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Emission Test Report

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EMISSION TEST REPORT

PETROLEUM REFINERY WASTEWATER TREATMENT SYSTEM
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EL SEGUNDO, CALIFORNIA

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1. INTRODUCTION

Under Section 111 of the Clean Air Act, the Environmental Protection Agency is required to develop standards of performance for stationary sources that have been determined to contribute significantly to air pollution. EPA is conducting a study to develop standards that would limit volatile organic compound emissions from new waste water treatment systems in petroleum refineries. Under contract to the Emission Measurement Branch, EPA, TRW Environmental Operations personnel conducted a testing program at the segregated and unsegregated water treatment systems at the Chevron USA, El Segundo Refinery in El Segundo, CA during August 1 to August 12, 1983.

The purpose of this test program was to provide estimates of the organic compound release rates from dissolved air flotation units (DAF) and induced air flotation unit (IAF). These release rates are necessary to estimate uncontrolled emission rates from uncovered flotation devices for potential emission reduction and cost effectiveness calculations.

The air flotation devices at Chevron's waste water treatment facilities are equipped with covers. Ventilation air is mechanically drawn or pumped through the covered spaces and is treated for odor control prior to release to the atmosphere. The ventilation air prior to the control devices was measured to estimate the organic release rate that would have occurred if the flotation devices were uncovered. This approach was used to estimate uncovered unit emission because of the difficulty in measuring a dispersed-source fugitive emission. It is assumed that the dominant factors affecting organic emission rates are the water characteristics and the physical turbulence caused by bubbling air through the water, and that meterological factors such as air temperature and wind speed are secondary parameters.

Tests were conducted to determine the mass flow rate and the organic species composition of the ventilation air from the DAF and the equalization basin in the segregated system effluent treatment plant, and the IAF servicing the unsegregated water treatment system. Limited screening tests were conducted after the activated carbon control devices servicing these units to estimate the hydrocarbon removal. During the air measurements, samples of the waste water were collected from various points in the treatment system to characterize the liquid streams. These samples were analyzed for chemical oxygen demand (COD), total organic carbon (TOC), total chromatographical organics (TCO), and oil and grease content using standard methods for water analysis.

The results of these tests are presented in Section 2. A description of the process and the operation during the test period is given in Section 3. The sampling locations and the sampling and analytical procedures are discussed in Sections 4 and 5 respectively. The appendices to this report contain example calculations, field data, test logs and a list of project participants.

2. SUMMARY AND DISCUSSION OF RESULTS

This section details the results of the testing and analysis at the El Segundo Refinery waste water treatment units. The overall refinery waste water treatment system is illustrated in Figure 3-1 and the sampling locations are indicated in Figures 4-1, 4-3, and 4-5. Table 2-1 presents a summary of the periods during which continuous hydrocarbon monitoring was performed at the indicated sample locations. Table 2-2 presents a summary of the periods during which integrated gas samples were collected, velocity or flow rate measurements were conducted and when liquid samples were collected from each location. The results are discussed separately for the Effluent Treatment Plant (DAF and equalization tank), the unsegregated water system (IAF) and the combined results of water analyses.

2.1 EFFLUENT TREATMENT PLANT TEST RESULTS

The results of testing at the dissolved air flotation (DAF) system and the equalization tank are discussed separately in this section.

2.1.1 DAF System

A summary of the daily average total hydrocarbon mass flow rates in the DAF ventilation air and the equalization ventilation air prior to the emission control devices is presented in Table 2-3. The total hydrocarbon measurement does not exclude methane. The hydrocarbon mass flow in the DAF ventilation air ranged from 6.17 lbs/hr to 9.01 lbs/hr (24-hour average basis) over the seven days of testing. The average mass flow was 7.21 lbs/hr (24-hour basis). The test results on a one-hour average basis for each day of testing are presented in Tables 2-4 to 2-10. The average total hydrocarbon concentration based on equivalents of propane is presented for each one-hour period. Propane was chosen as the calibration species because it is a stable compound and calibration mixtures are easily acquired and stored. For the organic species expected at refineries, the response of the analysis is directly proportional to

Table 2-1. SAMPLING LOG OF CONTINUOUS HYDROCARBON MONITORING:
SAMPLING LOCATIONS AT THE CHEVRON REFINERY - EL SEGUNDO, CALIFORNIA

	Sample location area								
	DAF tank			Equalization tank			IAF tank		
Date	Sample location	Time sampled	No. hours sampled	sample location	Time sampled	No. hours sampled	sample location	Time sampled	No. hours sampled
8/3/83	Ventilation air	0800-2400	16	Ventilation air	1100-2400	13			—
8/4/83	Ventilation air	0000-2400	24	Ventilation air	0000-2400	24			—
8/5/83	Ventilation air	0000-1100	16	Ventilation air	0000-1300	13			—
8/5/83				Exhaust	1400-1700	3			—
8/6/83	N O - - - - - T E S T S - - - - - O N - - - - - W E E K E N D								
8/7/83	N O - - - - - T E S T S - - - - - O N - - - - - W E E K E N D								
8/8/83	Ventilation air	1100-2400	13				Ventilation air	1700-2400	7
8/9/83	Ventilation air	0000-2400	24				Ventilation air	0000-2400	24
8/10/83	Ventilation air	0000-1100	11				Ventilation air	0000-2400	24
	Exhaust	1300-1600	3						
	Ventilation air	1700-2400	7						
8/11/83	Ventilation air	0000-1400	14				Ventilation air	0000-1400	14
8/12/83							Exhaust	0900-1200	3
							Exhaust	1200-1500	3

Exhaust = tank carbon house outlet vent.

Table 2-2. DAILY TIME TABLE OF SAMPLING ACTIVITIES AT THE CHEVRON REFINERY - EL SEGUNDO, CALIFORNIA

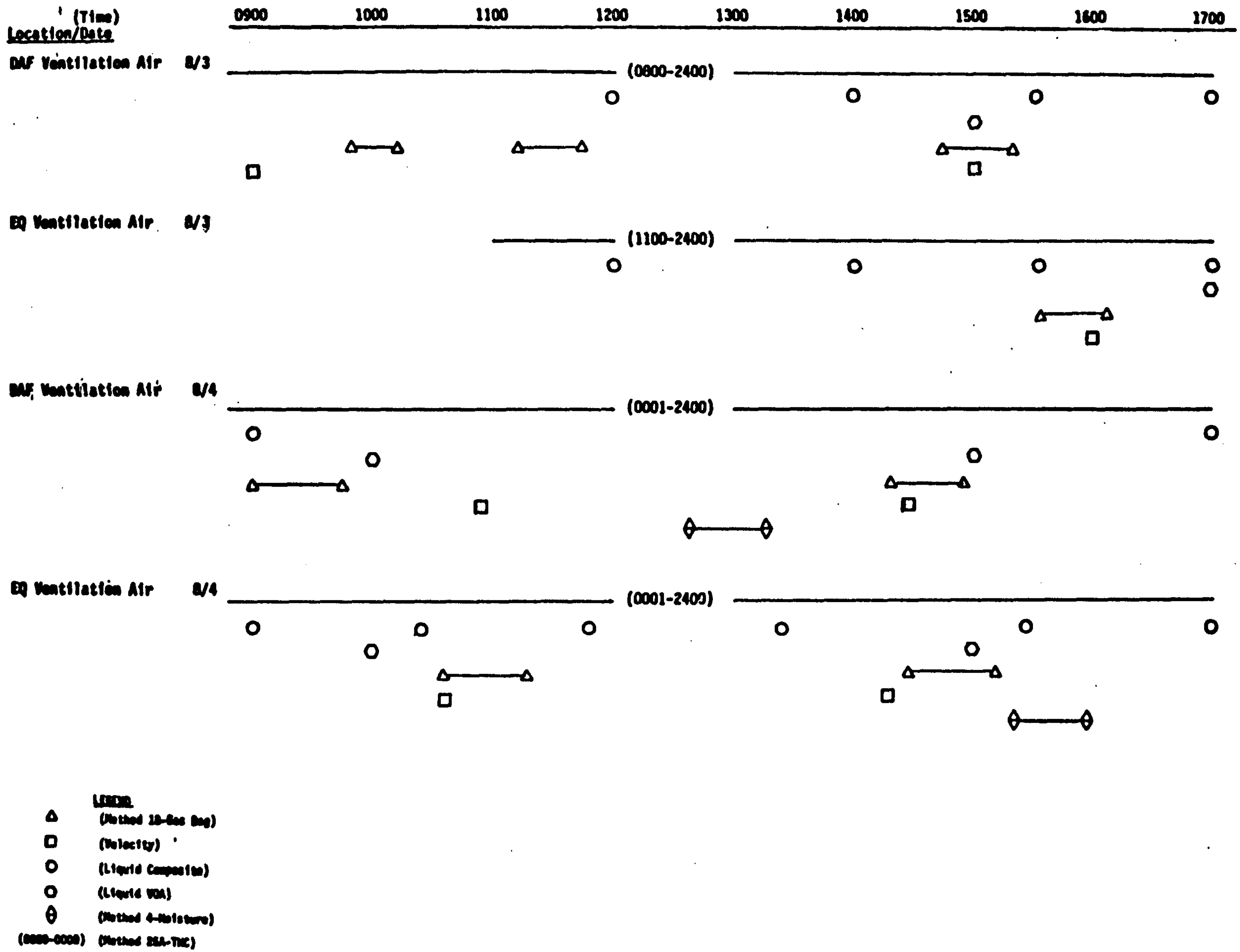


Table 2-2. Continued

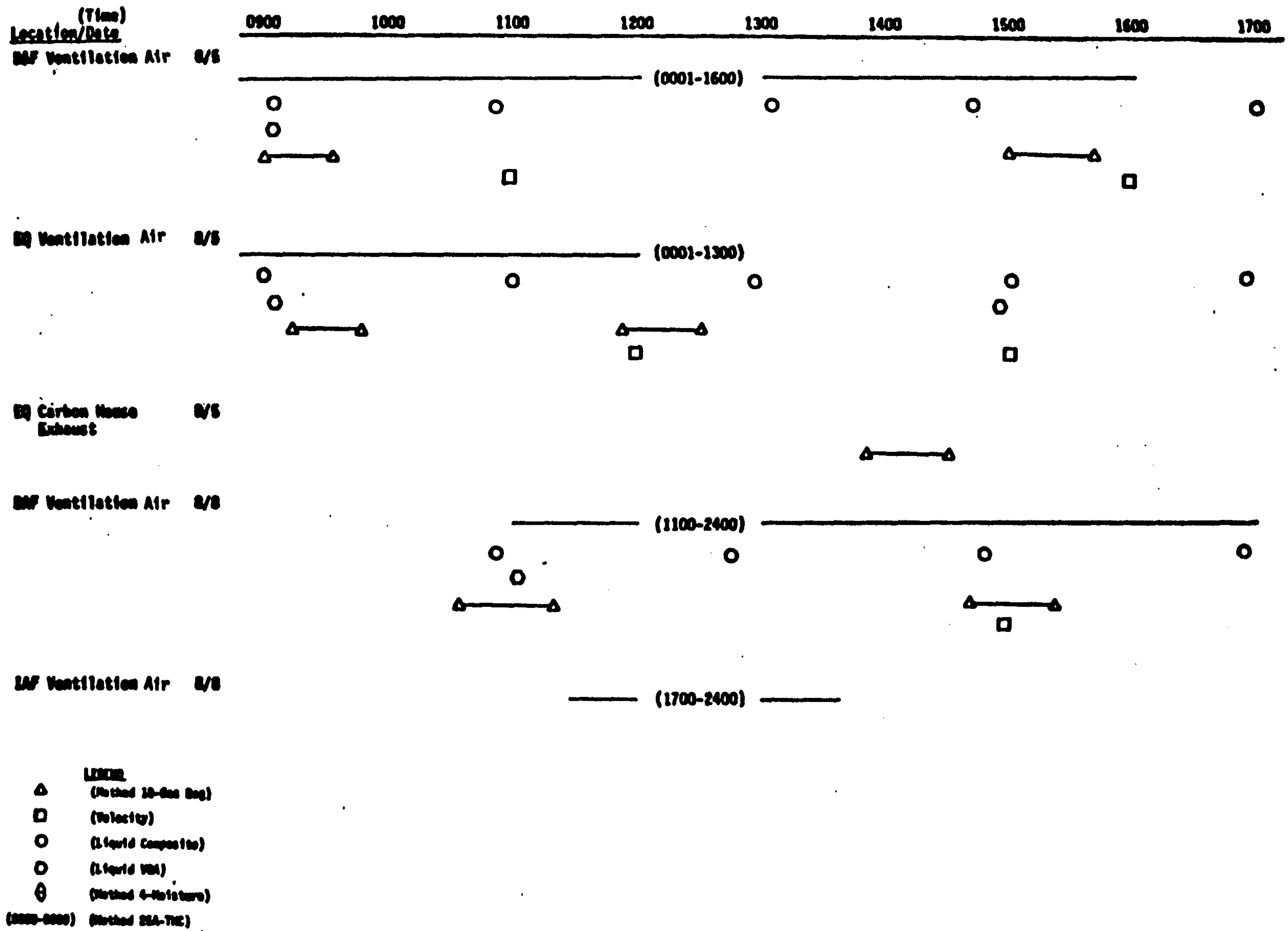


Table 2-2. Continued

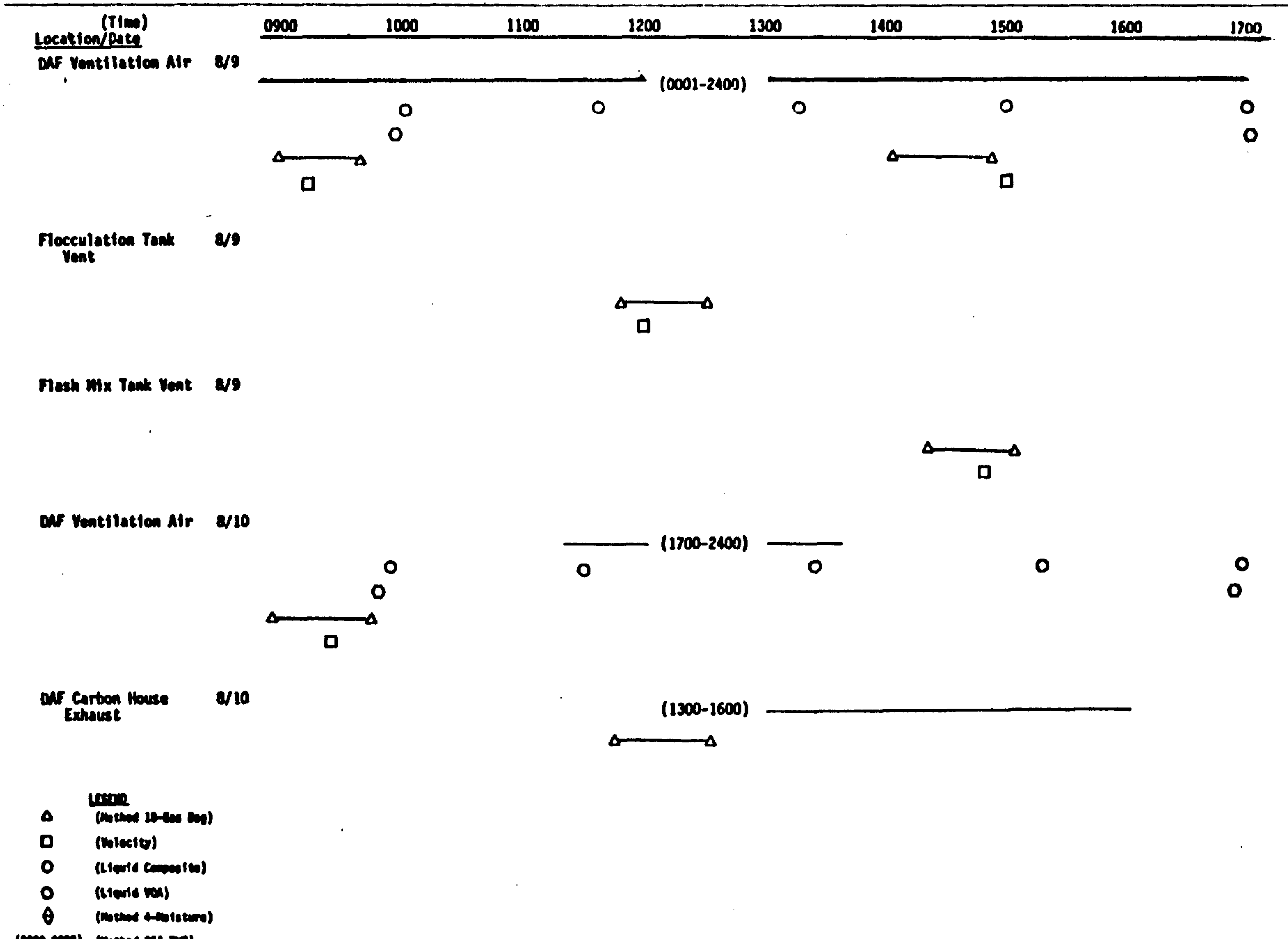


Table 2-2. Concluded

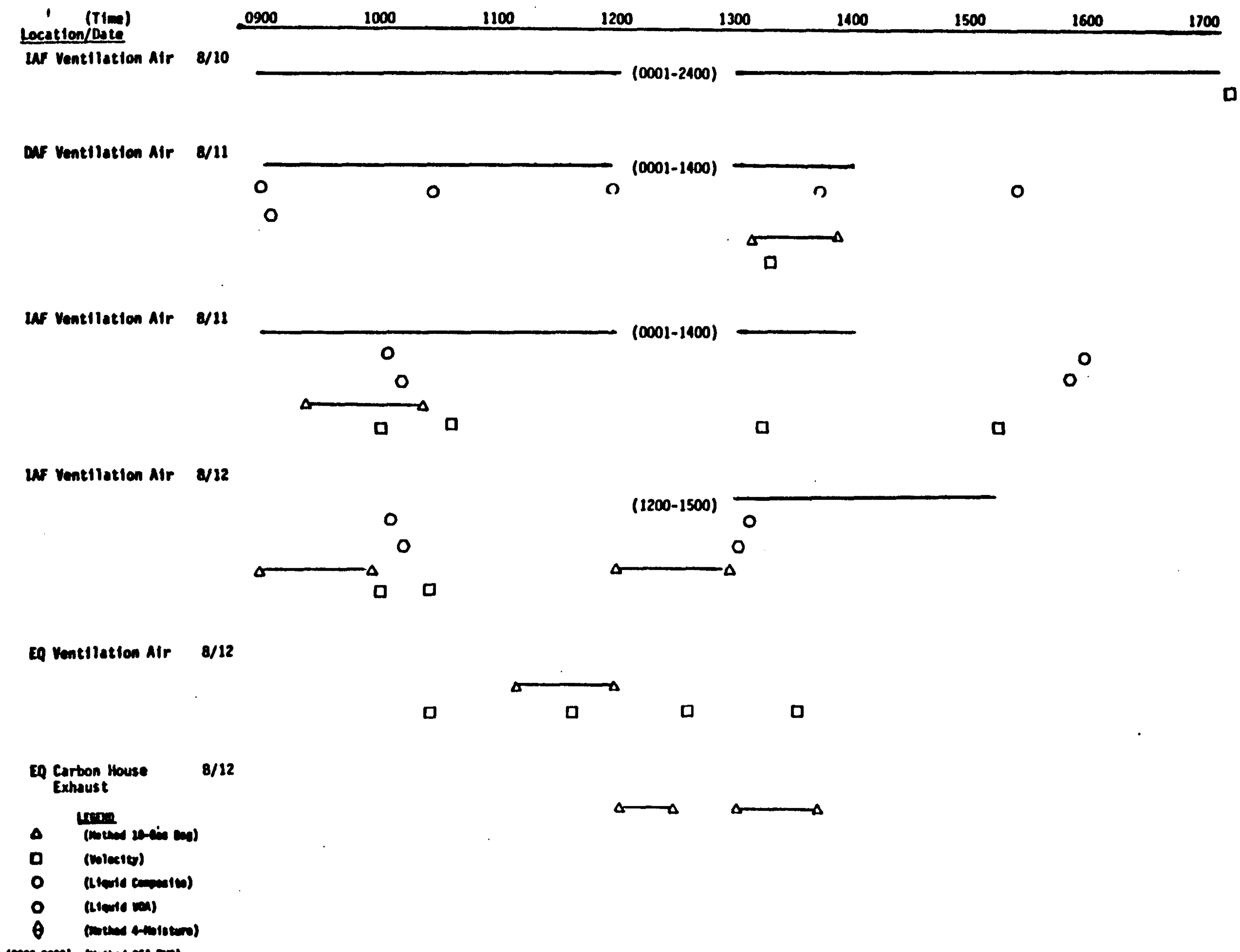


Table 2-3. SUMMARY OF DAILY EMISSION RATE AVERAGES: CONTINUOUS MONITORING RESULTS EFFLUENT TREATMENT PLANT, CHEVRON - EL SEGUNDO, CALIFORNIA

Sample location	Test day								
	8/3/83	8/4/83	8/5/83	8/8/83	8/9/83	8/10/83	8/11/83	8/12/83	Average
	Total hydrocarbon mass flow rate, lbs/hr								
DAF ventilation air (lbs/hr)	7.18	6.37	6.85	6.75	8.11	6.17	9.01	—	7.21
DAF carbon house outlet (lbs/hr)	—	—	—	—	—	1.68[a]	—	—	—
Equalization tank ventilation air (lbs/hr)	4.18	4.65	4.24	—	—	—	—	7.54[c,d,e]	4.36
Equalization tank carbon house outlet (lbs/hr)	—	—	4.62[b]	—	—	—	—	0.77[c,d]	—

[a] 2 hour average basis.

[b] 2 hour average basis.

[c] 0.5 hour average basis.

[d] Integrated samples collected for total hydrcarbon and species analysis.

[e] Not included in average.

Table 2-4. CONTINUOUS EMISSION RESULTS: HYDROCARBON MONITORING AT THE DAF VENTILATION AIR SAMPLE LOCATION, CHEVRON - EL SEGUNDO, CALIFORNIA TEST DAY 8/3/83

Time	Concentration[a] (ppm as C_3H_8)[a]	Flow[b] (SCFM)	Emission Rate (lbs/hr as C_3H_8)
0900[c]	533	2044	6.98
1000	470	2044	6.15
1100	508	2044	6.65
1200	513	2044	6.72
1300	523	2044	6.85
1400	546	2044	7.15
1500	506	2044	6.62
1600	507	2044	6.64
1700	491	2044	6.43
1800	482	2044	6.31
1900	479	2044	6.27
2000	476	2044	6.23
2100	475	2044	6.22
2200	518	2044	6.78
2300	958	2044	12.54
2400	786	2044	10.29
Average			7.18

[a]Concentration is average value for continuous readings across the hour (0-55 minutes) based on 5-minute readings.

[b]No pitot measurement on initial test day (8/3/83), therefore used average flow measurement during first week of test (8/3/83-8/5/83). See Table 2-11.

[c]Continuous Hydrocarbon Analyser (Beckman 400) on-line at DAF Outlet Sample Location starting the test period.

Table 2-5. CONTINUOUS EMISSION RESULTS: HYDROCARBON MONITORING AT THE DAF VENTILATION AIR SAMPLE LOCATION, CHEVRON - EL SEGUNDO, CALIFORNIA TEST DAY 8/4/83

Time	Concentration[a] (ppm as C_3H_8)	Flow[b] (SCFM)	Emission Rate (lbs/hr as C_3H_8)
0100	655	2007	8.42
0200	600	2007	7.72
0300	596	2007	7.67
0400	590	2007	7.95
0500	587	2007	7.55
0600	576	2007	7.41
0700	585	2007	7.52
0800	599	2007	7.70
0900	606	2007	7.79
1000	731	2007	9.39
1100	609	2007	7.83
1200	508	2007	6.53
1300	379	2007	4.87
1400	341	2007	4.38
1500	336	2007	4.32
1600	354	2007	4.55
1700	354	2007	4.55
1800	344	2007	4.42
1900	350	2007	4.50
2000	363	2007	4.66
2100	377	2007	4.84
2200	374	2007	4.81
2300	382	2007	4.91
2400	667	2007	8.57
Average			6.37

[a]Concentration is average value for continuous readings across the hour (0-55 minutes) based on 5-minute readings.

[b]Pitot measurements at initial and final periods of test day, therefore used average of flows measurements. See Table 2-11.

Table 2-6. CONTINUOUS EMISSION RESULTS: HYDROCARBON MONITORING AT THE DAF VENTILATION AIR SAMPLE LOCATION, CHEVRON - EL SEGUNDO, CALIFORNIA TEST DAY 8/5/83

Time	Concentration[a] (ppm as C_3H_8)	Flow[b] (SCFM)	Emission Rate (lbs/hr as C_3H_8)
0100	552	2081	7.36
0200	504	2081	6.72
0300	477	2081	6.36
0400	459	2081	6.11
0500	450	2081	6.00
0600	437	2081	5.82
0700	613	2081	8.17
0800	597	2081	7.96
0900	583	2081	7.77
1000	573	2081	7.64
1100	551	2081	7.34
1200	512	2081	6.82
1300	495	2081	6.60
1400	482	2081	6.42
1500	482	2081	6.42
1600[c]	456	2081	6.08
Average			6.85

[a]Concentration is average value for continuous readings across the hour (0-55 minutes) based on 5-minute readings.

[b]Pitot measurements at initial and final periods of test day, therefore used average of flows measurements. See Table 2-11.

[c]Test period discontinued for weekend period with instruments off-line and flamed out.

Table 2-7. CONTINUOUS EMISSION RESULTS: HYDROCARBON MONITORING AT THE DAF VENTILATION AIR SAMPLE LOCATION, CHEVRON - EL SEGUNDO, CALIFORNIA TEST DAY 8/8/83

Time	Concentration[a] (ppm as C_3H_8)	Flow[b] (SCFM)	Emission Rate (lbs/hr as C_3H_8)
1100[c]	521	2119	7.07
1200	475	2119	6.45
1300	489	2119	6.64
1400	466	2119	6.33
1500	580	2119	7.87
1600	551	2119	7.48
1700	492	2119	6.68
1800	521	2119	7.07
1900	413	2119	5.61
2000	470	2119	6.38
2100	496	2119	6.73
2200	509	2119	6.91
2300	494	2119	6.71
2400	480	2119	6.52
Average			6.75

[a]Concentration is average value for continuous readings across the hour (0-55 minutes) based on 5-minute readings.

[b]One pitot measurement during test day period, therefore used across test day. See Table 2-11.

[c]Continuous Hydrocarbon Analyzer (Beckman 400) on-line at DAF Outlet Sample Location resuming the test period from 8/5/83.

Table 2-8. CONTINUOUS EMISSION RESULTS: HYDROCARBON MONITORING AT THE DAF OUTLET SAMPLE LOCATION - CHEVRON, EL SEGUNDO, CALIFORNIA TEST DAY 8/9/83

Time	Concentration[a] (ppm as C_3H_8)	Flow[b] (SCFM)	Emission Rate (lbs/hr as C_3H_8)
0100	466	2133	6.37
0200	507	2133	6.93
0300	669	2133	9.14
0400	709	2133	9.69
0500	595	2133	8.13
0600	657	2133	8.98
0700	676	2133	9.24
0800	724	2133	9.89
0900	712	2133	9.73
1000	705	2133	9.63
1100	690	2133	9.43
1200	644	2133	8.80
1300	610	2133	8.33
1400	592	2133	8.09
1500	701	2133	9.58
1600	c	—	—
1700	645	2133	8.81
1800	627	2133	8.57
1900	575	2133	7.86
2000	568	2133	7.76
2100	541	2133	7.39
2200	540	2133	7.38
2300	551	2133	7.53
2400	515	2133	7.04
Average			8.11

[a]Concentration is average value for continuous readings across the hour (0-55 minutes) based on 5-minute readings.

[b]One flow measurement taken during test period, therefore used flow measurement across test day. See Table 2-11.

[c]Hydrocarbon Monitor (Beckman 400) off-line for repairs.

Table 2-9. CONTINUOUS EMISSION RESULTS: HYDROCARBON MONITORING AT THE DAF VENTILATION AIR AND DAF CARBON HOUSE OUTLET SAMPLE LOCATIONS CHEVRON, EL SEGUNDO, CALIFORNIA - TEST DAY 8/10/83

Time	Concentration[a] (ppm as C_3H_8)	Flow[b] (SCFM)	Emission Rate (lbs/hr as C_3H_8)
0100	495	1998	6.34
0200	488	1998	6.25
0300	470	1998	6.01
0400	464	1998	5.95
0500	449	1998	5.74
0600	481	1998	6.16
0700	478	1998	6.11
0800	464	1998	5.94
0900	460	1998	5.89
1000	449	1998	5.74
1100	502	1998	6.43
1200	c	—	—
1300[d]	95	1998	1.21
1400[d]	168	1998	2.15
1500[d]	131	1998	1.68
1600	c	—	—
1700	396	1998	5.06
1800	401	1998	5.13
1900	453	1998	5.80
2000	485	1998	6.21
2100	541	1998	6.92
2200	556	1998	7.11
2300	572	1998	7.32
2400	564	1998	7.22
Average		DAF Outlet DAF Carbon House	6.17 1.68

[a]Concentration is average value for continuous readings across the hour (0-55 minutes) based on 5-minute readings.

[b]One flow measurement taken during test period; therefore, used flow measurement across test day. See Table 2-11.

[c]Hydrocarbon Monitor (Beckman 400) off-line for switching sample locations.

[d]Monitoring DAF carbon house outlet sample location.

Table 2-10. CONTINUOUS EMISSION RESULTS: HYDROCARBON MONITORING AT THE DAF VENTILATION AIR SAMPLE LOCATION, CHEVRON - EL SEGUNDO, CALIFORNIA TEST DAY 8/11/83

Time	Concentration[a] (ppm as C_3H_8)	Flow[b] (SCFM)	Emission Rate (lbs/hr as C_3H_8)
0100	575	2371	8.73
0200	581	2371	8.82
0300	604	2371	9.18
0400	623	2371	9.46
0500	608	2371	9.23
0600	556	2371	8.44
0700	658	2371	9.99
0800	623	2371	9.46
0900	508	2371	7.72
1000	395	2371	6.00
1100	564	2371	8.57
1200	764	2371	11.60
1300	687	2371	10.43
1400[c]	558	2371	8.47
Average			9.01

[a]Concentration is average value for continuous readings across the hour (0-55 minutes) based on 5-minute readings.

[b]One flow measurement taken during test period, therefore used flow measurement across test day. See Table 2-11.

[c]End of test period at DAF outlet.

the carbon content. While the concentration results are on a propane basis and are not equal to the true hydrocarbon concentration, the calculated mass flow rates are equivalent to true hydrocarbon mass flow rates. The average gaseous flow rate result that was used for calculation of the mass flow is also given for each day of monitoring. A single value is used for each day because the ventilation blowers operated at constant speed and no changes were made to the ventilation configuration. On three days of testing (8/4, 8/5, 8/10), two flow determinations were performed each day to estimate the variation in the flow. These results are presented in Table 2-11. The difference between the two measurements ranged from 0 to 23.1 percent, with an average of 8.1 percent, which is typical of variations in pitot tube measurements.

The daily one-hour summaries show that short-term increases in mass flow rates occurred. Such increases occurred during 1400 hr 8/3, 2300 8/3 to 0100 8/4, 1000 8/4, 2400 8/4 to 0100 8/5, 0700 8/5, etc. These increases are directly correlated to those periods when the DAF tank was skimmed during each shift. After skimming was completed the measured concentration returned to a relatively constant level.

The results of the analysis of integrated gas samples of the DAF ventilation air are presented in Tables 2-12 and 2-13. The species analyses were obtained using two field gas chromatographic systems and were intended to generally identify the major components and their approximate concentrations. Calibrations standards were available for C1 to C5, benzene and m-xylene, so the results for these compounds can be calculated directly. Hexane, heptane, and p-xylene are calculated as equivalents of the nearest carbon number calibration species. Other peaks were also grouped with the closest eluting calibration species for computation. Since a benzene standard was used to establish a specific retention time for that compound, it can be concluded that the peak occurring at that time was benzene. However, these are some compounds found at refineries that tend to elute near benzene (such as methylcyclopentane and cyclohexane) and would be indistinguishable with this analytical systems. However, since clear identification of toluene and xylene were present, it is probable that at least part of the concentrations attributed to benzene was actually benzene.

Table 2-11. SUMMARY OF PITOT MEASUREMENTS TO DETERMINE THE DAF VENTILATION AIR FLOW RATE CHEVRON - EL SEGUNDO, CALIFORNIA

Test day	8/3/83	8/4/83	8/5/83	8/8/83	8/9/83	8/10/83	8/11/83
	Volumetric flow rate, SCFM						
Morning measurement	NM	2008	2095	2119	2133	1791	2371
Afternoon measurement	NM	2006	2068	NM	NM	2205	NM
Average (SCFM)	2044[a]	2007	2081	2119	2133	1998	2371
% difference between a.m. and p.m.		0	1.3			23.1	

NM - Not measured.

[a]Average of measured flow rates during test days 8/3/83 to 8/5/83.

Table 2-12. GAS CHROMATOGRAPHY RESULTS FROM THE DAF TEST DAYS 8/3/83 to 8/5/83 CHEVRON REFINERY, EL SEGUNDO, CALIFORNIA

DATE	8/3	8/3	8/4	8/4	8/5	8/5
TIME	1135-1235	1445-1545	930-1010	1430-1515	900-945	1500-1530
RUN NO.	2	3	1	2	1	2
ANALYTICAL RESULTS (ppmv as compound)						
C-1	46.8	46.5	53.6	45.5	53.8	58.3
C-2	5.7	7.0	6.4	5.3	6.7	6.5
C-3	6.8	8.1	8.3	6.2	7.1	8.3
C-4	3.8	5.0	4.9	4.4	4.2	
C-5	1.9	3.4	4.9	3.8	4.6	0.6
Hexane	10.1	16.9	23.0	15.1	10.7	18.0
Benzene	11.0	15.1	19.8	13.2	24.4	35.0
Heptane	10.0	11.8	21.3	6.6	2.6	
Toluene	39.2	45.3	55.5	32.4	46.7	44.4
m-Xylene	6.8	6.1	15.9	7.7	13.6	10.4
o-Xylene	3.4	3.0	7.9	3.0	5.0	3.8
TOTAL HYDROCARBON[a] (ppmv as compound)	145	168	217	143	179	185
CONTINUOUS MONITOR DATA						
Hydrocarbon Level (ppmv as C_3H_8)	510	526	668	339	583	482
Emission Rate (lb/hr)	6.69	6.88	8.59	4.35	7.82	6.38
PROCESS CONDITIONS						
% N_2	74.80	74.80	75.00	73.13	78.00	75.95
% O_2	21.20	20.7	21.30	19.93	20.15	19.65

[a]Total includes unidentified hydrocarbon responsive to GC/FID.

Table 2-13. GAS CHROMATOGRAPHY RESULTS FROM THE DAF TEST DAYS 8/8/83 to 8/11/83 CHEVRON REFINERY - EL SEGUNDO, CALIFORNIA

DATE	8/8	8/8	8/9	8/9	8/10	8/11
TIME	1100-1300	1500-1530	915-1040	1400-1455	904-1004	1315-1415
RUN NO.	1	2	1	2	1	1
ANALYTICAL RESULTS (ppmv as compound)						
C-1	55.3	52.9	37.5	34.8	26.4	29.2
C-2	4.5	3.9	2.4	1.8	2.1	0
C-3	5.6	5.0	2.2	2.6	2.0	2.1
C-4	4.0	4.8	3.6	3.2	1.7	6.5
C-5	3.4	4.0	4.8	4.8	0	9.2
Hexane	16.1	26.2	12.8	0	6.7	19.1
Benzene	39.8	63.6	49.2	8.0	23.7	55.2
Heptane			28.3	44.4	7.0	0
Toluene	46.4	75.1	17.1	17.4	0	61.5
m-Xylene	11.3	20.7	6.0	7.0	12.7	10.0
o-Xylene	3.9	8.2	22.4	24.2	5.2	10.2
TOTAL HYDROCARBON[a] (ppmv as compound)	190	264	186	148	87	203
CONTINUOUS MONITOR DATA						
Hydrocarbon Level (ppmv as C_3H_8)	495	580	709	592	460	622
Emission Rate (lb/hr)	6.72	7.87	9.68	8.09	5.28	8.22
PROCESS CONDITIONS						
% N_2	77.15	76.15	76.62	75.49	77.45	77.36
% O_2	19.75	19.55	19.81	19.55	19.92	19.64

[a]Total includes unidentified hydrocarbon responsive to GC/FID.

Additional descriptions of the chromatographic techniques are given in Section 5.

The general results of the species analysis are relatively consistent and the major components are methane and C6 to C8 components. The results of these analyses can be used to calculate a non-methane hydrocarbon emission rate, but these calculations were not performed for this report.

On 8/10/83, a short term test was conducted to estimate the hydrocarbon concentration at the DAF carbon house exhaust. For a two hour period, the average emission rate was 1.68 lbs/hr, while the daily average mass rate to the carbon house was 6.17 lbs/hr. The hydrocarbon removal efficiency for this short term test is 72.8 percent. This result should not be necessarily used to represent typical hydrocarbon control efficiencies of carbon absorption units because the system at Chevron was installed for odor control and not for maximum hydrocarbons emission reduction. A species analysis was also performed at this location on 8/10 and the results are presented in Table 2-14.

Since the ventilation air system at the DAF served three process tanks, measurements were performed at the individual vent tank lines to estimate the relative contribution to the total hydrocarbon mass flow. The sample locations are described in Section 4. The tests consisted of a measurement with a pitot tube to estimate volumetric flow rate and the collection of an integrated gas sample for total hydrocarbon concentration measurement. The results of this flow distribution measurements are presented in Table 2-15. The relative hydrocarbon mass flow from the Flocculation Tank and the Flash Mix Tank were 3.1 and 0.3 percent, respectively; therefore, 96.6 percent of the hydrocarbons measured in the ventilation air were from the DAF Tank. The samples collected for total hydrocarbon analyses were also analyzed for component identification. The only detectable peak was at the benzene elution time, and this compound concentration was much less than the corresponding peak in the samples from total DAF ventilation air stream. The results of this analysis are presented in Table 2-16.

Table 2-14. GAS CHROMATOGRAPH RESULTS FROM THE DAF CARBON HOUSE VENT (V-204) CHEVRON REFINERY - EL SEGUNDO, CALIFORNIA

DATE	8/10
TIME	1205
RUN NO./LOCATION	V-204
ANALYTICAL RESULTS (ppmv as compound)	
C-1	0
C-2	0
C-3	0
C-4	0
C-5	0
Hexane	14.5
Benzene	24.0
Heptane	14.9
Toluene	35.8
m-Xylene	0
o-Xylene	0
TOTAL HYDROCARBON[a] (ppmv as compound)	108
CONTINUOUS MONITOR DATA	
Hydrocarbon Level (ppmv as C_3H_8)	131
Emission Rate (lbs/hr)	1.85
PROCESS CONDITIONS	
% N_2	76.17
% O_2	19.61

[a]Total includes unidentified hydrocarbon responsive to GC/FID.

Table 2-15. MONITORED EMISSION RESULTS: HYDROCARBON MONITORING AT THE FLOCCULATION TANK (T-201) AND THE FLASH/MIX TANK (T-200) CHEVRON - EL SEGUNDO, CALIFORNIA

	Date	Time	Concentration[a] (ppm as C_3H_8)	Gaseous flow (SCFM)	Mass flow rate (lbs/hr as C_3H_8)	Percent total mass flow
Flocculation Tank	8/9/83	1140	74	570[b]	0.27	3.1
Flash/Mix Tank	8/9/83	1510	14	340[b]	0.0305	0.3
Average DAF system ventilation	8/9/83	1100-1500	541	2153	8.85	—

[a]Integrated gas bag analyzed with Beckman 400 FIA.

[b]Measured the velocity with plant installed pitot tubes.

Table 2-16. GAS CHROMATOGRAPH RESULTS FROM THE FLOCCULATION TANK (T-201) AND FLASH/MIX TANK (T-200) CHEVRON REFINERY - EL SEGUNDO, CALIFORNIA

DATE	8/9	8/9
TIME	1140	1510
RUN NO./LOCATION	T-201	T-200
ANALYTICAL RESULTS (ppmv as compound)		
C-1	0	0
C-2	0	0
C-3	0	0
C-4	0	0
C-5	0	0
Hexane	0	0
Benzene	4.6	3.5
Heptane	0	0
Toluene	0	0
m-Xylene	0	0
o-Xylene	0	0
TOTAL HYDROCARBON[a] (ppmv as compound)	20	20
CONTINUOUS MONITOR DATA		
Hydrocarbon Level (ppmv as C_3H_8)	74	14
Emission Rate (lbs/hr)	0.27	0.0305
PROCESS CONDITIONS		
% N_2	76.66	75.26
% O_2	19.76	19.42

[a]Total includes unidentified hydrocarbon responsive to GC/FID.

2.1.2 Equalization Tank

A summary of the daily average total hydrocarbon mass flow rates in the equalization tank prior to the emission control device is presented in Table 2-3. The total hydrocarbon measurement does not exclude methane. The hydrocarbon mass flow in the equalization tank ventilation air ranged from 4.18 lbs/hr to 4.65 lbs/hr (24-hour average basis) over the three days of testing. The average mass flow was 4.26 lbs/hr (24-hour basis).

The test results on a one-hour average basis for each day of testing are presented in Tables 2-17 to 2-19. The average total hydrocarbon concentration based on equivalents of propane is presented for each one-hour period. The average gas flow rate result that was used for calculation of the mass flow is presented in Table 2-20. The comparison of the daily flow rate differences of 0.8 to 1.3 percent justified the use of a single flow value for each day.

The composition analysis of the ventilation stream from the equalization tank is presented in Table 2-20. The hydrocarbon species analysis shows a relatively significant amount of methane and toluene and a number of peaks associated with the benzene and m-xylene calibration standards.

On 8/5/83 measurements were performed at the equalization tank carbon house outlet to estimate the hydrocarbon removal efficiency. The test results are shown in Table 2-19 at 1400-1600 pm. At the time, the carbon was apparently saturated and was not removing any hydrocarbons. The species analysis (Table 2-21) confirms that the hydrocarbons exiting the carbon house were essentially the same as those entering. On 8/12/83, tests were repeated at the equalization tank carbon house after the carbon was changed. The total hydrocarbon mass flow data are presented in Table 2-22 and the chromatographic speciation results are presented in Table 2-23. For the test with fresh carbon, when the inlet total hydrocarbon mass flow was 7.54 lbs/hr, the outlet rate was 0.77 lb/hr, for a hydrocarbon removal efficiency of 89.8 percent. The species analysis presented in Table 2-23 indicates that the hydrocarbons not collected in the carbon house was solely methane, and the carbon was achieving complete removal on heavier components, within the accuracy of the measurement technique.

Table 2-17. CONTINUOUS EMISSION RESULTS: HYDROCARBON MONITORING AT THE EQUALIZATION TANK VENTILATION AIR LOCATION, CHEVRON - EL SEGUNDO, CALIFORNIA TEST DAY 8/3/83

Time	Concentration[a] (ppm as C_3H_8)	Flow[b] (SCFM)	Emission Rate (lbs/hr as C_3H_8)
1200[c]	140	4240	3.80
1300	140	4240	3.80
1400	145	4240	3.94
1500	147	4240	3.99
1600	150	4240	4.07
1700	145	4240	3.94
1800	140	4240	3.80
1900	150	4240	3.99
2000	152	4240	4.13
2100	160	4240	4.35
2200	175	4240	4.75
2300	180	4240	4.89
2400	180	4240	4.89
Average			4.18

[a]Concentration is average value for continuous readings across the hour (0-55 minutes) based on 5-minute readings.

[b]One flow measurement taken during test periods; therefore, used flow measurement across test day. See Table 2-20.

[c]Hydrocarbon Monitor (Beckman 400) on-line.

Table 2-18. CONTINUOUS EMISSION RESULTS: HYDROCARBON MONITORING AT THE EQUALIZATION TANK VENTILATION AIR LOCATION, CHEVRON - EL SEGUNDO, CALIFORNIA TEST DAY 8/4/83

Time	Concentration[a] (ppm as C_3H_8)	Flow[b] (SCFM)	Emission Rate (lbs/hr as C_3H_8)
0100	185	4169	4.94
0200	185	4169	4.94
0300	190	4169	5.07
0400	190	4169	5.07
0500	190	4169	5.07
0600	190	4169	5.07
0700	192	4169	5.13
0800	190	4169	5.07
0900	185	4169	4.94
1000	180	4169	4.80
1100	190	4169	5.07
1200	175	4169	4.67
1300	175	4169	4.67
1400	170	4169	4.54
1500	165	4169	4.41
1600	160	4169	4.28
1700	155	4169	4.14
1800	155	4169	4.14
1900	150	4169	4.01
2000	155	4169	4.14
2100	160	4169	4.28
2200	165	4169	4.41
2300	160	4169	4.28
2400	170	4169	4.54
Average			4.65

[a]Concentration is average value for continuous readings across the hour (0-55 minutes) based on 5-minute readings.

[b]An initial and final flow measurement taken during test period; therefore, used average flow measurement across test day. See Table 2-20.

Table 2-19. CONTINUOUS EMISSION RESULTS: HYDROCARBON MONITORING AT THE EQUALIZATION TANK AND EQUALIZATION TANK CARBON HOUSE OUTLET LOCATIONS, CHEVRON - EL SEGUNDO, CALIFORNIA
TEST DAY 8/5/83

Time	Concentration[a] (ppm as C_3H_8)	Flow[b] (SCFM)	Emission Rate (lbs/hr as C_3H_8)
0100	170	4035	4.39
0200	170	4035	4.39
0300	170	4035	4.39
0400	170	4035	4.39
0500	170	4035	4.39
0600	180	4035	4.65
0700	180	4035	4.65
0800	160	4035	4.14
0900	155	4035	4.01
1000	152	4035	3.93
1100	150	4035	3.88
1200	155	4035	4.01
1300	152	4035	3.93
1400[c]	156[d]	4035	4.03
1500[c]	190[e]	4035	4.91
1600[c,f]	190[e]	4035	4.91
Average		Ventilation air	4.24
		Equalization tank carbon house outlet	4.62

[a]Concentration is average value for continuous readings across the hour (0-55 minutes) based on 5-minute readings.

[b]Pitot measurements at initial and final periods of test day; therefore, used average of flow measurements. See Table 2-10.

[c]Continuous hydrocarbon analyzer moved to sample Equalization Tank Carbon House Vent.

[d]Upwind side of Carbon House Vent.

[e]Downwind side of Carbon House Vent.

[f]End of test at the Equalization Tank area.

Table 2-20. SUMMARY OF PITOT MEASUREMENTS:
FLOW MONITORING AT THE EQUALIZATION TANK OUTLET
CHEVRON - EL SEGUNDO, CALIFORNIA

Test Day	8/3/83	8/4/83	8/5/83
AM Measurement (SCFM)	NM	4185	4009
PM Measurement (SCFM)	4240	4153	4062
Average (SCFM)	4240	4169	4035
% Difference	—	0.8	1.3

NM = Not measured.

Table 2-21. GAS CHROMATOGRAPH RESULTS FROM THE EQUALIZATION TANK
TEST DAYS 8/3/83 to 8/5/83
CHEVRON REFINERY, EL SEGUNDO, CALIFORNIA

DATE	8/3	8/4	8/4	8/5	8/5	8/5
TIME	1600-1700	1053-1235	1431-1510	930-1000	1228-1252	1400-1510
LOCATION	Ventilation air					Carbon house outlet
RUN NO.	1	1	2	1	2	OUT
ANALYTICAL RESULTS (ppmv as compound)						
C-1	27.0	29.4	24.6	17.7	20.4	22.3
C-2	2.0	1.2	0	0	1.8	1.6
C-3	0	0	0	0	0	0
C-4	0	0	0	0	0	0
C-5	0	0	0	0	0	0
Hexane	0	2.3	2.1	1.4	2.1	0
Benzene	7.7	9.7	4.9	7.8	12.5	20.4
Heptane						
Toluene	29.2	25.5	13.6	18.7	29.8	26.8
m-Xylene	4.6	4.0	1.7	3.6	7.0	0
o-Xylene	1.7	1.5	0	1.1	2.4	0
TOTAL HYDROCARBON[a] (ppmv as compound)	72	74	47	50	76	72
CONTINUOUS MONITOR DATA						
Hydrocarbon Level (ppmv as C_3H_8)	150	182	167	155	155	179
Emission Rate (lb/hr)	4.07	4.87	4.45	3.98	3.98	4.65
PROCESS CONDITIONS						
% N_2	73.60	73.80	78.20	77.50	77.77	76.55
% O_2	20.35	20.40	21.50	20.40	20.46	19.75

[a]Total includes unidentified hydrocarbon responsive to GC/FID.

Table 2-22. MONITORED EMISSION RESULTS: HYDROCARBON MONITORING AT THE EQUALIZATION TANKS VENTILATION AIR AND CARBON HOUSE EXHAUST CHEVRON - EL SEGUNDO, CALIFORNIA

Equalization Tank Carbon House Inlet	8/12/83	1129	284	4146[a]	7.54
Equalization Tank Carbon House Outlet	8/12/83[b]	1230	29	4146[a]	0.77

[a]Used the average flowrate measured at the Equalization Tank Outlet Sample Location during the test period 8/3/83 to 8/5/83.

[b]Tested hydrocarbon levels at the Equalization Tank Outlet (inlet to Carbon House) and Carbon House Vent after Chevron changed the activated charcoal.

Table 2-23. GAS CHROMATOGRAPH RESULTS AT THE EQUALIZATION TANK
TEST DAY 8/12/83
CHEVRON REFINERY, EL SEGUNDO, CALIFORNIA

DATE	8/12/83	8/12/83	8/12/83
TIME			
LOCATION	Ventilation air	Carbon house exhaust	
RUN NO.	1	1	2
ANALYTICAL RESULTS (ppmv as compound)			
C-1	15.4	24.4	23.5
C-2	0	0	0
C-3	0	0	0
C-4	0	0	0
C-5	0	0	0
Hexane	5.8	0	0
Benzene	38.6	0	0
Heptane	0	0	0
Toluene	0	0	0
m-Xylene	14.8	0	0
o-Xylene	5.6	0	0
TOTAL HYDROCARBON[a] (ppmv as compound)	89	24	23
CONTINUOUS MONITOR DATA			
Hydrocarbon Level (ppmv as C_3H_8)	284		29
Emission Rate (lb/hr)	7.54		0.77
PROCESS CONDITIONS			
% N_2	75.60	80.35	78.34
% O_2	19.58	23.86	19.92

[a]Total includes unidentified hydrocarbon responsive to GC/FID.

2.2 UNSEGREGATED WATER SYSTEM, IAF UNIT

The one-hour average concentration results are presented in Tables 2-24 to 2-28. The average total hydrocarbon concentration ranged from 6558 to 7600 ppm as C_3H_8. The hydrocarbon concentration was relatively constant and showed no trends. The flow from the IAF can be characterized as a breathing-type flow. For intermittant periods these would be small positive flows, followed by periods of zero flow or in-breathing to the unit. The flow was monitored constantly during the following periods: 1700-1900 8/10/83, 2100-2200 8/10/83, 0000-0100 8/11/83, 0900-1400 8/11/83, and 0900-1400 8/12/83. The results of these measurements are presented in Table 2-29. The measured equivalent positive flow rates were relatively consistant except for one period on 8/10/83-8/11/83. This lower measurement could have been caused by fugitive losses from inspection doors that are normally opened each shift. Prior to all other test runs, the doors were inspected and sealed tightly prior to flow monitoring.

Because of the intermittant nature of the gaseous flow from the IAF unit, no daily average mass flow rate in the ventilation air was calculated. The total hydrocarbon mass flow rate for those periods when ventilation air rates were available are listed in Tables 2-24 and 2-28. The mass rate ranged from 0.27 to 0.31 lb/hr, with an average of 0.27 lb/hr, when the low flow measurements are excluded. Attempts were made to provide a constant, positive flow of plant nitrogen to the IAF to provide a steady stream for measurement. These attempts were unsuccessful because of a pressure relief valve that opened at a pressure less than the ventilation stream backpressure.

The composition analysis of the ventilation stream from the IAF is presented in Table 2-30. The hydrocarbon species analysis shows a relatively significant amount of methane and a number of peaks in the C4 to C7 range. The inert gas at this location was essentially nitrogen, which corresponds to the expected results.

