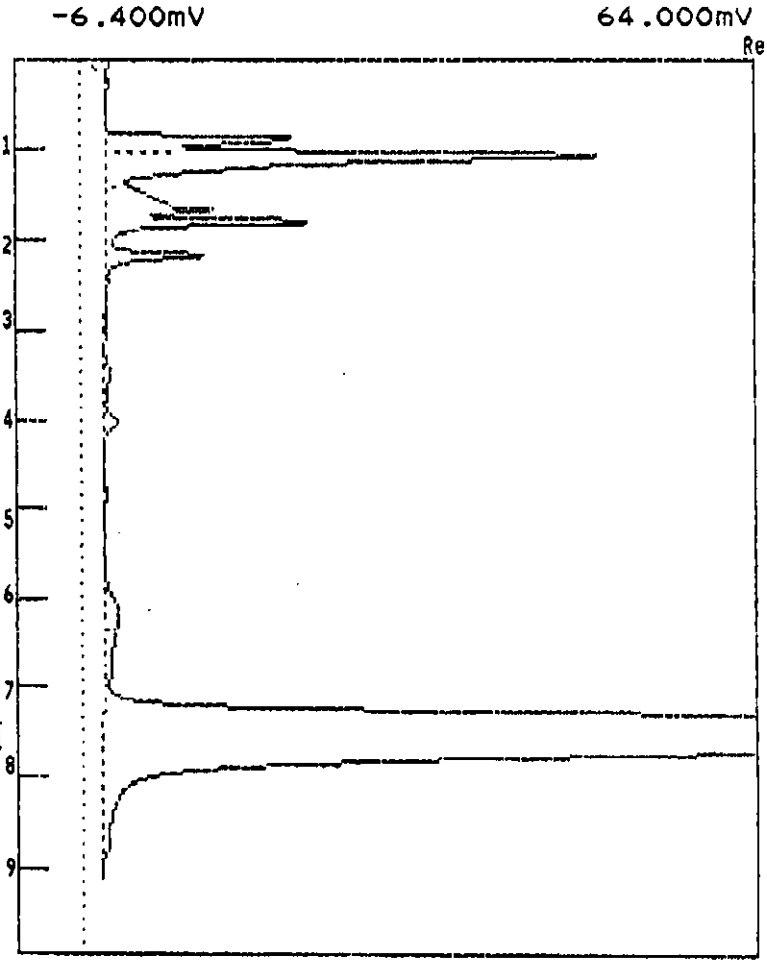
Description : Channel 1
Conditions : Clemson
: M26
: vol 500 ml
: R6 Imps 1-2
Date : 12/09/1994
Time : 16:13:53

-102.400mV 1024.000mV



Component	External	Units	Retention	Height	Area
(unknown)	N/A		0.000	2.200	10.18
F- 82.0 mg total	164.03	ug/ml	1.100	750.899	6802.90
Cl- 38.9 mg total	77.95	ug/ml	1.875	372.272	2280.90
(unknown)	N/A		2.558	1.319	17.14
Br-	2.01	ug/ml	3.558	3.042	26.65
NO4- 0.56 mg total	1.12	ug/	4.091	1.533	17.43
(unknown)	N/A		6.800	749.462	39561.50

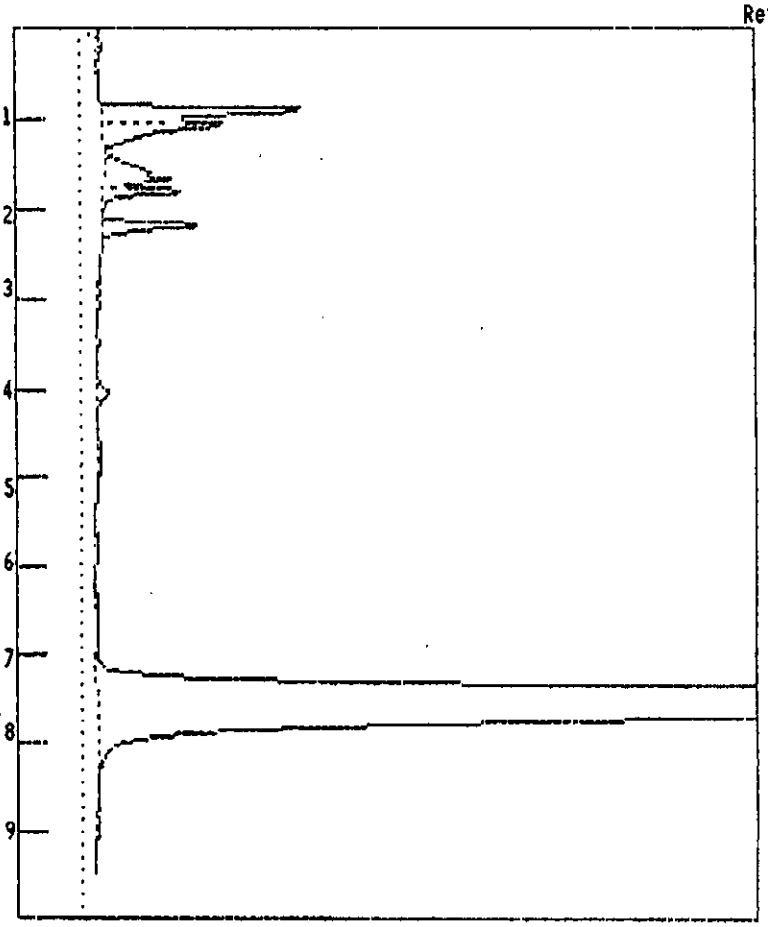
Description : Channel 1
Conditions : Clemson
: M26
: vol 500 ml
: R4 Imps 3-4
Date : 12/09/1994
Time : 16:24:49



Component	External	Units	Retention	Height	Area
(unknown)	N/A		0.000	2.700	20.66 M
F- 4.9mg total	9.82	ug/	1.066	47.936	445.43 M
Cl- 3.6 mg total	7.27	ug/ml	1.791	22.564	224.70 M
(unknown)	N/A		2.175	9.779	65.40 M
NO4- 0.45 mg total	0.91	ug/	4.041	1.268	14.22
(unknown)	N/A		6.308	1.227	13.44
(unknown)	N/A		6.725	0.669	11.00
SO4	244.58	ug/ml	7.433	275.739	5219.22
SO3-	1265.37	ug/ml	7.433	275.739	5219.22

Description : Channel 1
Conditions : Clemson
: M26
: vol 500 ml
: R5 Imps 3-4
Date : 12/09/1994
Time : 16:37:23

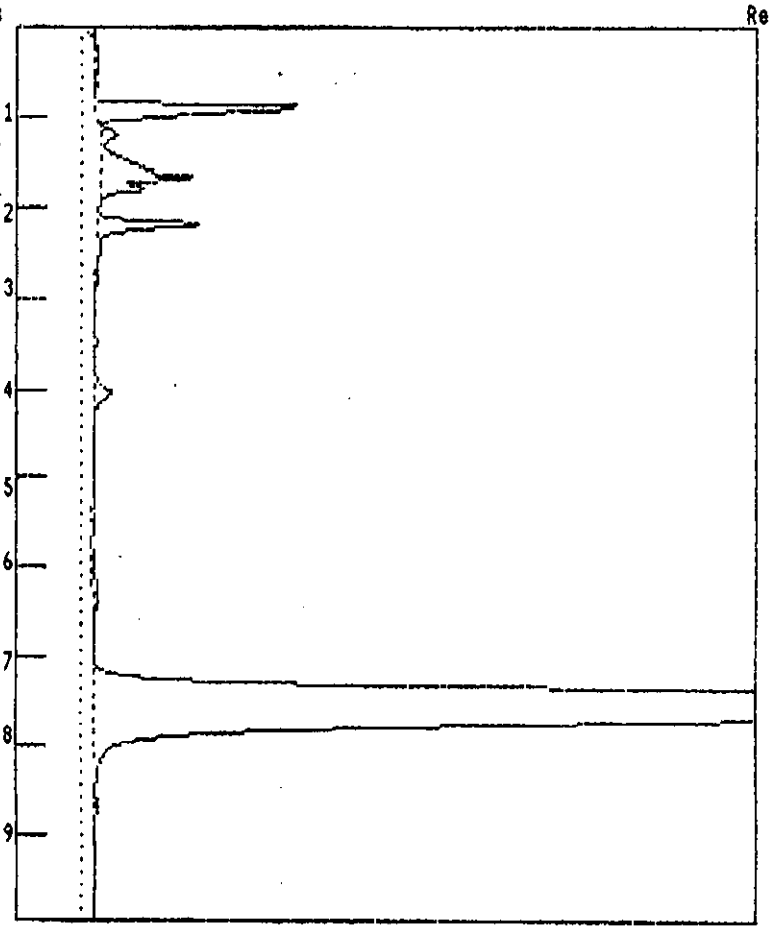
-6.400mV 64.000mV



Component	External	Units		Retention	Height	Area
F- 0.90mg total	1.80	ug/	1	1.050	11.872	110.42
Cl- 0.63 mg total	1.26	ug/ml		1.791	8.383	42.13 M
(unknown)	N/A		2	2.175	9.627	58.48
			3			
NO4- 0.39 mg total	0.79	ug/	4	4.050	1.300	12.40
			5			
			6			
			7			
SO3-	850.46	ug/ml	8	7.491	190.538	3494.05
			9			

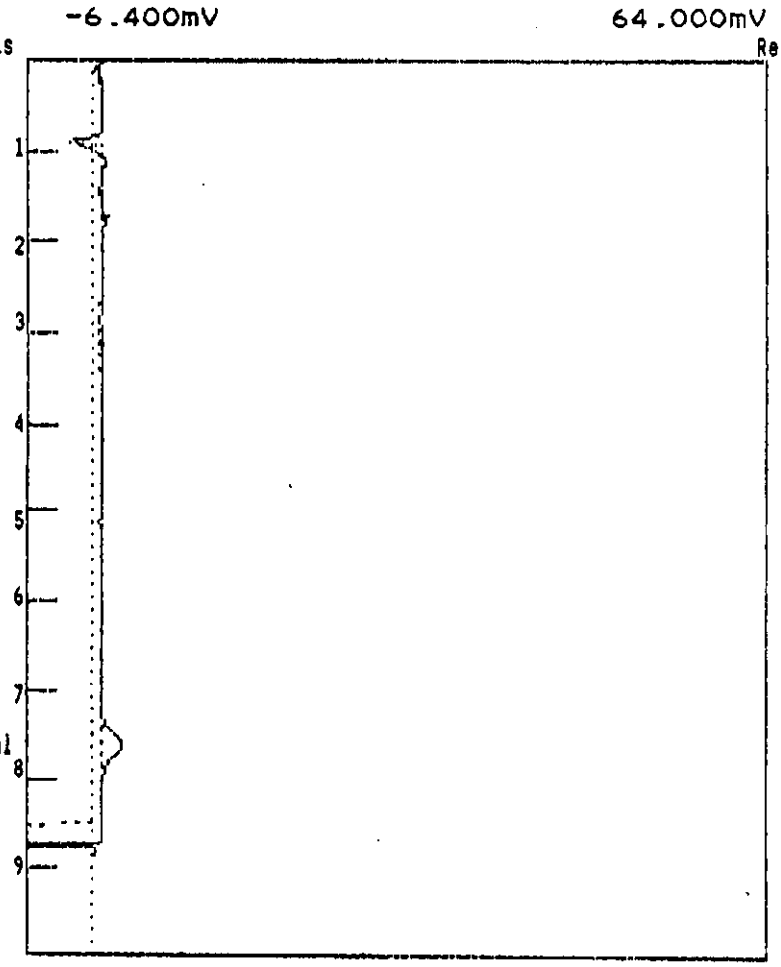
Description : Channel 1
Conditions : Clemson
: M26
: vol 500 ml
: R6 Imps 3-4
Date : 12/09/1994
Time : 16:48:41

