

ADDENDUM TO
SOURCE TEST REPORT
AB2588

PACIFIC ENERGY
6055 EAST WASHINGTON BOULEVARD
COMMERCE, CA 90040

UNITS TESTED:
LANDFILL GAS-FIRED INTERNAL COMBUSTION ENGINE
OTAY LANDFILL

TEST DATES:
APRIL 2-5, 1991

ISSUE DATE:
MAY 15, 1991

PARAMETERS MEASURED:
FORMALDEHYDE, HYDROGEN CHLORIDE, TOTAL SULFUR COMPOUNDS,
VINYL CHLORIDE, DICHLOROMETHANE, AND BENZENE EMISSIONS

TESTED BY:
SOUTH COAST ENVIRONMENTAL COMPANY
1915 MCKINLEY AVENUE, SUITE E
LA VERNE, CA 91750

REPORT NO: T1265
TESTED BY: Keith Hanna
REVIEWED BY: LAJ

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I. SELECTED RESULTS

PACIFIC ENERGY
 APRIL 2-5, 1991
 PROJECT: T1265
 UNIT: LANDFILL GAS-FIRED INTERNAL COMBUSTION ENGINES

I. SELECTED RESULTS - OTAY LANDFILL

A. FORMALDEHYDE RESULTS (EXHAUST)

RUN NO.	SAMPLE VOLUME (DSCF)	LB/SCF OF LFG	TOTAL FORMALDEHYDE (LB/HR)
1	2.12	8.33E-07	2.94E-02
2	1.99	6.09E-07	2.15E-02
3	1.90	<u>7.57E-07</u>	<u>2.67E-02</u>
AVERAGE =		7.33E-07	AVERAGE = 2.59E-02

B. HYDROGEN CHLORIDE RESULTS (EXHAUST)

RUN NO.	SAMPLE VOLUME (DSCF)	LB/SCF OF LFG	TOTAL HCL LB/HR
1	72.92	8.17E-06	2.88E-01
2	67.66	6.46E-06	2.28E-01
3	68.98	<u>6.49E-06</u>	<u>2.29E-01</u>
AVERAGE =		7.04E-06	2.48E-01

I. SELECTED RESULTS - OTAY LANDFILL (CONTINUED)

C. VINYL CHLORIDE RESULTS

i. INLET EMISSIONS

<u>RUN NO.</u>	<u>PPB</u>	<u>LB/HR</u>
1	5270	3.06E-02
2	5340	3.10E-02
3	5420	<u>3.15E-02</u>

AVERAGE = 3.10E-02

ii. EXHAUST EMISSIONS

<u>RUN NO.</u>	<u>PPB</u>	<u>LB/HR</u>	<u>LB/SCF OF LFG</u>
1	0.00	0.00E+00	0.00E+00
2	0.00	0.00E+00	0.00E+00
3	0.00	<u>0.00E+00</u>	<u>0.00E+00</u>

AVERAGE = 0.00E+00 0.00E+00

iii. PERCENT REDUCTION = 100%

I. SELECTED RESULTS - OTAY LANDFILL (CONTINUED)

D. DICHLOROMETHANE RESULTS

i. INLET EMISSIONS

<u>RUN NO.</u>	<u>PPB</u>	<u>LB/HR</u>
1	6180	4.88E-02
2	6010	4.75E-02
3	6200	<u>4.90E-02</u>

AVERAGE = 4.84E-02

ii. EXHAUST EMISSIONS

<u>RUN NO.</u>	<u>PPB</u>	<u>LB/HR</u>	<u>LB/SCF OF LFG</u>
1	437.0	2.77E-02	7.84E-07
2	365.0	2.31E-02	6.55E-07
3	410.0	<u>2.59E-02</u>	<u>7.35E-07</u>

AVERAGES = 2.56E-02 7.25E-07

iii. PERCENT REDUCTION = 47.1%

I. SELECTED RESULTS - OTAY LANDFILL (CONTINUED)

E. BENZENE RESULTS

i. INLET EMISSIONS

<u>RUN NO.</u>	<u>PPB</u>	<u>LB/HR</u>
1	1700	1.23E-02
2	1700	1.23E-02
3	1620	<u>1.18E-02</u>

AVERAGE = 1.21E-02

ii. EXHAUST EMISSIONS

<u>RUN NO.</u>	<u>PPB</u>	<u>LB/HR</u>	<u>LB/SCF OF LFG</u>
1	36.10	2.10E-03	5.95E-08
2	33.70	1.96E-03	5.56E-08
3	30.20	<u>1.76E-03</u>	<u>4.98E-08</u>

