Project No. 148

TEST REPORT
for the ARID TECHNOLOGIES
VAPOR RECOVERY UNIT
installed in
LANTANA, FL

Prepared for:

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1.0 INTRODUCTION

Matus Technical Services, Inc. (MTS) conducted an emission test program at a retail gasoline loading station located in Lantana, FL for the purpose of demonstrating capture efficiency of the Arid Technologies, Inc. vapor control unit and for the purpose of comparing vent stack emissions when PERMEATOR® is "OFF" versus "ON".

The testing period was continuous and lasted approximately 72 hours in length. Sampling was conducted at the outlet vent to the underground storage tanks when the PERMEATOR® was "OFF" and at three locations from the PERMEATOR® vapor recovery unit which is operated to control hydrocarbon (VOC) emissions during gasoline dispensing operations.

The emission rates are reported as total hydrocarbons in pounds per 24 hour period, pounds of hydrocarbons emitted from the vapor control unit per 1000 gallons of gasoline loaded into vehicles, and processor total hydrocarbon capture efficiency in percent.

Matus Technical Services used EPA test procedures in 40CFR60 Subpart XX, "Standard of Performance for Bulk Gasoline Loading Terminals". The specific parameters measured included the following:

At The Outlet Test Location: Total hydrocarbons by NDIR (Method 25B), exhaust volume by volume meter (Method 2A), volume meter temperature by thermocouple, outlet meter pressure by pressure transducer

At The Inlet Test Location: Total hydrocarbons by NDIR (Method 25B)

Dispensing Operations: Gasoline volume dispensed into vehicles.

Vapor Connections and Vapor Collection Piping: Leak test by explosimeter (Method 21).

Matus Technical Services was responsible for all on-site sampling as well as for the submission of this final report of the test results which include a description of the sampling and analytical methods and the calculations used.

2.0 SUMMARY OF RESULTS

The emission rate for the vapor control device and vent stack at this gasoline dispensing facility was determined. The results of the test under each condition are summarized in Table 2-1 below.

Table 2-1

TEST RESULTS

TERMINAL DESCRIPTION	Retail Gasoline Dispensing		
TEST DATE/TEST PERIOD	2/14-15/05	2/15-16/05	2/16-17/05
TEST CONDITIONS ……..……	Permeator Off Vent Off	Permeator On	Permeator Off Vent On
GASOLINE LOADED (Gallons)	19,186	19,121	18,908
AVERAGE INLET CONCENTRATION % (C_3)	NA	38.52	NA
AVERAGE OUTLET CONCENTRATION % (C_3)	39.79	0.72	41.58
AVERAGE HYDROCARBON EMISSION ……... (lbs/1000 gallons)	3.48	0.014	1.20
HYDROCARBON EMISSION RATE (lb/24hr)	66.84	0.27	22.75*
HYDROCARBON REMOVAL EFFICIENCY ..... (calculated using total inlet and outlet masses)	NA	99.27	NA
MTS PERSONNEL IN ATTENDANCE	Harold N. Matus P.E.		

*Note: An unquantifiable amount of gasoline vapors were released to atmosphere due to leaky tank fill points and during tank filling operation.

3.0 FACILITY AND SYSTEM OPERATION

3.1 Vapor Collection and Transfer

This site performs Stage II vapor recovery at its Lantana, FL retail operation. There are twelve fueling points equipped with Gilbarco Vapor Vac dispensers at this facility.

3.2 Vapor Recovery Unit (VRU)

The PERMEATOR® gasoline vapor processor is a membrane system which allows gasoline vapors to pass through and back into the storage tank, while preventing air from permeating the membrane which is vented to atmosphere.

4.0 TEST PROCEDURE

The vapor recovery unit hydrocarbon emission rate will be determined from processor outlet hydrocarbon concentration and outlet volume. The test methods MTS will use are specified in 40CFR60 Section 60.503 of Subpart XX. The methods include EPA Standard Reference Methods 2A, 21 and 25B.

4.1 Test Equipment and Installation

In this system the retentate, or exhaust of the PERMEATOR® was hard piped to a roots meter.

