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REPORT ON ALDEHYDE AND KETONE TESTING

Performed for:
SOLVAY MINERALS, INC.
CA-3 & CA 1 & 2 CALCINER STACKS
GREEN RIVER, WYOMING

Client Reference No: CO2863
CAE Project No: 7747-3
Revision 0: January 7, 1996

To the best of our knowledge, the data presented in this report are accurate and complete.

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SOLVAY2016_6_001611

Project Overview

SOLVAY2016_6_001612

PROJECT OVERVIEW

Solvay Minerals contracted Clean Air Engineering to perform an air emissions test program for gas fired calciners CA 1 & 2 and for gas fired calciner CA-3. The purpose of the test program was to quantify aldehydes and ketones in the exhaust gas of the calciners. The testing took place at the CA-3 Calciner Stack on July 24, 1996 and at the CA 1 & 2 Calciner Stack on July 26, 1996. EPA Method performed was BIF (Boilers and Industrial Furnaces) Method 0011 and associated Methods 1-4.

BIF 0011 results show acrolein was biased high by contribution from acetone at both CA-3 and CA 1&2 Calciners. Acetone could not be resolved from the major acrolein peak. To determine acrolein concentration the estimated concentration of acetone was subtracted from the acrolein mass.

Test run one on CA 1 & 2 Calciner Stack was aborted due to process upset. Test runs 2 through 4 are reported.

Test run one on CA-3 Calciner was non-isokinetic. The calculated isokinetic value was 89.9 percent. Isokinetic limits are 100% ± 10%.

Coordinating the field testing were:

D. Potter - Solvay Minerals, Inc.
T. Brown - Solvay Minerals, Inc.
S. Cook - Solvay Minerals, Inc.
S. Ferguson - Clean Air Engineering

Source identifications are shown in Table 1-1 and Table 1-2.

SOLVAY2016_6_001613

PROJECT OVERVIEW

Table 1-1:
CA 3 Calciner Profile

Unit Identification Number	AQD No. 48, CA-3
Process	Calciner
Fuel	Natural Gas
Heat Content	1080 Btu/ft^3.
Stack Height	180 feet
Stack Diameter	125.5 inches
Diameters to Upstream Disturbance	Approximately 9.0
Diameters to Downstream Disturbance	Approximately 5.5
Primary Control Equipment	Flakt ESP

Table 1-2:
CA 1 & 2 Calciner Profile

Unit Identification Number	AQD No. 17, CA 1 & 2
Process	Calciner
Fuel	Natural Gas
Heat Content	1080 Btu/ft^3
Stack Height	180.5 feet
Stack Diameter	144 inches
Diameters to Upstream Disturbance	Approximately 3.6
Diameters to Downstream Disturbance	Approximately 4.4
Primary Control Equipment	2-Buell ESP

Chemical abstract service (CAS) numbers and molecular weights are listed in Table 1-3

Table 1-3:
Compound (CAS) Numbers

Compound Name	Molecular Weight	CAS No.
Acetaldehyde	44.05	75-07-0 ✓
Acetone	58.08	67-64-1
Acrolein	56.06	107-02-8 ✓
Formaldehyde	30.03	50-00-0 ✓
Propionaldehyde	58.08	123-38-6 ✓
2-Butanone (MEK)	72.10	78-93-3 ✓

A summary of test results is shown in Table 1-4.

SOLVAY2016_6_001614

PROJECT OVERVIEW

Table 1-4:
Summary of Test Results

Source Constituent	Sampling Method	Average Concentration (ppmdv)	Average Emission (lb/hr)	Average Emission (lb/ton of trona)
CA-3 Calciner Stack				
Aldehydes & Ketones	BIF 0011			
Acetaldehyde		0.18	0.08	0.0007
Acetone		0.12	0.07	0.0006
Acrolein		0.28	0.16	0.0014
Formaldehyde		0.11	0.04	0.0003
Propionaldehyde		0.04	0.03	0.0002
2-Butanone		0.04	0.03	0.0003
CA 1 & 2 Calciner Stack				
Aldehydes & Ketones	BIF 0011			
Acetaldehyde		0.33	0.34	0.0012
Acetone		0.24	0.32	0.0012
Acrolein		0.51	0.67	0.0024
Formaldehyde		0.31	0.22	0.0008
Propionaldehyde		0.08	0.11	0.0004
2-Butanone		0.11	0.18	0.0006

The test conditions and results of analysis are presented in Tables 2-1 and 2-2 on pages 2-1 and 2-2.

SOLVAY2016_6_001615

Results

RESULTS

Table 2-1: CA-3 Calciner Stack - Aldehydes and Ketones

Run No.		1	2	3	Average
Date (1996)		July 24	July 24	July 24	
Start Time (approx.)		12:38	15:10	17:38	
Stop Time (approx.)		14:45	17:17	19:46	
Process Conditions[1]					
	Feed Rate (tons/hr)	120	120	120	**120**
Gas Conditions					
T_s	Temperature (°F)	306	309	307	**308**
B_{wo}	Moisture (volume %)	28.56	28.82	29.05	**28.81**
O_2	Oxygen (dry volume %)	12.3	12.3	13.0	**12.5**
CO_2	Carbon dioxide (dry volume %)	9.3	9.7	9.3	**9.4**
Volumetric Flow Rate					
Q_a	Actual conditions (acfm)	177,500	168,800	165,400	**170,567**
Q_{std}	Standard conditions (dscfm)	70,120	66,190	64,810	**67,040**
Formaldehyde					
C	Concentration (lb/dscf)	1.14E-08	7.78E-09	6.63E-09	**8.61E-09**
C	Concentration (µg/dscm)	1.83E+02	1.25E+02	1.06E+02	**1.38E+02**
C	Concentration (ppmdv)	0.147	0.100	0.085	**0.110**
E	Emission rate (lb/hr)	0.048	0.031	0.026	**0.035**
E	Emission rate (lb/ton of trona)	0.0004	0.0003	0.0002	**0.0003**
Acetaldehyde					
C	Concentration (lb/dscf)	8.48E-09	2.89E-08	2.50E-08	**2.08E-08**
C	Concentration (µg/dscm)	1.36E+02	4.62E+02	4.00E+02	**3.33E+02**
C	Concentration (ppmdv)	0.074	0.252	0.218	**0.182**
E	Emission rate (lb/hr)	0.036	0.115	0.097	**0.082**
E	Emission rate (lb/ton of trona)	0.0003	0.0010	0.0008	**0.0007**
Propionaldehyde					
C	Concentration (lb/dscf)	3.07E-09	8.43E-09	6.95E-09	**6.15E-09**
C	Concentration (µg/dscm)	4.91E+01	1.35E+02	1.11E+02	**9.85E+01**
C	Concentration (ppmdv)	0.020	0.056	0.046	**0.041**
E	Emission rate (lb/hr)	0.013	0.033	0.027	**0.025**
E	Emission rate (lb/ton of trona)	0.0001	0.0003	0.0002	**0.0002**
Acrolein[2]					
C	Concentration (lb/dscf)	2.04E-08	5.47E-08	4.69E-08	**4.07E-08**
C	Concentration (µg/dscm)	3.27E+02	8.75E+02	7.52E+02	**6.51E+02**
C	Concentration (ppmdv)	0.140	0.376	0.323	**0.280**
E	Emission rate (lb/hr)	0.086	0.217	0.183	**0.162**
E	Emission rate (lb/ton of trona)	0.0007	0.0018	0.0015	**0.0014**
Acetone[2]					
C	Concentration (lb/dscf)	9.27E-09	2.54E-08	2.16E-08	**1.88E-08**
C	Concentration (µg/dscm)	1.48E+02	4.07E+02	3.46E+02	**3.01E+02**
C	Concentration (ppmdv)	0.061	0.169	0.143	**0.124**
E	Emission rate (lb/hr)	0.039	0.107	0.084	**0.075**
E	Emission rate (lb/ton of trona)	0.0003	0.0008	0.0007	**0.0006**
2-Butanone					
C	Concentration (lb/dscf)	4.57E-09	1.04E-08	8.21E-09	**7.72E-09**
C	Concentration (µg/dscm)	7.32E+01	1.66E+02	1.32E+02	**1.24E+02**
C	Concentration (ppmdv)	0.024	0.055	0.044	**0.041**
E	Emission rate (lb/hr)	0.019	0.041	0.032	**0.031**
E	Emission rate (lb/ton of trona)	0.0002	0.0003	0.0003	**0.0003**

[1] Process conditions provided by Solvay Minerals, Inc.
[2] Acetone and acrolein peaks unresolved. See comments in project overview.

SOLVAY2016_6_001617

RESULTS

Table 2-2:
CA 1 & 2 Calciner Stack - Aldehydes and Ketones

Run No.		2	3	4	Average
Date (1996)		July 26	July 26	July 26	
Start Time (approx.)		14:01	16:21	18:27	
Stop Time (approx.)		15:42	18:08	20:08	
Process Conditions[1]					
	Feed Rate (tons/hr)	282	280	278	**280**
Gas Conditions					
T_s	Temperature (°F)	372	372	374	**373**
B_{wo}	Moisture (volume %)	24.59	25.42	25.74	**25.25**
O_2	Oxygen (dry volume %)	14.9	14.2	13.7	**14.3**
CO_2	Carbon dioxide (dry volume %)	7.0	7.1	7.7	**7.3**
Volumetric Flow Rate					
Q_a	Actual conditions (acfm)	392,900	400,100	410,300	**401,100**
Q_{std}	Standard conditions (dscfm)	149,000	150,100	153,000	**150,700**
Formaldehyde					
C	Concentration (lb/dscf)	3.50E-08	2.32E-08	1.46E-08	**2.43E-08**
C	Concentration (µg/dscm)	5.60E+02	3.72E+02	2.34E+02	**3.89E+02**
C	Concentration (ppmdv)	0.449	0.298	0.187	**0.311**
E	Emission rate (lb/hr)	0.313	0.209	0.134	**0.219**
E	Emission rate (lb/ton of trona)	0.0011	0.0007	0.0005	**0.0008**
Acetaldehyde					
C	Concentration (lb/dscf)	3.27E-08	2.50E-08	5.58E-08	**3.78E-08**
C	Concentration (µg/dscm)	5.24E+02	4.00E+02	8.94E+02	**6.06E+02**
C	Concentration (ppmdv)	0.286	0.218	0.488	**0.331**
E	Emission rate (lb/hr)	0.293	0.225	0.512	**0.343**
E	Emission rate (lb/ton of trona)	0.0010	0.0008	0.0018	**0.0012**
Propionaldehyde					
C	Concentration (lb/dscf)	1.26E-08	9.20E-09	1.59E-08	**1.25E-08**
C	Concentration (µg/dscm)	2.01E+02	1.47E+02	2.54E+02	**2.01E+02**
C	Concentration (ppmdv)	0.083	0.061	0.105	**0.083**
E	Emission rate (lb/hr)	0.112	0.083	0.146	**0.114**
E	Emission rate (lb/ton of trona)	0.0004	0.0003	0.0005	**0.0004**
Acrolein[2]					
C	Concentration (lb/dscf)	8.46E-08	6.95E-08	6.81E-08	**7.41E-08**
C	Concentration (µg/dscm)	1.35E+03	1.11E+03	1.09E+03	**1.19E+03**
C	Concentration (ppmdv)	0.581	0.478	0.468	**0.509**
E	Emission rate (lb/hr)	0.756	0.626	0.625	**0.669**
E	Emission rate (lb/ton of trona)	0.0027	0.0022	0.0022	**0.0024**
Acetone[2]					
C	Concentration (lb/dscf)	3.97E-08	3.43E-08	3.37E-08	**3.59E-08**
C	Concentration (µg/dscm)	6.35E+02	5.50E+02	5.39E+02	**5.75E+02**
C	Concentration (ppmdv)	0.263	0.228	0.223	**0.238**
E	Emission rate (lb/hr)	0.354	0.309	0.309	**0.324**
E	Emission rate (lb/ton of trona)	0.0013	0.0011	0.0011	**0.0012**
2-Butanone					
C	Concentration (lb/dscf)	2.38E-08	1.66E-08	1.85E-08	**1.96E-08**
C	Concentration (µg/dscm)	3.81E+02	2.67E+02	2.96E+02	**3.14E+02**
C	Concentration (ppmdv)	0.127	0.089	0.099	**0.105**
E	Emission rate (lb/hr)	0.213	0.150	0.169	**0.177**
E	Emission rate (lb/ton of trona)	0.0008	0.0005	0.0006	**0.0006**

[1] Process conditions provided by Solvay Minerals, Inc.
[2] Acetone and acrolein peaks unresolved. See comments in project overview.

SOLVAY2016_6_001618

Description of Installation

SOLVAY2016_6_001619

DESCRIPTION OF INSTALLATION

Solvay Minerals, Inc., located near Green River, Wyoming, is a mine and refinery with corporate offices in Houston, Texas. Soda ash operations at the Green River, Wyoming facility began initial production in May of 1982. On May 27, 1992 Solvay S.A. of Belgium purchased the Green River facilities from Tenneco, Inc. and changed the name to Solvay Minerals, Inc.

The primary raw material for the Green River facility is sodium sesquicarbonate which is commonly referred to as trona. The trona is mined at the plant site from an ore bed located 1,500 feet below the surface. The trona is hoisted to the surface before refining into soda ash and other sodium-based products.

The caustic/sulfite system is fed unfiltered saturated sodium carbonate solution from the soda ash process. Insolubles are separated by settling and filtration. At this point the caustic carbonate liquor is reacted with lime forming caustic soda. The remaining sodium carbonate liquor is reacted with sulfur dioxide forming sodium sulfite. At the completion of the refining process the caustic soda and the sodium sulfite are stored pending shipment.

The trona that is fed to the soda ash calciners is heated, resulting in thermal calcination of the sodium sesquicarbonate forming a crude soda ash. The crude soda ash is dissolved in water and the insolubles are separated from the solution by settling and filtration. The insolubles are disposed of in the mine void. The high-purity saturated solution of sodium carbonate is then fed to crystallizers where a large amount of water is removed and a slurry of sodium carbonate monohydrate crystals is formed. This slurry is then further dewatered and washed by a series of cyclones and centrifuges. The resulting monohydrate crystals are fed through dryers forming a high quality soda ash, which then is ready for storage and shipment.

The facility is equipped with baghouses, scrubbers and electrostatic precipitators (ESP) to control emissions.

A schematic of the process shown in Figure 3-1.

SOLVAY2016_6_001620

DESCRIPTION OF INSTALLATION

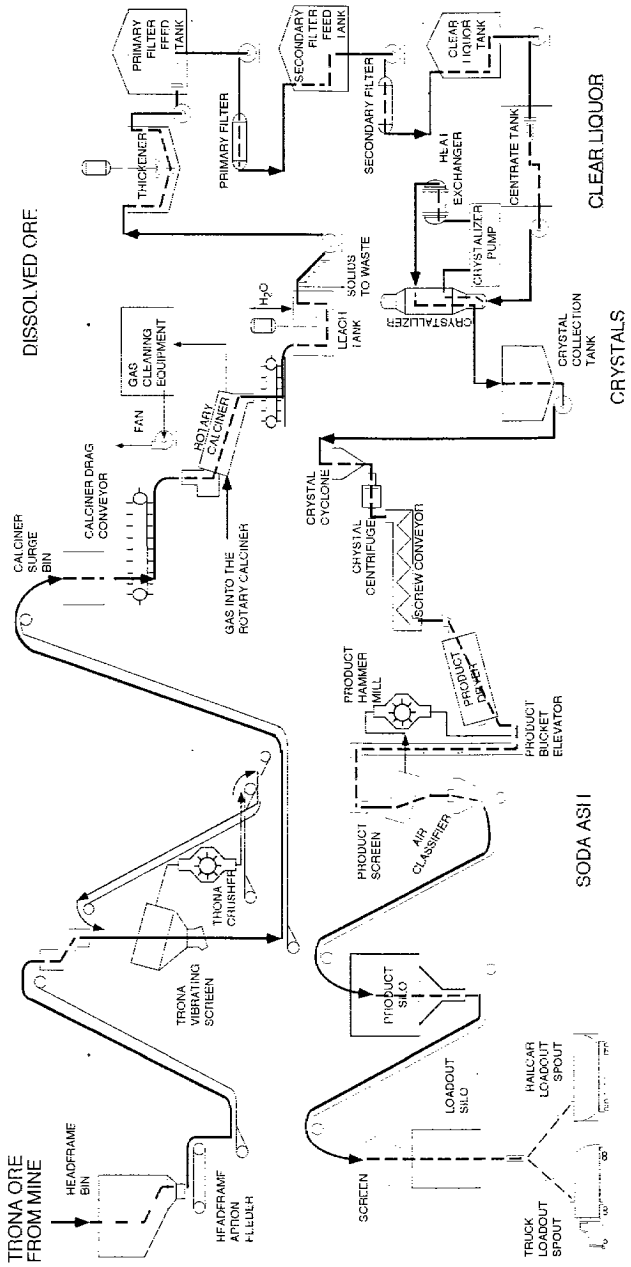


Figure 3-1: Process Schematic

SOLVAY2016_6_001621

Methodology

METHODOLOGY

The sampling followed procedures as detailed in U.S. Environmental Protection Agency (EPA) Methods 1, 2, 3, 4 and BIF 0011. The following table summarizes the methods and their respective sources.

Table 4-1:
Summary of Sampling Procedures

Title 40 CFR Part 60 Appendix A	
Method 1	"Sample and Velocity Traverses for Stationary Sources"
Method 2	"Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)"
Method 3	"Gas Analysis for the Determination of Dry Molecular Weight"
Method 4	"Determination of Moisture Content in Stack Gases"
Title 40 CFR Part 266 Appendix IX	
Method 0011	"Sampling for Aldehyde and Ketone Emissions from Stationary Sources"

These methods appear in detail in Title 40 of the Code of Federal Regulations (CFR).

These sampling, recovery and analytical procedures are summarized on pages 4-2 through 4-7.

All equipment was calibrated at the Clean Air Engineering laboratory prior to shipment to the job site. A post calibration was performed on each meter box at the conclusion of testing to verify that calibration was maintained throughout the test program. Calibration sheets can be found in Appendix Section C.

SOLVAY2016_6_001623

METHODOLOGY

SAMPLING POINT DETERMINATION

Sampling point locations were determined according to EPA Method 1.

Table 4-2 outlines the sampling point configurations. Figure 4-1 through 4-2 illustrate the sampling points and orientation of sampling ports for each of the sources tested in the program.