-6.400mV 64.000mV



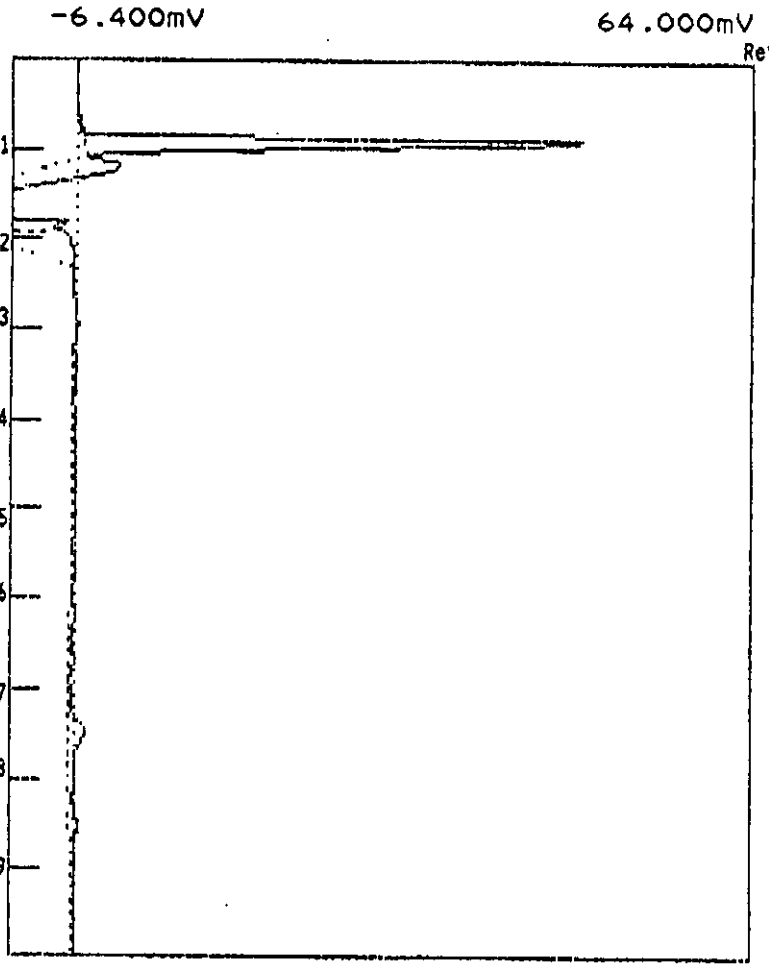
Component	External	Units	Retention	Height	Area
(unknown)	N/A		0.883	20.206	144.32
F- 0.10mg total	0.21	ug/ml	1.191	1.591	12.88
Cl- 1.58mg total	3.16	ug/ml	1.666	8.578	105.20 M
(unknown)	N/A		2.175	9.975	62.20 M
NO4- 0.55mg total	.11	ug/	4.041	1.500	17.40
(unknown)	N/A		6.250	0.453	13.45
SO3-	833.21	ug/ml	7.475	187.108	3422.32

Description : Channel 1
Conditions : Clemson
: M26
: H20 Blank
Date : 12/09/1994
Time : 17:33:36



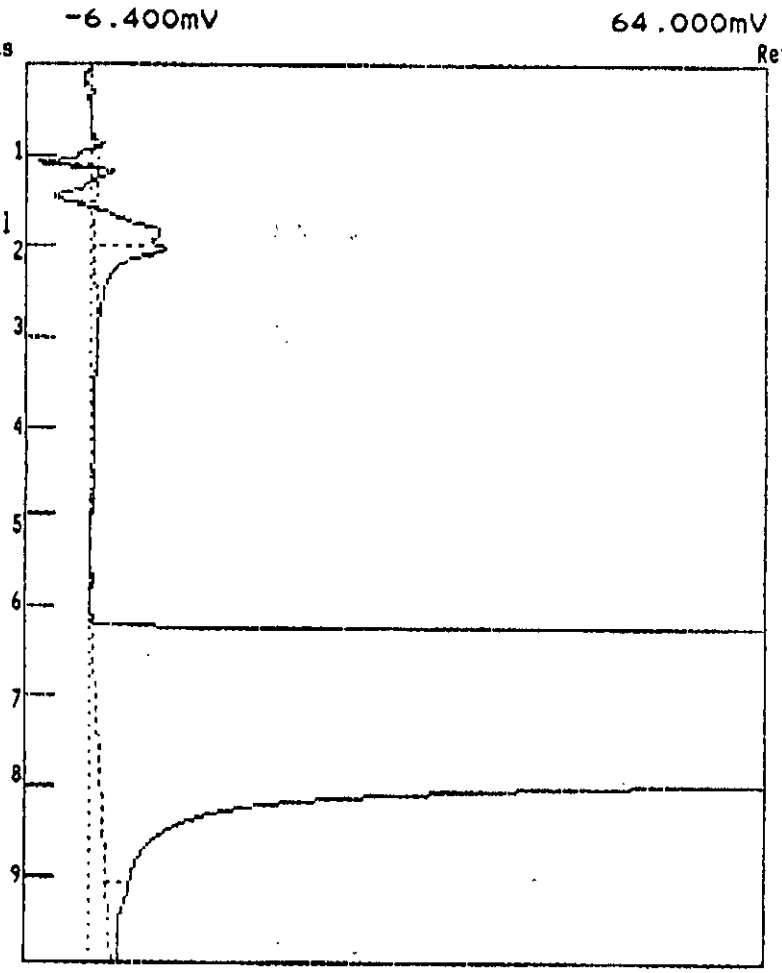
Component	External	Units	Retention	Height	Area
SO4	1.98	ug/ml	7.600	2.100	44.25 M
(unknown)	N/A		8.500	2.566	354.99 M
(unknown)	N/A		8.691	59.107	193.98 M

Description : Channel 1
Conditions : Clemson
: M26
: NaOH Blank
Date : 12/09/1994
Time : 17:43:38



Component	External	Units	Retention	Height	Area
(unknown)	N/A		0.875	49.809	338.10
F-	2.93	ug/ml	1.166	6.004	161.40
Cl-	2.76	ug/ml	1.808	13.874	92.32 M
(unknown)	N/A		2.308	0.779	161.40 M
SO3-	9.58	ug/ml	7.475	1.570	31.69 M
(unknown)	N/A		8.458	0.717	17.00 M

Description : Channel 1
Conditions : Clemson
: M26
: H2SO4 Blank
Date : 12/09/1994
Time : 18:04:32



Component	External	Units	Retention	Height	Area
Cl-	2.08	ug/ml	1.900	6.287	69.53 M
(unknown)	N/A		2.041	7.006	110.83 M
(unknown)	N/A		6.341	751.523	64078.33 M
(unknown)	N/A		9.058	2.346	49.77 M
(unknown)	N/A		9.641	0.950	10.59 M

Armstrong Environmental, Inc.

7715 Sovereign Row • Dallas, TX 75247 • (214) 631-0021 • Fax (214) 905-0634

DATE: Dec. 13, 1994

PAGES: 15
(Including cover sheet)

TO: John Lloyd
The Ceramic Center

FROM: Jeff Lovett

RE: Air Quality Testing Sample Analysis

COMMENTS:

December 13, 1994

College of Engineering
Center for Engineering Ceramic Manufacturing
B13 Olin Hall, Box 340908
Calhoun Drive
Clemson University
Clemson, SC 29634-0908

Attn: John Lloyd

Subject: Air Quality Testing Sample Analysis
Armstrong Environmental, Inc. Project W-1394-94

Dear Mr. Lloyd

The sample analysis you requested was performed using USEPA Title 40 Methodology and specifications. Results indicate the following:

	Total mg	
Sample	SO3	SO2
R1M5/8	32.55	96.28
R2M5/8	24.30	99.03
R3M5/8	26.59	99.94
Blanks		
80% IPA	0.006 mg/ml	
H2O2	0.028 mg/ml	
Detection Limit	0.006 mg/ml	

	F-	Cl-
R4M26	85.8	42.9
R5M26	75.9	38.1
R6M26	82.1	40.4
Blanks		
H2O	N/D	N/D
H2SO4	N/D	N/D
NaOH	N/D	N/D

Detection Limit 0.2 ug/ml

We are pleased to have been of service to Clemson University. If you have any questions please give me a call.

Submitted by:
Armstrong Environmental, Inc.

Jeff Lovett
Project Manager
JL/jl

Method 6/8 Laboratory Analysis

Plant Clemson
Location Furnace #1 Ex
Train SOx

Location		Total Grams	Total Mg
R1 M5/8 Imp1	SO3	0.03255	32.55
Imp 2-3	SO2	0.096275	96.28
R2 M5/8 Imp1	SO3	0.024298	24.30
Imp 2-3	SO2	0.099026	99.03
R3 M5/8 Imp1	SO3	0.02659	26.59
Imp 2-3	SO2	0.099943	99.94
Blank H2O2	SO2	0.000138	0.14
Blank IPA	SO3	3.44E-05	0.03

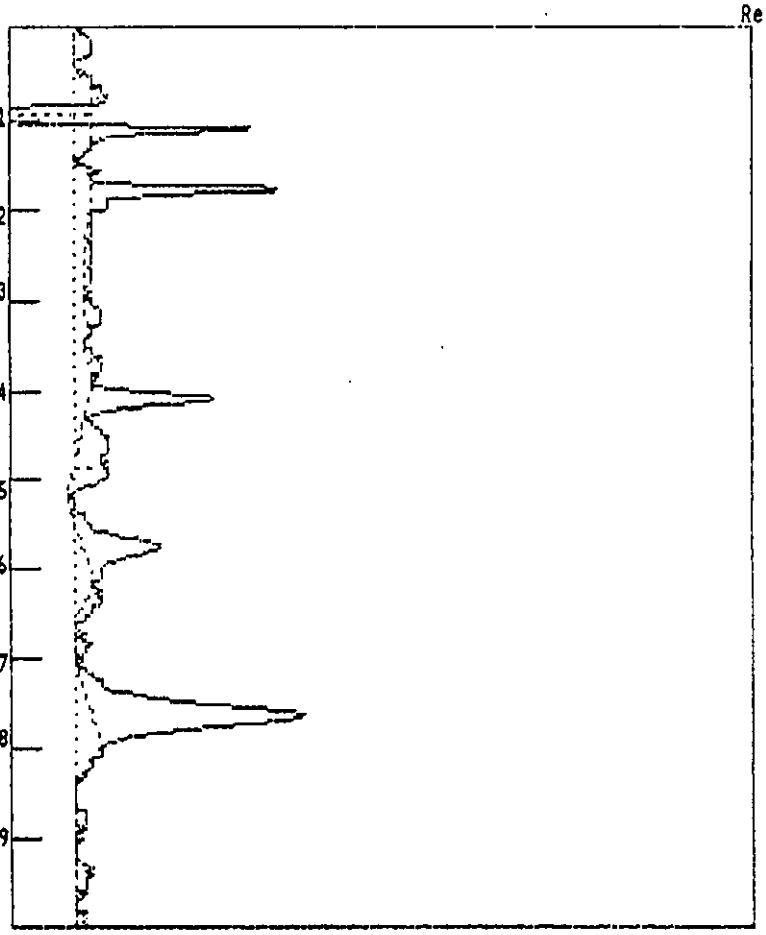
Location	Volume mls	Dilution	Titer			Avg Titer
R1 M5/8 Imp1	200	1	2.4	2.3	2.4	2.366667
Imp 2-3	500	1	3.5	3.5	3.5	3.5
R2 M5/8 Imp1	200	1	1.7	1.8	1.8	1.766667
Imp 2-3	500	1	3.6	3.6	3.6	3.6
R3 M5/8 Imp1	200	1	1.9	1.9	2	1.933333
Imp 2-3	500	1	3.6	3.7	3.6	3.633333
Blank H2O2	5	1	0.5	0.5	0.5	0.5
Blank IPA	5	1	0.1	0.1	0.1	0.1