On 8/12/83, a test was performed to estimate the hydrocarbon removal efficiency of the carbon drum. The results are presented in Table 2-28. The inlet and outlet mass rates were essentially the same. Since this system was installed for odor control and the low flow rates from the IAF were not causing a detectable odor, Chevron was not routinely replacing

Table 2-24. CONTINUOUS EMISSION RESULTS: HYDROCARBON MONITORING AT THE IAF VENTILATION AIR SAMPLE LOCATION, CHEVRON - EL SEGUNDO, CALIFORNIA TEST DAY 8/8/83

Time	Concentration[a] (ppm as C_3H_8)	Flow (SCFM)	Emission Rate[b] (lbs/hr as C_3H_8)
1800[c]	6725	NM	—
1900	6967	NM	—
2000	7000	NM	—
2100	7000	NM	—
2200	7000	NM	—
2300	6917	NM	—
2400	6900	NM	—
Average	6930 ppm as C_3H_8		

[a]Concentration is average value for continuous readings across the hour (0-55 minutes) on 5-minute readings.

[b]Due to varying flowrates between day and night periods, emission rate calculations are based on actual flow measurements only at the times monitored. See Table 2-29.

[c]Continuous Hydrocarbon Analyzer (Beckman 402) on-line at IAF Outlet Sample Location starting the test period.

NM = Not measured.

Table 2-25. CONTINUOUS EMISSION RESULTS: HYDROCARBON MONITORING AT THE IAF VENTILATION AIR SAMPLE LOCATION, CHEVRON - EL SEGUNDO, CALIFORNIA TEST DAY 8/9/83

Time	Concentration[a] (ppm as C_3H_8)	Flow (SCFM)	Emission Rate[b] (lbs/hr as C_3H_8)
0100	6850	NM	—
0200	6800	NM	—
0300	6800	NM	—
0400	6800	NM	—
0500	6800	NM	—
0600	6800	NM	—
0700	6817	NM	—
0800	6853	NM	—
0900	6796	NM	—
1000	6810	NM	—
1100	6558	NM	—
1200	6571	NM	—
1300	6693	NM	—
1400	6769	NM	—
1500	6815	NM	—
1600	6800	NM	—
1700	6995	NM	—
1800	7090	NM	—
1900	7138	NM	—
2000	7144	NM	—
2100	7117	NM	—
2200	7075	NM	—
2300	6990	NM	—
2400	6950	NM	—
Average	6868 ppm as C_3H_8		

[a]Concentration is average value for continuous readings across the hour (0-55 minutes) on 5-minute readings.

[b]Due to varying flowrates between day and night periods, emission rate calculations are based on actual flow measurements only at the times monitored. See Table 2-29.

NM = Not measured.

Table 2-26. CONTINUOUS EMISSION RESULTS: HYDROCARBON MONITORING AT THE IAF OUTLET SAMPLE LOCATION, CHEVRON - EL SEGUNDO, CALIFORNIA TEST DAY 8/10/83

Time	Concentration[a] (ppm as C_3H_8)	Flow (SCFM)	Emission Rate[b] (lbs/hr as C_3H_8)
0100	6900	NM	—
0200	6900	NM	—
0300	6825	NM	—
0400	6800	NM	—
0500	6780	NM	—
0600	6750	NM	—
0700	6690	NM	—
0800	6660	NM	—
0900	6640	NM	—
1000	6650	NM	—
1100	6700	NM	—
1200	6750	NM	—
1300	6810	NM	—
1400	6890	NM	—
1500	6750	NM	—
1600	6775	NM	—
1700	6900	5.7	0.25
1800	7050	5.7	0.25
1900	6850	5.7	0.25
2000	6800	NM	—
2100	6850	0.38	0.017
2200	6800	0.38	0.017
2300	6790	NM	—
2400	6700	NM	—
Average	6792 ppm as C_3H_8		

[a]Concentration is average value for continuous readings across the hour (0-55 minutes) on 5-minute readings.

[b]Due to varying flowrates between day and night periods, emission rate calculations are based on actual flow measurements only at the times monitored. See Table 2-29.

NM = Not measured.

Table 2-27. CONTINUOUS EMISSION RESULTS: HYDROCARBON MONITORING AT THE IAF OUTLET SAMPLE LOCATION, CHEVRON - EL SEGUNDO, CALIFORNIA TEST DAY 8/11/83

Time	Concentration[a] (ppm as C_3H_8)	Flow (SCFM)	Emission Rate[b] (lbs/hr as C_3H_8)
0100	6650	0.41	0.018
0200	6700	NM	—
0300	6750	NM	—
0400	6730	NM	—
0500	6720	NM	—
0600	6750	NM	—
0700	6800	NM	—
0800	6890	NM	—
0900	6950	6.3	0.28
1000	7170	6.3	0.29
1100	7250	6.3	0.29
1200	7300	6.3	0.29
1300	7490	6.3	0.31
1400[c]	7600	6.3	0.31
Average			0.29

[a] Concentration is average value for continuous readings across the hour (0-55 minutes) on 5-minute readings.

[b] Flow measured 4 times between 0951-1559 with 4 flow values averaging to 6.3 SCFM. See Table 2-29.

[c] Test period discontinued at IAF outlet until following day period.

NM = Not measured.

Table 2-28. CONTINUOUS EMISSIONS RESULTS: HYDROCARBON MONITORING AT THE IAF OUTLET AND IAF CARBON DRUM SAMPLE LOCATION
CHEVRON - EL SEGUNDO, CALIFORNIA
TEST DAY 8/12/83

Time	Concentration[a] (ppm as C_3H_8)	Flow (SCFM)	Emission Rate[b] (lbs/hr as C_3H_8)
0900[c]	6271[d]	5.8	0.22
1000	6589[d]	5.8	0.24
1100	6614[d]	5.8	0.24
1200[e]	7222	5.8	0.27
1300	7222	5.8	0.27
1400[f]	7292	5.8	0.27
Average		IAF Ventilation air	0.27
		IAF Carbon Drum	0.23

[a]Concentration is average value for continuous readings across the hour (0-55 minutes) on 5-minute readings.

[b]Flow measured 4 times between 1033-1446 with 4 flow values averaging to 3.8 SCFM. See Table 2-29.

[c]Continuous Hydrocarbon Analyzer (Beckman 402) on-line at IAF Carbon Drum Vent Sample Location restarting the test period.

[d]On-line at the IAF Carbon Drum Vent.

[e]Continuous Hydrocarbon Analyzer (Beckman 402) switched to IAF ventilation air sample location.

[f]End of test period.

Table 2-29. IAF FLOW MEASUREMENTS: CHEVRON - EL SEGUNDO, CALIFORNIA

Date	Time	Temperature (°F)	Feet	Time period in min	Anemometer average rate (ft/min)		Actual volumetric flowrate (ACFM)	Standard volumetric flowrate (SCFM)
					Indicated	True		
8/10/83	1745-1903	84	744	15	49.6	68.8	6.0	5.7
8/10/83	2145-2230[a]	72	194	45	4.3	b	0.38	0.38
8/11/83	0045-0120[a]	72	190	40	4.7	b	0.41	0.41
8/11/83	0951-1016	88	1275	25	51.0	70.8	6.1	5.8
8/11/83	1032-1103	88	1725	30	69.0	91.1	7.9	7.5
8/11/83	1310-1357	88	2042	47	43.4	66.3	5.8	5.5
8/11/83	1517-1559	88	2294	42	54.6	75.8	6.7	6.4
8/12/83	1033-1119	84	2197	46	48.1	66.8	5.8	5.4
8/12/83	1130-1215	84	1725	45	38.3	58.5	5.0	4.9
8/12/83	1230-1315	84	2080	45	46.2	64.2	5.6	5.4
8/12/83	1400-1446	84	2194	46	48.1	66.8	5.8	5.7

[a]Flow measurements monitored during night period with lower process gas temperatures.

[b]Not within manufacturer's range suggested for the anemometer.

Table 2-30. GAS CHROMATOGRAPHY RESULTS FROM THE IAF
TEST DAYS 8/11/83 to 8/12/83
CHEVRON REFINERY, EL SEGUNDO, CALIFORNIA

DATE	8/11	8/11	8/12	8/12
TIME	0924-0942	1213-1245	1213-1254	1040-1120
LOCATION	Ventilation air		Carbon drum outlet	
RUN NO.	1	2	1	2
ANALYTICAL RESULTS (ppmv as compound)				
C-1	1602	2818	2156	1762
C-2	7.6	3217	8.2	4.5
C-3	18.2	2913	21.8	12.8
C-4	42.0	80.5	72.1	36.4
C-5	283	220	510	110
Hexane	1288	6127	2005	2033
Benzene	835	2642	2101	1074
Heptane	826	938	793	449
Toluene	421	0	0	0
m-Xylene	252	105	385	168
o-Xylene	145	31.7	106	67.8
TOTAL HYDROCARBON[a] (ppmv as compound)	5720	19,092	8158	5717
CONTINUOUS MONITOR DATA				
Hydrocarbon Level (ppmv as C_3H_8)	6950	7300	7222	6601
Emission Rate (lb/hr)	0.20	0.21	0.18	0.16
PROCESS CONDITIONS				
% N_2	91.98	93.90	90.71	83.09
% O_2	6.00	6.60	7.19	12.98

[a]Total includes unidentified hydrocarbon responsive to GC/FID.

the drums. It would be expected that the carbon would become saturated under these conditions. A sample of the drum outlet stream was collected and analyzed, and the results are shown in Table 2-30. This result confirms the similarity of the inlet and outlet gases.

2.3 PROCESS WATER ANALYSES

Tables 2-31 through 2-39 provide the process water analysis for the composite and grab samples taken during the hydrocarbon (air) monitoring.

Designated samples (item, location) were analyzed for the following parameters:

- TOC (total organic carbon);
- COD (chemical oxygen demand);
- oil and grease; and
- TCO (total chromatographable organics/hydrocarbon speciation (C_7-C_{30}) and VOA by purge and trap GC/FID.

All analytical parameters are reported in milligrams per liter (ppmw), except purge and trap values which are given in parts per billion (ppbw).

The most critical factors in the measurement of the process water parameters were the collection of representative samples at the site location and obtaining a representative aliquot for analysis in the laboratory. In most cases the samples involved two-phase oil/water mixtures which contributed to the non-homogeneity of the samples and to the variation in the sample values.

The sampling points at the Chevron Effluent Treatment Plant were dictated by the physical layout and available sample locations. The samples were collected from streams at elevated temperatures, stored on ice, and shipped to the TRW laboratory. Sample preservatives were not utilized in preference to immediate analysis (24-48 hours) and to the elevated levels of hydrocarbons in the streams. Upon arrival at the laboratory all samples were homogenized prior to analysis; however, the two-phased system and the cooling of the sampling affected the homogeneity of the samples. All samples were brought to room temperature and shaken vigorously before samples were removed. In addition, due to the high levels of the parameters being measured, the size of the sample aliquots were small which also contributed to the variability from sample to sample.

Table 2-31. CHEVRON, EL SEGUNDO, CALIFORNIA SAMPLES TAKEN ON 8/3/83

	TRW No.	COD mg/L	Oil/grease mg/L	TOC mg/L	TCO mg/L
Liquid Composite Samples					
DAF-in	4,957	2,969	491	—	71.56
		3,008	535	—	
DAF-out	4,961	1,748	133	—	30.90
			144	—	
EQ-out	4,972	1,911	123	—	21.00
		1,870	120		
Volatile Organic Samples					
DAF-in #1 VOA (1650)[a]	4,973	—	—	611	—
DAF-out #1 VOA (1650)	4,975	—	—	365	—
EQ-out VOA (1650)	4,987	—	—	661	—

[a]Time sample taken.

(continued)

Table 2-31. Concluded

	TRW No.		mg/L
Liquid Composite Samples			
DAF-in	4,957	Toluene	13.302
		C_8	2.278
		C_9	1.328
		C_9	1.040
		C_9	17.709
		C_{10}	2.679
		C_{11}	4.207
		C_{12}	4.940
		C_{12}	5.339
		C_{12}	12.214
		C_{12}	2.932
		C_{12}	1.436
		C_{12}	1.930
		C_{12}	1.487
		C_{13}	10.496
		C_{13}	3.128
		C_{14}	4.838
		C_{15}	3.570
		C_{15}	3.066
DAF-out	4,961	Toluene	3.643
		C_9	2.595
		C_9	15.412
		C_{10}	4.972
		C_{10}	5.549
		C_{11}	0.828
		C_{11}	1.383
		C_{11}	2.679
		C_{12}	2.232
		C_{13}	2.257
EQ-out	4,972	Toluene	3.301
		C_9	2.460
		C_9	11.538
		C_{10}	3.927
		C_{10}	3.617
		C_{12}	1.180

Note: Benzene could not be determined due to a co-eluting peak in the solvent.

Note: These values were calculated using average response factors of C_7-C_{11}, C_{11}-C_{16}, and C_{17} to C_{25} hydrocarbons. Due to the reduced response of C_{17} to C_{25} hydrocarbons as compared to C_7-C_{11}, high values of some C_{17}-C_{25} compounds were found.

Table 2-32. CHEVRON, EL SEGUNDO, CALIFORNIA SAMPLES TAKEN ON 8/4/83

	TRW No.	COD mg/L	Oil/grease mg/L	TOC mg/L
<u>Liquid Composite Samples</u>				
DAF-in	4,958	4,024	440	—
		4,228	441	—
DAF-out	4,962	1,545	125	—
		1,585	94	—
		1,565	126	—
EQ-out	4,970	2,033	148	—
		2,155	142	—
<u>Volatile Organic Samples</u>				
DAF-in-VOA pm (1500)	4,974	—	—	484
DAF-in-VOA (1000)	4,977	—	—	a
DAF-out VOA pm (1500)	4,976	—	—	478
		—	—	475
		—	—	550
		—	—	542
DAF-out VOA (1000)	4,982	—	—	464
EQ-out VPA (1000)	4,988	—	—	455
EQ-out VOA (1500)	4,989	—	—	511

[1]Sample lost; replaced with aliquot from DAF-in, TRW #4958, liquid composite sample result was 1,096 mg/L.

Table 2-33. CHEVRON, EL SEGUNDO, CALIFORNIA SAMPLES TAKEN ON 8/5/83

	TRW No.	COD mg/L	Oil/grease mg/L	TOC mg/L	TCO mg/L
Liquid Composite Samples					
DAF-in	4,959	8,056	6.14	—	—
DAF-out	4,963	2,179	2.37	—	—
EQ-out	4,971	1,240	110	—	—
		1,301	109	—	—
Volatile Organic Samples					
DAF-in VOA (0915)	4,978	—	—	a	—
DAF-in VOA (1530)	4,979	—	—	722	—
DAF-out VOA (0915)	4,983	—	—	578	—
DAF-out VOA (1530)	4,984	—	—	713	—
EQ-out VOA (1530)	4,990	—	—	600	—
EQ-out VOA (0915)	4,991	—	—	b	—

[a] Sample lost; replaced with aliquot from DAF-in, TRW #4,959, liquid composite samples. Results are 849, 940, 860 mg/L.

[b] Sample lost; replaced with aliquot from EQ-out, TRW #4,971, liquid composite samples. Results are 416, 398, 476 mg/L.

Table 2-34. CHEVRON, EL SEGUNDO, CALIFORNIA SAMPLES TAKEN ON 8/8/83

	TRW No.	COD mg/L	Oil/grease mg/L	TOC mg/L	TCO mg/L
<u>Liquid Composite Samples</u>					
DAF-in	4,960	2,155	383	—	41.94
		2,114	376	—	—
DAF-out	4,964	1,470	0.21	—	22.38
API-2 Inlet A (201)	4,965	20.3	6.4	—	1.74
API-2 Inlet B (202)	4,966	2,560	65.49	—	84.00
API-2 Inlet C (203)	4,967	463	20.9	—	9.30
API-2 Inlet D (204)	4,968	480	26.97	—	8.26
API-4	4,969	2,440	18.26	—	45.66
<u>Volatile Organic Samples</u>					
DAF-in VOA (1100)	4,980	—	—	538	—
DAF-in VOA (1500)	4,981	—	—	a	—
DAF-out VOA (1100)	4,985	—	—	622	—
DAF-out VOA (1500)	4,986	—	—	b	—

[a]Sample lost; replaced with aliquot from DAF-in, TRW #4,960, liquid composite samples. TOC result is 616 mg/L.

[b]Sample lost; replaced with aliquot from DAF-out, TRW #4,964, liquid composite samples. TOC result if 774 mg/L.

(continued)

Table 2-34. Continued

	TRW No.		mg/L
Liquid Composite Samples			
DAF-in	4,960	Toluene	9.920
		C_8	2.312
		C_9	13.518
		C_{10}	3.935
		C_{10}	3.901
		C_{10}	1.871
		C_{12}	4.727
		C_{12}	1.407
		C_{12}	0.783
		C_{12}	0.801
		C_{13}	4.496
		C_{14}	2.837
		C_{15}	0.838
		C_{15}	3.285
		C_{16}	3.136
DAF-out	4,964	Toluene	5.085
		C_9	10.601
		C_9	3.697
		C_{10}	3.284
		C_{10}	1.210
API-2 Inlet A (201)	4,965		
API-2 Inlet B (202)	4,966	Toluene	2.571
		C_8	1.005
		C_9	2.065
		C_9	23.039
		C_9	1.858
		C_{10}	7.464
		C_{10}	12.990
		C_{11}	5.835
		C_{11}	0.932
		C_{11}	0.051
		C_{11}	1.153
		C_{11}	4.145
		C_{12}	14.226

(continued)

Table 2-34. Concluded

	TRW No.		mg/L
		C_{13}	13.544
		C_{13}	4.316
		C_{14}	8.411
		C_{14}	2.306
		C_{15}	9.465
		C_{16}	7.679
		C_{17}	59.638
		C_{18}	45.744
		C_{19}	65.488
API-2 Inlet C (203)	4,967	Toluene	2.165
		C_8	1.034
API-2 Inlet D (204)	4,968		
API-4	4,969	Toluene	6.595
		C_8	1.848
		C_9	12.555
		C_{10}	3.390
		C_{10}	3.291
		C_{10}	3.341
		C_{12}	8.448
		C_{12}	2.436
		C_{12}	1.395
		C_{12}	1.447
		C_{13}	7.986
		C_{13}	1.654
		C_{14}	5.173
		C_{15}	1.388
		C_{15}	5.558
		C_{16}	4.977
		C_{17}	46.394

Table 2-35. CHEVRON, EL SEGUNDO, CALIFORNIA SAMPLES TAKEN ON 8/9/83

	TRW No.	COD mg/L	Oil/grease mg/L	TOC mg/L	TCO mg/L
Liquid Composite Samples					
DAF-out	5,022	1,579	154	—	—
API-2 Inlet A (201)	5,028	693	61.56	—	—
API-2 Inlet B (202)	5,029	3,155	19.50	—	—
API-2 Inlet C (203)	5,040	5,179	32.27	—	—
API-2 Inlet D (204)	5,041	2,230	18.28	—	—
API-4	5,030	620	23.90	—	—
Volatile Organic Samples					
DAF-in VOA (0900)	5,007	—	—	482	—
DAF-in VOA (1342)	5,010	—	—	440	—
DAF-out VOA (0900)	5,006	—	—	341	—
DAF-out VOA (1340)	5,008	—	—	509	—

Table 2-36. CHEVRON, EL SEGUNDO, CALIFORNIA SAMPLES TAKEN ON 8/10/83

	TRW No.	COD mg/L	Oil/grease mg/L	TOC mg/L	TCO mg/L
<u>Liquid Composite Samples</u>					
DAF-in	5,024	2,170	23.80	—	—
DAF-in	5,025	2,121	53.98	—	—
DAF-out	5,023	2,078	47.75	—	—
API-2 SP 201	5,031	594	33.80	—	—
API-2 SP 202	5,012	2,764	42.48	—	—
API-2 SP 203	5,013	950	70.03	—	—
API-2 SP 204	5,014	2,635	32.62	—	—
<u>Volatile Organic Samples</u>					
DAF-in VOA (0920)	5,002	—	—	619	—
DAF-in VOA (1600)	5,005	—	—	471	—
DAF-out VOA (0920)	5,004	—	—	546	—
DAF-out VOA (1600)	5,011	—	—	511	—

Table 2-37. CHEVRON, EL SEGUNDO, CALIFORNIA SAMPLES TAKEN ON 8/11/83

	TRW No.	COD mg/L	Oil/grease mg/L	TOC mg/L	TCO mg/L
Liquid Composite Samples					
DAF-in	5,027	2,316	43.74	—	95.26
DAF-out	5,026	1,410	54.92	—	22.42
IAF-in	5,034	811	61.58	—	12.58
IAF-out	5,035	201	46.73	—	11.06
API-4	5,033	1,616	43.59	—	96.20
API-2 SP 201	5,015	100	17.97	—	9.20
API-2 SP 202	5,016	1,700	37.24	—	30.68
API-2 SP 203	5,021	99	24.45	—	8.60
API-2 SP 204	5,017	450	33.06	—	51.98
Volatile Organic Samples					
DAF-in VOA (0900)	5,001	—	—	530	—
DAF-in VOA (1530)	5,003	—	—	355	—
DAF-out VOA (0900)	5,000	—	—	454	—
DAF-out VOA (1530)	5,009	—	—	343	—
IAF-in VOA (1000)	4,993	—	—	64.5	—
IAF-in VOA (1600)	4,994	—	—	402	—
IAF-out VOA (1000)	4,992			134	
IAF-out VOA (1600)	4,995	—	—	52.0	—

(continued)

Table 2-37. Continued

	TRW No.		mg/L
<u>Liquid Composite Samples</u>			
DAF-in	5,027	Toluene	14.141
		C_8	1.211
		C_8	1.471
		C_8	5.429
		C_8	1.901
		C_9	2.553
		C_9	6.035
		C_9	3.027
		C_{10}	5.068
		C_{10}	7.398
		C_{10}	6.526
		C_{12}	15.370
		C_{13}	14.351
		C_{13}	4.388
		C_{14}	9.436
		C_{15}	10.194
		C_{16}	6.915
		C_{17}	58.459
		C_{18}	47.247
		C_{19}	44.281
		C_{20}	28.031
DAF-out	5,026	Toluene	4.430
		C_8	0.838
		C_9	0.805
		C_9	7.528
		C_{10}	4.021
		C_{10}	3.658
		C_{11}	1.375
		C_{12}	0.852
		C_{13}	0.920
IAF-in	5,034	Toluene	1.549
		C_8	0.668
IAF-out	5,035	Toluene	1.334
		C_8	0.581

(continued)

Table 2-37. Continued

	TRW No.		mg/L
API-4	5,033	Toluene	39.430
		C_8	28.123
		C_8	11.348
		C_9	4.708
		C_9	2.586
		C_9	0.954
		C_9	13.200
		C_{10}	3.242
		C_{10}	1.512
		C_{10}	1.126
		C_{10}	4.686
		C_{10}	3.127
		C_{10}	2.379
		C_{11}	1.349
		C_{11}	1.502
		C_{11}	1.561
		C_{12}	1.976
		C_{13}	1.679
		C_{15}	1.832
		C_{16}	2.025
API-2 SP 201	5,015		
API-2 SP 202	5,016	Toluene	2.221
		C_8	1.434
		C_9	1.188
		C_9	3.697
		C_{10}	3.205
		C_{10}	3.147
		C_{11}	1.684
		C_{13}	4.622
		C_{13}	1.450
		C_{13}	2.900
		C_{14}	4.285
		C_{15}	3.544
API-2 SP 203	5,021	Toluene	0.902

(continued)

Table 2-37. Concluded

	TRW No.		mg/L
API-2 SP 204	5,017	Toluene	<0.5
		C_{11}	4.055
		C_{11}	1.755
		C_{11}	1.505
		C_{11}	1.002
		C_{11}	1.395
		C_{11}	2.130
		C_{12}	12.261
		C_{12}	3.872
		C_{12}	4.312
		C_{13}	10.914
		C_{14}	7.363
		C_{15}	3.839
		C_{16}	70.078

Table 2-38. CHEVRON, EL SEGUNDO, CALIFORNIA SAMPLES TAKEN ON 8/12/83

	TRW No.	COD mg/L	Oil/grease mg/L	TOC mg/L	TCO mg/L
Liquid Composite Samples					
IAF-in	5,036	320	14.14	—	—
IAF-out	5,038	302	64.95	—	—
API-4	5,039	202	26.5	—	—
API-2 SP 201	5,020	405	12.0	—	—
API-2 SP 202	5,019	1,584	70.71	—	—
API-2 SP 203	5,018	1,000	36.74	—	—
API-2 SP 204	5,037[a]	—	—	—	—
Volatile Organic Samples					
IAF-in VOA (0900)	4,998	—	—	86.0	—
IAF-in VOA (1250)	4,999	—	—	57.0	—
IAF-out VOA (0900)	4,997	—	—	162	—
IAF-out VOA (1330)	4,996	—	—	46.0	—

[a]Sample broken in laboratory.

Table 2-39. C_1 to C_7 SPECIATION BY GC/FID PURGE AND TRAP CHEVRON, EL SEGUNDO, CALIFORNIA

TRW No.	Sample Number	Compound	Date Taken	Concentration (in ppb)
4973	DAF-IN-#1-VOA	$C_2H_6S_2$	8/03/83	187
		Benzene		118
		Toluene		341
4975	DAF-OUT-#1-VOA	$C_2H_6S_2$	8/03/83	1420
		Benzene		2660
		$C_4H_{10}S_2$		432
		Toluene		7200
4987	EQ-OUT-VOA	$C_2H_6S_2$	8/03/83	939
		Benzene		1970
		$C_4H_{10}S_2$		411
		Toluene		5710
4987	EQ-OUT-VOA	$C_2H_6S_2$	8/03/83	943
		Benzene		1770
		$C_4H_{10}S_2$		410
		Toluene		5020
4980	DAF-302-IN-VOA-1100	Benzene	8/08/83	11400
		Toluene		13000
4985	DAF-302-OUT-VOA-1100	Benzene	8/08/83	9790
		Toluene		11600
5003	DAF-202-IN-1530-VOA	$C_2H_6S_2$	8/11/83	204
		Benzene		9230
		$C_4H_1S_2$		274
		Toluene		9860

(continued)

Table 2-39. Concluded

TRW No.	Sample Number	Compound	Date Taken	Concentration (in ppb)
5009	DAF-202-OUT-1530-VOA	Benzene	8/11/83	7750
		$C_4H_{10}S_2$		59
		Toluene		8940
4994	IAF-IN-VOA-1600	Benzene	8/11/83	2120
		Toluene		2110
4994	IAF-IN-VOA-1600	Benzene	8/11/83	1980
		Toluene		2000
4995	IAF-OUT-VOA-1600	Benzene	8/11/83	1970
		Toluene		2080

The differences in the results obtained from the utilization of the two water sampling procedures is attributed to the collection of 40 mL samples (VOA bottles) versus a composite sample 4 liters) integrated over time. In addition, analysis of samples from a composite bottle at a later date for purgable VOCs is affected by the homogeneity of the sample and the loss of volatiles during storage.

3. PROCESS DESCRIPTION

The Chevron refinery in El Segundo is a large refinery with a crude throughput capacity of 405,000 barrels per calendar day (b/cd).[1] The Effluent Guidelines Division of the Environmental Protection Agency (EPA) places Chevron in refinery subcategory C which includes refineries producing petroleum products by the use of topping, cracking, and petrochemical operations.[2] At the time of the test, the refinery was operating at less than full capacity. Table 3-1 lists the crude throughputs reported during the test period.

3.1 REFINERY WASTEWATER SYSTEM

The refinery wastewater system at Chevron, (Figure 3-1) is divided into two separate systems. The segregated system handles the majority of the oily wastewater while the unsegregated systems handles mostly non-oily wastewaters. Each system will be described in detail below.

3.2 SEGREGATED SYSTEM

The main components of the segregated system are the #4 API separator and the Effluent Treating Plant (ETP). Wastewater is collected at individual process units and directed by a main trunkline to the #4 separator. An additional API separator (#3 separator) collects tank draw off water from one section of the plant and also empties into the trunkline leading to the #4 separator. In the newer units, process drains in the segregated system have raised hubs which prevent stormwater and other surface waters from entering the drain. In the older units, raised concrete barriers surround each unit and limit water flowing to the segregated drains.

The segregated system handles approximately 2.3 million gallons of wastewater each day (MGD). The principal contributors of wastewater are crude storage tank water draws, desalters, sour water concentrators, caustic oxidizers, and the Isomax unit. Not all of these processes

Table 3-1. CRUDE THROUGHPUT DURING TEST PERIOD

Date	Crude throughput (b/cd)
8-1-83	181,600
8-2-83	183,500
8-3-83	183,300
8-4-83	178,800
8-5-83	177,600
8-6-83	183,900
8-7-83	184,700
8-8-83	170,400
8-9-83	116,800
8-10-83	182,300
8-11-83	172,100
8-12-83	Not available

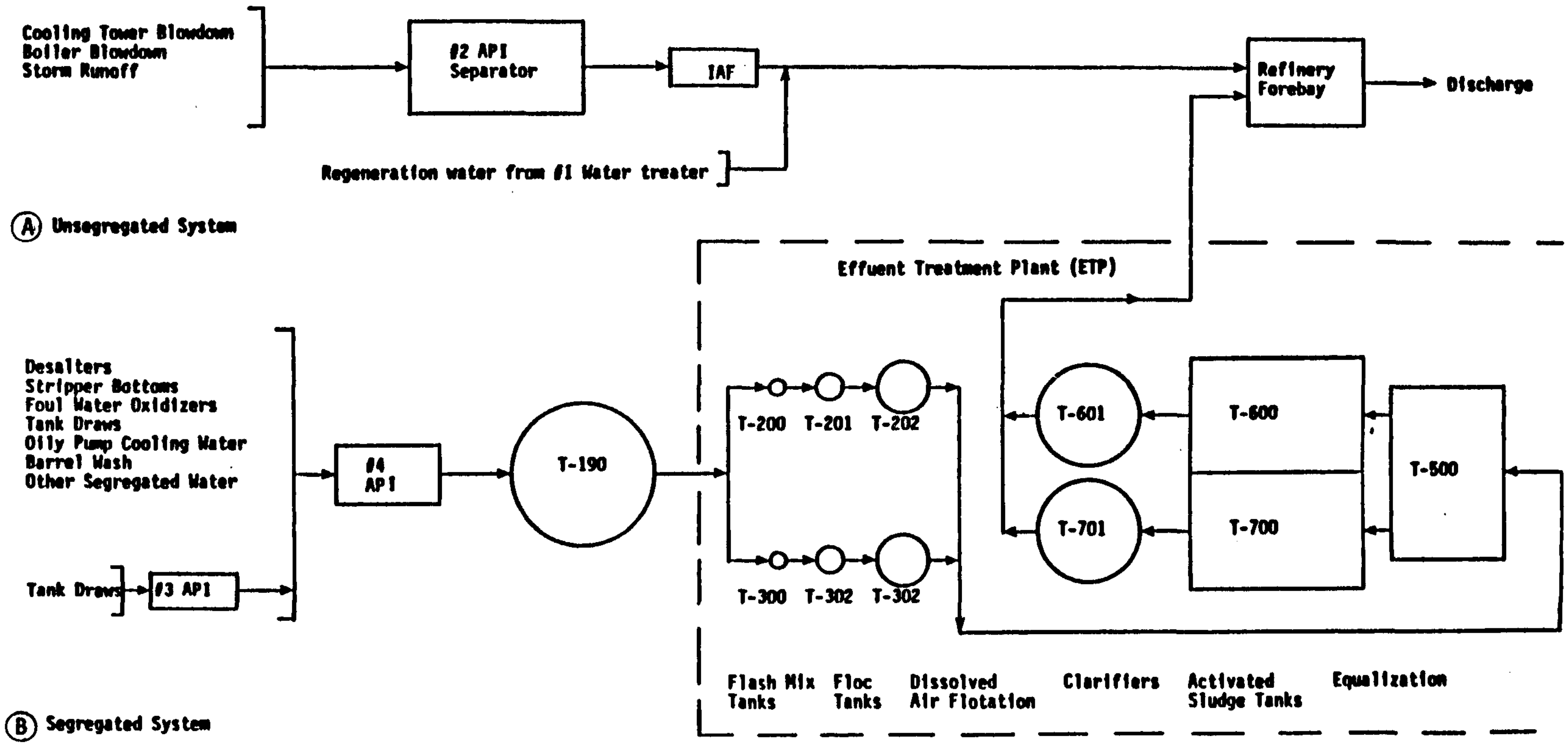


Figure 3-1. General scheme of wastewater flow: Chevron Refinery - El Segundo, California.

produce oily wastewaters. Wastewater from the oxidizers and concentrators is directed to the segregated system because of high biological oxygen demand (BOD) and not due to oil concentrations.

The main components of the segregated system are shown in Figure 3-1. The #4 API separator has a volume of 240,000 gallons of water and handles an average flow of 1600 gallons per minute (gpm). Retention time for wastewater in the separator is approximately 4 hours. The separator is equipped with a concrete cover having caulked joints. Breather valves protect the cover against excessive pressure or vacuum. Manholes provide for visual inspection of the separator and oil skimming troughs are adjusted manually to maximize oil removal. Actual skimming of the separator is performed manually as needed by plant operators in charge of maintaining all of the API separators. The #3 API separator has a volume of 50,000 gallons and serves one section of the refinery as described above.

Effluent from the #4 separator is pumped to a storage tank designated T-190. This tank serves as an equalization tank for the ETP. The effects of any sudden change in water quality or quantity can be minimized by controlling the flow from T-190 to the ETP. T-190 is 35 feet high with a diameter of 115 feet. Maximum capacity is approximately 2.5 million gallons although normal capacity is roughly 60 percent of this. With an average flow of 1600 gpm, retention times of 25 hours can be achieved. The constant flow and water quality supplied to the ETP enhances the effectiveness of the biological treatment processes.

From T-190, wastewater flow splits into dual treatment trains. Each train contains a flash mix tank (T-200 and T-300), a flocculation tank (T-201 and T-301), and a dissolved air flotation system (T-202 and T-302). Following the dissolved air flotation systems, the wastewater converges into an equalization basin (T-500) and then again splits into dual trains. Two activated sludge tanks (T-600 and T-700) and two clarifiers (T-601 and T-701) complete the wastewater treatment steps before the effluent is sent to the refinery forebay. Effluent from the unsegregated system combines with effluent from the segregated system at the forebay and the combined stream is discharged to Santa Monica Bay.

The flash mix tanks are used for pH adjustment and polymer addition. An acid tank, a caustic tank and a polymer tank feed both flash mixers. At the time of the test, no chemicals were being mixed with the wastewater. Chemical addition is usually used to improve the effectiveness of dissolved air flotation. However, since Chevron was having no difficulty meeting their effluent guidelines (as established by the National Pollution Discharge Elimination System [NPDES] permit), the refinery did not feel the additional cost of chemical addition was warranted. Chevron was currently reevaluating the use of chemical addition.

The flocculation tanks following the mix tanks are designed to provide adequate retention time so that the flocculation process can function effectively. Retention times of up to 30 minutes are possible. As with the mix tanks, wastewater was flowing through the tanks at the time of the test but no function was being served.

The dissolved air flotation systems were manufactured by EIMCO Envirotech and installed in 1974. Each tank is 52 feet in diameter and 11 feet high, not including the height of the cover. Nominal capacity for the tank is 155,000 gallons. Only one DAF was in operation. Each tank was provided with a fiberglass cover which rose vertically 5 feet from the sides of the tank and covered the entire flotation chamber. The cover had twenty-one 4 inch holes spaced around its side to allow ventilation air to enter the DAF. There were also three access doors on each cover, and a center hole in the cover for ventilation.

The air flotation process consisted of recycling a portion of the treatment wastewater and saturating it with air. A 75 Hp pump was used to recycle approximately 520 gpm of treated wastewater. A 10 Hp compressor pressurized the saturated wastewater to approximately 60 to 80 psi. Release of this pressurized stream into the flotation chamber at atmospheric pressure produced the bubbles needed for flotation.

The skimmer mechanism in the DAF was operated intermittently. The skimmer removed floating oil and suspended solids to a slop tank located next to the DAF's. Usually the skimmer was operated less than one hour per shift (3 shifts per day). The capacity of the slop tank was a factor considered by the operators in determining use of the skimmer. Oil and solids collected in the slop tank were removed periodically by a vacuum truck and disposed at a landfarm operated by Chevron.

As mentioned above, only one DAF was operating at the time of the test. The operators manual for the ETP at Chevron stated that when one treatment train was down, higher oil content may be expected in effluent leaving the DAF. To compensate for this, it was recommended that the polyelectrolyte dose be increased, feed to the DAF be minimized, and excess oil entering the equalization tank be skimmed off by a vacuum tank. Operators did not find it necessary to implement any of these strategies while the second DAF was down.

Effluent from the DAF's converges into a single trunkline which directs the wastewater to the equalization basin. The equalization basin is a large, rectangular tank (116 feet x 160 feet) with a capacity of 1.51 million gallons. Fifty-four static aerators are used to maintain aerobic conditions in the wastewater. Normal air flow from the aerators is 800 scfm. Under usual conditions, Chevron would expect little free oil at this stage of treatment. If floating oil is present, it is removed by vacuum trucks.

The principal purpose of the equalization basin is to maintain a wastewater flow which is consistent in quantity and quality entering the biological treatment system. Dual activated sludge tanks follow equilization, each with a capacity of 900,000 gallons. Normal flow of wastewater to each of the activated sludge tanks is 880 gpm (not including recycle). Bio-oxidation takes place with the help of 230 static aerators in each tank. Normal air flow is 5520 scfm. Maintenance of consistent quantity and quality wastewater enhances bio-oxidation by providing a stable environment where micro-organisms can thrive.

Following each activated sludge tank is a clarifier 80 feet in diameter and 13 feet deep. Wastewater is introduced into the clarifier through a center well 28 feet in diameter. Entrance through the center well reduces the velocity of the influent and creates a quiescent stage which allows for optimal settling of the solids. Polyelectrolyte can be added to enhance settling but Chevron was not adding these chemicals during the test period. Settled sludge in the clarifier contains micro-organisms which are valuable to the activated sludge process. Therefore some of the sludge is returned to the activated sludge tanks to maintain effective bio-oxidation. Excess sludge is directed to sludge thickening tank, the sludge digestor, and is then removed to the refinery landfarm.

Finished water from the clarifier is sent to the refinery forebay for discharge to Santa Monica Bay. The forebay is a large, buried tank with a volume of 634,000 gallons. The average flow of effluent from the forebay is 4500 gpm. Wastewater from both the segregated and unsegregated systems is discharged at this point.

3.3 UNSEGREGATED SYSTEM

The unsegregated system is comprised of the #2 API separator and the induced air flotation system (IAF). Four trunklines collect wastewater from different sections of the refinery and empty into the separator. The main contributors of wastewater to this system are cooling tower blowdowns, boiler blowdowns, pump gland flushwater, and stormwater. Overflow from the segregated system can also be directed to this separator. The unsegregated system is also shown in Figure 3-1.

The #2 separator is the largest separator at Chevron with a capacity of 2.05 million gallons. The normal flow of wastewater to this separator is 3000 gpm. Nominal residence time is 11 hours but this varies substantially due to short-circuiting of wastewater through the separator. Actual residence time of 3-4 hours are more realistic. The separator is divided into 5 sections; A, B, C, D, and E. Sections A, B, and C comprise only one-third of the total separator volume but remove the majority of the oil. From these sections, wastewater flows to section D and E through port holes and under curtain walls. Outfall from sections D and E enters a collection box where it is pumped to the IAF.

The #2 separator is completely covered with concrete panels. The joints are caulked and breather valves protect the roof against excessive vacuum or pressure. Any section of the separator can be taken out of service for repairs. Diversion boxes on each trunk allow wastewater to be diverted to the #4 separator should a major upset occur in the section of the refinery served by the trunkline. During the test, wastewater from one trunkline was being diverted to the segregated system.

The IAF was installed in 1981 as part of the refinery effluent compliance plan. The unit is a WEMCO Model 144X capable of treating a maximum of 5000 gpm of wastewater. At Chevron, average flow is approximately 3000 gpm but fluctuations can result, particularly following storms. An example of an IAF system is shown in Figure 3-2.

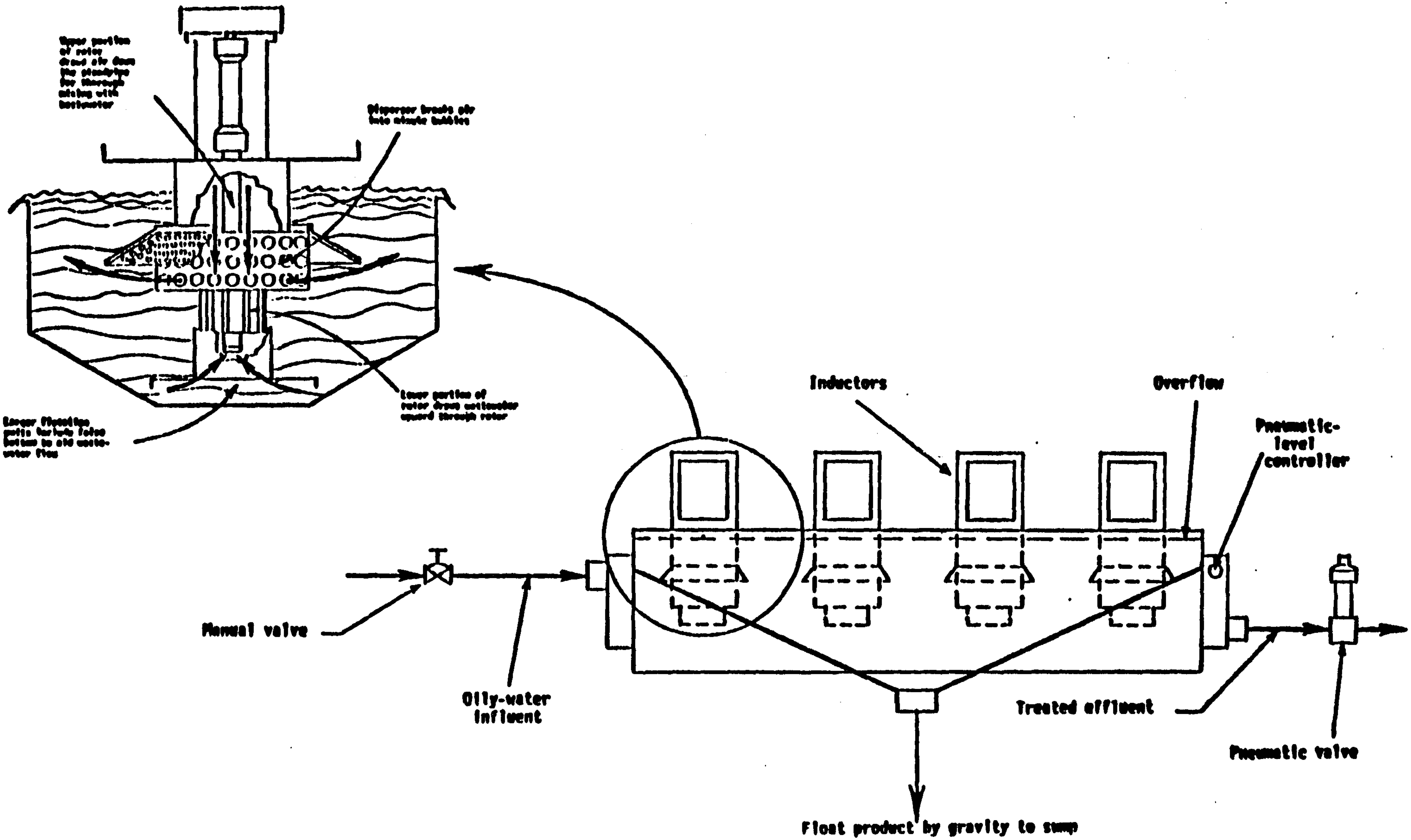


Figure 3-2. IAF system similar to that used at the Chevron Refinery - El Segundo, California.

The IAF was installed to remove insoluble wastewater contaminants such as oil, coke, catalyst fines, and precipitant metal. All forms of unsegregated water flow to the IAF with the exception of effluent from the #1 water treater which is low in insoluble contaminants. This wastestream is mixed with the effluent from the IAF and sent to the forebay for discharge.

Polyelectrolyte can be added to the IAF to enhance oil removal. By design, this addition would be made only if effluent oil concentrations were observed to be high. During the test period no chemical addition was necessary.

Final disposal of all refinery wastewater is through the forebay. As mentioned above, both segregated and unsegregated wastewaters converge at this point. The forebay was constructed in 1958 and is a buried concrete structure with a volume of 634,000 gallons. Average wastewater flow is 4,500 gpm with the nominal residence time being approximately 2 hours. If required, final oil skimming is performed at the forebay before discharge to the Santa Monica Bay.

3.4 WASTEWATER MONITORING SYSTEM

Chevron employs a wastewater monitoring system which is designed to detect process upsets as quickly as possible. Numerous sample points are located throughout the drain system and water from five primary sample points is collected each shift. Samples are analyzed for temperature, pH, sulfides, ammonia, phenols and oil concentration. There is one primary sample point located in each trunkline of the drain system. These sample points are designated SP-401 (segregated system), SP-201, SP-202, SP-203, and SP-204 (unsegregated system). If samples from any of the primary points exceed specification for a given parameter, further samples are taken in the trunkline to isolate the source of the upset. Remedial action to correct upsets may include diversion of an unsegregated trunkline to the segregated system or an increase in residence time for wastewater in tank T-190 preceding the ETP. Information acquired through the sampling program is reported each shift in the effluent turnover report.

Operating parameters and wastewater characteristics are also recorded for the various processes in the ETP and IAF systems. These are reported in the turnover report along with the information mentioned above. This allows Chevron to monitor NPDES compliance parameters on a regular basis.

3.5 ODOR CONTROL SYSTEM

Since the Chevron refinery is located in a densely populated area, efforts are made to control odorous air emissions. All facilities in the wastewater system that handle oily wastewater are provided with covers and in some cases, odor control devices are also used. Specific odor control techniques for the wastewater system will be discussed below.

3.5.1 IAF System

The WEMCO IAF is designed to be gas tight. There are eight access doors located on the unit and each door is gasketed and can be tightly sealed. Plant utility air can be introduced to the vapor space at the effluent end of the IAF. By design, the pressure of the utility air would be slightly greater than that found in the vapor space of the IAF. This would allow clean air makeup to be continually fed to the unit while accumulated hydrocarbons are forced out. The gaseous emissions are directed to two 55-gallon drums of activated carbon. During the test, only one drum was connected to the outlet pipe. The activated carbon drums are supplied by Calgon and hold 150 lbs of carbon. The estimated life span of a drum is four to six months.

After installing the IAF, Chevron evaluated the effectiveness of the odor control system. Because the hydrocarbon concentration in the IAF remained well below the lower explosive limit the use of utility air for purging was discontinued. This removed a potential source of odor problems and decreased maintenance of the carbon drums.

Additional odor control devices were used on equipment associated with the IAF. Activated carbon stacks were located on the roof of the clarifier and oily sludge sump. The clarifiers received oil skimmings and sludge from the IAF. Settled sludge was directed to sludge treatment facilities and any floating oil was recycled to the #2 API. The carbon stacks prevented any odors from being emitted from these tanks.

3.5.2 Effluent Treating Plant

Extensive odor control measures have been taken by Chevron in the ETP. The fuel tanks, flash mix tanks, and dissolved air flotation tanks are all covered with vapors vented to an activated carbon bed. A diagram of this system is shown in Figure 3-3.

The covers on the tanks in the ETP are not air tight but are provided with ventilation holes. The cover of each flash mix tank has three 3-inch diameter ventilation holes and 1 inspection door. The cover of each flocculation tank has ten 3-inch ventilation holes and three inspection doors. Further, the cover on each dissolved air flotation tank has 22 3-inch ventilation holes and three inspection doors. As shown in Figure 3-3, each tank is connected to the vapor recovery system by fiberglass reinforced piping. Two blowers (one operating, one 100 percent spare) rated at 4000 cfm create a vacuum within the system which draws VOC emissions and ventilation air from each tank. The approximate amounts of air drawn from each tank are shown in the figure. Ventilation air accounts for nearly 98 percent of the air flow to the carbon beds.

Before entering the carbon beds, air passes through demister pads to remove excess moisture and a preheater which can raise the air temperature 5-10°F. The preheater is a finned tube exchanger with plant steam used as the heat source.

There are two activated carbon beds which receive vapors from the flash mix, floc, and DAF tanks. Only one bed is on line at any time. The dimension of each carbon bed is 12'x12'x4' high. Activated carbon particles range from 1/16 to 3/16 inches in size. By design, the expected life of the activated carbon is four to five weeks. Carbon replacement times vary, however, since breakthrough at the beds is determined by odor detection. The primary purpose of the carbon beds is odor control, and therefore, the beds are only changed if significant odors are detected by the operators.

A similar odor control system is used on the equalization tank. The equalization tank has 13 8-inch ventilation holes located on one side of the basin. Eight outlet ports are located on the opposite side. Fiberglass reinforced piping connects the outlet ports to dual activated carbon beds identical to those described above. Two blowers (one operating, one 100 percent spare) rated at 4000 cfm create a vacuum which draws

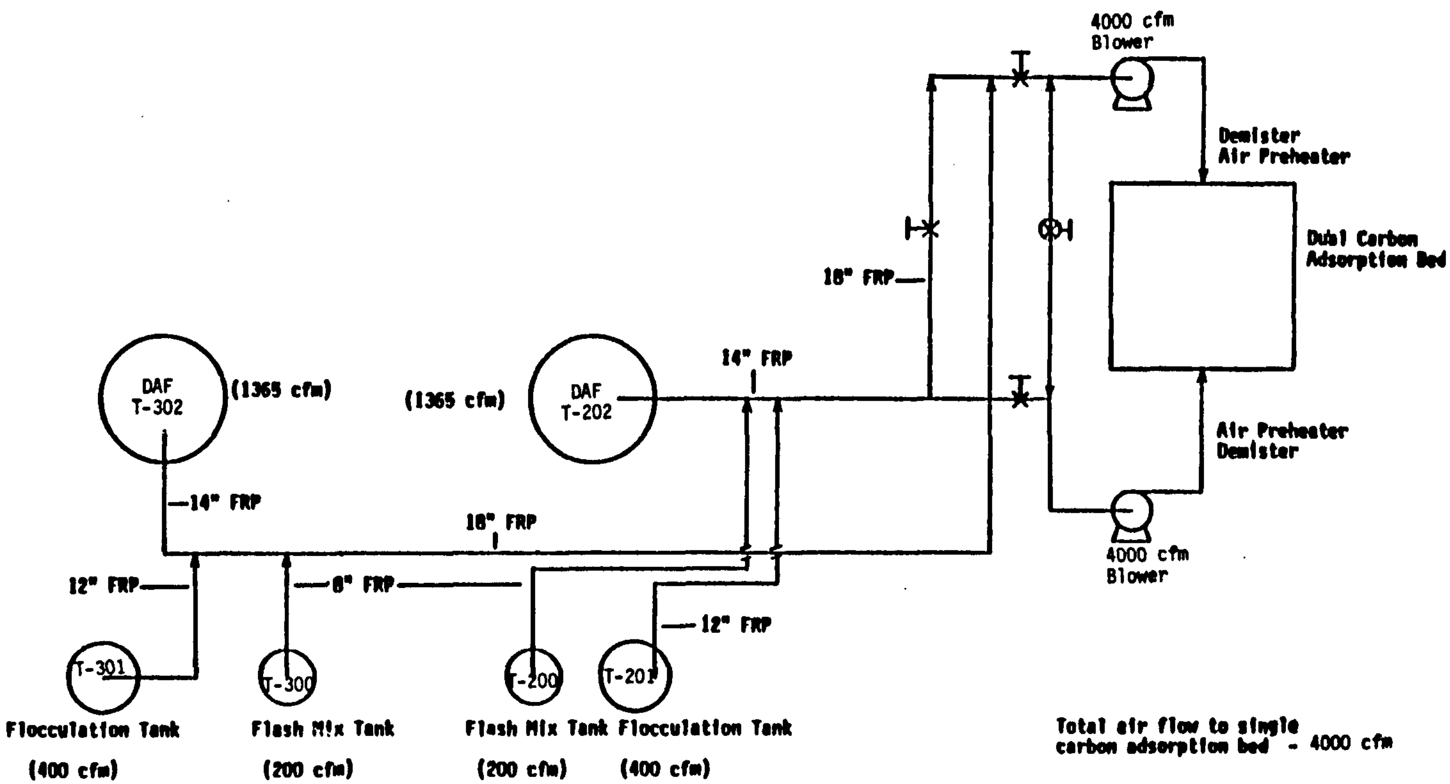


Figure 3-3. Odor control system for DAF system. FRP = fiberglass reinforced pipe. (Numbers in parenthesis indicate approximate air flow from each unit.)

vapors to the carbon beds. Operation of the carbon beds is the same as that described above. Only one bed is on line at a given time and carbon replacement is based on odor detection. The odor control system for the equalization tank is shown in Figure 3-3.