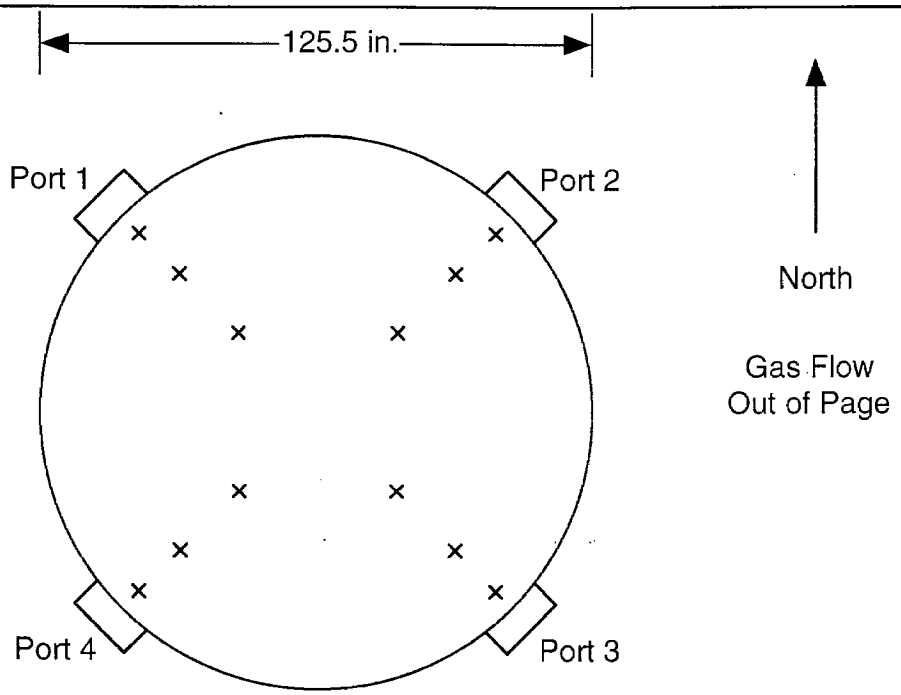
Table 4-2:
Sampling Points

Location	Constituent	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
CA-3 Stack	Aldehydes/Ketones	1-3	4	3	10	120	4-1
CA 1 & 2 Stack	Aldehydes/Ketones	2-4	4	6	4	96	4-2

SOLVAY2016_6_001624

METHODOLOGY

SAMPLING POINT DETERMINATION (CONTINUED)



Sampling Point	Port to Point Distance (in.)
1	37.1
2	18.3
3	5.5

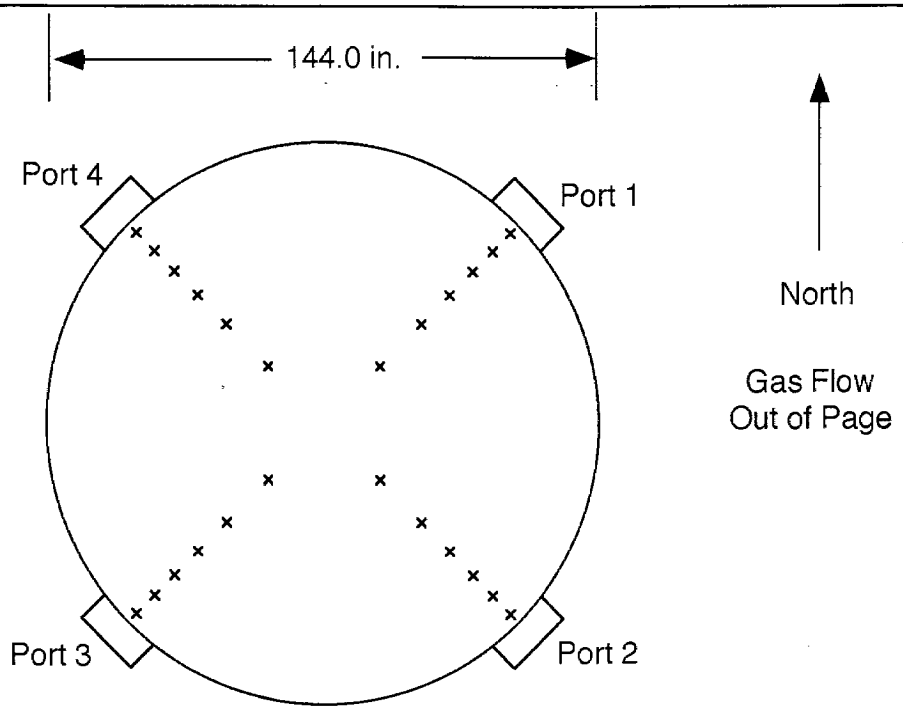
Diameters to upstream disturbance: 9.0 Limit: 2.0
Diameters to downstream disturbance: 5.5 Limit: 0.5

Figure 4-1: CA-3 Calciner Stack Sampling Point Determination (Method 0011)

SOLVAY2016_6_001625

METHODOLOGY

SAMPLING POINT DETERMINATION (CONTINUED)



Sampling Point	Port to Point Distance (in.)
1	51.3
2	36.0
3	25.5
4	17.0
5	9.6
6	3.0

Diameters to upstream disturbance: 3.6 Limit: 2.0
Diameters to downstream disturbance: 4.4 Limit: 0.5

Figure 4-2: CA 1 & 2 Calciner Stack Sampling Point Determination (Method 0011)

SOLVAY2016_6_001626

METHODOLOGY

VELOCITY AND VOLUMETRIC FLOW RATE - EPA METHOD 2

EPA Method 2 was used, in conjunction with aldehydes and ketones testing, to determine the gas velocity and flow rate at the test locations. Figure 4-3 includes the components of the EPA Method 2 sampling apparatus.

Each set of velocity determinations included the measurement of gas velocity pressure and gas temperature at each of the EPA Method 1 traverse points. The velocity pressures were measured with a Type S pitot tube. Gas temperature measurements were made using a Type K thermocouple and digital pyrometer.

GAS COMPOSITION AND MOLECULAR WEIGHT - EPA METHOD 3

In order to determine the oxygen (O_2) concentration, carbon dioxide (CO_2) concentration and gas molecular weight, a time-integrated sample of the gas was obtained and analyzed in accordance with EPA Method 3. The gas sample was collected into a vinyl sample bag from the aldehydes and ketones testing. The contents of the bag were analyzed for O_2 and CO_2 concentrations using an Orsat gas analyzer.

MOISTURE CONTENT - EPA METHOD 4

The flue gas moisture content at the test locations was determined in accordance with EPA Method 4, in conjunction with aldehydes and ketones testing. Figure 4-3 includes the components of the EPA Method 4 sampling apparatus. The gas moisture was determined by quantitatively condensing the water in chilled impingers. The amount of moisture condensed was determined gravimetrically. A dry gas meter was used to measure the volume of gas sampled. The amount of water condensed and the volume of gas sampled were used to calculate the gas moisture content in accordance with EPA Method 4.

SOLVAY2016_6_001627

METHODOLOGY

ALDEHYDE AND KETONE EMISSIONS - BIF METHOD 0011

BIF Method 0011 was used to measure aldehydes and ketones at the CA-3 Calciner Stack and at the CA 1 & 2 Calciner Stack. The method utilizes the reaction of formaldehyde with 2,4-dinitrophenylhydrazine (DNPH) to form the stable formaldehyde dinitrophenylhydrazone derivative. The derivative is extracted, solvent-exchanged, concentrated, and then analyzed by high performance liquid chromatography (HPLC).

Figure 4-3 shows the major components of the BIF 0011 sampling train. The sampling train contained a glass-lined temperature-controlled probe equipped with a pitot tube (for measuring stack gas flow rate) and a sharp-edged glass button-hook nozzle. The exit of the probe was connected directly to a series of four full size impingers. The first two impingers each contained 100 milliliters of 2, 4-DNPH. The third impinger was dry, and the fourth contained 300 grams of silica gel. The impingers were immersed in an ice bath for the duration of each test.

Procedures for selecting sampling locations and for operation of the train were derived from EPA Method 5 and associated Methods 1 through 4. The sampling train was leak-checked before and after each test run. Sampling was performed isokinetically (within ±10%) at each traverse point.

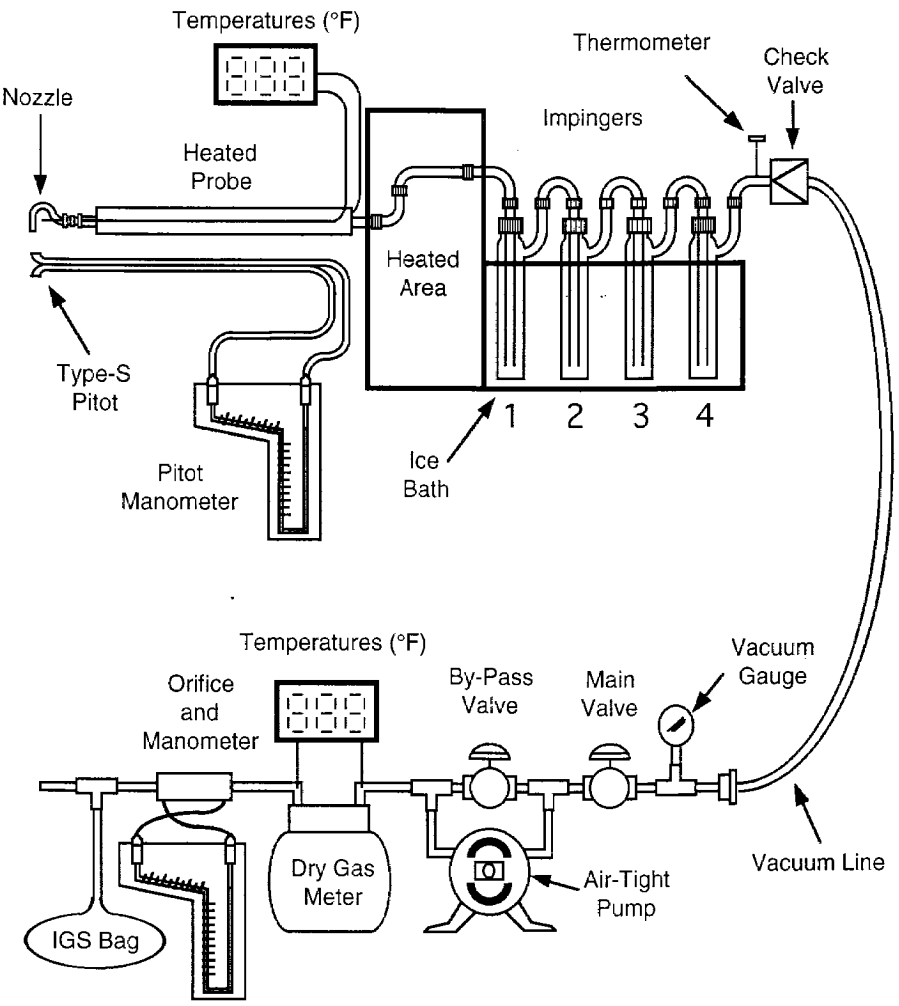
At the conclusion of each test run, the probe and nozzle were rinsed and brushed with methylene chloride, which was collected into a glass sample container. The volumes of the first three impinger solutions were measured, and the solutions transferred to a glass container. The impingers were quantitatively rinsed with methylene chloride and HPLC water. These rinses were collected along with the impinger solutions.

Analysis of the collected samples was performed by Zenon Environmental Laboratories located in Burlington Ontario. The impinger contents and rinses from the sampling trains were analyzed for aldehydes and ketones in accordance with BIF 0011 procedures. The solutions were extracted with methylene chloride, and the DNPH-formaldehyde derivative was determined using reverse phase high performance liquid chromatography with an ultraviolet (UV) absorption detector operating at 360 nanometers. Identification and quantification of compounds in the samples were done by comparison of retention times and area counts, respectively, with those of standard samples.

SOLVAY2016_6_001628

METHODOLOGY

FORMALDEHYDE EMISSIONS (CONTINUED)



Impinger Contents
1) 100 ml DNPH
2) 100 ml DNPH
3) empty
4) 300 g silica gel

Figure 4-3: Aldehyde and Ketone Sampling Apparatus (BIF Method 0011)

SOLVAY2016_6_001629

Appendix

APPENDIX

SAMPLE CALCULATIONS ..... A
PARAMETERS ..... B
CALIBRATION DATA C
FIELD DATA ..... D
FIELD DATA PRINTOUTS ..... E
LABORATORY DATA ..... F
CHAIN OF CUSTODY ..... G
OPERATING DATA ..... H

A

SAMPLE CALCULATIONS

A

SAMPLE CALCULATIONS (CONTINUED)

3. Sample gas pressure (in. Hg)

$$P_s = P_{bar} + \left(\frac{P_g}{13.6}\right)$$

$$= 23.75 + \left(\frac{-0.3}{13.6}\right)$$

$$= 23.73 \text{ in. Hg}$$

Where:

P_{bar}	barometric pressure (in. Hg)
P_g	sample gas static pressure (in. H_2O)
P_s	absolute sample gas pressure (in. Hg)
13.6	conversion factor (in. H_2O/in. Hg)

4. Actual vapor pressure (in. Hg)[1]

$$P_v = P_s$$

$$= 23.73 \text{ in. Hg}$$

Where:

P_v	vapor pressure, actual (in. Hg)
P_s	absolute sample gas pressure (in. Hg)

5. Moisture content (%)

$$B_{wo} = \frac{V_{wstd}}{V_{mstd} + V_{wstd}}$$

$$= \frac{17.15}{50.32 + 17.15}$$

$$= 0.2542$$

$$\times 100\% = 25.42\ \%$$

Where:

B_{wo}	proportion of water vapor in the gas stream by volume (%)
V_{mstd}	volume of gas sample through the dry gas meter at standard conditions (ft^3)
V_{wstd}	volume of water collected at standard conditions (ft^3)

SAMPLE CALCULATIONS (CONTINUED)

6. Saturated moisture content (%)

$$B_{ws} = \frac{(P_v)}{(P_s)}$$

$$= \frac{(23.73)}{(23.73)}$$

$$= 1.0$$

$$\times 100\% = 100.0\ \%$$

Where:

B_{ws}	proportion of water vapor in the gas stream by volume at saturated conditions (%)
P_s	absolute sample gas pressure (in. Hg)
P_v	vapor pressure, actual (in. Hg)

Whichever moisture value is smaller is used for B_{wo} in the following calculations.

7. Molecular weight of dry gas stream (lb/lb·mole)

$$M_d = M_{CO_2}\frac{(CO_2)}{(100)} + M_{O_2}\frac{(O_2)}{(100)} + M_{CO+N_2}\frac{(CO+N_2)}{(100)}$$

$$= 44.0\frac{(7.1)}{(100)} + 32.0\frac{(14.2)}{(100)} + 28.0\frac{(78.7)}{(100)}$$

$$= 29.70\ \frac{lb}{lb \cdot mole}$$

Where:

M_d	dry molecular weight of sample gas (lb/lb·mole)
M_{CO_2}	molecular weight of carbon dioxide (lb/lb·mole)
M_{O_2}	molecular weight of oxygen (lb/lb·mole)
$M_{CO}+N_2$	molecular weight of carbon monoxide and nitrogen (lb/lb·mole)
CO_2	proportion of carbon dioxide in the gas stream by volume (%)
O_2	proportion of oxygen in the gas stream by volume (%)
$CO+N_2$	proportion of carbon monoxide and nitrogen in the gas stream by volume (%)
100	conversion factor (%)

SAMPLE CALCULATIONS (CONTINUED)

8. Molecular weight of sample gas (lb/lb·mole)

$$M_s = (M_d)(1 - B_{wo}) + (M_{H_2O})(B_{wo})$$
$$= (29.70)(1 - 0.2542) + (18.0)(0.2542)$$
$$= 26.73 \frac{\text{lb}}{\text{lb} \cdot \text{mole}}$$

Where:

B_{wo}	proportion of water vapor in the gas stream by volume
M_d	dry molecular weight of sample gas (lb/lb·mole)
M_{H_2O}	molecular weight of water (lb/lb·mole)
M_s	molecular weight of sample gas, wet basis (lb/lb·mole)

9. Velocity of sample gas (ft/sec)

$$V_s = (K_p)(C_P)\left(\overline{\sqrt{\Delta P}}\right)\left(\sqrt{\frac{(\overline{T_s} + 460)}{(M_s)(P_s)}}\right)$$
$$= (85.49)(0.84)(0.717)\left(\sqrt{\frac{(372 + 460)}{(26.73)(23.73)}}\right)$$
$$= 59.0 \frac{\text{ft}}{\text{sec}}$$

Where:

K_p	velocity pressure coefficient (dimensionless)
C_p	pitot tube constant
M_s	molecular weight of sample gas, wet basis (lb/lb·mole)
P_s	absolute sample gas pressure (in. Hg)
T_s	average sample gas temperature (°F)
V_s	sample gas velocity (ft/sec)
$\sqrt{\Delta P}$	average square roots of velocity heads of sample gas (in. H_2O)
460	°F to °R conversion constant

10. Total flow of sample gas (acfm)

$$Q_a = (60)(A_s)(V_s)$$
$$= (60)(113.10)(59.0)$$
$$= 400{,}100 \text{ acfm}$$

Where:

A_s	cross sectional area of sampling location (ft^2)
Q_a	volumetric flow rate at actual conditions (acfm)
V_s	sample gas velocity (ft/sec)
60	conversion factor (sec/min)

SAMPLE CALCULATIONS (CONTINUED)

11. Total flow of sample gas (dscfm)

$$Q_{std} = \frac{(Q_a)(P_s)(17.64)(1-B_{wo})}{(\overline{T_s}+460)}$$

$$= \frac{(400{,}100)(23.73)(17.64)(1-0.2542)}{(372+460)}$$

$$= 150{,}100 \text{ dscfm}$$

Where:

B_{wo}	proportion of water vapor in the gas stream by volume
P_s	absolute sample gas pressure (in. Hg)
Q_a	volumetric flow rate at actual conditions (acfm)
Q_{std}	volumetric flow rate at standard conditions, dry basis (dscfm)
T_s	average sample gas temperature (°F)
17.64	conversion factor (°R/in. Hg)
460	°F to °R conversion constant

12. Formaldehyde concentration (µg/dscm)[1]

$$C_{\mu g/dscm} = \frac{(m_n)}{(V_{mstd})}(35.31)$$

$$= \frac{(530)}{50.32}(35.31)$$

$$= 3.72E^{+02}\ \frac{\mu g}{dscm}$$

Where:

$C_{\mu g/dscm}$	concentration (µg/dscm)
m_n	net mass of formadehyde collected (µg)
V_{mstd}	volume of gas sample through the dry gas meter at standard conditions (ft^3)
35.31	conversion factor (ft^3/m^3)

[1] The calculations for other aldehydes and ketones are performed in a similar manner.

SAMPLE CALCULATIONS (CONTINUED)

13. Formaldehyde concentration (lb/dscf)[1]

$$C_{lb/dscf} = \frac{(m_n)}{(V_{mstd})(4.5359E^{+08})}$$

$$= \frac{(530)}{(50.32)(4.5359E^{+08})}$$

$$= 2.32E^{-08}\ \frac{lb}{dscf}$$

Where:

$C_{lb/dscf}$	concentration (lb/dscf)
m_n	net mass of formadehyde collected (µg)
V_{mstd}	volume of gas sample through the dry gas meter at standard conditions (ft^3)
$4.5359E^{+08}$	conversion factor (µg/lb)

14. Formaldehyde emission (lb/hr)

$$E_{lb/hr} = (C_{lb/dscf})(Q_{std})(60)$$

$$= (2.32E^{-08})(150,100)(60)$$

$$= 0.209\ \frac{lb}{hr}$$

Where:

$C_{lb/dscf}$	concentration (lb/dscf)
Q_{std}	volumetric flow rate at standard conditions, dry basis (dscfm)
$E_{lb/hr}$	emission rate (lb/hr)
60	conversion factor (min/hr)

15. Formaldehyde concentration (ppmdv)[2]

$$C_{ppmdv} = (C_{lb/dscf})\left(\frac{(385.3)(10^6)}{M_{CHCO}}\right)$$

$$= (2.32E^{-08})\left(\frac{(385.3)(10^6)}{30.03}\right)$$

$$= 0.298\ \text{ppmdv}$$

Where:

$C_{lb/dscf}$	concentration (lb/dscf)
10^6	conversion factor (ppm)
385.3	conversion factor (ft^3/lb·mole)
M_{CHCO}	molecular weight of formaldehyde

[1] The calculations for other aldehydes and ketones are performed in a similar manner.