Standarization Ba (ClO2)4

Titer			Avg Titer	Normality
11.6	11.7	11.6	11.63333	0.008595989

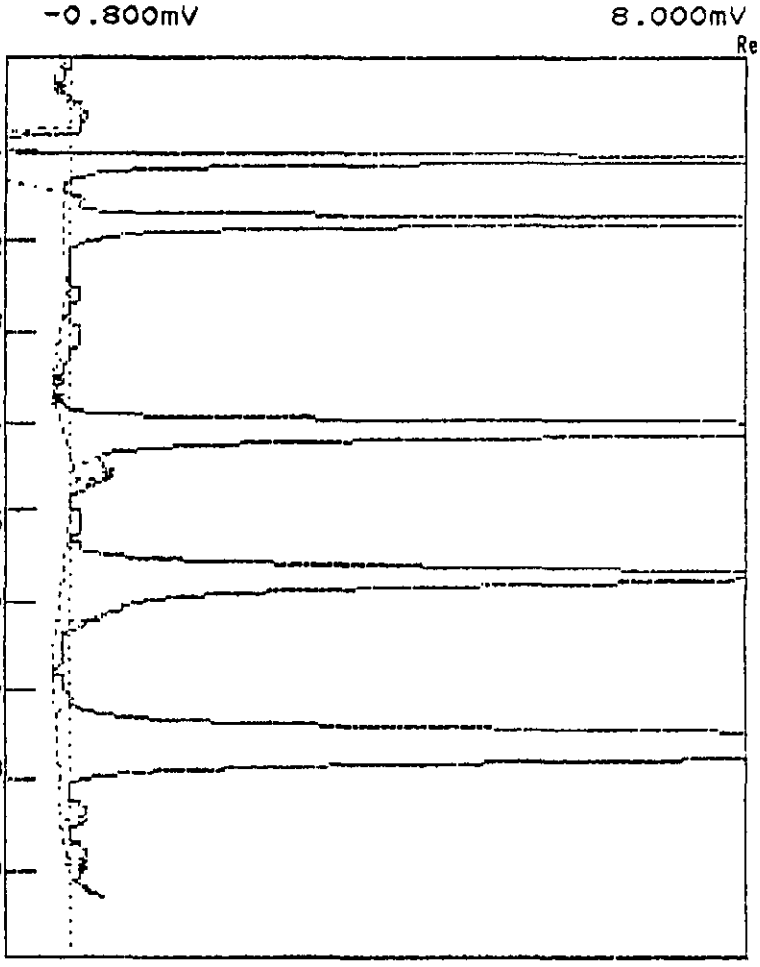
All titrations performed using 5 ml aliquot

Description : Channel 1
Conditions : 5 anion std
: 1/100
Date : 12/09/1994
Time : 14:49:48



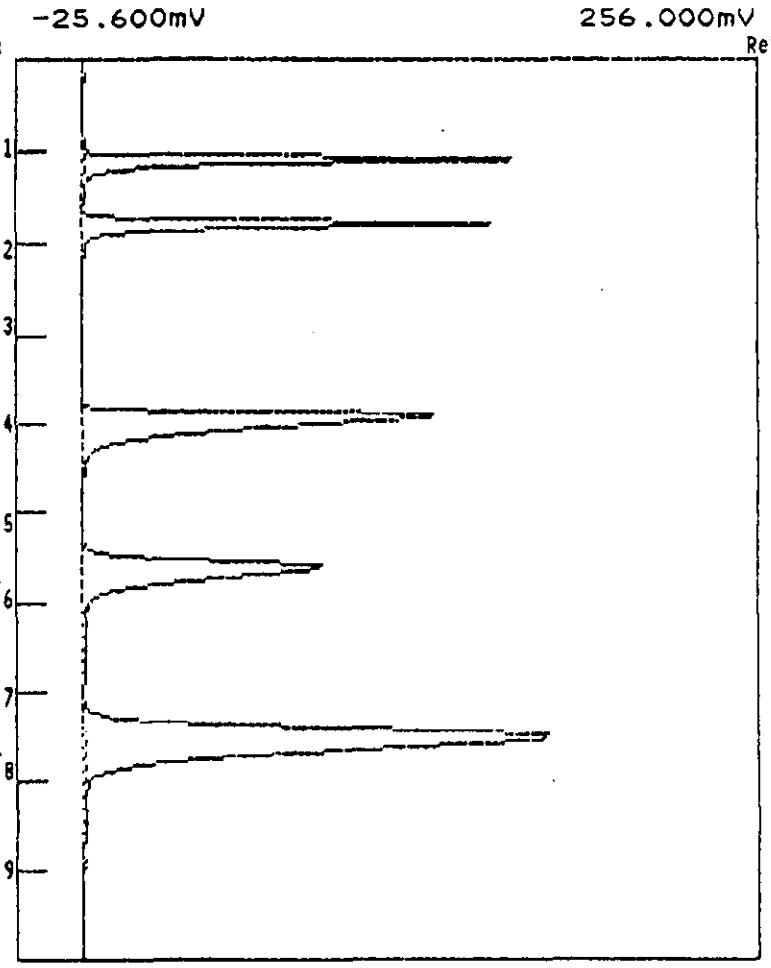
Component	External	Units	Retention	Height	Area
Cl-	0.47	ug/ml	1.750	2.409	14.80 M
NO4-	0.79	ug/	4.075	1.538	14.29 M
PO4-	1.78	ug/ml	5.708	0.930	17.56 M
SO4	2.08	ug/ml	7.633	2.518	48.62 M

Description : Channel 1
Conditions : 5 anion std
: 1/10
Date : 12/09/1994
Time : 15:07:20



Component	External	Units	Retention	Height	Area
F-	2.00	ug/	1.075	19.173	122.94 M
Cl-	3.02	ug/ml	1.758	16.164	101.07 M
NO4-	10.34	ug/	4.050	15.510	162.35 M
PO4-	15.88	ug/ml	5.691	8.692	137.45 M
SO4	15.00	ug/ml	7.608	18.554	334.96 M

Description : Channel 1
Conditions : 5 anion std
Date : 12/09/1994
Time : 15:22:15



Component	External	Units	Retention	Height	Area
F-	20.01	ug/	1.066	165.712	865.33
Cl-	30.02	ug/ml	1.766	156.644	886.60
NO4-	100.03	ug/	3.916	134.384	1660.42
PO4-	150.06	ug/ml	5.600	91.434	1336.55
SO4	150.04	ug/ml	7.516	178.940	3207.75

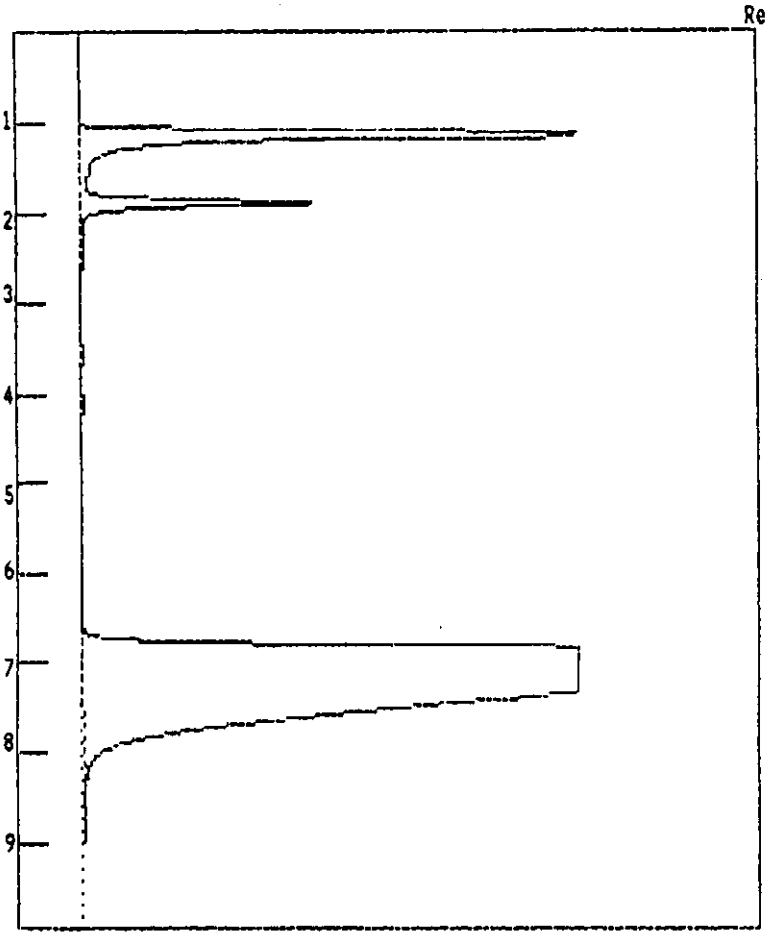
Description : Channel 1
Conditions : Clemson
: M26
: vol 500 ml
: R4 Imps 1-2
Date : 12/09/1994
Time : 15:33:36

-102.400mV 1024.000mV

Component	External	Units		Retention	Height	Area
F- 80.9mg total	161.80	ug/	1	1.050	752.695	6711.14
Cl- 39.3 mg total	78.76	ug/ml	2	1.825	389.121	2304.41
(unknown)	N/A		3	2.800	1.001	11.59
Br-	2.73	ug/ml		3.525	3.428	36.17
NO4- 0.92mg total	1.85	ug/	4	4.083	2.873	28.85
			5			
			6			
(unknown)	N/A		7	6.808	750.986	36598.28
			8			
			9			

Description : Channel 1
Conditions : Clemson
: M26
: vol 500 ml
: R5 Imps 1-2
Date : 12/09/1994
Time : 16:03:06