3.5.3 Process Upsets During Test

Gaseous VOC emissions from the DAF and equalization tanks were monitored during the test period. Monitoring ports were installed in the fiberglass reinforced piping which carried the gaseous vents of these tanks to the activated carbon beds. Gaseous emissions from the floc tanks and flash mix tanks added a small quantity of flow to that being drawn from the DAF. Only one DAF train was in operation during the test. However, the blowers were still drawing flow from the DAF train not in service. Flow measurements established that the out of service train was having no effect on the flow of gases from the operating DAF.

Process upsets could be monitored with the assistance of the wastewater treatment plant operators at Chevron. Normal operating practice called for process unit operators to inform the treatment plant when an upset had occurred in the plant. An upset would include any event which could potentially disrupt the biological treatment processes or result in a failure to meet NPDES requirements. Examples of upsets include excessive acidic or caustic wastewater entering the drain system, or sudden surges of oily wastewater.

Due to the design of the effluent treating plant, most process upsets are easily controlled. Tank T-190 serves to equalize the quantity and quality of wastewater flowing to the ETP. Therefore, the influent wastewater to the DAF remains relatively constant. A few minor process irregularities were reported during the testing period but little, if any, change was observed in the VOC concentration of the DAF vent.

Operational practices of the DAF did result in abrupt changes in gaseous VOC emissions as recorded by the continuous monitoring equipment. As discussed earlier, the skimmer mechanism was operated only intermittently. Because of this, an oil film was allowed to build up on the surface of the flotation chamber. This oil film acted to suppress VOC emissions from the unit. When the skimmer was turned on, the oil film was removed and VOC were released into the vapor space of the flotation chamber. The continuous monitoring equipment recorded a sudden increase in VOC concentration which gradually reached a maximum level. When the skimmer was shut down, VOC concentrations returned to the level observed before skimming.

Tables 3-2 and 3-3 summarize the major parameters characterizing wastewater flow to and from the DAF and IAF systems. The data given were acquired from the refinery effluent turnover reports compiled during each shift by Chevron operators. For the DAF (Table 3-2), fluctuations in influent waste quantity, temperature, pH, and oil concentration was observed. The quantity of wastewater flowing to the DAF varied from 1400 gpm to 2000 gpm. Temperature of the influent wastewater ranged from 72°F to 96°F while pH valued ranged from 8.1 to 10.8. In most cases, the changes in these parameters were gradual over time. These fluctuations had little effect on the VOC concentrations recorded by the continuous monitoring equipment.

Influent oil concentrations exhibited a wide range. The lowest concentration recorded was 47 mg/l and the highest concentration was 420 mg/l. The fact that measurements for oil concentration are instantaneous measurements could account for the wide range observed.

Table 3-3 summarizes the parameters characterizing wastewater flow to and from the IAF. Influent flow rates ranged from 800 gpm to 3780 gpm. The recording device that measures flow to the IAF was malfunctioning during the test and the flow rates given are based on the estimated effluent from the #2 API separator. Wastewater temperatures ranged from 90°F to 106°F. This temperature range is higher than that for DAF. The DAF inlet temperatures would be expected to be lower because of the effect of Tank T-190 which acts as a holding tank.

Influent oil concentrations to the IAF ranged from 12 mg/l to 60 mg/l. These low concentrations would be expected since the IAF handles relatively non-oily wastewater. As with the concentration observed in the DAF influent, the range of concentrations observed may be due in part to sampling techniques.

Table 3-2. SUMMARY OF REFINERY EFFLUENT SYSTEM TURNOVER - DISSOLVED AIR FLOTATION SYSTEM

Date	Shift	#4 API effluent oil (mg/l)	DAF influent GPM	°F	pH	DAF influent oil (mg/l)	DAF effluent oil (mg/l)	Recycle rate (GPM)	Dissolved air (CFM)
7-25	1	220	1600	92	8.6	410	115	530	1.5
	2	240	2800	93	8.9	205	110	525	1.5
	3	98	1800	88	9.3	190	90	530	1.6
7-26	1	120	1800	87	9.2	213	135	540	1.3
	2	290	1900	92	9.3	175	110	530	1.5
	3	79	1800	86	9.6	180	110	540	1.6
7-27	1	210	1900	87	9.2	100	15	540	1.3
	2	---	1800	92	9.2	160	110	540	1.5
	3	48	2000	88	9.3	260	30	520	1.8
7-28	1	110	1900	88	9.3	200	20	530	1.5
	2	240	1600	93	9.6	240	95	530	1.5
	3	200	1600	75	9.5	250	50	550	1.5
7-29	1	300	1500	89	9.4	300	60	530	1.4
	2	270	1600	95	9.8	250	20	530	1.5
	3	260	1600	75	9.9	310	200	550	1.5
7-30	1	---	---	---	---	---	---	---	---
	2	71	2000	90	8.9	110	40	540	1.6
	3	220	2000	91	8.7	240	150	540	1.7
7-31	1	210	2000	91	8.6	260	140	540	1.7
	2	93	2000	95	8.6	180	80	---	---
	3	210	1800	75	8.5	260	150	550	1.5
8-1	1	320	1800	89	8.9	180	85	520	1.5
	2	125	1900	94	8.9	190	88	540	1.6
	3	260	2000	90	8.8	180	94	530	1.5
8-2	1	160	1600	88	8.8	47	43	520	1.5
	2	210	1800	93	9.4	280	95	530	1.6
	3	120	1800	88	9.9	320	78	530	1.5
8-3	1	120	1900	88	9.4	120	29	520	1.5
	2	175	1900	93	9.4	210	0	530	1.6
	3	90	2000	87	9.5	260	38	530	1.5
8-4	1	130	1900	90	9.1	140	54	520	1.5
	2	260	2000	75	10.1	330	210	525	1.5
	3	100	2000	88	10.8	76	50	520	1.5

(continued)

Table 3-2. Concluded

Date	Shift	#4 API effluent oil (mg/l)	DAF influent GPM	°F	pH	DAF influent oil (mg/l)	DAF effluent oil (mg/l)	Recycle rate (GPM)	dissolved air (CFM)
8-5	1	130	1900	90	9.0	86	19	520	1.5
	2	200	1900	78	9.0	190	100	525	1.5
	3	90	2000	85	9.3	106	31	520	1.5
8-6	1	180	2000	94	9.0	150	71	530	1.6
	2	280	2000	78	8.6	220	110	525	1.5
	3	110	2000	85	8.6	94	42	530	1.5
8-7	1	100	2000	96	8.3	180	88	530	1.6
	2	260	2000	75	8.1	210	160	525	1.5
	3	83	1600	92	8.3	260	110	530	1.6
8-8	1	89	1600	95	8.3	140	110	530	1.6
	2	180	1600	72	8.2	190	100	525	1.5
	3	180	1400	91	9.0	100	34	520	1.5
8-9	1	120	1400	95	8.5	120	44	520	1.6
	2	120	1600	88	8.2	400	68	530	1.6
	3	---	1800	89	8.4	290	50	510	1.5
8-10	1	68	1800	94	8.5	130	64	520	1.6
	2	240	1800	87	8.5	55	24	510	1.5
	3	200	1800	91	8.6	57	23	520	1.5
8-11	1	160	1800	75	9.1	70	65	525	1.5
	2	270	2000	89	8.8	420	31	520	1.4

Table 3-3. SUMMARY OF REFINERY EFFLUENT SYSTEM TURNOVER--INDUCED AIR FLOTATION SYSTEM

Date	Shift	#2 API effluent (IAF feed - GPM)	°F	IAF influent oil (mg/l)	IAF effluent oil (mg/l)
7-25	1	800	90	21	---
	2	2520	106	25	8
	3	2200	94	19	10
7-26	1	3060	104	26	---
	2	2900	102	22	16
	3	2600	95	30	10
7-27	1	2180	100	50	20
	2	2200	102	20	5
	3	2400	96	30	10
7-28	1	1700	100	60	5
	2	2480	98	30	0
	3	3140	96	---	10
7-29	1	3380	101	30	5
	2	3600	102	---	---
	3	2320	104	28	18
7-30	1	---	---	---	---
	2	3040	107	22	10
	3	2400	102	25	16
7-31	1	4080	100	21	16
	2	2800	100	---	---
	3	2600	99	22	15

(continued)

Table 3-3. Continued

Date	Shift	#2 API effluent (IAF feed - GPM)	°F	IAF influent oil (mg/l)	IAF effluent oil (mg/l)
8-1	1	2840	100	22	8
	2	---	96	18	9
	3	2400	100	---	18
8-2	1	2960	99	25	19
	2	2600	97	24	10
	3	2680	97	18	12
8-3	1	2500	98	20	0
	2	2780	98	21	9
	3	2320	97	18	14
8-4	1	2260	98	22	12
	2	2480	99	25	19
	3	---	95	20	14
8-5	1	2900	98	24	12
	2	2740	99	24	17
	3	2000	98	18	10
8-6	1	2880	98	31	9
	2	3600	98	25	16
	3	3200	94	12	7
8-7	1	2160	95	23	9
	2	2800	95	24	---
	3	2560	95	19	7
8-8	1	2400	96	13	8
	2	2400	94	---	11
	3	2600	92	30	18

(continued)

Table 3-3. Concluded

Date	Shift	#2 API effluent (IAF feed - GPM)	°F	IAF influent oil (mg/l)	IAF effluent oil (mg/l)
8-9	1	1800	93	21	7
	2	2400	90	18	12
	3	2360	94	24	15
8-10	1	2200	96	20	10
	2	2600	96	29	17
	3	2200	100	28	14
8-11	1	2200	100	25	17
	2	1280	96	25	8
	3	---	---	---	---

4. LOCATION OF SAMPLE POINTS

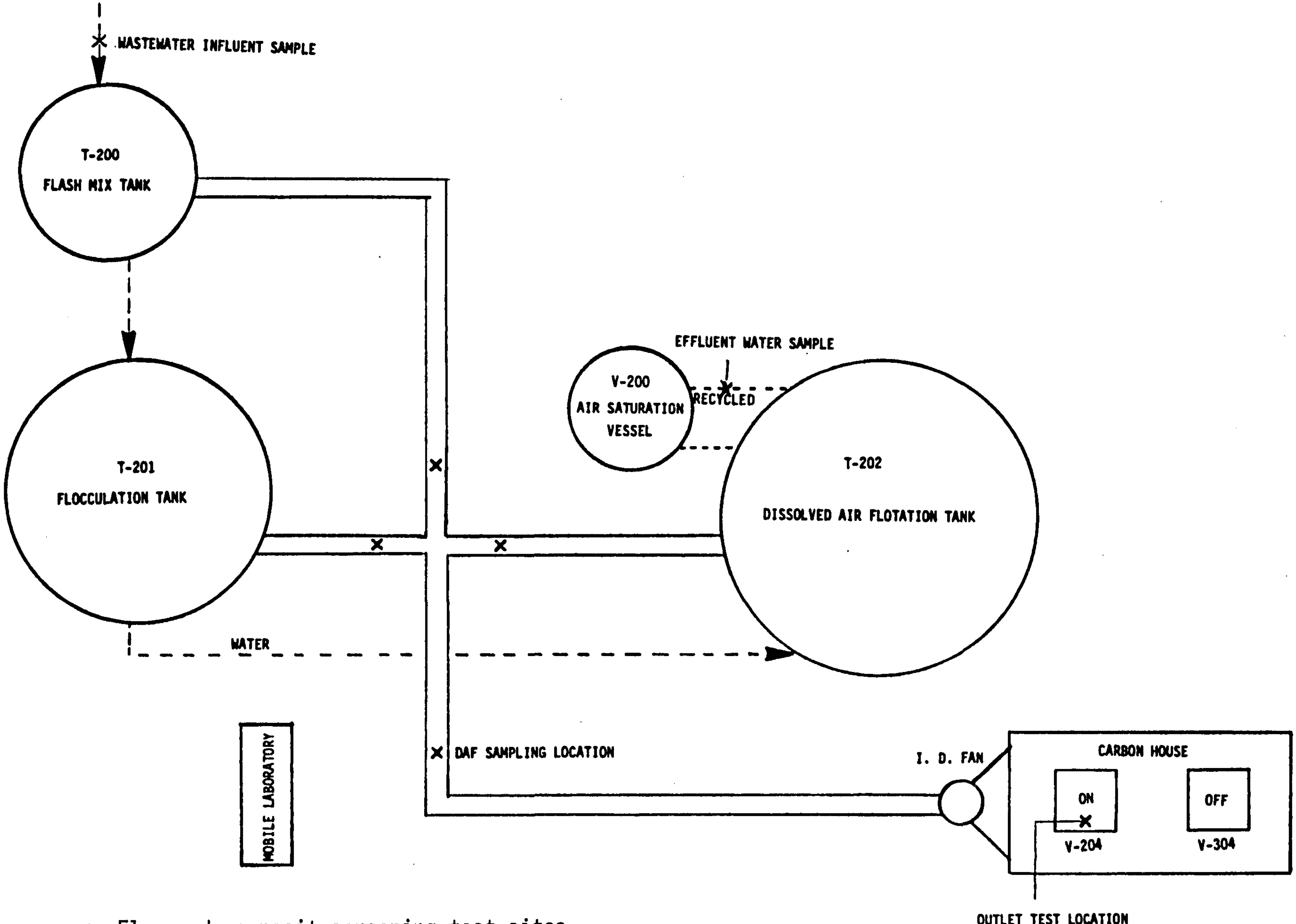
The gaseous and water sampling locations during testing at the Effluent Treatment Plant serving the segregated waste waters are shown in Figures 4-1 and 4-3.

The sample location for the combined ventilation air from the dissolved air flotaton unit was located in a horizontal run of nominal 18-inch fiberglass pipe. The pipe was fitted with two 1-inch ports at 90° orientation for velocity traverses. The ports were located more than eight pipe diameters downstream and more than two diameters upstream of a disturbance. The location of velocity measurement points in the flow crossection at this site are shown in Figure 4-2. The duct was also equipped with a separate one-inch port within one foot of the flow measurement plane for access for collection of gaseous samples.

The test locations for estimating the flow contribution to the total ventilation air from the DAF tank, the flocculation tank, and the mix tank were located in horizontal runs of fiberglass pipe. Access to the flow stream was through ¼-inch fittings installed as pressure taps for process flow meters. These locations were usually near bends in the duct work and were not ideal flow measurement sites. The gas velocity was measured at a "typical" or average point in the crossection. Gas samples were extracted through the same fittings.

The test site for the ventilation air from the equilization tank was in a horizontal run of 24-inch fiberglass pipe. Two ports at 90° orientation were installed for velocity measurement at a location more than two diameters upstream of a disturbances. The points on the area crossection used for velocity measurements are shown in Figure 4-4.

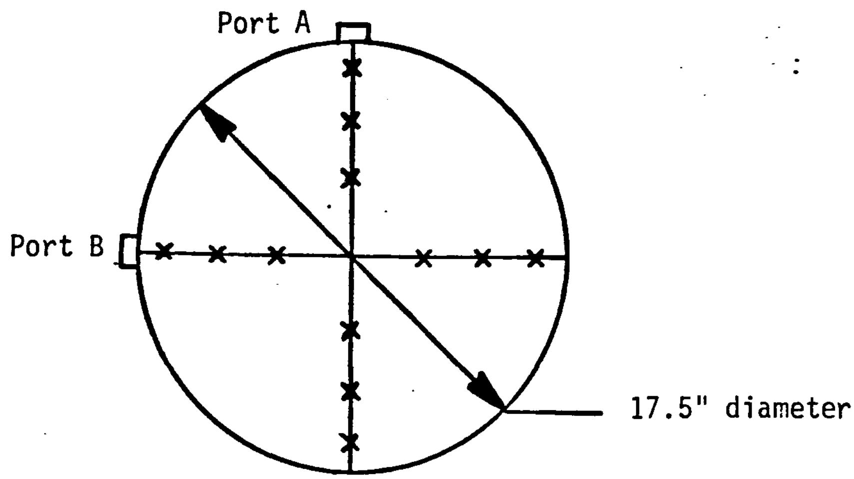
The water sampling sites during these tests were the influent and effluent of the DAF system, the effluent from the equilization tank and the #4 API separator forebay. The DAF influent was obtained from a sampling tap installed in the feed line from T-190 to the T-200 mix



× – Flow and composit screening test sites

Figure 4-1. Dissolved air flotation treatment system at Chevron Refinery - El Segundo, California.

DAF OUTLET



Traverse Point Number	Distance from Sample Port, Inches
1	0.7
2	2.5
3	5.2
4	12.3
5	14.9
6	16.7

Figure 4-2. DAF outlet sample location with traverse points.

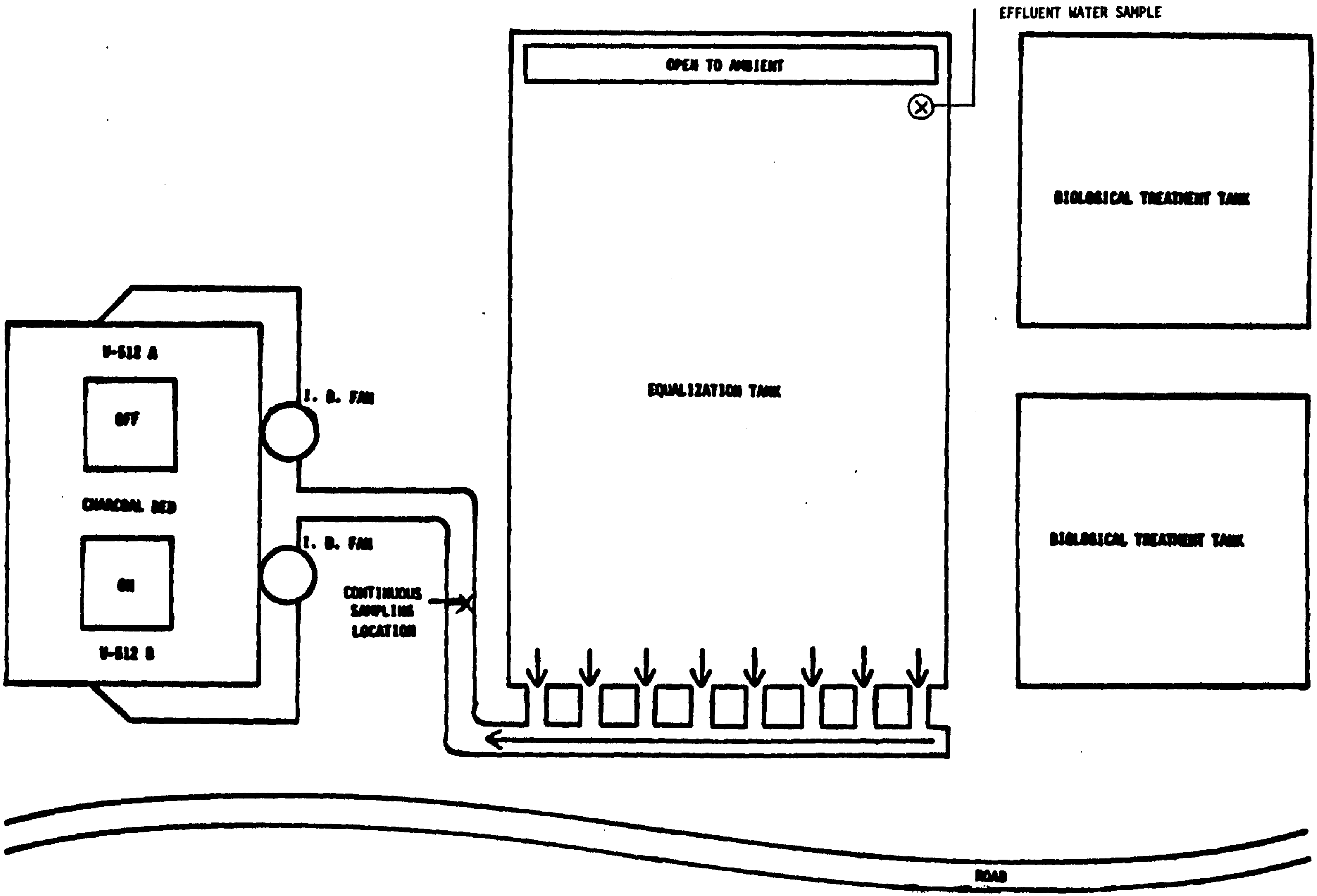
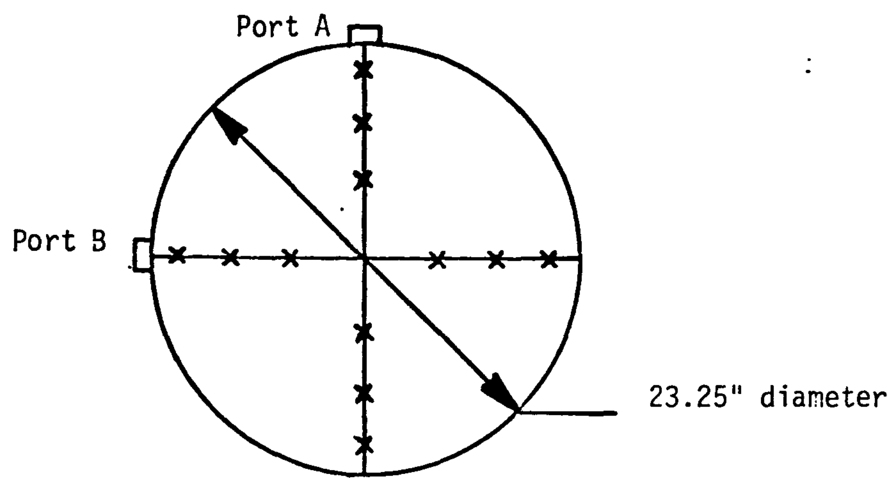


Figure 4-3. Equalization tank system at Chevron Refinery - El Segundo, California.

EQUALIZATION TANK OUTLET



Traverse Point Number	Distance from Sample Port, Inches
1	1.0
2	3.4
3	6.9
4	16.4
5	19.8
6	22.2

Figure 4-4. Equalization tank outlet sample location with traverse points.

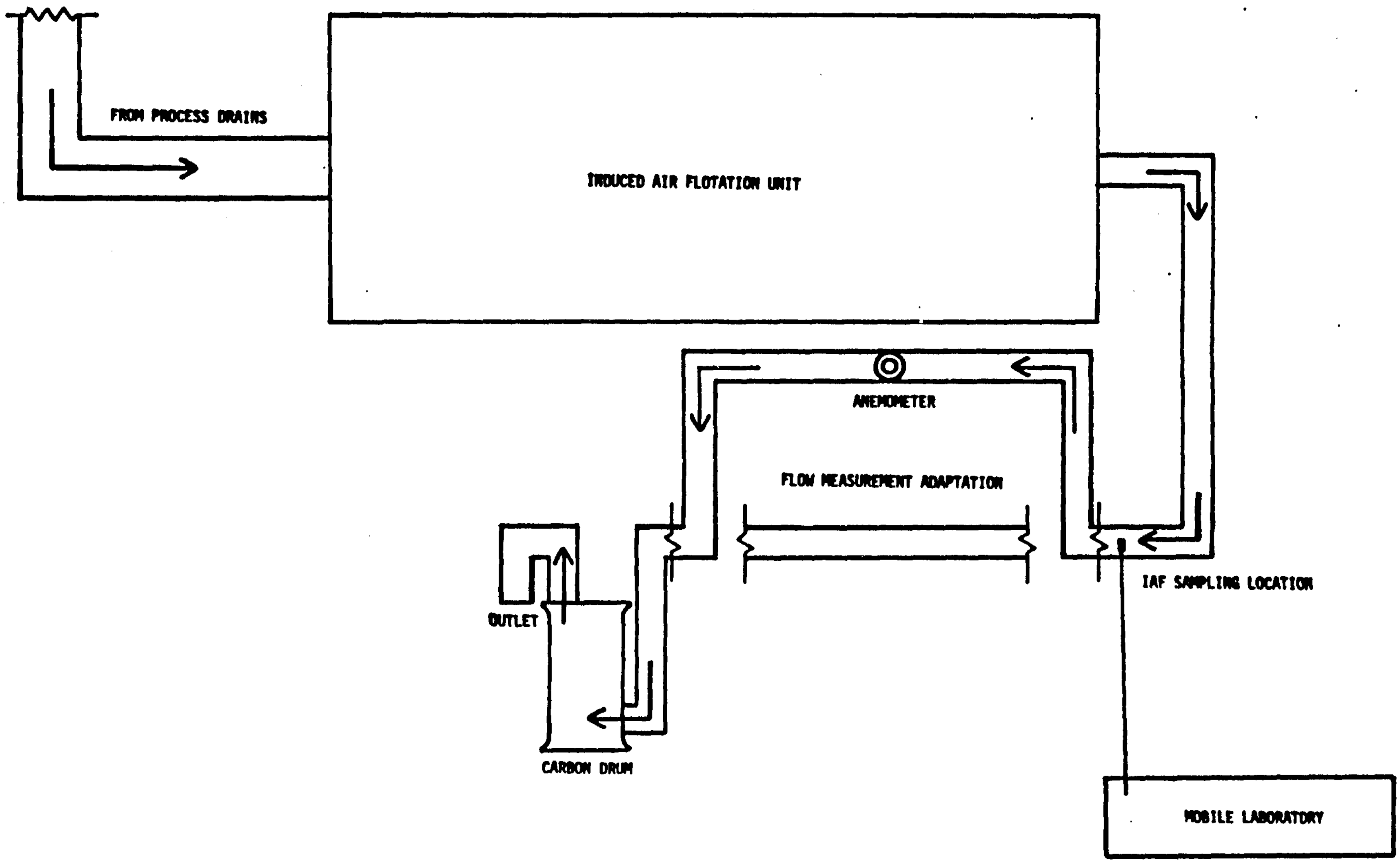


Figure 4-5. IAF treatment system at Chevron Refinery - El Segundo, California.

tank. The DAF effluent sample was obtained from a sampling tap in the recycle pump discharge. The equalization basin effluent and API influent samples were obtained by dipping a grab sample from the overflow sump and forebay, respectively.

The sampling location after the carbon absorption control devices was at the exit crossection to the atmosphere. The carbon house exhausts through a rectangular opening on the roof of the building. The sample collection probe was positioned near the center of the opening, or at the downwind portion if prevailing wind conditions caused turbulence at the leading edge.

The sample location for measurement of ventilation air from the IAF was at the vent line to the carbon drums. This line was a two-inch plastic pipe. The total flow in this line was routed through a volume measurement meter. Samples for determination of gaseous components were extracted through a ½-inch hole in the meter housing duct.

Influent and effluent water samples were collected from the sampling stations used by Chevron at the IAF inlet and outlet. Water samples at the #2 API separator were collected at three separate forebays by dipping a grab sample.

5. SAMPLING AND ANALYTICAL PROCEDURES

The sampling and analytical procedures used to evaluate the gaseous and liquid streams are presented in this section. The methodologies are discussed separately as gaseous VOC methods (5.1), fixed gas analysis (5.2), gas flow measurement (5.3), liquid sampling (5.4), and liguid sample analysis (5.5).

5.1 GASEOUS VOC METHODS

Two procedures were used to measure the VOC content of the gaseous streams. EPA Method 18 was used to determine the general VOC species in the samples, and a procedure similiar to EPA Method 25A was used to measure the equivalent total hydrocarbon content of the streams.

5.1.1 EPA Method 18

"EPA Method 18. Measurement of Gaseous Organic Compound Emissions by Gas Chromotography", (promulgated October 18, 1983, Federal Register 48 FR 48328) was used to characterize the organic components in the streams tested. Samples were collected using the integrated bag technique of Method 18. Figure 5-1 illustrates the apparatus.

A clean 2.5 cubic foot TEDLAR® flexible bag was used for each run. The bags were cleaned by filling with dry nitrogen and venting the bag contents to the atmosphere until no background organics were detected by the analysis system. Prior to sampling the sampling apparatus and flexible bag were leak checked by evacuating each to 29" Hg vacuum and monitoring the pressure for 10 minutes. If a change of less than 1" Hg is observed, the components are judged leak-free. The sample probe, sample connecting tubing, and the sample bag were operated at ambient temperature. To prepare for sampling the vacuum source can was evacuated to -29" Hg. The system was then assembled and the sample probe was placed near the centroid of the duct to be sampled. Sampling was

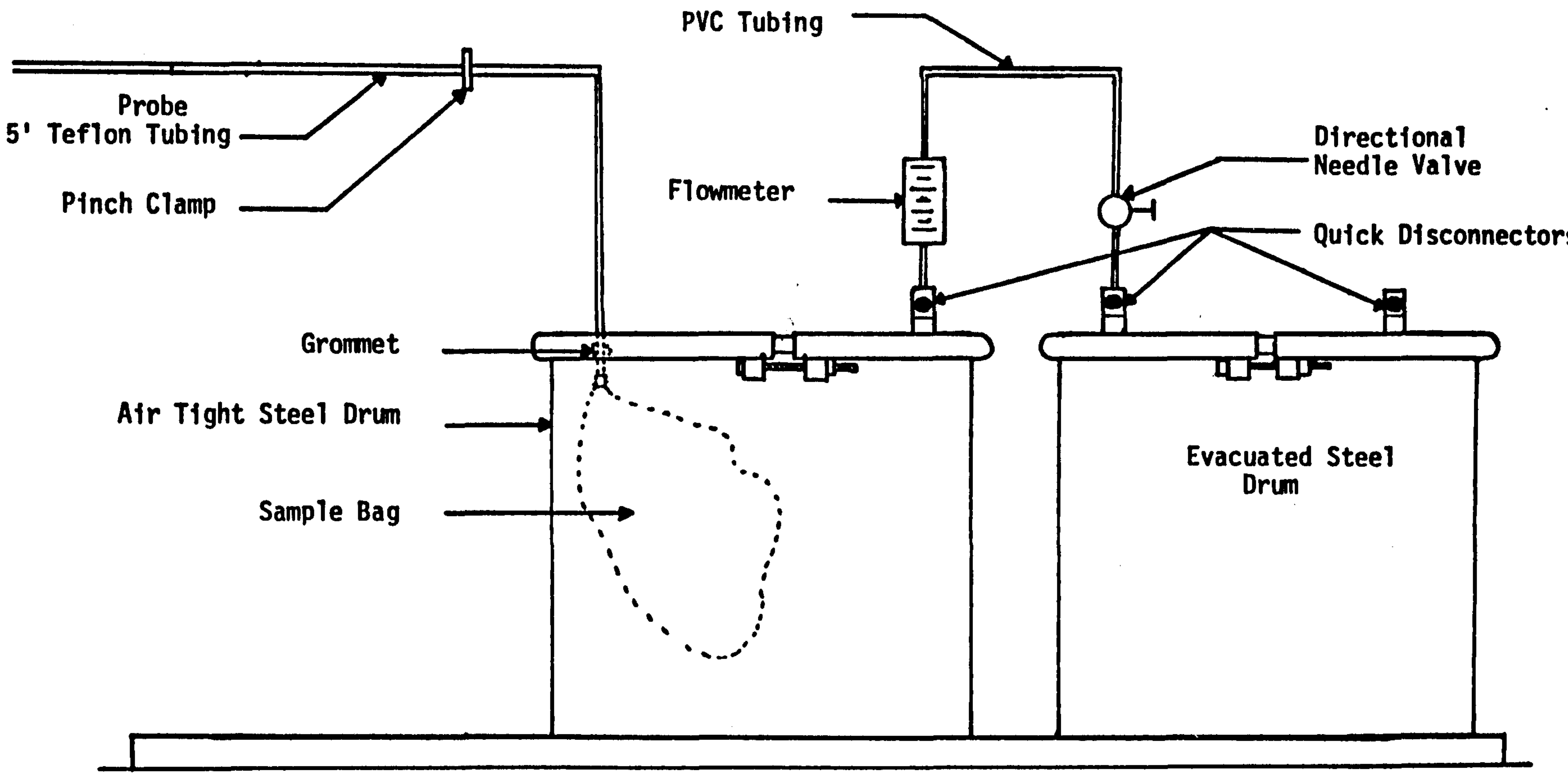


Figure 5-1. Gas bag sampling system.

started by opening the flow control valve and was maintained at a constant rate using the rotameter for about one hour. At the end of the sampling period, the flow valve was closed, the probe was disconnected, and the bag inlet was sealed. The sample bag was transported to the on-site mobile laboratory for analysis.

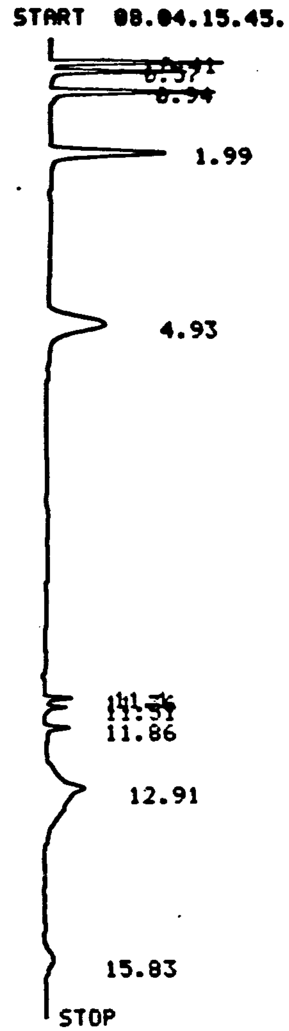
Two gas chromatograph systems with flame ionization detectors were used to analyze each sample. One system was used to separate and quantify low molecular weight parafins and olefins while the other system was used to measure aromatics and higher molecular weight components.

The system used to measure low molecular weight compounds (termed C_1-C_5 components) was a Shimadzu GC Mini 1 with a Shimadzu Chromatopac digital integrator/recorder. The operating parameters were:

- Column: 6 ft x 1/8 in. I.D. stainless steel.
- Column support: Poracil C.
- Column temperature/program: 35°C/constant.
- Sample loop size/temperature: 1 ml/ambient.
- Carrier gas/flow: He/50 ml/min.

A calibration gas mixture containing known concentrations of methane, (15.1 ppm) ethane (14.6 ppm), propane (15.6 ppm), butane (15.2 ppm), and pentane (15.6 ppm) in nitrogen was used to obtain a area factor and retention time for each of these compounds. Figure 5-2 presents an example of a GC/FID calibration run for C_1-C_5 speciation. During sample analysis, the peaks near these retention times were grouped as the nearest carbon number, and the concentration was calculated using the corresponding calibration factor for that carbon number. Figures 5-3 to 5-5 present examples of GC/FID analysis runs for C_1-C_5 speciation at each sample location.

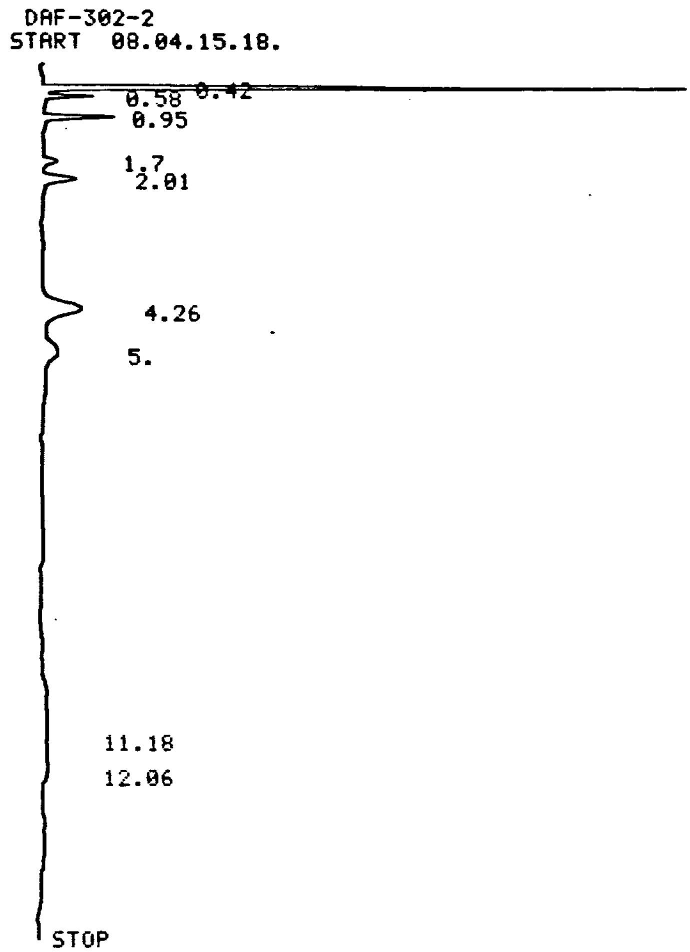
The GC/FID analysis example run for C_1-C_5 speciation (Figure 5-4) provides an illustration of problems with inconsistencies in the analytical procedures. Standards were not available to provide elution time standards for the 18 peaks identified by the GC/FID with areas. Therefore, the total organic concentration from the analysis was a sum of all the peaks and not just the identified peaks. Another problem was the slight variance of the elution time during the test day. The operator justified



C-R1A
SMPL # 00
FILE # 7
REPT # 31
METHOD 44

#	NAME	TIME	CONC	MK	AREA
1	METH	0.41	0		867
2	ETHA	0.57	0	V	632
3	PROP	0.94	0		957
		1.99			1202
		4.93			1461
		11.1			71
		11.36		V	164
		11.51		V	130
		11.86			147
		12.91			1730
6	HEXA	15.83	0		281
	TOTAL		0		7647

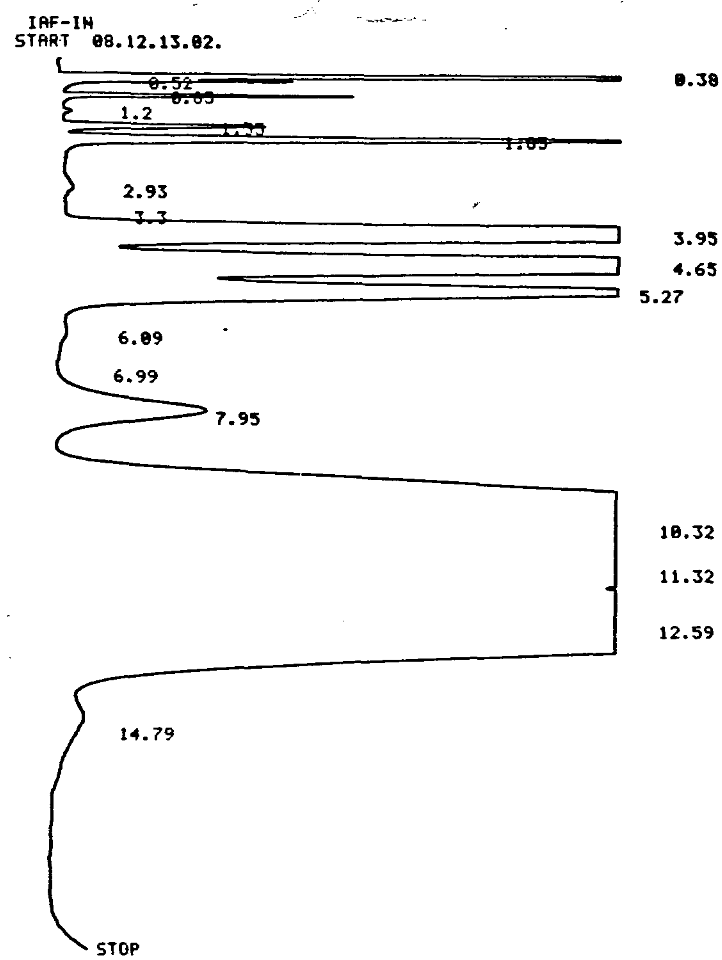
Figure 5-2. Example of GC/FID calibration for C_1-C_5 speciation.



C-R1A
SMPL # 00
FILE # 7
REPT # 30
METHOD 44

#	NAME	TIME	CONC	MK	AREA
1	METH	0.42	0		2668
2	ETHA	0.58	0	V	244
3	PROP	0.95	0	V	389
		1.7			139
		2.01			339
		4.26			823
		5.		V	370
		11.18			158
		12.06		V	225
	TOTAL		0		5358

Figure 5-3. Example of GC/FID analysis on DAF ventilation air - gas bag sample for C_1-C_5 speciation.

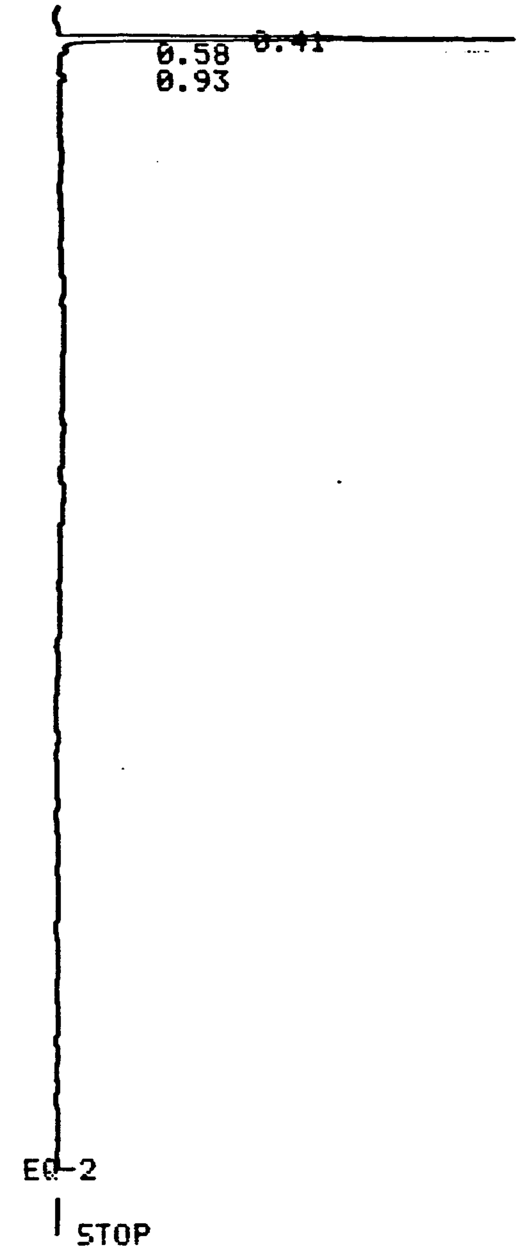


C-R1A
SMPL # 00
FILE # 7
REPT # 109
METHOD 44

#	NAME	TIME	CONC	MK	AREA
1	METH	0.38	0		119387 – C1
2	ETHA	0.52	0	T	504 – C2
		0.85		T	1864 – C3
		1.2		T	78
		1.55		T	2214
		1.85		TV	8467 – C4
		2.93			270
		3.3			60
		3.95		V	69883
		4.65		V	69964 – C5
5	PENT	5.27	0	V	26065
5	PENT	6.09	0	V	394
		6.99			31
		7.95		V	9734
		10.32		V	142835
		11.32		V	194904
		12.59		V	183987 – C6
6	HEXA	14.79	0	T	1475
	TOTAL		0		832124

Figure 5-4. Example of GC/FID analysis on IAF ventilation air - gas bag sample for C_1-C_5 speciation.

EQ-2
START 08.04.16.17.



C-R1A
SMPL # 00
FILE # 7
REPT # 32
METHOD 44

#	NAME	TIME	CONC	MK	AREA
1	METH	0.41	0		1491
2	ETHA	0.58	0	T	12
3	PROP	0.93	0		27
	TOTAL		0		1531

Figure 5-5. Example of GC/FID analysis on equalization tank - gas bag #2 sample for C_1-C_5 speciation.

the difference from the Chromatopac peak labels and the operator notes (see Figure 5-4) as the temperature differential in the field laboratory across a test day.

The system used to measure aromatic and higher molecular weight compounds (termed semi-volatile) was a Shimadzu GC Mini II equipped with a Shimadzu Chromatopac integrator. The operating parameters were:

- Column: 6 ft x 1/8 in. I.D. stainless steel.
- Column support: OV-1 on 80/100 Supelco.
- Column temperature/program: 25°C/constant.
- Sample loop size/temperature: 1 ml/225°C.
- Carrier gas/flow: He/20 ml/min.

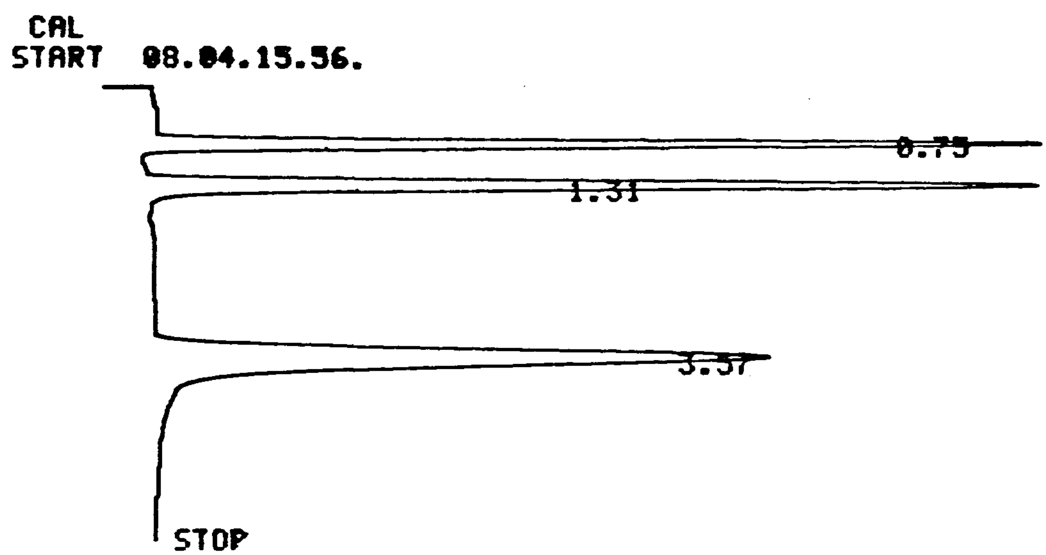
A calibration mixture of 49.8 ppm benzene and 49.9 ppm m-xylene in nitrogen was used to determine calibration factors and retention times for these two compounds. Qualitative gaseous standards were prepared from liquid hexane, heptane and toluene were used to determine the retention time for these compounds. Figure 5-6 presents an example of a GC/FID calibration run for C_6-C_9 speciation. During sample analysis, hexane, heptane, benzene and toluene were expressed as equivalent benzene concentrations and C_8 and higher components were expressed as m-xylene equivalent concentrations. Figures 5-7 to 5-9 present examples of GC/FID analysis runs for C_6-C_9 speciation at each sample location.

5.1.2 EPA Method 25A

Procedures similiar to those described in EPA Method 25A (Federal Register 48 FR 37595) were used to continuously measure the total hydrocarbon concentration in the gaseous streams tested. Two Beckman Model 400 and one Beckman Model 402 flame ionization analyzers were used at the respective sample locations. The sample probes were placed near the centroid of the duct to be sampled. A continuous sample flow was maintained through heated Teflon® sampling lines. The instrument operating parameters were:

Site: DAF ventilation and carbon house

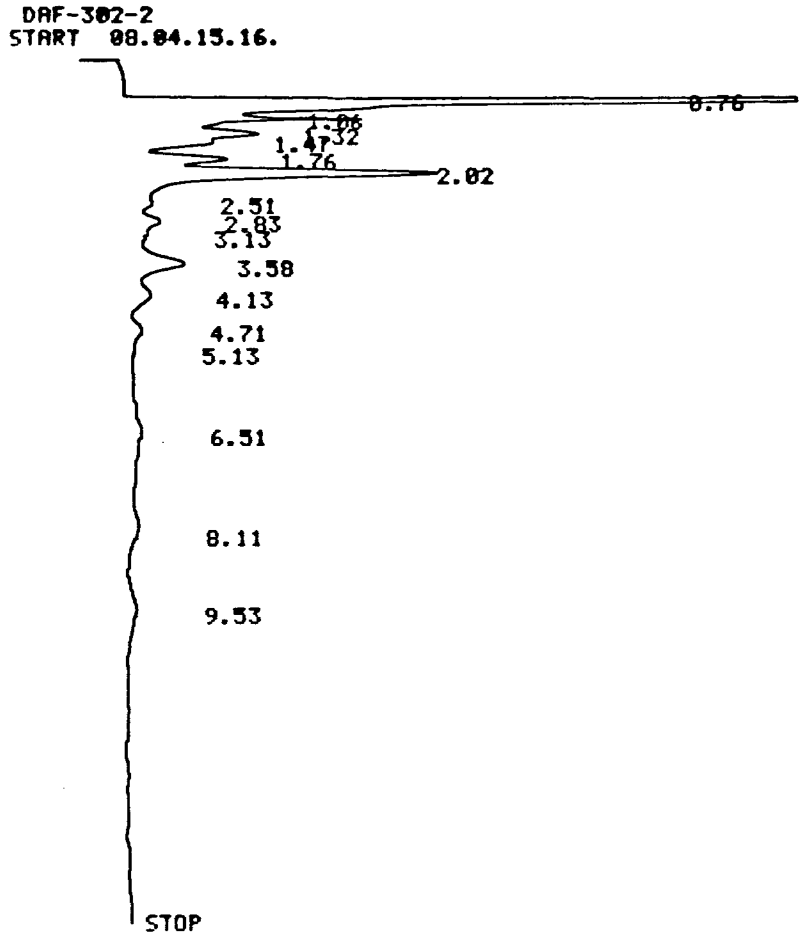
- Analyzer: Beckman Model 400.
- Serial #: 100216 and 1001826.



C-R1A
SMPL # 00
FILE # 2
REPT # 130
METHOD 44

#	NAME	TIME	CONC	MK	AREA
1	C1-C5	0.75	0		6515
3	BENZ	1.31	0		7935
6	-M XYL	3.57	0		10798
	TOTAL		0		25249

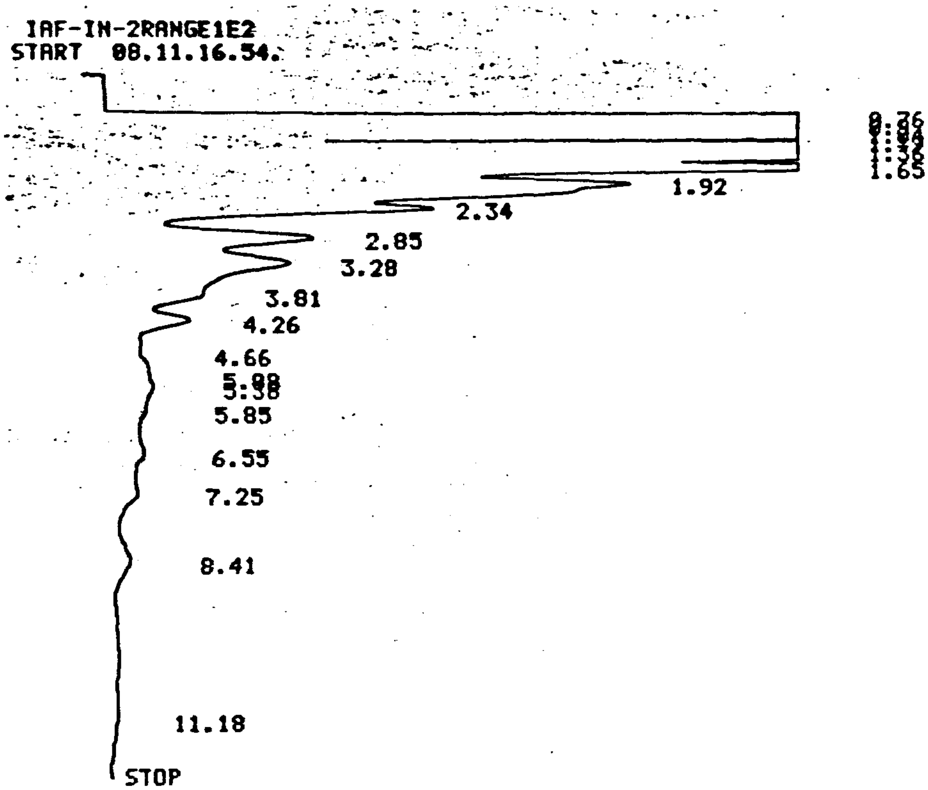
Figure 5-6. Example of GC/FID calibration for C_6-C_9 speciation.