The inlet analysis equipment consists of a Horiba Model PIR-2000 non-dispersive infrared analyzer (NDIR). The analyzer was operated in the range of 0-60% as propane and was calibrated on-site with propane in nitrogen standards.

Inlet samples were drawn from the vapor line upstream of the point where the vapor line enters the recovery unit. A stainless steel sample pump with Teflon diaphragm was used to draw the sample from the inlet through a Teflon sample line to the inlet hydrocarbon analyzer.

The permeate or return analysis equipment consisted of a Summit non-dispersive infrared analyzer (NDIR). The analyzer was also operated in the range of 0-60% as propane and was calibrated on-site with propane in nitrogen standards.

Permeate samples were drawn from the vapor line upstream of the point where the vapor line returns to the storage tanks. A stainless steel sample pump with Teflon diaphragm was used to draw the sample from the permeate line through a Teflon sample line to the inlet hydrocarbon analyzer.

Outlet volume was measured with a Romet model RM1000DCID rotary gas meter. A Pulse-A-Matic transmitter, attached to the rotary gas meter, sent a single pulse for every half a cubic foot through the meter. Using test ports in the hard piping, temperature was measured with a K type thermocouple and meter pressure was measured with a Rosemount pressure transmitter.

Outlet samples were drawn from a site on or near the rotary gas meter. The outlet analyzer was a Horiba Model PIR-2000 NDIR analyzer operating in the range 0 - 4% C_3. A stainless steel sample pump with Teflon diaphragm was used to draw the sample from the outlet through a Teflon sample line to the outlet analyzer. The analysis system was housed in a laboratory trailer parked adjacent to the recovery unit.

A Campbell Scientific data acquisition system (DAS) was used to collect and log the data obtained from the above mentioned instrumentation. The DAS monitors readings once each second and reports the results in one minute averages.

4.2 Test Equipment Calibration

Analyzer calibration gases will conform to approximately 25, 50 and 90% of full range. Zero reference gas was hydrocarbon free air. All calibration gases conformed to applicable Reference Method requirements, and were traceable to NIST Standard Reference Materials.

After field use, the dry gas meter and rotary meter were checked at an intermediate flow rate of approximately 60% of rated flow. If the calibration values have changed less than 1.5%, the field data are acceptable. If a change from the previous calibration values is more than 1.5%, the meter will be recalibrated over its full range of flow.

Temperature and pressure transmitters used for field measurements were calibrated after testing. Calibration data forms for the rotary meter, thermocouple, and pressure transmitters are shown in Appendix C.

4.3 Analysis Procedure

Prior to initiating the emissions test, all vapor fittings on the processor were leak tested. The test lasted 72 hours. Two approximate 24 hour periods were without the PERMEATOR® operating. One of these 24 hours was with the pressure vacuum (PV) valve removed from the vent pipe and the second 24 hour period was with the PV valve attached to the vent pipe. During these two time frames only the outlet analyzer and flow were monitored. The third 24 hour period was while the PERMEATOR® is in operation and the inlet and outlet hydrocarbon concentrations were continuously recorded. The analyzers were zero and span checked about once every six hours. The average volume meter temperatures and pressures, during each one minute interval, were logged by the DAS and used to convert actual meter volume to standard conditions.

During the test period gasoline dispensing data will be gathered from the computers logging the gasoline loading data.

4.4 Data Analysis

The hydrocarbon analyzer readings were averaged by the DAS over each one minute interval. The vapor volumes were obtained by totaling the number of pulses over each one minute period. The volumes were then converted to standard conditions using the recorded temperature and pressures.

Inlet and return volumes were calculated from outlet composition using the formulas described in Method 2B which are included in the next section. The outlet mass was then calculated as the product of outlet volume, pollutant concentration and the standard density of the pollutant. The pounds per 1000 gallons dispensed rating was calculated by dividing the total hydrocarbon mass emitted by the amount of gasoline dispensed.