AVERAGE = 1.94E-03 5.50E-08

iii. PERCENT REDUCTION = 84.0%

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II. FORMALDEHYDE RESULTS

COMPANY: PACIFIC ENERGY
 DATE: APRIL 2, 1991
 UNIT: ICE #1-EXHAUST
 REPORT: T1265

CARB METHOD #430 RESULTS

RUN #	PARAMETER	UG/SAMPLE COLLECTED	BLANK	UG/SAMPLE	LB/HR*	LB/SCF	LFG**
#1	FORMALDEHYDE	700	2.4	7.00E+02	2.94E-02	8.33E-07	
#2	FORMALDEHYDE	480	2.4	4.80E+02	2.15E-02	6.09E-07	
#3	FORMALDEHYDE	570	2.4	5.70E+02	2.67E-02	7.57E-07	
AVERAGE =					2.59E-02	7.33E-07	

*LB UG	SAMPLE	DSCF	GRAMS	60 MIN	1 LB	30 G/GMOLE
HR SAMPLE	DSCF	MIN	1E+6UG	HR	453.6G	210 G/GMOLE

** LB	LB	1 HR	1 MIN
SCF LFG	HR	60 MIN	588 SCF LFG

ADDITIONAL INFORMATION

RUN#	DSCF	DSCM	VOL. FLOW DSCFM***
#1	2.12	0.060	4712
#2	1.99	0.056	4712
#3	1.90	0.054	4712

*** TOTAL CARBON ANALYSIS.

III. HYDROGEN CHLORIDE RESULTS

COMPANY: PACIFIC ENERGY
 DATE: APRIL 2, 1991
 UNIT: ICE#1-OTAY LANDFILL (HCL)
 REPORT: T1265

CARB METHOD #421 RESULTS

RUN #	PARAMETER	UG/SAMPLE COLLECTED	BLANK	UG/SAMPLE	LB/HR**	LB/SCF LFG**
#1	HCL	33800	376	3.38E+04	2.88E-01	8.17E-06
#2	HCL	24800	376	2.48E+04	2.28E-01	6.46E-06
#3	HCL	25400	376	2.54E+04	2.29E-01	6.49E-06
AVERAGE =					2.48E-01	7.04E-06

* LB UG SAMPLE DSCF GRAMS 60 MIN 1 LB

 HR SAMPLE DSCF MIN 1E+6 HR 453.6G

** LB LB 1 HR 1 MIN

 SCF LFG HR 60 588 SCF LFG

ADDITIONAL INFORMATION

RUN#	DSCF	DSCM	VOL. FLOW DSCFM
#1	72.92	2.065	4712
#2	67.66	1.916	4712
#3	68.98	1.954	4712

IV. VINYL CHLORIDE, DICHLOROMETHANE, AND BENZENE RESULTS

CLIENT: PACIFIC ENERGY
 JOB NO: T1220
 UNIT: ICE #1-EXHAUST (OTAY LANDFILL)
 DATE: APRIL 2, 1991
 RUN #: #1

SELECTED CHLORINATED AND BROMINATED HYDROCARBONS

PARAMETER	PPB	MW	LB/HR*	LB/SCF LFG**
VINYLE CHLORIDE	0.00	62.50	0.00E+00	0.00E+00
DICHLOROMETHANE	437.00	85.00	2.77E-02	7.84E-07
BENZENE	36.10	78.12	2.10E-03	5.95E-08

*EQUATION 1: $lb/hr = PPB * MW * 1.583E-10 * DSCFM$

PPB = parts per billion, concentration

MW = molecular weight

$1.583E-10$ = conversion factor

DSCFM = Dry standard cubic feet per minute = 4712

**EQUATION 2: $LB/SCF LFG = (LB/HR)/((SCFM LFG)*60 MIN/HR)$

SCFM LFG = 588

(TAKEN FROM IC ENGINE FIELD DATA SHEET)

CLIENT: PACIFIC ENERGY
JOB NO: T1220
UNIT: ICE #1-EXHAUST (OTAY LANDFILL)
DATE: APRIL 2, 1991
RUN #: #2

SELECTED CHLORINATED AND BROMINATED HYDROCARBONS

PARAMETER	PPB	MW	LB/HR*	LB/SCF LFG**
VINYLE CHLORIDE	0.00	62.50	0.00E+00	0.00E+00
DICHLOROMETHANE	365.00	85.00	2.31E-02	6.55E-07
BENZENE	33.70	78.12	1.96E-03	5.56E-08