C-R1A
SMPL # 00
FILE # 2
REPT # 128
METHOD 44

#	NAME	TIME	CONC	MK	AREA
1	C1-C5	0.76	0		10824
2	HEXA	1.06	0	V	2355
3	BENZ	1.32	0	V	2076
4	HEPT	1.47	0	V	1061
		1.76		V	1490
5	TOLU	2.02	0	V	5242
		2.51		V	466
		2.83		V	731
		3.13		V	321
6	-M XYL	3.58	0	V	1642
7	ODXYL	4.13	0	V	635
		4.71		V	281
		5.13		V	31
		6.51			115
		8.11			192
		9.53			71
	TOTAL		0		27542

Figure 5-7. Example of GC/FID analysis on DAF ventilation air - gas bag sample for C_6-C_9 speciation.

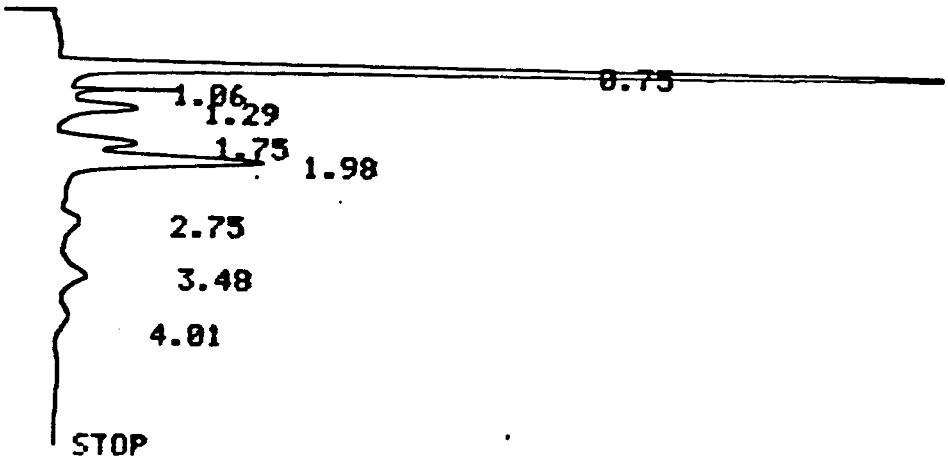


C-R1A
SMPL # 08
FILE # 2
REPT # 208
METHOD 44

#	NAME	TIME	CONC	MK	AREA
1	C1-C5	0.76	0		12853
		0.9		V	17628
2	HEXA	1.04	0	V	61568
		1.19		V	11532
3	BENZ	1.36	0	V	41149
4	HEPT	1.65	0	V	14933
		1.92		V	16229
		2.34		V	6116
		2.85		V	5604
		3.28		V	8173
6	-M XYL	3.81	0	V	2027
7	ODXYL	4.26	0	V	2411
		4.66		V	730
		5.08		V	1342
		5.38		V	1754
		5.85		V	869
		6.55		V	1875
		7.25		V	1602
		8.41		V	1054
		11.18		V	654
	TOTAL		0		210114

Figure 5-8. Example of GC/FID analysis on IAF ventilation air - gas bag sample for C_6-C_9 speciation.

EQ-2
START 08.04.16.32.



C-R1A
SMPL # 00
FILE # 2
REPT # 132
METHOD 44

#	NAME	TIME	CONC	MK	AREA
1	C1-C5	0.75	0		6197
2	HEXA	1.06	0	V	331
3	BENZ	1.29	0	V	781
		1.75			763
5	TOLU	1.98	0	V	2171
		2.75			255
		3.48			353
		4.01			146
	TOTAL		0		11001

Figure 5-9. Example of GC/FID analysis on equalization tank #2 gas bag sample for C_6-C_9 speciation.

- Fuel Pressure: 22 PSI.
- Sample Pressure: 3.0 PSI.
- Air Pressure: 15 PSI.
- Sample line length/approximate temperature: 25 feet/ambient.

Site: Equalization tank and carbon house

- Analyzer: Beckman Model 402.
- Serial #: 1001303.
- Fuel Pressure: 25 PSI.
- Sample Pressure: 3.0 PSI.
- Air Pressure: 16 PSI.
- Sample line length/approximate temperature: 25 feet/ambient.

Site: IAF ventilation air and carbon drum

- Analyzer: Beckman Model 402.
- Serial #: 1001303.
- Fuel Pressure: 25 PSI.
- Sample Pressure: 3.0 PSI.
- Air Pressure: 16 PSI.
- Sample line length/approximate temperature: 25 feet/ambient.

The sampling period varied among the separate sites tested. However, during the duration of sampling at a site, the analyzer were operated continuously 24-hours per day. The analyzers were equipped with strip chart recorders for data reduction. The instruments were calibrated with compressed gas standards of propane in a balance of air.

The calibration gas standards were supplied by Scott Speciality Gases and certified to within ±2 percent of the labeled calibration gas values. The calibration gas standards used at Chevron are, listed in ppm as propane: 49.9, 100.1, 500.5, 1002.5, and 4010.1.

The initial calibration prior to commencing a test series at a test location, or follow-up calibration prior to re-commencing a test series after an instrument shut-down, included the following calibration sequence. First a trial sampling of the source stream would indicate the appropriate concentration range for which the instrument would be operated. Second, the initial calibration of the instrument on this pre-determined scale included introducing zero gas and the high-level calibration gas separately to the sample manifold. The output was then adjusted to the appropriate levels. No instrument adjustments were made after this time. Third, a periodic response check was performed by introducing the zero and high level calibration gas with no adjustments. A response within ±1 percent of span value was required or recalibration would have been performed. Fourth, a linearity check was performed on the instrument span range by introducing mid-level and low-level calibration gases. The difference between the measurement system responses and the predicted response were recorded. The differences were assured to be less than five percent of the respective calibration gas values before the measurement system was placed on-line for monitoring. Table 5-1 lists the operational parameters and calibration gas standards used at each sample location.

A monitor system response time check was performed at each sample location. The check was performed by introducing the high-level calibration gas at the inlet to the sample line feeding the measurement system. The time interval was measured for the analyzer to respond by 95 percent of the calibration gas value. The short sample lines gave response times of 15-17 seconds within the allowed limit of 30 seconds.

Zero and span drift determinations were made during and after each test period. The frequency of drift checks were determined by the operational status of the analyzer and total length of the test. During the initial operation of the analyzer, after the measurement system had been powered down, the FIA required frequent drift checks (one to two hours) for maintaining the drift values below the specified three percent limit. A complete calibration sequence was completed if a drift check demonstrated the necessity. After the frequent drift checks verified the calibration stability of the measurement system, the drift checks were performed three times during the 12-hour test day period (0600, 1200, 1800). Test periods of less than 12-hour periods required the two-hour drift check frequency.

Table 5-1. CONTINUOUS MONITOR CALIBRATION GASES

Sample location	Instrument	Scale (ppm)	Calibration gas levels		
			(low)	(mid)	(high)
				ppmv as C_3H_8	
DAF Ventilation Air	Beckman 400	0-1000	100.1	500.5	1002.5
DAF Carbon House Exhaust	Beckman 400	0-100	NA	49.9	100.1
IAF Ventilation Air	Beckman 402	0-10,000	500.5	1002.1	4010.0
IAF Carbon Drum	Beckman 402	0-10,000	500.5	1002.1	4010.0
Equalization Tank Ventilation Air	Beckman 402	0-1000	100.1	500.5	1002.5
Equalization Tank Carbon House	Beckman 402	0-1000	100.1	500.5	1002.5

NA = Not available.

Figure 5-10 presents an example of a calibration check at the DAF sampling location with a recalibration required. The sequence was initiated at 0800 on 8/4/83 by introducing zero, high, and mid-calibration gases separately. The upward drift at the three levels was approximately one percent. Therefore, the zero and high standards were re-introduced and analyzer adjustments made. Next, a linearity check is performed with the mid standard (no adjustment) and the sample reconnected for monitoring.

The calibration gas level reintroduced for the drift check was determined by the sample measurement levels. The DAF sample locations ranged from 600-1000 ppm and the 1002.5 ppmv as C_3H_8 was used for the span drift check; the IAF sample locations ranged from 6000-7500 ppm and the 4010.0 ppmv as C_3H_8 was used. The equalization tank sample locations ranged from 100-200 ppm and the 100.1 ppmv as C_3H_8 was used.

The continuous monitor data were reduced by determining the average organic concentration measured into ppmv as propane. Direct computation of the recorded stripchart outputs was applicable because the high-level calibration was equivalent to 100 percent of the recorder span value. The exception was the IAF measurement system calibrated on the 0-10,000 ppm scale. The IAF calibration was performed with 40 percent of scale being equivalent to the 4010 ppmv as propane.

The measured concentrations are presented on a ppmv as propane equivalent. The one-hour concentration averages were calculated from direct output readings at five-minute intervals. The results were calculated on the hour; therefore, periods with drift checks and calibration were averaged to the hour from the partial measurements.

5.2 PERMANENT GAS ANALYSIS

A gas chromatograph equipped with a thermal conductivity detector was used to analyze each bag sample collected for VOC analysis to determine the nitrogen, oxygen, and carbon dioxide content. This procedure was intended to characterize the balance gas constituents and is allowed in Section 1.2 of EPA Method 3 (42 FR 41768) for this purpose.

The chromatograph used was a Shimadzu GC-3BT with a Shimadzu Chromotopac integrator. The operating parameters were:

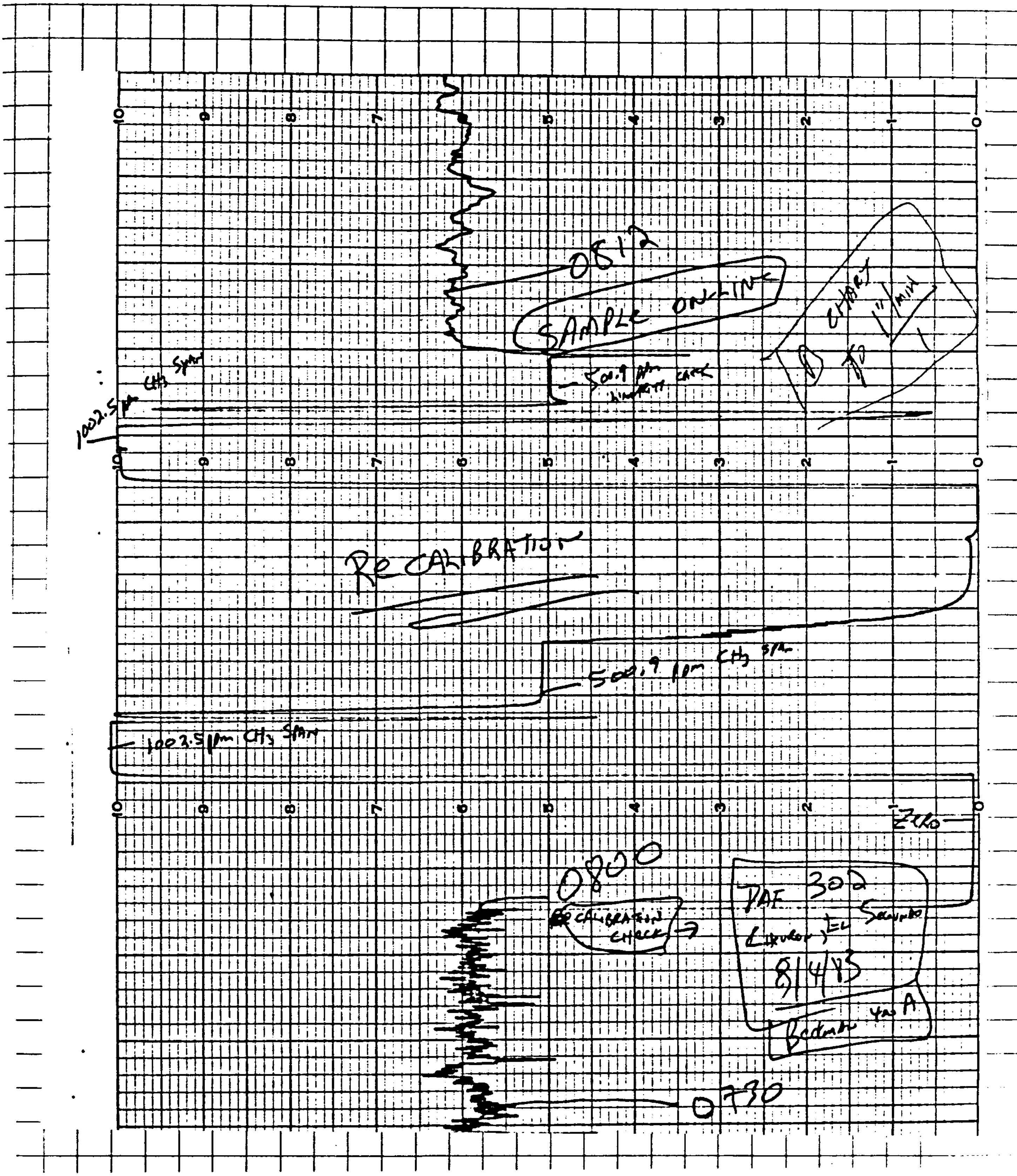


Figure 5-10. Example of a calibration check with a recalibration required.

- Column: 6 ft x 1/8 in. I.D. stainless steel.
- Column support: 60/80 molecular sieve.
- Column temperature/program: 105°C/constant.
- Sample loop size/temperature: 2 ml/35°C.
- Carrier gas/pressure: He/3 PSI.

The chromatograph was calibrated with a cylinder standard of Scotty II-Mix containing (by volume) 14.8 percent CO_2, 7.07 percent O_2, 78.13 percent N_2 with a ±2 percent certification. Figure 5-11 provides an example of GC/TCD calibration and Figure 5-12 provides an example of a GC/TCD analysis run for the balance gas constituents.

5.3 GASEOUS VOLUMETRIC FLOW MEASUREMENT

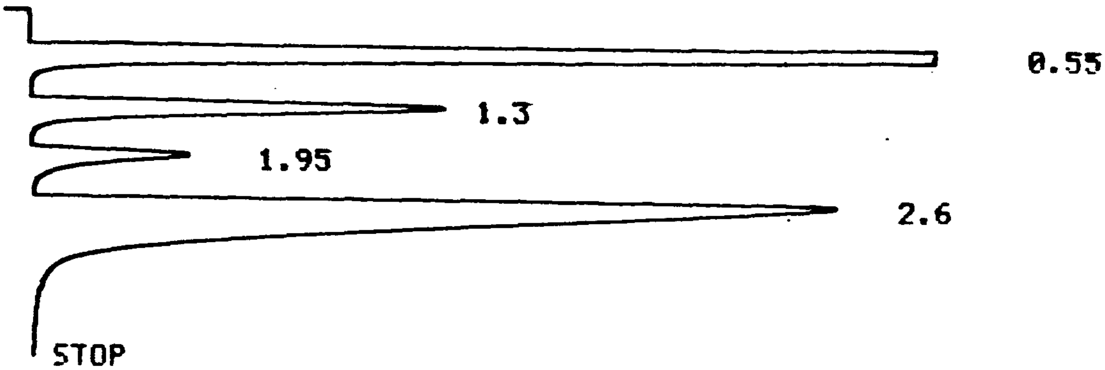
Two procedures were used to measure the gaseous flow rate at the sample sites, depending on the flow rate and system configuration. At the DAF tank vents and the equalization tank vent, EPA Methods 1, 2, and 3 were used to determine the volumetric flow rates using a pitot tube. The measurement location were ideal as defined by Method 1 and no problems were encountered during testing. Measurement was performed in the morning and afternoon of each day of testing and the two measurements were averaged for a daily value.

At the induced air flotation unit vent a modification of EPA Method 2A (Federal Register Vol. 48, No. 247, December 22, 1983) was used. The flow rate at this site was small and variable and the allowable back-pressure allowed on the IAF unit was essentially zero. Unsuccessful attempts were made to used a turbine-type meter with a 9000 cubic foot per hour rating. The system that proved useable was a fabricated meter based on a 4" diameter aneometer housed in a section of duct with the same nominal diameter as the aneometer:

A Jewelled Anemometer was used at the IAF sample location for measuring the velocity through a four-inch adaption between the IAF ventilation air and the carbon drum inlet. Figure 5-13 provides a schematic representation of the velocity measurement system.

The anemometer was calibrated by the manufacturer (Davis Instrument Mfg.) and the calibration/correction data is provided in Appendix A. No in-house calibration was performed since this was the first use of the anemometer.

CAL
START 08.04.16.18.



C-R1A
SMPL # 00
FILE # 4
REPT # 1486
METHOD 44

#	NAME	TIME	CONC	MK	AREA
1	AIR	0.55	92.3258		52856
2	CO-2	1.3	14.0085		10032
3	O-2	1.95	6.6363		3915
4	N-2	2.6	73.2655	V	42487
	TOTAL		186.2362		109293

CALIB 1

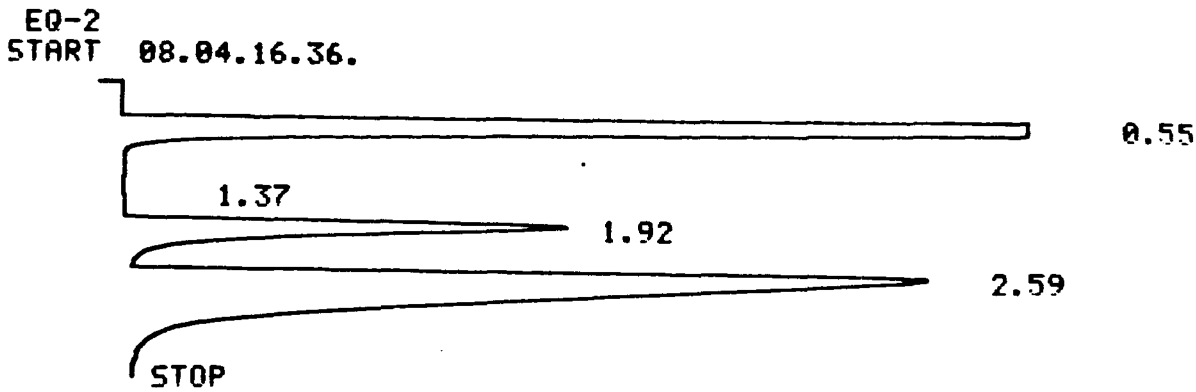
C-R1A
SMPL # 00
FILE # 4
REPT # 1487
METHOD 44
CLB C1 1

#	NAME	TIME	CONC	MK	AREA
1	AIR	0.55			52856
2	CO-2	1.3			10032
3	O-2	1.95			3915
4	N-2	2.6		V	42487
	TOTAL		0		109293

ID TBL 4
MAX 5
MODE 1

#	NAME	TIME	WINDOW	F1/F2	C1/C2
1	AIR	0.55	10	0.001892	100
2	CO-2	1.26		0.001475	14.8
3	O-2	1.95		0.001805	7.07
4	N-2	2.56		0.001839	78.13

Figure 5-11. Example of GC/TCD calibration for stationary gas analysis.



C-R1A
SMPL # 00
FILE # 4
REPT # 1490
METHOD 44

#	NAME	TIME	CONC	MK	AREA
1	AIR	0.55	116.9525		61818
3	O-2	1.92	21.5084		11913
4	N-2	2.59	78.2411	V	42549
	TOTAL		216.7021		116280

Figure 5-12. Example of GC/TCD analysis on equalization tank #2 gas bag sample for stationary gases.

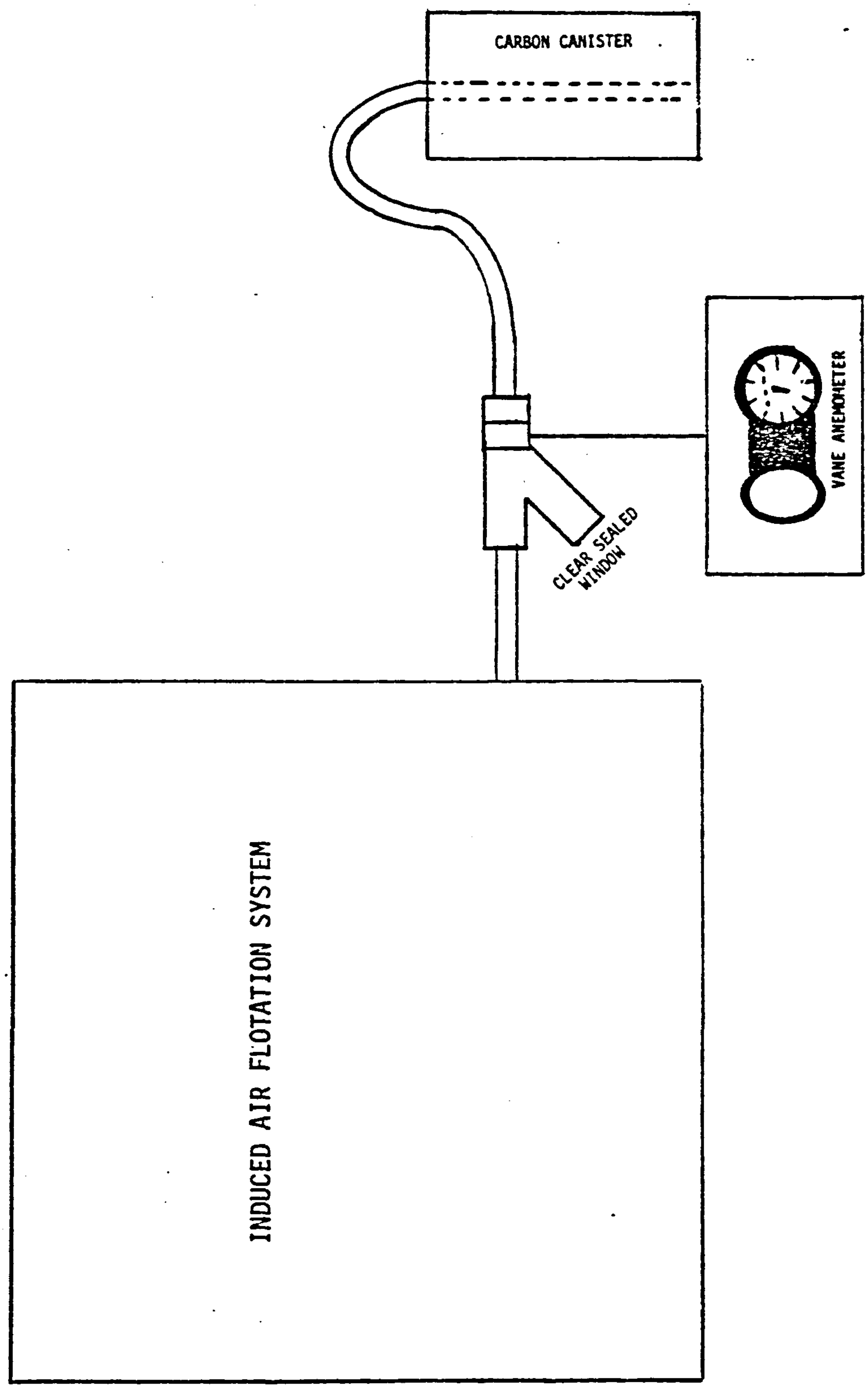


Figure 5-13. Velocity measurement system adapted into IAF ventilation air, Chevron - El Segundo, California.

The operation of the IAF unit was that it flucculated in flow rate and direction. For limited intervals during the test period, the meter was monitored and dial readings were taken at each flow reversal point, along with the time. The positive flows were accumulated for the test period, and an average equivalent flow rate was calculated. This equivalent flow was used to calculate a VOC mass flow rate only for those periods of actual flow determination because of the variability of the flow.

5.4 LIQUID SAMPLE METHODS

Liquid process samples were collected from sample taps used by the refinery for process quality control. Two types of samples were collected and were termed "void of air" (VOA) and "composite".

The void of air samples were collected by completely filling a 40 mL bottle with a grab sample. These bottles are fitted with a special cap to eliminate air bubbles from the sample. The composite samples were collected by cummulatively combining three to four equal volume grab samples into a one gallon amber bottle.

Both sample types were taken from a process stream flowing in a pipe, through a sample line which was purged prior to sample collection. The samples were stored on ice in insulated containers after collecting, and during shipment to the TRW facility at the Research Triangle Park, North Carolina for analysis. The bottles were prepared by the following cleaning procedures.

5.5 LIQUID SAMPLE ANALYSIS METHODS

5.5.1 Total Organic Carbon (TOC)

This method is applicable to the measurement of organic carbon in drinking and surface waters as well as domestic and industrial wastes.

5.5.1.1 Summary of Method. Organic carbon in a sample is converted to carbon dioxide (CO_2) by photochemical oxidation. The CO_2 is measured to determine the total organic carbon. The sample is initially purged by vacuum to remove inorganic carbon. Sample inorganic carbon is eliminated or must be compensated for because it is usually a large part of the total carbon. The instrument is calibrated versus a standard solution of potassium hydrogen phthalate (KHP).

5.5.1.2 Interferences/Quality Control. Removal of carbonate and bicarbonate by acidification and purging with nitrogen or other inert gas can result in the loss of volatile organic substances. Volatiles also can be lost if the samples are allowed to heat up.

Repeatability of replicate injections can be effected by non-homogeneity of samples. This can occur if large carbon containing particulate matter is not representatively collected in the sample injection syringe. It is also necessary to collect and maintain the samples in bottles with no head space so as to minimize the volatilization of organic components. This phenomenon is apparent after the TOC analysis of theoretically identical samples in which one was collected in a VOA bottle (no head space) and another collected in a larger sample bottle only half to three-quarters full. Repeatability and representativeness can be improved by homogenizing (by mixing) the samples prior to analysis.

The precision measurement based upon repeated injection of three randomly selected samples appears to be a function of the concentration when measured on the basis of the standard deviation. The standard deviations in one case for two of the samples cannot be considered to be equal (at the 95% level of significance), but there appears to be no difference between the standard deviations when comparing one of the first two with the third. When compared on the basis of the relative standard deviation, RSD, (or % RSD), the precision for all three measurements appears to be the same.

The accuracy of the technique is best represented here by injecting a known volume of the calibration standard and comparing the results to the theoretical value. In this case, the highest standard used to calibrate was a 100 mg/L (100 ppm) solution of KHP.

The accuracy measurement is based on an in-house standard and indicates about a 9% positive bias (or accuracy), based on the mean of the measurements. However, a statistical hypothesis test that the bias is zero would be accepted at the 95% level of confidence. Stated differently there is a 95% probability of being correct if we say that our data does not show a significant difference from zero.

All samples were diluted as necessary to fall within the limits of the calibration.

5.5.2 Chemical Oxygen Demand (COD)

This test method is considered an independent measurement of the organic matter in a sample. The Chemical Oxygen Demand (COD) method determines the quantity of oxygen required to oxidize the organic matter in a waste sample, under specific conditions of oxidizing agent, temperature, and time.

5.5.2.1 Summary of Method. Organic and oxidizable inorganic substances in the sample are oxidized by potassium dichromate in 50% sulfuric acid solution at reflux temperature. Silver sulfate is used as a catalyst and mercuric sulfate is added to remove chloride interference. The excess dichromate is titrated with standard ferrous ammonium sulfate, using orthophenanthroline ferrous complex as an indicator.

5.5.2.2 Interferences/Quality Control. Volatile straight-chain aliphatic compounds are not oxidized to any appreciable extent. This limitation occurs partly because volatile organics are present in the vapor space and do not come in contact with the oxidizing liquid. Straight-chain aliphatic compounds are oxidized more effectively when silver sulfate is added as a catalyst. However, silver sulfate reacts with the halides to produce precipitates that are only oxidized partially. This can be partially overcome by adding mercuric sulfate to complex the halides prior to the reflux step.

The replicated chemical oxygen demand readings are given in Table 5-2. Seven samples were replicated and the means, standard deviations, and coefficients of variation for the COD readings are given in Columns 4, 6, and 8, respectively in the table. Assuming that the coefficient of variation of the chemical oxygen demand (COD) readings should remain constant, the pooled estimate of the coefficient of variation is 0.0435, or 4.4% and is a good measure of the precision.

5.5.3 Oil and Grease

This method includes the measurement of fluorocarbon-113 extractable matter from industrial and domestic wastes. It is applicable to the determination of relatively nonvolatile hydrocarbons, vegetable oils, animal fats, waxes, soaps, greases and related matter.

5.5.3.1 Summary of Method. The sample is acidified to a low pH (<2) and serially extracted with fluorocarbon-113 in a separatory funnel. The solvent is evaporated from the extract and the residue weighed on an analytical balance.

Table 5-2. REPLICATED COD AND O & G MEASUREMENTS

			Means		Standard Deviation		Coefficient of Variation	
TRW Sample #	COD mg/L	O & G mg/L	COD mg/L	O & G mg/L	COD mg/L	O & G mg/L	COD	O & G
4957	2968	491	3238	513.0	381.8	31.1	0.1179*	0.0606
	3508	535						
4958	4106	453	4119	444.7	102.6	7.23	0.0249	0.0163
	4024	440						
	4228	441						
4960	2155	382	2135	379.0	29.0	4.24	0.0136	0.0112
	2114	376						
4961	1748	133	1748	133.5	0.0	0.71	0.0000	0.0053
	1748	144						
4962	1545	125	1565	115.0	20.0	18.2	0.0218	0.1582
	1585	94						
	1565	126						
4971	1240	110	1271	109.5	43.1	0.71	0.0340	0.0065
	1301	109						
4973	1911	123	1891	121.5	29.0	2.12	0.0153	0.0175
	1870	120						

5.5.3.2 Interferences/Quality Control. Fluorocarbon-113 has the ability to dissolve not only oil and grease but also other organic substances. No known solvent will selectively dissolve only oil and grease. Solvent removal results in the loss of short-chain hydrocarbons and simple aromatics by volatization. Significant portions of petroleum distillates from gasoline through No. 2 fuel oil are lost in the process. In addition, heavier residuals of crude oils and heavy fuel oils contain a significant percentage of residue-type materials that are not soluble in fluorocarbon-113.

Replicated oil and grease (O & G) readings for seven samples are shown in Table 5-2. Sample means, standard deviations, and coefficients of variation are shown in Columns 5, 7, and 9, respectively. Pooling the coefficients of variation for O & G gives a precision of 7.9, or almost double the precision of the COD readings.

5.5.4 Total Chromatographable Organics (TCO)/Hydrocarbon Speciation

This method is applicable for the measurement of hydrocarbons in surfaces waters, domestic and industrial wastes.

5.5.4.1 Summary of Method. The analysis for TCO was performed by gas chromatography with flame ionization detection. Component speciation was done by separation with a fused silica capillary (0.25 mm), GC column (SPB-1 boiling point column). The reported values are in milligrams per liter of sample, and is a total integrated value representing hydrocarbons ranging between C_5 and C_{30}.

For additional breakdown, i.e., hydrocarbon speciation, the resulting chromotography was broken down into C (toluene) through C_{30} hydrocarbons. The values in milligrams per liter were calculated using average response factors of C_7-C_{11}, C_{11}-C_{16} and C_{17} to C_{25} hydrocarbons. Due to the reduced response on a FID of C_{17} to C_{25} hydrocarbons as compared to C_7-C_{11} high values of some C_{17}-C_{25} compounds were found.

Each sample was prepared by extracting a 500 ml aliquot with methylene chloride both at an acidic and basic pH, combining the methylene chloride extracts, and then reducing the solvent to a final volume of 25 ml. Each sample was spiked with an internal spike to check recovery.

5.5.4.2 Interferences/Quality Control. The sample is serially extracted with methylene chloride and concentrated to provide sufficient hydrocarbons for analysis. The concentration step results in the loss of short-chain hydrocarbons and simple aromatics (BP < 100°C) by volatilization. In addition, the extraction partition coefficient for certain compounds does vary. For a measure of extraction efficiency, each sample and control samples (distilled organic free water) were spiked with Napthalene-d_8 which resulted in recoveries between 75 and 85 percent.

5.5.5 Purge and Trap (Volatile Organic Analysis)

The volatile organics in water were qualitatively identified by utilizing EPA Method 624 with mass spectral identification. After examination of several representative samples, each water sample was quantitated by purge and trap with GC/FID.

5.5.5.1 Summary of Method. The GC/MS analysis was performed on a Finnigan 4000 with an INCOS data system. A Tekmar purge and trap apparatus was used according to EPA Method 624. The GC column used was a 6 ft x 1/8 in stainless steel packed with 0.2% CW 1500 on 60/80 Carbopack C. Oven conditions were 15°C programmed to 190°C at 10°C/min and held for 25 minutes. A 5 ml aliquot of each sample was taken for analysis and spiked with 750 ng Bromofluorobenzene (BFB) for an internal standard. Comparison by identification by GC/MS was done by spectral library searches and comparison with known standards (Figures 5-14 and 5-15). Quantitative analysis was obtained by GC/FID (Figures 5-16 and 5-17) using the same identical chromatography conditions as employed with GC/MS qualitative analysis runs.

5.5.5.2 Interferences/Quality Control. Contamination can occur whenever high-level and low-level samples are analyzed sequentially. When utilizing GC/FID detection only, co-eluting peaks can give a positive bias to values obtained for the components of interest.

Data quality techniques utilized for these analyses included the following:

1. A complete page of the system following a high level VOA sample.
2. Bromoflurobenzene (BFB) was used as an internal standard in all samples and control standards. In addition, benzene and toluene were quantitatively based on their respective response values to BFB.
3. When evidence of co-eluting was detected, values were not reported for selected compounds.

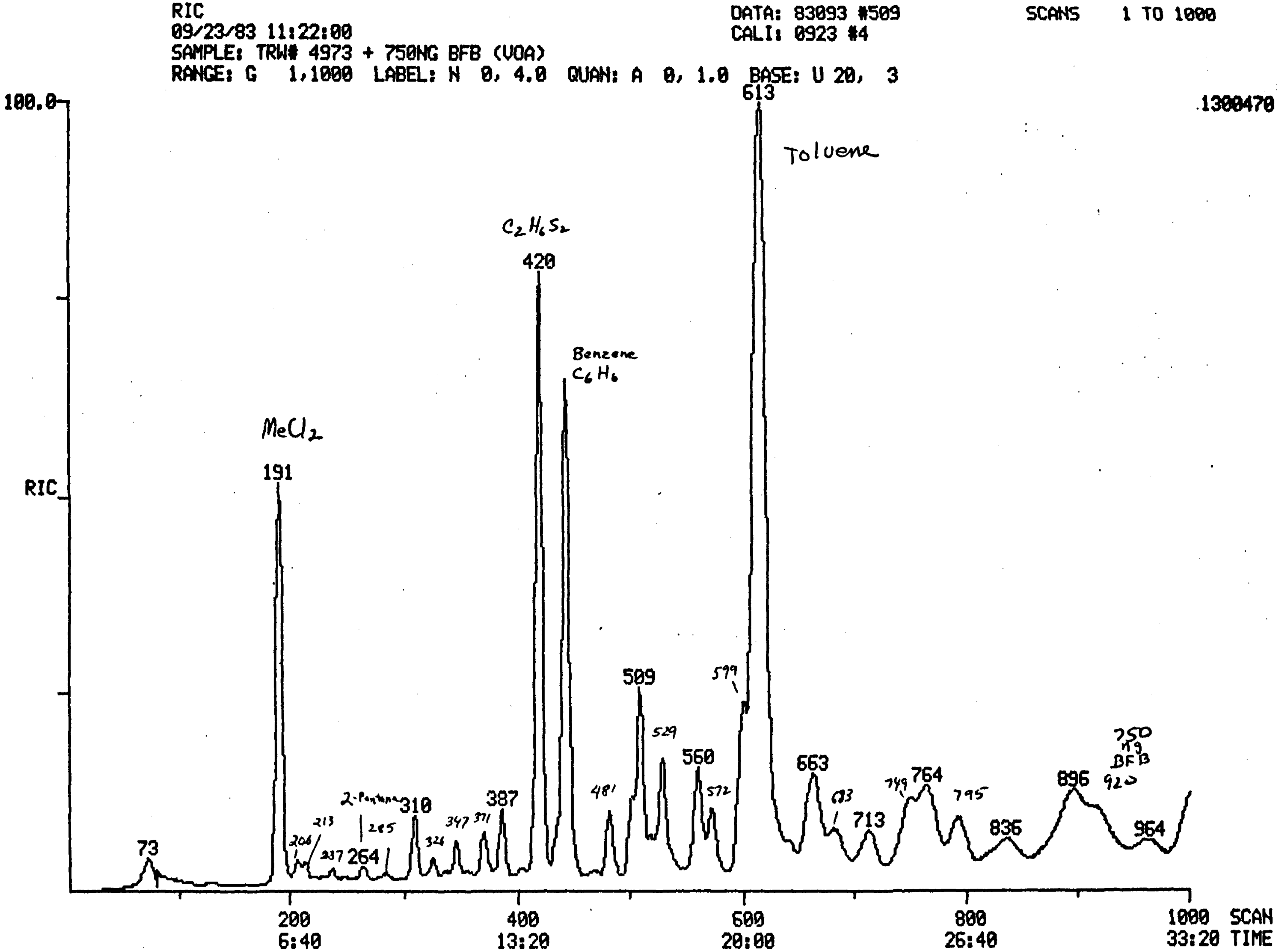


Figure 5-14. Mass spectrometer qualitative analysis by purge and trap, sample no. DAF-IN-#1-VOA.

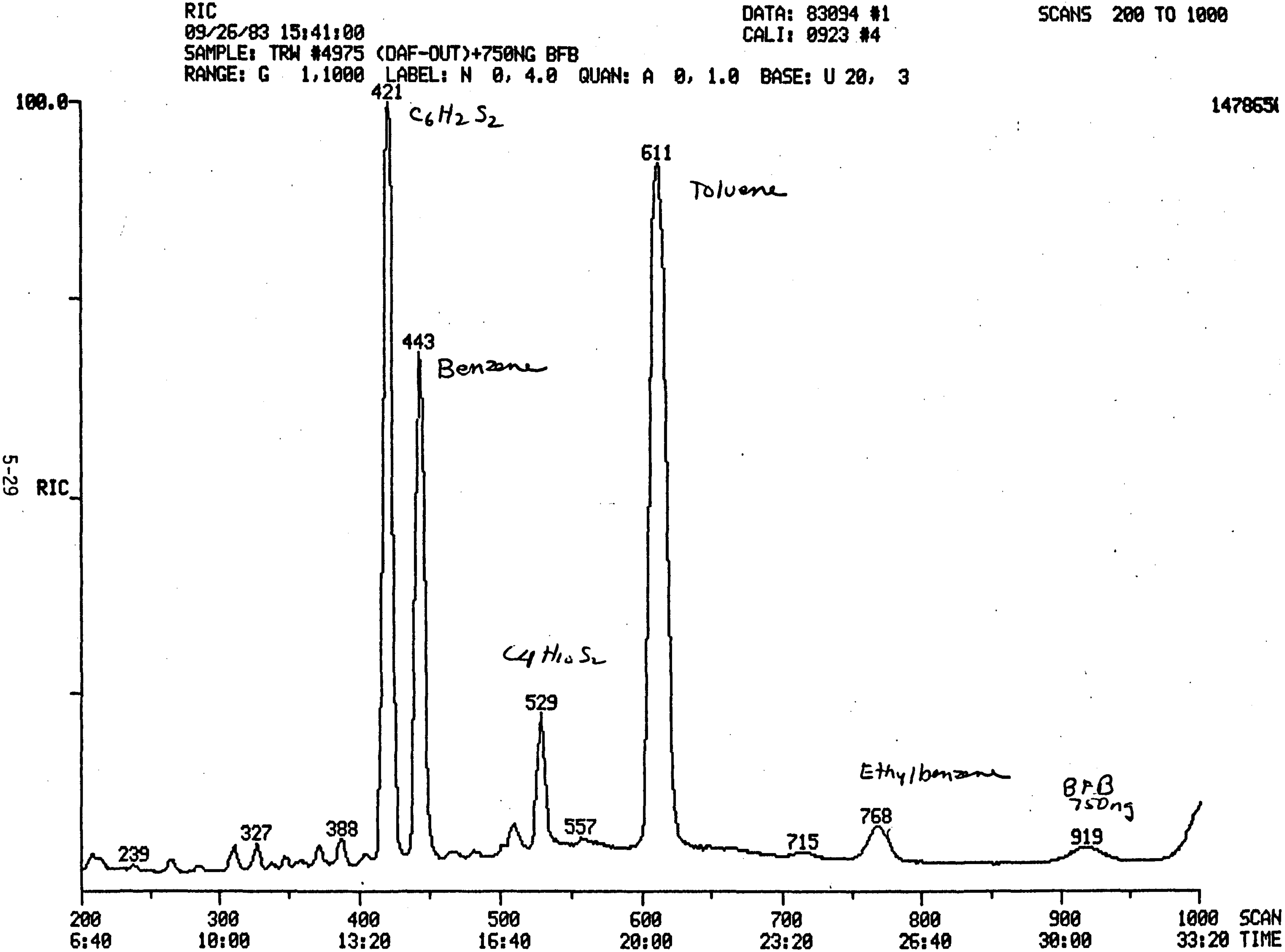


Figure 5-15. Mass spectrometer qualitative analysis by purge and trap, sample no. DAF-OUT-#1-VOA.

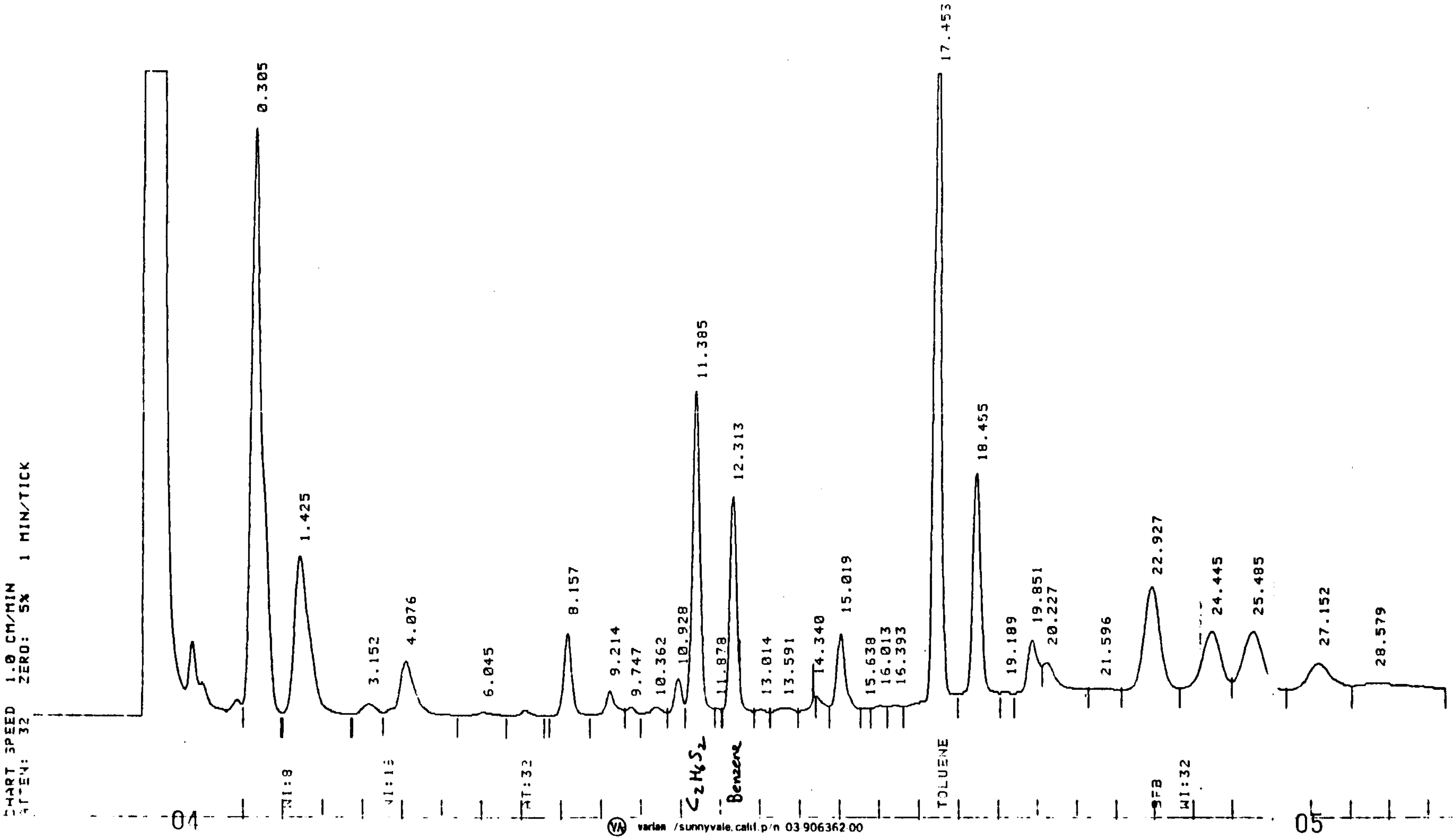


Figure 5-16. GC/FID quantitative analysis by purge and trap, sample no. DAF-IN-#1-VOA.

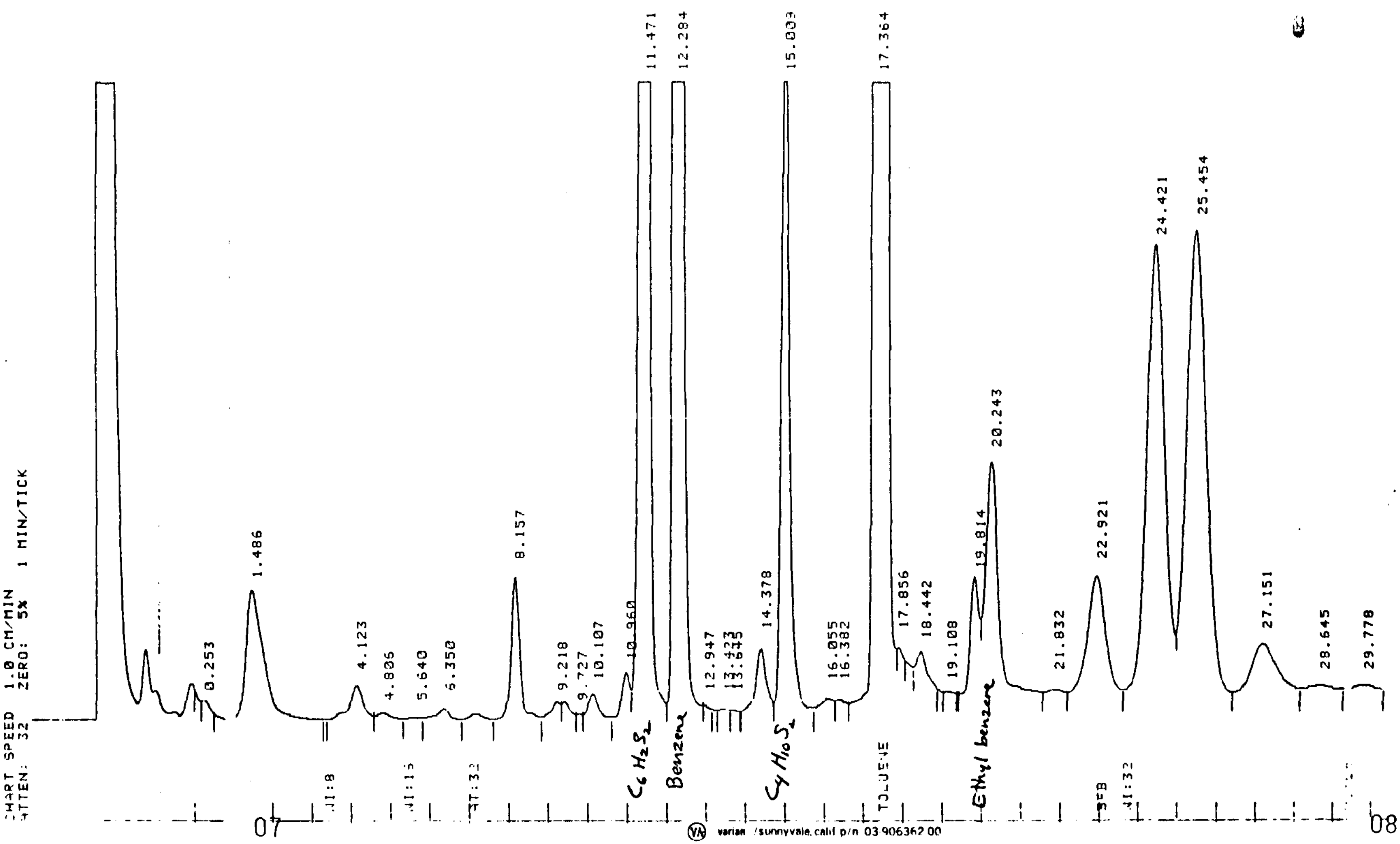


Figure 5-17. GC/FID quantitative analysis by purge and trap, sample no. DAF-OUT-#1-VOA.

Table 5-3 gives concentration and quality parameters for an in-house standard and replicated results for TRW Sample No. 4973. BFB is bromofluorobenzene and was spiked into the in-house standard sample and the three replicated samples at the same concentration. The accuracy is estimated as the percent bias the mean of the three BFB readings is from the in-house standard, and is calculated to be about 52 percent. Precision is estimated as the pooled coefficient of variation for all the compounds (including BFB) and is calculated to be 9.6 percent. The sample here was not filtered before the replicated samples were drawn.

Table 5-4 gives GC/FID data for an induced air flotation (IAF) sample and a dissolved air flotation sample. These samples were filtered before analysis. Accuracy estimates for IAF and DAF, respectively are 9.8 and 19.3 percent. The precision is 29.3 and 3.7 percent, respectively. In view of the fact that only duplicate analyses were performed, the precision figures for the filtered samples appears not to be significantly different (29.3 and 3.7 percent) from those for the unfiltered sample (9.6 percent). The accuracy for the filtered samples (9.8 and 19.3 percent) appear to be significantly better than the accuracy of the unfiltered sample (52 percent). It appears that the solid material in the unfiltered matrix decreased the accuracy possible in the analysis.

Table 5-3. GC/FID READINGS FOR ACCURACY/PRECISION ESTIMATES

Compound	In-house Standard ppb	TRW Sample No. 4973: Replication No. 1 ppb	2 ppb	3 ppb	Means ppb	Std. dev. ppb	CV
$C_2H_6S_2$	–	240	227	198	221.7	21.5	0.0970
C_6H_6	352	187	174	142	167.7	23.1	0.1381
$C_6H_5CH_3$	348	502	519	441	487.3	41.0	0.0842
BFB	596	863	927	927	905.7	37.0	0.0408

$$\% \text{ Accuracy} = \frac{905.7-596}{596} \times 100 = 51.9\%$$

% Precision = pooled CV for compounds in Sample No. 4973 = 9.6%.

Table 5-4. PRECISION/ACCURACY ESTIMATES FOR IAF/DAF SAMPLES

Compound	In-house Standard	IAF, TRW #4987			DAF, TRW #4994		
		1	2	CV	1	2	CV
$C_6H_2S_2$, ppb	—	939	943	0.0030	—	—	—
C_6H_6, ppb	—	1970	1770	0.3860	2120	1980	0.0483
$C_4H_{10}S_2$, ppb	—	411	410	0.0017	—	—	—
$C_6H_6CH_3$, ppb	—	5710	5020	0.0909	2110	2000	0.0379
BFB, counts	170417	143078	164324	0.5370	135529	139579	0.0208

For IAF:

$$\text{Accuracy} = \frac{170417 - ((143078 + 164324)/2)}{170417} \times 100 = 9.8\%$$

For DAF:

$$\text{Accuracy} = \frac{170417 - ((135529 + 139579)/2)}{170417} \times 100 = 19.3\%$$

Precision:

Pooled CV for IAF = $\pm$ 29.8%.

Pooled CV for DAF = $\pm$ 3.7%.

REFERENCES

1. Cantrell, Aileen. Annual Refining Survey. Oil and Gas Journal. March 21, 1983.

2. Environmental Protection Agency. Petroleum Refining Point Source Category Effluent Limitations Guidelines, Pretreatment Standards, and New Source Performance Standards. 47 FR 46434. October 16, 1982.