[2] The calculations for other aldehydes and ketones are performed in a similar manner using the appropriate molecular weight.

B

PARAMETERS

B

SOLVAY MINERALS, INC.
CAE Project No: 7747-3
CA-3 Calciner Stack

ALDEHYDE and KETONE PARAMETERS-BIF 0011

Run No.		1	2	3
Date (1996)		July 24	July 24	July 24
Start Time (approx.)		12:38	15:10	17:38
Stop Time (approx.)		14:45	17:17	19:46
Sampling Conditions				
Y_d	Dry gas meter correction factor	0.9971	0.9971	0.9971
C_p	Pitot tube coefficient	0.84	0.84	0.84
P_g	Static Pressure (in. H_2O)	-0.3	-0.3	-0.3
A_s	Sample location area (ft^2)	85.90	85.90	85.90
P_b	Barometric Pressure (in. Hg)	24.04	24.04	24.04
D_n	Nozzle diameter (in.)	0.375	0.375	0.375
O_2	Oxygen (dry volume %)	12.3	12.3	13.0
CO_2	Carbon Dioxide (dry volume %)	9.3	9.7	9.3
V_{lc}	Liquid collected (ml)	573.7	584.9	607.3
V_m	Volume metered, meter conditions (ft^3)	90.76	90.29	91.50
T_m	Dry gas meter temperature (°F)	111	104	97
T_s	Stack temperature (°F)	306	309	307
ΔH	Meter box orifice pressure drop (in. H_2O)	1.46	1.47	1.54
Θ	Total sampling time (min)	120	120	120
Flow Results				
V_{wstd}	Volume of water collected (ft^3)	27.00	27.53	28.59
V_{mstd}	Volume metered, standard (ft^3)	67.56	68.00	69.80
P_s	Sample gas pressure, absolute (in. Hg)	24.02	24.02	24.02
P_v	Vapor pressure, actual (in. Hg)	24.02	24.02	24.02
B_{wo}	Moisture in sample (% by volume)	28.56	28.82	29.05
B_{ws}*	Saturated moisture (% by volume)	100.00	100.00	100.00
$\sqrt{\Delta P}$	Velocity Head ($\sqrt{in.}$ H_2O)	0.438	0.415	0.407
M_d	MW of sample gas, dry (lb/lb-mole)	29.98	30.04	30.01
M_s	MW of sample gas, wet (lb/lb-mole)	26.56	26.57	26.52
V_s	Velocity of sample (ft/sec)	34.4	32.8	32.1
%I	Isokinetic sampling (%)	89.9*	95.9	100.5
Q_a	Volumetric flow rate, actual (acfm)	177,500	168,800	165,400
Q_{std}	Volumetric flow rate, standard (dscfm)	70,120	66,190	64,810

SOLVAY MINERALS, INC.
CAE Project No: 7747-3
CA-3 Calciner Stack

ALDEHYDE and KETONE PARAMETERS-BIF 0011

Formaldehyde		**Blank**			
m_n	Matter collected (μg)	BDL	350	240	210
	Volume of sample (ml)	580	1,140	1,040	1,020
	Blank correction (μg)		0.0	0.0	0.0
$m_{n,net}$	Matter collected, net (μg)		350	240	210
C	Concentration (lb/dscf)		1.14E-08	7.78E-09	6.63E-09
C	Concentration (μg/dscm)		1.83E+02	1.25E+02	1.06E+02
E	Emission rate (lb/hr)		0.048	0.031	0.026
C	Concentration (ppmdv)		0.147	0.100	0.085
Acetaldehyde		**Blank**			
m_n	Matter collected (μg)	BDL	260	890	790
	Volume of sample (ml)	580	1,140	1,040	1,020
	Blank correction (μg)		0.0	0.0	0.0
$m_{n,net}$	Matter collected, net (μg)		260	890	790
C	Concentration (lb/dscf)		8.48E-09	2.89E-08	2.50E-08
C	Concentration (μg/dscm)		1.36E+02	4.62E+02	4.00E+02
E	Emission rate (lb/hr)		0.036	0.115	0.097
C	Concentration (ppmdv)		0.074	0.252	0.218
Propionaldehyde		**Blank**			
m_n	Matter collected (μg)	BDL	94	260	220
	Volume of sample (ml)	580	1,140	1,040	1,020
	Blank correction (μg)		0.0	0.0	0.0
$m_{n,net}$	Matter collected, net (μg)		94	260	220
C	Concentration (lb/dscf)		3.07E-09	8.43E-09	6.95E-09
C	Concentration (μg/dscm)		4.91E+01	1.35E+02	1.11E+02
E	Emission rate (lb/hr)		0.013	0.033	0.027
C	Concentration (ppmdv)		0.020	0.056	0.046
Acrolein		**Blank**			
m_n	Matter collected (μg)[1]	15	641	1,701	1,501
	Volume of sample (ml)	580	1,140	1,040	1,020
	Blank correction (μg)		15	15	15
$m_{n,net}$	Matter collected, net (μg)		626	1,686	1,486
C	Concentration (lb/dscf)		2.04E-08	5.47E-08	4.69E-08
C	Concentration (μg/dscm)		3.27E+02	8.75E+02	7.52E+02
E	Emission rate (lb/hr)		0.086	0.217	0.183
C	Concentration (ppmdv)		0.140	0.376	0.323
Acetone		**Blank**			
m_n	Matter collected (μg)[1]	15	299	799	699
	Volume of sample (ml)	580	1,140	1,040	1,020
	Blank correction (μg)		15	15	15
$m_{n,net}$	Matter collected, net (μg)		284	784	684
C	Concentration (lb/dscf)		9.27E-09	2.54E-08	2.16E-08
C	Concentration (μg/dscm)		1.48E+02	4.07E+02	3.46E+02
E	Emission rate (lb/hr)		0.039	0.101	0.084
C	Concentration (ppmdv)		0.061	0.169	0.143
2-Butanone		**Blank**			
m_n	Matter collected (μg)	BDL	140	320	260
	Volume of sample (ml)	580	1,140	1,040	1,020
	Blank correction (μg)		0.0	0.0	0.0
$m_{n,net}$	Matter collected, net (μg)		140	320	260
C	Concentration (lb/dscf)		4.57E-09	1.04E-08	8.21E-09
C	Concentration (μg/dscm)		7.32E+01	1.66E+02	1.32E+02
E	Emission rate (lb/hr)		0.019	0.041	0.032
C	Concentration (ppmdv)		0.024	0.055	0.044

BDL indicates value was below the detection limit.

[1] Acetone and acrolein peaks unresolved. See comments in project overview.

SOLVAY MINERALS, INC.
CAE Project No: 7747-3
CA 1&2 Calciner Stack

ALDEHYDE and KETONE PARAMETERS-BIF 0011

Run No.		**2**	**3**	**4**
Date (1996)		July 26	July 26	July 26
Start Time (approx.)		14:01	16:21	18:27
Stop Time (approx.)		15:42	18:08	20:08
Sampling Conditions				
Y_d	Dry gas meter correction factor	0.9984	0.9984	0.9984
C_p	Pitot tube coefficient	0.84	0.84	0.84
P_g	Static Pressure (in. H_2O)	-0.4	-0.3	-0.3
A_s	Sample location area (ft^2)	113.10	113.10	113.10
P_b	Barometric Pressure (in. Hg)	23.75	23.75	23.75
D_n	Nozzle diameter (in.)	0.270	0.270	0.270
O_2	Oxygen (dry volume %)	14.9	14.2	13.7
CO_2	Carbon Dioxide (dry volume %)	7.0	7.1	7.7
V_{lc}	Liquid collected (ml)	340.6	364.3	378.1
V_m	Volume metered, meter conditions (ft^3)	65.46	66.68	68.44
T_m	Dry gas meter temperature (°F)	99	96	100
T_s	Stack temperature (°F)	372	372	374
ΔH	Meter box orifice pressure drop (in. H_2O)	1.14	1.17	1.23
Θ	Total sampling time (min)	96	96	96
Flow Results				
V_{wstd}	Volume of water collected (ft^3)	16.03	17.15	17.80
V_{mstd}	Volume metered, standard (ft^3)	49.15	50.32	51.34
P_s	Sample gas pressure, absolute (in. Hg)	23.72	23.73	23.73
P_v	Vapor pressure, actual (in. Hg)	23.72	23.73	23.73
B_{wo}	Moisture in sample (% by volume)	24.59	25.42	25.74
B_{ws}	Saturated moisture (% by volume)	100.00	100.00	100.00
$\sqrt{\Delta P}$	Velocity Head ($\sqrt{in.}$ H_2O)	0.705	0.717	0.735
M_d	MW of sample gas, dry (lb/lb-mole)	29.72	29.70	29.78
M_s	MW of sample gas, wet (lb/lb-mole)	26.83	26.73	26.75
V_s	Velocity of sample (ft/sec)	57.9	59.0	60.5
%I	Isokinetic sampling (%)	97.8	99.4	99.5
Q_a	Volumetric flow rate, actual (acfm)	392,900	400,100	410,300
Q_{std}	Volumetric flow rate, standard (dscfm)	149,000	150,100	153,000

SOLVAY MINERALS, INC.
CAE Project No: 7747-3
CA 1&2 Calciner Stack

ALDEHYDE and KETONE PARAMETERS-BIF 0011

Formaldehyde		**Blank**			
m_n	Matter collected (μg)	BDL	780	530	340
	Volume of sample (ml)	580	640	680	700
	Blank correction (μg)		0.0	0.0	0.0
$m_{n,net}$	Matter collected, net (μg)		780	530	340
C	Concentration (lb/dscf)		3.50E-08	2.32E-08	1.46E-08
C	Concentration (μg/dscm)		5.60E+02	3.72E+02	2.34E+02
E	Emission rate (lb/hr)		0.313	0.209	0.134
C	Concentration (ppmdv)		0.449	0.298	0.187
Acetaldehyde		**Blank**			
m_n	Matter collected (μg)	BDL	730	570	1,300
	Volume of sample (ml)	580	640	680	700
	Blank correction (μg)		0.0	0.0	0.0
$m_{n,net}$	Matter collected, net (μg)		730	570	1,300
C	Concentration (lb/dscf)		3.27E-08	2.50E-08	5.58E-08
C	Concentration (μg/dscm)		5.24E+02	4.00E+02	8.94E+02
E	Emission rate (lb/hr)		0.293	0.225	0.512
C	Concentration (ppmdv)		0.286	0.218	0.488
Propionaldehyde		**Blank**			
m_n	Matter collected (μg)	BDL	280	210	370
	Volume of sample (ml)	580	640	680	700
	Blank correction (μg)		0.0	0.0	0.0
$m_{n,net}$	Matter collected, net (μg)		280	210	370
C	Concentration (lb/dscf)		1.26E-08	9.20E-09	1.59E-08
C	Concentration (μg/dscm)		2.01E+02	1.47E+02	2.54E+02
E	Emission rate (lb/hr)		0.112	0.083	0.146
C	Concentration (ppmdv)		0.083	0.061	0.105
Acrolein		**Blank**			
m_n	Matter collected (μg)[1]	15	1,901	1,601	1,601
	Volume of sample (ml)	580	640	680	700
	Blank correction (μg)		15	15	15
$m_{n,net}$	Matter collected, net (μg)		1,886	1,586	1,586
C	Concentration (lb/dscf)		8.46E-08	6.95E-08	6.81E-08
C	Concentration (μg/dscm)		1.35E+03	1.11E+03	1.09E+03
E	Emission rate (lb/hr)		0.756	0.626	0.625
C	Concentration (ppmdv)		0.581	0.478	0.468
Acetone		**Blank**			
m_n	Matter collected (μg)[1]	15	899	799	799
	Volume of sample (ml)	580	640	680	700
	Blank correction (μg)		15	15	15
$m_{n,net}$	Matter collected, net (μg)		884	784	784
C	Concentration (lb/dscf)		3.97E-08	3.43E-08	3.37E-08
C	Concentration (μg/dscm)		6.35E+02	5.50E+02	5.39E+02
E	Emission rate (lb/hr)		0.354	0.309	0.309
C	Concentration (ppmdv)		0.263	0.228	0.223
2-Butanone		**Blank**			
m_n	Matter collected (μg)	BDL	530	380	430
	Volume of sample (ml)	580	640	680	700
	Blank correction (μg)		0.0	0.0	0.0
$m_{n,net}$	Matter collected, net (μg)		530	380	430
C	Concentration (lb/dscf)		2.38E-08	1.66E-08	1.85E-08
C	Concentration (μg/dscm)		3.81E+02	2.67E+02	2.96E+02
E	Emission rate (lb/hr)		0.213	0.150	0.169
C	Concentration (ppmdv)		0.127	0.089	0.099

BDL indicates value was below the detection limit.

[1] Acetone and acrolein peaks unresolved. See comments in project overview.

CALIBRATION DATA

C

Meter Box Full Test Calibration

DATE March 14, 1996

Operator R. Lindberg

Meter Box No: D-12	Meter Box ΔH@: 1.8349	Meter Box Yd: 0.9971	Barometric Pressure: 24.91

				Standard Meter Gas Volume			Meter Box Gas Volume (ft^3)			Std. Meter Temperature (°F)			Meter Box Temperature (°F)					
Q	ΔH	ΔP	Y_{ds}	Initial	Final	V_{ds}	Initial	Final	V_d	Inlet	Outlet	T_{ds}	Inlet	T_o	T_d	Time	Y_d	H@
0.36	0.50	-0.60	1.0000	0.000	5.051	5.051	414.686	419.807	5.121	64.0	64.0	64.0	71	67	69.0	11.72	0.9925	1.7961
0.37	0.50	-0.60	1.0000	0.000	5.043	5.043	419.807	424.928	5.121	64.0	64.0	64.0	72	67	69.5	11.52	0.9919	1.7409
0.61	1.50	-1.30	1.0000	0.000	10.030	10.030	451.613	461.783	10.170	64.0	64.0	64.0	77	69	73.0	13.78	0.9949	1.8820
0.61	1.50	-1.30	1.0000	0.000	10.040	10.040	461.788	471.961	10.173	64.0	64.0	64.0	75	69	72.0	13.79	0.9937	1.8809
0.87	3.00	-2.10	1.0000	0.000	10.359	10.359	476.363	486.728	10.365	64.0	64.0	64.0	79	70	74.5	10.04	1.0042	1.8696
0.87	3.00	-2.10	1.0000	0.000	10.100	10.100	493.332	503.434	10.102	64.0	64.0	64.0	80	70	75.0	9.71	1.0056	1.8396
																AVERAGE	0.9971	1.8349

Nomenclature

P_b	Barometric Pressure (in. Hg)
Q	Flow Rate (cfm)
ΔH	Orifice Pressure Differential (in. H_2O)
ΔP	Inlet Pressure Differential (in. H_2O)
V_d	Gas Meter Volume - Dry (ft^3)
V_{ds}	Standard Meter Volume - Dry (ft^3)
T_d	Average Meter Box Temperature (°F)
T_o	Outlet Meter Box Temperature (°F)
T_{ds}	Average Standard Meter Temperature (°F)
Y_d	Meter Correction Factor (unitless)
Y_{ds}	Standard Meter Correction Factor (unitless)
ΔH@	Orifice Pressure Differential giving 0.75 cfm of air at 68°F and 29.92 in. Hg (in. H_2O)

Equations

$$Y_d = (Y_{ds})\left[\frac{V_{ds}}{V_d}\right]\left[\frac{T_d + 460}{T_{ds} + 460}\right]\left[\frac{P_b + \Delta P / 13.6}{P_b + \Delta H / 13.6}\right]$$

$$\Delta H@ = \frac{0.0319(\Delta H)}{P_b(T_o + 460)}\left[\frac{(T_{ds} + 460)\,\Theta}{(V_{ds})(Y_{ds})}\right]^2$$

$$Q = \frac{17.64\,(V_{ds})(P_b)}{(T_{ds} + 460)(\Theta)}$$

Vacuum Gauge

Standard (in. Hg)	Vacuum Gauge
5.3	5.0
7.8	7.5
10.2	10.0
12.8	12.5
15.4	15.0
18.0	17.5
20.4	20.0

Clean Air Engineering

SOLVAY2016_6_001647

Meter Box Post Test Calibration

DATE: 8/5/96

Operator: R. Lindberg

Project Number: 7747

Client/Owner: SOLVAY MINERALS INC

Meter Box No: D-12	Meter Box Vacuum: 7.0	Meter Box Yd: 0.9971	Barometric Pressure: 24.88

				Standard Meter Gas Volume			Meter Box Gas Volume (ft ^{3})			Std. Meter Temperature (°F)			Meter Box Temperature (°F)					
Q	ΔH	ΔP	Y_{ds}	Initial	Final	V_{ds}	Initial	Final	V_d	Inlet	Outlet	T_{ds}	Inlet	T_o	Tî	Time	Y_d	H@
0.64	1.70	-1.50	1.0000	0.0	10.045	10.045	343.603	353.793	10.190	82.0	82.0	82.0	98.0	90.0	94.0	12.70	.9981	1.8609
0.64	1.70	-1.50	1.0000	0.0	10.083	10.083	353.793	363.835	10.042	82.0	82.0	82.0	98.0	90.0	94.0	12.76	1.0167	1.8644
0.64	1.70	-1.50	1.0000	0.0	11.061	11.061	363.835	374.966	11.131	82.0	82.0	82.0	98.0	91.0	94.5	14.00	1.0071	1.8617
																AVERAGE	1.0073	

Nomenclature

P_b	Barometric Pressure (in. Hg)
Q	Flow Rate (cfm)
ΔH	Orifice Pressure Differential (in. H_20)
ΔP	Inlet Pressure Differential (in. H_20)
V_d	Gas Meter Volume - Dry (ft^3)
V_{ds}	Standard Meter Volume - Dry (ft^3)
T_d	Average Meter Box Temperature (°F)
T_o	Outlet Meter Box Temperature (°F)
T_{ds}	Average Standard Meter Temperature (°F)
Y_d	Meter Correction Factor (unitless)
Y_{ds}	Standard Meter Correction Factor (unitless)
ΔH@	Orifice Pressure Differential giving 0.75 cfm of air at 68°F and 29.92 in. Hg (in. H_20)

Equations

$$Y_d = (Y_{ds})\left[\frac{V_{ds}}{V_d}\right]\left[\frac{T_d + 460}{T_{ds} + 460}\right]\left[\frac{P_b + \Delta P / 13.6}{P_b + \Delta H / 13.6}\right]$$

$$\Delta H@ = \frac{0.0319(\Delta H)}{P_b(T_o + 460)}\left[\frac{(T_{ds} + 460)\Theta}{(V_{ds})(Y_{ds})}\right]^2$$

$$Q = \frac{17.64\ (V_{ds})(P_b)}{(T_{ds} + 460)(\Theta)}$$

Clean Air Engineering

SOLVAY2016_6_001648

Pyrometer Calibration Sheet

Pyrometer No.: Meter D-12
Calibrated By: R. Lindberg
Date: June 20, 1996

Office: Denver
Client: In House Check
Job or Reference No.: 65-0000

Temperature Scale Used: X **Fahrenheit** ___ Celsius

Calibration: X **Pre-Test** ___ Post Test

Calibration Reference Settings for Fahrenheit Scale	Pyrometer Reading	Calibration Reference Settings for Celsius Scale
50° F	50°	25° C
100° F	100°	50° C
150° F	150°	75° C
200° F	201°	100° C
250° F	251°	125° C
300° F	301°	150° C
350° F	350°	175° C
400° F	399°	200° C
450° F	448°	225° C
500° F	498°	250° C
550° F	548°	275° C
600° F	599°	300° C

