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Seminar

on

Tank Truck Rack Vapor Recovery/Collection Equipment and its Relation to Tankage

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INTRODUCTION

The operation of loading a non-pressure rated tank truck displaces a volume of air and product vapor mixture equal to the liquid volume of the truck. This presentation is one of four being presented this afternoon and will deal will the vapor collection portion of tank truck vapor control operations.

Vapor control for tank trucks is practiced for one of the following reasons:

- regulatory control on volatile organic compounds[1]
- regulatory control on odors
- economic recovery of vapors as product liquid
- regulatory control on employee exposure

Vapor control systems for hydrocarbons can be broadly classified under the following six groups:

- Carbon Absorption
- Thermal Oxidation
- Refrigeration
- Compression-Refrigeration-Absorption
- Compression-Refrigeration-Condensation
- Lean Oil Absorption

For vapor control of chemical products, other types of vapor control device are liquid scrubbing, and vapor balance with tank roof-mounted vent condensing.

SAFETY ASPECTS AND TECHNIQUES OF TRUCK RACK VAPOR COLLECTION

Rack Roof

In multi-product terminals such as those of those of the ILTA, sometimes the same loading spot is used by trucks for products requiring vapor control and those that do not. Even at a rack dedicated to vapor control, it is prudent to design any cover over the rack with a ridge vent to prevent accumulation of vapors. This reduces employee exposure for top-loading trucks and reduces chance of fire.

Overfill

Continuous open-hatch gauging of tank truck product would not be practiced with vapor collection, thus requiring the use of product meters, or weighing on a scale for any non-petroleum products with poor lubricating or corrosive characteristics. Overfill protection can be incorporated into the top of the truck and/or in a "knockout pot" in front of the vapor recovery equipment. We recommend that any overfill device be of the continuous self-checking type, particularly because of the severe vibration conditions the overfill device has to endure.

INTRODUCTION (Continued)

Overfill (Continued)

Even with truck-mounted overfill, the knockout pot is always a good investment in that it protects the vapor recovery equipment from liquid slugs it is not designed to handle, whether from overfilling or condensation in the vapor line.

Thermal Oxidation

If the vapor control device is a thermal oxidation device such as a flare or incinerator, a further safety consideration is flashback of flame. One safe way to prevent this is to incorporate a water seal with automatic make-up as part of the knockout pot. The water seal is typically 6-10" w.c. which is well within the 18" w.c. test requirement for gasoline trucks.[4] Flame arrestors are also common in the outlet from each truck.

Preventive Maintenance

The safety and reliability of vapor recovery equipment is ensured by routine preventive maintenance measures.[2] These require the operator to have a portable gas detector or bag-capture to monitor the vapor concentrations at dry-break connections, seals, hoses, pressure-vacuum vents for proper seating and hatch covers for warping. These are measured with the probe located within one inch from the potential leak source and requires recordkeeping of the test results. Trucks also should undergo annual leak-testing with air or hydrotest.

Isolation

It is good practice to install a light weight check valve in the vapor recovery lines from each of multiple loading spots to prevent vapor from one truck displacing into another, rather than to the vapor control equipment. The check valve pressure drop should be selected to ensure that the overall system pressure drop is below the truck pressure rating.

Odor

For malodorous compounds, agencies such as Texas Air Control Board make a practice of requesting control technology for all operations with products whose odor threshold is below 1 ppm_v.

Vapor Holders

Vapor holders are designed to minimize fluctuations in V.O.C. concentration and air-vapor mixture flow rate to the vapor recovery system. Vapor holders are typically steel tanks

Vapor Holders (Continued)

equipped with an elastomeric bladder, or two concentric shell with an elastomeric seal.

The elastomers require periodic inspection to ensure no degradation of the material.

Piping Connections

Most new trucks are equipped with bottom loading connections, which provide the lesser turbulence of submerged loading. The vapor line to the truck vapor space is also piped on the truck to a point close to ground to avoid the need for any overhead rack operations.

Top loading operations can be modified for vapor recovery by using a special top-loading vapor head, equipped with a annular space vapor collector. This is connected to a compatible truck-mounted adapter on a permanently fixed submerged fill line.

EMISSION CALCULATIONS METHODS

Prior to installation of any vapor recovery equipment, the magnitude of the potential uncontrolled emission problem can be estimated[6] using the equations in EPA's "Compilation of Air Pollutant Emission Factors" AP-42, available through the U. S. Government printing office, Washington, D.C. 20402.

This estimate is accurate for hydrocarbon liquid loading within 30 percent and takes the following form:

$$L_L = 12.46 \frac{SPM}{T}$$

where L_L = loading loss, lb/10^3 gal. of liquid loaded
S = a saturation factor (see table below)
P = true vapor pressure of liquid, psia
M = molecular weight of vapors, lb/lb-mole
T = absolute temperature, °R (=°F+460)

The saturation factor (S) represents the expelled vapor's fractional approach to saturation.

Loading Mode	Clean Tank Truck	Dedicated Tank Truck	Dedicated Vapor Balance
Submerged	0.50	0.60	1.00
Splash	1.45	1.45	1.00

EMISSION CALCULATIONS METHODS (Continued)

For gasoline loading, as an example, using submerged fill or bottom loading a "typical" uncontrolled emission rate is 5 lb/1000 gallons loaded. To achieve a controlled level of even 0.67 lb/1000 gal (80 mg/l) would require a vapor recovery system at least 87% efficient. Proposed regulations for large bulk gasoline terminals are even twice as stringent as the 80 mg/l figure.

From a regulatory point, efficiency of vapor control is normally determined at agreed periodic intervals by testing V.O.C. exhaust volume and volume of product loaded simultaneously along with V.O.C. concentration, temperature and pressure. Routinge monitoring of vapor control equipment is usually done by mechanical monitoring of the equipment rather than continuous analytical.

The analytical devices used in V.O.C. measurement is usually one of the following:

- Flame ionization analyzer
- Non dispersive infrared analyzer
- Gas chromatograph

REFERENCES

1. "Control of Hydrocarbons from Tank Truck Gasoline Loading Terminals" EPA-450/2-77-02 (OAQPS No. 1.2-082).

2. "Control of V.O.C. Leaks from Gasoline Tank Trucks and Vapor Collection Systems" EPA-450/2-78-051 (OAQPS No. 1.2-119).

3. "Bulk Gasoline terminals - Background Information for Proposed Standards" draft E.I.S.

4. "Leak Testing of Gasoline Tank Trucks" Scott Environmental Technology Inc., (EPA Emission Standards any Engineering Division - Draft Report, August 10, 1977).

5. "Compilation of Air Pollutant Emission Factors" U.S. EPA Publication AP-42 (OAQPS, Research Triangle Park).

6. "Evaporation loss from tank cars, tank trucks and marine vessels" API Bulletin No. 2514.