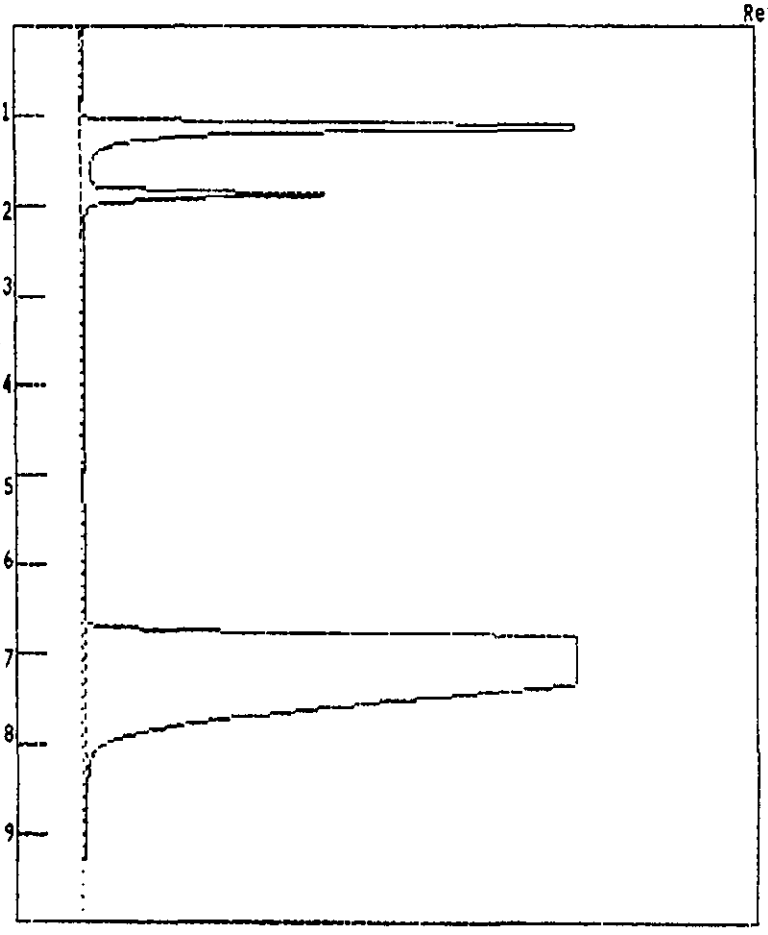
-102.400mV 1024.000mV



Component	External	Units	Retention	Height	Area
(unknown)	N/A		0.558	0.514	16.48
F- 75.0 mg total	150.08	ug/ml	1.108	751.991	6227.88
Cl- 37.5 mg total	75.11	ug/ml	1.875	353.328	2198.41
Br-	2.08	ug/ml	3.550	3.053	27.52
NO4- 0.58 mg total	1.16	ug/	4.108	1.708	18.15
(unknown)	N/A		6.833	750.384	37949.15

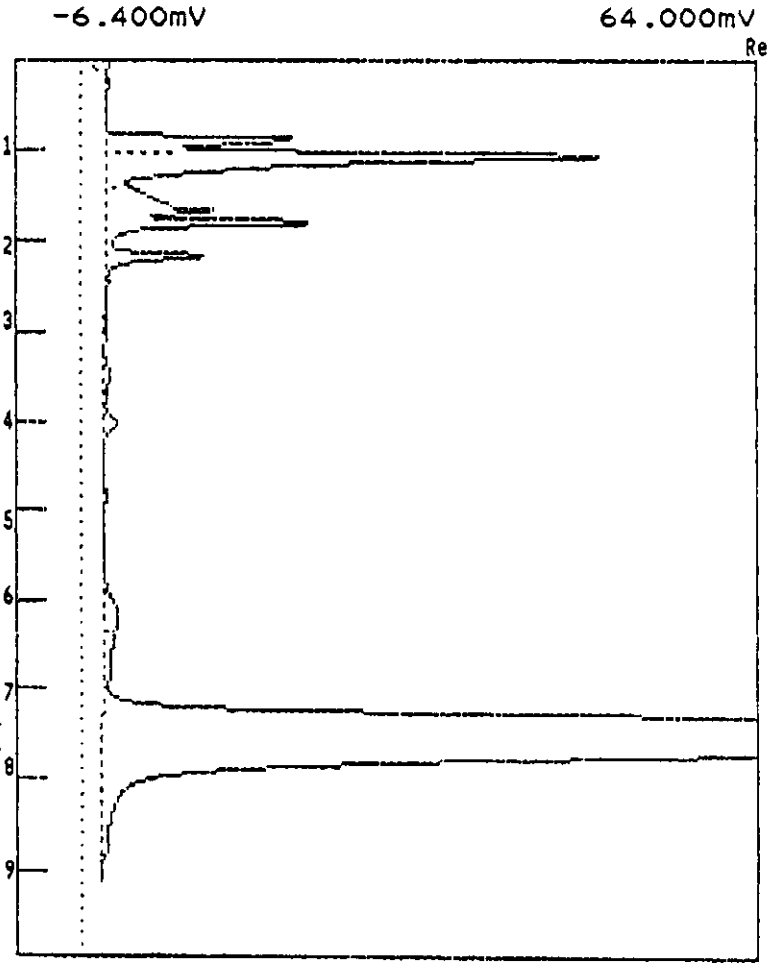
Description : Channel 1
Conditions : Clemson
: M26
: vol 500 ml
: R6 Imps 1-2
Date : 12/09/1994
Time : 16:13:53

-102.400mV 1024.000mV



Component	External	Units	Retention	Height	Area
(unknown)	N/A		0.000	2.200	10.18
F- 82.0 mg total	164.03	ug/ml	1.100	750.899	6802.90
Cl- 38.9 mg total	77.95	ug/ml	1.875	372.272	2280.90
(unknown)	N/A		2.558	1.319	17.14
Br-	2.01	ug/ml	3.558	3.042	26.65
NO4- 0.56 mg total	1.12	ug/	4.091	1.533	17.43
(unknown)	N/A		6.800	749.462	39561.50

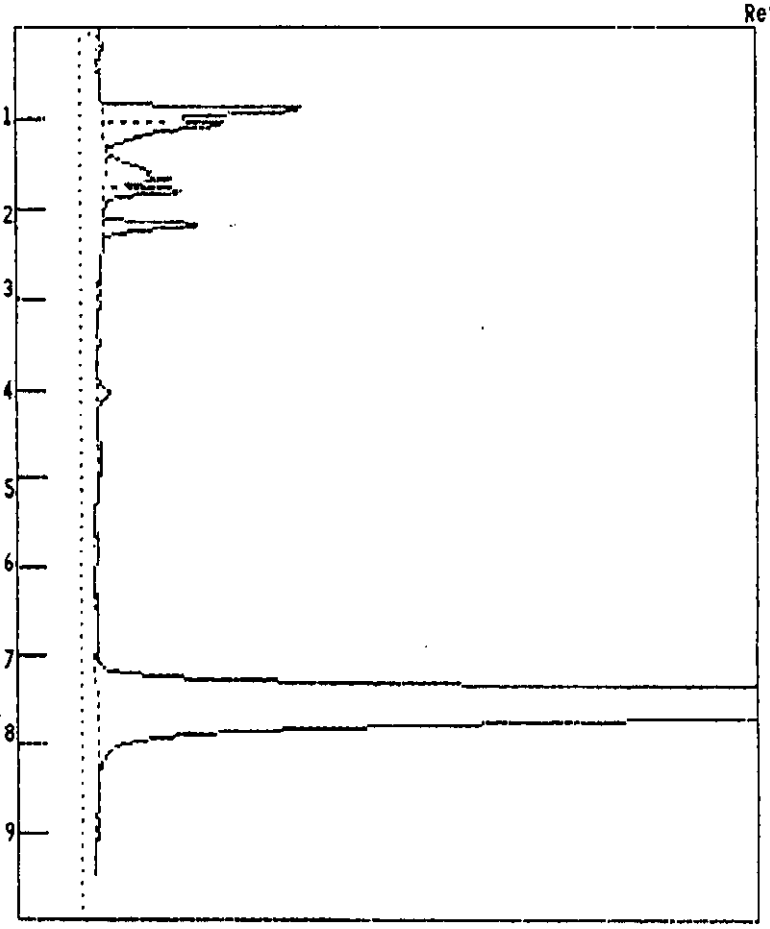
Description : Channel 1
Conditions : Clemson
: M26
: vol 500 ml
: R4 Imps 3-4
Date : 12/09/1994
Time : 16:24:49



Component	External	Units	Retention	Height	Area
(unknown)	N/A		0.000	2.700	20.66 M
F- 4.9 mg total	9.82	ug/	1.066	47.936	445.43 M
Cl- 3.6 mg total	7.27	ug/ml	1.791	22.564	224.70 M
(unknown)	N/A		2.175	9.779	65.40 M
NO4- 0.455 mg total	0.91	ug/	4.041	1.268	14.22
(unknown)	N/A		6.308	1.227	13.44
(unknown)	N/A		6.725	0.669	11.00
SO4	244.58	ug/ml	7.433	275.739	5219.22
SO3-	1265.37	ug/ml	7.433	275.739	5219.22

Description : Channel 1
Conditions : Clemson
: M26
: vol 500 ml
: R5 Imps 3-4
Date : 12/09/1994
Time : 16:37:23

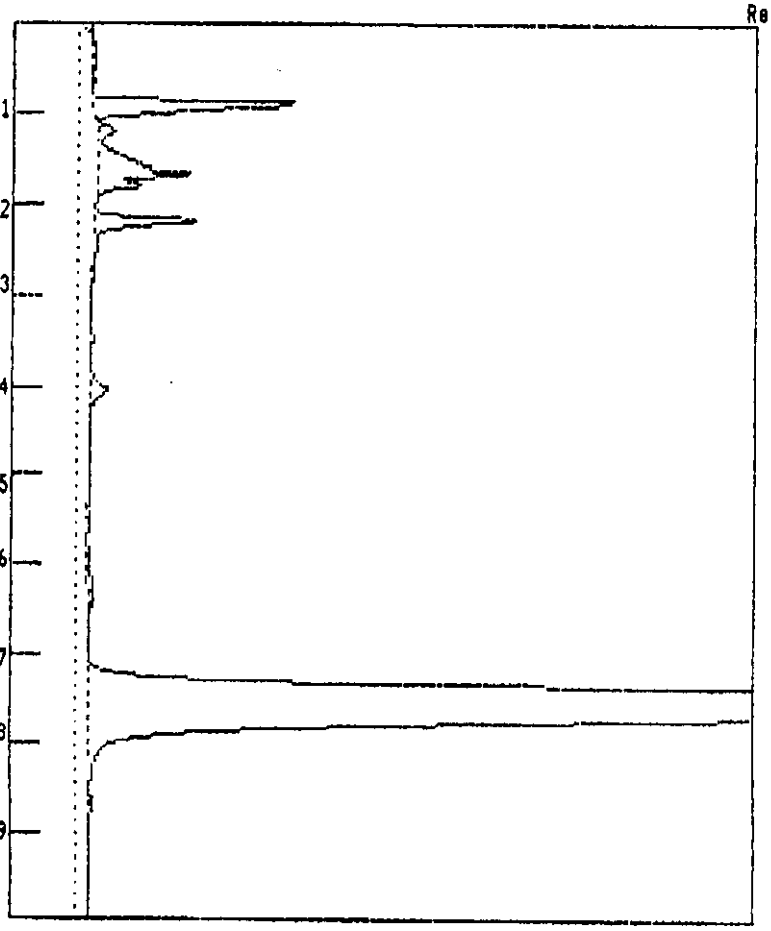
-6.400mV 64.000mV



Component	External	Units	Retention	Height	Area
F- 0.90mg total	1.80	ug/	1.050	11.872	110.42
Cl- 0.63 mg total	1.26	ug/ml	1.791	8.383	42.13 M
(unknown)	N/A		2.175	9.627	58.48
NO4- 0.39 mg total	0.79	ug/	4.050	1.300	12.40
SO3-	850.46	ug/ml	7.491	190.538	3494.05

