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On-Shore Production of Crude Oil and Natural Gas

Fugitive Volatile Organic Compound Emission Sources

Emission Test Report AMOCO Production Company Hastings Plant Brazoria County, Texas

DCN 81-222-018-04-28

EMB Report No. 80-OSP-2

EMISSION TEST REPORT

FUGITIVE VOC TESTING
AT THE
AMOCO HASTINGS GAS PLANT

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SECTION 1

INTRODUCTION

This report presents the results of testing for fugitive VOC (Volatile Organic Compounds) emissions at the Amoco Hastings gas plant. The testing was performed by Radian Corporation on October 14 through October 17, 1980. This work was funded and administered by the Emission Measurement Branch of the U.S. Environmental Protection Agency. The purpose of this testing was to develop data to be used in support of New Source Performance Standards for onshore production facilities.

The testing described in this report consisted of a screening survey using two fugitive emission detection methods, EPA Method 21 using portable analyzers and soap scoring. The objectives of this testing were to:

1) Determine leak frequency by each method, and

2) Collect comparative data on each method so that emission data from other sources could be used to support New Source Performance Standards.

The following sections present a summary of results, a description of the process configuration, and the testing methodology. A full listing of the data and other supplemental information are included in the appendices.

SECTION 2

SUMMARY OF RESULTS

This section presents a summary of the screening data. A full data listing is included as Appendix A.

The gas plant screening results are summarized in Tables 2-1 and 2-2. Table 2-1 presents the distribution of VOC concentration readings for each source type, while Table 2-2 presents similar data on soap scores.

It should be noted that the source type called flanges actually includes a variety of pipe-to-pipe connections including threaded fittings, unions, and compression-type tubing fittings. Welded joints were not included in this survey. The "other" category represents a group of sources that were too few in number to warrant separate listing. Included in the "other" category were sight glasses, vacuum breakers, meters, pig traps, control valve diaphragm vents, and thermowells.

TABLE 2-1. SUMMARY OF RESULTS. AMOCO HASTINGS PLANT
VOC CONCENTRATION OCCURRENCE DISTRIBUTION

Screening Value (ppmv)	Source Type															
	Flanges		Process Drains		Open Ended Lines		Relief Valves		Valves		Pump Seals		Compressors		Other	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
0 to 199	264	94.0	2	40.0	44	67.7	6	85.7	323	63.8	5	55.6	0	0.0	13	86.7
200 to 9,999	11	3.9	2	40.0	9	13.8	0	0.0	98	19.4	0	0.0	0	0.0	0	0.0
>= 10,000	6	2.1	1	20.0	12	18.5	1	14.3	85	16.8	4	44.4	4	100.0	2	13.3
Total Sources Screened	281	18.2	5	100.0	65	97.0	7	53.8	506	89.6	9	64.3	4	50.0	15	100.0
Sources Not Screened	1264*	81.8	0	0.0	2	3.0	6	46.2	59	10.4	5	35.7	4	50.0	0	0.0
Total Sources	1545*		5		67		13		565		14		8		15	

- Number of sources
% - Percent of total sources screened
* - Estimated value - every fifth flange was surveyed

TABLE 2-2. SUMMARY OF RESULTS: AMOCO HASTINGS PLANT
SOAP SCORING OCCURRENCE DISTRIBUTION

	Source Type															
	Flanges		Process Drains		Open Ended Lines		Relief Valves		Valves		Pump Seals		Compressors		Other	
Soap Score	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
0	254	94.8	0	-	19	76.0	3	100.0	317	64.8	1	25.0	0	-	14	93.3
1	2	0.7	0	-	1	4.0	0	0.0	18	3.7	0	0.0	0	-	0	0.0
2	3	1.1	0	-	1	4.0	0	0.0	44	9.0	1	25.0	0	-	0	0.0
3	5	1.9	0	-	0	0.0	0	0.0	44	9.0	0	0.0	0	-	0	0.0
4	4	1.5	0	-	4	16.0	0	0.0	66	13.5	2	50.0	0	-	1	6.7
Total Sources Screened	268	17.3	0	0.0	25	37.3	3	23.1	489	86.5	4	28.6	0	0.0	15	100.0
Sources Not Soaped	1277*	82.7	5	100.0	42	62.7	10	76.9	76	13.5	10	71.4	8	100.0	0	0.0
Total Sources	1545*		5		67		13		565		14		8		15	

- Number of sources
% - Percent of total sources screened
* - Estimated value - every fifth flange was surveyed

SECTION 3

PROCESS DESCRIPTION

The Amoco Hastings gas plant removed natural gas liquids by the cryogenic separation principle. The feed gas to the unit was a mixture of lift gas* and newly produced gas from area oil wells. Natural gas liquids were removed at the plant and separated into an ethane/propane stream, which was transported via pipeline to a chemical plant, and a butane-plus gasoline stream which was routed to a refinery. The treated gas stream (primarily methane) was split between lift gas and pipeline sales gas. The cryogenic unit was operating at its rated capacity of about 30 MMSCFD (million standard cubic feet per day) during the testing. The total plant capacity, including the gas by-passed directly to lift-gas, was about 76 MMSCFD.