APPENDIX A

SAMPLE CALCULATIONS AND RESULTS

- Flow and Emission Rate Calculation Examples
- Summary Gas Analysis Sheets
- DAF and Equalization Tank Flow Computations
- IAF Flow Results
- Continuous Monitor Results

APPENDIX A - EXAMPLE CALCULATIONS

Example #1) <u>IAF - Flow Measurement with Vane Anemometers</u>

(A) $$V_{an} \text{ (CFM)} = \frac{Ft_{an}}{min} \times Area_{an} \; Ft^2$$

(B) $$V_s \text{ (SCFM)} = \left(\frac{V_{an} \times 17.64 \times P_b}{T + 460}\right)$$

(Example of flow measurement calculation at 1745 during IAF run on 8/10/83)

$$V_{an} \text{ @ 1745 Run 8-10 (CFM)} = \frac{744 \text{ ft}}{15 \text{ min}} \times .0873 \text{ ft}^2$$

$$= 4.3 \text{ CFM}_{an}$$

$$V_s \text{ (SCFM)} = \left(\frac{4.3 \times 17.64 \times 29.8}{84 + 460}\right)$$

$$= 4.18 \text{ SCFM}$$

SCFM = standard cubic feet per minute

V_{an} = volume measured through vane anemometer

V_s = volume standardized to standard temperature and pressure

P_b = barometric pressure

T = temperature of stack gas

Example #2) <u>DAF and Equalization Tank Flow Measurements with a Standard Pitot</u>

(A) Average molecular weight of dry stack gas = MW_d

$$MW = (\%CO_2 \times \frac{44}{100}) + (\%O_2 \times \frac{32}{100}) + (\%N_2 \times \frac{28}{100})$$

(B) Stack velocity @ stack conditions, fpm = V_s

$$V_s = 4310 \times \sqrt{\Delta P_s \times (T_s + 460)} \quad \left(\frac{1}{P_s \times MW}\right)^{\frac{1}{2}} = \text{fpm}$$

(C) Stack gas volume @ dry standard conditions, DSCFM = Q_s

$$Q_s = \frac{17.64 \times V_s \times A_s \times P_s}{(T_s + 460)}$$

(Example of flow measurement calculation at DAF during 8/8/83 run)

(A) $MW_d = (0 \times \frac{44}{100}) + (19.7 \times \frac{32}{100}) + (76.1 \times \frac{28}{100})$

$= 27.61$

(B) $V_s = 4310 \sqrt{-.44 \times 545} \quad \left(\frac{1}{29.80 \times 27.61}\right)^{\frac{1}{2}}$

$= 1316.18$ fpm

(C) $Q_s = \frac{17.64 \times 1316.18 \text{ fpm} \times 1.67 \text{ ft}^2 \times 29.80 \text{ in. Hg}}{545\ ^{o}F}$

$= 2119.07$ SCFM

Example #3) Mass Emission Rate for VOC as C_3H_8

(A) Sample calculation to provide the conversion factor of C_3H_8 from ppm to mg/m^3

$$CF_{C_3H_8} = \left(\frac{44g}{mole}\right)\left(\frac{1\ mole}{25.71\ L}\right)\left(\frac{28.32\ L}{ft^3}\right)\left(\frac{35.31\ ft^3}{m^3}\right)\left(\frac{1000\ mg}{g}\right)\left(\frac{mg/m^3}{10^6 ppm}\right)$$

$$= 1.71\ mg/m^3$$

(B) Emission rate = lb/hr

$$E_{VOC} = \left(VOCppm\right)\left(\frac{1.71\ mg}{m^3}\right)\left(\frac{m^3}{35.31\ ft^3}\right)\left(\frac{Q_s\ ft^3}{min}\right)\left(\frac{60\ min}{hr}\right)\left(\frac{g}{1000}\right)\left(\frac{lb}{453.6g}\right)$$

Example - of Emission Rate calculation on IAF 8/10/83 run at 0900

$$E_{VOC} = \left(6640ppm\right)\left(\frac{1.71\ mg}{m^3}\right)\left(\frac{m^3}{35.31\ ft^3}\right)\left(\frac{4.1\ ft}{min}\right)\left(\frac{60\ min}{hr}\right)\left(\frac{g}{1000\ mg}\right)\left(\frac{lb}{453.6\ g}\right)$$

$$= 0.17\ lbs/hr$$

IAF FLOW RESULTS

IAF FLOW MEASUREMENTS:
CHEVRON - EL SEGUNDO, CALIFORNIA

Date	Time	Temperature (°F)	Measured Rate (Feet)	Measured Rate (Time Period in Min)	Anemometer Average Rate (Ft/Min)	Actual Volumetric Flowrate (ACFM)	Standard Volumetric Flowrate (SCFM)
8/10/83	1745-1903	84	744	15	49.6	4.3	4.1
8/10/83	2145-2230[a]	72	194	45	4.3	0.38	0.38
8/11/83	0045-0120[a]	72	190	40	4.7	0.41	0.41
8/11/83	0951-1016	88	1275	25	51	4.4	4.2
8/11/83	1032-1103	88	1725	30	69	6.0	5.7
8/11/83	1310-1357	88	2042	47	43.4	3.8	3.6
8/11/83	1517-1559	88	2294	42	54.6	4.8	4.6
8/12/83	1033-1119	84	2197	45.7	48.1	4.2	3.9
8/12/83	1130-1215	84	1725	45	38.3	3.3	3.2
8/12/83	1230-1315	84	2080	45	46.2	4.0	3.9
8/12/83	1400-1446	84	2194	45.6	48.1	4.2	4.1

[a]Flow measurements monitored during night period with lower process gas temperatures.

Davis Anemometer Correction Chart

DAVIS INSTRUMENT MFG. CO., INC.
CALIBRATION CORRECTION CHART

SERIAL NO. ______________________

DATE June 15, 1983

TYPE – BALL BEARING

TRUE F.P.M.	INDICATED F.P.M.	TRUE F.P.M.	INDICATED F.P.M.
30	18	1800	1860
50	36	2000	2065
70	53	2200	2275
90	75	2400	2490
100	85	2600	2700
200	180	2800	2910
300	290	3000	3120
400	400	3200	3335
500	505	3400	3550
600	610	3600	3765
700	715	3800	3975
800	820	4000	4180
900	925	4200	4390
1000	1030	4400	4595
1200	1235	4600	4800
1400	1445	4800	5025
1600	1655	5000	5260

SUMMARY GAS ANALYSIS SHEETS

Air C3 15.6
C4 15.2
C5 15.6
C6 15.9

WORK SHEET

Mini 1 Calibration

Range 10^3
~~Atten 8~~
atten 16

Methane	area	→	*		
8/2	846	856			
8/3	1616	1529	*	1552	*1287
8/4	910	905	867		
8/5	972	986	856	820	881
8/8	~~895~~	910	920	935	
8/9	796	815	883		
8/10	835	822	826	857	
8/11	813	824	1524 ~~858~~	1389	1641*
8/12	823	849			
Ethane					
8/2	1082	1098			
8/3	677	679	*	635	*717
8/4	665	694	632	6	
8/5	758	746	724	680	724
8/8	715	692	745	698	
8/9	729	771	736		
8/10	782	762	729	798	
8/11	781	787	858	845	1014*
8/12	902	887			
Propane					
8/2	1670	1690			
8/3	1036	1057	*	978	*1046
8/4	1030	1002		957	
8/5	1040	1144	1008	950	1014
8/8	1094	1071	1093	1069	
8/9	1074	1101	1106		
8/10	1120	1129	1081	1214	
8/11	1152	1136	1182	1229	1392*
8/12 *	1328	1336			

Butane	area	→			
8/2	2279	2300			
8/3	1386	1432	*	1330	*1414
8/4	1392	1377	1202		
8/5	1515	1428	1354	1329	1319
8/8	1502	1459	1359	1361	
8/9	1440	1432	1384		
8/10	1556	1516	1439	1466	
8/11	1573	1562	1675	1520	1618*
8/12	1845	1725			
Pentane					
8/2	3172	3056			
8/3	1808	1871	*	1716	*1896
8/4	1784	1752	1461		
8/5	1877	1883	1685	1589	1901
8/8	1877	1862	1816	1828	
8/9	1731	1824	1796		
8/10	1906	1833	1956	1896	
8/11	1944	1939	~~8575~~	2011	2153*
8/12	2140	2143			
Hexane					
8/2	5369	4595			
8/3	2646	2502	*	2095	*2360
8/4	2427	2061	1730		
8/5	2119	2382	2276	2309	—
8/8	2257	2033	2058	1913	
8/9	2112	2030	2338		
8/10	2143	2082	2211	2032	
8/11	2309	2212	2438	2771	?
8/12	2658	2813			

* new bottle

He =
H_2 =
Air =

Range 10^3
Attn 8

Chevron, El Segundo, CA, Aug '83

benzene = 49.8
xylene = 49.9

WORK SHEET

Mini 2 Calibration

												ave	
~~xylene~~ benzene	area					~~Attn 8~~ Attn 4						morn	aft
8/2	8227												
8/3	~~7463~~	~~4568~~	9633	9442	*	8808	8658	*					8969
8/4	~~10957~~	7815	7716	7649		7846	7737	7935					7783
8/5	7648	7705	~~7775~~	7775	7600 X	8089	8160	8272				7804	8174
8/8	~~5094~~	8047	8169	8109	8373								8174
8/9	~~7616~~	8048	7941	8120	8125					x = 8058	s = 86	x = ~~8058~~	s = ~~211~~
8/10	7825	7897	7953	8090	8042							x 7941	s 112
8/11	7873	7730	7870	8048	~~8605~~							x 7749	s 374
8/12	8544	8797	7795	8081								8304	451
~~benzene~~ xylene													
8/2	10771												
8/3	~~7478~~	~~5280~~	11004	10059	*	29881	11191	*					10751
8/4	10621	10898	9402	~~8624~~		10206	9163	10798					10181
8/5	7757	~~9188~~	[illegible]	9389	8761 X	12058	12500	12500				8773	12355
8/8	~~7614~~	10211	11864	10910	10978								10991
8/9	~~7116~~	8944	9383	9895	10425					x = 9662	s = 640	x = 9152	~~1266~~
8/10	10990	10522	9901	10241	10545							x 10284	s 265
8/11	10117	9531	9330	10214	~~12077~~							x 9798	s 434
8/12	10071	12572	8968	9370								10230	1632

2294724

* sample analyzed between these calibrations

X use morning = 8773 = .0057 aft = 12355 = 0.0040

49.9/12355

TRW
ENVIRONMENTAL ENGINEERING DIVISION

8/3/83

SUMMARY GAS ANALYSIS DAF-302-3

COMPONENT RUN	ppm	ppm	(continued)		
C-1	46.3	46.5	unknown	12.6**	11.9**
C-2	7.0	7.0	Toluene	45.8**	44.8**
C-3	7.9	8.3	unknown	2.2**	2.2**
~~C-4~~ unknown	2.2*	2.6*	unknown	1**	<1**
~~C-5~~ C-4	4.7	5.3	xylene	6.3	6.0
~~C-6~~ unknown	14.1*	13.5*	xylene	3.1	2.9
~~BENZENE~~ C-5	4.1	2.8	unknown	2.7	2.6
~~TOLUENE~~ C-6	17.1**	16.6**			
Benzene	15.5	14.8			
~~XYLENE~~ Heptane	11.6**	11.9**			
(continued)				204	200
TOTAL HC					
%M					
% CO_2	ND	ND			
% CO	ND	ND			
% N_2	76.2	73.4			
% O_2	21.3	20.1			
	97.5	93.5			
% CH_4					
TOTAL %					

* as propane

** as benzene

TRW
ENVIRONMENTAL ENGINEERING DIVISION

8/3/83

SUMMARY GAS ANALYSIS DAF-302-2

COMPONENT RUN	ppm	ppm			
C-1	47.7	45.9	unknown	11.6**	10.5**
C-2	5.7	5.7	Toluene	41.3**	37.2**
C-3	6.9	6.6	unknown	3.5**	1.6**
~~C-4~~ Unknown	2.0*	2.0*	unknown	3.5**	<1**
C-~~5~~4	4.1	3.4	Xylene	8.3	5.3
~~C-6~~ unknown	6.5*	6.0*	xylene	4.4	2.5
~~BENZENE~~ C-5	1.9	2.0	unknown	4.1	8.2
~~TOLUENE~~ C-6	10.2**	9.9**			
Benzene	11.7	10.4			
~~XYLENE~~ Heptane	10.3 **	9.7**			
(continued above)					
TOTAL HC				180	161
%M					
% CO_2 ND					
% CO ND					
% N_2 74.8					
% O_2 21.3					
96.1					
% CH_4					
TOTAL %					

* as propane

** as benzene

TRW
ENVIRONMENTAL ENGINEERING DIVISION

EQT-1 8/3/83

SUMMARY GAS ANALYSIS

COMPONENT RUN	ppm	ppm			
C-1	27.4	26.6	xylene	5.3	4.0
C-2	<1	<1	xylene	1.9	1.5
C-3	<1	<1			
C-4					
C-5					
C-5	1.8 **	2.1 **			
BENZENE	7.5	7.9			
~~TOLUENE~~ unknown	3.7 **	7.7 **			
Toluene	31.0 **	27.4 **			
~~XYLENE~~ unknown	5.5 **	3.4 **			
(continued above) →				84	82
TOTAL HC					
%M					
% CO_2	ND				
% CO	ND				
% N_2	73.3	74.0			
% O_2	20.1	20.6			
	93.4	94.6			
% CH_4					
TOTAL %					

** as benzene

TRW

ENVIRONMENTAL ENGINEERING DIVISION

8/4/83

Skimming

SUMMARY GAS ANALYSIS DAF-302-1

COMPONENT RUN	ppm	ppm			
C-1	55.0	52.3	unknown	[illegible]**	[illegible]**
C-2	6.7	6.1	Toluene	54.2**	56.9**
C-3	8.5	8.0	unknown	7.7**	9.9**
~~C-4~~ unknown	2.3*	2.3*	unknown	3.7**	4.6**
~~C-5~~ C-4	5.1	4.6	unknown	8.5**	10.4**
~~C-6~~ unknown	12.3 *	13.8*	Xylene	15.0**	16.9**
~~BENZENE~~ C-5	4.4	5.1	Xylene	8.1**	7.7**
~~TOLUENE~~ C-6	22.8 **	23.1 **	unknown	6.4*	7.4**
Benzene	19.6	20.1	unknown	7.5**	6.8**
~~XYLENE~~ Heptane	21.0 **	21.6**			
(continued above) →				288	298
TOTAL HC					
%M					
% CO_2					
% CO					
% N_2	75.0				
% O_2	21.3				
	96.3				
% CH_4					
TOTAL %					

* as propane

** as benzene

TRW
ENVIRONMENTAL ENGINEERING DIVISION

8/4/83

SUMMARY GAS ANALYSIS DAF-302-2

COMPONENT RUN	ppm	ppm			
C-1	45.9	45.1	benzene	13.2	13.3
C-2	5.2	5.4	heptane	6.4**	6.8**
C-3	6.3	6.1	unknown	8.9**	9.5**
~~C-4~~ unknown	2.5*	2.2*	toluene	31.3**	33.5**
~~C-5~~ C4	5.0	3.9	unknown	1.9**	3.0**
~~C-6~~ unknown	<1*	ND*	unknown	5.0**	4.7**
~~BENZENE~~ unknown	<1*	ND*	xylene	7.5	8.0
~~TOLUENE~~ unknown	15.3*	12.9*	xylene	2.9	3.1
C5	4.2	3.5	unknown	1.5**	1.8**
~~XYLENE~~ C6	15.2**	15.1**	unknown	2.4**	1.2**
(continued above) →				181	179
TOTAL HC					
%M					
% CO_2	ND				
% CO	ND				
% N_2	73.5	72.5	73.4		
% O_2	20.0	19.8	20.0		
	93.5	92.3	93.4		
% CH_4					
TOTAL %					

* as propane

** as benzene

TRW
ENVIRONMENTAL ENGINEERING DIVISION

8/4/83

EQT-1

SUMMARY GAS ANALYSIS

COMPONENT RUN	ppm	ppm			
C-1	29.6	29.3	xylene	4.3	3.7
C-2	1.2	1.3	Xylene	1.5	1.5
C-3	<1	<1			
C-4	ND	<1			
C-5					
C-6	2.3 **	2.3 **			
BENZENE	9.5	9.9			
~~TOLUENE~~ unknown	7.6 **	7.7 **			
Toluene	25.3 **	25.8 **			
~~XYLENE~~ unknown	3.0 **	2.6 **			
(continued above)		→			
TOTAL HC				84	84
%M					
$\% CO_2$					
% CO					
$\% N_2$	73.8				
$\% O_2$	20.4				
	94.2				
$\% CH_4$					
TOTAL %					

** as benzene

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ENVIRONMENTAL ENGINEERING DIVISION

8/4/83

SUMMARY GAS ANALYSIS EQT-2

COMPONENT RUN	ppm	ppm			
C-1	25.2	24.0	xylene	1.8	1.7
C-2	<1	ND	xylene	<1	<1
C-3	<1	<1			
C-4					
C-5					
C-6	2.1 **	2.1 **			
BENZENE	4.7	5.0			
~~TOLUENE~~ unknown	4.7	4.9			
Toluene	13.2	13.9			
~~XYLENE~~ unknown	1.4	1.6			
(continued above) →					
TOTAL HC				53	53
%M					
% CO_2	ND				
% CO	ND				
% N_2	78.2				
% O_2	21.5				
	99.7				
% CH_4					
TOTAL %					

** as benzene

DGA

TRW 8/5/83

ENVIRONMENTAL ENGINEERING DIVISION

SUMMARY GAS ANALYSIS DAF-302-1

COMPONENT RUN	ppm	ppm	—continued—		
C-1	~~58.2~~ 57.4	~~51.4~~ 50.2	uk	9.4	10.7
C-2	7.3	6.1	Toluene	44.3	49.1
C-3	7.4	6.9	uk	1.3	2.1
C-4 uk	2.6	2.1	uk	2.0	4.5
~~C-5~~ C4	4.2	4.3	m-x ~~o-x~~	12.4 4.6	15.1 5.4
~~C-6~~ uk	11.2	10.1	uk uk	3.4 5.9	4. 5.6
~~BENZENE~~ C5	5.6	3.6			
~~TOLUENE~~ ~~B2~~ uk	11.3	—			
~~Tol~~ hex	12.1	9.3			
~~XYLENE~~ Bu?	20.7	28.1			
Heptane	46	—			
TOTAL HC				227.9	217.2
%M ND					
% CO_2 ND					
% CO ND					
% N_2	80.15	78.0	78.0		
% O_2	22.00	20.3	20.1		
% CH_4					
TOTAL %					

	Sne
air	Y
CO_2	N
O_2	Y
N_2	Y

8/5/83

TRW

ENVIRONMENTAL ENGINEERING DIVISION

DAP-302-2

SUMMARY GAS ANALYSIS

COMPONENT RUN	ppm	ppm	— Continued	ppm	ppm
C-1	58	58.7	U12	12.6	13.2
C-2	5.9	7.1	Tol	44.7	44
C-3	8	8.6	U12	3.4	3.8
~~C-4~~ U12	2.6	3.1	U12	5.2	4.8
~~C~~-5 U12	8.2	7.2	U12	2.1	2.2
~~C-6~~ U12	41	—	m-XYL	10.6	10.2
~~BENZENE~~ U12	15.9	13.8	o-XYL	3.9	3.6
~~TOLUENE~~ U12	8.5	5.2	U12	2.3	1.9
C5	1.2	—		1.8	2.7
~~XYLENE~~ C6	17.9	18.0		2.5	2.3
Benz	35.0	35.1		2.3	2.7
TOTAL HC				256.2	248.1
%M					
% CO_2					
% CO					
% N_2	75.5 ~~76.9~~	76.4			
% O_2	19.6 ~~19.8~~	19.7			
% CH_4					
TOTAL %					

8/5/83 DGA

TRW
ENVIRONMENTAL ENGINEERING DIVISION

E-QT-1

SUMMARY GAS ANALYSIS

COMPONENT RUN	ppm	ppm	-CONTINUED-	ppm	ppm
C-1	~~18.3~~ 17.9	~~18~~ 17.5	o-xyl	1.0	1.2
C-2	<1	<1			
C-3	<1	<1			
C-4	—	—			
C-5	—	—			
C-6	1.4	1.4			
BENZENE	7.6	8.1			
~~TOLUENE~~ U12	3.4	3.5			
TOL	18.7	18.7			
~~XYLENE~~ U16	1.4	1.1			
m-xyl	3.6	3.7			
TOTAL HC				55.0	55.2
%M					
% CO_2					
% CO					
% N_2	~~77.8~~ 77.2	77.8			
% O_2	~~20.6~~ 20.2	20.6			
% CH_4					
TOTAL %					

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ENVIRONMENTAL ENGINEERING DIVISION

8/5/83

SUMMARY GAS ANALYSIS CQT-2

COMPONENT RUN	ppm	ppm	- CONTINUED	~~ppm~~	ppm
C-1	20.3	20.5	m-xyl	7.4	6.7
C-2	1.7	1.9	o-xyl	2.5	2.2
C-3 UR	<1	–	UR	1.2	–
~~C-4~~ C3	<1	<1	UR	1.9	–
C-5	–	–			
C-6	2	2.2			
BENZENE	12.6	12.5			
~~TOLUENE~~ UR	4.9	4.9			
TOL	30.6	29.1			
XY~~LENE~~ UR	<1				
UR	3.3	3.6			
TOTAL HC				88.4	82.6
%M					
% CO_2					
% CO					
% N_2	78.1	78.5	76.7		
% O_2	20.7	20.7	20.		
% CH_4					
TOTAL %					

DGA

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8/5/83

ENVIRONMENTAL ENGINEERING DIVISION

CHO-1

SUMMARY GAS ANALYSIS

COMPONENT RUN	ppm	ppm	~~ppm~~ CONTINUED	TOTALS ppm
C-1	~~22.1~~ 22.5	~~23.2~~ 22.6	~~23.4~~ 22.9	
C-2	1.7	<1	3.1	
C-3	<1	<1	<1	
C-4 ~~4.6~~	–	–	–	
C-5	–	–	–	
C-6	1.9	2	NM	
BENZENE	20.1	20.8	NM	
~~TOLUENE~~ 4.2	10	10.5	NM	
Tol	30.6	23	NM	
XYLENE				
				35.8 78.9
TOTAL HC				
%M				
% CO_2				
% CO				
% N_2	76.9	76.4		
% O_2	19.8	19.7		
% CH_4				
TOTAL %				

8/8/83 DGA

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ENVIRONMENTAL ENGINEERING DIVISION

SUMMARY GAS ANALYSIS DAF-302-1

COMPONENT RUN	ppm	ppm	-CONTINUED-		
C-1	54.8	55.9	UNK	2.9	2.8
C-2	3.9	5.1	UNK	2.1	2.
C-3	5.4	5.9	m-XYL	11.6	11
C-4 UNK	2.3	2.4	O-XYL	4.1	3.6
C-5 C4	4.1	4	UNK	1.3	1.2
C-6 UNK	9.9	11.6	UNK	<1	1.2
BENZENE C5	3.2	3.5	UNK	1.8	2.2
TOLUENE C6	16.1	16.2	UNK	1.6	~~2~~.9
Benz	40.2	39.5			
XYLENE UNK	6	5.6			
Toluene	46.5	46.2			
TOTAL HC				217.8	221.8
%M					
% CO_2					
% CO					
% N_2	77.	77.3			
% O_2	19.7	19.8			
% CH_4					
TOTAL %					

8/8/83 DGA

TRW
ENVIRONMENTAL ENGINEERING DIVISION

SUMMARY GAS ANALYSIS DAS - 302 R

COMPONENT RUN	ppm	ppm	- CONTINUED -		
C-1	51.7	54.1	Benzene	63.9	63.3
C-2	3.5	4.7	UK	12.9	12.6
C-3	4.7	5.4	Toluene	75.7	74.6
C-4 UK	2.8	2.5	UK	8.6	2.6
C-5 C4	5.0	4.6	UK	7.8	6.7
C-6 UK	11.1	13.3	m-xyl	21.3	20.1
BENZENE C5	3.7	4.3	o-xyl	9.1	7.4
TOLUENE UK	2.2	2.4	UK	5.9	3.9
UK	5.8	3.3	UK UK	1.9 4.3	<1 <1
XYLENE UK	14	16.5	UK UK	4.2 9.8	1.1 3.6
Hexane	26.3	26.1	UK UK	5.5 8	5.3
TOTAL HC			UK	4.6	4.6
				376.3	347
%M					
% CO_2					
% CO					
% N_2	75.7	76.6			
% O_2	19.4	19.7			
% CH_4					
TOTAL %					

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ENVIRONMENTAL ENGINEERING DIVISION

8/9/83 DGA

SUMMARY GAS ANALYSIS DAF-302-1

COMPONENT RUN	ppm	ppm	CONTINUED	
C-1	37.4	37.6	~~UK~~ ~~[illegible]~~	1~~70~~
C-2	2.5	2.2	UK 19.5 20.3 ~~37.4 37.5~~	UK 2.5 2.4
C-3	2.2	2.2	~~Hex~~ UK 37.4 37.5 ~~49.7 48.7~~	UK 1.7 1.7
~~C-4~~ UK	1.9	1.4	Benz 49.7 48.7	UK 2.7 2.4
~~C-5~~ C4	3.8	3.4	Hept 27.6 29.0	UK 1.5 1.6
~~C-6~~ UK	17.4	18.2	Tol 16.7 17.5	
~~BENZENE~~ UK	12	12.3	UK 91.7 93.4	
~~TOLUENE~~ UK	4.6	4.3	UK 9. 9.8	
UK	26.2	23.9	m-xyl 5.9 6.2	
~~XYLENE~~ UK	18.3	19.5	o xyl 22.2, 22.6	
UK UK	~~8~~6 5.4	77.0	UK 9.2 9	
TOTAL HC				435 / 444.1
%M				
% CO_2				
% CO				
% N_2	76.63	76.62		
% O_2	19.82	19.8		
% CH_4				
TOTAL %				

TRW 8/9/83 DGA

ENVIRONMENTAL ENGINEERING DIVISION

SUMMARY GAS ANALYSIS DAF-302-2

COMPONENT RUN	ppm	ppm	cont	need
C-1 C1	34.9	34.8	heptane 42.9 45.9	o-xyl 23.8 24.7
C-2	2.1	1.5	u/k 28.6 29.0	u/k 10.2 11.1
C-3	2.9	2.4	Tol 17.3 18	2.7 3.4
C-4 u/k	1.6	1.8	u/k 92.5 96.3	1 1.3
C-5 C4	3.	3.5	u/k 10.2 10.1	3.2 3.
C-6 u/k	12.4	13.2	m-xyl 6.8 7.1	3.5 2.9
BENZENE u/k	6.9	8.3		1.3 2.
TOLUENE u/k	2.2	3.8		
u/k	16.5	16.7		
XYLENE ~~hexane~~ u/k	23.6	24.7		
benz	7.8	8.2		
TOTAL HC				357.9 / 373.7
%M				
% CO_2				
% CO				
% N_2	75.41	75.58		
% O_2	19.5	19.6		
% CH_4				
TOTAL %				

373.7

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ENVIRONMENTAL ENGINEERING DIVISION

8/9/83

OGA

SUMMARY GAS ANALYSIS

T-201-1

COMPONENT RUN	ppm	ppm		
C-1	15.6	–		
C-2	<1	ND		
C-3				
C-4				
C-5				
C-6 ~~hexane~~ UK	2.1	1.7		
BENZENE	4.5	4.7		
~~TOLUENE~~ UK	7.9	7.7		
XYLENE				
TOTAL HC	30.1	29.7 ~~14.1~~		
%M				
% CO_2				
% CO				
% N_2	76.82	76.51		
% O_2	19.87	19.65		
% CH_4				
TOTAL %				

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ENVIRONMENTAL ENGINEERING DIVISION

8/9/83 DGA

SUMMARY GAS ANALYSIS T200-1

COMPONENT RUN	ppm			
C-1	16.2	16		
C-2				
C-3				
C-4				
C-5				
C-6 ~~hexane~~ u/c	1.4	1.4		
BENZENE	3.3	3.6		
~~TOLUENE~~ ~~heptane~~ u/c	5.8	6.1		
u/c	.2	—		
~~XYLENE~~				
TOTAL HC	28.7	27.1		
%M				
% CO_2				
% CO				
% N_2	75.33	75.19		
% O_2	19.46	19.38		
% CH_4				
TOTAL %				

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ENVIRONMENTAL ENGINEERING DIVISION

SUMMARY GAS ANALYSIS DAF-302-1

continued

COMPONENT RUN	ppm	ppm		
C-1	24.2	28.7	u12	43.1 43.9
C-2	1.6	2.7	u12	3.2 3.5
C-3	1.8	2.1	u12	2.8 3.4
~~C-4~~ u12	1.4	< 1	m-xyl	12.9 12.5
~~C-5~~ C4	2.1	1.4	o-xyl	5.4 5.0
~~C-6~~ u12	3.5	3.3	u12	2.3 2.2
~~BENZENE~~ C6	6.7	6.7	u12	1.2 3.1
~~TOLUENE~~ u12	1.9	—	u12	2.9 2.3
Benzene	22.2	25.2	u12	4.4 2.5
~~XYLENE~~ heptane	6.9	7.1		
u12	5.6	5.7		
TOTAL HC				156.1 161.3
%M				
% CO_2				
% CO				
% N_2	77.83	77.67		
% O_2	20.10	19.74		
% CH_4				
TOTAL %				

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ENVIRONMENTAL ENGINEERING DIVISION

8/10/83 DGA

SUMMARY GAS ANALYSIS

V-204-1

COMPONENT RUN	ppm	ppm	continued	
C-1	18.1	19.6	u12	1.1 1.1
C-2				
C-3				
C-4				
~~C-5~~ u12	1.8	–		
~~C-6~~ u12	4.2	–		
~~BENZENE~~ hexane	14.3	14.6		
~~TOLUENE~~ benzene	23.3	24.7		
heptane	14.7	15		
~~XYLENE~~ u12	9.6	9.9		
Toluene	35.1	36.6		122.1 121.5
TOTAL HC				
%M				
% CO_2				
% CO				
% N_2	76.28	76.06		
% O_2	19.66	19.57		
% CH_4				
TOTAL %				

8/11/84

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SUMMARY GAS ANALYSIS

1A-P-OUT

COMPONENT RUN	1		continued	continued
C-1	1762		UK 1208	UK 83.9
C-2	4.5		UK 1180	" 132
C-3	12.8		UK 1303	" 48.3
C-4 UK	<1		hexane 2033	" 92.5
C-5 UK	12.7		benzene 1074	" 80.4
C-6 C4	36.4		heptane 449	" 18.8
BENZENE UK	1.6		UK 596	" 84.7
TOLUENE UK	459		UK 219	" 4.3 71.4
UK	518		UK 178	" 27.2 13.9
XYLENE C5	110		m-xyl 168	" 30.3
	70.1		o-xyl 67.8	" 6.3
TOTAL HC				12,162
%M				
% CO_2				
% CO				
% N_2	83.09			
% O_2	12.98			
% CH_4				
TOTAL %				

TRW
ENVIRONMENTAL ENGINEERING DIVISION

8/11/83 DGA

(inlet)

1 of 2

SUMMARY GAS ANALYSIS

run 1 APM — run 2 — IAF-1 CONTINUED

COMPONENT RUN	1		~~[illegible]~~	
C-1	1607	1597	uk 1735	1724
C-2	7.6	7.6	uk 1705	1708
C-3	18.2	18.1	uk 39	
C-4 uk	1.1	1.2	uk 1.5	
C-5 uk	15.3	15.4	hexane ~~uk~~ 1310	1267
C-6 c4	42.3	41.7	uk 854 benzene 848	831 822
BENZENE uk	1.8	2.3	heptane 845 uk 738	803 706
TOLUENE uk	438	429	TOLUENE 432 uk 412	410 367
c5	286	279	uk 348 uk 311	318 267
XYLENE uk	210	207	m-XYL 268 o-XYL 171	237 119
uk	20.1	66	uk 311 uk 44	113 19
TOTAL HC uk	1095	1068	uk 71.7 uk 109	uk 244 uk 33.8
%M				
% CO_2				
% CO				
% N_2	91.91	92.06		
% O_2	5.96	6.05		
% CH_4				
TOTAL %				

TRW
ENVIRONMENTAL ENGINEERING DIVISION

8/11/83

(inlet)

SUMMARY GAS ANALYSIS 1AF-1 2 of 2

COMPONENT RUN	1			
C-1 wt	139	18		
C-2	108	35.7		
C-3	105	43.2		
C-4	74.2	40.1		
C-5	1.9	-		
C-6	8.2	7.1		
BENZENE				
TOLUENE				
XYLENE				
TOTAL HC	14,738	13,867		
%M				
% CO_2				
% CO				
% N_2				
% O_2				
% CH_4				
TOTAL %				

8/11/83

TRW
ENVIRONMENTAL ENGINEERING DIVISION

1 of 2

SUMMARY GAS ANALYSIS

DAS-302-1

COMPONENT RUN	1		continued	
C-1	28.9	29.6	uk 5.8	5.8
C-2	<1	1.1	benzene 55.7	54.8
C-3	2.2	2.0	uk 17.2	17.4
C-4 uk	3.6	4.1	Toluene 61.8	61.3
C-5 C4	6.3	6.6	uk 10.2	9.9
C-6 uk	17.8	17.2	uk 9.6	10.7
BENZENE C5	8.5	9.9	M-xyl p 18.8	19.7
TOLUENE uk	4.4	6.8	O-xyl 8.6	7.9
uk	3.5	4.1	uk 8.2	6.0
XYLENE uk	3.1	3.4	uk 2.6	1.3
hexane	19.2	19.	uk 5.2	2.8
~~TOTAL~~ TOTAL ~~HC~~				
%M				
% CO_2				
% CO				
% N_2	76.88	77.84		
% O_2	19.62	19.67		
% CH_4				
TOTAL %				

8/11/83

TRW

ENVIRONMENTAL ENGINEERING DIVISION

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SUMMARY GAS ANALYSIS

DAF-302-1

COMPONENT RUN	1.			
C-1 u/2	5.2	3.5		
C-2	5.2	5.2		
C-3	3.1	2.1		
C-4	5.5	4.7		
C-5	7.1	7.3		
C-6	5.7	5.6		
BENZENE				
TOLUENE				
XYLENE				
TOTAL HC	333.5	330.3		
%M				
% CO_2				
% CO				
% N_2				
% O_2				
% CH_4				
TOTAL %				

TRW
ENVIRONMENTAL ENGINEERING DIVISION

8/11/83

SUMMARY GAS ANALYSIS

IAF-IN-2

COMPONENT RUN	1 ①	co 2		
C-1	2818	UK 2686	UK 151	
C-2	3217	UK 2848	m-XYL 105	
C-3	2917	UK 2596	o-XYL 31.7	
C-4 UK	~~29~~.3	UK 194	UK 308	
C-5 UK	2.8	hexane 6127	UK 129	
C-6 C4	80.5	benzene 2642	UK 103	
BENZENE UK	1030	heptane 938	UK 101	
TOLUENE UK	1107	UK 1057	UK 77.4	
C5	220	UK 399	UK 67.8	
XYLENE UK	5.8	UK 373	UK 39.7	
UK	162	UK 507	UK 2	
TOTAL HC			32,568	
%M				
% CO_2				
% CO				
% N_2	93.12			
% O_2	6.56			
% CH_4				
TOTAL %				

TRW
ENVIRONMENTAL ENGINEERING DIVISION

8-12-63

SUMMARY GAS ANALYSIS

EG-045

COMPONENT RUN	1			
C-1	23.6	23.4		
C-2 ug/l	1.5	3.2		
C-3 ug/l	1.0	2.4		
C-4 ug/l	1.4	–		
C-5 ug/l	–	1.9		
C-6 ug/l	1.5	–		
BENZENE ug/l	1.1	2		
TOLUENE ug/l	6.3	4.5		
uK	1.5	–		
XYLENE				
TOTAL HC	37.9	37.4		
%M				
% CO_2				
% CO				
% N_2	78.48	78.21		
% O_2	19.99	19.85		
% CH_4				
TOTAL %				

TRW
ENVIRONMENTAL ENGINEERING DIVISION

8-12-83

SUMMARY GAS ANALYSIS

~~EQ-IN~~
EQ-OUT-2

COMPONENT RUN	1 ppm			
C-1	15.4			
C-2 UK ~~hexane~~	1.3			
C-3 UK	1.3			
C-4 UK	1.3			
C-5				
C-6				
BENZENE				
TOLUENE				
XYLENE				
TOTAL HC	19.3			
%M				
% CO_2				
% CO				
% N_2	76.23	75.97		
% O_2	19.7	19.46		
% CH_4				
TOTAL %				

TRW
ENVIRONMENTAL ENGINEERING DIVISION

8-12-83

SUMMARY GAS ANALYSIS ~~CG OUT~~-2 ~~CG OUT~~-2

CG-IN

COMPONENT RUN	1 ppm			
C-1	25.3	23.5	uk 1	< 1
C-2 uk	1.8	1.7	uk 6.6	5.3
C-3 uk	4.2	3.3	uk 4.2	4.7
C-4 uk	9.3	8.9	uk 2.5	1.7
C-5 hexane	5.6	6	uk 1.7	—
C-6 benzene	36.7	40.5	uk 2.4	—
BENZENE uk	3.2	—	uk 1	< 1
TOLUENE uk	69.0	71.2	uk —	1.4
uk	1.1	1.3		
XYLENE M-xyl	14.5	15.1		
o-xyl	5.3	5.8		
TOTAL HC			195.4	190.4
%M				
% CO_2				
% CO				
% N_2	80.35			
% O_2	23.86			
% CH_4				
TOTAL %				

TRW
ENVIRONMENTAL ENGINEERING DIVISION

8-12-83

SUMMARY GAS ANALYSIS

IAF-2N

COMPONENT RUN		1 ppm						
C-1		2156	UK	2283	UK	320	UK	23.4
C-2		8.2	UK	2155	M-XYL	385	UK	485
C-3		21.8	UK	17.3	O-XYL	106	UK	59.9
C-4	UK	25.9	UK	935	UK	159		
C-5	C4	72.1	hexane	2005	UK	47.8		
C-6	UK	3.2	UK	1213	UK	70.3		
BENZENE	UK	818	BENZ	2101	UK	120		
TOLUENE	C5	510	HEPT	793	UK	122		
	UK	305	UK	553	UK	125		
XYLENE	UK	114	UK	384	UK	112		
	UK	1673	UK	351	UK	113		
TOTAL HC								20,309
%M								
% CO_2								
% CO								
% N_2		90.71						
% O_2		7.19						
% CH_4								
TOTAL %								

DAF AND EQUALIZATION TANK FLOW COMPUTATIONS

TEST DAY 8/1/83

Press 'key code' to enter variable. Press 'Z' for results.

CURRENT VALUE	KEY CODE	PARAMETERS IN METHODS 2-5
68	A	Meter Temperature (F)
.65	B	Stack Static Pressure (in.H2O)
0	C	Stack Moisture Collected (gm)
29.8	D	Barometric Pressure (in.Hg)
1.6	E	Meter Pressure (in.H2O)
1	F	Meter Volume (cu.ft.)
0	G	Percent CO2
21	H	Percent O2
74.8	I	Percent N2
240.529	J	Stack dimension (sq.in.)
1	K	Sampling time (min.)
.1	L	Sampling nozzle diameter (in.)
7.21571	M	Delps Subroutine result

PRESS <C> TO CONTINUE.

Tt(min.)	1	Vm(scf)	.999521
Dn(in.)	.1	Vm(scm)	.0283064
Ps(in.H2O)	.65	Vw gas(scf)	0
Vm(cu.ft.)	1	% moisture	0
Vw(gm.)	0	Md	1
Pm(in.H2O)	1.6	MWd	27.664
Tm(F)	68	MW	27.664
Pb(in.Hg.)	29.8	Vs(fpm)	1275.17
% CO2	0	Flow(acfm)	2129.96
% O2	21	Flow(acmm)	60.3206
% N2	74.8	Flow(scfm)	2043.56
SQR(DELPS)	7.21571	Flow(scmm)	57.8737
As(sq.in.)	240.529	% I	1497.9
Ts(F)	89	% EA	-1676.25

DAF 202 8/1/83

TEST DAY 8/3/83

Press 'key code' to enter variable. Press 'Z' for results.

CURRENT VALUE	KEY CODE	PARAMETERS IN METHODS 2-5
68	A	Meter Temperature (F)
-.5	B	Stack Static Pressure (in.H2O)
0	C	Stack Moisture Collected (gm)
27.8	D	Barometric Pressure (in.Hg)
1.6	E	Meter Pressure (in.H2O)
1	F	Meter Volume (cu.ft.)
0	G	Percent CO2
20.3	H	Percent O2
73.6	I	Percent N2
424.558	J	Stack dimension (sq.in.)
1	K	Sampling time (min.)
.1	L	Sampling nozzle diameter (in.)
8.48541	M	Delps Subroutine result

PRESS <C> TO CONTINUE.

Tt(min.)	1	Vm(scf)	.999521
Dn(in.)	.1	Vm(scm)	.0283064
Ps(in.H2O)	-.5	Vw gas(scf)	0
Vm(cu.ft.)	1	% moisture	0
Vw(gm.)	0	Md	1
Pm(in.H2O)	1.6	MWd	27.104
Tm(F)	68	MW	27.104
Pb(in.Hg.)	27.8	Vs(fpm)	1517.11
% CO2	0	Flow(acfm)	4472.93
% O2	20.3	Flow(acmm)	126.673
% N2	73.6	Flow(scfm)	4240.71
SQR(DELPS)	8.48541	Flow(scmm)	120.097
As(sq.in.)	424.558	% I	1274.1
Ts(F)	93.9999	% EA	-2334.41

EQ TANK 8/3/83

CHEVRON/EL SEGUNDO

d3

EJ

FF

TEST DAY 8/4/83

Press 'key code' to enter variable. Press 'Z' for results.

CURRENT VALUE	KEY CODE	PARAMETERS IN METHODS 2-5
68	A	Meter Temperature (F)
.65	B	Stack Static Pressure (in.H2O)
0	C	Stack Moisture Collected (gm)
29.8	D	Barometric Pressure (in.Hg)
1.6	E	Meter Pressure (in.H2O)
1	F	Meter Volume (cu.ft.)
0	G	Percent CO2
20.6	H	Percent O2
74.2	I	Percent N2
240.529	J	Stack dimension (sq.in.)
1	K	Sampling time (min.)
.1	L	Sampling nozzle diameter (in.)
7.07012	M	Delps Subroutine result

PRESS <C> TO CONTINUE.

Tt(min.)	1	Vm(scf)	.999521
Dn(in.)	.1	Vm(scm)	.0283064
Ps(in.H2O)	.65	Vw gas(scf)	0
Vm(cu.ft.)	1	% moisture	0
Vw(gm.)	0	Md	1
Pm(in.H2O)	1.6	MWd	27.368
Tm(F)	68	MW	27.368
Pb(in.Hg.)	29.8	Vs(fpm)	1256.18
% CO2	0	Flow(acfm)	2098.24
% O2	20.6	Flow(acmm)	59.4222
% N2	74.2	Flow(scfm)	2005.82
SQR(DELPS)	7.07012	Flow(scmm)	56.805
As(sq.in.)	240.529	% I	1526.08
Ts(F)	90.999	% EA	-2037.18

DAF 8/4/83

DAF 4

#3 1

TEST DAY 8/5/83

Press 'key code' to enter variable. Press 'Z' for results.

CURRENT VALUE	KEY CODE	PARAMETERS IN METHODS 2-5
68	A	Meter Temperature (F)
.65	B	Stack Static Pressure (in.H2O)
0	C	Stack Moisture Collected (gm)
29.8	D	Barometric Pressure (in.Hg)
1.6	E	Meter Pressure (in.H2O)
1	F	Meter Volume (cu.ft.)
0	G	Percent CO2
19.9	H	Percent O2
76.9	I	Percent N2
240.529	J	Stack dimension (sq.in.)
1	K	Sampling time (min.)
.1	L	Sampling nozzle diameter (in.)
7.39987	M	Dalps Subroutine result

PRESS <C> TO CONTINUE.

Tt(min.)	1	Vm(scf)	.999521
Dn(in.)	.1	Vm(scm)	.0283064
Ps(in.H2O)	.65	Vw gas(scf)	0
Vm(cu.ft.)	1	% moisture	0
Vw(gm.)	0	Md	1
Pm(in.H2O)	1.6	MWd	27.9
Tm(F)	68	MW	27.9
Pb(in.Hg.)	29.8	Vs(fpm)	1302.17
% CO2	0	Flow(acfm)	2175.07
% O2	19.9	Flow(acmm)	61.5979
% N2	76.9	Flow(scfm)	2068
SQR(DELPS)	7.39987	Flow(scmm)	58.5658
As(sq.in.)	240.529	% I	1480.2
Ts(F)	93.9999	% EA	4955.18

#

8/5

DAF 8/5/83

Press 'key code' to enter variable. Press 'Z' for results.

CURRENT VALUE	KEY CODE	PARAMETERS IN METHODS 2-5
68	A	Meter Temperature (F)
.35	B	Stack Static Pressure (in.H2O)
0	C	Stack Moisture Collected (gm)
29.8	D	Barometric Pressure (in.Hg)
1.6	E	Meter Pressure (in.H2O)
1	F	Meter Volume (cu.ft.)
0	G	Percent CO2
20.4	H	Percent O2
73.8	I	Percent N2
424.558	J	Stack dimension (sq.in.)
1	K	Sampling time (min.)
.1	L	Sampling nozzle diameter (in.)
8.31435	M	Delps Subroutine result

PRESS <C> TO CONTINUE.

Tt(min.)	1	Vm(scf)	.999521
Dn(in.)	.1	Vm(scm)	.0283064
Ps(in.H2O)	.35	Vw gas(scf)	0
Vm(cu.ft.)	1	% moisture	0
Vw(gm.)	0	Md	1
Pm(in.H2O)	1.6	MWd	27.192
Tm(F)	68	MW	27.192
Pb(in.Hg.)	29.8	Vs(fpm)	1482.57
% CO2	0	Flow(acfm)	4371.07
% O2	20.4	Flow(acmm)	123.789
% N2	73.8	Flow(scfm)	4152.84
SCR(DELPS)	8.31435	Flow(scmm)	117.609
As(sq.in.)	424.558	% I	1301.05
Ts(F)	93.9999	% EA	-2225.13

Press 'key code' to enter variable. Press 'Z' for results.

CURRENT VALUE	KEY CODE	PARAMETERS IN METHODS 2-5
68	A	Meter Temperature (F)
.35	B	Stack Static Pressure (in.H2O)
0	C	Stack Moisture Collected (gm)
29.8	D	Barometric Pressure (in.Hg)
1.6	E	Meter Pressure (in.H2O)
1	F	Meter Volume (cu.ft.)
0	G	Percent CO2
21.5	H	Percent O2
78.2	I	Percent N2
424.558	J	Stack dimension (sq.in.)
1	K	Sampling time (min.)
.1	L	Sampling nozzle diameter (in.)
8.21207	M	Delps Subroutine result

PRESS <C> TO CONTINUE.

Tt(min.)	1	Vm(scf)	.999521
Dn(in.)	.1	Vm(scm)	.0283064
Ps(in.H2O)	.35	Vw gas(scf)	0
Vm(cu.ft.)	1	% moisture	0
Vw(gm.)	0	Md	1
Pm(in.H2O)	1.6	MWd	28.776
Tm(F)	68	MW	28.776
Pb(in.Hg.)	29.8	Vs(fpm)	1423.45
% CO2	0	Flow(acfm)	4196.8
% O2	21.5	Flow(acmm)	118.853
% N2	78.2	Flow(scfm)	4008.98
SCR(DELPS)	8.21207	Flow(scmm)	113.534
As(sq.in.)	424.558	% I	1347.74
Ts(F)	90.9999	% EA	-2514.03

EQ

Eq. TANK 8/5/83

Am

TEST DAY 8/8/83

Press 'key code' to enter variable. Press 'Z' for results.

CURRENT VALUE	KEY CODE	PARAMETERS IN METHODS 2-5
68	A	Meter Temperature (F)
-.44	B	Stack Static Pressure (in.H2O)
0	C	Stack Moisture Collected (gm)
29.8	D	Barometric Pressure (in.Hg)
1.6	E	Meter Pressure (in.H2O)
1	F	Meter Volume (cu.ft.)
0	G	Percent CO2
19.7	H	Percent O2
76.1	I	Percent N2
240.529	J	Stack dimension (sq.in.)
1	K	Sampling time (min.)
.1	L	Sampling nozzle diameter (in.)
7.4308	M	Delps Subroutine result

PRESS <C> TO CONTINUE.

Tt(min.)	1	Vm(scf)	.999521
Dn(in.)	.1	Vm(scm)	.0283064
Ps(in.H2O)	-.44	Vw gas(scf)	0
Vm(cu.ft.)	1	% moisture	0
Vw(gm.)	0	Md	1
Pm(in.H2O)	1.6	MWd	27.612
Tm(F)	68	MW	27.612
Pb(in.Hg.)	29.8	Vs(fpm)	1316.18
% CO2	0	Flow(acfm)	2198.47
% O2	19.7	Flow(acmm)	62.2607
% N2	76.1	Flow(scfm)	2119.07
SQR(DELPS)	7.4308	Flow(scmm)	60.012
As(sq.in.)	240.529	% I	1444.53
Ts(F)	85	% EA	5046.13

DAF 202 8/8/83

TEST DAY 8/9/83

#11
8-9-83
2345

Press 'key code' to enter variable. Press 'Z' for results.

CURRENT VALUE	KEY CODE	PARAMETERS IN METHODS 2-5
68	A	Meter Temperature (F)
-.45	B	Stack Static Pressure (in.H2O)
0	C	Stack Moisture Collected (gm)
29.85	D	Barometric Pressure (in.Hg)
1.6	E	Meter Pressure (in.H2O)
1	F	Meter Volume (cu.ft.)
0	G	Percent CO2
19.8	H	Percent O2
76.62	I	Percent N2
247.45	J	Stack dimension (sq.in.)
1	K	Sampling time (min.)
.1	L	Sampling nozzle diameter (in.)
7.22097	M	Delps Subroutine result

PRESS <C> TO CONTINUE.

Tt(min.)	1	Vm(scf)	1.00119
Dn(in.)	.1	Vm(scm)	.0283538
Ps(in.H2O)	-.45	Vw gas(scf)	0
Vm(cu.ft.)	1	% moisture	0
Vw(gm.)	0	Md	1
Pm(in.H2O)	1.6	MWd	27.7896
Tm(F)	68	MW	27.7896
Pb(in.Hg.)	29.85	Vs(fpm)	1273.87
% CO2	0	Flow(acfm)	2189.02
% O2	19.8	Flow(acmm)	61.9931
% N2	76.62	Flow(scfm)	2133.02
SQR(DELPS)	7.22097	Flow(scmm)	60.4071
As(sq.in.)	247.45	% I	1478.84
Ts(F)	80	% EA	4629.62

DAF 8/9/83
302

TEST DAY 8/10/83

#12
8-10

Press 'key code' to enter variable. Press 'Z' for results.

CURRENT VALUE	KEY CODE	PARAMETERS IN METHODS 2-5
68	A	Meter Temperature (F)
-.42	B	Stack Static Pressure (in.H2O)
0	C	Stack Moisture Collected (gm)
29.85	D	Barometric Pressure (in.Hg)
1.6	E	Meter Pressure (in.H2O)
1	F	Meter Volume (cu.ft.)
0	G	Percent CO2
20.1	H	Percent O2
77.83	I	Percent N2
247.45	J	Stack dimension (sq.in.)
1	K	Sampling time (min.)
.1	L	Sampling nozzle diameter (in.)
6.1984	M	Delps Subroutine result

PRESS <C> TO CONTINUE.

Tt(min.)	1	Vm(scf)	1.00119
Dn(in.)	.1	Vm(scm)	.0283538
Ps(in.H2O)	-.42	Vw gas(scf)	0
Vm(cu.ft.)	1	% moisture	0
Vw(gm.)	0	Md	1
Pm(in.H2O)	1.6	MWd	28.2244
Tm(F)	68	MW	28.2244
Pb(in.Hg.)	29.85	Vs(fpm)	1084.98
% CO2	0	Flow(acfm)	1864.43
% O2	20.1	Flow(acmm)	52.8008
% N2	77.83	Flow(scfm)	1790.89
SQR(DELPS)	6.1984	Flow(scmm)	50.718
As(sq.in.)	247.45	% I	1761.36
Ts(F)	87.8333	% EA	4495.43

202
DAF 8/10/83

TEST DAY 8/11/83

#14
8-11-83

Press 'key code' to enter variable. Press 'Z' for results.