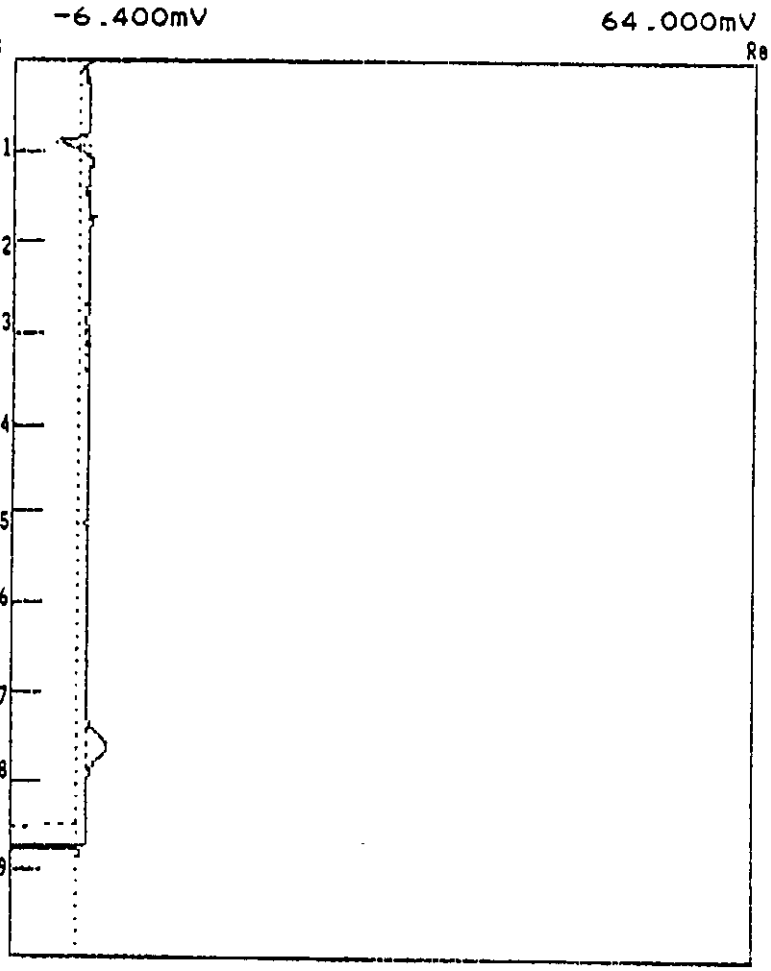
Description : Channel 1
Conditions : Clemson
: M26
: vol 500 ml
: R6 Imps 3-4
Date : 12/09/1994
Time : 16:48:41

-6.400mV 64.000mV



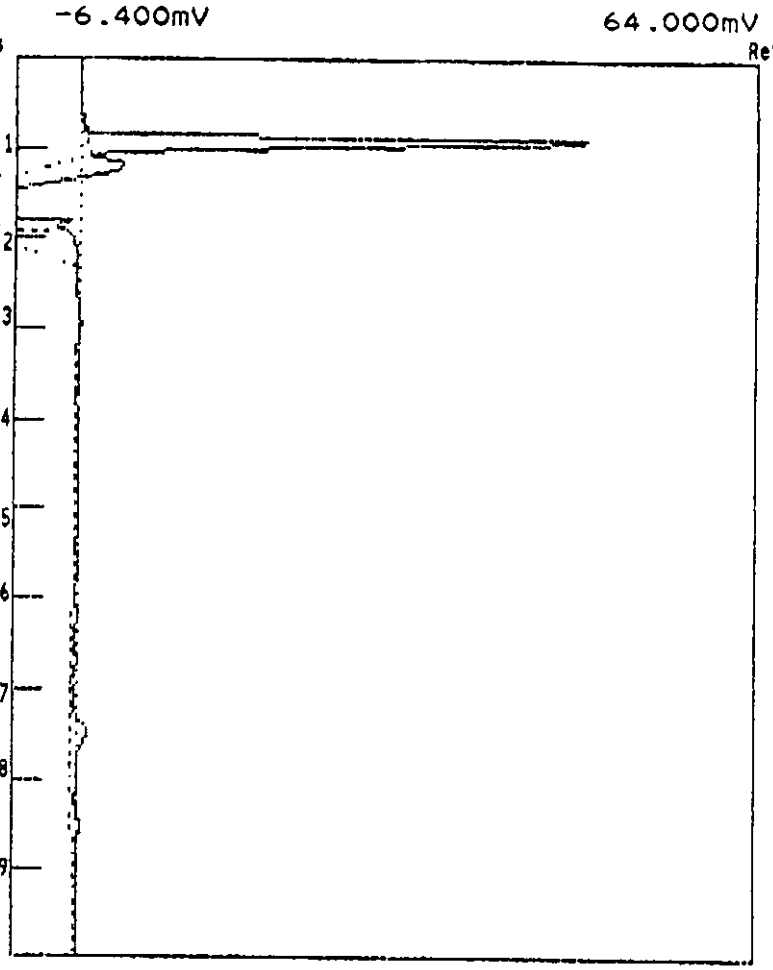
Component	External	Units	Retention	Height	Area
(unknown)	N/A		0.883	20.206	144.32
F- 0.10mg total	0.21	ug/ml	1.191	1.591	12.88
Cl- 1.58mg total	3.16	ug/ml	1.666	8.578	105.20 M
(unknown)	N/A		2.175	9.975	62.20 M
NO4- 0.55mg total	.11	ug/	4.041	1.500	17.40
(unknown)	N/A		6.250	0.453	13.45
SO3-	833.21	ug/ml	7.475	187.108	3422.32

Description : Channel 1
Conditions : Clemson
: M26
: H20 Blank
Date : 12/09/1994
Time : 17:33:36



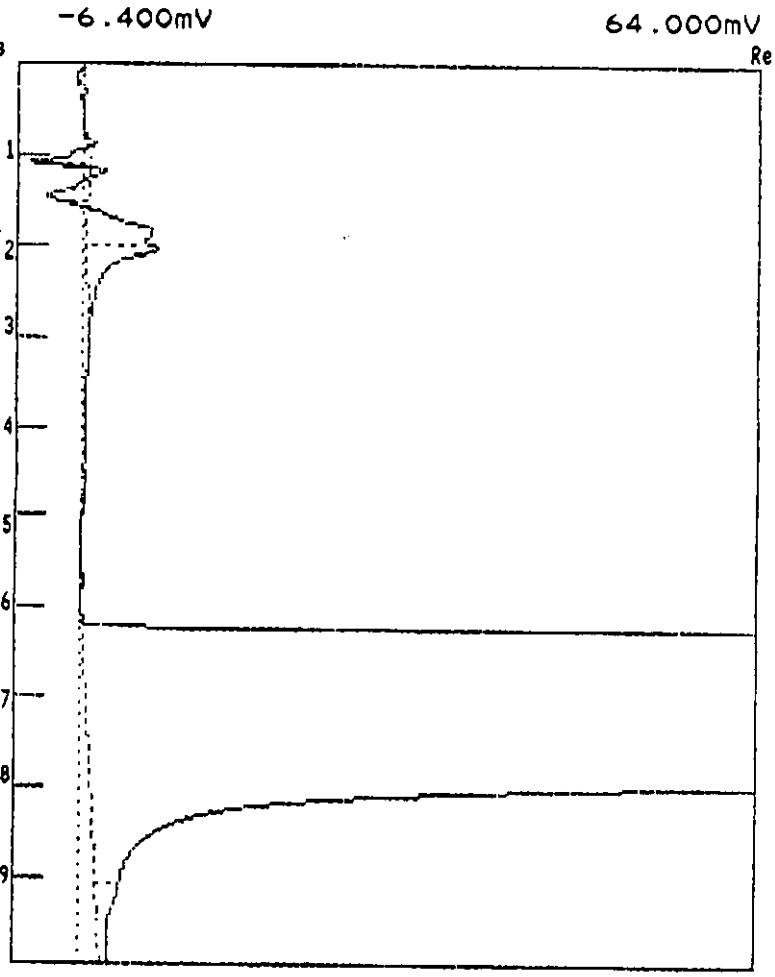
Component	External	Units	Retention	Height	Area
SO4	1.98	ug/ml	7.600	2.100	44.25 M
(unknown)	N/A		8.500	2.566	354.99 M
(unknown)	N/A		8.691	59.107	193.98 M

Description : Channel 1
Conditions : Clemson
: M26
: NaOH Blank
Date : 12/09/1994
Time : 17:43:38



Component	External	Units	Retention	Height	Area
(unknown)	N/A		0.875	49.809	338.10
F-	2.93	ug/ml	1.166	6.004	161.40
Cl-	2.76	ug/ml	1.808	13.874	92.32 M
(unknown)	N/A		2.308	0.779	161.40 M
SO3-	9.58	ug/ml	7.475	1.570	31.69 M
(unknown)	N/A		8.458	0.717	17.00 M

Description : Channel 1
Conditions : Clemson
: M26
: H2SO4 Blank
Date : 12/09/1994
Time : 18:04:32



Component	External	Units	Retention	Height	Area
Cl- (unknown)	2.08	ug/ml	1.900	6.287	69.53 M
	N/A		2.041	7.006	110.83 M
(unknown)	N/A		6.341	751.523	64078.33 M
(unknown)	N/A		9.058	2.346	49.77 M
(unknown)	N/A		9.641	0.950	10.59 M

Armstrong Environmental, Inc.

7715 Sovereign Row • Dallas, TX 75247 • (214) 631-0021 • Fax (214) 905-0634

DATE: Dec. 13, 1994

PAGES: 15
(Including cover sheet)

TO: John Lloyd
The Ceramic Center

FROM: Jeff Lovett

RE: Air Quality Testing Sample Analysis

COMMENTS:

SUMMARY OF TEST RESULTS
PLANT #5 - PARTICULATES

	Test #1	Test #2	Test #3	Test #4	Test #5	Test #6		
Volume @ Meter (Vm):	38.010	39.862	40.683	41.364	40.379	40.692		ft^3
Avg Sqrt Delta P:	0.796	0.775	0.782	0.784	0.775	0.770		
Sampling Time (min):	60	60	60	60	60	60		min
Barometric Pressure (Pbar):	30.10	30.10	30.10	30.10	30.10	30.10		inHg
Avg Delta H:	1.34	1.46	1.52	1.55	1.50	1.46		
Volume in impingers (mls):	35.5	49.2	39.5	62.0	57.7	64.1		mls
Stack Pressure (Ps):	30.15	30.15	30.15	30.15	30.14	30.13		inHg
Stack Temperature (Ts):	878	880	886	880	889	883		R
Meter Coefficient (Y):	0.9874	0.9874	0.9874	0.9874	0.9874	0.9874		
Pitot Coefficient (Cp):	0.84	0.84	0.84	0.84	0.84	0.84		
Meter Temperature (Tm):	524	543	548	554	558	545		R
Area Stack (As):	28.27	28.27	28.27	28.27	28.27	28.27		ft^2
Area Nozzle (An):	0.000334	0.000334	0.000334	0.000334	0.000334	0.000334		ft^2
Percent CO2 (%):	2.0	2.0	2.0	2.0	2.0	2.0		%
Percent O2 (%):	18.0	18.0	18.0	18.0	18.0	18.0		%
Percent N2 (%):	80.0	80.0	80.0	80.0	80.0	80.0		%
Particulates (mg):	18.4	18.2	14.4	14.6	19.2	18.1		mg
							Overall Average	
Molecular Weight Dry (Md):	29.04	29.04	29.04	29.04	29.04	29.04	29.04	lb/lbmol
Volume Water (Vwstd):	1.67	2.31	1.86	2.92	2.71	3.02	2.41	scf
Volume Gas Measured (Vmstd):	38.17	38.65	39.05	39.32	38.10	39.32	38.77	scf
Wet Fraction (Bws):	0.0419	0.0565	0.0454	0.0691	0.0665	0.0712	0.0584	
Molecular Weight Wet (Ms):	28.6	28.4	28.5	28.3	28.3	28.3	28.4	lb/lbmol
Volume Gas Sampled (Vma):	69.3	67.8	68.4	68.7	68.3	67.7	68.4	ft^3
Stack Gas Velocity (Vs):	57.7	56.4	57.0	57.2	56.8	56.3	56.9	ft/s
Volumetric Flowrate (Qs):	58906	57418	57576	58216	57260	57151	57754	scfm
Volumetric Flowrate (Qa):	97907	95691	96633	97054	96441	95595	96553	scfm
Grainloading (gr/dscf):	0.0074	0.0073	0.0057	0.0057	0.0078	0.0071	0.0068	gr/dscf
Particulate Concentration (cs):	1.06E-06	1.04E-06	8.11E-07	8.22E-07	1.11E-06	1.01E-06	9.76E-07	lb/dscf
Particulate Emissions (pmr):	3.75	3.58	2.80	2.87	3.81	3.48	3.38	lb/h
Percent Isokinetic Sampling:	94.8	100.1	99.6	101.7	100.0	103.9	100.0	%