Calibration Reference Information

Reference Used: Omega Serial No: T-87031

Calibrated By: R&R INSTRM. Date Calibrated: 12/27/96

Calibration Report No.: 52722-1

Clean Air Engineering

Pyrometer Calibration Sheet

Pyrometer No.: Meter D-12
Calibrated By: R. Lindberg
Date: AUG. 9, 1996

Office: Denver
Client: SOLVAY MINERALS
Job or Reference No.: 7747

Temperature Scale Used: X **Fahrenheit** ___ Celsius

Calibration: ___ Pre-Test X **Post Test**

Calibration Reference Settings for Fahrenheit Scale	Pyrometer Reading	Calibration Reference Settings for Celsius Scale
50° F	52°	25° C
100° F	101°	50° C
150° F	151°	75° C
200° F	202°	100° C
250° F	253°	125° C
300° F	302°	150° C
350° F	352°	175° C
400° F	400°	200° C
450° F	450°	225° C
500° F	500°	250° C
550° F	550°	275° C
600° F	600°	300° C

Calibration Reference Information

Reference Used: Omega Serial No: T-87031

Calibrated By: R&R INSTRM. Date Calibrated: 12/27/96

Calibration Report No.: 52722-1

Clean Air Engineering

Meter Box Full Test Calibration

Date: March 6,1996

Operator: Ron M Luikaart

Meter Box No: D6	Meter Box ΔH@: 1.7344	Meter Box Yd: 0.9984	Barometric Pressure: 25.00

				Standard Meter Gas Volume			Meter Box Gas Volume (ft^3)			Std. Meter Temperature (°F)			Meter Box Temperature (°F)					
Q	ΔH	ΔP	Y_{ds}	Initial	Final	V_{ds}	Initial	Final	V_d	Inlet	Outlet	T_{ds}	Inlet	T_o	T_d	Time	Y_d	H@
0.37	0.50	-1.70	1.0000	0.000	5.001	5.001	183.198	188.280	5.082	62.0	62.0	62.0	72	70	71.0	11.50	0.9946	1.7345
0.37	0.50	-1.70	1.0000	0.000	5.002	5.002	188.280	193.357	5.077	63.0	63.0	63.0	73	70	71.5	11.52	0.9948	1.7465
0.63	1.50	-3.00	1.0000	0.000	10.002	10.002	205.400	215.492	10.092	62.0	62.0	62.0	76	71	73.5	13.33	0.9996	1.7445
0.64	1.50	-3.00	1.0000	0.000	10.002	10.002	215.492	225.598	10.106	62.0	62.0	62.0	77	72	74.5	13.30	1.0001	1.7334
0.90	3.00	-7.10	1.0000	0.000	10.011	10.011	238.697	248.673	9.976	62.0	62.0	62.0	80	72	76.0	9.38	1.0001	1.7213
0.90	3.00	-7.10	1.0000	0.000	10.009	10.009	248.673	258.650	9.977	62.0	62.0	62.0	81	73	77.0	9.40	1.0016	1.7261
																AVERAGE	0.9984	1.7344

Nomenclature

P_b	Barometric Pressure (in. Hg)
Q	Flow Rate (cfm)
ΔH	Orifice Pressure Differential (in. H_20)
ΔP	Inlet Pressure Differential (in. H_20)
V_d	Gas Meter Volume - Dry (ft^3)
V_{ds}	Standard Meter Volume - Dry (ft^3)
T_d	Average Meter Box Temperature (°F)
T_o	Outlet Meter Box Temperature (°F)
T_{ds}	Average Standard Meter Temperature (°F)
Y_d	Meter Correction Factor (unitless)
Y_{ds}	Standard Meter Correction Factor (unitless)
ΔH@	Orifice Pressure Differential giving 0.75 cfm of air at 68°F and 29.92 in. Hg (in. H_20)

Equations

$$Y_d = (Y_{ds})\left[\frac{V_{ds}}{V_d}\right]\left[\frac{T_d + 460}{T_{ds} + 460}\right]\left[\frac{P_b + \Delta P / 13.6}{P_b + \Delta H / 13.6}\right]$$

$$\Delta H@ = \frac{0.0319(\Delta H)}{P_b(T_o + 460)}\left[\frac{(T_{ds} + 460)\Theta}{(V_{ds})(Y_{ds})}\right]^2$$

$$Q = \frac{17.64\ (V_{ds})(P_b)}{(T_{ds} + 460)(\Theta)}$$

Vacuum Gauge

Standard (in. Hg)	Vacuum Gauge
5.0	4.9
7.5	8.0
10.0	9.9
12.5	12.3
15.0	14.9
17.5	17.2
20.0	19.5

SOLVAY2016_6_001651

Meter Box Post Test Calibration

DATE: 8/8/96

Operator: R. Lindberg

Project Number: 7747

Client/Owner: SOLVAY MINERALS

Meter Box No: D-6	Meter Box Vacuum: 4.0	Meter Box Yd: 0.9984	Barometric Pressure: 25.04

				Standard Meter Gas Volume			Meter Box Gas Volume (ft 3)			Std. Meter Temperature (°F)			Meter Box Temperature (°F)					
Q	ΔH	ΔP	Y_{ds}	Initial	Final	V_{ds}	Initial	Final	V_d	Inlet	Outlet	T_{ds}	Inlet	T_o	Tî	Time	Y_d	H@
0.55	1.20	-1.30	1.0000	0.0	10.059	10.059	692.007	702.410	10.403	79.0	79.0	79.0	92.0	88.0	90.0	14.88	.9794	1.7735
0.55	1.20	-1.10	1.0000	0.0	10.044	10.044	702.410	712.821	10.411	80.0	80.0	80.0	93.0	89.0	91.0	14.87	.9778	1.7798
0.55	1.20	-1.10	1.0000	0.0	10.048	10.048	712.821	723.229	10.408	80.0	80.0	80.0	93.0	89.0	91.0	14.86	.9784	1.7760
															AVERAGE		.9786	

Nomenclature

P_b	Barometric Pressure (in. Hg)
Q	Flow Rate (cfm)
ΔH	Orifice Pressure Differential (in. H_20)
ΔP	Inlet Pressure Differential (in. H_20)
V_d	Gas Meter Volume - Dry (ft^3)
V_{ds}	Standard Meter Volume - Dry (ft^3)
T_d	Average Meter Box Temperature (°F)
T_o	Outlet Meter Box Temperature (°F)
T_{ds}	Average Standard Meter Temperature (°F)
Y_d	Meter Correction Factor (unitless)
Y_{ds}	Standard Meter Correction Factor (unitless)
ΔH@	Orifice Pressure Differential giving 0.75 cfm of air at 68°F and 29.92 in. Hg (in. H_20)

Equations

$$Y_d = (Y_{ds})\left[\frac{V_{ds}}{V_d}\right]\left[\frac{T_d + 460}{T_{ds} + 460}\right]\left[\frac{P_b + \Delta P / 13.6}{P_b + \Delta H / 13.6}\right]$$

$$\Delta H@ = \frac{0.0319(\Delta H)}{P_b(T_o + 460)}\left[\frac{(T_{ds} + 460)\Theta}{(V_{ds})(Y_{ds})}\right]^2$$

$$Q = \frac{17.64\ (V_{ds})(P_b)}{(T_{ds} + 460)(\Theta)}$$

Clean Air Engineering

SOLVAY2016_6_001652

Pyrometer Calibration Sheet

Pyrometer No.: Meter D-6
Calibrated By: R. Lindberg
Date: AUG. 9, 1996

Office: Denver
Client: SOLVAY MINERALS
Job or Reference No.: 7747

Temperature Scale Used: X **Fahrenheit** ___ Celsius

Calibration: ___ Pre-Test X **Post Test**

Calibration Reference Settings for Fahrenheit Scale	Pyrometer Reading	Calibration Reference Settings for Celsius Scale
50° F	51°	25° C
100° F	100°	50° C
150° F	151°	75° C
200° F	202°	100° C
250° F	253°	125° C
300° F	303°	150° C
350° F	352°	175° C
400° F	401°	200° C
450° F	451°	225° C
500° F	501°	250° C
550° F	551°	275° C
600° F	602°	300° C

Calibration Reference Information

Reference Used: Omega Serial No: T-87031

Calibrated By: R&R INSTRM. Date Calibrated: 12/27/96

Calibration Report No.: 52722-1

Clean Air Engineering

Nozzle Calibration Sheet

Client: Solvay

Job or Ref No: 7747

Calibrated by: S. Ferguson

Unit: EP-1,2 EP-5

Date: 7/24

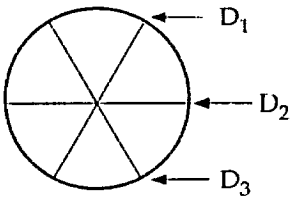
Runs: 1-

Nozzle Identification	D_1 (inches)	D_2 (inches)	D_3 (inches)	ΔD (inches)	ΔD_{ave} (inches)
270	0.270	0.270	0.270	0.000	0.270
375	0.376	0.376	0.375	0.001	0.375

D_1, D_2, D_3 = three nozzle diameter measurements

ΔD = maximum difference between any two diameters
$\Delta D \leq 0.004$ inches*

ΔD_{avg} = average of D_1, D_2, D_3



* (40 CFR 60, Appendix A, Method 5, Section 5.1)

CS 006 Nozzle
CNVS/TRG.R1-2/7/94

CAE Clean Air Engineering

TYPE S PITOT TUBE INSPECTION DATA

DATE 2/2/96

PITOT NUMBER M-6-2
12-1-94-1

Pitot Tube Assembly Level YES

Pitot Tube openings damaged? NO (Yes(explain, see comments) or No)

α_1 = 1 deg. (<10), α_2 = 0 deg. (<10), β_1 = 3 deg. (<5), β_2 = 1 deg. (<5)

Y = 2 deg., 0 = 0 dog., A = .732 in.

Z = A sin Y = .026 in.; <1/8 in.

W = A sin 0 = .000 in.; <1/32 in.

Pa .366 in. Pb .366

P = (Pa +Pb)/2 .366 in.

Dt (tube dia.) = .25 in.

P/Dt = 1.46 (≥ 1.05 and ≤ 1.50)

COMMENTS: 6' EFF. PROBE, DEPT. 65, Cp = .84

WIND TUNNEL CALIBRATION REQUIRED? NO (Yes or No)

CALIBRATION BY: RON M. LUIKAART

TYPE S PITOT TUBE INSPECTION DATA

DATE 8-15-96

PITOT NUMBER 506A65
M-6-3-65

Pitot Tube Assembly Level YES

Pitot Tube openings damaged? NO (Yes{explain, see comments} or No)

α_1 = 2 deg. (<10), α_2 = 1 deg. (<10), β_1 = 2 deg. (<5), β_2 = 3 deg. (<5)

Y = 2 deg., θ = 2 deg., A = .699 in.

Z = A sin Y = .024 in.; <1/8 in.

W = A sin θ = .024 in.; <1/32 in.

Pa .350 in. Pb .349

P = (Pa +Pb)/2 .3495 in.

Dt (tube dia.) = .25 in.

P/Dt = 1.40 (≥ 1.05 and ≤ 1.50)

COMMENTS: 6' EFF M-5 PROBE

WIND TUNNEL CALIBRATION REQUIRED? NO (Yes or No)

CALIBRATION BY: R. Lindberg

D

FIELD DATA

D

Orsat Readings

Client	SOLVAY	Project Number	7747
Plant	GREEN RIVER	Unit	EP 5
Date	7/24/96	Fuel Type	NAT GAS
Orsat ID	65-2	Leak Check?	OK

$$F_o = \frac{20.9 - \%O_2}{\%CO_2}$$

F_o = 1.083 to 1.230 (for bituminous coal)

Run Number	Location	Bag ID	Trial	Percent CO_2	Percent $CO_2 + O_2$	Percent O_2	F_o	Sample Time	Analysis Time	Analyst
1	STACK	EP 5	1	9.2	21.4	12.2		1238 1445	1515	JC
	M0011		2	9.4	21.8	12.4				
			3	9.4	21.8	12.4		12.3		
			Avg.	9.3	21.7	~~18.4~~	12.4			
2	STACK	EP-5	1	9.6	22.2	12.6		1510-1717	1800	JC
	M0011		2	9.8	22.0	12.2				
			3	9.8	22.0	12.2		12.3		
			Avg.	9.7	22.1	13.4				
3	STACK	EP-5	1	9.3	22.3	13.0		1938 1946	2000	SJ
	M0011		2	9.3	22.3	13.0				
			3	9.3	22.2	12.9				
			Avg.	9.3		13.0				
			1							
			2							
			3							
			Avg.							
			1							
			2							
			3							
			Avg.							
			1							
			2							
			3							
			Avg.							
			1							
			2							
			3							
			Avg.							
			1							
			2							
			3							
			Avg.							

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TEST LOCATION: STACK

UNIT: EP5 **RUN:** 1

FORMALDEHYDE TESTING FIELD DATA SHEET

METHOD: 0011 **PAGE** 1 **OF** 2

Client SOLVAY MINERALS	Project No. 7747
Plant GREENRIVER, WY.	Date 7/24/96
Meter Operator [illegible] AART	
Probe Operator ED McGAFFICK	

Meter Box No. D12	Sample Box No.
Meter Yd .9971	Meter ΔH@ 1.8349
K Factor 7.5	Pitot Cp .84
Leak Rate Before .002 [cfm] [Lpm] @ 15 (in.Hg)	
Leak Rate After .002 [cfm] [Lpm] @ 14 (in.Hg)	
Pitot Leak Check Before: ☑	After: Good ☑ Bad ☐

Cross-Section of Test Location

Duct Dimensions (in.) 125.5

Static Press. (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
-.3	4.75, 12.5		

Amb. Temp. (°F) 90	Bar. Press. 24.04 [in. Hg] [mbar]
Probe I.D. No. G 06A 65	
Liner Material GLASS	

Filter No. N/A			
Thimble No. N/A			
Nozzle Diameter .375		Nozzle I.D. .375	

H_2O 550.2 [ml] [gm]	Silica Gel (gm) 23.5
Total V_{lc} ~~550~~, 573.7	
Start Time: ~~12:47~~ 12:38 RML	Stop Time: 1445

Traverse Point Number	Min/pt 10 Elapsed Time	Velocity Head ΔP's (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume - V_m Init. Vol. [ft³] [L] 726.40	Stack Temp. T_s (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in. Hg)	XAD Trap Temp T_t (°F)	Notes
~~4~~ 3-1 RML	5	.22	1.7	730.57	302	250	249	54	102	103	6	N/A	
1	10	.22	1.7	734.64	303	252	251	48	102	103	6		
1	15	.24	1.8	738.86	302	254	252	49	104	103	6		
2	20	.24	1.8	743.10	303	249	253	50	106	103	6		
3	25	.15	1.1	746.38	300	252	254	52	109	104	4		
3	30	.15	1.1	749.70	301	251	253	53	110	105	4		
4-1	35	.19	1.4	753.39	302	249	252	55	110	105	5		
1	40 RML	~~.17~~ .17	~~1.4~~ 1.3	757.98	305	250	251	57	111	105	5		
2	45	.17	1.3	760.58	304	250	249	59	112	106	5		
2	50	.17	1.3	764.19	304	249	250	60	113	106	5		
3	55	.13	.98	767.35	300	249	248	62	114	108	4		
3	60	.13	.98	770.53	301	250	247	59	114	108	4		
	Total	*	~~2.16~~ 16.46 RML	90.76	3627				2566				
	Average	.4354	1.46		306				111				

* Sum of square roots.

Circle correct bracketed units on data sheet.

Clean Air Engineering

SOLVAY2016_6_001660

DS001 General
CNVS/TRG.R3-4/6/94

TEST LOCATION: STACK **FORMALDEHYDE TESTING FIELD DATA SHEET** **METHOD:** CCM **PAGE** 2 **OF** 2

UNIT: SP5 **RUN:** 1

Client SOLVAY MINERALS	Project No. 7747
Plant GREEN RIVER, WY.	Date 7/24/96
Meter Operator RONN LUKAART	
Probe Operator	

Meter Box No.	Sample Box No.
Meter Yd	Meter ΔH@
K Factor	Pitot Cp
Leak Rate Before	[cfm] [Lpm] @ (in.Hg)
Leak Rate After	[cfm] [Lpm] @ (in.Hg)
Pitot Leak Check Before: ☐	After: Good ☐ Bad ☐

Cross-Section of Test Location

[N] [UP]

Duct Dimensions (in.)

Static Press. (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]

Amb. Temp. (°F)	Bar. Press. [in. Hg] [mbar]
Probe I.D. No.	
Liner Material	

Filter No.		
Thimble No.		
Nozzle Diameter	Nozzle I.D.	

H_2O [ml] [gm]	Silica Gel (gm)
Total V_{lc}	

Start Time:	Stop Time:

Traverse Point Number	Min/pt 10 Elapsed Time	Velocity Head ΔP's (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume - V_m Init. Vol. [ft^3] [L]	Stack Temp. T_s (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet T_{min} (°F)	DGM Outlet T_{mout} (°F)	Pump Vacuum (in. Hg)	XAD Trap Temp T_t (°F)	Notes
1-1	65	.20	1.5	774.46	307	251	250	52	111	109	5	N/A	
1	70	.20	1.5	778.17	310	250	248	50	115	109	5		
2	75	.19	1.4	781.86	310	251	252	50	116	110	5		
2	80	.19	1.4	785.62	309	249	253	54	116	110	5		
3	85	.16	1.2	789.08	308	250	254	55	117	110	4		
3	90	.16	1.2	792.50	309	250	252	57	117	111	4		
1-1	95	.21	1.6	796.49	311	251	250	58	117	112	6		
1	100	.25	1.9	800.83	314	249	253	52	118	112	7		
2	105	.26	2.0	805.24	313	252	250	54	118	112	7		
2	110	.26	2.0	809.68	313	253	251	56	119	113	7		
3	115	.19	1.4	813.44	310	252	253	57	119	113	5		
3	120	.19	1.4	817.16	311	249	252	60	120	113	5		
	Total	*	18.5		3705				27	40			
	Average												

SOLVAY2016_6_001661

DS 001 General
CNVS/TRG.R3-4/6/94

* Sum of square roots.

Circle correct bracketed units on data sheet.