CURRENT VALUE	KEY CODE	PARAMETERS IN METHODS 2-5
68	A	Meter Temperature (F)
-.5	B	Stack Static Pressure (in.H2O)
0	C	Stack Moisture Collected (gm)
29.85	D	Barometric Pressure (in.Hg)
1.6	E	Meter Pressure (in.H2O)
1	F	Meter Volume (cu.ft.)
0	G	Percent CO2
19.62	H	Percent O2
76.88	I	Percent N2
247.45	J	Stack dimension (sq.in.)
1	K	Sampling time (min.)
.1	L	Sampling nozzle diameter (in.)
8.22392	M	Delps Subroutine result

PRESS <C> TO CONTINUE.

Tt(min.)	1	Vm(scf)	1.00119
Dn(in.)	.1	Vm(scm)	.0283538
Ps(in.H2O)	-.5	Vw gas(scf)	0
Vm(cu.ft.)	1	% moisture	0
Vw(gm.)	0	Md	1
Pm(in.H2O)	1.6	MWd	27.8048
Tm(F)	68	MW	27.8048
Pb(in.Hg.)	29.85	Vs(fpm)	1450.49
% CO2	0	Flow(acfm)	2492.53
% O2	19.62	Flow(acmm)	70.5886
% N2	76.88	Flow(scfm)	2371.02
SQR(DELPS)	8.22392	Flow(scmm)	67.1473
As(sq.in.)	247.45	% I	1330.4
Ts(F)	93.0834	% EA	2700.99

DAF 202 8/1/83

CONTINUOUS MONITOR RESULTS

DAF CONTINUOUS MONITOR INSTRUMENT CHARTS

TRW

LOCATION Chevron DAF 302 POLLUTANT VOC DATE 8/3/83

INSTRUMENT RANGE (PPM) 0-1000ppm CH_3 CALIBRATED BY CBS

Record Data Every 3-5 Minutes 1002.5ppm CH_3 SPAN

Time	Scale Reading	ppm	HR AVG
0945	53 * 53,54	531.3 *	533
1000	55 53,53	551.3	
1015	53 44,44	531.3	
1030	46 46,46	461.1	489
(1) 1045			
1050	45,45,45	451.1	450
1105	45,52,54	451.1	
1120	53,45	431.1	
(2) 1140	51,52,52	511.3	
1155	52,51,52	521.3	508
(3) Switching	400	instruments	
1230	50 50,53	501.2	
1245	52,52,52	521.3	513
1300	50,50,52	501.2	
1315	52,53,54	521.3	
1330	53,54,50	531.3	
1345	54.5,52,53	546.4	523

479

Time	Scale Reading	ppm	Hourly Avg
1400	52.5,53,56	526.3	
1415	54,56,51	541.3	
1430	55,55,54	551.3	
1445	54,56,55	541.3	546
1500	53.5,53,54	536.3	
1515	52,50,50	521.3	
1530	48.5,49,51	486.2	
1545	51.5,45,50	516.3	506
1600	51,49,48	511.3	
1615	48	481.2	490
#	Recalibrated		

NOTES: 400 B Analyzer

Red on Chart

H_2 - 21 PSI

O_2 - 15 PSI

Sample - 3.0 PSI

* Calculating w/ HP 41C Program SDR

(1) Flameout - Recal, X100

(2) " " "

(3) 400 A Analyzer - Red on Chart

*5 minute Reading (ex) 945, 950, 955

LOCATION Chevron DAF 302 POLLUTANT VOC DATE 8/3/83

INSTRUMENT RANGE (PPM) 0-1000 CALIBRATED BY CBS

Record Data Every 3-5 Minutes 1002.5 ppm span

Time	Scale Reading	ppm	
1645	51 51,50	511.2	507
1700	50 51,50	501.2	
1715	49 48,50	491.2	
1730	49 49,47	491.2	
1745	48 49,50	481.1	491
1800	48 48,47	481.1	
1815	48 48,48	481.1	
1830	49 49,49	491.2	
1845	48 49,48	481.1	482
1900	49 48,48	491.2	
1915	48 47,48	481.1	
1930	49 47,48	491.2	
1945	47 50,47	471.1	479
2000	47 48,48	471.1	
2015	47 49,47	471.1	
2030	47 48,48	471.1	
2045	47 47,48	471.1	476

Time	Scale Reading	ppm	
2100	48 47,48	481.1	
2115	47 46,48	471.1	
2130	46 48,48	461.1	
2145	48 48,48	481.1	475
2200	47 47,48	471.1	
2215	49 46,45	491.2	
2230	48 47,48	481.1	
2240	48 48	481.1	skimm… proce… 224…
2250	70 80	701.7	518
2300	83 89	832.0	
2310	96 96	962.3	
2320	98 98	982.4	
2330	97 98	972.4	
2340	98 97	982.4	
2350	100 100	1002.4	958
2400	103 99	1032.5	skimmi… off 2400
2410	103 93	1032.5	

continued

NOTES: 400 A: Analyzer
Red on chart
Sample 3.2 PSI
H_2 - 21 PSI
O_2 = 15 PSI

TRW

303

LOCATION Chevron DAF 302 POLLUTANT VOA DATE 8/4/83

INSTRUMENT RANGE (PPM) ~~[illegible]~~ 0-1000ppm CALIBRATED BY CBS

Record Data Every 3-5 Minutes

Time	Scale Reading	ppm	
2420	87 83	872.1	
2430	82 81	822.0	
2440	76 74	761.8	
2450	73 73	731.8	786
100	71 70	711.7	
110	69 67	691.7	
120	67 66	671.6	
130	65 64	651.6	
140	63 62	631.5	
150	62 60	621.5	655
200	62 59,62	621.5	
215	61 59,60	611.5	
230 ~~245~~	61 57,59	611.5	
245	61 62,58	611.5	600
300	61 60,61	611.5	
315	60 59,59	601.4	
330	59 61,58	591.4	

Time	Scale Reading	ppm	
345	59 61,58	591.4	596
400	60	601.4	600
ran out of chart paper			
430	59	591.4	
445	60	601.4	
500	57	571.4	
515	59	591.4	
530	59	591.4	
545	58	581.4	
600	58.5	586.4	
615	59	591.4	
630	56	561.3	
645	59	591.4	
700	58	581.4	
715	59	591.4	
730	59	591.4	
800	58	581.4	

NOTES:

TRW

?? DAF 302 ~~Ask DBS~~

LOCATION ~~Equalization Tank~~ POLLUTANT VOC DATE 8/4/83

INSTRUMENT RANGE (PPM) 0-1000 ppm CALIBRATED BY MWH

Record Data Every 3-5 Minutes 1002.5 ppm CH_3 Span

Time	Scale Reading	HR AVG ppm
0435	59	
40	60	
45	59	
50	59	
55	58	590
0500	59	
05	62	
10	61	
15	59	
20	59	
25	60	
30	59	
35	57	
40	57	
45	58	
50	57	
55	57	587

~~590~~

Time	Scale Reading	ppm
0600	57	
05	58	
10	57	
15	57	
20	59	
25	57	
30	57	
35	57	
40	57	
45	56	
50	59	
55	60	576
0700	58	
05	57	
0710	58	
15	58	
20	59	

~~Avg 57.9~~

NOTES:

?? These reading can not be from Eq. Tank (Never got over 200!. Ask DBS where #'s came from GDS

— Could be from DAF 302 Ask DAS to be sure

— If is DAF 302 Then is Duplicate of CAH reductions

TRW

LOCATION ~~Equalization Tank~~ DAF POLLUTANT VOC DATE 8/4/83

INSTRUMENT RANGE (PPM) 0-1000 CALIBRATED BY MWH

Record Data Every 3-5 Minutes 1000.5 ppm CH_3 Span

Time	Scale Reading	ppm
0725	59	
30	57	
35	60	
40	59	
45	59	
50	59	
55	59	585
0800	60	
0810	61	
15	61	
20	62	
25	59	
30	60	
35	60	
40	59	
45	59	
50	59	

Time	Scale Reading	ppm
0855	59	599
0900	58	
05	57	
10	58	
15	58	
20	57	
25	58	
30	56	
35	55	
40	55	
~~45~~	~~63~~	
~~1000~~ 50	70	
55	82	606
1000	85	
05	83	
~~20~~ 10	81	
~~20~~ 15	78	

~~Avg. 62.5~~

NOTES:

TRW

LOCATION ~~Equalization Tank~~ DAF POLLUTANT VOC DATE 8/4/83

INSTRUMENT RANGE (PPM) 0-1000 ppm CALIBRATED BY MWH

Record Data Every 3-5 Minutes 1002.5 ppm CH_3 Span

Time	Scale Reading	ppm
1020	75	
25	74	
30	71	
35	68	
40	68	
45	66	
50	65	
55	65	731
1100	65	
05	63	
10	63	
15	64	
20	63	
25	60	
30	59	
35	61	
40	59	

Time	Scale Reading	ppm
1145	58	
50	58	
55	~~58~~	604 ~~557~~
1200	58	
05	57	
10	57	
15	56	
20	53	
25	52	
30	50	
35	48	
40	47	
45	45	
50	44	
55	43	508
1300	42	
05	40	

~~Avg 58.05~~

NOTES:

TRW

LOCATION ~~Equalization Tank~~ DAF POLLUTANT VOC DATE 8/4/83

INSTRUMENT RANGE (PPM) 0-1000 ppm CALIBRATED BY MWH

Record Data Every 3-5 Minutes 1002.5 ppm CH_3 Span

Time	Scale Reading	ppm
1310	39	
15	38	
20	40	
25	39	
30	38	
35	37	
40	36	
45	36	
50	35	
55	35	37.9
1400	36	
05	36	
10	35	
15	34	
20	34	
25	33	
30	32	

Time	Scale Reading	ppm
1435	33	
40	34	
45	34	
50	34	
55	34	34.1
1500	33	
05	33	
10	33	
15	33	
20	33	
25	34	
30	33	
35	34	
40	33	
45	35	
50	34	
55	35	~~33~~ 33.6

~~Avg 34.8~~

NOTES:

TRW

LOCATION ~~Equalization Tank~~ DAF POLLUTANT VOC DATE 8/4/83

INSTRUMENT RANGE (PPM) 0-1000 ppm CALIBRATED BY MWH

Record Data Every 3-5 Minutes 1002.5 ppm CH_3 Span

Time	Scale Reading	ppm
1600	34	
1605	34	
Calibrate		
1645	36	
50	36	
55	37	354
1700	36	
05	35	
10	36	
15	37	
20	37	
25	36	
30	35	
35	35	
40	34	
45	35	
50	35	

Time	Scale Reading	ppm
1755	34	354
1800	34	
05	34	
10	34	
15	34	
20	34	
25	35	
30	35	
35	35	
40	34	
45	35	
50	34	
55	35	344
1900	34	
05	35	
10	34	
15	35	

NOTES:

TRW

LOCATION Equalization Tank POLLUTANT VOC DATE 8/4/83

INSTRUMENT RANGE (PPM) 0-1000 ppm CALIBRATED BY MWH

Record Data Every 3-5 Minutes 1000.5 ppm CH_3 Span

Time	Scale Reading	ppm
1920	35	
25	35	
30	34	
35	35	
40	35	
45	36	
50	36	
55	36	350
2000	36	
05	35	
10	36	
15	36	
20	36	
25	35	
30	36	
35	37	
40	37	

Time	Scale Reading	ppm
2045	38	
50	37	
55	37	363
2100	38	
05	38	
10	38	
15	38	
20	38	
25	37	
30	37	
35	36	
40	37	
45	38	
50	38	
55	39	377
2200	38	
05	38	

~~Avg 36.6~~

NOTES:

TRW

LOCATION ~~Equalization Tank~~ DAF POLLUTANT VOC DATE 8/4-8/5/83

INSTRUMENT RANGE (PPM) 0-1000 ppm CALIBRATED BY MWH

Record Data Every 3-5 Minutes 1002.5ppm CH_3 9ppm

Time	Scale Reading	ppm
2210	37	
15	37	
20	36	
25	37	
30	38	
35	37	
40	37	
45	36	
50	37	
55	41	374
2300	38	
05	~~39~~ 37	
10	39	
15	38	
2320	39	382
PROCESS Interruption		
0040	71	

Time	Scale Reading	ppm
0045	68	
50	65	
55	63	667
0100	61	
05	60	
10	58	
15	57	
20	56	
25	55	
30	54	
35	54	
40	53	
45	52	
50	51	
55	52	552
0200	51	
05	51	

~~Avg 46.9~~

NOTES: Avg ≅ 62-65 During the process Int.

TRW

DAF

LOCATION ~~Equalization Tank~~ POLLUTANT VOC DATE 8/5/83

INSTRUMENT RANGE (PPM) 0-1000 ppm CALIBRATED BY MWH

Record Data Every 3-5 Minutes 1008.5

Time	Scale Reading	ppm
0210	51	
15	52	
20	51	
25	51	
30	50	
35	50	
40	49	
45	50	
50	50	
55	49	504
0300	49	
05	49	
10	49	
15	48	
00	48	
25	47	
30	48	

Time	Scale Reading	ppm
0335	47	
40	49	
45	46	
50	46	
55	47	477
0400	46	
05	46	
10	46	
15	146	
20	46	
25	45	
30	45	
35	45	
40	46	
45	47	
50	47	
55	46	459

~~Avg 47.8~~

NOTES:

WORK SHEET

~~Equalization Tank~~ 8/5/83
VAF

	Time	Scale Reading	PPM		Time	Scale	PPM		Time	Scale	ppm	
	0500	45			0700	50			0900	59		
	05	45			05	57			05	58		
	10	44			10	63			10	58		
	15	45			15	65			15	58		
	00	44			20	65			20	58		
	05	45			25	66			25	59		
	30	45			30	65			30	59		
	35	45			35	63			35	58		
	40	45			40	61			40	58		
	45	44			45	61			45	59		
	50	45			50	60			50	58		
	55	44	450		55	60	613		55	58	8	583
	0600	45			0800	60			1000	58		
	05	44			05	60			05	57		
	10	44			10	60			10	57		
	15	44			15	60			15	58		
	20	43			20	60			20	57		
	25	43			25	59			25	57		
	30	43			30	60			30	58		
	35	43			35	59			35	58		
	40	44			40	60			40	57		
	45	44			45	59	597		45	57		
	50	44			50	Calibrate			50	57		
	55	44	437		~~55~~				55	57		573
										8		
Avg	—	44.2		Avg	—	55.6		Avg	—	57.9		

WORK SHEET

VPTF Equalization Tank 8/5/83

	Time	Scale	PPM		Time	Scale	PPM		Time	Scale	PPM
	1100	58			1300	52			1500	52	
	05	59			05	52			05	50	
	10	57			10	52			10	50	
	15	57			15	51			15	50	
	20	56			20	51			20	49	
	25	55			25	51			25	48	
	30	55			30	49			30	47	
	35	54			35	49			35	47	
	40	54			40	48			40	47	
	45	53			45	48			45	47	
	50	52			50	46			50	45	
	55	51	551		55	45	495		55	47	482
	1200	51			1400	45			1600	46	
	05	54			05	45			05	46	
	10	51			10	45			10	45	
	15	51			15	45			15	46	
	20	51			20	45			20	46	
	25	50			25	45			25	45	
	30	51			30	45			30	45	456
	35	50			35	48		End	~~35~~		
	40	52			40	51			~~40~~		
	45	51			45	55		Avg	~~45~~	47.3	
	50	51			50	56			~~50~~		
	55	53			55	54			~~55~~		
	Avg —	53.1	—		Avg	~~49~~					
			512			49.9	49?				

TRW

LOCATION DAF-CHEVRON POLLUTANT THC DATE 8-8-83

INSTRUMENT RANGE (PPM) 0-1000 CALIBRATED BY CBS

Record Data Every 3-5 Minutes

Time	Scale Reading	ppm
1100	52.0	521.3
1200	47.4	475.3
1300	48.9	487.8
1400	46.7	466.3
1500	58.1	580.4
1600	55.4	550.9
1700	49.5	492.2
1800	52.4	521.3
1900	41.5	412.7
2000	47.3	470.2
2100	49.9	496.2
2200	51.2	509.3
2300	49.7	494.2

Time	Scale Reading	ppm

NOTES:

TRW

LOCATION DAF-Chevron POLLUTANT THC DATE 8-9-83

INSTRUMENT RANGE (PPM) 0-1000 CALIBRATED BY CBS

Record Data Every 3-5 Minutes + Converted to hourly Averages.

Time	AVG. Scale Reading	ppm
0000	48.3	480.2
0100	46.9	465.7
0200	51.0	507.3
0300	67.2	669.3
0400	71.2	709.4
0500	59.8	594.8
0600	65.9	656.7
0700	67.6	676.4
0800	72.5	724.5
0900	71.2	712.5
1000	70.5	705.5
1100	69.0	690.4
1200	64.4	644.2
1300	60.0	610.1
1400	59.2	592.1
* 1500	[illegible]	701.4
1600	70.1	

Time	AVG. Scale Reading	ppm
1700	64.5	645.3
1800	62.7	626.9
1900	57.5	575.0
2000	56.9	568.5
2100	54.1	540.9
2200	54.0	539.9
2300	55.1	550.9

NOTES: * Leak in system, No Data.

TRW

LOCATION DAF-Chevron POLLUTANT THC DATE 8-10-83

INSTRUMENT RANGE (PPM) 0-1000 CALIBRATED BY CBS

Record Data Every 3-5 Minutes + converted to hourly Averages.

	Time	Avg. Scale Reading	ppm
	0000	51.5	514.8
	0100	49.5	494.7
	0200	48.8	487.7
	0300	47.0	469.6
	0400	46.5	464.1
	0500	44.9	448.6
	0600	48.3	480.6
	0700	48.0	477.6
	0800	46.6	463.7
	0900	46.3	460.2
	1000	45.1	448.7
	1100	50.5	502.5
*1	1200		
Carbon House	1300	9.5	94.7
Carbon House	1400	16.8	168.42
Carbon House	1500	13.1	131.3
*2	1600		

Time	Avg. Scale Reading	ppm
1700	39.5	395.7
1800	40.0	400.6
1900	45.3	453.1
2000	48.4	484.7
2100	54.0	540.8
2200	55.5	555.8
2300	57.1	571.8

NOTES: *1: NO DATA {Moving Sample Lines + Re-cal.}

*2: NO DATA { " " " " }

TRW

LOCATION DAF-Chevron POLLUTANT THC DATE 8-11-83

INSTRUMENT RANGE (PPM) 0-1000 CALIBRATED BY CBS

Record Data Every 3-5 Minutes & converted to hourly Averages.

Time	AV. Scale Reading	ppm
0000	57.1	564.1
0100	58.1	574.9
0200	58.8	581.4
0300	61.1	604.2
0400	63.0	623.4
0500	61.5	608.3
0600	56.3	556.5
0700	66.5	658.1
0800	63.1	623.4
0900	51.3	508.0
1000	39.5	396.0
1100	56.3	563.9
1200	76.3	764.4
1300	68.5	686.7
1400	55.7	557.9

Time	AV. Scale Reading	ppm

NOTES:

EQUALIZATION TANK CONTINUOUS MONITOR INSTRUMENT CHARTS

TRW

LOCATION Equalization Tank POLLUTANT VOC DATE 8/3/83

INSTRUMENT RANGE (PPM) 0-1002.5 ppm CH_4 CALIBRATED BY MWH

Record Data Every 3-5 Minutes 1002.5 ppm CH_4 Span

Time	Scale Reading	ppm	
1238	14	140.3	
1245	14	140.3	140
1315	14	140.3	
1345	14	140.3	140
1445	14	140.3	
1430	15	150.3	145
1500	15	150	
1515	15	150	
1530	calibrating		
1545	14	140	147
1600	15	150	
1615	15	150	
1630	15	150	
1645	15	150	150
1700	15	150	
1715	15	150	
1730	14	140	

Time	Scale Reading	ppm	
1745	14	140	145
1800	14	140	
1815	14	140	
1830	14	140	
1845	~~15~~ 14	140	140
1900	15	150	
1915	15	150	
1930	15	150	
1945	15	150	150
2000	14	140	
2015	15	150	
2030	16	160.3	
2045	16	160	152
2100	16	160	
2115	16	160	
2130	16	160	
2145	16	160	160

(continued)

NOTES: Zero - 0% scale

1002.5 ppm - 100% scale

TRW

LOCATION Equalization Tank POLLUTANT VOC DATE 8/3/83

INSTRUMENT RANGE (PPM) 0-1000 ppm CH_4 CALIBRATED BY MWH

Record Data Every 3-5 Minutes

	Time	Scale Reading	ppm	
	2200	17	170.4	
	2215	18	180.4	
	2230	18	180	
	2245	17	170	175
	2300	18	180	
	2315	18	180	
	2330	18	180	
	2345	18	180	180
8/4	2400	18	180	
	2415	18	180	
	2430	18	180	
	2445	18	180	180
	0100	18	180	
	0115	19	190.4	
	0130	19	190	
	0145	18	180	185
	0200	18	180	

Time	Scale Reading	ppm
215	18	180
230	19	190
245	19	190
300	19	190
315	19	190
330	19	190
345	19	190
400	19	190
415	19	190
430	19	190
445	19	190
500	19	190
515	19	190
530	19	190
545	19	190
600	19	190
615	19	190
630	19	190
645	19	190
700	20	200.4
715	19	190
730	19	190

NOTES:

TRW

LOCATION Equalization Tank POLLUTANT VOC DATE 8/4/83 (1 of 2)

INSTRUMENT RANGE (PPM): 0-1000 ppm CALIBRATED BY GBS

Record Data Every 3-5 Minutes 1002.5 ppm CH_4 SPAN

Time	Scale Reading	ppm		Time	Scale Reading	ppm	
0745	19	190	192	1615	16	160	
0815	19	190		1645	16	160	160
0845	19	190	190	1715 (1)	16	160	
0915	18	180		1745	15	150	155
0945	18	180	185	1815	15	150	
1015	18	180		1845	16	160	155
1045	18	180	180	1915	15	150	
1115	19	190		1945	15	150	155
1145	19	190	190	2015	15	150	
1215	18	180		2045	16	160	[illegible]
1245	17	170	175	2115	16	160	
1315	17	170		2145	16	160	160
1345	18	180	175	2215	16	160	
1415	17	170		2245	17	170	[illegible]
1445	17	170	170	2315	16	160	
1515	17	170		2345	16	160	[illegible]
1545	16	160	165	2415	17	170	

(Continued)

NOTES: Beckman 402

Sample 3 PSI

Fuel 26 PSI

Air 15.5 PSI

(1) 1658 Recalibration Check

MWA

TRW

LOCATION Equalization Tank POLLUTANT VOC DATE 8/4/83 - 8/5/83 (2 of 2)

INSTRUMENT RANGE (PPM) 0-1000 ppm CALIBRATED BY LBS

Record Data Every 3-5 Minutes 1002.5 ppm CH_3 Span

Time	Scale Reading	ppm	
2445	17	170	170
0115	17	170	
0145	17	170	170
0215	17	170	
0245	17	170	170
0315	17	170	
0345	17	170	170
0415	17	170	
0445	17	170	170
0515	17	170	
0545	17	170	170
0615	18	180	
0645	18	180	180
0715	18	180	
0745	18	180	180

Time	Scale Reading	ppm

NOTES:

TRW

LOCATION Equalization Tank POLLUTANT VOC DATE 8/5/83

INSTRUMENT RANGE (PPM) 0-1000 ppm CH_4 CALIBRATED BY GBS

Record Data Every 3-5 Minutes ~~0~~002.5 ppm CH_4 span

Time	Scale Reading	ppm	AVG
0800	16.5		
0830	16		
0900	16		16
0930	15.5		
1000	15.5		15.5
1030	15.5		
1100	15		15.2
1130	15		
1200	15		15
1230	15		
1300	14		15.5
1330	15		
1400	15.5		15.2

Time	Scale Reading	ppm

NOTES: Beckman 402

Sample 3PSI

Fuel 26 PSI

Air 15.5 PSI

TRW

LOCATION Carbon House Outlet @ Equalization Tank POLLUTANT VOC DATE 8/5/83

INSTRUMENT RANGE (PPM) 0–1000 ppm CALIBRATED BY GBS

Record Data Every 3-5 Minutes ~~[illegible]~~ 500 ppm CH_4 span checked with 100.2 ppm 50.5 ppm

Time	Scale Reading	ppm	AVG
1410	12		
1425	12		12
1440	① 19		
1455	19.5		
1510	19		19
1525	19		
1540	19		19
1555	19		
1610	19		19

Time	Scale Reading	ppm

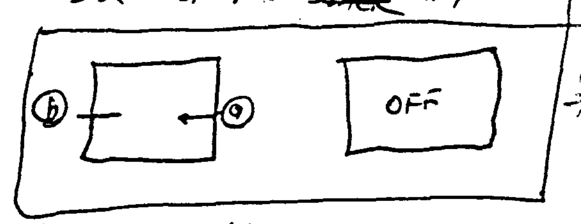
NOTES: Beckman ~~[illegible]~~ 402

Sample 3 PSI

Fuel 26 PSI

Air 15.5 PSI

① Moved sample probe from up wind side (a) to down ~~up~~ wind side (b) of ~~[illegible]~~ ~~stack~~ vent



Sample probe ~6' into ~~[illegible]~~ ~~stack~~ vent

IAF CONTINUOUS MONITOR INSTRUMENT CHARTS

TRW

LOCATION IAF ~~[illegible]~~ Chevron POLLUTANT VOC DATE 8/8/83 - 8/9/83

INSTRUMENT RANGE (PPM) 0-10,000 CALIBRATED BY MWH

Record Data Every 3-5 Minutes 4010 ppm CH_3 span

Time	Scale Reading	ppm
1800	67.25	6725
1900	69.67	6967
2000	~~70.00~~	~~7000~~
2100	70.00	7000
2200	70.00	7000
2300	69.17	6917
2400	69.00	6900
0100	68.50	6850
0200	68.00	6800
0300	68.00	6800
0400	68.00	6800
0500	68.00	6800
0600	68.00	6800
0700	68.17	6817
0800	68.53	6853
0900	67.96	6796
1000	68.10	6810

Time	Scale Reading	ppm
1100	65.58	6558
1200	65.71	6571
1300	66.93	6693
1400	67.69	6769
1500	68.15	6815
1600	68.00	6800
1700	69.95	6995
1800	70.90	~~7[illegible]~~ 7090
1900	71.38	71.35
2000	71.44	7144
2100	71.17	7117
2200	70.75	7075
2300	69.90	6990
2400	69.50	6950
0100	69.00	6900
0200	69.00	6900
0350	68.25	6825

in Batch, see chart

NOTES:

TRW

LOCATION IAF/Chevron POLLUTANT VOC DATE 8/9-8/10/83

INSTRUMENT RANGE (PPM) 0-10,000 CALIBRATED BY MWH

Record Data Every 3-5 Minutes 4010 ppm CH_3 Span

Time	Scale Reading	ppm
0400	6800	6800
0500	6780	6780
0600	67.50	6750
0700	66.90	6690
0800	66.60	6660
0900	66.40	6640
1000	~~[illegible]~~ 66.50	~~[illegible]~~ 66.50
1100	6700	6700
1200	67.50	6750
1300	68.10	6810
1400	68.90	6890
1500	69.50	6950
1600	67.75	67.75
1700	69.00	69.00
1800	70.50	7050
1900	68.50	6850
2000	68.00	6800

1630-0640 Calibrate

Close IAF Door

0913-0953 Calibrate

Time	Scale Reading	ppm
2100	68.50	6850
2200	68.00	6800
2300	67.90	6790
2400	67.00	6700
0100	66.50	6650
0200	67.00	6700
0300	67.50	6750
0400	67.30	6730
0500	67.20	6720
0600	67.50	6750
0700	68.00	6800
0800	68.90	6890
0900	69.50	6950
1000	71.70	7170
1100	72.30	7250
1200	73.00	7300
1300	74.90	7490
1400	76.00	7600
~~1500~~		

NOTES:

TRW

LOCATION IAF Carbon Drum OUTLET POLLUTANT VOC DATE 8/10/83

INSTRUMENT RANGE (PPM) 0-10,000 CALIBRATED BY CBS

Record Data Every 3-5 Minutes 4010 ppm CH_3 Span

Time	Scale Reading	ppm
1100	72.50	7250
1200	73.50	7350
1300	74.60	7460
1423	75.00	7500

Time	Scale Reading	ppm

NOTES:

TRW

LOCATION IAF-CHEVRON POLLUTANT THC DATE 8-12-83

INSTRUMENT RANGE (PPM) 0-10000 CALIBRATED BY CBS

Record Data Every 3-5 Minutes + Converted to hourly Averages.

	Time	AVG. Scale Reading	ppm
Carbon Drum Outlet	0900	64.6	6271.4
	1000	67.9	6588.9
	1100	68.1	6614.0
Carbon Drum Inlet	1200	72.6	7221.9
	1300	72.6	7221.9
	1400	73.3	7291.7

Time	AVG. Scale Reading	ppm

NOTES:

APPENDIX B

FIELD DATA SHEETS

- DAF and Equalization Tank Velocity Traverse Sheets
- IAF Anemometer Measurements
- Liquid Sampling Log

DAF Velocity Traverse Sheets

(9)

VELOCITY TRAVERSE

PLANT Chevron
DATE 8/9/83
LOCATION DAF
STACK I.D.
BAROMETRIC PRESSURE, in. Hg
STACK GAUGE PRESSURE, in. H_2O
OPERATORS MWH WK

Comment: Flow distribution at DAF tanks
pitot ΔP determined by reversing direction of opening 180°F & taking readings

velocity head using installed pitot tubes ~~orifice plates~~

SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
T-201	~~0.03~~ to	89°F
Floculation	~~0.04 "H_2O~~	
	0.015 "H_2O	89
	0.02 "H_2O	.
	with P-type	
	pitot tube	
	diameter =	12¼"
flow =	570 cfm	
	assume	C_p = 0.99
AVERAGE		

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
T-200	0.20-0.16	~~85~~ 89
Flash mix	= 0.04" H_2O	
	diameter =	8¼"
flow =	340 cfm	
T-202	DAF	T = 89
	0.30-0.05	
	= 0.25	
	Dia = ~~8~~ 15"	
flow =	2460 cfm	
AVERAGE		

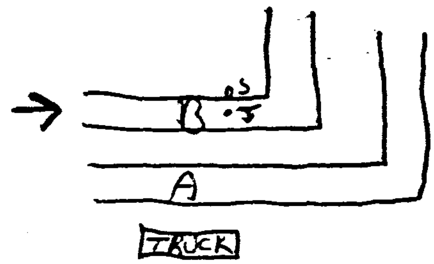
EPA (Dur) 233
4 72

1

PRELIMINARY VELOCITY TRAVERSE

Water

PLANT Chevron
DATE 8/1/83
LOCATION
STACK I.D.
BAROMETRIC PRESSURE, in. Hg
STACK GAUGE PRESSURE, in. H_2O
OPERATORS



SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
B-S-1	.10	89
2	.10	89
3	.10	89
D-T 1	.08	89
2	.09	89
3	.10	89
AVERAGE		

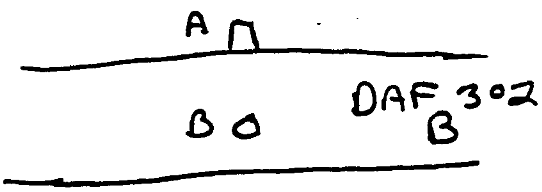
TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

EPA (Dur) 233
4 72

(4)

VELOCITY TRAVERSE

PLANT ______
DATE 202 A
LOCATION DAF ~~302~~ - B
STACK I.D. ______
BAROMETRIC PRESSURE, in. Hg ______
STACK GAUGE PRESSURE, in. H_2O -.43 " H_2O
OPERATORS G.D. HENRY



SCHEMATIC OF TRAVERSE POINT LAYOUT

100

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
B - A - 1	.065	96
2	.075	96
3	.075	96
4	.080	94
5	.080	94
6	.080	94°
B - B - 1	.06	94°
2	.065	95
3	.07	95
4	.085	96
5	.09	95
6	.09	95
AVERAGE		

1600

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
B-A-1	.095 ~~.085~~	89
2	.10	89
3	.105	90
4	.10	89
5	.10	89
6	.095	89
B-B-1	.080	89
2	.095	89
3	.10	91
4	.10	91
5	.105	90
6	.10	90
	STATIC -.45" H_2O	
AVERAGE		

EPA (Dur) 233
4 72

③

VELOCITY TRAVERSE

PLANT Chevron El Segundo
DATE 8/4/83
LOCATION 302 DAF
STACK I.D. 17 3/4
BAROMETRIC PRESSURE, in. Hg
STACK GAUGE PRESSURE, in. H_2O .25
OPERATORS D. Savia

SCHEMATIC OF TRAVERSE POINT LAYOUT

Am

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
T-1	.09	90°
2	.08	
3	.09	
4	.09	
5	.10	
6	.10	
S-1	.08	
2	.09	
3	.09	
4	.09	
5	.09	
6	.10	
AVERAGE		

Pm

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
T-1	.08	91°
2	.09	
3	.09	
4	.09	
5	.10	
6	.10	
S-1	.10	
2	.09	
3	.09	
4	.09	
5	.09	
6	.09	
AVERAGE		

EPA (Dur) 233
4 72

(5)

VELOCITY TRAVERSE

PLANT Chevron El Segundo

DATE 8-5-83

LOCATION DAF-302

STACK I.D. 15" 17.75

BAROMETRIC PRESSURE, in. Hg

STACK GAUGE PRESSURE, in. H_2O .65

OPERATORS D. Savia

SCHEMATIC OF TRAVERSE POINT LAYOUT

AM

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
T- 1	.09	90°
2	.09	
3	.10	
4	.10	
5	.10	
6	.10	
S - 1	.10	
2	.09	
3	.10	
4	.11	
5	.11	
6	.10	
AVERAGE		

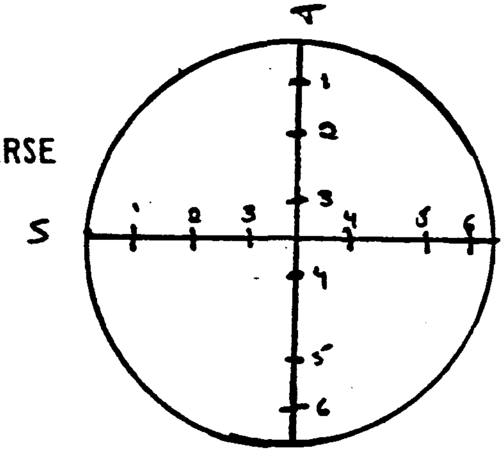
PM

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
T - 1	.08	94°
2	.09	
3	.09	
4	.10	
5	.11	
6	.11	
S- 1	.08	
2	.10	
3	.10	
4	.11	
5	.11	
6	.11	
AVERAGE		

7

VELOCITY TRAVERSE

PLANT Chevron El Segundo
DATE 8/8/83 2350 hrs.
LOCATION DAF-~~302~~ 202 w/c
STACK I.D. 18" 17 3/4
BAROMETRIC PRESSURE, in. Hg 29.80
STACK GAUGE PRESSURE, in. H_2O -.44
OPERATORS D. Savia



SCHEMATIC OF TRAVERSE POINT LAYOUT

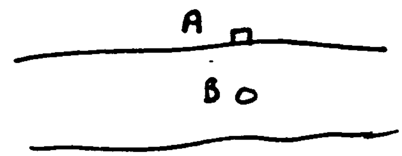
TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
T - 1	.08	84°
2	.09	
3	.10	
4	.10	
5	.11	
6	.11	
S - 1	.09	
2	.10	
3	.10	
4	.11	
5	.11	
6	.11	
AVERAGE		

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

(8)

VELOCITY TRAVERSE

PLANT CHEVRON/EL Segundo
DATE 8/9/83
LOCATION DAF - 202
STACK I.D.
BAROMETRIC PRESSURE, in. Hg
STACK GAUGE PRESSURE, in. H_2O -.47 " H_2O
OPERATORS G.D. HENRY



SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
DAF-~~302~~ 202-B-1	.08	85
" " B-2	.11	85
" " B-3	.11	85
" " B-4	.11	85
" " B-5	.105	85
" " B-6	.10	85
A-1	.08	85
A-2	.09	85
A-3	.10	85
A-4	.11	85
A-5	.11	85
A-6	.115	85
AVERAGE		

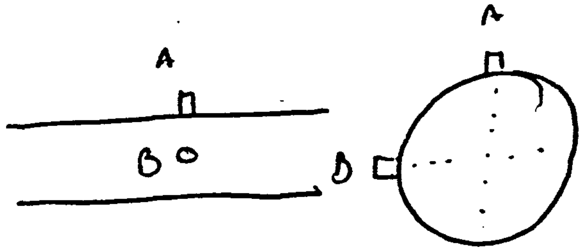
TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

EPA (Dur) 233
4 72

10

VELOCITY TRAVERSE

PLANT CHEVRON/EL Segundo
DATE 8/9/83
LOCATION DAF-~~302~~ 202 WK
STACK I.D. _
BAROMETRIC PRESSURE, in. Hg _
STACK GAUGE PRESSURE, in. H_2O −.44" H_2O
OPERATORS GD H



SCHEMATIC OF TRAVERSE POINT LAYOUT

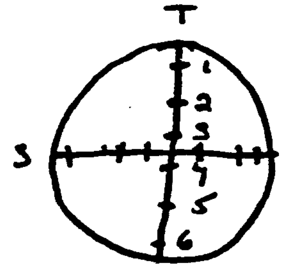
TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
DAF-302-B-1	.105	85
" 2	.105	85
" 3	.11	85
" 4	.11	85
" 5	.11	85
" 6	.11	85
" A-1	.07	88
" 2	.08	89
" 3	.10	89
" 4	.10	89
" 5	.10	89
6	.10	89
AVERAGE		

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

11

PRELIMINARY VELOCITY TRAVERSE

PLANT Chevron El Segundo
DATE 8/9/83 2345 Hours
LOCATION DAF 302
STACK I.D. 18"
BAROMETRIC PRESSURE, in. Hg 29.85
STACK GAUGE PRESSURE, in. H_2O – .45
OPERATORS D. Savia



SCHEMATIC OF TRAVERSE POINT LAYOUT

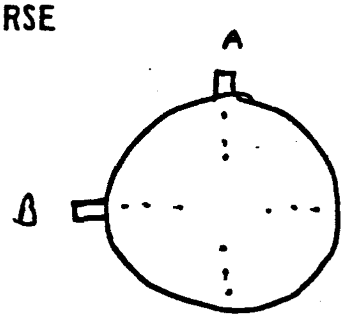
TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
T - 1	.08	80°
2	.09	
3	.10	
4	.10	
5	.10	
6	.10	
S - 1	.09	
2	.10	
3	.10	
4	.10	
5	.10	
6	.10	
AVERAGE		

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

EPA (Dur) 233
4 72

VELOCITY TRAVERSE

PLANT CHEVRON/EL SEGUNDO
DATE 8/10/83
LOCATION DAF-202 A
STACK I.D.
BAROMETRIC PRESSURE, in. Hg
STACK GAUGE PRESSURE, in. H_2O -.42" H_2O
OPERATORS G.D. HENRY



SCHEMATIC OF TRAVERSE POINT LAYOUT

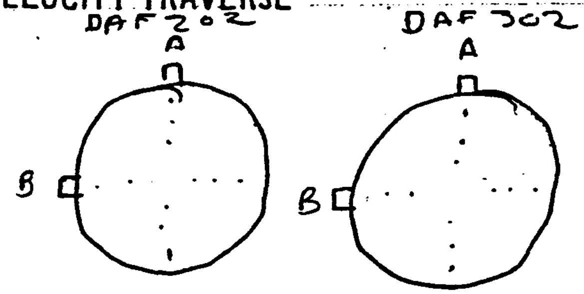
TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
A-1	.05	87
2	.07	88
3	.07	88
4	.08	88
5	.09	88
6	.08	87
B 1	.04	88
2	.07	88
3	.07	88
4	.07	88
5	.08	88
6	.08	88
AVERAGE		

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

(13)

VELOCITY TRAVERSE

PLANT Chevron / EL Segundo
DATE 8/10/83
LOCATION DAF 202 + 302
STACK I.D.
BAROMETRIC PRESSURE, in. Hg
STACK GAUGE PRESSURE, in. H_2O ≥ .50" H_2O
OPERATORS G.D. HENRY



SCHEMATIC OF TRAVERSE POINT LAYOUT

DAF-202 Time 12:30

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
202-A-1	.07	96
2	.10	96
3	.11	96
4	.12	96
5	.12	96
6	.13	96
B-1	.08	96
2	.10	96
3	.11	96
4	.12	96
5	.12	94
6	.125	94
AVERAGE		

DAF 302 Time 1240

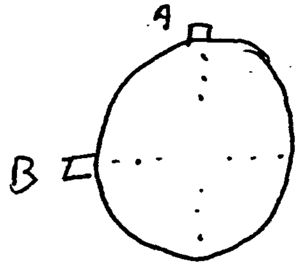
TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
302-A-1	.07	90
2	.09	90
3	.105	90
4	.11	90
5	.11	90
6	.10	90
B-1	.04	93
2	.07	80
3	.09	79
4	.09	89
5	.09	91
6	.09	91
AVERAGE		

EPA (Dur) 233
4 72

#14

VELOCITY TRAVERSE

PLANT CHEVRON/EL Segundo
DATE 8/11/83
LOCATION DAF-202-A
STACK I.D.
BAROMETRIC PRESSURE, in. Hg
STACK GAUGE PRESSURE, in. H_2O -.5" H_2O
OPERATORS G.D. HENRY



SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
A- 1	.08	93
2	.115	93
3	.13	93
4	.13	93
5	.14	94
6	.14	93
B- 1	.10	93
2	.13	93
3	.13	93
4	.13	93
5	.13	93
6	12	93

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

Equalization Tank Velocity Traverse Sheets

1

VELOCITY TRAVERSE

PLANT Chevron - El Segundo
DATE 8-3-83 1555
LOCATION Equalization Tank
STACK I.D. 23¼
BAROMETRIC PRESSURE, in. Hg 29.80
STACK GAUGE PRESSURE, in. H_2O
OPERATORS MWH / DBS

SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
T-1	.13	94°F
-2	.13	
3	.13	
4	.13	
5	.13	
6	.13	
S-1	.12	94°F
2	.13	
3	.14	
4	.13	
5	.13	
6	.13	
AVERAGE		

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

3

VELOCITY TRAVERSE

PLANT Chevron El Segundo
DATE 8/4/83
LOCATION ~~[illegible]~~ EQ Out
STACK I.D. 23 1/4
BAROMETRIC PRESSURE, in. Hg 29.8
STACK GAUGE PRESSURE, in. H_2O
OPERATORS

EQ - OUT

am

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
S-1	.12	90°
2	.13	
3	.13	
4	.13	
5	.13	
6	.13	
T-1	.12	
2	.12	
3	.13	
4	.13	
5	.12	
6	.12	
AVERAGE		

SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
S-1	.13	94°
-2	.14	
-3	.14	
-4	.13	
5	.13	
6	.12	
T-1	.13	
2	.13	
3	.11	
4	.11	
5	.12	
6	.11	
AVERAGE		

EPA (Dur) 233
4 72

START Run ① 1035

3

VELOCITY TRAVERSE

PLANT Chevron El Segundo
DATE 8-5-83
LOCATION EQ-Out
STACK I.D. 24"
BAROMETRIC PRESSURE, in. Hg
STACK GAUGE PRESSURE, in. H_2O .35
OPERATORS D. Savia

SCHEMATIC OF TRAVERSE POINT LAYOUT

AM

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
T-1	.13	91°
2	.13	
3	.13	
4	.12	
5	.12	
6	.11	
S-1	.11	
2	.13	
3	.13	
4	.12	
5	.12	
6	.12	
AVERAGE		

PM

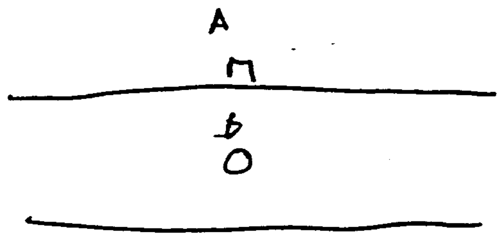
TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
T-1	.12	95°
2	.12	
3	.13	
4	.13	
5	.13	
6	.13	
S-1	.12	
2	.12	
3	.12	
4	.13	
5	.13	
6	.14	
AVERAGE		

EPA (Dur) 233
4 72

4

VELOCITY TRAVERSE

PLANT CHEVRON / EL SEGUNDO
DATE 8/12/83
LOCATION Equalization tank
STACK I.D.
BAROMETRIC PRESSURE, in. Hg
STACK GAUGE PRESSURE, in. H_2O – .50" H_2O
OPERATORS G.D. HENRY



SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
A-1	.22	90
2	.22	90
3	.20	90
4	.19	90
5	.19	90
6	.14	90
B-1	.22	90
2	.22	90
3	.22	90
4	.20	90
5	.20	90
6	.18	90
AVERAGE		

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

IAF Anemometer Measurements

Chevron
~~F87~~ IAF
1745 hrs 8/10/83
WK MWH
132 ft^3

		time	
START	4 670	00:00	out
END	4 802	1:18:3	

~~in~~

	ft,	elaped time - minutes		Δ time	~~volume ft3~~ out	~~volume~~ ~~out~~ in
start	4650	00:00.00	~~out~~			
top reverse	4909	3:09.00	out	3:09.00	259 ft	
top reverse	4776	4:31.94	in			-133 ft
top reverse	5023	7:45.00	out	3:13	247 ft	
top reverse	4940	9:24.00	in			-83 ft
top reverse	5055	11:03.00	out	1:39	115 ft	
top reverse	5037	11:41.00	in			-18 ft.
top reverse	5120	13:14.00	out	1:33	83	
top reverse	5069	13:49.00	in			-51
top reverse	5109	14:29.00	out	0:40	40	
top reverse	5078	14:58.00	in			-.31
				② 10:23		

5 POSITIVE PERIODS
IN 15 MINUTES

$\boxed{\text{744 FT / 15 MIN}}$ or

③ 1.37 FT/SEC

1.28 FT/SEC

1.16 FT/SEC

0.89 FT/SEC

Chevron IAF
8/10/83

START@2145 hrs DD8
STOP@0030 hrs Tot(-3

START		Elapsed Time MIN: Sec		
	5930	0:00		
Reverse	5940	2.04	10	2:04
R	5933	3:22		
	5957	6:07	24	2:45
	5911	8:00		
	5943	10:30	32	2:30
	5907	12:43		
	5939	14:50	32	2:07
	5907	16:50		
	5932	19:00	25	2:10
	5915	21:01		
	5919	23:24	4	2:23
	5915	24:50		
	5919	27:50	4	3:00
	5911	29:06		
	5916	32:42	5	3:36
	5882	34:35		
	5910	37:30	28	2:55
	5890	39:18		
	5907	41:41	17	2:23
	5887	43:02		
	5900	45:00	13	1:38

4
:52

* Reading at 0045 - (5920)

temperature = 84°F
Anemometer readings

Chevron IAF
8/11/83
WK MWH

~~Reading~~

Reading, ft	elapsed time, min	
5120	00:00.0	

0915 - anemometer indicates essentially no flow
0920

	Reading, ft	elapsed time, min	
	5120	00:00	inflow
	5100	00:49.7	
stopped		1:36	
	5100	1:53	outflow
	5120	3:10	
	stopped		
	5120	4:36	outflow
	5128	5:21	
	stopped	10:00	

end readings 11:00.0

Chevron IAF
8/11/83 0045
Start
Stop 0120

Start	Elapsed Time		
5868	00:00		
5905	7:05	37	7:05
5770	10:05		
5850	13:08	80	3:03
5840	15:03		
5858	17:24	18	2:21
5814	19:16		
5843	22:06	29	2:50
5816	24:54		
~~[illegible]~~	~~[illegible]~~		
5833	27:15	17	2:21
5802 +	30:05		
5824 +	33:54	2	3:49
5826 +	34:32	2	0:38
5828	35:39	2	1:07
5826	36:10		
5826.5	36:30	0.5	0:20
5824.5	36:50		
5826	37:45	1.5	:55
5827	39:25	1	1:40
5807	40:00		5
		190	26 15/100

Reading at 0252 5700

START TIME : 0950 AM 8/11/83 - mwsl.