A simplified schematic of the process is shown in Figure 3-1. The raw feed gas was compressed and then chilled by heat exchange, propane refrigeration, and expanded at the Turbo expander. Condensed liquids were separated and routed to the depropanizer and split into the ethane/propane stream overhead and the butane-plus gasoline stream as the bottom product.

Fugitive emission testing was performed on all facilities which were considered to be an integral part of the cryogenic separation unit, including heat exchangers, chillers, expansion/compression turbines, and the distillation columns. In addition, the ethane/propane and propane refrigeration compressor area, the ethane/propane metering area, and the product and

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*"Lift Gas" is defined as dehydrated and recompressed natural gas, which is then returned to the area oil wells to artifically lift the oil to the surface by decreasing the density of the column of fluid. (This is an alternate method to pumping produced fluids that will not flow to the surface by natural reservoir pressures).

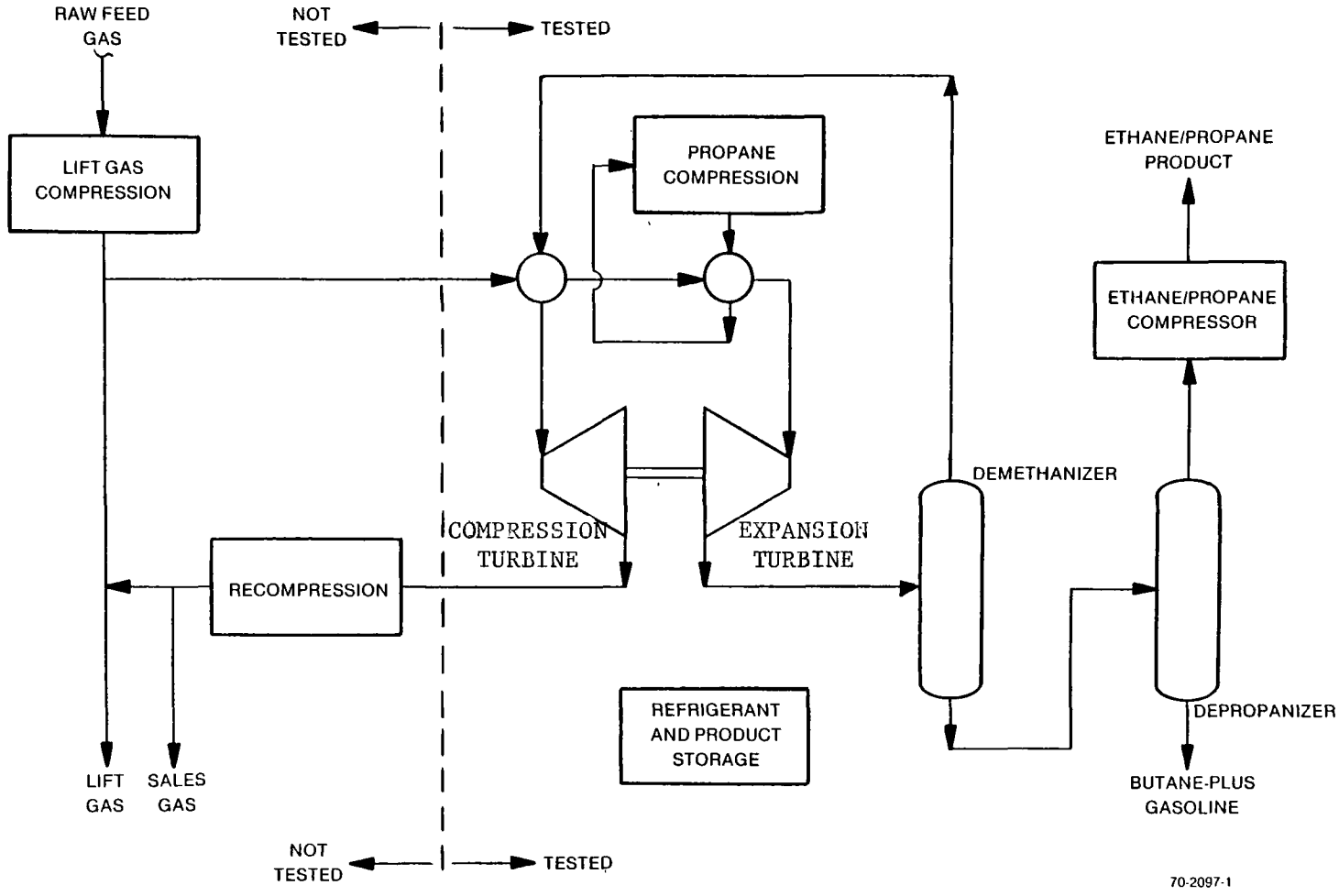

Figure 3-1. Simplified flow diagram.

refrigerant storage area were tested. The data were recorded so as to distinguish between these facilities by assigning a unit number to each area:

Unit 1 - Cryogenic unit,
Unit 2 - Ethane/propane and refrigerant compressor area,
Unit 3 - Ethane/propane metering facilities, and
Unit 4 - Product and refrigerant storage.

The lift gas compressors and the methane recompressors were not tested.

SECTION 4

TESTING METHODOLOGY

The fugitive emissions testing at this site was limited to "screening." Screening is a generic term covering any quick, portable method of detecting fugitive emissions. Two screening methods were used in parallel on this task, instrumental screening (using the Century Systems OVA-108) and soap scoring.

The instrumental screening was done according to the procedures specified in EPA Proposed Method 21,[1] which is included as Appendix B. The instrument performance evaluations are included as Tables 4-1 and 4-2. Method 21 only requires the exact concentration to be recorded if it is over the leak definition specified in the applicable standard, but since this effort was more oriented to standards support than to regulatory monitoring, the maximum screening value was recorded for all sources.