Clean Air Engineering

TEST LOCATION: STACK

FORMALDEHYDE TESTING FIELD DATA SHEET

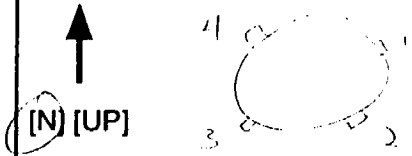
METHOD: 0011 **PAGE** 1 **OF** 2

UNIT: SP5 **RUN:** 2

Client SOLVAY MINERALS	Project No. 7747
Plant GREEN RIVER, WY	Date 7/24/96
Meter Operator F. McGaffick	
Probe Operator R. Luikaart	

Meter Box No. D-12	Sample Box No. R2
Meter Yd .9971	Meter ΔH@ 1.8349
K Factor 7.5	Pitot Cp .84
Leak Rate Before .004 [cfm] [Lpm] @ 15 (in.Hg)	
Leak Rate After .002 [cfm] [Lpm] @ 10 (in.Hg)	
Pitot Leak Check Before: ☑	After: Good ☑ Bad ☐

Cross-Section of Test Location



Duct Dimensions (in.) 125.5			
Static Press. (in. H_2O) -.4	Port Len. (in.) 4.75, 12.5	Gas Flow [In] [Out] of page	First point all the way [In] [Out]

Amb. Temp. (°F) 90	Bar. Press. 24.04 [in. Hg] [mbar]
Probe I.D. No. G 06A-65	
Liner Material GLASS	

Filter No. N/A			
Thimble No. N/A			
Nozzle Diameter .375		Nozzle I.D. .375	

H_2O 563.5 [ml] [gm]	Silica Gel (gm) 21.4
Total V_{lc} 584.9	

Start Time: 15:10	Stop Time: 17:17

Traverse Point Number	Min/pt 10 Elapsed Time	Velocity Head ΔP's (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume - V_m Init. Vol. [ft^3] [L] 817.40	Stack Temp. T_s (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in. Hg)	XAD Trap Temp T_t (°F)	Notes
2-1	5	.20	1.5	821.33	315	245	250	60	112	112	4	N/A	
1	10	.20	1.5	825.16	314	249	250	51	103	108	4		
2	15	.20	1.5	828.98	313	247	253	46	104	109	4		
2	20	.21	1.6	832.96	314	250	250	44	105	107	4		
3	25	.16	1.2	836.40	312	249	250	43	105	105	4		
3	30	.15	1.1	839.65	310	249	249	43	105	105	4		
1	35	.16	1.2	843.10	311	249	248	50	104	103	4		
1	40	.16	1.2	846.52	313	250	252	51	106	104	4		
2	45	.16	1.2	849.93	311	248	249	52	105	103	4		
2	50	.16	1.2	853.34	311	249	248	50	105	103	4		
3	55	.15 *	1.4	856.92	309	250	250	42	106	104	4		K=9.2 *
3	60	15	1.4 EM	860.52	309	250	250	40	107	104	4		
	Total	*4.9618	16.0 EM	90.29	3742				25	54			
	Average	.4155	1.471		309				104				

* Sum of square roots.

Circle correct bracketed units on data sheet.

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CNVS/TRG.R3-4/6/94

SOLVAY2016_6_001662

TEST LOCATION: STACK

FORMALDEHYDE TESTING FIELD DATA SHEET

METHOD: 0011 **PAGE** 2 **OF** 2

UNIT: SP5 **RUN:** 2

Client SOLVAY MINERALS	Project No. 7744
Plant GREEN RIVER, WY.	Date 7/24/96
Meter Operator	
Probe Operator	

Meter Box No.	Sample Box No.
Meter Yd	Meter ΔH@
K Factor 9.2	Pitot Cp
Leak Rate Before	[cfm] [Lpm] @ (in.Hg)
Leak Rate After	[cfm] [Lpm] @ (in.Hg)
Pitot Leak Check Before: ☐	After: Good ☐ Bad ☐

Cross-Section of Test Location

[N] [UP]

Duct Dimensions (in.)

Static Press. (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]

Amb. Temp. (°F)	Bar. Press. [in. Hg] [mbar]
Probe I.D. No.	
Liner Material	

Filter No.		
Thimble No.		
Nozzle Diameter	Nozzle I.D.	

H_2O [ml] [gm]	Silica Gel (gm)
Total V_{lc}	

Start Time:	Stop Time:

Traverse Point Number	Min/pt 10 Elapsed Time	Velocity Head ΔP's (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume - V_m Init. Vol. [ft^3] [L] 860.52	Stack Temp. T_s (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet T_{min} (°F)	DGM Outlet T_{mout} (°F)	Pump Vacuum (in. Hg)	XAD Trap Temp T_t (°F)	Notes
4-1	65	.15	1.4	864.15	309	248	247	49	101	102	4	N/A	
1	70	.16	1.5	868.05	310	250	249	50	102	103	4		
2	75	.15	1.4	871.70	308	250	250	52	102	101	4		
2	80	.15	1.4	875.43	308	250	251	53	104	102	4		
3	85	.13	1.2	878.86	305	251	249	54	104	101	4		
3	90	.13	1.2	882.33	304	249	250	56	105	101	4		
1	95	.20	1.8	886.47	307	248	249	48	107	102	6		
1	100	.20	1.8	890.60	306	247	249	42	105	100	6		
2	105	.22	2.0	894.95	305	249	248	42	104	100	6		
2	110	.22	2.0	899.40	307	248	249	44	104	100	6		
3	115	.20	1.8	903.45	305	249	250	47	104	100	6		
3	120	.20	1.8	907.69	302	247	247	49	103	99	6		
	Total	*5.0099	19.30		3676				2456				
	Average												

SOLVAY2016_6_001663

DS 001 General
CNVS/TRG.R3-4/6/94

* Sum of square roots.

Circle correct bracketed units on data sheet.

Clean Air Engineering

TEST LOCATION: Stack

Formaldehyde **TESTING**

FIELD DATA SHEET

METHOD: 0011 **PAGE** 1 **OF** 2

UNIT: EP5 **RUN:** 3

Client Solvay Minerals	Project No. 7747
Plant Green River WY	Date 7-24-96
Meter Operator RON M. LUIKAART	
Probe Operator ED McGAFFICK	

Meter Box No. D-12	Sample Box No. 1
Meter Yd .9971	Meter ΔH@ 1.8349
K Factor 9.2	Pitot Cp .84
Leak Rate Before .003 [cfm] [Lpm] @ 15 (in.Hg)	
Leak Rate After .003 [cfm] [Lpm] @ 15 (in.Hg)	
Pitot Leak Check Before: ☑	After: Good ☑ Bad ☐

Cross-Section of Test Location

[N] [UP]

Duct Dimensions (in.)	125.5

Static Press. (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
-.3	4.75/12.5		

Amb. Temp. (°F) 90	Bar. Press. 24.04 [in. Hg] [mbar]
Probe I.D. No. 6-06A-65	
Liner Material GLASS	

Filter No. NA		
Thimble No. NA		
Nozzle Diameter .375	Nozzle I.D. .375	

H_2O 584.7 [ml] [gm]	Silica Gel (gm) 22.6
Total V_{lc} 607.3	

Start Time: 1738	Stop Time: 1946

Traverse Point Number	Min/pt 10 Elapsed Time	Velocity Head ΔP's (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume - V_m Init. Vol. [ft³] [L] 907.80	Stack Temp. T_s (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in. Hg)	XAD Trap Temp T_t (°F)	Notes
3-1	5	.19	1.7	911.87	306	248	251	58	94	95	5	NA	
1	10	.19	1.7	915.95	308	248	249	54	96	96	5		
2	15	.19	1.7	919.98	308	249	247	55	99	96	5		
2	20	.19	1.7	923.98	305	248	254	52	99	95	5		
3	25	.14	1.3	927.51	306	249	245	55	101	95	4		
3	30	.14	1.3	931.00	305	250	248	57	100	95	4		
4-1	35	.14	1.3	934.54	304	249	253	55	98	95	4		
1	40	.14	1.3	938.02	306	249	253	50	100	95	4		
2	45	.14	1.3	941.56	305	249	250	48	100	95	4		
2	50	.14	1.3	945.11	304	249	250	50	102	96	4		
3	55	.11	1.0	948.23	305	249	248	53	100	95	4		
3	60	.11	1.0	951.35	304	250	252	54	100	96	4		
	Total	*	16.6	91.50	3666				33	33			
	Average	.407.2	1.54		307				97				

SOLVAY2016_6_001664

DS001 General
CNVS/TRG.R3-4/6/94

* Sum of square roots.

Circle correct bracketed units on data sheet.

Clean Air Engineering

TEST LOCATION: Stack

Formaldehyde TESTING FIELD DATA SHEET

METHOD: 0011 **PAGE** 2 **OF** 2

UNIT: EP-5 **RUN:** 3

Client	Solvay Minerals	Project No.	7747
Plant	Green River, WY	Date	7-24-96
Meter Operator	RONM. LUKHART		
Probe Operator	CD McGARRICK		

Meter Box No.	D-12	Sample Box No.	
Meter Yd	.9971	Meter ΔH@	1.8349
K Factor	9.2	Pitot Cp	.84
Leak Rate Before		[cfm] [Lpm] @	(in.Hg)
Leak Rate After		[cfm] [Lpm] @	(in.Hg)
Pitot Leak Check Before: ☐		After: Good ☐	Bad ☐

Cross-Section of Test Location

[N] [UP]

Duct Dimensions (in.)			
Static Press. (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]

Amb. Temp. (°F)	Bar. Press. [in. Hg] [mbar]
Probe I.D. No.	
Liner Material	

Filter No.		
Thimble No.		
Nozzle Diameter	Nozzle I.D.	

H_2O [ml] [gm]	Silica Gel (gm)
Total V_{lc}	

Start Time:	Stop Time:

Traverse Point Number	Min/pt 10 Elapsed Time	Velocity Head ΔP's (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume - V_m Init. Vol. [ft^3] [L]	Stack Temp. T_s (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet T_{min} (°F)	DGM Outlet T_{mout} (°F)	Pump Vacuum (in. Hg)	XAD Trap Temp T_t (°F)	Notes
1-1	65	.18	1.7	955.34	307	251	249	56	97	95	5	NA	
1	70	.16	1.5	959.10	310	248	248	57	100	96	5		
2	75	.16	1.5	962.90	309	249	251	59	100	96	5		
2	80	.18	1.7	966.89	308	248	250	60	100	95	5		
3	85	.14	1.3	970.44	309	249	250	49	99	94	5		
3	90	.14	1.3	973.99	308	250	252	50	98	94	5		
2-1	95	.22	2.0	978.31	308	249	251	52	96	93	6		
1	100	.22	2.0	982.61	311	249	255	53	99	93	6		
2	105	.22	2.0	986.97	310	248	250	54	100	93	6		
2	110	.22	2.0	991.34	310	250	248	56	100	93	6		
3	115	.18	1.7	995.33	309	249	254	58	100	93	6		
3	120	.18	1.7	999.30	310	250	252	59	100	93	6		
	Total	*	20.4		3709				23	17			
	Average												

SOLVAY2016_6_001665

001 General
CNVS/TRG.R3-4/6/94

* Sum of square roots.

Circle correct bracketed units on data sheet.

Clean Air Engineering

Orsat Readings

Client Solvay Minerals	Project Number 7747
Plant Green River, WY	Unit EP - 1 & 2
Date 7/26/96	Fuel Type Natural Gas
Orsat ID 65-2	Leak Check? OK

$$F_o = \frac{20.9 - \%O_2}{\%CO_2}$$

F_o = 1.083 to 1.230 (for bituminous coal)

Run Number	Location	Bag ID	Trial	Percent CO_2	Percent $CO_2 + O_2$	Percent O_2	F_o	Sample Time	Analysis Time	Analyst
2	Stack	Run 2	1	7.0	22.0	15.0		1401-1542	1900	SR
M0011			2	7.0	21.9	14.9				
			3	7.0	21.9	14.9				
			Avg.	7.0		14.9				
3	Stack	Run 3	1	7.0	21.2	14.2		1621-1805	1905	SR
M0011			2	7.1	21.3	14.2				
			3	7.1	21.3	14.2				
			Avg.	7.1		14.2				
4	Stack	Run 4	1	7.7	21.3	13.6		1827-2008	2030	SR
M0011			2	7.7	21.4	13.7				
			3	7.7	21.4	13.7				
			Avg.	7.7		13.7				
			1							
			2							
			3							
			Avg.							
			1							
			2							
			3							
			Avg.							
			1							
			2							
			3							
			Avg.							
			1							
			2							
			3							
			Avg.							
			1							
			2							
			3							
			Avg.							

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TEST LOCATION: STACK

FORMALDEHYDE TESTING FIELD DATA SHEET

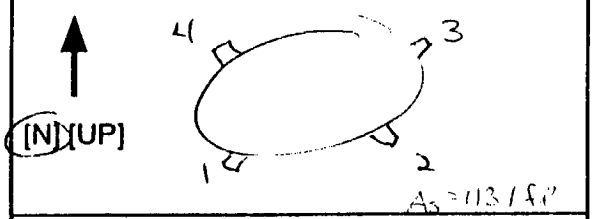
METHOD: 0011 **PAGE** 1 **OF** 2

UNIT: EP 1+2 **RUN:** 2

Client SOLVAY MINERALS	Project No. 7747
Plant GREEN RIVER, WY.	Date 7/26/96
Meter Operator RON M. LUIKAART	
Probe Operator N/A	

Meter Box No. D6	Sample Box No. 2
Meter Yd .9984	Meter ΔH@ 1.7344
K Factor 2.25	Pitot Cp .84
Leak Rate Before .002 (cfm) [Lpm] @ 15 (in.Hg)	
Leak Rate After .002 (cfm) [Lpm] @ 14 (in.Hg)	
Pitot Leak Check Before: ☑	After: Good ☑ Bad ☐

Cross-Section of Test Location



Duct Dimensions (in.)	144		
Static Press. (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
-.4	6		

Amb. Temp. (°F) 90	Bar. Press. 23.75 [in. Hg] [mbar]	
Probe I.D. No. M-6-2		
Liner Material GLASS		
Filter No. N/A		
Thimble No. N/A		
Nozzle Diameter .270	Nozzle I.D. .270	
H_2O 322.3 [ml] [gm]	Silica Gel (gm) 18.3	
Total V_{lc} 340.6		
Start Time: 14:01	Stop Time: 15:42	

Traverse Point Number	Min/pt 4 Elapsed Time	Velocity Head ΔP's (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume - V_m Init. Vol. [ft³] [L] 1142.30	Stack Temp. T_s (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet T_{min} (°F)	DGM Outlet T_{mout} (°F)	Pump Vacuum (in. Hg)	XAD Trap Temp T_t (°F)	Notes
1-1	4	.58	1.3	445.29	372	256	249	56	101	102	4	N/A	
2	8	.58	1.3	448.28	373	256	252	52	105	103	4		
3	12	.58	1.3	451.17	373	253	250	53	105	103	4		
4	16	.58	1.3	454.10	372	251	252	54	107	105	4		
5	20	.50	1.1	456.86	372	250	251	56	107	106	4		
6	24	.28	.63	458.92	372	249	252	56	103	105	2		
1-1	28	.56	1.3	461.82	373	251	253	57	98	102	4		
2	32	.56	1.3	464.70	374	252	250	57	100	102	4		
3	36	.56	1.3	467.69	374	252	256	56	99	101	4		
4	40	.53	1.2	470.44	376	251	260	56	97	100	4		
5	44	.46	1.0	472.97	375	250	260	57	97	99	3		
6	48	.34	.77	475.28	372	250	252	58	97	98	3		
	Total	*	13.8	65.46	4478				1142				
	Average	.7052	1.14		372				99				

SOLVAY2016_6_001662

D 001 General
CNVS/TRG.R3-4/6/94

* Sum of square roots.

Circle correct bracketed units on data sheet.

Clean Air Engineering

TEST LOCATION: STACK

FORMALDEHYDE TESTING FIELD DATA SHEET

METHOD: 0011 **PAGE** 2 **OF** 2

UNIT: EP 1 & 2 **RUN:** 2

Client SOLVAY MINERALS	Project No. 7747
Plant GREEN RIVER, WY	Date 7/26/96
Meter Operator	
Probe Operator	

Meter Box No.	Sample Box No.
Meter Yd	Meter ΔH@
K Factor	Pitot Cp
Leak Rate Before	[cfm] [Lpm] @ (in.Hg)
Leak Rate After	[cfm] [Lpm] @ (in.Hg)
Pitot Leak Check Before: ☐	After: Good ☐ Bad ☐

Cross-Section of Test Location

[N] [UP]

Duct Dimensions (in.)

Static Press. (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]

Amb. Temp. (°F)	Bar. Press. [in. Hg] [mbar]
Probe I.D. No.	
Liner Material	

Filter No.		
Thimble No.		
Nozzle Diameter	Nozzle I.D.	

H_2O [ml] [gm]	Silica Gel (gm)
Total V_{lc}	

Start Time:	Stop Time:

Traverse Point Number	Min/pt 4 Elapsed Time	Velocity Head ΔP's (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume - V_m Init. Vol. [ft³] [L]	Stack Temp. T_s (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet T_{min} (°F)	DGM Outlet T_{mout} (°F)	Pump Vacuum (in. Hg)	XAD Trap Temp T_t (°F)	Notes
3-1	52	.57	1.3	478.20	372	249	252	60	92	95	4	N/A	
2	56	.58	1.3	481.10	373	251	249	60	95	95	4		
3	60	.56	1.3	484.03	373	251	250	60	91	94	4		
4	64	.53	1.2	486.81	373	250	251	60	89	93	4		
5	68	.47	1.1	489.45	375	250	251	59	96	96	4		
6	72	.26	.59	491.43	373	252	250	57	96	95	2		
4-1	76	.53	1.2	494.12	370	251	253	54	101	97	4		
2	80	.53	1.2	497.05	370	249	252	54	94	95	4		
3	84	.53	1.2	499.85	369	252	251	56	97	97	4		
4	88	.53	1.2	502.69	368	251	252	57	100	99	4		
5	92	.49	1.1	505.41	368	250	251	58	105	101	4		
6	96	.37	.83	507.76	369	249	250	59	98	100	3		
	Total	*	13.52		4458				23	11			
	Average												

SOLVAY2016_6_00166

D0001 General
CNVS/TRG.R3-4/6/94

* Sum of square roots.

Circle correct bracketed units on data sheet.

Clean Air Engineering

TEST LOCATION: STACK

FORMALDEHYDE TESTING FIELD DATA SHEET

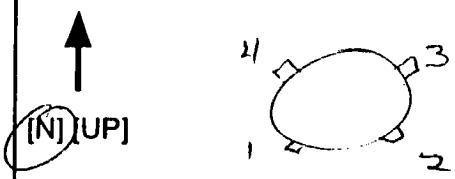
METHOD: 0011 **PAGE** 1 **OF** 2

UNIT: EP 1 & 2 **RUN:** 3

Client SOLVAY MINERALS	Project No. 7747
Plant GREEN RIVER, WY.	Date 7/26/96
Meter Operator RON M. LUIKAART	
Probe Operator "	

Meter Box No. D6	Sample Box No. 2
Meter Yd .9984	Meter ΔH@ 1.7344
K Factor 2.25	Pitot Cp .84
Leak Rate Before .002 [cfm] [Lpm] @ 15 (in.Hg)	
Leak Rate After .00 [cfm] [Lpm] @ (in.Hg)	
Pitot Leak Check Before: ☑	After: Good ☑ Bad ☐

Cross-Section of Test Location



Duct Dimensions (in.)			
144			
Static Press. (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
-.3	6		

Amb. Temp. (°F) 90	Bar. Press. 23.79 [in. Hg] [mbar]
Probe I.D. No. M-6-2	
Liner Material GLASS	

Filter No. N/A		
Thimble No. N/A		
Nozzle Diameter .270	Nozzle I.D. .270	

H_2O 344.2 [ml] [gm]	Silica Gel (gm) 20.1
Total V_{lc} 364.3	

Start Time: 16:21	Stop Time: 18:08

Traverse Point Number	Min/pt 4 Elapsed Time	Velocity Head ΔP's (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume - V_m Init. Vol. [ft^3] [L] 508.15	Stack Temp. T_s (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet T_{min} (°F)	DGM Outlet T_{mout} (°F)	Pump Vacuum (in. Hg)	XAD Trap Temp T_t (°F)	Notes
4-1	4	.55	1.2	511.06	368	252	247	54	96	101	4	N/A	
2	8	.56	1.3	513.99	368	255	250	52	97	100	4		
3	12	.58	1.3	516.96	366	252	250	52	91	96	4		
4	16	.58	1.3	519.95	367	250	249	52	88	95	4		
5	20	.49	1.1	522.66	368	249	251	54	90	94	4		
6	24	.29	.65	524.73	367	249	252	60	93	93	2		
-1	28	.59	1.3	527.62	373	250	251	58	91	91	4		
2	32	.58	1.3	530.57	373	252	255	56	92	91	4		
3	36	.56	1.3	533.45	373	252	249	56	92	91	4		
4	40	.57	1.3	536.47	374	251	252	57	93	90	4		
5	44	.49	1.1	539.16	373	250	256	58	95	91	4		
6	48	.33	.74	541.36	372	250	254	59	96	91	4		
	Total	*	13.89	66.68	4442				2238				
	Average	.7167	1.16		372				96				

* Sum of square roots.