	Reading	Elapsed Time		Temp (AIR)
Bump.	5304	0.00.00		840
	5250	35.5 sec.		
	5285	1:04.9	35	0:30
	5210	1:55		
	5215	2:12	5	0:17
	5183	2:36		
	5496	6:14	313	3:38
	5495	6:31		
	5515	6:57	20	0:26
	5403	8:03		
	5405	8:16	2	0:15
	5353	8:47		
	5603	11:03	250	2:16
	5461	12:28		
	5470	12:45	9	0:17
	5392	13:39		
	5633	16:25	241	2:46
	5630	16:29		
	5688	17:12	58	0:43
	5682	17:26		
	5703	17:45	21	0:19
	5549	19:14		
	5870	22:27	321	3:13
	5870	23:08		880
	5732	24:29		4
			1275	14:41

(33) · 33

.99
44
10.89

.10
× 3.14

8/11/83, MWSL page 2

Reading	Elapsed Time	Temp (Air)
6029	27:34	~~78~~
5899	29:38	
5922	30:24	
5894	30:51	
6151	33:49	End of Big Bump 88°

START Time 1032 8/11/83 CBS

6230	0:00 sec		
6310	33:~~24~~	80	:33
6350	1:54:~~47~~	40	1:21
6170	4:06:~~64~~		
6410	6:25:~~77~~	240	2:19
6320	7:34:~~68~~		
6640	10:41:~~99~~	320	3:07
6400	12:46:~~71~~		
6685	15:30:~~44~~	285	
6570	16:37:~~20~~		
6620	17:39:~~50~~	50	
6600	18:02:~~87~~		
6685	19:05:~~79~~	85	
6810	20:41 ~~20:41~~	125	
6600	22:47		
6830	25:02	230	
6720	26:20		
6850	27:53	130	
6990	28:43	140	

START TIME 1310 DATE 8/11/83 CBS

ANNM READING		ELAPSED TIME
1955		0:00
1900		:58:~~04~~
2112	212	1:48
2045		4:36
2250	205	7:47
2300	50	9:50
2290		10:28
2372	82	12:38
2320		13:14
2340	20	13:27
2475	135	15:42
2440		16:10
2480	40	16:32
2465		16:59
2633	168	19:10
2575		20:43
2808	233	24:17
2795		25:04
2935	140	28:01
2833		29:54
2930	97	31:10
3084	154	32:04
2945		32:44
297[illegible]	25	33:3[illegible]

READING		EL. TIME
3280		36:04
3100		37:04
3145	45	37:45
3326	181	~~40~~ 40:09
3285		41:31
3235		43:41
3490	255	47:09

2042 / 47

START Time Finish time
1517 8/11/83

ANN. Reading		Elapsed Time
3910		:23
3940	30	1:29
4180	240	4:10
4185	5	4:32
4250	65	5:23
4175		5:52
4195	20	6:08
4150		6:35
4195	45	7:08
4043		7:57
4310	267	10:31
4300		10:52
4310	10	11:17
4275		11:56
4310	35	12:33
4288		12:55
4295	7	13:10
4290		13:56
4450	160	15:36
4428		16:20
4515	87	17:33
4510		17:56
4450		19:02
4495	45	20:07

ANN		Time
4720		23:15
4710		23:54
4728	18	24:29
4690		25:20
4950	260	29:18
4925		29:46
4970	45	30:23
4910		31:00
5105	195	33:27
4930		35:31
5185	255	37:55
5055		39:15
5365	310	42:01

2294/42 min

PRELIMINARY VELOCITY TRAVERSE

PLANT: Chevron - IAF
DATE: 8-12-83
LOCATION: IAF
STACK I.D.: Start Time 10:33
BAROMETRIC PRESSURE, in. Hg:
STACK GAUGE PRESSURE, in. H_2O:
OPERATORS: CBS

SCHEMATIC OF TRAVERSE POINT LAYOUT

Anemometer Reading ~~TRAVERSE POINT NUMBER~~	Elapsed Time ~~VELOCITY HEAD (Δp_s), in. H_2O~~	STACK TEMPERATURE (T_s), °F
1100	0:00	84
1235	1:21	135
1170	2:22	
1255	3:17	85
1045	5:42	
1280	8:22	235
1180	9:39	
1200	10:11	20
1180	10:33	
1240	11:19	60
1205	11:47	
1240	12:15	35
1225	12:20	
1255	12:49	30
1225	13:15	
1275	13:57	50
1245	14:23	
1290	15:07	45
1255	15:32	
1425	17:56	170
1250	19:45	
1405	21:57	155
1340	23:04	
1525	24:58	185
AVERAGE		

~~TRAVERSE POINT NUMBER~~	~~VELOCITY HEAD (Δp_s), in. H_2O~~	STACK TEMPERATURE (T_s), °F
1312	26:59	
1590	29:39	278
1394	31:32	
1615	34:11	221
1540	34:52	
1576	35:25	36
1545	35:46	
1683	37:18	138
1750	38:38	67
1710	39:08	
1725	39:31	15
1683	40:01	
1775	41:02	92
1710	41:42	
1730	42:13	20
1690	42:43	
1760	44:13	70
1740	44:52	
1795	45:42	84 55
		~~2197~~
AVERAGE		

EPA (Dur) 233
4 72

PRELIMINARY VELOCITY TRAVERSE

PLANT CHEVRON
DATE 8/12/83
LOCATION IAF
STACK I.D. START time 1130
BAROMETRIC PRESSURE, in. Hg
STACK GAUGE PRESSURE, in. H_2O
OPERATORS G.D. HENRY

START Time 11:30

ANEM. Read. ~~TRAVERSE POINT NUMBER~~	ELAPSED Time ~~VELOCITY HEAD (Δp_s), in. H_2O~~	STACK TEMPERATURE (T_s), °F
1830	000	
1860	028	~~2~~30
1665	3:01	
1885	6:15	225
1855	6:49	
1860	7:06	5
1670	8:48	
1855	10:41	185
1835	11:01	
1680	11:42	45
1815	12:24	
1845	12:49	30
1730	13:46	
2020	15:57	140
1895	17:58	
1535	18:34	40
1825	19:03	
2025	20:38	100
2010	21:13	
1985	22:09	
2035	22:46	50
2000	23:13	
2070	24:19	70
2030	25:08	
AVERAGE		

SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
2085	25:49	55
2065	26:14	
2100	27:05	35
2090	27:17	
2165	28:27	75
2130	28:59	
2150	29:26	30
2090	30:15	
2095	30:28	5
2080	31:16	
2200	33:08	120
2135	34:29	
2285	36:16	150
2245	36:43	
2345	38:51	100
2330	39:12	
2405	40:10	75
2445	41:14	40
2430	41:56	
2500	43:12	30
2495	43:22	
2540	44:18	45
2530	44:36	
2535	45:01	5
25[illegible] AVERAGE	45:13	

1725/45

PRELIMINARY VELOCITY TRAVERSE

PLANT CHEVRON
DATE 8/12/83
LOCATION IAF
STACK I.D. Start time 12:30
BAROMETRIC PRESSURE, in. Hg
STACK GAUGE PRESSURE, in. H_2O
OPERATORS GDIt

Anem. Reading ~~TRAVERSE POINT NUMBER~~	Elapsed Time ~~VELOCITY HEAD (Δp_s), in. H_2O~~	STACK TEMPERATURE (T_s), °F
2920	000	
3120	3:31	200
2995	4:25	
3020	4:54	25
3080	5:09	60
3105	5:48	25
3150	6:30	45
3140	6:51	
3250	8:29	90
3220	8:53	
3250	10:04	30
3200	10:40	
3430	13:27	170
3375	14:09	
3470	15:16	95
3395	16:50	
3275	18:14	
3395	19:31	120
3390	19:43	
3450	2026	60
3325	21:42	
3330	2158	5
3325	22:09	
3470	23:51	145
AVERAGE		

EPA (Dur) 233
4 72

SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
3440	24:29	
3500	24:57	60
3440	25:38	
3500	26:24	60
3480	26:54	
3570	28:17	90
3535	28:41	
3630	29:38	95
3580	30:28	
3595	30:50	15
3540	31:38	
3700	33:43	160
3635	34:29	
3690	35:08	55
3650	35:58	
3795	37:51	145
3765	38:35	
3780	39:05	15
3725	39:37	
3850	41:14	125
3840	41:35	
3960	43:09	120
3940	43:31	
3985	44:18	45
3970 AVERAGE	44:40	
3995	45:15	25

~~VELOCITY TRAVERSE~~ Burp Data

PLANT Chevron El Segundo
DATE 8/12/83
LOCATION IAF
STACK I.D. 4" Start time 1400
BAROMETRIC PRESSURE, in. Hg
STACK GAUGE PRESSURE, in. H_2O
OPERATORS D. SAVIA

SCHEMATIC OF TRAVERSE POINT LAYOUT

Reading ~~TRAVERSE POINT NUMBER~~	Elapsed time VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
9900	000	
180	3:10	280
9990	4:44	
875	7:45	285
132	9:07	
~~[illegible]~~	~~9:32~~	
330	11:59	198
264	12:41	
278	13:01	14
272	13:31	
358	14:40	86
315	15:23	
345	15:41	30
340	16:02	
393	16:58	53
352	18:30	
495	21:46	143
494	22:02	
505	22:32	11
380	23:38	
635	26:53	255
550	27:13	
652	28:52	102
634	29:12	
AVERAGE		

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
666	29:47	32
650	30:12	
623	31:06	
731	32:50	108
690	33:56	
720	34:33	30
713	34:59	
960	37:40	247
840	39:16	
1060	42:30	220
980	43:30	
1080	45:39	100
		2194
AVERAGE		

Liquid Sampling Log

WORK SHEET

Liquid Sample
Day Wed 8-3-83

Sample #	1	2	3
Time	12:00	2:30	4:50
DAF IN	~~12:00~~	~~2:30~~	
Comp	DBS ~~12:00~~	~~2:30~~ DBS	~~4:~~ MWJ
VOA	~~12:00~~	~~2:31~~	~~4~~ MWJ
DAF OUT	~~12:01~~	~~2:31~~	~~4~~ MWJ
Comp	DBS	DBS	MWJ
VOA			MWJ
EQ OUT			~~DBS~~
Comp		~~DBS~~	DBS
VOA		~~DBS~~	DBS

(ex) DAF IN. Sample #1 → D.I #1   ~~EQ~~ EO #1

WORK SHEET

Liquid Sample
~~8/4/83~~ 8/4/83

Gas Sample
Bag

Sample #							
Time	9:00	10:00	11:00	12:00	1300	1400	1500
DAF IN							
Comp	DBS	DBS	DBS	DBS	DBS	DBS	DBS
VOA		CBS					
DAF Out	DBS	DBS	DBS	DBS	DBS	DBS	DBS
Comp							
VOA		CBS					
EQ Out	DBS	—	DBS	DBS	—	DBS	DBS
Comp							
VOA							

~~Bag #~~	~~1~~	
~~Time~~	~~9:00/10:0~~	
~~DAF~~		
~~EQ~~		

WORK SHEET

Liquid Sample
8/5/83

	0900	1000	1100	1200	1300	1400	1500	1600
DAF - IN								
Comp	DBS	DBS	DBS	—	DBS	DBS		
VOA	BS					DBS		
DAF - Out								
Comp	DBS	DBS	DBS	—	DBS	DBS		
VOA	BS					BS	BS	
EQ - Out								
Comp	DBS	DBS	DBS	—	DBS	DBS		
VOA	DBS					B	BS	

WORK SHEET

Liquid Sample

DAY	8/8				8/9		8/10		8/11					
Time														
DAF 302 IN														
Comp	~~1100~~	~~1200~~	~~1300~~	~~1400~~	~~1500~~ 1000	500	1000	400	900					
VOA	~~1500~~ 1100	500		↓		↓	↓	↓	↓					
DAF 302 OUT	~~1100~~	1												
Comp	1100	1200	1300	1400	~~1500~~ 1000	500	1000	400	900					
VOA	~~1100~~ 1100	500	↓	↓	↓	↓	↓	↓	↓					

APPENDIX C

ANALYTICAL DATA

- Gas Chromatograph Worksheet
- Continuous Monitor Example
- Gas Chromatograph Analysis Examples

Mini 2

GC WORKSHEET

Start/stop ~~COLUMN~~: 11:35 - 12:35 RUN NUMBER: DAF - 302 - 2 DATE: 8/3/83

COMPOUND	RETENTION TIME IN CM. .75	COUNTS 16672	~~SPAN~~ counts 16833	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND ppm		~~CONCENTRATION AS BENZENE~~ R= conc/area
Hexane	1.07	1830	1791	8	0	10.2	9.9	see benzene
Benzene	1.32	2100	1869			11.7	10.4	.00555
Heptane	1.47	1852	1742			10.3	9.7	see benzene
UK	1.74	2085	1891			11.6	10.5	see benzene
Toluene	2.0	7448	6712			41.3	37.2	see benzene
UK	2.48	632	293			3.5	1.6	see benzene
~~BENZENE~~ UK	2.81	634	130			3.5	<1	see benzene
Xylene ~~TOLUENE~~	3.53	1788	1153			8.3	5.3	.00463
xylene ~~XYLENE~~	4.05	949	531			4.4	2.5	.00463
	4.65	738	400			4.1	2.2	~~see~~ benzene
TOTAL HYDRO-CARBONS (THC)								

TRW
ENVIRONMENTAL ENGINEERING DIVISION

Minis ~~#~~ 1

GC WORKSHEET

COLUMN: 2:45-3:15 RUN NUMBER: DAF-302-3 DATE: 8/3/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ counts	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		~~CONCENTRATION AS BENZENE~~ R = conc/area
C_1	.42	4586	4605	16	0	46.3	46.5	.0101
C_2	.59	323	322			7.0	7.0	.0216
C_3	.98	524	557			7.9	8.3	.0151
U.K	1.78	148	174			2.2	2.6	see propane
C_4	2.12	430	491			4.7	5.3	.0109
UK	4.57	934	894			14.1	13.5	see propane
~~BENZENE~~ C_5	5.36	478	330			4.1	2.8	.0086
~~TOLUENE~~ C_6	14.53	127	23			<1	<1	.0066
~~XYLENE~~								
TOTAL HYDRO-CARBONS (THC)								

TRW
ENVIRONMENTAL ENGINEERING DIVISION

Mini 2

GC WORKSHEET

COLUMN: 2:45 - 3:15 RUN NUMBER: DAF-302-3 DATE: 8/3/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ Counts	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		CONCENTRATION AS BENZENE
Hexane	1.09	3090	2992	8	0	17.1	16.6	See benzene
Benzene	1.32	2785	2668			15.5	14.8	.00535
Heptane	1.53	2096	2140			11.6	11.9	See benzene
UK	1.83	2265	2145			12.6	11.9	See benzene
toluene Toluene	2.11 / 2.07	8251	8077			45.8	44.8	See benzene
UK	2.67 / 2.61	399	392			2.2	2.2	See benzene
~~[illegible]~~	3.01 / 2.96	166	142			1	<1	See benzene
xylene ~~[illegible]~~	3.82 / 3.73	1359	1303			6.3	6.0	.00463
xylene ~~[illegible]~~	4.4 / 4.3	669	638			3.1	2.9	.00463
	5.07 / 4.93	482	463			2.7	2.6	See benzene
TOTAL HYDRO-CARBONS (THC)								

TRW
ENVIRONMENTAL ENGINEERING DIVISION

~~EO~~ Mini?

GC WORKSHEET

COLUMN: -5:00 RUN NUMBER: EQT-1 DATE: 8/3/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ counts	ATTENUATION ~~ ~~	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND ppm		~~CONCENTRATION AS BENZENE~~ R = conc/area
C_1	.41	2710	2630	16	0	27.4	26.6	.0101
C_2	.58	39	46	↓	↓	<1	1	.0216
C_3	.94	53	53			<1	<1	.0151
C_4								
C_5								
C_6								
BENZENE								
TOLUENE								
XYLENE								
TOTAL HYDROCARBONS (THC)								

Mine 2

GC WORKSHEET

COLUMN: 5:60 RUN NUMBER: FQT-1 DATE: 8/3/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ counts	ATTENUATION -	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		CONCENTRATION AS BENZENE
Hexane	1.07	328	383	8	0	1.8	2.1	see benzene
Benzene	1.32	1360	1419			7.5	7.9	.00555
UK	1.81	663	1391			3.7	7.7	see benzene
Toluene	2.06	5586	4944			31.0	27.4	see benzene
UK	2.89	1000	612			5.5	3.4	see benzene
xylene	3.69	1143	857			6.3	4.0	.00463
xylene ~~BENZENE~~	4.22	412	315			1.9	1.5	.00463
TOLUENE								
XYLENE								
TOTAL HYDRO-CARBONS (THC)								

TRW
ENVIRONMENTAL ENGINEERING DIVISION

Mini 2 Bad Range 10³

GC WORKSHEET

~~COLUMN~~ Start/Stop time: 10:30 → 11:00 RUN NUMBER: DAF-302-1 DATE: 8/3/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS BENZENE
C_1			10	4	0		
C_2							
C_3							
C_4							
C_5							
C_6	1.08	869					
BENZENE	3.58	179					
TOLUENE							
XYLENE	1.28	708					
TOTAL HYDRO-CARBONS (THC)							

divide counts by 2 for calculations of conc.

TRW
ENVIRONMENTAL ENGINEERING DIVISION

... sample about 100 ml.   Range 10^3

GC WORKSHEET

Start/Stop time: ~~COLUMN~~ 10:30 → 11:00   RUN NUMBER: DAF-302-1   DATE: 8/3/83

COMPOUND	RETENTION TIME IN ~~cm~~. min	COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS BENZENE
C_1	.43	4222		16			
C_2	.6	192					
C_3	.99	319					
C_4	2.12	214					
~~C_5~~ unidentified	4.54	251					
C_6							
~~BENZENE~~							
~~TOLUENE~~							
~~XYLENE~~							
TOTAL HYDROCARBONS (THC)							

TRW
ENVIRONMENTAL ENGINEERING DIVISION

HINI I

GC WORKSHEET

COLUMN: 3:40 -410 RUN NUMBER: ~~DEF~~-EQ-2 DATE: 8/4/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ counts	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		CONCENTRATION AS BENZENE
C_1	.41	1491	1421	16	0	25.2	24.0	.0169
C_2	.58	12	~~38~~0			<1	ND	.0220
C_3	.93	27	31			<1	<1	.0157
C_4								
C_5								
C_6								
BENZENE								
TOLUENE								
XYLENE								
TOTAL HYDRO-CARBONS (THC)								

GC WORKSHEET

COLUMN: 10:30 – 11:10 RUN NUMBER: EQT – 1 DATE: 8/4/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	SPAN counts	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		CONCENTRATION AS BENZENE
C_1	0.42	1754	1736	16	0	29.6	29.3	.0169
C_2	0.58	54	61			1.2	1.3	.0220
C_3	0.96	60	57			<1	<1	.0157
C_4	– 2.09	–	55			ND	<1	.0115
C_5								
C_6								
BENZENE								
TOLUENE								
XYLENE								
TOTAL HYDRO-CARBONS (THC)								

TRW
ENVIRONMENTAL ENGINEERING DIVISION

MINI 2

GC WORKSHEET

COLUMN: 230-3:00 RUN NUMBER: DAF-302-2 DATE: 8/4/83

COMPOUND	RETENTION TIME IN CM.		COUNTS	~~SPAN~~ counts	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		~~CONCENTRATION AS BENZENE~~ R
C/1 Hexane	1.07	1.06	2379	2355	8	0	15.2	15.1	see benzene
C/2 benzene	1.32		2071	2076			13.2	13.3	.00640
C/3 Hept ~~HNK~~	1.47		1007	1061			6.4	6.8	see benzene
C/4 UNK	1.75	1.76	1397	1490			8.9	9.5	see benzene
C/5 toluene	2.01	2.02	4886	5242			31.3	33.5	see benzene
C/6 UK	2.5	2.51	292	466			1.9	3.0	see benzene
~~BENZENE~~ UK	2.82	2.83	785	731			5.0	4.7	see benzene
~~TOLUENE~~ M XYL	3.53	3.58	1533	1642			7.5	8.0	.00490
XYLENE O-XYL	4.07	4.13	603	635			2.9	3.1	.00490
UK	4.69	4.71	233	281			1.5	1.8	see benzene
UK	8.04	8.11	373	192			2.4	1.2	see benzene
TOTAL HYDRO-CARBONS (THC)									

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TRW
ENVIRONMENTAL ENGINEERING DIVISION

GC WORKSHEET

COLUMN: 230-300 RUN NUMBER: DAF-302-2 DATE: 8/4/83

COMPOUND	RETENTION TIME IN CM.		COUNTS	SPAN counts	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		~~CONCENTRATION AS BENZENE~~ R
C_1	0.42		2716	2668	16	0	45.9	45.1	.0169
C_2	0.59	0.58	235	244	↓	↓	5.2	5.4	.0220
C_3	0.95		399	389			6.3	6.1	.0157
~~C~~4 UK	1.7		160	139			2.5	2.2	see propane
~~C_5~~ C_{11}	2.02	2.01	432	339			5.9 ~~[illegible]~~	3.9 ~~[illegible]~~	.0115
~~C_6~~ UK	2.29		28	—			<1	ND	see propane
BENZENE UK	3.93		29	—			<1	ND	see propane
~~TOLUENE~~ UK	4.27	4.26	977	823			15.3	12.9	see propane
C_5 ~~XYLENE~~	5.03	5	457	370			4.2	3.5	.0093/.0097
TOTAL HYDROCARBONS (THC)									

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NOTE: SKIMMING WAS OCCURRING when this SAMPLE WAS TAKEN [illegible]

Mini 2

GC WORKSHEET

~~COLUMN~~: 9:30-10:30 RUN NUMBER: DAF-302-1 DATE: 8/4/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ counts	~~ATTENUATION~~ counts	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		CONCENTRATION AS BENZENE
Ø1 Hexane	1.09	3559	3114	3606	0	22.8	23.1	See benzene
Ø2 Benzene	1.4	3066	3499	3148	↓	19.6	20.1	.00640
Ø3 Heptane	1.58	3288	3738	3378		21.0	21.6	See benzene
Ø4 UK	1.88	3004	3524	3108		19.2	19.9	see benzene
Ø5 Toluene	2.18	8468	9543	8892		54.2	56.9	see benzene
Ø6 UK	2.77	1200	1682	1542		7.7	9.9	See benzene
~~BENZENE~~ UK	3.14	575	1139	727		3.7	4.6	See benzene
~~TOLUENE~~ UK	3.42	1335	1759	1630		8.5	10.4	See benzene
Xylene ~~XYLENE~~	4.01	3061	4153	3443		15.0	16.9	.00490
Xylene	4.64	1651	2756	1582		8.1	7.7	.00490
UK	5.38	997	2058	1163		6.4	7.4	See benzene
TOTAL HYDRO-CARBONS (THC)	UK 11.21	1177	1625	1060	↓	7.5	6.8	

NOTE: SKIMMING WAS OCCURRING when

This sample was taken

GC WORKSHEET

Start/stop ~~COLUMN~~: 9:30-10:30 RUN NUMBER: DAF-302-1 DATE: 8/4/83

COMPOUND	RETENTION TIME IN CM.		COUNTS	~~SPAN~~ COUNTS	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		CONCENTRATION AS BENZENE
C_1	0.42	0.42	3255	3095	16	0	55.0	52.3	.0169
C_2	0.59	0.58	305	276			6.7	6.1	.0220
C_3	0.98	0.97	539	512			8.5	8.0	.0157
~~C4~~ UNK	1.8 ~~2.14~~	1.77	149	148			2.3	2.3	see propane
~~C5~~ C4	2.14	2.12	440	401			5.1	4.6	.0115
~~C6~~ UNK	4.64	4.57	284	881			12.3 ~~[illegible]~~	13.8	see propane
C5 ~~BENZENE~~	5.46	5.41	466	542			4.4	5.1	.00937
TOLUENE									
XYLENE									
TOTAL HYDRO-CARBONS (THC)									

TRW
ENVIRONMENTAL ENGINEERING DIVISION

Mine 2

GC WORKSHEET

COLUMN: 10:30 - 11:10 RUN NUMBER: EQT - 1 DATE: 8/4/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		CONCENTRATION AS BENZENE
1 Hexane	1.08	357	355	8	0	2.3	2.3	see benzene
2 Benzene	1.33	1483	1544			9.5	9.9	.00640
3 unk	1.82	1190	1211			7.6	7.7	see benzene
4 Toluene	2.09	3956	4036			25.3	25.8	see benzene
5 unk	2.95	464	401			3.0	2.6	see benzene
6 m-Xyl	3.76	885	760			4.3	3.7	.00490
~~BENZENE~~ o-Xyl	4.32	315	311			1.5	1.5	.00490
~~TOLUENE~~	~~6.84~~							~~See benzene~~
~~XYLENE~~								~~See benzene~~
TOTAL HYDRO-CARBONS (THC)								

TRW
ENVIRONMENTAL ENGINEERING DIVISION

GC WORKSHEET

COLUMN: 3:40 - 410 RUN NUMBER: EQ-2 DATE: 8/4/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ Counts	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		CONCENTRATION AS BENZENE
Hex	1.07	331	331	8	0	2.1	2.1	see benzene
Benz	1.3	740	781			4.7	5.0	.00640
UK	1.76	733	763			4.7	4.9	see benzene
Toluene	2.0	2058	2171			13.2	13.9	see benzene
UK	2.8	215	255			1.4	1.6	see benzene
Xylene	3.52	360	353			1.8	1.3	.00490
~~BENZENE~~ Ethyl	4.03	120	146			<1	<1	.00490
~~TOLUENE~~								
~~XYLENE~~								
TOTAL HYDRO-CARBONS (THC)								

TRW
ENVIRONMENTAL ENGINEERING DIVISION

MINI 1

GC WORKSHEET

COLUMN: 9:51 - 1006 RUN NUMBER: DAF -302-1 DATE: 8/5/83

COMPOUND	RETENTION TIME IN CM.		COUNTS	~~SPAN~~ CTS	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		CONCENTRATION AS BENZENE
C_1	0.42		3354	2939			~~58.7~~ ~~58.4~~ 57.4	~~51.4~~ ~~50.2~~ 50.2	0.0171 ~~0.0175~~
C_2	0.58	0.57	363	304			7.3	6.1	0.0201
C_3	0.97	0.96	493	454			7.4	6.9	0.0151
~~C4~~ UK	1.77	1.75	171	139			2.6	2.1	as propane
~~C5~~ C4	2.1	2.08	386	391			4.2	4.3	0.0109
~~C6~~ UK	4.53	4.49	742	665			11.2	10.1	as propane
C5 ~~BENZENE~~	5.36	5.31	374	241			5.6 ~~4.2~~	~~4.3~~ 3.6	0.0082
TOLUENE							~~5.6~~	~~3.6~~	
XYLENE									
TOTAL HYDRO-CARBONS (THC)									

TRW
ENVIRONMENTAL ENGINEERING DIVISION

GC WORKSHEET

COLUMN: 9:51-10:06 RUN NUMBER: DA-F-302-1 DATE: 8/5/83

COMPOUND	RETENTION TIME IN CM.		COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		CONCENTRATION AS BENZENE R morning =
* C_1 UK ~~Hexane~~	0.9	1.09	1772	ND ~~1463~~			11.3	—	0.0061 as BZ
C_2 Hexane	1.1	1.09	1902	1463			12.1	9.3	
C_3 Benzene	1.35	1.34	3249	4408			20.7	28.1	
* C_4 Heptane	1.51		718	-			4.6	-	
C_5 UK	1.84	1.83	1472	1674			9.4	10.7	
C_6 Tol	2.11		6938	2695			44.3	49.1	
UK ~~BENZENE~~	2.67	2.66	210	338			1.3	2.1	
UK TOLUENE	3.	2.99	322	713			2.0	4.5	
M-XYL XYLENE	3.84	3.82	2131	2457			12.1	15.1	0.0057
O-XYL	4.4	4.41	812	954			4.6	5.4	0.0051
UK	8.85	8.81	617	620			3.9	4	as BZ
UK	10.47	10.44	925	876			5.9	5.6	
TOTAL HYDRO-CARBONS (THC)									

* shoulder, may be a fluke

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ENVIRONMENTAL ENGINEERING DIVISION

HIN1 1

GC WORKSHEET

COLUMN: -1520 RUN NUMBER: DAF-302-2 DATE: 8/5/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ <T>	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		CONCENTRATION AS BENZENE R
C_1	0.41	3389	3434			58	58.7	~~0.0178~~ .0171
C_2	0.56	296	354			5.9	7.1	0.0201
C_3	0.90	527	570			8	8.6	0.0151
~~C_4~~ ule	1.6	174	208			2.6	~~3.1~~ 3.1	as propane
C_5 ule	1.88	452	476			8.2	7.2	"
C_6 ule	3.54	21	ND			<1	–	"
~~BENZENE~~ ule	3.91	1054	917			15.9	13.8	"
~~TOLUENE~~ ule	4.62	563	347			8.5	5.2	~~0.0087~~ "
C5 ~~XYLENE~~ peak	5.22	139	ND			1.2	–	0.0087
TOTAL HYDRO-CARBONS (THC)								

TRW
ENVIRONMENTAL ENGINEERING DIVISION

GC WORKSHEET

COLUMN: -1520 RUN NUMBER: DAF-2 DATE: 8/5/82

COMPOUND	RETENTION TIME IN CM.		COUNTS	~~SPAN~~ cts	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		CONCENTRATION AS BENZENE Rymon R adj		
C/1 Hexane	1.06	1.04	2934	2962			17.9	18.0	0.0064	0.0061	as Bz
C/2 benzene	1.32	1.31	5751	5768			35.0	35.1	"	"	as Bz
C3 u/k	1.75	1.74	2075	2174			12.6	13.2	"	"	as Bz
C4 Toluene	2.	1.59	7335	7221			44.7	44	"	"	As Bz
C/5 u/k	2.51	2.46	551 ~~857~~	624			3.4	3.8	"	"	As Bz
C/5 u/k	2.79	2.77	858 ~~342~~	749 ~~724~~			5.2	4.8	"	"	As Bz
~~BENZENE~~ 4/2 ~~m-xyl~~	3.05 ~~3.56~~	3.03	342 ~~2644~~	364			2.1	2.2	"	"	As Bz
TOLUENE ~~M P-XYL~~	3.53	3.5	2614	2520			10.6	10.2	0.0057	0.004	
XYLENE ~~O-XYL~~	4.05	4.	961	900			3.9	3.6		0.004	
u/k	4.61 5.11 6.41	4.62 6.29	384 67 289	318 4 447			2.3 1.8	1.9 2.7		0.0061	as Bz
	7.93 9.36	7.82 9.19	405 385	364 444			2.5 2.3	2.2 2.7			
TOTAL HYDRO-CARBONS (THC)											

TRW

ENVIRONMENTAL ENGINEERING DIVISION

MINI 1

GC WORKSHEET

COLUMN: ~1430-1515 RUN NUMBER: CHO-1 DATE: 8/5/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ CTS	~~ATTENUATION~~ CTS	DILUTION FACTOR (Diluted w/N_2) R=	CONCENTRATION AS COMPOUND			CONCENTRATION AS BENZENE R
C_1	0.42	1260	1325	1337	~~0.0175~~ .0175	21.5 ~~22.4~~	22.4 ~~23.2~~	22.9 ~~22.4~~	~~0.0175~~ .0171
C_2	0.56 0.98	84	11	155	.0201	1.7	<1	3.1	0.0201
C_3	0.93	55	91	57	.0151	<1	<1	<1	0.0151
~~C_4~~ un2	1.95	35	–	–		<1			as propane
~~C_5~~ un2	9.05	27	–	–		<1			
~~C_6~~ un2	10.42	26	–	–		<1			
BENZENE									
TOLUENE									
XYLENE									
TOTAL HYDRO-CARBONS (THC)									

$R = \frac{\text{conc}}{\text{area}}$

TRW
ENVIRONMENTAL ENGINEERING DIVISION

GC WORKSHEET

COLUMN: ~1430-1515 RUN NUMBER: CH0-1 DATE: 8/5/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ Counts	ATTENUATION ~~8~~	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		CONCENTRATION AS BENZENE R = A/C	
C1 Hex	1.06	318	326	8	0	1.9	2	0.0061	as Bz
C2 Benz	1.3	3294	3408			20.1	20.8		as Bz
C3 UK	1.76	1636	1727			10	10.5		
C4 Toluene	2	5022	5768			30.6	23		
C5									
C6									
BENZENE									
TOLUENE									
XYLENE									
TOTAL HYDRO-CARBONS (THC)									

TRW
ENVIRONMENTAL ENGINEERING DIVISION

MINI-1

GC WORKSHEET

COLUMN: 9:00-9:15 RUN NUMBER: BQT-1 DATE: 8/5/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ CTS	ATTENUATION	DILUTION FACTOR (Diluted w/N_2) CONC		CONCENTRATION AS COMPOUND		CONCENTRATION AS BENZENE R
C_1	0.41	1048	1027		17.9	17.5	~~18.3~~ ~~17.9~~	18. ~~17.6~~	~~0.0175~~ .0171
C_2	0.57 0.58	44	35				<1	<1	
C_3	0.96 0.95	45	30				<1	<1	
C_4									
C_5									
C_6									
BENZENE									
TOLUENE									
XYLENE									
TOTAL HYDRO-CARBONS (THC)									

TRW
ENVIRONMENTAL ENGINEERING DIVISION

GC WORKSHEET

COLUMN: 9:00 - 9:15 RUN NUMBER: R QT-1 DATE: 8/5/83

COMPOUND	RETENTION TIME IN CM.		COUNTS	~~SPAN~~ CTS	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		CONCENTRATION AS BENZENE R
C_1 Hexene	1.09	1.08	228	227			1.4	1.4	as Bz .0064
C_2 Benzene	1.33	1.32	1192	1263			7.6	8.1	as Bz
C_3 U.K.	1.83		540	554			3.4	3.5	as Bz
C_4 Toluene	2.06	2.09	2924	2927			18.7	18.7	as Bz
C_5 U.K.	2.97	2.96	227	179			1.4	1.1	as Bz
C_6 m-XYL	3.77	3.76	629	643			3.6	3.7	0.0057
~~BENZENE~~ o-XYL	4.34	4.32	179	204			1.0	1.2	0.0057
~~TOLUENE~~									
~~XYLENE~~									
TOTAL HYDRO-CARBONS (THC)									

TRW
ENVIRONMENTAL ENGINEERING DIVISION

MIWI 1

GC WORKSHEET

COLUMN: ______ RUN NUMBER: EQT-2 DATE: 8/5/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ CTS	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		CONCENTRATION AS BENZENE R
C_1	0.42	1189	120			20.3	20.5	~~0.0195~~ .021
C_2	0.58	84	95			1.7	1.9	0.0201
~~C_3~~ UD	0.82	30	0 ~~53~~			<1	—	as propane
~~C_4~~ C_3	0.91	39	53			<1	<1	0.0151
C_5								
C_6								
BENZENE								
TOLUENE								
XYLENE								
TOTAL HYDRO-CARBONS (THC)								

TRW
ENVIRONMENTAL ENGINEERING DIVISION

GC WORKSHEET

COLUMN: 12:30 – 12:50   RUN NUMBER: EQT-2   DATE: 8/5/83

COMPOUND	RETENTION TIME IN CM.		COUNTS	SPAN CTS	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		~~CONCENTRATION AS BENZENE~~ R= conc/area
C1 Hex	1.06	1.05	307	342			2	2.2	0.0064 mom as Bz
C2 Benz	1.31	1.3	1982	1953			12.6	12.5	as Bz
C3 UK	1.78	1.77	772	773			4.9	4.9	
C4 Tolu	2.03	2.01	4793	4564			30.6	29.1	
C5 UK	2.56		63				<1		
C6 UK	2.85	2.82	512	406			3.3	2.6	
~~BENZENE~~ m-XYL	3.61	3.58	1315	1179			7.4	6.7	0.0057 as Xyl
~~TOLUENE~~ o-XYL	4.14	4.1	437	377			2.5	2.2	0.0057 as Xyl
~~XYLENE~~ UK	6.54		185				1.2	–	as Bz
UK	8.12		291				1.9	–	as Bz
TOTAL HYDROCARBONS (THC)									

M1W1 ~~1?~~

GC WORKSHEET

COLUMN: 1100-1300 RUN NUMBER: DAF-302-1 DATE: 8/8/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		CONCENTRATION AS BENZENE
C_1	0.41 ~~[illegible]~~	3323	3385 ~~3277~~			54.8	55.9	0.0165
C_2	0.56 ~~[illegible]~~	191	250 ~~220~~			3.9	5.1	0.0205
C_3	0.89 0.88	373	407 ~~328~~			5.4	5.9	0.0144
~~C_4~~ uk	1.58 1.56	157	166 ~~173~~			2.3	2.4	as C_3 0.0144
~~C_5~~ C4 ~~uk~~	1.86 1.89	384	371 ~~430~~			4.1	4.0	0.0107
~~C_5~~ uk	3.88 3.84 ~~3.84~~	686	804 ~~923~~			9.9	11.6	as C3 0.0144
C5 ~~BENZENE~~	4.57 4.55 ~~[illegible]~~	375	420 ~~536~~			3.2	3.5	0.00845
~~TOLUENE~~ uk	~~4.84~~							
~~XYLENE~~								
TOTAL HYDRO-CARBONS (THC)								

GC WORKSHEET

COLUMN: 1100-1300   RUN NUMBER: DAF-302-1   DATE: 8/8/83

COMPOUND	RETENTION TIME IN CM.		COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		CONCENTRATION AS BENZENE B = conc/area
C_1 hexane	1.06		2653	2663			16.1	16.2	as Bz 0.0061
C_2 benz	1.39	1.4	6595	6481			40.2	39.5	0.0061
C_3 UK	1.88	1.87	977	928			6	5.4	"
C_4 Tol	2.2	2.19	7627	7577			46.5	46.2	~~0.00459~~ "
C_5 UK	2.79	2.77	478	452			2.9	2.8	"
C_6 UK	3.45	3.43	343	326			2.1	2.	"
~~BENZENE~~ m-xyl	4.01	3.98	2560	2414			11.6	11	0.00454
TOLUENE o-xyl	4.58	4.55	904	796			4.1	3.6	0.00454
~~XYLENE~~ u	5.33	5.28	215	202			1.3	1.2	as Benz 0.00454
u	7.43	7.35	104	198			<.1	1.2	
u	9.26	9.18	297	367			1.8	2.2	
u	10.94	10.87	263	311			1.6	1.9	
TOTAL HYDRO-CARBONS (THC)									

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MHW 1

SKIMMING.

GC WORKSHEET

COLUMN: 1500 – 1529 RUN NUMBER: DAS-302-2 DATE: 8/8/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		CONCENTRATION AS BENZENE R
C_1	0.41 0.4	3134	3277			51.7	54.1	0.0165
C_2	0.56 0.54	170	230			3.6	4.7	0.0205
C_3	0.88 .87	.306 306	378			4.7	5.4	0.0144
~~C4~~ UK	1.53 1.5	191	172			2.8	2.5	as C3
~~C5~~ ~~UK~~ C4	1.79 1.77	468	430			5.0	4.6	0.0107
~~C6 UK~~	~~2.07~~	~~772~~ 13	~~923~~			<1	–	as C3
~~BENZENE~~ UK	3.69 3.63	773 ~~431~~	923			11.1	13.3	as C3
~~TOLUENE~~ C5	4.29 4.25	434 ~~455~~	506			3.7	4.3	0.00845
~~XYLENE~~ UK	4.84	155	164			2.2	2.4	as C3
UK	9.22 9.07	401	231			5.8	3.3	as C3
C6								0.00767
TOTAL HYDRO-CARBONS (THC)								

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SKIMMING

GC WORKSHEET

COLUMN: 1500 – 1527 RUN NUMBER: DAF – 302 – 2 DATE: 8/8/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND ppm	CONCENTRATION AS BENZENE
~~C~~1 UK	0.91	2699	2708			16 / 16.5	as benzene 0.00609
C2 hex	1.03 1.07	4323 ~~1073~~	4286			26.3 / 26.1	
~~C3~~ UK	1.1	~~3245~~	~~4286~~				
~~C~~4 Benz	1.38	10487	10386			63.9 / 63.3	
C5 UK	1.86	2117	2065			12.9 / 12.6	
C6 TOL	2.13	12428	12246			75.7 / 74.6	
~~BENZENE~~ UK	2.68	1420	1247			8.6 / 7.6	
~~TOLUENE~~ UK	3.3 3.28	1283	1107			7.8 / 6.7	
~~XYLENE~~ m-XYL	3.83	4688	4430			21.3 / 20.1	0.00454
o-XYL UK	4.42 4.39 5.08 5.53 5.56	2013 467 320	1622 437 70			9.1 / 7.4 5.9 / 3.9 1.9 / <1	0.00454 as Benz 0.00609
	6.02 5.94 6.55 6.46	717 687	131 187			4.3 / <1 4.2 / 1.1	
TOTAL HYDRO-CARBONS (THC)	7.03 7.01 7.95 8.78 8.73 10.37 10.34	1616 914 1307 750	583 — 712 760			9.8 / 3.6 5.5 / — 8. / 4.3 4.6 / 4.6	

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MINI I

BZ = 49.8 ppm
m XYl = 49.9 ppm

GC WORKSHEET

COLUMN: 0915 ~~0855~~ - 1010 RUN NUMBER: DAF-302-1 DATE: 8/9/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ CTS	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS BENZENE R = conc/area
C_1	0.4	2060	2068			37.4 37.6	0.0182
C_2	0.55	130	110			2.5 2.2	0.0196
C_3	0.89	154	156			2.2 2.2	0.0143
~~C_4~~ uk	1.59	132	102			1.9 1.4	as propane
~~C_5~~ C_4	1.88	358	318			3.8 3.4	0.0107
C_6 uk	3.56	1220	1274			17.4 18.2	as propane
~~BENZENE~~ uk	4.65	838	860			12. ~~20~~ 12.3	
~~TOLUENE~~ uk	5.27	326	300			4.6 4.3	
~~XYLENE~~ uk	5.72 10.22	17 1835	~~200~~ – 1675			<1 – 26.2 23.9	
uk uk uk	11.15 12.15 12.45 12.4	1283 420 1079	1368 ~~1192~~ – 1242			18.3 19.5 6 – 15.4 17.0	
TOTAL HYDRO-CARBONS (THC)							

C5 5.13-4.5 min
C6 13.9-11.79
morn aft

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ENVIRONMENTAL ENGINEERING DIVISION

MINI 2

GC WORKSHEET

COLUMN: ~~0855~~ .0915 - 1040 RUN NUMBER: DAP-302-1 DATE: 8/9/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ CTS	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS BENZENE
~~C1~~ UK ~~tol~~ UK	0.42 1.11	3455 6059	3291 6076			19.5 20.3 37.4 37.5	as Benz 0.0062
~~C2~~ Benz	1.42	8036	7888			49.7 48.7	
~~C3~~ hept	1.58	4465	4698			27.6 29.0	
~~C4~~ TOL	1.87	2707	2829			16.7 17.5	
~~C5~~ UK Tol	2.21	14846	15122			91.7 93.4	
~~C6~~	2.81	1453	1578			9. 9.8	
~~BENZENE~~ m-XYL	3.42	1138	1194			5.9 6.2	0.0052
~~TOLUENE~~ o-XYL	4.04	4305	4382			22.2 22.6	0.0052
~~XYLENE~~ 412 UK	4.66 5.41	1487 405	1459 397			9.2 9 2.5 2.4	as Benz 0.0062
	7.54 9.12 9.42	278 77 438	282 136 389			1.7 1.7 <1 <1 2.7 2.4	
	11.16	248	253			1.5 1.6	
TOTAL HYDRO-CARBONS (THC)							

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MIN 1

SKIMMING WAS STARTED AT 1430 hrs

~~STRIPPING~~

GC WORKSHEET

COLUMN: 1400-1455 RUN NUMBER: DA-F-302-2 DATE: 8/9/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ CTS	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS ~~BENZENE~~ R = cond area
C_1	0.41 .39	1921	1515			34.9 34.8	0.0182
C_2	0.54	106	79			2.1 1.5	0.0196
C_3	0.88 .89	201	166			2.9 2.4	0.0143
~~C_4~~ UK	~~0~~.58	109	124			1.6 1.8	as propane
~~C_5~~ C4	1.88 1.87	279	326			3.- 3.5	0.0107
~~C_6~~ UK	3.97 3.94	869	925			12.4 13.2	as propane
~~BENZENE~~ UK	4.68 4.64	482	580			6.9 8.3	
~~TOLUENE~~ UK	5.29 5.22	152	267			2.2 3.8	
~~XYLENE~~							
TOTAL HYDRO-CARBONS (THC)							

C5 4.5 m (ext) - 5.13 (meas)

C4

SKIMMING GAS

GC WORKSHEET

COLUMN: 1400-1450 RUN NUMBER: DAF-302-2 DATE: 8/9/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ CTS	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS BENZENE
C_1 UNK ~~hexane~~	0.83 ~~1.09~~ 0.92	2678	2710			16.5 16.7	as benzene 0.0062
C_2 UNK ~~hexane~~	1.09 1.07	3816	3994			23.6 24.7	
C_3 benzene	1.25 1.24	1257	1323			7.8 8.2	
C_4 hept ~~UNK~~	1.43 1.42	6944	7428			42.9 45.9	
C_5 UNK	1.61 1.61	4631	4700			28.6 29.0	
C_6 TOL	1.9 1.9	2803	2908			17.3 18	
~~BENZENE~~ UK	2.25 2.24	14962	15591			92.5 96.3	
~~TOLUENE~~	2.87 2.87	1656	1630			10.2 10.1	
~~XYLENE~~ m-XYL	3.53 3.54	1328	1378			6.8 7.1 ~~8.8~~	0.0052
o-XYL	4.14 4.14 4.75 4.76 5.56 5.56 ~~444~~	4611 1657 ~~1657~~ 441	4775 1800 556			23.8 24.7 10.2 11.1 2.7 3.4	0.0052 0.0062 0.0062
	7.11 7.21 ~~161~~ 7.68 7.76 ~~514~~	~~441~~ 161 ~~161~~ 514	206 492			1 1.3 3.2 3.0	
TOTAL HYDRO-CARBONS (THC)	9.68 9.72 11.59 11.56	570 208	473 327			3.5 2.9 1.3 2.0	

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ENVIRONMENTAL ENGINEERING DIVISION

MIN 11

GC WORKSHEET

COLUMN: 1140 - 1150 RUN NUMBER: T-201-1 DATE: 8/9/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS ~~BENZENE~~ R
C_1	0.39	862				15.6	0.0182
C_2	0.56	21				<1	0.0196
C_3							
C_4							
C_5							
C_6							
BENZENE							
TOLUENE							
XYLENE							
TOTAL HYDRO-CARBONS (THC)							

TRW
ENVIRONMENTAL ENGINEERING DIVISION

MINI 2

GC WORKSHEET

COLUMN: 1140 -1150 RUN NUMBER: T-201-1 DATE: 8/9/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ CTS	ATTENUATION	DILUTION FACTOR ($Diluted w/N_2$)	CONCENTRATION AS COMPOUND	CONCENTRATION AS ~~BENZENE~~ R
C/1 ~~hexane~~ U12	1.05 1.04	343 ~~442~~	272 ~~4060~~			2.1 1.7	as benzene 0.0062
C/2 benz	1. 1.39	729	757			4.5 4.7	
C/3 ~~toluene~~ U12	2.22 2.21	1285	1251			7.9 7.7	
C4 1							
C/5							
C/6							
~~BENZENE~~							
~~TOLUENE~~							
~~XYLENE~~							
TOTAL HYDRO-CARBONS (THC)							

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MINI 1

GC WORKSHEET

COLUMN: 1510 – 1530 RUN NUMBER: T200-1 DATE: 8/5/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ CTS	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS ~~BENZENE~~ R
C_1	0.39	891	880			16.2 16	0.0182
C_2							
C_3							
C_4							
C_5							
C_6							
BENZENE							
TOLUENE							
XYLENE							
TOTAL HYDRO-CARBONS (THC)							

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GC WORKSHEET

COLUMN: ~~14~~ 1510 - 1530 RUN NUMBER: T200 - 1 DATE: 8/9/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ cts	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS ~~BENZENE~~ R
C_1 uk ~~Hexane~~	107	233	230			1.4 1.4	as benzene · 0.0062
C_2 Benz	1.39	538	589			3.3 3.6	
C_3 hept	1.58	31	–			<1	
C_4 uk	2.23	945	989			5.8 6.1	
C_5 uk	4.1	326	–			2.	
C_6							
BENZENE							
TOLUENE							
XYLENE							
TOTAL HYDRO-CARBONS (THC)							

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MINIL

GC WORKSHEET

COLUMN: 0904-1000 RUN NUMBER: DAF-302-1 DATE: 8/10/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS ~~BENZENE~~ R
** C_1 ~~UK~~	~~0.91~~	~~741~~					
C_2 hexane	1.09	1062	1065			6.7 6.7	as benzene 0.0063
C_3 UK ~~benz~~	1.25	301	-			1.9	
C_4 benz	1.43	3544	4017			22.2 25.2	
C_5 hept	1.64	1104	1136			6.9 7.1	
C_6 UK ~~7oy~~	1.94	890	912			5.6 5.7	
BENZENE UK	2.3 2.28	6879	6996			43.1 43.9	
TOLUENE UK	2.95 2.9	504	562			3.2 3.5	
~~m-xyl~~ UK	3.61 3.59	439	540			2.8 3.4	
m-xyl * m-xyl	4.28 4.22	2653	2575			12.9 12.5	0.0049
o-xyl XYLENE o-xyl	4.94 4.87	1117	1036			5.4 5.0	0.0045
	5.76 5.67	362	351			2.3 2.2	0.0063
	8.01 7.89	190	502			1.2 3.1	
	9.98 9.85	470	310			2.9 2.3	
	11.98 11.84	691	396			4.4 2.5	
TOTAL HYDRO-CARBONS (THC)							

* m-xyl cal gas has Tr of 4.4-4.2

** The occasional peak at 0.91 is sometimes a shoulder. Resolution appears to be temperature-dependent. So, I am deleting it from this and other days.

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GC WORKSHEET

COLUMN: 1205-1245 RUN NUMBER: V-204-1 DATE: 8/10/87

COMPOUND	RETENTION TIME IN CM.	COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND ppm	CONCENTRATION AS ~~BENZENE~~ R
C_1	0.37	1003	1083			18.1 19.6	0.0181
C_2 \	0.54 0 ~~54~~	32	46			<1 <1	0.0190
C_3	0.86 0.87	54	79			<1 1.1	0.0137
~~C_4~~ uk	1.53 1.51	32	32			<1 <1	as propane 0.0137
~~C_5~~ C4	1.81 1.81	71	71			<1 <1	0.0102
C_6/ uk	3.78 3.8	130	27			1.8 <1	as propane
~~BENZENE~~							
~~TOLUENE~~							
~~XYLENE~~							
TOTAL HYDRO-CARBONS (THC)							

MINI 2

GC WORKSHEET

COLUMN: 1205-1245 RUN NUMBER: V204-1 DATE: 8/10/83

COMPOUND	RETENTION TIME IN CM.		COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND		CONCENTRATION AS ~~BENZENE~~ R
C_1 UK	1.06		660				4.1	-	as benzene 0.0063
C_2 hex	1.12 ~~1.18~~		2274	2326			14.3	14.6	
C_3 bz	1.39	1.4	3712	3946			23.3	24.7	
C_4 hept	1.58	1.6	2341	2391			14.7	15.	
C_5 ~~Tol~~ UK	1.88	1.87	1524	1585			9.6	9.9	
C_6 Tol ~~UK~~	2.18	2.19	5604	5836			35.1	36.6	
BENZENE UK	3.12	3.11	183	171			1.1	1.1	
TOLUENE									
XYLENE									
TOTAL HYDROCARBONS (THC)									

TRW
ENVIRONMENTAL ENGINEERING DIVISION

GC WORKSHEET

COLUMN: 0904 - 1000 RUN NUMBER: DAF - 302-1 DATE: 8/10/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND ppm	CONCENTRATION AS ~~BENZENE~~ R
C_1	0.39	1338	1587			24.2 28.7	0.0181
C_2	0.54	84	142			1.6 2.7	0.0190
C_3	0.89 0.88	131	152			1.8 2.1	0.0137
~~C_4~~ unk	1.1	100	60			1.4 4.1	as propane 0.0137
~~C_5~~ C4	1.9 1.89	205	134			2.1 1.4	0.0102
~~C_6~~ unk	4.06 4.	258	239			3.5 3.3	as propane
BENZENE							
TOLUENE							
XYLENE							
TOTAL HYDRO-CARBONS (THC)							

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MINII

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GC WORKSHEET

COLUMN: ______ RUN NUMBER: ~~[illegible]~~ IA-7-1 DATE: ~~[illegible]/83~~ 2/11/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ cts	~~ATTENUATION~~ counts	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS ~~BENZENE~~ R
C_1	.39	87087	90065	86582		1,607 1597	0.0184
C_2	.53	429	1773	424		7.6 7.6	0.0179
C_3	.87	1373	7187	1364		18.2 18.1	0.0133
C_4 uk	1.23	86		93		1.1 1.2	w propane 0.0133
C_5 ~~C4~~ uk	1.58	1150	23679	1160		15.3 15.4	0.0133
c4 C4 C_6 ~~uk~~	1.88	4381	31441	4324		42.3 41.7	0.0097
~~BENZENE~~ uk	3.01	134		171		1.8 2.3	as propane
TOLUENE uk	4.	33017	38418	32338		438 429	
XYLENE C5	4.72	35974	41778	35175		286 279 ~~478 462~~	0.0079
uk uk	5.33 8.03 10.43	15773 5286 82431	32839 8497	~~1585~~ 15588 4975 80450		260 207 70.1 66.0 1095 1068	
	11.43 12.77	130654 129372	144697 140788	129597 128618		1735 1721 1705 1708	
TOTAL HYDRO-CARBONS (THC)	15.17 17.77 18.57	2963 111 53				39 1.5 <1	

MINIL

GC WORKSHEET

inlet

COLUMN: - 0940 RUN NUMBER: ~~DAF-302-2~~ IAF-1 DATE: ~~8/10/83~~ 8/11/83

COMPOUND	RETENTION TIME IN CM. #1 #2	COUNTS	SPAN CTS	ATTENUATION	DILUTION FACTOR (Diluted w/N_2) #3 CTS	CONCENTRATION AS COMPOUND runs 1 & 2	CONCENTRATION AS ~~BENZENE~~ R
C_1 hexane	1.11 1.12	207314	200430		213230	1310 1267	as benzene
ui2 benz C_2 ~~tol~~ ~~ui~~	1.24 1.47	135118 134220	131510 ~~131510~~ ←	130030	141990 273770	854 831 848 822	0.00063
C_3 hept	1.57	133769	127970 ~~[illegible]~~		*	845 808	
Toluene C_4 ui	1.84 2.25	116801 68423	64800 ← ~~129720~~)	111760	116430 69900	738 706 432 410	
C_5 ui	2.49	65212	58140		60380	412 367	
C_6 ui2 ui2	2.86 3.51	55150 49184	50280 42180		51550 42550	348 318 311 267	
m-xyl o-xyl BENZENE	4.11 4.53	65420 41657	57930 29180		60500 36610	268 237 171 119	0.004
TOLUENE	5.51 6.0	25441 7024	17830 2940		14220 ~~[illegible]~~	311 113 ~~[illegible]~~44 19	as benzene
XYLENE	6.6 7.1 7.6	11343 17200 21950	3860 5550 2840		2430 6940 6960	71.7 244 89 33.0 ~~10~~139 18	
	8.71 9.56 11.46	17074 16550 11737	5650 6840 6340		~~19~~30900 10240 8280	108 35.7 105 43.2 74.2 40.1	
	12.76 13.7	303 1294	~~[illegible]~~ 1120		– –	1.9 ~~23.9~~ 8.2 7.1	
TOTAL HYDRO-CARBONS (THC)							

MINI 1

GC WORKSHEET

COLUMN: 1315 -1410 RUN NUMBER: DLP-302-1 DATE: 8/11/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ CTS	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS ~~BENZENE~~
C_1	.39	1565	1604			28.9 29.6	0.0184
C_2	0.54 .53	55	62			<1 1.1	0.0179
C_3	0.86 .85	164 ~~222~~	153			2.2 2.0	0.0133
~~C4~~ uk	1.53 1.51	272	309			3.6 4.1	as propane 0.0133
~~C5~~ C4	1.8 1.79	650	687			6.3 6.6	0.0097
~~C6~~ uk	2.29	18				<1	as propane
~~BENZENE~~	3.29 3.79 3.75	61 1341	1298			<1 17.8 17.2	as propane
C5 ~~TOLUENE~~	4.44 4.41 1076 5.03 4.95 328	~~1247~~ ~~1076~~	1249 516			8.5 9.9 4.4 6.8	0.0079 as propane
XYLENE	5.31	17 ~~329~~	–			<1 –	
	9.66 9.6 11.78 11.74	262 236	312 254			3.5 4.1 3.1 3.4	
TOTAL HYDRO-CARBONS (THC)							

TRW
ENVIRONMENTAL ENGINEERING DIVISION

MIW12

GC WORKSHEET

COLUMN: 1315 - ~~210~~ 1410 RUN NUMBER: DAR-302-1 DATE: 8/11/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ CTS	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS ~~BENZENE~~ R
~~C1~~ hexane	1.06 1.11	3037	3006			19.2 19	as benzene 0.0063
~~C2~~ MEK ~~benzene~~	1.22 1.22	924	916			5.8 5.8	
~~C3~~ benzene ~~...~~	1.41	8815	8675			55.7 54.8	
~~C4~~ MIK	1.86	2719	2753			17.2 17.4	
Toluene ~~C5~~	2.2 2.19	9778	9701			61.8 61.3	
~~C6~~	2.78 3.42 3.43	1617 1512	1570 1697			10.2 9.9 9.6 10.7	
m-xyl ~~BENZENE~~ o-xyl	4. 3.99 4.6 4.59	4599 2106	4801 1918			18.8 19.7 8.6 7.9	0.0044 0.0041
~~TOLUENE~~	5.35 5.33 5.85 5.83	1303 408	955 261			8.2 6.0 2.6 1.3	as benzene 0.0063
~~XYLENE~~	6.37 6.33 6.82 6.81	823 819	450 550			5.2 2.8 5.2 3.5	
	7.35 7.44 7.85 7.84 8.4 8.39	908 496 870	827 332 738			5.7 5.2 3.1 2.1 5.5 4.7	
	9.22 9.21 10.97 10.91	1126 982	1228 879			7.1 7.8 5.7 5.6	
TOTAL HYDRO-CARBONS (THC)							

TRW

ENVIRONMENTAL ENGINEERING DIVISION

HINII

GC WORKSHEET

COLUMN: ____________ RUN NUMBER: IAF-OUT DATE: 8/11/81

COMPOUND	RETENTION TIME IN CM.	COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS ~~BENZENE~~ R
C_1	0.38	95516				1762	0.0184
C_2	0.51	252				4.5	0.0179
C_3	0.85	963				12.8	0.0133
~~C_4~~ u	1.17	21				< 1	as propane 0.0133
~~C_5~~ u	1.5	960				12.7	as propane
~~C_6~~ C4	1.78	3777				36.4	0.0097
BENZENE	2.77	117				1.6	as propane
TOLUENE	3.74 4.4	34569 38978				455 518	
XYLENE (C5)	4.97 7.49	13824 5276				110 70.1	0.0079 as propane
	9.62 10.55	90934 88850				1208 1180	
	11.75	98115				1303	
TOTAL HYDRO-CARBONS (THC)							

Run 2

GC WORKSHEET

COLUMN: ______ RUN NUMBER: IAF-OUT DATE: 8/11/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS ~~BENZENE~~ R
C_1 hex	1.05	321760				2033	as benzene 0.0063
C_2 benz	1.36	170010				1074	
C_3 hept	1.65	71090				449	
C_4	1.92	94290				594	
C_5	2.35	33530				219	
C_6 m-xyl	2.86 3.3	28210 40940				178 168	0.0041
o-xyl BENZENE	3.82 4.30	16540 13270				67.8 83.9	0.0041 as benzene
TOLUENE	5.41 5.88	20760 7640				~~83~~.132 48.3	
XYLENE	6.58 7.4	15430 12720				97.5 80.4	
	7.56 8.46 9.54 9.65	2980 13400 3580 680				18.8 ~~84.9~~ 84.7 22.6 4.3	
	10.11 11.85	11300 4310				71.4 27.2	
TOTAL HYDRO-CARBONS (THC)	12.61 12.76 14.26	2200 4790 1000				13.9 30.3 6.3	

MINI #1

GC WORKSHEET

COLUMN: ______ RUN NUMBER: IAP-1N-2 DATE: 8/11/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ CTS	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS ~~BENZENE~~ P
C_1	0.38	152731				2818	0.0184
C_2	0.52	1834				32.7	0.0179
C_3	.83	2205				29.3	0.0133
~~C_4~~ UK	1.14	210				2.8	as propane
~~C_5~~ UK C4	1.47 1.73	2199 8343				29.2 80.5	0.0097
~~C_6~~ UK UK	2.67 3.6	274 77530				 1030	as propane
C5 ~~BENZENE~~	4.22 4.77	83393 27760				1107 220	0.0079
~~TOLUENE~~ UK UK	5.48 7.12	433 12231				5.8 162	as propane
~~XYLENE~~ UK UK	9.12 9.58	202251 214481				2686 2848	
UK UK	11.05 ~~15.18~~ 18.58	195484 ~~31~~ 14591				2596 194	
TOTAL HYDRO-CARBONS (THC)							

TRW
ENVIRONMENTAL ENGINEERING DIVISION

MIW-12

GC WORKSHEET

COLUMN: ______ RUN NUMBER: IAF-ID-2 DATE: 3/11/83

COMPOUND	RETENTION TIME IN CM.	COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS ~~BENZENE~~ R
C_1 hexane	1.04	964505	731000 ~~615680~~			~~46127~~ 4620	as benzene 0.0063
C_2 benz	1.34 1.36	418117	411490			2642 2600	
C_3 hept	1.62 1.65	148492	149330			938 944	
C_4 MIK	1.89 1.92	167214	162290			1057 1026	
C_5	2.29 2.34 2.79 2.85 59003	63177 ~~63197~~	61160 56040			399 387 373 354	
C_6	3.21 3.28 3.71 3.81 23915	80156 ~~59003~~	81730 20270			507 517 151 128	
BENZENE m-xyl o-xyl	4.16 4.26 4.58 4.66	25560 7762	24110 7300			~~162~~ 105 ~~152~~ 58.8 ~~49~~ 31.7 ~~44~~ 29.9	0.0041 0.0041
TOLUENE	5.25 5.38 6.36 6.55	48741 20376	17540 18750			308 118 129 118	as benzene 0.0063
XYLENE	7.03 7.25 8.16 8.41	16251 15928	16020 10540			103 101 101 102	
	9.69 10.69	12248 10729				77.4 67.8	
	12.86 14.53	6287 318				39.7 2	
TOTAL HYDRO-CARBONS (THC)							

TRW

ENVIRONMENTAL ENGINEERING DIVISION

MINI. 1.

