Sept 30th 2004 summary data report from Vapor Systems Technologies, Inc. to Federal EPA

From Glenn K. Walker, President

Vapor Systems Technologies, Inc. (VST) has extensive experience with vapor recovery systems, and our data confirms that there is a fugitive vapor emission problem at gasoline dispensing facilities (GDF). The problem is in fact more severe than anticipated, but VST has several solutions that will resolve fugitive vapor emission problems.

VST has established three (3) Enhanced Vapor Recovery (EVR) GDF test sites in California: 1) VR Assist system with vent stack membrane processor, 2) VR Assist system (ORVR compatible) without vent stack membrane processor, and 3) VR Balance system with vent stack membrane processor. These test sites have generated significant data that demonstrate reduced front-end emissions, reduced liquid losses during vehicle refueling, reduced fugitive emissions, and on-board refueling vapor recovery (ORVR) compatibility. The test data confirms all three VST technologies meet and exceed California's performance standards.

Additional VST test sites are currently being established in other regions throughout the U.S. as well as internationally.

TEST DATA SYNOPSIS

I. Underground Storage Tank (UST) System Leak Rate and Fugitive Emissions:

a. Positive tank pressure leaks to atmosphere due to leaking UST systems, but UST leaks and fugitive emissions cannot escape a system that is managed at or below atmospheric pressure. VST tests include an Emission Control System (**ENVIRO-LOC™ ECS Membrane Processor)** that maintains the UST system pressure at or below atmospheric pressure. To continuously monitor the system, a pressure transducer controls the vapor membrane system with a -.20 to +.20 inch water column range. (.20 inch water column equals .007 psi)

b. Prior to the installation of the VST membrane processor, the underground tank system demonstrated a considerably high leak rate with a high level of maintenance required to achieve a tight system. VST has found this to be typical of most GDF.

c. A VST's membrane processor has been installed and functioning for almost 2 years. Considerable effort has been applied to maintain the service station system integrity.

d. A 2 inch vacuum decay test is conducted each night during minimal station dispensing activity. The vacuum decay test is performed so as to determine system tightness. When calculating this test, an algorithm developed by Veeder-Root to enhance their In Station Diagnostics (ISD) system design, is used. The focus is aimed at meeting the latest CARB requirements. During minimal station dispensing activity, with the use of the algorithm, the average leak rate of fugitive vapor emissions for 5/04 to 9/04 was 4.276 ft^3/hr. (See Graph 1 - includes daily leak rates)

e. Monthly pressure decay tests are conducted in order to assure system tightness.

II. ORVR Compatibility, Fugitive Emissions, and Leak Rate

The growing trend of ORVR vehicle penetration in California is contributing to an increase in the fugitive vapor emission problem. Test data from VST 50 Car test confirms the rate of growth for ORVR vehicles in California (see Chart 1 - 50 Car Test).

50 Car Test

Test Date	8/02	2/04	7/04
ORVR Vehicle Penetration	26%	38%	44%

Chart 1- 50 Car Test

VST's membrane processor technology reduces fugitive vapor emissions by operating the storage tank system in a -.2 to +.2 inch water column range. The VST membrane processor design separates fresh air from volatile organic compounds (VOC's), pumps fresh air from the UST, and simultaneously returns, in excess of 99%, the VOC's to the storage tank system. The separation and removal of the fresh air reduces vapor growth and allows the storage system to maintain a constant negative pressure.

Negative pressure in a storage tank system eliminates fugitive emission leaks, and reduces the inventory losses that are associated with the storage tank pressurization. More importantly, by eliminating positive tank pressure, the storage system operates safely.

Data from one test site collected a year apart demonstrates an increase in fugitive emission rates and membrane processor run time. (See Chart 2- Increased ORVR vehicle penetration effects) As the ORVR vehicle penetration increases, the fugitive emission rates increase during dispensing activity. Thus, increased processor run time is required to maintain desired pressure ranges for the UST system.