Circle correct bracketed units on data sheet.

SOLVAY2016 6 001669

Clean Air Engineering

TEST LOCATION: STACK

FORMALDEHYDE TESTING FIELD DATA SHEET

METHOD: 0011 **PAGE** 2 **OF** 2

UNIT: EP 1+2 **RUN:** 3

Client SOLVAY MINERALS	Project No. 7747
Plant GREEN RIVER, WY.	Date 7/26/96
Meter Operator RON M. LUIKAART	
Probe Operator "	

Meter Box No.	Sample Box No.
Meter Yd	Meter ΔH@
K Factor	Pitot Cp
Leak Rate Before	[cfm] [Lpm] @ (in.Hg)
Leak Rate After	[cfm] [Lpm] @ (in.Hg)
Pitot Leak Check Before: ☐	After: Good ☐ Bad ☐

Cross-Section of Test Location

[N] [UP]

Duct Dimensions (in.)

Static Press. (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]

Amb. Temp. (°F)	Bar. Press. [in. Hg] [mbar]
Probe I.D. No.	
Liner Material	

Filter No.		
Thimble No.		
Nozzle Diameter	Nozzle I.D.	

H_2O [ml] [gm]	Silica Gel (gm)
Total V_{lc}	

Start Time:	Stop Time:

Traverse Point Number	Min/pt 4 Elapsed Time	Velocity Head ΔP's (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume - V_m Init. Vol. [ft^3] [L]	Stack Temp. T_s (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet T_{min} (°F)	DGM Outlet T_{mout} (°F)	Pump Vacuum (in. Hg)	XAD Trap Temp T_t (°F)	Notes
2-1	52	.59	1.3	544.29	374	250	253	58	98	92	4	N/A	
2	56	.59	1.3	547.21	378	251	253	58	101	94	4		
3	60	.55	1.2	550.03	375	251	253	59	101	94	4		
4	64	.53	1.2	552.82	375	251	252	58	101	94	4		
5	68	.47	1.1	555.52	375	250	252	56	102	95	4		
6	72	.29	.65	557.61	373	249	252	54	102	96	3		
-1	76	.57	1.3	560.56	374	253	252	56	103	97	4		
2	80	.61	1.4	563.60	373	253	253	57	104	97	4		
3	84	.61	1.4	566.63	373	252	252	58	104	97	4		
4	88	.60	1.4	569.70	374	251	253	59	105	98	4		
5	92	.53	1.2	572.51	374	250	252	59	106	99	4		
6	96	.35	.79	574.83	373	249	252	60	104	99	3		
	Total	*	13.84		4491				3	83			
	Average												

SOLVAY2016_6_001670

D0001 General
CNVS/TRG.R3-4/6/94

* Sum of square roots.

Circle correct bracketed units on data sheet.

Clean Air Engineering

TEST LOCATION: STACK

FORMALDEHYDE TESTING FIELD DATA SHEET

METHOD: 0011 **PAGE** 1 **OF** 2

UNIT: EP142 **RUN:** 4

Client SOLVAY MINERALS	Project No. 7747
Plant GREEN RIVER, WY.	Date 7/26/96
Meter Operator RON M. LUIKAART	
Probe Operator "	

Meter Box No. D6	Sample Box No. 1
Meter Yd .9984	Meter ΔH@ 1.7344
K Factor 2.25	Pitot Cp .84
Leak Rate Before .001 [cfm] [Lpm] @ 15 (in.Hg)	
Leak Rate After .001 [cfm] [Lpm] @ 16 (in.Hg)	
Pitot Leak Check Before: ☑	After: Good ☑ Bad ☐

Cross-Section of Test Location

[N] [UP]

Duct Dimensions (in.)			144
Static Press. (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
-.3	6	[Out]	[In]

Amb. Temp. (°F) 90	Bar. Press. 23.75 [in. Hg] [mbar]
Probe I.D. No. M-6-2	
Liner Material GLASS	

Filter No. N/A		
Thimble No. N/A		
Nozzle Diameter .270	Nozzle I.D. .270	

H_2O 360.2 [ml] [gm]	Silica Gel (gm) 17.9
Total V_{lc} 378.1	

Start Time: 1827	Stop Time: 2008

Traverse Point Number	Min/pt 4 Elapsed Time	Velocity Head ΔP's (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume - V_m Init. Vol. [ft^3] [L] 575.15	Stack Temp. T_s (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet T_{min} (°F)	DGM Outlet T_{mout} (°F)	Pump Vacuum (in. Hg)	XAD Trap Temp T_t (°F)	Notes
1-1	4	.61	1.4	578.18	375	250	252	54	101	101	4	N/A	
2	8	.61	1.4	581.23	373	252	250	52	100	99	4		
3	12	.63	1.4	584.29	374	254	251	53	100	99	4		
4	16	.63	1.4	587.34	375	252	249	54	102	99	4		
5	20	.55	1.2	590.19	374	251	250	56	100	99	3		
6	24	.35	.79	592.49	374	250	252	56	101	99	3		
1-1	28	.61	1.4	595.55	372	248	248	58	99	99	4		
2	32	.62	1.4	598.61	375	252	250	59	99	98	4		
3	36	.59	1.3	601.57	375	251	250	60	100	98	4		
4	40	.56	1.3	604.49	376	251	250	58	101	99	4		
5	44	.47	1.1	607.18	375	250	251	54	102	99	4		
6	48	.32	.72	609.46	374	249	251	55	100	99	3		
	Total		14.81	68.44	4492				2393				
	Average	.7356	1.23		374				100				

* Sum of square roots.

Circle correct bracketed units on data sheet.

SOLVAY2016_6_00167

DS-001 General
CNVS/TRG.R3-4/6/94

Clean Air Engineering

TEST LOCATION: STACK

FORMALDEHYDE TESTING FIELD DATA SHEET

METHOD: 0011 **PAGE** 2 **OF** 2

UNIT: EP 1+2 **RUN:** 4

Client SOLVAY MINERALS	Project No. 7747
Plant GREENRIVER, WY.	Date 7/26/96
Meter Operator RON M. LUIKAART	
Probe Operator "	

Meter Box No.	Sample Box No.
Meter Yd	Meter ΔH@
K Factor	Pitot Cp
Leak Rate Before	[cfm] [Lpm] @ (in.Hg)
Leak Rate After	[cfm] [Lpm] @ (in.Hg)
Pitot Leak Check Before: ☐	After: Good ☐ Bad ☐

Cross-Section of Test Location

↑

[N] [UP]

Duct Dimensions (in.)

Static Press. (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]

Amb. Temp. (°F)	Bar. Press. [in. Hg] [mbar]
Probe I.D. No.	
Liner Material	

Filter No.		
Thimble No.		
Nozzle Diameter	Nozzle I.D.	

H_2O [ml] [gm]	Silica Gel (gm)
Total V_{lc}	

Start Time:	Stop Time:

Traverse Point Number	Min/pt 4 Elapsed Time	Velocity Head ΔP's (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume - V_m Init. Vol. [ft³] [L]	Stack Temp. T_s (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in. Hg)	XAD Trap Temp T_t (°F)	Notes
3-1	52	.60	1.4	612.50	375	250	248	56	100	98	4	N/A	
2	56	.60	1.4	615.57	375	251	249	57	102	98	4		
3	60	.61	1.4	618.62	376	250	249	58	102	98	4		
4	64	.56	1.3	621.55	376	251	250	59	102	99	4		
5	68	.50	1.1	624.25	376	250	249	50	102	99	4		
6	72	.32	.72	626.45	370	249	250	47	100	98	3		
4-1	76	.59	1.3	629.38	373	248	251	48	99	98	4		
2	80	.59	1.3	632.32	372	251	250	49	100	98	4		
3	84	.61	1.4	635.34	372	252	251	50	101	98	4		
4	88	.58	1.3	638.30	372	250	252	51	101	98	4		
5	92	.55	1.2	641.12	372	251	250	53	101	99	4		
6	96	.41	.92	643.59	372	250	251	54	102	99	3		
	Total	*	14.74		4481				2392				
	Average												

* Sum of square roots.

Circle correct bracketed units on data sheet.

Clean Air Engineering

001 General
CNVS/TRG.R3-4/6/94

SOLVAY2016_6_001672

FIELD DATA PRINTOUTS

E

Field Data Printout

Location:	CA-3 Calciner Stack	Method:	BIF 0011	Bar. Press. (in. Hg):	24.04
Test Run:	1	Testing Type:	Formaldehyde	Assumed Moisture (%):	28.56
Client:	Solvay Minerals, Inc.				
Project No:	7747-3			Nozzle Diameter (D_n):	0.375
Test Date:	7/24/96			O_2 (dry volume %):	12.3
Meter ΔH@:	1.8349	Area (ft^2):	85.90	CO_2 (dry volume %):	9.3
Meter Y_d:	0.9971			Start Time (approx.):	12:38
Pitot C_p:	0.84	Filter No:	N/A	Stop Time (approx.):	14:45
Static P:	-0.3	Thimble No:	N/A	H_2O (condensate, ml):	550.2
		Beaker No:	N/A	H_2O (silica, g):	23.5

Traverse Point	Run Time	Pitot ΔP_s	Sample ΔH	Metered (ft^3)	Stack T_s	Dry Gas Meter $T_{m\ in}$	Dry Gas Meter $T_{m\ out}$	$\sqrt{\Delta P_s}$ (calculated)	Volume (calculated)	Isokinetics (calculated)
	0.0	(in. H_2O)	(in. H_2O)	726.40	(°F)	(°F)	(°F)	($\sqrt{in.\ H_2O}$)	(ft^3)	(%)
3-01	5.0	0.22	1.70	730.57	302	102	103	0.47	4.17	93.7
3-01	10.0	0.22	1.70	734.64	303	102	103	0.47	4.07	91.5
3-02	15.0	0.24	1.80	738.86	302	104	103	0.49	4.22	90.6
3-02	20.0	0.24	1.80	743.10	303	106	103	0.49	4.24	90.9
3-03	25.0	0.15	1.10	746.38	300	109	104	0.39	3.28	88.3*
3-03	30.0	0.15	1.10	749.70	301	110	105	0.39	3.32	89.3*
4-01	35.0	0.19	1.40	753.39	302	110	105	0.44	3.69	88.3*
4-01	40.0	0.17	1.30	757.98	305	111	105	0.41	4.59	116.2*
4-02	45.0	0.17	1.30	760.58	304	112	106	0.41	2.60	65.7*
4-02	50.0	0.17	1.30	764.19	304	113	106	0.41	3.61	91.1
4-03	55.0	0.13	0.98	767.35	300	114	108	0.36	3.16	90.6
4-03	60.0	0.13	0.98	770.53	301	114	108	0.36	3.18	91.3
1-01	65.0	0.20	1.50	774.40	307	114	109	0.45	3.87	90.0*
1-01	70.0	0.20	1.50	778.17	310	115	109	0.45	3.77	87.7*
1-02	75.0	0.19	1.40	781.86	310	116	110	0.44	3.69	87.9*
1-02	80.0	0.19	1.40	785.62	309	116	110	0.44	3.76	89.5*
1-03	85.0	0.16	1.20	789.08	308	117	110	0.40	3.46	89.6*
1-03	90.0	0.16	1.20	792.50	309	117	111	0.40	3.42	88.5*
2-01	95.0	0.21	1.60	796.49	311	117	112	0.46	3.99	90.3
2-01	100.0	0.25	1.90	800.83	314	118	112	0.50	4.34	90.2
2-02	105.0	0.26	2.00	805.24	313	118	112	0.51	4.41	89.9*
2-02	110.0	0.26	2.00	809.68	313	119	113	0.51	4.44	90.3
2-03	115.0	0.19	1.40	813.44	310	119	113	0.44	3.76	89.1*
2-03	120.0	0.19	1.40	817.16	311	120	113	0.44	3.72	88.2*
Final	120.0		1.46	90.76	306	111		0.44		

Field Data Printout

Location: CA-3 Calciner Stack
Test Run: 2
Client: Solvay Minerals, Inc.
Project No: 7747-3
Test Date: 7/24/96
Meter ΔH@: 1.8349
Meter Y_d: 0.9971
Pitot C_p: 0.84
Static P: -0.3

Method: BIF 0011
Testing Type: Formaldehyde

Area (ft^2): 85.90

Filter No: N/A
Thimble No: N/A
Beaker No: N/A

Bar. Press. (in. Hg): 24.04
Assumed Moisture (%): 28.82

Nozzle Diameter (D_n): 0.375
O_2 (dry volume %): 12.3
CO_2 (dry volume %): 9.7
Start Time (approx.): 15:10
Stop Time (approx.): 17:17
H_2O (condensate, ml): 563.5
H_2O (silica, g): 21.4

Traverse Point	Run Time	Pitot ΔP_s (in. H_2O)	Sample ΔH (in. H_2O)	Metered (ft^3)	Stack T_s (°F)	Dry Gas Meter $T_{m\ in}$ (°F)	Dry Gas Meter $T_{m\ out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.\ H_2O}$)	Volume (calculated) (ft^3)	Isokinetics (calculated) (%)
	0.0			817.40						
2-01	5.0	0.20	1.50	821.33	315	112	112	0.45	3.93	92.1
2-01	10.0	0.20	1.50	825.16	314	103	108	0.45	3.83	90.7
2-02	15.0	0.20	1.50	828.98	313	104	109	0.45	3.82	90.3
2-02	20.0	0.21	1.60	832.96	314	105	107	0.46	3.98	92.0
2-03	25.0	0.16	1.20	836.40	312	105	105	0.40	3.44	91.0
2-03	30.0	0.15	1.10	839.65	310	105	105	0.39	3.25	88.7*
1-01	35.0	0.16	1.20	843.10	311	104	103	0.40	3.45	91.5
1-01	40.0	0.16	1.20	846.52	313	106	104	0.40	3.42	90.5
1-02	45.0	0.16	1.20	849.93	311	105	103	0.40	3.41	90.3
1-02	50.0	0.16	1.20	853.34	311	105	103	0.40	3.41	90.3
1-03	55.0	0.15	1.40	856.92	309	106	104	0.39	3.58	97.7
1-03	60.0	0.15	1.40	860.52	309	107	104	0.39	3.60	98.1
4-01	65.0	0.15	1.40	864.15	309	101	102	0.39	3.63	99.7
4-01	70.0	0.16	1.50	868.05	310	102	103	0.40	3.90	103.6
4-02	75.0	0.15	1.40	871.70	308	102	101	0.39	3.65	100.2
4-02	80.0	0.15	1.40	875.43	308	104	102	0.39	3.73	102.1
4-03	85.0	0.13	1.20	878.86	305	104	101	0.36	3.43	100.7
4-03	90.0	0.13	1.20	882.33	304	105	101	0.36	3.47	101.7
3-01	95.0	0.20	1.80	886.47	307	107	102	0.45	4.14	97.9
3-01	100.0	0.20	1.80	890.60	306	105	100	0.45	4.13	98.0
3-02	105.0	0.22	2.00	894.95	305	104	100	0.47	4.35	98.5
3-02	110.0	0.22	2.00	899.40	307	104	100	0.47	4.45	100.9
3-03	115.0	0.20	1.80	903.45	305	104	100	0.45	4.05	96.1
3-03	120.0	0.20	1.80	907.69	302	103	99	0.45	4.24	100.6
Final	120.0		1.47	90.29	309	104		0.42		

Field Data Printout

Location: CA-3 Calciner Stack
Test Run: 3
Client: Solvay Minerals, Inc.
Project No: 7747-3
Test Date: 7/24/96
Meter ΔH@: 1.8349
Meter Y_d: 0.9971
Pitot C_p: 0.84
Static P: -0.3

Method: BIF 0011
Testing Type: Formaldehyde
Area (ft^2): 85.90
Filter No: N/A
Thimble No: N/A
Beaker No: N/A

Bar. Press. (in. Hg): 24.04
Assumed Moisture (%): 29.05
Nozzle Diameter (D_n): 0.375
O_2 (dry volume %): 13.0
CO_2 (dry volume %): 9.3
Start Time (approx.): 17:38
Stop Time (approx.): 19:46
H_2O (condensate, ml): 584.7
H_2O (silica, g): 22.6

Traverse Point	Run Time	Pitot ΔP_s (in. H_2O)	Sample ΔH (in. H_2O)	Metered (ft^3)	Stack T_s (°F)	Dry Gas Meter $T_{m\ in}$ (°F)	Dry Gas Meter $T_{m\ out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.\ H_2O}$)	Volume (calculated) (ft^3)	Isokinetics (calculated) (%)
	0.0			907.80						
3-01	5.0	0.19	1.70	911.87	306	94	95	0.44	4.07	100.7
3-01	10.0	0.19	1.70	915.95	308	96	96	0.44	4.08	100.8
3-02	15.0	0.19	1.70	919.98	308	99	96	0.44	4.03	99.3
3-02	20.0	0.19	1.70	923.98	305	99	95	0.44	4.00	98.4
3-03	25.0	0.14	1.30	927.51	306	101	95	0.37	3.53	101.0
3-03	30.0	0.14	1.30	931.00	305	100	95	0.37	3.49	99.8
4-01	35.0	0.14	1.30	934.54	304	98	95	0.37	3.54	101.4
4-01	40.0	0.14	1.30	938.02	306	100	95	0.37	3.48	99.6
4-02	45.0	0.14	1.30	941.56	305	100	95	0.37	3.54	101.3
4-02	50.0	0.14	1.30	945.11	304	102	96	0.37	3.55	101.2
4-03	55.0	0.11	1.00	948.23	305	100	95	0.33	3.12	100.6
4-03	60.0	0.11	1.00	951.35	304	100	96	0.33	3.12	100.4
1-01	65.0	0.18	1.70	955.34	307	97	95	0.42	3.99	101.2
1-01	70.0	0.16	1.50	959.10	310	100	96	0.40	3.76	100.9
1-02	75.0	0.16	1.50	962.90	309	100	96	0.40	3.80	101.9
1-02	80.0	0.18	1.70	966.89	308	100	95	0.42	3.99	101.0
1-03	85.0	0.14	1.30	970.44	309	99	94	0.37	3.55	102.0
1-03	90.0	0.14	1.30	973.99	308	98	94	0.37	3.55	102.0
2-01	95.0	0.22	2.00	978.31	308	96	93	0.47	4.32	99.5
2-01	100.0	0.22	2.00	982.61	311	99	93	0.47	4.30	99.0
2-02	105.0	0.22	2.00	986.97	310	100	93	0.47	4.36	100.2
2-02	110.0	0.22	2.00	991.34	310	100	93	0.47	4.37	100.4
2-03	115.0	0.18	1.70	995.33	309	100	93	0.42	3.99	101.2
2-03	120.0	0.18	1.70	999.30	310	100	93	0.42	3.97	100.8
Final	120.0		1.54	91.50	307	97		0.41		