SUMMARY OF TEST RESULTS
BORAL BRICK PLANT #5 - SULFUR COMPOUNDS

	Test #1	Test #2	Test #3	
Volume @ Meter (Vm):	38.010	39.862	40.683	ft^3
Avg Sqrt Delta P:	0.796	0.775	0.782	
Sampling Time (min):	60	60	60	min
Barometric Pressure (Pbar):	30.10	30.10	30.10	inHg
Avg Delta H:	1.34	1.46	1.52	
Volume in impingers (mls):	35.5	49.2	39.5	mls
Stack Pressure (Ps):	30.15	30.15	30.15	inHg
Stack Temperature (Ts):	878	880	886	R
Meter Coefficient (Y):	0.9874	0.9874	0.9874	
Pitot Coefficient (Cp):	0.84	0.84	0.84	
Meter Temperature (Tm):	524	543	548	R
Area Stack (As):	28.27	28.27	28.27	ft^2
Area Nozzle (An):	0.000334	0.000334	0.000334	ft^2
Percent CO2 (%):	2.0	2.0	2.0	%
Percent O2 (%):	18.0	18.0	18.0	%
Percent N2 (%):	80.0	80.0	80.0	%
Total SO2 (mg):	96.3	99.0	99.9	mg
Total SO3 (mg):	32.6	24.3	26.6	mg

				Average	
Molecular Weight Dry (Md):	29.04	29.04	29.04	29.04	lb/lbmol
Volume Water (Vwstd):	1.67	2.31	1.86	1.95	scf
Volume Gas Measured (Vmstd):	38.17	38.65	39.05	38.62	scf
Wet Fraction (Bws):	0.0419	0.0565	0.0454	0.0479	
Molecular Weight Wet (Ms):	28.6	28.4	28.5	28.5	lb/lbmol
Volume Gas Sampled (Vma):	69.3	67.8	68.4	68.5	ft^3
Stack Gas Velocity (Vs):	57.7	56.4	57.0	57.0	ft/s
Volumetric Flowrate (Qs):	58906	57418	57576	57966	scfm
Volumetric Flowrate (Qa):	97907	95691	96633	96744	scfm
Percent Isokinetic Sampling:	94.8	100.1	99.6	98.17	%
SO2 Concentration (cs):	2.52	2.56	2.56	2.55	mg/dscf
SO2 Emissions rate (pmr):	19.65	19.46	19.49	19.54	lb/h
SO3 Concentration (cs):	0.85	0.63	0.68	0.72	mg/dscf
SO3 Emissions rate (pmr):	6.64	4.77	5.19	5.54	lb/h

SUMMARY OF TEST RESULTS
BORAL BRICK PLANT #5 - FLUORIDES

	Test #4	Test #5	Test #6	
Volume @ Meter (Vm):	41.364	40.379	40.692	ft^3
Avg Sqrt Delta P:	0.784	0.775	0.770	
Sampling Time (min):	60	60	60	min
Barometric Pressure (Pbar):	30.10	30.10	30.10	inHg
Avg Delta H:	1.55	1.50	1.46	
Volume in impingers (mls):	62.0	57.7	64.1	mls
Stack Pressure (Ps):	30.15	30.14	30.13	inHg
Stack Temperature (Ts):	880	889	883	R
Meter Coefficient (Y):	0.9874	0.9874	0.9874	
Pitot Coefficient (Cp):	0.84	0.84	0.84	
Meter Temperature (Tm):	554	558	545	R
Area Stack (As):	28.27	28.27	28.27	ft^2
Area Nozzle (An):	0.000334	0.000334	0.000334	ft^2
Percent CO2 (%):	2.0	2.0	2.0	%
Percent O2 (%):	18.0	18.0	18.0	%
Percent N2 (%):	80.0	80.0	80.0	%
Fluoride (mg):	85.8	75.9	82.1	mg

				Average	
Molecular Weight Dry (Md):	29.04	29.04	29.04	29.04	lb/lbmol
Volume Water (Vwstd):	2.92	2.71	3.02	2.88	scf
Volume Gas Measured (Vmstd):	39.32	38.10	39.32	38.91	scf
Wet Fraction (Bws):	0.0691	0.0665	0.0712	0.0689	
Molecular Weight Wet (Ms):	28.3	28.3	28.3	28.3	lb/lbmol
Volume Gas Sampled (Vma):	68.7	68.3	67.7	68.2	ft^3
Stack Gas Velocity (Vs):	57.2	56.8	56.3	56.8	ft/s
Volumetric Flowrate (Qs):	58216	57260	57151	57542	scfm
Volumetric Flowrate (Qa):	97054	96441	95595	96363	scfm
Total HF (mg):	90.35	79.92	86.45	85.57	mg
HF Concentration (cs):	2.30	2.10	2.20	2.20	mg/dscf
HF Emissions rate (pmr):	17.69	15.89	16.62	16.73	lb/h
Percent Isokinetic Sampling:	101.7	100.0	103.9	101.9	%

SUMMARY OF TEST RESULTS
BORAL BRICK PLANT #5 - CHLORIDES

	Test #4	Test #5	Test #6	
Volume @ Meter (Vm):	41.364	40.379	40.692	ft^3
Avg Sqrt Delta P:	0.784	0.775	0.770	
Sampling Time (min):	60	60	60	min
Barometric Pressure (Pbar):	30.10	30.10	30.10	inHg
Avg Delta H:	1.55	1.50	1.46	
Volume in impingers (mls):	62.0	57.7	64.1	mls
Stack Pressure (Ps):	30.15	30.14	30.13	inHg
Stack Temperature (Ts):	880	889	883	R
Meter Coefficient (Y):	0.9874	0.9874	0.9874	
Pitot Coefficient (Cp):	0.84	0.84	0.84	
Meter Temperature (Tm):	554	558	545	R
Area Stack (As):	28.27	28.27	28.27	ft^2
Area Nozzle (An):	0.000334	0.000334	0.000334	ft^2
Percent CO2 (%):	2.0	2.0	2.0	%
Percent O2 (%):	18.0	18.0	18.0	%
Percent N2 (%):	80.0	80.0	80.0	%
Chloride (mg):	42.9	38.1	40.4	mg

				Average	
Molecular Weight Dry (Md):	29.04	29.04	29.04	29.04	lb/lbmol
Volume Water (Vwstd):	2.92	2.71	3.02	2.88	scf
Volume Gas Measured (Vmstd):	39.32	38.10	39.32	38.91	scf
Wet Fraction (Bws):	0.0691	0.0665	0.0712	0.0689	
Molecular Weight Wet (Ms):	28.3	28.3	28.3	28.3	lb/lbmol
Volume Gas Sampled (Vma):	68.7	68.3	67.7	68.2	ft^3
Stack Gas Velocity (Vs):	57.2	56.8	56.3	56.8	ft/s
Volumetric Flowrate (Qs):	58216	57260	57151	57542	scfm
Volumetric Flowrate (Qa):	97054	96441	95595	96363	scfm
Total HCl (mg):	44.10	39.17	41.53	41.60	mg
HCl Concentration (cs):	1.12	1.03	1.06	1.07	mg/dscf
HCl Emissions rate (pmr):	8.64	7.79	7.99	8.14	lb/h
Percent Isokinetic Sampling:	101.7	100.0	103.9	101.9	%

STACK TEST FIELD SHEET

PLANT: BORAL BRICK-PLANT #5

DATE: NOVEMBER 8, 1994

REPETITION: 1

SOURCE: KILN EXHAUST

OPERATOR: JP LLOYD

SAMPLE BOX: 1

METER BOX: 1

AMBIENT TEMPERATURE: 55 F

BAROMETRIC PRESSURE: 30.1 inHg

ASSUMED MOISTURE: 10 %

PROBE LENGTH: 89 inches

NOZZLE DIAMET 0.24733 inches

STACK DIAMETE 72 inches

METER H : 1.804

C FACTOR: 0.84

METER COEF.(GAMMA): 0.9874

PROGRAM SETTINGS

STO 0: 0.79731

STO 1: 3.2248

STO 2: 2.5

STO 3: 607.386

IMPINGERS

		INITIAL	FINAL
#1:	100 ml 80% IPA		42
#2:	100 ml 3% H2O2		131
#3:	100 ml 3% H2O2		129
#4:	216.8 g SILICA GEL		250.3
#5:			
#6:			

FILTER WEIGHTS

TARE WEIGHT: 0.3524

DRIED FILTER: 0.3682

PROBE WASH: 0.00256

GAS ANALYSIS

%O: 18

%CO: 0

%CO2: 2

%N2: 80

Md: 29.04

Ms: 27.936

STACK TEST DATA SHEET

PLANT: BORAL BRICK-PLANT #5
DATE: NOVEMBER 8, 1994
REPETITION: 1

PRE-TEST LEAK CHECK
METER: 0 VACUUM: 15
PITOTS: (+) 1.5
(-) 1.6

POST-TEST LEAK CHECK
METER: 0 VACUU 9
PITOTS: (+) ----
(-) ----

POINT # B/A	CLOCK TIME	STATIC PRESS	PITOT P	ORIFICE H DESIRED	ORIFICE H ACTUAL	DRY GAS METER V DESIRED	DRY GAS METER V ACTUAL	STACK TEMP	PROBE TEMP	FILTER BOX	IMP OUTLET	DGM TEMP INLET	DGM TEMP OUTLET	VACUUM (inHg)
1	8:38:00	0.65	0.35	0.72	0.72	607.386	607.386	394	248	255	54	57	56	3
2			0.42	0.86	0.86	608.6	608.5	403	250	248	47	57	56	3
3			0.42	0.86	0.86	609.9	609.8	413	249	248	47	58	57	3
4			0.43	0.88	0.88	611.1	611.1	412	248	250	46	59	57	3
5			0.38	0.78	0.77	612.5	612.5	441	249	251	47	60	57	3
6			0.43	0.88	0.88	613.7	613.7	447	248	250	49	61	58	3
7			0.72	1.48	1.48	615.0	614.9	454	248	250	50	62	58	4
8			0.78	1.60	1.6	616.7	616.6	457	248	251	52	64	59	4
9			1.1	2.26	2.26	618.4	618.3	389	250	251	56	67	60	4.5
10			0.84	1.72	1.72	620.5	620.4	411	251	250	60	68	60	4.5
11			0.88	1.80	1.8	622.4	622.2	397	251	251	67	69	61	4.5
12			0.75	1.54	1.53	624.2	624.1	393	251	249	73	70	62	4.5
1			1.1	2.26	2.25	626.0	625.8	404	248	249	67	64	62	5
2			1.05	2.15	2.15	628.0	627.9	410	249	249	73	68	63	5
3			0.95	1.95	1.95	630.1	629.9	414	248	250	76	69	63	5
4			0.89	1.82	1.82	632.0	631.9	416	250	250	76	69	63	5
5			0.72	1.48	1.48	633.9	633.8	418	251	249	77	70	64	5
6			0.54	1.11	1.11	635.6	635.5	419	248	247	77	70	64	4
7			0.53	1.09	1.09	637.1	636.9	421	252	249	76	70	64	3.5
8			0.48	0.98	1.04	638.5	638.4	423	248	250	77	70	65	3.5
9			0.45	0.92	0.92	639.9	639.8	422	250	250	76	72	66	3.5
10			0.46	0.94	0.94	641.2	641.1	422	249	248	75	71	65	3.5
11			0.53	1.09	1.08	642.6	642.5	423	249	250	75	72	66	3.5
12			0.52	1.07	1.07	644.0	643.9	419	250	251	76	73	67	3.5
						645.479	645.396							
AVG	60	0.65	0.7963		1.344		38.01	417.583					63.8125	