The soap scoring method was modeled after a method used in screening fugitive emissions from petroleum production facilities.[2] The soap solution was prepared from 100 ml. of rug shampoo (HR Professional Formula) mixed with a gallon of either distilled water or a mixture of distilled water and ethylene glycol. The solution was applied using a common garden sprayer.

Each source was sprayed with soap solution, being sure to coat all areas of potential leakage. A careful inspection was then conducted to detect any bubble formation. A soap score was then assigned based on the estimated bubble volume generated in a six-second observation:

[1] Federal Register, v46 n2 Monday Jan. 5, 1981, pp. 1160.

[2] Eaton, W.S., et al. "Fugitive Hydrocarbon Emissions from Petroleum Production Operations." API Publication No. 4322, American Petroleum Institute (1980).

TABLE 4-1

CALIBRATION ERROR DETERMINATION

Instrument ID Century Systems OVA-108

Serial Number: 2158

Calibration Gas Data 1-9-81

Calibration = 7990 ppmv

Run No.	Instrument Meter Reading, ppm	Difference[1] ppm
1.	8000	-10
2.	8200	-210
3.	8000	-10
4.	8000	-10
5.	8000	-10
6.	8400	-410
7.	8100	-110
8.	8500	-510
9.	8200	-210

Mean Difference -166

$$\text{Calibration Error} = \frac{\text{Mean Difference}^{(2)}}{\text{Calibration Gas Concentration}} \times 100 \quad -2.1$$

[1] Calibration Gas Concentration - Instrument Reading

TABLE 4-2

RESPONSE TIME DETERMINATION

Instrument ID: Century Systems OVA-108 Serial Number: 2158

Calibration Gas Concentration: 7990 ppmv

1-9-81

90% Response Time:

	Without Dilution Probe	With Dilution Probe
1.	5.8 Seconds	7.1 Seconds
2.	7.0 Seconds	9.5 Seconds
3.	5.5 Seconds	7.0 Seconds
Mean Response Time	6.1 Seconds	7.8 Seconds

Soap Score	Estimated Bubble Volume
0	No detectable bubbles
1	0 to 1 cc/6 sec
2	1 to 10 cc/6 sec.
3	10 to 100 cc/6 sec.
4	>100 cc/6 sec.

The screening methods outlined above were used on every accessible source except for flanges. Approximately 20 percent of the flanges were screened because of their large population. Sources screened included valves, flanges, pumps, compressors, open-ended lines, drains, relief valves, and other miscellaneous sources. The survey was conducted on a line-by-line basis to minimize the time required to obtain process data, such as the composition and phase of the material in the line. For those sources that were not screened due to either physical inaccessibility or safety problems which prevented close approach, entries were recorded on the data sheets to insure that a complete source inventory was obtained.