Field Data Printout

Location: CA 1&2 Calciner Stack
Test Run: 2
Client: Solvay Minerals, Inc.
Project No: 7747-3
Test Date: 7/26/96
Meter ΔH@: 1.7344
Meter Y_d: 0.9984
Pitot C_p: 0.84
Static P: -0.4

Method: BIF 0011
Testing Type: Formaldehyde

Area (ft^2): 113.10

Filter No: N/A
Thimble No: N/A
Beaker No: N/A

Bar. Press. (in. Hg): 23.75
Assumed Moisture (%): 24.59

Nozzle Diameter (D_n): 0.270
O_2 (dry volume %): 14.9
CO_2 (dry volume %): 7.0
Start Time (approx.): 14:01
Stop Time (approx.): 15:42
H_2O (condensate, ml): 322.3
H_2O (silica, g): 18.3

Traverse Point	Run Time	Pitot ΔP_s (in. H_2O)	Sample ΔH (in. H_2O)	Metered (ft^3)	Stack T_s (°F)	Dry Gas Meter $T_{m\ in}$ (°F)	Dry Gas Meter $T_{m\ out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.\ H_2O}$)	Volume (calculated) (ft^3)	Isokinetics (calculated) (%)
	0.0			442.30						
1-01	4.0	0.58	1.30	445.29	372	101	102	0.76	2.99	98.9
1-02	8.0	0.58	1.30	448.28	373	105	103	0.76	2.99	98.5
1-03	12.0	0.58	1.30	451.17	373	105	103	0.76	2.89	95.2
1-04	16.0	0.58	1.30	454.10	372	107	105	0.76	2.93	96.1
1-05	20.0	0.50	1.10	456.86	372	107	106	0.71	2.76	97.3
1-06	24.0	0.28	0.63	458.92	372	103	105	0.53	2.06	97.4
2-01	28.0	0.56	1.30	461.82	373	98	102	0.75	2.90	97.9
2-02	32.0	0.56	1.30	464.70	374	100	102	0.75	2.88	97.1
2-03	36.0	0.56	1.30	467.69	374	99	101	0.75	2.99	101.0
2-04	40.0	0.53	1.20	470.44	376	97	100	0.73	2.75	95.8
2-05	44.0	0.46	1.00	472.97	375	97	99	0.68	2.53	94.6
2-06	48.0	0.34	0.77	475.20	372	97	98	0.58	2.23	96.8
3-01	52.0	0.57	1.30	478.20	372	92	95	0.75	3.00	101.5
3-02	56.0	0.58	1.30	481.10	373	95	95	0.76	2.90	97.1
3-03	60.0	0.56	1.30	484.03	373	91	94	0.75	2.93	100.2
3-04	64.0	0.53	1.20	486.81	373	89	93	0.73	2.78	98.0
3-05	68.0	0.47	1.10	489.45	375	96	96	0.69	2.64	98.0
3-06	72.0	0.26	0.59	491.43	373	96	95	0.51	1.98	98.7
4-01	76.0	0.53	1.20	494.12	370	101	97	0.73	2.69	93.3
4-02	80.0	0.53	1.20	497.05	370	94	95	0.73	2.93	102.5
4-03	84.0	0.53	1.20	499.85	369	97	97	0.73	2.80	97.4
4-04	88.0	0.53	1.20	502.69	368	100	99	0.73	2.84	98.3
4-05	92.0	0.49	1.10	505.41	368	105	101	0.70	2.72	97.3
4-06	96.0	0.37	0.83	507.76	369	98	100	0.61	2.35	97.4
Final	96.0		1.14	65.46	372	99		0.71		

Field Data Printout

Location: CA 1&2 Calciner Stack
Test Run: 3
Client: Solvay Minerals, Inc.
Project No: 7747-3
Test Date: 7/26/96
Meter ΔH@: 1.7344
Meter Y_d: 0.9984
Pitot C_p: 0.84
Static P: -0.3

Method: BIF 0011
Testing Type: Formaldehyde
Area (ft^2): 113.10
Filter No: N/A
Thimble No: N/A
Beaker No: N/A

Bar. Press. (in. Hg): 23.75
Assumed Moisture (%): 25.42
Nozzle Diameter (D_n): 0.270
O_2 (dry volume %): 14.2
CO_2 (dry volume %): 7.1
Start Time (approx.): 16:21
Stop Time (approx.): 18:08
H_2O (condensate, ml): 344.2
H_2O (silica, g): 20.1

Traverse Point	Run Time	Pitot ΔP_s (in. H_2O)	Sample ΔH (in. H_2O)	Metered (ft^3)	Stack T_s (°F)	Dry Gas Meter $T_{m\ in}$ (°F)	Dry Gas Meter $T_{m\ out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.\ H_2O}$)	Volume (calculated) (ft^3)	Isokinetics (calculated) (%)
	0.0			508.15						
4-01	4.0	0.55	1.20	511.06	368	96	101	0.74	2.91	99.9
4-02	8.0	0.56	1.30	513.99	368	97	100	0.75	2.93	99.8
4-03	12.0	0.58	1.30	516.96	366	91	96	0.76	2.97	100.1
4-04	16.0	0.58	1.30	519.95	367	88	95	0.76	2.99	101.2
4-05	20.0	0.49	1.10	522.66	368	90	94	0.70	2.71	99.7
4-06	24.0	0.29	0.65	524.73	367	93	93	0.54	2.07	98.6
3-01	28.0	0.59	1.30	527.62	373	91	91	0.77	2.89	97.5
3-02	32.0	0.58	1.30	530.57	373	92	91	0.76	2.95	100.2
3-03	36.0	0.56	1.30	533.45	373	92	91	0.75	2.88	99.6
3-04	40.0	0.57	1.30	536.47	374	93	90	0.75	3.02	103.6
3-05	44.0	0.49	1.10	539.16	373	95	91	0.70	2.69	99.1
3-06	48.0	0.33	0.74	541.36	372	96	91	0.57	2.20	98.5
2-01	52.0	0.59	1.30	544.29	374	98	92	0.77	2.93	98.1
2-02	56.0	0.59	1.30	547.21	378	101	94	0.77	2.92	97.6
2-03	60.0	0.55	1.20	550.03	375	101	94	0.74	2.82	97.4
2-04	64.0	0.53	1.20	552.82	375	101	94	0.73	2.79	98.2
2-05	68.0	0.47	1.10	555.52	375	102	95	0.69	2.70	100.7
2-06	72.0	0.29	0.65	557.61	373	102	96	0.54	2.09	98.9
1-01	76.0	0.57	1.30	560.56	374	103	97	0.75	2.95	99.6
1-02	80.0	0.61	1.40	563.60	373	104	97	0.78	3.04	99.1
1-03	84.0	0.61	1.40	566.63	373	104	97	0.78	3.03	98.8
1-04	88.0	0.60	1.40	569.70	374	105	98	0.77	3.07	100.8
1-05	92.0	0.53	1.20	572.51	374	106	99	0.73	2.81	98.0
1-06	96.0	0.35	0.79	574.83	373	104	99	0.59	2.32	99.5
Final	96.0		1.17	66.68	372	96		0.72		

Field Data Printout

Location: CA 1&2 Calciner Stack
Test Run: 4
Client: Solvay Minerals, Inc.
Project No: 7747-3
Test Date: 7/26/96
Meter ΔH@: 1.7344
Meter Y_d: 0.9984
Pitot C_p: 0.84
Static P: -0.3

Method: BIF 0011
Testing Type: Formaldehyde

Area (ft^2): 113.10

Filter No: N/A
Thimble No: N/A
Beaker No: N/A

Bar. Press. (in. Hg): 23.75
Assumed Moisture (%): 25.74

Nozzle Diameter (D_n): 0.270
O_2 (dry volume %): 13.7
CO_2 (dry volume %): 7.7
Start Time (approx.): 18:27
Stop Time (approx.): 20:08
H_2O (condensate, ml): 360.2
H_2O (silica, g): 17.9

Traverse Point	Run Time	Pitot ΔP_s	Sample ΔH	Metered	Stack T_s	Dry Gas Meter $T_{m\ in}$	Dry Gas Meter $T_{m\ out}$	$\sqrt{\Delta P_s}$ (calculated)	Volume (calculated)	Isokinetics (calculated)
	0.0	(in. H_2O)	(in. H_2O)	(ft^3) 575.15	(°F)	(°F)	(°F)	($\sqrt{in.\ H_2O}$)	(ft^3)	(%)
1-01	4.0	0.61	1.40	578.18	375	101	101	0.78	3.03	99.3
1-02	8.0	0.61	1.40	581.23	373	100	99	0.78	3.05	100.1
1-03	12.0	0.63	1.40	584.29	374	100	99	0.79	3.06	98.9
1-04	16.0	0.63	1.40	587.34	375	102	99	0.79	3.05	98.5
1-05	20.0	0.55	1.20	590.19	374	100	99	0.74	2.85	98.5
1-06	24.0	0.35	0.79	592.49	374	101	99	0.59	2.30	99.4
2-01	28.0	0.61	1.40	595.55	372	99	99	0.78	3.06	100.5
2-02	32.0	0.62	1.40	598.61	375	99	98	0.79	3.06	99.9
2-03	36.0	0.59	1.30	601.57	375	100	98	0.77	2.96	99.0
2-04	40.0	0.56	1.30	604.49	376	101	99	0.75	2.92	100.1
2-05	44.0	0.47	1.10	607.18	375	102	99	0.69	2.69	100.4
2-06	48.0	0.32	0.72	609.46	374	100	99	0.57	2.28	103.2
1-01	52.0	0.60	1.40	612.50	375	100	98	0.77	3.04	100.8
1-02	56.0	0.60	1.40	615.57	375	102	98	0.77	3.07	101.6
1-03	60.0	0.61	1.40	618.62	376	102	98	0.78	3.05	100.2
1-04	64.0	0.56	1.30	621.55	376	102	99	0.75	2.93	100.3
1-05	68.0	0.50	1.10	624.25	376	102	99	0.71	2.70	97.8
1-06	72.0	0.32	0.72	626.45	370	100	98	0.57	2.20	99.4
4-01	76.0	0.59	1.30	629.38	373	99	98	0.77	2.93	97.9
4-02	80.0	0.59	1.30	632.32	372	100	98	0.77	2.94	98.1
4-03	84.0	0.61	1.40	635.34	372	101	98	0.78	3.02	99.1
4-04	88.0	0.58	1.30	638.30	372	101	98	0.76	2.96	99.5
4-05	92.0	0.55	1.20	641.12	372	101	99	0.74	2.82	97.3
4-06	96.0	0.41	0.92	643.59	372	102	99	0.64	2.47	98.5
Final	96.0		1.23	68.44	374	100		0.7346		

F

LABORATORY DATA

F

PROJECT NARRATIVE
ZENON Laboratories
Zenon Project: AN960722
Zenon Submission #:6G0799
Client: Clean Air Engineering
Client Project: 7747

I. SAMPLE RECEIPT/ANALYSIS

a) Sample Listing

Zenon ID	Client Sample ID	Date Sampled	Date Received	Run Date
Aldehydes and Ketones via HPLC				
029005 96	Field Blank	96/07/24	96/07/27	96/08/09
029006 96	Reagent Blank	96/07/24	96/07/27	96/08/09
029007 96	Run #1 EP-5 Stack	96/07/24	96/07/27	96/08/09
029008 96	Run #2 EP-5 Stack	96/07/24	96/07/27	96/08/09
029009 96	Run #3 EP-5 Stack	96/07/24	96/07/27	96/08/09

b) Shipping Problems: none encountered

c) Documentation Problems: none encountered

II. SAMPLE PREP:

No problems encountered

III. SAMPLE ANALYSIS:

a) Surrogate/Internal Recoveries: all within control limits

b) Hold Times: method 0011 recommended hold times are 30 days for the extraction and 30 days for extract prior to analysis. Both of these steps were achieved well within recommended hold times.

c) Instrument Calibration: all within control limits

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above.
In addition, I certify, that to the best of my knowledge and belief, the data as reported are true and accurate.
Release of the data contained in this data package has been authorized by the cognizant laboratory official or his/her designee, as verified by this signature.

R.A. McLeod

Ronald A. McLeod, Ph.D.; Principal Scientist

Aug 29th 1996

Date

ZENON LABORATORIES

5555 North Service Road
Burlington, Ontario, Canada L7L 5H7
Tel: (905) 332-8788
Fax: (905) 332-9169

Certificate of Analysis

CLIENT INFORMATION

Attention: Kim Collins
Client Name: Clean Air Engineering
Project: 7747
Project Desc: Formaldehyde Analysis

Address: 7000 North Broadway,
Building 2 Unit 200
Denver, CO
80221
Fax Number: 303-650-9747
Phone Number: 303-650-9745

LABORATORY INFORMATION

Contact: Ron McLeod
Project: AN960722
Date Received: 96/07/27
Date Reported: 96/08/12

Submission No.: 6G0827
Sample No.: 029005-029225

NOTES: *"-" = not analysed '<' = less than Method Detection Limit (MDL) 'NA' = no data available*
LOQ can by determined for all analytes by multiplying the appropriate MDL X 3.33
Solids data is based on dry weight except for biota analyses.
Organic analyses are not corrected for extraction recovery standards except for isotope dilution methods, (i.e. CARB 429 PAH, all PCDD/F and DBD/DBF analyses)

Methods used by Zenon are based upon those found in 'Standard Methods for the Examination of Water and Wastewater', Seventeenth Edition. Other methods are based on the principles of MISA or EPA methodologies.

All work recorded herein has been done in accordance with normal professional standards using accepted testing methodologies, quality assurance and quality control procedures except where otherwise agreed to by the client and testing company in writing. Any and all use of these test results shall be limited to the actual cost of the pertinent analysis done. There is no other warranty expressed or implied. Your samples will be retained at Zenon for a period of three weeks from receipt of data or as per contract.

COMMENTS:

* Acrolein and acetone peaks unresolved. Acrolein is the major contributor. Reported value is based on the total response for acrolein and acetone relative to instrument response to the acrolein-DNP derivative.

Certified by:

A division of PHILIP Analytical Services Corporation
SOLVAY2016_6_001684

Zenon Environmental Laboratories - Certificate of Analysis

			Field	Reagent	Run #1	Run #2	Run #3	Run 2	Run 3	Run 4
Client ID:			Blank	Blank	EP-5 Stack	EP-5 Stack	EP-5 Stack	EP-1&2 Stack	EP-1&2 Stack	EP-1&2 Stack
Zenon ID:			029005 96	029006 96	029007 96	029008 96	029009 96	029223 96	029224 96	029225 96
Date Sampled:			96/07/24	96/07/24	96/07/24	96/07/24	96/07/24	96/07/26	96/07/26	96/07/26
Component	**MDL**	**Units**								
Formaldehyde	1	ug	<	<	350	240	210	780	530	340
Acetaldehyde	1	"	<	<	260	890	790	730	570	1300
Acrolein	1	"	<	<	940*	2500*	2200*	2800*	2400*	2400*
Acetone	1	"	15	15	<300*	<800*	<700*	<900*	<800*	<800*
Propionaldehyde	1	"	<	<	94	260	220	280	210	370
2-Butanone	1	"	<	<	140	320	260	530	380	430

Client:Clean Air Engineering Project:7747

SOLVAY2016_6_001685

ZENON LABORATORIES

FAX TRANSMISSION

NUMBER OF PAGES INCLUDING COVER PAGE: 1

DATE: August 30th, 1996

ATTENTION: Kim Collins

COMPANY: CAE

RE: Sample Volumes for the Aldehyde/Ketone Samples

FAX # 303-650-9747 PHONE # 303-650-9745

FROM: **RON McLEOD**

COMMENTS:

The sample volumes as received are as follows:

Zenon ID #	CAE ID	Volume (mL)
029005	Field Blank	580
029006	Reagent Blk	280
029007	Run 1 EP 5 Stack	1140
029008	Run 2 EP 5 Stack	1040
029009	Run 3 EP 5 Stack	1020
029223	Run 1 EP 1&2 Stack	640
029224	Run 2 EP 1&2 Stack	680
029225	Run 3 EP 1&2 Stack	700

Ron

If you do not receive all pages, please call 905-332-8788

Originals to Follow: YES_____ NO X

VIA Mail_____ Courier_____ Other_____

G

SOLVAY MINERALS, INC.
GREEN RIVER, WYOMING

Client Reference No: CO2863
CAE Project No: 7747-3

CHAIN OF CUSTODY

G

Revision 0

CHAIN OF CUSTODY RECORD

MBR456 - 29004

№ 09523

PROJ. NO. 7747
DEPT. NO. 65
PROJECT NAME: SOLVAY MINERALS
SAMPLERS: (Signature) Steve Ferguson

LAB NO.	SAMPLE NO.	DATE	TIME	SAMPLE LOCATION	NO. OF CONTAINERS	*HPLC ANALYSIS						REMARKS
29000		7/24	Ø	REAGENT BLANK	1	X						*HPLC ANALYSIS FOR:
29001		7/24	RUN 1	EP-5 STACK	2	X						- FORMALDEHYDE
03		7/24	RUN 2	EP-5 STACK	2	X						- ACETONE
04		7/24	RUN 3	EP-5 STACK	2	X						- 2-BUTANONE
29005		7/24	Ø	FIELD BLANK	1	X						- ACROLEIN
												- ACETALDEHYDE
												- PROPIONALDEHYDE

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Steve Ferguson	7/24/96 2100	ZENON			
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by:	Date / Time		
		[illegible] - Zenon	960727 1200 pm		

REMARKS:

SOLVAY 2016_6_001689

CAE
Clean Air Engineering
500 W. Wood Street
Palatine, IL 60067
708/991-3300

WHITE-PRINT FILE COPY YELLOW-RECORD FILE COPY PINK- RETAIN COPY GOLD-CUSTOMER COPY

CHAIN OF CUSTODY RECORD

MB R4516 - 29722

№ 09494

PROJ. NO. 7747

DEPT. NO. 65

PROJECT NAME: SOLVAY MINERALS

SAMPLERS: (Signature) Steve Ferguson

LAB NO.	SAMPLE NO.	DATE	TIME	SAMPLE LOCATION	NO. OF CONTAINERS	*HPLC ANALYSIS						REMARKS
												*HPLC ANALYSIS FOR:
29723		7/26	RUN 2	EP-1&2 STACK 1 LAG	1	X						- FORMALDEHYDE
24		7/26	RUN 3	EP-1&2 STACK ↓	1	X						- ACETONE
25		7/26	RUN 4	EP-1&2 STACK ↓	1	X						- 2-BUTANONE
		7/26		EXTRA DNPH 250 AG	1							- ACROLEIN
		7/26		WASTE DNPH + H_2O + $MeCl_2$	4 ml							- ACETALDEHYDE
												- PROPIONALDEHYDE