STACK TEST FIELD SHEET

PLANT: BORAL BRICK-PLANT #5

DATE: NOVEMBER 8, 1994

REPETITION: 2

SOURCE: KILN EXHAUST

OPERATOR: JP LLOYD

SAMPLE BOX: 1

METER BOX: 1

AMBIENT TEMPERATURE: 76 F

BAROMETRIC PRESSURE: 30.1 inHg

ASSUMED MOISTURE: 4 %

PROBE LENGTH: 89 inches

NOZZLE DIAMETE 0.247333 inches

STACK DIAMETER 72 inches

METER H : 1.804

C FACTOR: 0.84

METER COEF.(GAMMA): 0.98742

PROGRAM SETTINGS

STO 0: 0.85719

STO 1: 3.2248

STO 2: 2.5

STO 3: 650.578

IMPINGERS

		INITIAL	FINAL
#1:	100 ml 80% IPA		52
#2:	100 ml 3% H2O2		136
#3:	100 ml 3% H2O2		131
#4:	207.3 g SILICA GEL		237.5
#5:			
#6:			

FILTER WEIGHTS

TARE WEIGHT: 0.3479

DRIED FILTER: 0.3632

PROBE WASH: 0.00293

GAS ANALYSIS

%O: 18

%CO: 0

%CO2: 2

%N2: 80

Md: 29.04

Ms: 28.5984

STACK TEST DATA SHEET

PLANT: BORAL BRICK-PLANT #5
DATE: NOVEMBER 8, 1994
REPETITION: 2

PRE-TEST LEAK CHECK
METER: 0.002 VACUUM: 15
PITOTS: (+) 6.2
(-) 6.6

POST-TEST LEAK CHECK
METER: 0 VACUUM 12
PITOTS: (+) ----
(-) ----

POINT # A/B	CLOCK TIME	STATIC PRESS	PITOT P	ORIFICE H DESIRED	ORIFICE H ACTUAL	DRY GAS METER DESIRED	DRY GAS METER ACTUAL	STACK TEMP	PROBE TEMP	FILTER BOX	IMP OUTLET	DGM TEMP INLET	DGM TEMP OUTLET	VACUUM (inHg)
1	10:36:00	0.68	1.05	2.49	2.49	650.578	650.578	422	255	244	68	74	73	3.5
2			0.94	2.23	2.23	652.8	652.8	428	248	256	59	76	76	3.5
3			0.91	2.16	2.15	654.9	654.8	432	250	252	59	78	76	3.5
4			0.81	1.92	1.92	656.9	656.9	456	251	249	65	81	77	3.5
5			0.68	1.61	1.61	658.8	658.8	463	251	248	68	81	76	3
6			0.69	1.63	1.63	660.6	660.6	466	249	250	71	82	77	3
7			0.53	1.26	1.26	662.4	662.4	368	248	251	75	84	78	3
8			0.48	1.14	1.14	663.9	663.9	416	248	248	76	83	77	2.5
9			0.44	1.04	1.04	665.4	665.4	418	250	249	78	85	78	2.5
10			0.45	1.07	1.06	666.8	666.8	404	251	250	75	85	79	2.5
11			0.49	1.16	1.16	668.3	668.3	403	251	250	75	86	80	3
12			0.51	1.21	1.21	669.8	669.8	402	251	250	76	88	81	3
1			0.35	0.83	0.83	671.3	671.3	407	250	250	68	86	82	2
2			0.36	0.85	0.85	672.6	672.6	409	250	250	66	86	82	2.5
3			0.38	0.90	0.9	673.9	673.8	414	248	249	64	87	83	2.5
4			0.42	1.00	0.99	675.2	675.2	413	250	247	59	84	80	2.5
5			0.4	0.95	0.95	676.6	676.6	414	250	246	59	83	81	2.5
6			0.41	0.97	0.97	677.9	677.9	419	249	247	59	84	82	2.5
7			0.68	1.61	1.61	679.3	679.3	423	252	250	60	88	84	3
8			0.78	1.85	1.85	681.1	681.1	424	248	251	61	89	84	3
9			0.76	1.80	1.8	683.0	682.9	423	248	251	62	91	84	3
10			0.8	1.90	1.89	684.8	684.8	422	249	251	62	91	85	3
11			0.78	1.85	1.84	686.7	686.7	420	249	250	61	93	86	3
12			0.71	1.68	1.68	688.6	688.6	414	251	252	61	94	86	3
						690.440	690.44							
AVG	60	0.68	0.775052		1.461		39.862	419.9583					82.60417	

STACK TEST FIELD SHEET

PLANT: BORAL BRICK-PLANT #5

DATE: NOVEMBER 8, 1994

REPETITION: 3

SOURCE: KILN EXHAUST

OPERATOR: JP LLOYD

SAMPLE BOX: 1

METER BOX: 1

AMBIENT TEMPERATURE: 72 F

BAROMETRIC PRESSURE: 30.1 inHg

ASSUMED MOISTURE: 4 %

PROBE LENGTH: 89 inches

NOZZLE DIAMETE 0.247333 inches

STACK DIAMETER 72 inches

METER H : 1.804

C FACTOR: 0.84

METER COEF.(GAMMA): 0.98742

PROGRAM SETTINGS

STO 0: 0.869615

STO 1: 3.2248

STO 2: 2.5

STO 3: 695.407

IMPINGERS

	INITIAL	FINAL
#1:	100 ml 80% IPA	51
#2:	100 ml 3% H2O2	133
#3:	100 ml 3% H2O2	127
#4:	206.6 g SILICA GEL	235.1
#5:		
#6:		

FILTER WEIGHTS

TARE WEIGHT: 0.3507

DRIED FILTER: 0.3636

PROBE WASH: 0.00146

GAS ANALYSIS

%O: 18

%CO: 0

%CO2: 2

%N2: 80

Md: 29.04

Ms: 28.5984

STACK TEST DATA SHEET

PLANT: BORAL BRICK-PLANT #5
DATE: NOVEMBER 8, 1994
REPETITION: 3

PRE-TEST LEAK CHECK
METER: 0.003 VACUUM: 15
PITOTS: (+) 2.8
(-) 3.1

POST-TEST LEAK CHECK
METER: 0 VACUUM 8
PITOTS: (+) ---
(-) ---

POINT # B/A	CLOCK TIME	STATIC PRESS	PITOT P	ORIFICE H DESIRED	ORIFICE H ACTUAL	DRY GAS METER DESIRED	DRY GAS METER ACTUAL	STACK TEMP	PROBE TEMP	FILTER BOX	IMP OUTLET	DGM TEMP INLET	DGM TEMP OUTLET	VACUUM (inHg)
1	12:10:00	0.67	0.39	0.96	0.92	695.407	695.407	408	248	249	59	86	84	3
2			0.39	0.96	0.92	696.8	696.7	418	250	250	56	87	86	3
3			0.41	1.00	0.97	698.1	698.1	419	250	248	53	87	86	3
4			0.41	1.00	0.97	699.5	699.5	421	251	248	53	89	86	3
5			0.42	1.02	1	700.9	700.8	424	248	250	53	89	86	3
6			0.42	1.02	1.02	702.3	702.2	425	249	248	55	89	86	3
7			0.74	1.80	1.8	703.7	703.6	430	248	246	58	90	86	4
8			0.82	2.00	1.99	705.6	705.5	431	250	248	61	91	86	4
9			0.79	1.93	1.92	707.6	707.5	430	250	248	63	90	86	4
10			0.81	1.98	1.98	709.5	709.4	428	248	248	68	90	86	4
11			0.86	2.10	2.1	711.5	711.4	426	249	247	75	90	86	4
12			0.61	1.49	1.48	713.5	713.4	448	251	248	83	90	86	4
1			0.99	2.41	2.41	715.2	715.1	465	250	248	80	88	85	5
2			0.96	2.34	2.34	717.3	717.23	470	252	250	74	89	86	5
3			1	2.44	2.44	719.5	719.36	418	248	250	70	90	86	5
4			0.82	2.00	1.99	721.6	721.53	427	251	250	68	91	86	4.5
5			0.66	1.61	1.61	723.6	723.5	416	249	249	66	91	86	4
6			0.6	1.46	1.46	725.4	725.3	416	248	250	63	91	86	4
7			0.53	1.29	1.29	727.1	726.9	418	250	251	62	92	87	3.5
8			0.52	1.27	1.27	728.6	728.5	418	250	252	62	92	87	3.5
9			0.47	1.15	1.15	730.2	730.1	418	250	250	62	93	87	3
10			0.5	1.22	1.22	731.7	731.6	418	248	250	60	94	88	3.5
11			0.53	1.29	1.29	733.2	733.1	417	249	251	59	94	88	3
12			0.4	0.98	0.98	734.8	734.7	419	250	250	60	93	88	3
						736.188	736.09							
AVG	60	0.67	0.781597		1.522		40.683	426.1667					88.25	

STACK TEST FIELD SHEET

PLANT: BORAL BRICK-PLANT #5

DATE: NOVEMBER 8, 1994

REPETITION: 4

SOURCE: KILN EXHAUST

OPERATOR: JP LLOYD

SAMPLE BOX: 1

METER BOX: 1

AMBIENT TEMPERATURE: 81.2 F

BAROMETRIC PRESSURE: 30.1 inHg

ASSUMED MOISTURE: 4 %

PROBE LENGTH: 89 inches

NOZZLE DIAMETE 0.247333 inches

STACK DIAMETER 72 inches

METER H : 1.804

C FACTOR: 0.84

METER COEF.(GAMMA): 0.98742

PROGRAM SETTINGS

STO 0: 0.884899

STO 1: 3.2248

STO 2: 2.5

STO 3: 741.402

IMPINGERS

		INITIAL	FINAL
#1:	100 ml 1N H2SO4		133
#2:	100 ml 1N H2SO4		115
#3:	100 ml 1N NaOH		105
#4:	100 ml 1N NaOH		100
#5:	218.9 g SILICA GEL		227.9
#6:			