*EQUATION 1: $lb/hr = PPB * MW * 1.583E-10 * DSCFM$

PPB = parts per billion, concentration

MW = molecular weight

1.583E-10 = conversion factor

DSCFM = Dry standard cubic feet per minute = 4712

**EQUATION 2: $LB/SCF LFG = (LB/HR)/((SCFM LFG)*60 MIN/HR)$

SCFM LFG = 588

(TAKEN FROM IC ENGINE FIELD DATA SHEET)

CLIENT: PACIFIC ENERGY
 JOB NO: T1220
 UNIT: ICE #1-EXHAUST (OTAY LANDFILL)
 DATE: APRIL 2, 1991
 RUN #: #3

 SELECTED CHLORINATED AND BROMINATED HYDROCARBONS

PARAMETER	PPB	MW	LB/HR*	LB/SCF LFG**
VINYLE CHLORIDE	0.00	62.50	0.00E+00	0.00E+00
DICHLOROMETHANE	410.00	85.00	2.59E-02	7.35E-07
BENZENE	30.20	78.12	1.76E-03	4.98E-08

*EQUATION 1: lb/hr = PPB * MW * 1.583E-10 * DSCFM

PPB = parts per billion, concentration
 MW = molecular weight

1.583E-10 = conversion factor

DSCFM = Dry standard cubic feet per minute =

4712

**EQUATION 2: LB/SCF LFG = (LB/HR)/((SCFM LFG)*60 MIN/HR)

SCFM LFG = 588

(TAKEN FROM IC ENGINE FIELD DATA SHEET)

CLIENT: PACIFIC ENERGY
 JOB NO: T1220
 UNIT: ICE #1-INLET (OTAY LANDFILL)
 DATE: APRIL 2, 1991
 RUN #: #1

 SELECTED CHLORINATED AND BROMINATED HYDROCARBONS

PARAMETER	PPB	MW	LB/HR*
VINYLE CHLORIDE	5270.00	62.50	3.06E-02
DICHLOROMETHANE	6180.00	85.00	4.88E-02
BENZENE	1700.00	78.12	1.23E-02

*EQUATION 1: lb/hr = PPB * MW * 1.583E-10 * DSCFM

PPB = parts per billion, concentration
 MW = molecular weight
 1.583E-10 = conversion factor
 DSCFM = Dry standard cubic feet per minute =
 (TAKEN FROM IC ENGINE FIELD DATE SHEET)

CLIENT: PACIFIC ENERGY
 JOB NO: T1220
 UNIT: ICE #1-INLET (OTAY LANDFILL)
 DATE: APRIL 2, 1991
 RUN #: #2

 SELECTED CHLORINATED AND BROMINATED HYDROCARBONS

PARAMETER	PPB	MW	LB/HR*
VINYLE CHLORIDE	5340.00	62.50	3.10E-02
DICHLOROMETHANE	6010.00	85.00	4.75E-02
BENZENE	1700.00	78.12	1.23E-02

*EQUATION 1: lb/hr = PPB * MW * 1.583E-10 * DSCFM

PPB = parts per billion, concentration
 MW = molecular weight
 1.583E-10 = conversion factor
 DSCFM = Dry standard cubic feet per minute =
 (TAKEN FROM IC ENGINE FIELD DATE SHEET)

CLIENT: PACIFIC ENERGY
 JOB NO: T1220
 UNIT: ICE #1-INLET (OTAY LANDFILL)
 DATE: APRIL 2, 1991
 RUN #: #3

 SELECTED CHLORINATED AND BROMINATED HYDROCARBONS

PARAMETER	PPB	MW	LB/HR*
VINYL CHLORIDE	5420.00	62.50	3.15E-02
DICHLOROMETHANE	6200.00	85.00	4.90E-02
BENZENE	1620.00	78.12	1.18E-02

*EQUATION 1: $lb/hr = PPB * MW * 1.583E-10 * DSCFM$

PPB = parts per billion, concentration
 MW = molecular weight
 1.583E-10 = conversion factor
 DSCFM = Dry standard cubic feet per minute =
 (TAKEN FROM IC ENGINE FIELD DATE SHEET)

V. EXHAUST FLOW DATA

COMPANY: PACIFIC ENERGY
DATE: MAY 6, 1991
UNIT: ICE #1
REPORT #: T11265

EXHAUST FLOW RATE CALCULATIONS

CALCULATIONS BASED ON INLET GAS FLOW RATE AND CARBON BALANCE FROM
TOTAL CARBON ANALYSIS.