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Steve Ferguson	7/26/96 2100	ZENON			
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by:	Date / Time		
		[signature] - Zenon	9/6/96 11:00		

REMARKS:

SOLVAY2016_6_001690

Clean Air Engineering
500 W. Wood Street
Palatine, IL 60067
708/991-3300

[redacted]TE-P[redacted] FIL[redacted]PY [redacted]LOW[redacted]OR[redacted]E C[redacted] PIN[redacted]ETA[redacted]PY [redacted]LD-C[redacted]OME[redacted]PY [redacted]

H

OPERATING DATA

H

CALCINER EP-5

Formaldehyde Test

7/24/1996

Field	Field Voltage % of Maximum	Precip Current (DC ma)
1	55	1250
2	100	1700
3	100	1600
4	101	1700
5	99	1700
6	99	1750

CALCINER EP-1/2

Formaldehyde and HAPS

7/26/1996

Field	Volts	Precip Current (DC ma)
1A	311	324
1B	379	1383
1C	369	1403
1D	371	1407
1E	321	1411
1F	451	1407
2A	151	7
2B	444	1264
2C	452	1399
2D	441	1403
2E	447	1403
2F	434	1403

CALCINER LOG SHEET
07-24-96 11:45PM

PM SHIFT INSPECTION CA1&2 PM SHIFT INSPECTION CA3 _____
AM SHIFT INSPECTION CA1&2 T. WILLIAMS AM SHIFT INSPECTION CA3 _____

	1AM	3AM	5AM	7AM	9AM	11AM	1PM	3PM	5PM	7PM	9PM	11PM
A CALCINER TONS PER HOUR	128.	0.0	0.0	0.0	130.	130.	132.	132.	132.	131.	131.	124.
A RAKE OVERFLOW TEMPERATURE	176.0	176.0	176.0	176.0	176.0	176.0	178.0	180.0	180.0	180.0	180.0	176.0
A CLASS. OVERFLOW SPECIFIC GRAVITY	1310.	1310.	1310.	1310.	1310.	1310.	1320.	1316.	1316.	1316.	1316.	1318.
A CALCINER ORE SPILL TEMP	292.	220.	138.	158.	272.	273.	313.	310.	304.	309.	287.	288.
B CALCINER TONS PER HOUR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	90.0	0.0
B RAKE OVERFLOW TEMPERATURE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B CLASS. OVERFLOW SPECIFIC GRAVITY	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1316.	0.000	0.000	0.000	0.000
B CALCINER ORE SPILL TEMP	105.	111.	107.	106.	106.	108.	106.	104.	108.	104.	323.	92.6
							12:40 #1 - 14:50	15:10 #2 - 17:20		17:35 - 19:45 #3		
C CALCINER TONS PER HOUR	99.9	101.	112.	114.	115.	120.	121.	118.	122.	118.	130.	104.
C RAKE OVERFLOW TEMPERATURE	190.0	190.0	190.0	190.0	190.0	190.0	180.0	188.0	188.0	188.0	178.0	182.0
C CLASS. OVERFLOW SPECIFIC GRAVITY	1320.	1320.	1270.	1318.	1318.	1318.	1310.	1314.	1314.	1314.	1302.	1302.
C CALCINER ORE SPILL TEMP	306.	333.	266.	295.	299.	295.	325.	299.	300.	296.	278.	300.
CL1 RAKE O/F SPEC. GRAVITY	1112.	1112.	1112.	1112.	1112.	1112.	1128.	1122.	1122.	1122.	1122.	1112.
CL2 RAKE O/F SPEC. GRAVITY	1052.	1052.	1052.	1052.	1052.	1052.	1118.	1140.	1140.	1140.	1140.	1052.
WEAK LIQUOR SPECIFIC GRAVITY	1060.	1060.	1060.	1060.	1060.	1060.	1072.	1074.	1074.	1074.	1074.	1060.
CA1 PRI. LIQ.	281.	29.9	23.1	61.3	279.	281.	302.	299.	303.	295.	306.	275.
CA2 PRI. LIQ.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.1	202.	36.5
SEC. LIQ	581.	78.4	47.1	198.	560.	592.	623.	666.	658.	658.	1000	560.

CA1 GAS TOT 2394.33
CA2 GAS TOT 922.88
SEC GAS TOT 2144.22

SOLVAY2016_0011694

CALCINER LOG SHEET
07-26-96 11:45PM

PM SHIFT INSPECTION CA1&2 / AM SHIFT INSPECTION CA1&2 T. WILLIAMS
PM SHIFT INSPECTION CA3 / AM SHIFT INSPECTION CA3

	1AM	3AM	5AM	7AM	9AM	11AM	1PM	3PM	5PM	7PM	9PM	11PM
A CALCINER TONS PER HOUR	139.	141.	139.	138.	140.	139.	140.	142.	140.	138.	146.	136.
A RAKE OVERFLOW TEMPERATURE	180.0	180.0	176.0	176.0	176.0	182.0	182.0	182.0	162.0	162.0	162.0	180.0
A CLASS. OVERFLOW SPECIFIC GRAVITY	1300.	1300.	1310.	1302.	1302.	1328.	1328.	1290.	1300.	1300.	1300.	1320.
A CALCINER ORE SPILL TEMP	309.	297.	299.	355.	218.	345.	344.	304.	322.	336.	301.	285.
B CALCINER TONS PER HOUR	140.	140.	140.	140.	140.	140.	140.	140.	140.	140.	140.	140.
B RAKE OVERFLOW TEMPERATURE	180.0	180.0	176.0	176.0	176.0	182.0	182.0	182.0	162.0	162.0	162.0	180.0
B CLASS. OVERFLOW SPECIFIC GRAVITY	1310.	1310.	1308.	1306.	1306.	1310.	1310.	1290.	1310.	1310.	1310.	1312.
B CALCINER ORE SPILL TEMP	274.	282.	292.	348.	278.	329.	343.	309.	311.	312.	306.	284.
C CALCINER TONS PER HOUR	153.	153.	155.	0.0	0.0	153.	0.0	14.9	114.	117.	117.	158.
C RAKE OVERFLOW TEMPERATURE	186.0	186.0	182.0	182.0	182.0	180.0	180.0	180.0	180.0	180.0	176.0	188.0
C CLASS. OVERFLOW SPECIFIC GRAVITY	1302.	1302.	1306.	1306.	1306.	1290.	1290.	1290.	1290.	1310.	1316.	1318.
C CALCINER ORE SPILL TEMP	306.	308.	317.	124.	113.	311.	296.	336.	255.	323.	316.	315.
CL-3 RAKE O/F SPEC. GRAVITY	1060.	1060.	1064.	1070.	1070.	1110.	1110.	1110.	1110.	1110.	1060.	1090.
CL-5 RAKE O/F SPEC. GRAVITY	1074.	1074.	1074.	1074.	1074.	1074.	1070.	1070.	1070.	1070.	1130.	1136.
WEAK LIQUOR SPECIFIC GRAVITY	142.0	142.0	1050.	1050.	1050.	1062.	1062.	1062.	1062.	1062.	1062.	1050.
1 PRI. LIQ.	246.	250.	247.	218.	218.	216.	302.	300.	295.	309.	296.	246.
2 PRI. LIQ.	351.	349.	351.	341.	341.	338.	337.	341.	344.	341.	341.	349.
LIQ	1402	1400	1400	1336	1347	1337	1400	1399	1305	1299	1298	1400

TOT 3115.96
TOT 2770.63
TOT 3735.61

#1 14:00 - 15:45
#2 16:20 - 18:10
#3 18:25 - 20:10

26 Jul 96 20:35:28 2

GROUP 188 CH2

11:00	-2.3	139.5	145.9	145.890	298.0	????????	386.6	4.36
12:00	-2.4	139.9	143.3	143.397	293.1	????????	392.4	4.40
13:00	-2.4	140.0	138.9	139.804	336.8	????????	388.0	4.1[illegible]
14:00	-2.4	140.0	139.5	139.445	336.7	????????	388.5	4.[illegible]
15:00	-2.4	140.0	138.5	138.498	338.3	????????	390.2	4.2[illegible]
16:00	-2.3	140.0	138.0	138.008	335.9	????????	388.9	4.2[illegible]
17:00	-2.4	140.0	141.4	141.322	321.6	????????	387.5	4.3[illegible]
18:00	-2.3	140.0	141.5	141.533	316.5	????????	388.6	4.2[illegible]
19:00	-2.4	140.0	145.5	145.388	306.6	????????	386.4	4.4[illegible]
20:00	-2.4	140.0	145.7	145.719	308.1	????????	389.0	4.33

	PCCA2A	WCAF14	FCBR5B*	FCBR5A	TCCA2_P	CA2_CONT	TCCA2_O	FCFN118
		TPH TRONA		MAIN GAS CALCINER		[illegible]		MCFM
[illegible]	-2.4	140.0	70.0*	145.035	305.0*		389.0	4.39
[illegible]	-2.2	140.0	144.5	144.407	313.3		387.7	4.18
[illegible]	42.6	41.6	70.0	26.6	0.0	36.3	72.6	48.5
	AUTO	AUTO	MAN	CAS	MAN	CAS	AUTO	CAS

CA2_CONTRL_ SWITCH OFFGAS OR PRODUCT
SWITCH
SELKIMP
SELECTX2

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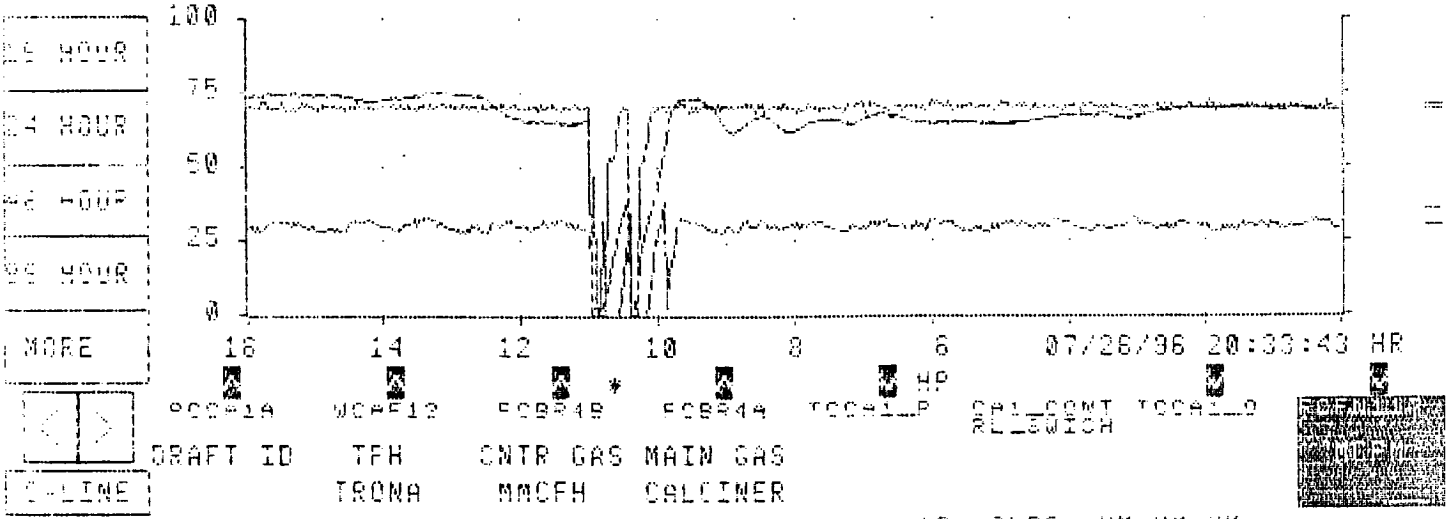
GROUP 183 CA1

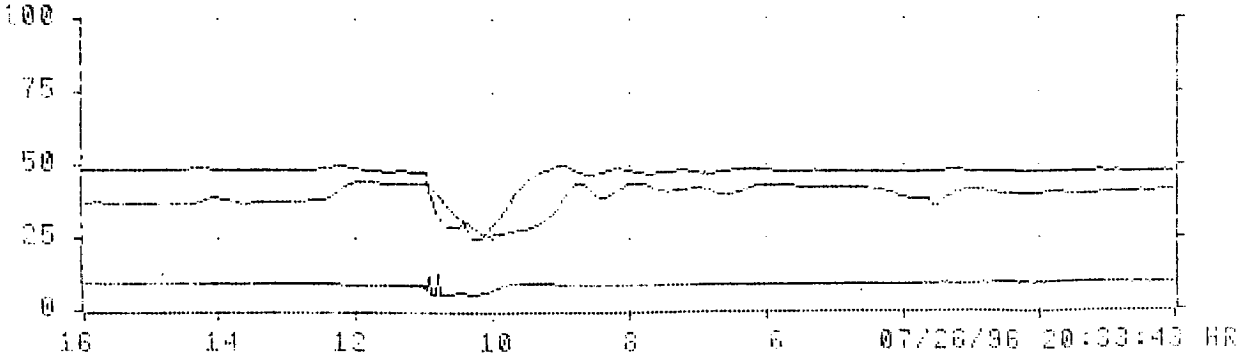
11:00	-3.59	116.2	86.03	86.032	224.6	????????	251.2	2.73
12:00	-2.03	140.1	138.21	138.233	287.6	????????	382.6	4.44
13:00	-1.33	139.9	132.50	132.490	334.0	????????	382.6	4.[illegible]
14:00	-2.04	140.0	135.74	135.723	323.3	????????	381.5	4.34
15:00	-1.98	140.2	133.82	133.768	338.6	????????	384.6	4.28
16:00	-2.03	140.0	132.64	132.641	336.8	????????	383.0	4.25
17:00	-1.99	140.0	137.30	137.288	315.6	????????	381.3	4.[illegible]
18:00	-1.99	139.9	138.73	138.681	321.2	????????	382.1	4.[illegible]
19:00	-2.02	140.3	143.12	143.037	320.0	????????	382.1	4.5[illegible]
20:00	-2.00	140.2	143.33	143.348	323.0	????????	383.3	4.58
	FCCA1A	WCAF13	FCBR4B *	FCBR4A	TCCA1_P HP	CA1_CONT RL_SWICH	TCCA1_D	FCFM117
	DRAFT ID	TPH TRONA	CNTR GAS MMCFH	MAIN GAS CALCINER				MCFM
SP	-2.00	140.0	70.00*	141.483	305.0*		383.0	4.54
PV	-1.76	139.4	141.79	141.809	331.8		383.8	4.47
OP%	65.6	44.8	68.0	37.4	0.0	35.5	70.7	59.[illegible]
	AUTO	AUTO	[illegible]	CAS	[illegible]	CAS	AUTO	CAS

26 Jul 96 20:34:11 2

GROUP 183 CH1 16 HOURS HM HM HM HM



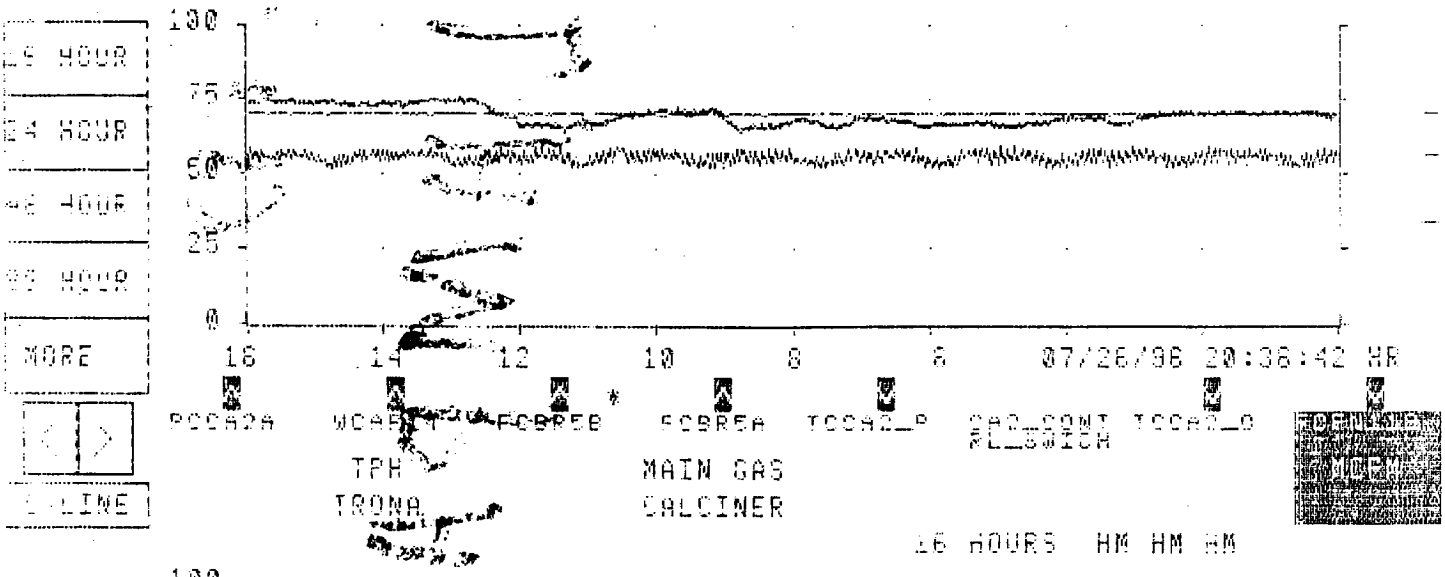
16 HOURS HM HM HM



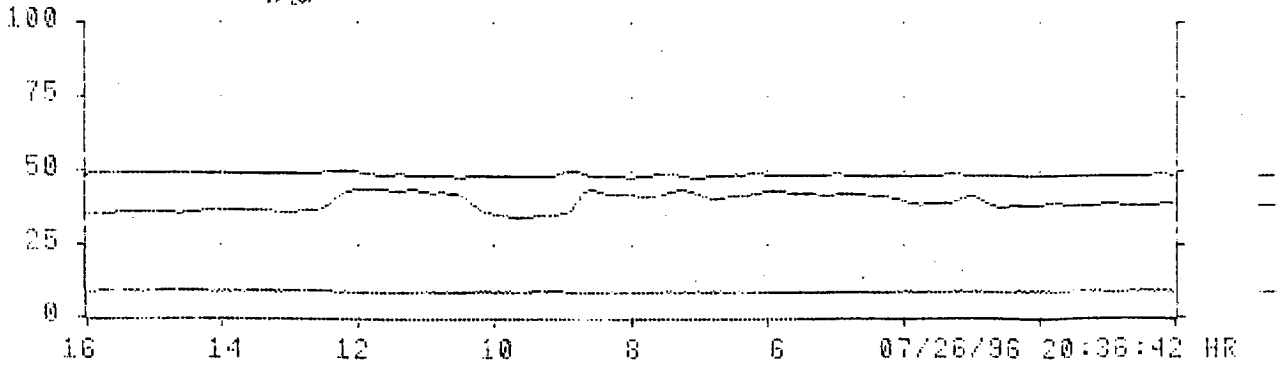
26 Jul 96 20:36:55

GROUP 188 CA2?

16 HOURS HM HM HM HM



16 HOURS HM HM HM



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