GC WORKSHEET

COLUMN: ______ RUN NUMBER: EG-065 DATE: 8-12-83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~ cts	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS ~~BENZENE~~
C_1	0.36 .38	1307	1295			23.6 23.4	0.0181
C_2							
C_3							
C_4							
C_5							
C_6							
BENZENE							
TOLUENE							
XYLENE							
TOTAL HYDRO-CARBONS (THC)							

MINI-2

GC WORKSHEET

COLUMN: ______ RUN NUMBER: EQ-OCLS DATE: 8-12-83

COMPOUND	RETENTION TIME IN CM.	COUNTS	~~SPAN~~	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS ~~BENZENE~~ R
C_1 ug/L	2.88 2.81	152	115 ~~174~~			<1 <1	as benzene 0.0060
C_2 "	3.87 3.53	250	526			1.5 3.2	
C_3 "	4.63 4.43	174	359			1.0 2.4	
C_4 "	~~5.41~~ 6.8 5.41	— 235	152 —			— 1.4 <1 —	—
C_5 "	7.41 6.67 7.47	157	312 136			<1 1.9 <1	
C_6 "	8.04	255	—			1.5 —	
BENZENE "	9.73 9.73	191	324			1.1 2	
TOLUENE "	11.41 1123	1058	~~733~~ 748			6.3 4.5	
XYLENE "	13.79	246	—			1.5 ~~1.5~~ —	
"	14.85	130	—			<1 —	
TOTAL HYDRO-CARBONS (THC)							

TRW

ENVIRONMENTAL ENGINEERING DIVISION

MINI-1

GC WORKSHEET

COLUMN: ______ RUN NUMBER: E9-out-2 DATE: 8-12-83

COMPOUND	RETENTION TIME IN CM.	COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS BENZENE
C_1	0.38	1320				15.4	0.0181
C_2							
C_3							
C_4							
C_5							
C_6							
BENZENE							
TOLUENE							
XYLENE							
TOTAL HYDRO-CARBONS (THC)							

MINI 2

GC WORKSHEET

COLUMN: ______ RUN NUMBER: EG-0117-2 DATE: 8-12-83

COMPOUND	RETENTION TIME IN CM.	COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS BENZENE R
C_1 het	1.08	96				<1	as benzene 0.0060
C_2 uk	4.09	219				1.3	
C_3	4.88	150				<1	
C_4	6.22	223				1.3	
C_5	8.02	214				1.3	
C_6							
BENZENE							
TOLUENE							
XYLENE							
TOTAL HYDRO-CARBONS (THC)							

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MINI-1

GC WORKSHEET

COLUMN: ________ RUN NUMBER: EG-ZN DATE: 8-12-83

COMPOUND	RETENTION TIME IN CM.	COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS ~~BENZENE~~ R
C_1	0.38	1402	1289			25.3 23.5	0.0181
C_2 412	1.86	154	148			1.8 1.7	as propane 0.0117
C_3 412	3.99	362	284			4.2 3.3	"
C_4							
C_5							
C_6							
BENZENE							
TOLUENE							
XYLENE							
TOTAL HYDRO-CARBONS (THC)							

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MINI 2

GC WORKSHEET

COLUMN: ______________ RUN NUMBER: CG-8W DATE: 8-12-73

COMPOUND	RETENTION TIME IN CM.	COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted W/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS ~~BENZENE~~ l
			CTS				
C_1 412 412	0.88 .89 (0.91	504 1052	1491			9.3 8.5	as benzene 0.0060
C_2 Hex	1.12 ~~1.67~~	935 ~~290~~	994 ~~363~~			5,6 6.	
C_3 ~~412~~	~~1.41~~	~~404~~				-	
C_4 benz	1.3	6125	6749			36.7 46,5	-
C_5 412 412	1.75 2.01	540 11512	 11874			3,2 49.0 71.2	
C_6	2.81	183	223			1.1 1.3	
m-xyl o-xyl BENZENE	3.56 4.08	2970 1088	3096 1183			14.5 15.1 5.3 5.8	0.0049 "
TOLUENE 4K	4.44 6.44 6.5	166 1102	148 882			1 <1 6.6 5.3	as benzene
XYLENE	8.03 9.82	701 425	735 280			4.2 4.7 2.5 1.7	
	10.07 10.53 11.44 1285	287 403 174	 151			1.7 - 2.4 - 1.0 <1	
	7.18		230			- 1.4	
TOTAL HYDRO-CARBONS (THC)							

MINI I

GC WORKSHEET

COLUMN: ________ RUN NUMBER: IAF-IN DATE: 8-12-83

COMPOUND	RETENTION TIME IN CM.	COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS ~~BENZENE~~ R
C_1	.38	119387				2154	0.0181
C_2	.52	504				9.2	0.0163
C_3	.85	1864				21.9	0.0117
C_4 uk	1.55	2214				25.9	as propane 0.0117 -
C_5 c4	1.85	8467				72.1	0.0685
C_6 uk uk	2.93 3.95	270 69883				3.2 818	as propane 0.0017 "
cs BENZENE	4.65	69964				516	0.6073
TOLUENE uk	5.27 ~~6.49~~ 7.95	26005 9734				305 114	as propane 0.0017
XYLENE	~~7.43~~ 10.34 142835 11.32	~~142595~~ 194924				1673 2283	
	12.57 14.79	183957 1475				2155 17.3	
TOTAL HYDRO-CARBONS (THC)							

TRW

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MINI 2

GC WORKSHEET

COLUMN: ______ RUN NUMBER: JAF-IN DATE: 2-12-83

COMPOUND	RETENTION TIME IN CM.	COUNTS	SPAN	ATTENUATION	DILUTION FACTOR (Diluted w/N_2)	CONCENTRATION AS COMPOUND	CONCENTRATION AS BENZENE
C_1 u.i.	0.9	155935				935	as benzene 0.0060
C_2 hex	1,07	334290 ~~202311~~				2005	
C_3 ~~benz~~ u.i.	1.16	202311				1213	
C_4 benz	1.39	350302				2101	
C_5 hept	1.74	132257				793	
C_6 u.i.	2.04 2.22	92246 64086				553 384	
BENZENE	2.59 3.11	58505 53420				351 320	
m-XYL TOLUENE o-XYL	3.61 4.22	78886 21760				385 106	0.0019 0.0019
XYLENE u.i.	4.76 5.22	26512 7974				159 47.8	as benzene
	5.69 6.07 6.55	11729 20016 20253				70.3 120 122	
	7.43 8.18	20844 18767				125 112	
TOTAL HYDRO-CARBONS (iTHC)	9.62 10.78 11.5 12.64	19906 3894 8093 9580				113 23.4 48.5 59.9	

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ENVIRONMENTAL ENGINEERING DIVISION

APPENDIX D

SAMPLING METHODS AND ANALYTICAL TECHNIQUE

503 OIL AND GREASE

In the determination of oil and grease, an absolute quantity of a specific substance is not measured. Rather, groups of substances with similar physical characteristics are determined quantitatively on the basis of their common solubility in trichlorotrifluoroethane. "Oil and grease" is any material recovered as a substance soluble in trichlorotrifluoroethane. It includes other material extracted by the solvent from an acidified sample (such as sulfur compounds, certain organic dyes, and chlorophyll) and not volatilized during the test. It is important that this limitation be understood clearly. Unlike some constituents that represent distinct chemical elements, ions, compounds, or groups of compounds, oils and greases are defined by the method used for their determination.

The methods presented here are suitable for biological lipids and mineral hydrocarbons. They also may be suitable for most industrial wastewaters or treated effluents containing these materials, although sample complexity may result in either low or high results because of lack of analytical specificity. The method is not applicable to measurement of low-boiling fractions that volatilize at temperatures below 70 C.

1. Significance

Certain constituents measured by the oil and grease analysis may influence wastewater treatment systems. If present in excessive amounts, they may interfere with aerobic and anaerobic biological processes and lead to decreased wastewater treatment efficiency. When discharged in wastewater or treated effluents, they may cause surface films and shoreline deposits leading to environmental degradation.

A knowledge of the quantity of oil and grease present is helpful in proper design and operation of wastewater treatment systems and also may call attention to certain treatment difficulties.

2. Selection of Method

For liquid samples, three methods are presented: the partition-gravimetric method (A), the partition-infrared method (B), and the Soxhlet method (C). Method B is designed for samples that might contain volatile hydrocarbons that otherwise would be lost in the solvent removal operations of the gravimetric procedure. Method C is the method of choice when relatively polar, heavy petroleum fractions are present, or when the levels of nonvolatile greases may challenge the solubility limit of the solvent. For low levels of oil and grease (<10 mg/L), Method B is the method of choice because gravimetric methods do not provide the needed precision.

Method D is a modification of the Soxhlet Method and is suitable for sludges and similar materials. Method E can be used in conjunction with Methods A, B, C, or D to obtain a hydrocarbon measurement in addition to, or instead of, the oil and grease measurement. This method separates hydrocarbons from the total oil and grease on the basis of polarity.

3. Sampling and Storage

Collect a representative sample in a wide-mouth glass bottle that has been rinsed with the solvent to remove any detergent film, and acidify in the sample bottle. Collect a separate sample for an oil and grease determination and do not subdivide in the laboratory. When information is required about average grease concentration over an extended period, examine individual portions collected at prescribed time intervals to eliminate losses of grease on sampling equipment during collection of a composite sample.

In sampling sludges, take every possible precaution to obtain a representative sample. When analysis cannot be made immediately, preserve samples with 1 mL conc HCl/80 g sample. Never preserve samples with $CHCl_3$ or sodium benzoate.

503 A. Partition-Gravimetric Method

1. General Discussion

a. Principle: Dissolved or emulsified oil and grease is extracted from water by intimate contact with trichlorotrifluoroethane. Some extractables, especially unsaturated fats and fatty acids, oxidize readily; hence, special precautions regarding temperature and solvent vapor displacement are included to minimize this effect.

b. Interference: Trichlorotrifluoroethane has the ability to dissolve not only oil and grease but also other organic substances. No known solvent will selectively dissolve only oil and grease. Solvent removal results in the loss of short-chain hydrocarbons and simple aromatics by volatilization. Significant portions of petroleum distillates from gasoline through No. 2 fuel oil are lost in this process. In addition, heavier residuals of petroleum may contain a significant portion of materials that are not extractable with the solvent.

2. Apparatus

a. Separatory funnel, 1 L, with TFE* stopcock.

b. Distilling flask, 125 mL.

c. Water bath.

d. Filter paper, 11 cm diam.†

3. Reagents

a. Hydrochloric acid, HCl, 1 + 1.

b. Trichlorotrifluoroethane‡ (1,1,2-trichloro-1,2,2-trifluoroethane), boiling point 47 C. The solvent should leave no measurable residue on evaporation; distill if necessary. Do not use any plastic tubing to transfer solvent between containers.

c. Sodium sulfate, Na_2SO_4, anhydrous crystal.

4. Procedure

Collect about 1 L of sample and mark sample level in bottle for later determination of sample volume. Acidify to pH 2 or lower; generally, 5 mL HCl is sufficient. Transfer to a separatory funnel. Carefully rinse sample bottle with 30 mL trichlorotrifluoroethane and add solvent washings to separatory funnel. Preferably shake vigorously for 2 min. However, if it

*Teflon or equivalent.

†Whatman No. 40 or equivalent.

‡Freon or equivalent.

is suspected that a stable emulsion will form, shake gently for 5 to 10 min. Let layers separate. Drain solvent layer through a funnel containing solvent-moistened filter paper into a clean, tared distilling flask. If a clear solvent layer cannot be obtained, add 1 g Na_2SO_4 to the filter paper cone and slowly drain emulsified solvent onto the crystals. Add more Na_2SO_4 if necessary. Extract twice more with 30 mL solvent each but first rinse sample container with each solvent portion. Combine extracts in tared distilling flask and wash filter paper with an additional 10 to 20 mL solvent. Distill solvent from distilling flask in a water bath at 70 C. Place flask on a water bath at 70 C for 15 min and draw air through it with an applied vacuum for the final 1 min. Cool in a desiccator for 30 min and weigh.

5. Calculation

If the organic solvent is free of residue, the gain in weight of the tared distilling flask is mainly due to oil and grease. Total gain in weight, A, of tared flask less calculated residue, B, from solvent blank is the amount of oil and grease in the sample:

$$\text{mg oil and grease/L} = \frac{(A - B) \times 1{,}000}{\text{mL sample}}$$

6. Precision and Accuracy

Methods A, B, and C were tested by a single laboratory on a sewage sample. By this method the oil and grease concentration was 12.6 mg/L. When 1-L portions of the sewage were dosed with 14.0 mg of a mixture of No. 2 fuel oil and Wesson oil, recovery of added oils was 93% with a standard deviation of 0.9 mg.

503 B. Partition-Infrared Method (TENTATIVE)

1. General Discussion

a. Principle: Although the extraction procedure for this method is identical to that of Method A, infrared detection permits the measurement of many relatively volatile hydrocarbons. Thus, the lighter petroleum distillates, with the exception of gasoline, may be measured accurately. Adequate instrumentation allows for the measurement of as little as 0.2 mg oil and grease/L.

b. Interference: Some degree of selectivity is offered by this method to overcome some of the coextracted interferences discussed in Method A. Heavier residuals of petroleum may contain a significant portion of materials insoluble in trichlorotrifluoroethane.

c. Definitions: A "known oil" is defined as a sample of oil and/or grease that represents the only material of that type used or manufactured in the processes represented by a wastewater. An "unknown oil" is defined as one for which a representative sample of the oil or grease is not available for preparation of a standard.

2. Apparatus

a. Separatory funnel, 1 L, with TFE* stopcock.

b. Infrared spectrophotometer, double beam, recording.

c. Cells, near-infrared silica.

d. Filter paper, 11 cm diam.†

3. Reagents

a. Hydrochloric acid, HCl, 1 + 1.

b. Trichlorotrifluoroethane. See 503A.3b.

c. Sodium sulfate, Na_2SO_4, anhydrous, crystal.

*Teflon or equivalent.
†Whatman No. 40 or equivalent.

d. Reference oil: Prepare a mixture, by volume, of 37.5% iso-octane, 37.5% hexadecane, and 25% benzene. Store in sealed container to prevent evaporation.

4. Procedure

Refer to Method A for sample collection, acidification, and extraction. Collect combined extracts in a 100-mL volumetric flask and adjust final volume to 100 mL with solvent.

Prepare a stock solution of known oil by rapidly transferring about 1 mL (0.5 to 1.0 g) of the oil or grease to a tared 100-mL volumetric flask. Stopper flask and weigh to nearest milligram. Add solvent to dissolve and dilute to mark. If the oil identity is unknown (¶ 1c) use the reference oil (¶ 3d) as the standard. Using volumetric technics, prepare a series of standards over the range of interest. Select a pair of matched near-infrared silica cells. A 1-cm-path-length cell is appropriate for a working range of about 4 to 40 mg. Scan standards and samples from 3,200 cm^{-1} to 2,700 cm^{-1} with solvent in the reference beam and record results on absorbance paper. Measure absorbances of samples and standards by constructing a straight baseline over the scan range and measuring absorbance of the peak maximum at 2,930 cm^{-1} and subtracting baseline absorbance at that point. If the absorbance exceeds 0.8 for a sample, select a shorter pathlength or dilute as required. Use scans of standards to prepare a calibration curve.

5. Calculation

$$\text{mg oil and grease/L} = \frac{A \times 1{,}000}{\text{mL sample}}$$

where:

A = mg of oil or grease in extract as determined from calibration curve.

6. Precision and Accuracy

See 503A.6. By this method the oil and grease concentration was 17.5 mg/L. When 1-L portions of the sewage were dosed with 14.0 mg of a mixture of No. 2 fuel oil and Wesson oil, the recovery of added oils was 99% with a standard deviation of 1.4 mg.

503 C. Soxhlet Extraction Method

1. General Discussion

a. Principle: Soluble metallic soaps are hydrolyzed by acidification. Any oils and solid or viscous grease present are separated from the liquid samples by filtration. After extraction in a Soxhlet apparatus with trichlorotrifluoroethane, the residue remaining after solvent evaporation is weighed to determine the oil and grease content. Compounds volatilized at or below 103 C will be lost when the filter is dried.

b. Interference: The method is entirely empirical and duplicate results can be obtained only by strict adherence to all details. By definition, any material recovered is oil and grease and any filtrable trichlorotrifluoroethane-soluble substances, such as elemental sulfur and certain organic dyes, will be extracted as oil and grease. The rate and time of extraction in the Soxhlet apparatus must be exactly as directed because of varying solubilities of different greases. In addition, the length of time required for drying and cooling extracted material cannot be varied. There may be a gradual increase in weight, presumably due to the absorption of oxygen, and/or a gradual loss of weight due to volatilization.

2. Apparatus

a. Extraction apparatus. Soxhlet.

b. Vacuum pump or other source of vacuum.

c. Buchner funnel, 12 cm.

d. Electric heating mantle.

e. Extraction thimble, paper.

f. Filter paper, 11 cm diam.*

g. Muslin cloth disks, 11 cm diam.

3. Reagents

a. Hydrochloric acid, HCl, 1 + 1.

b. Trichlorotrifluoroethane: See 503A.3*b*.

c. Diatomaceous-silica filter aid suspension,† 10 g/L distilled water.

4. Procedure

Collect about 1 L of sample in a wide-mouth glass bottle and mark sample level in bottle for later determination of sample volume. Acidify to pH 2 or lower; generally, 5 mL HCl is sufficient. Prepare a filter consisting of a muslin cloth disk overlaid with filter paper. Wet paper and muslin and press down edges of paper. Using a vacuum, pass 100 mL filter aid suspension through prepared filter and wash with 1 L distilled water. Apply vacuum until no more water passes filter. Filter acidified sample. Apply vacuum until no more water passes through filter. Using forceps, transfer filter paper to a watch glass. Add material adhering to edges of muslin cloth disk. Wipe sides and bottom of collecting vessel and Buchner funnel with pieces of filter paper soaked in solvent, taking care to remove all films caused by grease and to collect all solid material. Add pieces of filter paper to filter paper on watch glass. Roll all filter paper containing sample and fit into a paper extraction thimble. Add any pieces of material remaining on watch glass. Wipe watch glass with a filter paper soaked in solvent and place in paper extraction thimble. Dry filled thimble in a hot-air oven at 103 C for 30 min. Fill thimble with glass wool or small glass beads. Weigh extraction flask. Extract oil and grease in a Soxhlet apparatus, using trichlorotrifluoroethane at a rate of 20 cycles/hr for 4 hr. Time from first cycle. Distill solvent from extraction flask in a water bath at 70 C. Place flask on a water bath at 70 C for 15 min and draw air through it using an applied vacuum for the final 1 min. Cool in a desiccator for 30 min and weigh.

*Whatman No. 40 or equivalent.

†Hyflo Super-Cel, Johns-Manville Corp., or equivalent.

5. Calculation

See Section 503A.5.

6. Precision and Accuracy

See Section 503A.6. By this method the oil and grease concentration was 14.8 mg/L. When 1-L portions of the sewage were dosed with 14.0 mg of a mixture of No. 2 fuel oil and Wesson oil, the recovery of added oils was 88% with a standard deviation of 1.1 mg.

503 D. Extraction Method for Sludge Samples

1. General Discussion

a. Principle: Drying acidified sludge by heating leads to low results. Magnesium sulfate monohydrate is capable of combining with 75% of its own weight in water in forming $MgSO_4 \cdot 7H_2O$ and is used to dry sludge. After drying, the oil and grease can be extracted with trichlorotrifluoroethane.

b. Interference: See 503C.1*b*.

2. Apparatus

a. Extraction apparatus. Soxhlet.

b. Vacuum pump or other source of vacuum.

c. Extraction thimble, paper.

d. Grease-free cotton: Extract nonabsorbent cotton with solvent.

3. Reagents

a. Hydrochloric acid, HCl, conc.

b. Magnesium sulfate monohydrate: Prepare $MgSO_4 \cdot H_2O$ by overnight drying of a thin layer in an oven at 150 C.

c. Trichlorotrifluoroethane: See 503A.3*b*.

4. Procedure

In a 150-mL beaker weigh a sample of wet sludge, 20 ± 0.5 g, of which the dry-solids content is known. Acidify to pH 2.0 (generally, 0.3 mL conc HCl is sufficient). Add 25 g $MgSO_4 \cdot H_2O$. Stir to a smooth paste and spread on sides of beaker to facilitate subsequent removal. Let stand until solidified, 15 to 30 min. Remove solids and grind in a porcelain mortar. Add the powder to a paper extraction thimble. Wipe beaker and mortar with small pieces of filter paper moistened with solvent and add to thimble. Fill thimble with glass wool or small glass beads. Extract in a Soxhlet apparatus, using trichlorotrifluoroethane, at a rate of 20 cycles/hr for 4 hr. If any turbidity or suspended matter is present in the extraction flask, remove by filtering through grease-free cotton into another weighed flask. Rinse flask and cotton with solvent. Distill solvent from extraction flask in water at 70 C. Place flask on a water bath at 70 C for 15 min and draw air through it using an applied vacuum for the final 1 min. Cool in a desiccator for 30 min and weigh.

5. Calculation

$$\text{Oil and grease as \% of dry solids} = \frac{\text{gain in weight of flask, g} \times 100}{\text{weight of wet solids, g} \times \text{dry solids fraction}}$$

6. Precision

The examination of six replicate samples of sludge yielded a standard deviation of 4.6%.

503 E. Hydrocarbons

1. Significance

In the absence of specially modified industrial products, oil and grease is composed primarily of fatty matter from animal and vegetable sources and hydrocarbons of petroleum origin. A knowledge of the percentage of each of these constituents in the total oil and grease minimizes the difficulty in determining the major source of the material and simplifies the correction of oil and grease problems in wastewater treatment plant operation and stream pollution abatement.

2. General Discussion

a. Principle: Silica gel has the ability to absorb polar materials. If a solution of hydrocarbons and fatty materials in trichlorotrifluoroethane is mixed with silica gel, the fatty acids are selectively removed from solution. The materials not eliminated by silica gel adsorption are designated hydrocarbons by this test.

b. Interference: The more polar hydrocarbons, such as complex aromatic compounds and hydrocarbon derivatives of chlorine, sulfur, and nitrogen, may be adrection is unnecessary if dilution water meets the blank criteria stipulated above. If the dilution water does not meet these criteria, proper corrections are difficult and results become questionable.

7. Precision and Accuracy

In a series of interlaboratory studies, each involving 86 to 102 laboratories (and as many river water and wastewater seeds), 5-day BOD measurements were made on synthetic water samples containing a 1:1 mixture of glucose and glutamic acid in the total concentration range of 5 to 340 mg/L. The regression equations for mean value, $\bar{X}$, and standard deviation, S, from these studies were:

$$\bar{X} = 0.665 \text{ (added level, mg/L)} - 0.149$$

$$S = 0.120 \text{ (added level, mg/L)} + 1.04$$

For the 300-mg/L mixed primary standard, the average 5-day BOD was 199.4 mg/L with a standard deviation of 37.0 mg/L.

8. References

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508 OXYGEN DEMAND (CHEMICAL)

The chemical oxygen demand (COD) is a measure of the oxygen equivalent of the organic matter content of a sample that is susceptible to oxidation by a strong chemical oxidant. For samples from a specific source, COD can be related empirically to BOD, organic carbon, or organic matter content.

1. Selection of Method

The dichromate reflux method is preferred over other methods using oxidants because of superior oxidizability, applicability to a wide variety of samples, and ease of manipulation. The test is most useful for monitoring and control, especially after correlations with constituents[1,2] such as BOD and organic carbon have been developed. For most organic compounds oxidation is 95 to 100% of the theoretical value.[2-4] Pyridine is not oxidized.[2] Benzene and other volatile organics are oxidized if they have sufficient contact with the oxidants.[2] While the carbonaceous portion of nitrogen-containing organic matter is oxidized, no oxidation of ammonia, either present in a waste or liberated from the nitrogen-containing organic matter, takes place in the absence of significant chloride concentrations.

2. Sampling and Storage

Test unstable samples without delay. Homogenize samples containing settleable solids in a blender to permit representative sampling. If there is to be a delay before analysis, preserve the sample by acidification to pH 2 or lower with conc sulfuric acid (H_2SO_4). Make preliminary dilutions for wastes containing a high COD to reduce the error inherent in measuring small volumes of sample.

508 A. Dichromate Reflux Method

1. General Discussion

a. Principle: Most types of organic matter are oxidized by a boiling mixture of chromic and sulfuric acids. A sample is refluxed in strongly acid solution with a known excess of potassium dichromate ($K_2Cr_2O_7$). After digestion the remaining unreduced $K_2Cr_2O_7$ is titrated with ferrous ammonium sulfate (FAS), the amount of $K_2Cr_2O_7$ consumed is determined, and the amount of oxidizable organic matter is calculated in terms of oxygen equivalent.

b. Interferences and limitations: Volatile straight-chain aliphatic compounds are not oxidized to any appreciable extent. This failure occurs partly because volatile organics are present in the vapor space and do not come in contact with the oxidizing liquid. Straight-chain aliphatic compounds are oxidized more effectively when silver sulfate (Ag_2SO_4) is added as a catalyst. However, Ag_2SO_4 reacts with chloride, bromide, and iodide to produce precipitates that are oxidized only partially. The difficulties caused by the presence of halides can be largely, though not completely, overcome by complexing with mercuric sulfate ($HgSO_4$) before the refluxing procedure.[3] Do not use the test for samples containing more than 2,000 mg chloride/L.

Nitrite (NO_2^-) exerts a COD of 1.1 mg O_2/mg NO_2^--N. Because concentrations of NO_2^- in polluted waters rarely exceed 1 or 2 mg NO_2^--N/L the interference is considered insignificant and usually is ignored. To eliminate a significant interference due to NO_2^-, add 10 mg sulfamic acid/mg NO_2^--N present in the refluxing flask. Also add the same amount of sulfamic acid to the reflux flask containing the distilled water blank.

Reduced inorganic species such as ferrous iron, sulfide, manganous manganese, etc., are oxidized quantitatively under the test conditions. For samples containing significant levels of these species, stoichiometric oxidation can be assumed from known initial concentration of the interfering species and corrections can be made to the COD value obtained.

c. Minimum detectable concentration: Determine COD values of >50 mg/L using 0.250*N* $K_2Cr_2O_7$. With 0.025*N* $K_2Cr_2O_7$, COD values from 5 to 50 mg/L can be determined but with lesser accuracy.[3]

2. Apparatus

Reflux apparatus, consisting of 500-mL

24.5

or 250-mL erlenmeyer flasks with ground-glass 24/40 neck* and 300-mm jacket Liebig, West, or equivalent condensers,† with 24/40 ground-glass joint, and a hot plate having sufficient power to produce at least 1.4 W/cm² of heating surface, or equivalent.

3. Reagents

a. Standard potassium dichromate solution, 0.250*N*: Dissolve 12.259 g $K_2Cr_2O_7$, primary standard grade, previously dried at 103 C for 2 hr, in distilled water and dilute to 1,000 mL.

b. Silver sulfate, Ag_2SO_4, reagent or technical grade, crystals or powder.

c. Sulfuric acid reagent: Add Ag_2SO_4 to conc H_2SO_4 at the rate of 22 g Ag_2SO_4/4 kg bottle. Let stand 1 to 2 days to dissolve Ag_2SO_4.

d. Sulfuric acid, H_2SO_4, conc.

e. Ferroin indicator solution: Dissolve 1.485 g 1,10-phenanthroline monohydrate and 695 mg $FeSO_4 \cdot 7H_2O$ in distilled water and dilute to 100 mL. This indicator solution may be purchased already prepared.‡

f. Standard ferrous ammonium sulfate titrant, approximately 0.25*N*: Dissolve 98 g $Fe(NH_4)_2(SO_4)_2 \cdot 6H_2O$ (FAS) in distilled water. Add 20 mL conc H_2SO_4, cool, and dilute to 1,000 mL. Standardize this solution daily against standard $K_2Cr_2O_7$ solution, as follows:

Dilute 10.0 mL standard $K_2Cr_2O_7$ solution to about 100 mL. Add 30 mL conc H_2SO_4 and cool. Titrate with FAS titrant, using 0.10 to 0.15 mL (2 to 3 drops) ferroin indicator.

Normality of FAS solution

$$= \frac{\text{Volume } 0.25N\ K_2Cr_2O_7 \text{ solution titrated, mL}}{\text{Volume FAS used in titration, mL}} \times 0.25$$

g. Mercuric sulfate: $HgSO_4$, crystals or powder.

h. Sulfamic acid: Required only if the interference of nitrites is to be eliminated (see ¶ 1*b* above).

i. Potassium hydrogen phthalate standard: Lightly crush and then dry potassium acid phthalate ($HOOCC_6H_4COOK$) to constant weight at 120 C, dissolve 425 mg in distilled water, and dilute to 1,000 mL. Potassium hydrogen phthalate has a theoretical COD of 1.176 g O_2/g and this solution has a theoretical COD of 500 mg O_2/L. Prepare fresh for each use.

4. Procedure

a. Treatment of samples with ≤50 mg COD/L: Place 50.0 mL sample (for samples with COD >900 mg COD/L, use a smaller sample portion diluted to 50.0 mL) in the 500-mL refluxing flask. Add 1 g $HgSO_4$, several glass beads, and very slowly add 5.0 mL sulfuric acid reagent, with mixing to dissolve $HgSO_4$. Cool while mixing to avoid possible loss of volatile materials. Add 25.0 mL 0.250*N* $K_2Cr_2O_7$ solution and mix. Attach flask to condenser and turn on cooling water. Add remaining sulfuric acid reagent (70 mL) through open end of condenser. Continue swirling and mixing while adding sulfuric acid reagent. CAUTION: *Mix reflux mixture thoroughly before applying heat to prevent local heating of flask bottom and a possible blowout of flask contents.* If sample volumes other than 50 mL are used, keep ratios of reagent weights, volumes, and strengths constant. See Table 508:I for examples of applicable ratios. Maintain these ratios and follow the procedure as outlined above.

Use 1 g $HgSO_4$ with a 50.0-mL sample to complex up to a maximum of 100 mg chloride (2,000 mg/L) For smaller samples use less $HgSO_4$, according to the chloride concentration: maintain a 10:1 ratio of $HgSO_4$:Cl. A slight precipitate does not affect the determination adversely. Gener-

*Corning 5000 or equivalent.

†Corning 2360, 91548, or equivalent.

‡G. F. Smith Chemical Co., Columbus, Ohio.

TABLE 508:I. REAGENT QUANTITIES AND NORMALITIES FOR VARIOUS SAMPLE SIZES

Sample Size *mL*	0.25*N* Standard Dichromate *mL*	Sulfuric Acid Reagent *mL*	$HgSO_4$ *g*	Normality of FAS	Final Volume before Titration *mL*
10.0	5.0	15	0.2	0.05	70
20.0	10.0	30	0.4	0.10	140
30.0	15.0	45	0.6	0.15	210
40.0	20.0	60	0.8	0.20	280
50.0	25.0	75	1.0	0.25	350

ally. COD cannot be measured accurately in samples containing more than 2,000 mg chloride/L.

Reflux mixture for 2 hr. Use a shorter period for particular wastes if it has been shown that the shorter period yields the same COD as that found by 2-hr refluxing. Cover open end of condenser with a small beaker to prevent foreign material from entering refluxing mixture. Cool and wash down condenser with distilled water.

Disconnect reflux condenser and dilute mixture to about twice its volume with distilled water. Cool to room temperature and titrate excess $K_2Cr_2O_7$ with FAS, using 0.10 to 0.15 mL (2 to 3 drops) ferroin indicator. Although the quantity of ferroin indicator is not critical, use the same volume for all titrations. Take as the end point of the titration the first sharp color change from blue-green to reddish brown. The blue-green may reappear.

Reflux and titrate in the same manner a blank containing the reagents and a volume of distilled water equal to that of sample.

b. Alternate procedure for low-COD samples: Follow the above procedure, ¶ 4*a*, with two exceptions: (*i*) Use standard 0.025*N* $K_2Cr_2O_7$, and (*ii*) titrate with 0.025*N* FAS. Exercise extreme care with this procedure because even a trace of organic matter on glassware or from the atmosphere may cause gross errors.

If a further increase in sensitivity is required, concentrate a larger volume of sample before digesting under reflux as follows: Add all reagents to a sample larger than 50 mL and reduce total volume to 150 mL by boiling in the refluxing flask open to the atmosphere without the condenser attached. Compute amount of $HgSO_4$ to be added (before concentration) on the basis of a weight ratio of 10:1, $HgSO_4$:Cl, using the amount of chloride present in the original volume of sample. Carry a blank reagent through the same procedure.

This technic has the advantage of concentrating the sample without significant losses of easily digested volatile materials. Hard-to-digest volatile materials such as volatile acids are lost, but an improvement is gained over ordinary evaporative concentration methods.

c. Determination of standard solution: Evaluate the technic and quality of reagents by testing a standard potassium hydrogen phthalate solution.

5. Calculation

$$\text{mg COD/L} = \frac{(A - B) \times N \times 8{,}000}{\text{mL sample}}$$

where:

A = volume FAS used for blank, mL,
B = volume FAS used for sample, mL, and
N = normality of FAS.

6. Precision and Accuracy

A set of synthetic samples containing potassium hydrogen phthalate and NaCl was tested by 74 laboratories.[5] At 200 mg COD/L in the absence of chloride, the standard deviation was ± 13 mg/L (coefficient of variation, 6.5%). At 160 mg COD/L and 100 mg chloride/L the standard deviation was ± 14 mg/L (coefficient of variation, 10.8%).

508 B. References

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ORGANIC CARBON, TOTAL

Method 415.1 (Combustion or Oxidation)

STORET NO. Total 00680
Dissolved 00681

1. Scope and Application
   1.1 This method includes the measurement of organic carbon in drinking, surface and saline waters, domestic and industrial wastes. Exclusions are noted under Definitions and Interferences.
   1.2 The method is most applicable to measurement of organic carbon above 1 mg/1.
2. Summary of Method
   2.1 Organic carbon in a sample is converted to carbon dioxide (CO_2) by catalytic combustion or wet chemical oxidation. The CO_2 formed can be measured directly by an infrared detector or converted to methane (CH_4) and measured by a flame ionization detector. The amount of CO_2 or CH_4 is directly proportional to the concentration of carbonaceous material in the sample.
3. Definitions
   3.1 The carbonaceous analyzer measures all of the carbon in a sample. Because of various properties of carbon-containing compounds in liquid samples, preliminary treatment of the sample prior to analysis dictates the definition of the carbon as it is measured. Forms of carbon that are measured by the method are:
      A) soluble, nonvolatile organic carbon; for instance, natural sugars.
      B) soluble, volatile organic carbon; for instance, mercaptans.
      C) insoluble, partially volatile carbon; for instance, oils.
      D) insoluble, particulate carbonaceous materials, for instance; cellulose fibers.
      E) soluble or insoluble carbonaceous materials adsorbed or entrapped on insoluble inorganic suspended matter; for instance, oily matter adsorbed on silt particles.
   3.2 The final usefulness of the carbon measurement is in assessing the potential oxygen-demanding load of organic material on a receiving stream. This statement applies whether the carbon measurement is made on a sewage plant effluent, industrial waste, or on water taken directly from the stream. In this light, carbonate and bicarbonate carbon are not a part of the oxygen demand in the stream and therefore should be discounted in the final calculation or removed prior to analysis. The manner of preliminary treatment of the sample and instrument settings defines the types of carbon which are measured. Instrument manufacturer's instructions should be followed.

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4. Sample Handling and Preservation
   4.1 Sampling and storage of samples in glass bottles is preferable. Sampling and storage in plastic bottles such as conventional polyethylene and cubitainers is permissible if it is established that the containers do not contribute contaminating organics to the samples.
   NOTE 1: A brief study performed in the EPA Laboratory indicated that distilled water stored in new, one quart cubitainers did not show any increase in organic carbon after two weeks exposure.
   4.2 Because of the possibility of oxidation or bacterial decomposition of some components of aqueous samples, the lapse of time between collection of samples and start of analysis should be kept to a minimum. Also, samples should be kept cool (4°C) and protected from sunlight and atmospheric oxygen.
   4.3 In instances where analysis cannot be performed within two hours (2 hours) from time of sampling, the sample is acidified ($pH \leq 2$) with HCl or H_2SO_4.
5. Interferences
   5.1 Carbonate and bicarbonate carbon represent an interference under the terms of this test and must be removed or accounted for in the final calculation.
   5.2 This procedure is applicable only to homogeneous samples which can be injected into the apparatus reproducibly by means of a microliter type syringe or pipette. The openings of the syringe or pipette limit the maximum size of particles which may be included in the sample.
6. Apparatus
   6.1 Apparatus for blending or homogenizing samples: Generally, a Waring-type blender is satisfactory.
   6.2 Apparatus for total and dissolved organic carbon:
      6.2.1 A number of companies manufacture systems for measuring carbonaceous material in liquid samples. Considerations should be made as to the types of samples to be analyzed, the expected concentration range, and forms of carbon to be measured.
      6.2.2 No specific analyzer is recommended as superior.
7. Reagents
   7.1 Distilled water used in preparation of standards and for dilution of samples should be ultra pure to reduce the carbon concentration of the blank. Carbon dioxide-free, double distilled water is recommended. Ion exchanged waters are not recommended because of the possibilities of contamination with organic materials from the resins.
   7.2 Potassium hydrogen phthalate, stock solution, 1000 mg carbon/liter: Dissolve 0.2128 g of potassium hydrogen phthalate (Primary Standard Grade) in distilled water and dilute to 100.0 ml.
   NOTE 2: Sodium oxalate and acetic acid are not recommended as stock solutions.
   7.3 Potassium hydrogen phthalate, standard solutions: Prepare standard solutions from the stock solution by dilution with distilled water.
   7.4 Carbonate-bicarbonate, stock solution, 1000 mg carbon/liter: Weigh 0.3500 g of sodium bicarbonate and 0.4418 g of sodium carbonate and transfer both to the same 100 ml volumetric flask. Dissolve with distilled water.

7.5 Carbonate-bicarbonate, standard solution: Prepare a series of standards similar to step 7.3.

NOTE 3: This standard is not required by some instruments.

7.6 Blank solution: Use the same distilled water (or similar quality water) used for the preparation of the standard solutions.

8. Procedure

8.1 Follow instrument manufacturer's instructions for calibration, procedure, and calculations.

8.2 For calibration of the instrument, it is recommended that a series of standards encompassing the expected concentration range of the samples be used.

9. Precision and Accuracy

9.1 Twenty-eight analysts in twenty-one laboratories analyzed distilled water solutions containing exact increments of oxidizable organic compounds, with the following results:

Increment as TOC mg/liter	Precision as Standard Deviation TOC, mg/liter	Accuracy as Bias, %	Bias, mg/liter
4.9	3.93	+15.27	+0.75
107	8.32	+ 1.01	+1.08

(FWPCA Method Study 3, Demand Analyses)

Bibliography

1. Annual Book of ASTM Standards, Part 31, "Water", Standard D 2574-79, p 469 (1976).
2. Standard Methods for the Examination of Water and Wastewater, 14th Edition, p 532, Method 505, (1975).

APPENDIX E

TEST LOG

APPENDIX E - TEST LOG

Date	Time	Task Performed (with comments)
8/1/83	0800	TRW Test Crew and EPA representative arrive at the Chevron facility in El Segundo, California.
	0830	Chevron provides introductory/safety meeting.
	0900	Crew begins set-up at test sites. Problems with electricity supply, safety restrictions, and hot work permits cause delay in commencing the test period.
	1630	Crew departs test facility.
8/2/83	0800	TRW Test Crew and EPA representative arrive at the Chevron facility.
	0900	Chevron contact having problems with obtaining hot work permit and safety guidelines.
	1300	One of the two DAF tanks is down for repair. The off-line DAF unit will be tested for a background level.
	1500	Chevron requires a TRW operator on-site with the test instruments. Therefore, shift work is required.
	1700	Crew departs test facility.
8/3/83	0600	TRW Test Crew and EPA representative arrive at the Chevron facility.
	0830	Chevron personnel supply Hot Work Permit.
	0945	Continuous hydrocarbon monitors placed on-line for testing at DAF 202 and DAF 302 sample locations. (DAF 202 - Beckman 400 Analyzer, DAF 302 - Beckman 400 Analyzer).
	1030	DAF 202 #1 gas bag sample.
	1045	Beckman 400 with DAF 202, flames out. Lite and recalibrated.
	1135	DAF 202 #2 gas bag sample.
	1140	Beckman 400 with DAF 202, flames out. Lite and recalibrated.
	1200	Beckman 400 with DAF 202 flames out. Therefore, switch instruments with Beckman 400/DAF 302. The DAF 302 tank was down for repair and hydrocarbon level was slightly above ambient ($\approx$ 15 ppm).

Date	Time	Task Performed (with comments)
	1200 (cont.)	Liquid composite samples started at DAF-IN, DAF-OUT, and equalization tank sample location. Because DAF 302 was down for repair and not being sample, the DAF 202 being tested was referenced only as DAF.
	1235	Continuous hydrocarbon monitors placed on-line for testing at equalization tank sample location.
	1445	DAF #202 gas bag sample #3.
	1600	Equalization tank gas bag sample #1.
	1650	Liquid VOA samples at DAF-IN, DAF-OUT, and Equalization tank.
	1900	Crew departs test facility with the exception of the continuous analyzers operator. Night operator worked 1800-0600.
8/4/83	0600	Morning operator replace night operator.
	0900	TRW Test Crew and EPA representative arrive at the Chevron facility. Liquid composite samples started at DAF-IN, DAF-OUT, and Equalization OUT.
	0930	DAF gas bag sample #1 (DAF 202 referenced as DAF after DAF 302 was taken off-line).
	1000	Liquid VOA samples at DAF-IN, DAF-OUT, and Equalization OUT.
	1053	Equalization OUT gas bag sample #1.
	1430	DAF gas bag sample #2.
	1431	Equalization OUT gas bag sample #2.
	1500	Liquid VOA sample at DAF-IN, DAF-OUT, and Equalization OUT.
	1800	Crew departs test facility with night operator arriving for night shift.

Date	Time	Task Performed (with comments)
8/5/83	0600	Morning operator replaces night operator.
	0900	TRW Test Crew and EPA representative arrive at Chevron facility. Liquid composite sampled and VOA samples taken at DAF-IN, DAF-OUT, and Equalization OUT. DAF gas bag sample #1.
	0930	Equalization OUT gas bag sample #1.
	1228	Equalization OUT gas bag sample #2.
	1400	Moved Beckman 402 Analyzer from the Equalization OUT sample location to the Equalization tank carbon house outlet vent. Carbon house gas sample bag.
	1500	DAF gas bag sample #2. Liquid VOA samples at DAF-IN, DAF-OUT, and Equalization OUT.
	1600	End of test at Equalization tank carbon house.
	1700	End of test at DAF. Flame-out all instruments and packed for weekend.
	1800	Crew departs test facility.
8/8/83	0830	TRW Test Crew and EPA representative arrive at Chevron facility.
	1100	Beckman 400 on-line at DAF 202. DAF gas bag sample #1. Liquid composite and VOA at DAF.
	1200	Chevron personnel will take API liquid samples at API 201, 202, 203, 204, and API #4.
	1500	DAF gas bag sample #2. Liquid VOA samples at DAF-IN and DAF-OUT.
	1800	Beckman 402 on-line at IAF outlet (before carbon drum).
	1900	Crew departs test facility with night operator arriving for night shift.
8/9/83	0600	Morning operator replaces night operator.
	0900	TRW Test Crew and EPA representative arrive at Chevron facility.
	0915	DAF gas bag sample #1.

Date	Time	Task Performed (with comments)
8/9/83 (cont.)	1000	Liquid composite and VOA samples at DAF-IN and DAF-OUT Chevron personnel will take API liquid samples at API 201, 202, 203, 204 and API #4.
	1140	T-201 (flocculation tank) gas bag sample; analyzed on Beckman 400.
	1400	DAF gas bag sample #2.
	1510	T-200 (Flask/Mix tank) gas bag sample; analyzed on Beckman 400.
	1700	Liquid VOA samples at DAF-IN and DAF-OUT.
	1800	Crew departs test facility with night operator arriving for night shift.
8/10/83	0600	Morning operator replaces night operator.
	0900	TRW Test Crew and EPA representative arrive at Chevron facility.
	0904	DAF gas bag sample #1.
	1000	Liquid composite and VOA samples at DAF-IN and DAF-OUT. Chevron personnel will take API liquid samples at API 201, 202, 203, 204 and API #4.
	1205	Beckman 400 switched to DAF carbon house outlet (V-204). V-204 gas bag sample.
	1600	Liquid VOA samples at DAF-IN and DAF-OUT.
	1800	Crew departs test facility with night operator arriving for night shift.
8/11/83	0600	Morning operator replaces night operator.
	0900	TRW Test Crew and EPA representative arrive at Chevron facility. Liquid composite and VOA samples at DAF-IN and DAF-OUT. Chevron personnel will take API liquid samples at API 201, 202, 203, 204 and API #4.
	0924	IAF gas bag sample #1.
	1000	Liquid composite and VOA samples at IAF-IN and IAF-OUT.
	1315	DAF gas bag sample #1.

Date	Time	Task Performed (with comments)
8/11/83	1500	All instruments off-line and flamed out.
(cont.)	1530	Liquid VOA sampels at DAF-IN and DAF-OUT.
	1600	Liquid VOA samples at IAF-IN and IAF-OUT.
	1700	Crew departs test facility.
8/12/83	0800	TRW Test Crew and EPA representative arrive at Chevron facility.
	0900	Beckman 402 on-line at IAF carbon drum outlet. Liquid composite and VOA samples at IAF-IN and IAF-OUT. Chevron personnel will take API liquid samples at API 201, 202, 203, 204, and API #4.
	1129	Gas bag sample at Equalization tank outlet (Charcoal house inlet); ran on Beckman 400.
	1200	Beckman 402 switched to IAF outlet (Carbon drum inlet).
	1213	IAF gas bag sample #2.
	1230	Gas bag sample #1 at Equalization tank charcoal house outlet; ran on Beckman 400.
	1250	Liquid VOA samples at IAF-IN and IAF-OUT.
	1259	Gas bag sample #2 at Equalization tank charcoal house outlet; ran on Beckman 400.
	1500	All instruments off-line and flamed out.
	1700	Crew departs test facility.

APPENDIX F

PROJECT PARTICIPANTS

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U.S. Environmental Protection Agency (Representatives)

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