	3/03 to 8/03	**6/04 to 8/04**
Processor Flow Rate	.8 to 1 ft^3/min	.8 to 1 ft^3/min
Average hydrocarbon	35% to 40%	35% to 40%
Fugitive Emission Range	230 to 288 ft^3/day	346 to 432 ft^3/day
Membrane Processor Run Time	20%	30%

Chart 2 – Increased ORVR vehicle penetration effects

III. Mass Emission Calculation

Flow rate and hydrocarbon concentration data is converted and summarized by using the Mass Emission Calculation:

$$\text{Mass Emissions} = \text{Flow Rate} \times \text{Duty Cycle} \times \text{Average HC} \times \frac{1}{\text{Daily Dispensed}}$$

a. Time period 3/03 to 8/03 – ORVR vehicle penetration 26-38%
    i. Fugitive vapor emissions range from 1.52 to 1.90 lbs/1000 gallons dispensed. (Summer fuels)
    ii. Fugitive vapor emissions will approximately increase by one third with winter fuels and average hydrocarbons of 55 %. (2.39 to 2.99 lbs/1000 gallons dispensed).

b. Time period 6/04 to 8/04 – ORVR vehicle penetration 44%
    i. Fugitive vapor emissions range from 2.28 to 2.85 lbs/1000 gallons dispensed. (Summer fuels)
    ii. Fugitive vapor emissions will increase approximately one third with winter fuels and average hydrocarbons of 55% (3.58 to 4.48 lbs/1000 gallons dispensed).

IV. VST **ENVIRO-LOC™** Enhanced Vapor Recovery Nozzles

Over a 2 year timeline utilizing:

- 3 testing sites
- 36 fueling positions
- 1500 nozzle tests

California Air Resources Board (CARB) tests were conducted with each of the three VST nozzles styles. Averaged results calculated emissions of ≤ .044 lbs. per 1000 gallons dispensed. (Spillage, Liquid Retention, Dripless requirements) This represents approximately a 90 % reduction from current dispensing equipment and an 80% reduction below the new CARB requirements. (See Chart 3- Nozzle standards, requirements, and results)

Nozzle Category	Current USA standards	CARB EVR Requirement	**VST Test Results**
A. Liquid Retention	No known standard	≤ 100 ml. per 1,000 gal. dispensed	**≤ 8.74 ml. per 1,000 gal. dispensed**
B. Spillage	≤ .42 lbs per 1,000 gal. dispensed	≤ .24 lbs. per 1,000 gal. dispensed	**≤ .022 lbs. per 1,000 gal. dispensed**
C. Spitting	No known standard	≤ 1.0 ml. per refueling	**Zero**
D. Drops/refueling	No known standard	** ≤ 3 drops per refueling ** (included in spillage totals)	**≤ .79 drops per refueling**
Total Liquid Losses	**Excess of .60 lbs. per 1,000 gal.**	**Approx: .60 lbs per 1,000 gal.**	**Approx: .044 lbs. per 1,000 gal.**

Chart 3- Nozzle standards, requirements, and results

CONCLUSIONS

1. Most, if not all, positive tank pressure leaks to atmosphere due to leaking UST systems.

2. VST data indicates that the increase in ORVR vehicle penetration is increasing fugitive emissions when used with vacuum assisted vapor recovery systems.

3. VST's new technologies will provide the ability to utilize ORVR systems and Stage II systems simultaneously, thus reducing UST system pressures and eliminating fugitive vapor emissions caused by positive tank pressures.

4. VST's newest hanging hardware, including the ENVIRO-LOC™ vapor recovery nozzles, exceeds CARB's EVR front-end emissions standards by 90%.

5. There have been several discussions regarding vapor emission from uncontrolled stations (Non-Stage 2 areas). VST estimates tank emissions to be approximately 40% of the throughput converted to volume of vapors lost to atmosphere.

   Uncontrolled Gasoline Dispensing Storage Tank Emission Formula (Non-Stage 2)

$$\text{Mass Emissions} = \text{Leak Rate} \times \frac{28.3\,\text{L}}{1\,\text{Foot}^3} \times \frac{1\,\text{Mole}}{22.4\,\text{L}} \times \frac{44\,\text{Grams}}{1\,\text{Mole}} \times \frac{1\,\text{Pound}}{453.6\,\text{Grams}} \times \frac{1}{\text{Daily Dispensed}}$$

   Example – Uncontrolled Storage Tank Emissions

   Station with throughput of 150,000 gallons per month = 5,000 gallons per day

   A 40% vapor growth results in a leak rate of 2000 gallons/day (267 ft^3) of vapor emissions equals 6.47 lbs /1000 gallons dispensed daily.

COMMERCIAL AVAILABILITY

I. VST systems (3 new technologies) will be available in 2005 upon completion of CARB certifications.

   a. Assist, ORVR Assist, and Balance products will easily retrofit existing gasoline dispensing facilities to maximize regulatory compliance.

Sincerely,

Glenn K. Walker
President
Vapor Systems Technologies, Inc.

Enclosures
Leak rate graph

Station leak rate during minimal dispensing activity 5/10/04 - 9/22/04