EXHAUST O2 % = 7.86

INLET FLOW RATE (SCFM) = 588

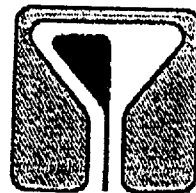
INLET CARBON CONC. (CONC. OF CO2, CO, CH4, NMHC IN PPM) = 920690
EXHAUST CARBON CONC. (CONC. OF CO2, CO, CH4, NMHC IN PPM) = 114880

EXHAUST FLOW CALCULATION = $\frac{(\text{INLET FLOW RATE})(\text{INLET CARBON CONC.})}{(\text{EXHAUST CARBON CONC.})}$

EXHAUST FLOW RATE (DSCFM) = 4712

EXHAUST FLOW RATE @ 0% O2 (DSCFM) = 2940

EXHAUST FLOW RATE @ 15% O2 (DSCFM) = 10415



ZALCO LABORATORIES, INC.
Analytical & Consulting Services

SOUTH COAST ENVIRONMENTAL
1915 McKinley, Suite E
Livermore, CA 91750
Attention: Russ Logan

Sample Description: PEN-OTAY LF Ice #1 Inlet

* CHROMATOGRAPHIC ANALYSIS (Z 1610) *

Components Mole % ppm Wt % G.P.M.

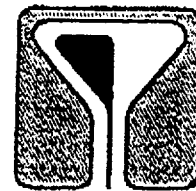
Carbon Dioxide	38.428	384280	60.666
Oxygen	2.198		2.522
Nitrogen	5.733		5.761
Carbon Monoxide	0.000		0.000
Methane	53.567	535,670	30.827
Ethane	0.000		0.000
Propane	0.000		0.000
Isobutane	0.004	40	0.008
N-Butane	0.000		0.000
Isopentane	0.000		0.000
N-Pentane	0.000		0.000
Hexanes+	0.070	700	0.215
Totals	100.000	920,690	100.000

* SPECIFIC GRAVITY (AIR = 1)	
* SPECIFIC VOLUME, cu.ft./lb	.9664
* GROSS CALORIFIC VALUE, BTU/cu.ft.	13.56
* GROSS CALORIFIC VALUE, BTU/cu.ft.	537.60
* GROSS CALORIFIC VALUE, BTU/lb	546.89
* NET CALORIFIC VALUE, BTU/cu.ft.	7414.66
* NET CALORIFIC VALUE, BTU/cu.ft.	484.14
* NET CALORIFIC VALUE, BTU/cu.ft.	492.51
* COMPRESSIBILITY FACTOR, Z, (60 F, 1 ATM)	.9975
* Water Saturated	
** Dry Gas @ 60 F, 14.73 psia	

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Richard L. Penner
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SOUTH COAST ENVIRONMENTAL
1915 McKinley, Suite E
Livermore, CA 94550

Attention: Russ Logan

Sample Description: PEN-OTAY LF Ice #1 Outlet

* CHROMATOGRAPHIC ANALYSIS (Z 1610) *

Components Mole % PPM Wt % G.P.M.

Carbon Dioxide	11.340	113,400	16.531
Oxygen	9.470	10.037	73.337
Nitrogen	79.040	320	.030
Carbon Monoxide	.032		
Methane	.1150	1150	.061
Ethane	0.000		0.000
Propane	0.000		0.000
Isobutane	0.000		0.000
N-Butane	0.000		0.000
Isopentane	0.000		0.000
N-Pentane	0.000		0.000
Hexanes+	0.001	10	.004
Totals =	100.000	114,880	100.000

* SPECIFIC GRAVITY (AIR = 1)	1.0510
* SPECIFIC VOLUME, cu.ft./lb.	12.47
* GROSS CALORIFIC VALUE, BTU/cu.ft.	1.31
* GROSS CALORIFIC VALUE, BTU/cu.ft.	1.34
* GROSS CALORIFIC VALUE, BTU/lb	16.05
* NET CALORIFIC VALUE, BTU/cu.ft.	1.19
* NET CALORIFIC VALUE, BTU/cu.ft.	1.21
* COMPRESSIBILITY FACTOR (Z) (60 F, 1 ATM)	.9995

* Water Saturated
Note: See attached ppm Hydrocarbon Analysts for a more accurate measurement of hydrocarbons.

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