FILTER WEIGHTS

TARE WEIGHT: 0.3486

DRIED FILTER: 0.3613

PROBE WASH: 0.00195

GAS ANALYSIS

%O: 18

%CO: 0

%CO2: 2

%N2: 80

Md: 29.04

Ms: 28.5984

STACK TEST DATA SHEET

PLANT: BORAL BRICK-PLANT #5
DATE: NOVEMBER 8, 1994
REPETITION: 4

PRE-TEST LEAK CHECK
METER: 0 VACUUM: 15
PITOTS: (+) 5.1
(-) 6.7

POST-TEST LEAK CHECK
METER: 0 VACUUM 9.5
PITOTS: (+) ----
(-) ----

POINT # A/B	CLOCK TIME	STATIC PRESS	PITOT P	ORIFICE H DESIRED	ORIFICE H ACTUAL	DRY GAS METER DESIRED	DRY GAS METER ACTUAL	STACK TEMP	PROBE TEMP	FILTER BOX	IMP OUTLET	DGM TEMP INLET	DGM TEMP OUTLET	VACUUM (inHg)
1	11:55:00	0.67	1.15	2.90	2.8	741.402	741.402	406	250	248	68	90	86	5
2			1.15	2.90	2.8	743.8	743.7	413	249	249	53	90	89	5
3			0.95	2.40	2.32	746.1	746.1	418	250	248	53	91	89	5
4			0.87	2.20	2.12	748.3	748.2	420	251	250	55	92	89	5
5			0.71	1.79	1.73	750.4	750.2	422	251	249	57	93	90	5
6			0.61	1.54	1.49	752.2	752	422	250	249	58	94	90	4
7			0.44	1.11	1.14	754.0	753.7	423	248	250	60	95	91	4
8			0.56	1.41	1.36	755.4	755.2	424	250	250	61	96	91	4
9			0.48	1.21	1.17	757.1	756.8	422	248	249	60	96	91	4
10			0.49	1.24	1.19	758.6	758.3	423	248	248	62	97	92	3.5
11			0.5	1.26	1.21	760.2	759.8	423	249	249	61	97	92	3.5
12			0.53	1.34	1.29	761.7	761.4	420	251	250	62	97	92	4
1			0.32	0.81	0.78	763.3	763.3	441	250	248	63	95	91	3
2			0.34	0.86	0.82	764.6	764.5	451	251	249	61	95	92	3
3			0.38	0.96	0.92	765.9	765.8	459	248	249	59	95	93	3
4			0.38	0.96	0.92	767.2	767.1	463	250	251	58	96	93	3
5			0.37	0.93	0.9	768.6	768.5	363	249	249	57	96	93	3
6			0.42	1.06	1.02	770.0	769.8	420	249	250	57	96	93	4
7			0.71	1.79	1.73	771.4	771.2	411	250	249	57	96	93	4.5
8			0.83	2.10	2.02	773.2	773.1	412	251	249	58	98	94	5
9			0.82	2.07	1.99	775.3	775	414	250	248	59	98	93	5
10			0.83	2.10	2.02	777.3	777	408	248	251	58	99	95	5
11			0.88	2.22	2.15	779.3	778.9	407	250	251	59	100	95	5
12			0.57	1.44	1.39	781.4	781	401	250	250	60	101	96	4
						783.029	782.766							
AVG	60	0.67	0.784031		1.553		41.364	420.25					93.64583	

STACK TEST FIELD SHEET

PLANT: BORAL BRICK-PLANT #5

DATE: NOVEMBER 8, 1994

REPETITION: 5

SOURCE: KILN EXHAUST

OPERATOR: JP LLOYD

SAMPLE BOX: 1

METER BOX: 1

AMBIENT TEMPERATURE: 80.5 F

BAROMETRIC PRESSURE: 30.1 inHg

ASSUMED MOISTURE: 4 %

PROBE LENGTH: 89 inches

NOZZLE DIAMETE 0.247333 inches

STACK DIAMETER 72 inches

METER H : 1.804

C FACTOR: 0.84

METER COEF.(GAMMA): 0.98742

PROGRAM SETTINGS

STO 0: 0.890028

STO 1: 3.2248

STO 2: 2.5

STO 3: 783.017

IMPINGERS

		INITIAL	FINAL
#1:	100 ml 1N H2SO4		133
#2:	100 ml 1N H2SO4		113
#3:	100 ml 1N NaOH		101
#4:	100 ml 1N NaOH		99
#5:	221.6 g SILICA GEL		233.3
#6:			

FILTER WEIGHTS

TARE WEIGHT: 0.3479

DRIED FILTER: 0.3633

PROBE WASH: 0.00376

GAS ANALYSIS

%O: 18

%CO: 0

%CO2: 2

%N2: 80

Md: 29.04

Ms: 28.5984

STACK TEST DATA SHEET

PLANT: BORAL BRICK-PLANT #5
DATE: NOVEMBER 8, 1994
REPETITION: 5

PRE-TEST LEAK CHECK
METER: 0 VACUUM: 10
PITOTS: (+) 4.9
(-) 5.5

POST-TEST LEAK CHECK
METER: 0 VACUUM 14
PITOTS: (+) ----
(-) ----

POINT # A/B	CLOCK TIME	STATIC PRESS	PITOT P	ORIFICE H DESIRED	ORIFICE H ACTUAL	DRY GAS METER DESIRED	DRY GAS METER ACTUAL	STACK TEMP	PROBE TEMP	FILTER BOX	IMP OUTLET	DGM TEMP INLET	DGM TEMP OUTLET	VACUUM (inHg)
1	3:30:00	0.54	0.97	2.48	2.36	783.017	783.017	466	248	256	75	95	95	5
2			1.05	2.68	2.56	785.2	785.1	425	250	254	61	95	97	5
3			0.92	2.35	2.24	787.5	787.4	414	248	252	61	96	97	5
4			0.88	2.25	2.15	789.6	789.5	414	248	246	64	96	97	5
5			0.7	1.79	1.71	791.7	791.5	415	248	246	67	97	96	4.5
6			0.57	1.46	1.39	793.6	793.3	416	248	250	66	97	97	4
7			0.55	1.40	1.34	795.3	794.9	418	250	250	64	96	96	3.5
8			0.54	1.38	1.32	796.9	796.6	419	250	249	65	97	96	4
9			0.48	1.23	1.17	798.5	798.2	420	250	251	62	101	99	3.5
10			0.47	1.20	1.15	800.1	799.7	419	249	249	58	99	98	3.5
11			0.49	1.25	1.19	801.6	801.2	421	249	249	58	99	98	3.5
12			0.47	1.20	1.15	803.2	802.7	417	249	250	57	100	99	3.5
1			0.37	0.95	0.9	804.7	804.2	425	251	249	59	97	98	3
2			0.39	1.00	0.95	806.0	805.5	429	251	251	56	98	99	3
3			0.4	1.02	0.98	807.4	806.9	430	250	251	53	95	97	3
4			0.41	1.05	0.99	808.8	808.2	434	249	250	53	96	98	3
5			0.4	1.02	0.98	810.3	809.6	433	248	249	53	96	97	3
6			0.52	1.33	1.27	811.7	811	429	251	251	54	97	97	3.5
7			0.42	1.07	1.02	813.3	812.6	465	250	251	55	98	98	3.5
8			0.76	1.94	1.85	814.7	813.9	473	252	250	54	97	97	4
9			0.68	1.74	1.66	816.7	815.9	477	249	251	55	100	99	4.5
10			0.8	2.04	1.95	818.5	817.7	418	248	251	55	101	100	5
11			0.77	1.97	1.88	820.5	819.6	422	250	251	55	101	100	5
12			0.8	2.04	1.95	822.4	821.5	404	250	247	56	100	99	5
						824.423	823.396							
AVG	60	0.54	0.775368		1.505		40.379	429.2917					97.66667	

STACK TEST FIELD SHEET

PLANT: BORAL BRICK-PLANT #5

DATE: NOVEMBER 8, 1994

REPETITION: 6

SOURCE: KILN EXHAUST

OPERATOR: JP LLOYD

SAMPLE BOX: 1

METER BOX: 1

AMBIENT TEMPERATURE: 78 F

BAROMETRIC PRESSURE: 30.1 inHg

ASSUMED MOISTURE: 4 %

PROBE LENGTH: 89 inches

NOZZLE DIAMETE 0.247333 inches

STACK DIAMETER 72 inches

METER H : 1.804

C FACTOR: 0.84

METER COEF.(GAMMA): 0.98742

PROGRAM SETTINGS

STO 0: 0.872186

STO 1: 3.2248

STO 2: 2.5

STO 3: 823.64

IMPINGERS

		INITIAL	FINAL
#1:	100 ml 1N H2SO4		145
#2:	100 ml 1N H2SO4		111
#3:	100 ml 1N NaOH		100
#4:	100 ml 1N NaOH		101
#5:	210.2 g SILICA GEL		217.3
#6:			

FILTER WEIGHTS

TARE WEIGHT: 0.346

DRIED FILTER: 0.3619

PROBE WASH: 0.00219

GAS ANALYSIS

%O: 18

%CO: 0

%CO2: 2

%N2: 80

Md: 29.04

Ms: 28.5984

STACK TEST DATA SHEET

PLANT: BORAL BRICK-PLANT #5
DATE: NOVEMBER 8, 1994
REPETITION: 6

PRE-TEST LEAK CHECK
METER: 0 VACUUM: 15
PITOTS: (+) 4.7
(-) 5.8

POST-TEST LEAK CHECK
METER: 0 VACUUM 10
PITOTS: (+) ----
(-) ---

POINT # B/A	CLOCK TIME	STATIC PRESS	PITOT P	ORIFICE H DESIRED	ORIFICE H ACTUAL	DRY GAS METER DESIRED	DRY GAS METER ACTUAL	STACK TEMP	PROBE TEMP	FILTER BOX	IMP OUTLET	DGM TEMP INLET	DGM TEMP OUTLET	VACUUM (inHg)
1	5:13:00	0.43	0.31	0.76	0.76	823.64	823.64	459	251	256	60	85	89	2.5
2			0.32	0.79	0.78	824.9	824.8	425	249	251	50	85	88	2.5
3			0.54	1.32	0.82	826.1	826.1	380	250	248	44	85	88	2.5
4			0.41	1.01	1.02	827.7	828.2	422	251	250	43	86	87	3
5			0.44	1.08	1.07	829.1	829.6	414	248	248	44	86	87	3
6			0.43	1.05	1.05	830.5	831	415	249	248	44	86	86	3.5
7			0.71	1.74	1.73	832.0	832.4	419	250	248	43	87	86	4
8			0.74	1.82	1.8	833.8	834.3	420	250	247	42	87	85	4
9			0.8	1.96	1.95	835.7	836.1	419	250	247	42	88	85	4.5
10			0.81	1.99	1.98	837.6	838.1	417	248	249	43	89	85	5
11			0.82	2.01	2	839.6	840	418	248	249	44	89	84	5
12			0.83	2.04	2.02	841.6	842	420	248	248	44	89	84	5
1			1.05	2.58	2.56	843.5	844	423	249	251	48	86	82	5.5
2			0.92	2.26	2.24	845.8	846	430	248	249	46	85	82	5
3			0.79	1.94	1.93	847.9	848.3	431	250	248	47	85	82	4.5
4			0.64	1.57	1.56	849.8	850.2	434	251	249	48	85	82	4
5			0.54	1.32	1.32	851.6	851.9	436	251	247	49	85	81	4
6			0.52	1.28	1.26	853.2	853.6	437	248	247	49	85	81	4
7			0.52	1.28	1.26	854.7	855.1	352	249	248	50	85	81	4
8			0.44	1.08	1.07	856.3	856.7	464	250	248	50	85	80	4
9			0.42	1.03	1.02	857.8	858.1	467	248	248	49	84	80	4
10			0.44	1.08	1.07	859.2	859.6	471	248	246	49	84	79	3.5
11			0.64	1.57	1.56	860.6	860.9	366	251	247	50	83	79	4
12			0.64	1.32	1.32	862.4	862.7	417	248	246	49	83	78	4
						863.967	864.332							
AVG	60	0.43	0.770411		1.465		40.692	423.1667					84.54167	