5.0 CALCULATIONS

The outlet hydrocarbon (HC) mass is calculated from the measured outlet volume corrected to standard conditions, the outlet HC concentration as propane and the density of propane. Standard conditions are 68 degrees F and 29.92 inches Hg.

The outlet volume during any one minute test interval is corrected to standard conditions using the formula:

$$Vscf_{(out)} = 17.65\ (\text{Vacf})\ \frac{(P_A)}{(T + 460)} \qquad \text{(SCF)}$$

Where:

- 17.65 = Standard Temperature / Standard Pressure
- V_{acf} = Recorded meter volume in cubic feet
- P_A = Absolute pressure (barometric plus turbine meter) in inches of mercury
- T = Temperature in volume meter in °F

The mass of hydrocarbons emitted from the outlet during any one minute test period is calculated from:

$$MCH_{(out)} = 519.5\ (Vscf_{(out)})\ (HC_{(out)}) \qquad \text{(mg)}$$

Where:

- $HC_{(out)}$ = Hydrocarbon concentration at the outlet in $\%C_3$

Note: The density of propane is 51,950 mg/ft^3

For recovery efficiency of the PERMEATOR®, the feed volume is calculated from the outlet volume, outlet hydrocarbon concentration, permeate hydrocarbon concentration and inlet hydrocarbon concentration.

$$\text{Vscf}_{(in)} = \frac{(Vscf_{(out)})(HC_{(P)} - HC_{(out)})}{(HC_{(p)} - HC_{(in)})}$$

Where:

- $HC_{(in)}$ = Hydrocarbon concentration at the inlet in $\%C_3$
- $HC_{(P)}$ = Hydrocarbon concentration at the permeate in $\%C_3$

The inlet mass during any one minute test interval is:

$$MHC_{(in)} = 519.5\ (Vscf_{(in)})\ (HC_{(in)})$$

The hydrocarbon removal efficiency is calculated from the inlet and outlet mass. Efficiency can be calculated on an hourly basis using the total mass in and out for the hour or overall for the entire test period using the overall mass in and out.

$$HC_{(eff)} = \frac{MHC_{(in)} - MHC_{(out)}}{MHC_{(in)}} \text{ x } 100 \qquad (\%)$$

The gallonage weighted average emission is calculated from the total amount of hydrocarbons emitted divided by the total amount of gasoline dispensed.

$$M/L_{(avg)} = \frac{\sum MHC_{(out)}}{Ld\,(453{,}592)} \qquad (\text{lb}/1000\ \text{gal})$$

Where:

Ld = Gasoline loaded in gallons.

6.0 TEST RESULTS

The one minute test results are presented in Appendices A, B and C includes: sample gas concentrations, inlet and outlet volume in standard cubic feet (SCF), inlet and outlet hydrocarbon mass in grams and milligrams respectively, and hydrocarbon recovery efficiency.

During the test program there were several times when gasoline vapors would be released to atmosphere and could not be quantified. Most of this occurred during tank filling operations. It can be assumed that more vapors were released from the tanks during tank filling operations when the tank had a greater backpressure in the tank. The greatest amount would be released when the tank had 3 inches of backpressure from the PV valve and the PERMEATOR® is not in operation. There was also leakage at the tank fill points in the beginning of the third day of testing which was also when the PERMEATOR® was not in operation. This leakage prevented the pressure in the tanks to build up to the level necessary to release the PV valve. After the tank fill points were tightened the pressure in the tanks did build up thus causing the PV valve to steadily release gasoline vapors.

Included in Appendix D is the gasoline dispensing activity.

Samples of the gasoline in the storage tanks were analyzed and the results are located in Appendix E.

Instrument calibration records and calibration gas certificates are included in Appendix F.

APPENDIX A

ONE MINUTE RESULTS - VENT WITH PV VALVE OFF

APPENDIX B

ONE MINUTE RESULTS - PERMEATOR

APPENDIX C

ONE MINUTE RESULTS - VENT WITH PV VALVE ON

APPENDIX D

GASOLINE DISPENSING RECORDS

APPENDIX E

GASOLINE LABORATORY RESULTS

APPENDIX F

CALIBRATION RECORDS