TANK BATTERY ANALYSIS FOR VAPOR RECOVERY APPLICATION

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ABSTRACT

Tank Batteries can emit volatile organic compounds (VOC's) or gas vapors. Quantities of gas are directly proportional to the volume of crude oil present at the Tank Battery sight. Other factors effecting gas vapor volumes include line pressures, separation equipment pressures, and ambient temperatures. These vapors can be recovered and sold if sufficient volumes are present.

INTRODUCTION

Vapor Recovery Units (VRU's) are designed to remove gas from Tank Batteries or other vessels at extremely low suction pressures and pump the gas at pipe line pressures. Suction pressures can be as low as 0.25 psig. Utilizing pressure transmitters on the Tank Battery, VRU's have adjustable set points to have the unit start, bypass, or shut off when no gas is available. As per UMC Automation, (one of several VRU manufacturers), 50 cubic feet of natural gas can emit from 1 barrel of 40 gravity oil. Identifying Tank Battery locations with high oil production is the logical first step in VRU application analysis. Additional steps outlined below are Tank Battery inspection, volume testing, gas analysis, and economic evaluation.

SIGHT INSPECTION

Prior to beginning the actual volume testing, the Tank Battery and associated equipment needs to be checked to assure that all equipment is functioning properly. Special attention should be paid to all oil dump valves on heaters or other separation equipment. Any worn dump valves will allow gas production that would other wise go to gas sales into the stock tank, elevating gas volumes during the test. If the vent lines for the stock tanks are connected to any water tanks on location, water dump valves will also need to be inspected/replaced as needed. Seals around hatches need to be inspected and replaced as needed so gas will not escape without being measured. During testing, it is important that all gas vapors to escape through the vent line to which our orifice tester or choke nipple (figure 1) is attached.

VOLUME TESTING

Once all equipment is checked and all tank hatches are functioning properly, an orifice test or choke nipple is installed in the vent line. The orifice tester can be attached to either a chart recorder or an electronic flow meter (EFM). If a chart recorder (Barton) is used, I would recommend a 20 dp range. Clock rotation should be set on at least 24 hour. One of the advantages of utilizing EFM's is the fact that the volume will be calculated instantly. When using an EFM, assure that the static pressure can be manually set at 13.2 psia or 0.0 psig. Also, special attention needs to be paid to the dp zero and the differential cutoff. As most Enardo valves and hatches have relief settings at 4 oz., the orifice plate should be sized to have a maximum differential pressure of 7 inches of H2O. If tanks tested have higher relief pressure equipment, a higher dp can be maintained. A higher dp can alleviate low volume errors such a zero shift.

GAS ANALYSIS

Figure 2 is a pair of gas analyses secured from the gas sales on the Pioneer Natural Resources' (PNR) Shackleford Spraberry Unit Tracts 51, 68&69 and the Vapor Recovery Unit on the same Tank Battery. If you examine the analyses, you will note the liquid content or GPM of the VRU analysis is 19.129 GPM or 273% higher than the analysis for the corresponding gas sales. It should be noted that the two analyses discussed were secured at their respective meter runs. For securing a gas sample directly from a stock tank, your gas lab can provide you with a large evacuated cylinder. If possible, attached the cylinder to the tank and open the valve on the cylinder. As the cylinder is under negative pressure, enough gas can be secured for analysis. Evaluating the liquid content of VRU gas is essential in determining the economics of VRU application.

ECONOMICS

Figure 3 illustrates the actual November 2005 pricing (MCF) of the gas production at the Tank Battery and the MCF

pricing of the VRU gas. $14.55 per MCF represents a 155% higher price than the $9.378 per MCF of the standard production gas. Once a gas volume for a given Tank Battery is established, a Vapor Recovery Unit can be sized depending on the anticipated line pressure and the volume of gas to move. The particular unit we are using as an example is a HYBON HB-50W-5-18B. This unit is designed to move 50 MCF/D at a maximum discharge pressure of 50 PSIG. Estimating a price for the unit and installation at $35,000, pay out of for this unit is approximately 5.7 months (figure 4).

CONSIDERATIONS

Vapor Recovery Units can be packaged as air or water cooled units. PNR's experience has been to utilize water cooled units. As VRU's operate on tank pressures, the placement of the transmitter for sensing tank pressure is crucial. The transmitter and associated "sensing line" cannot be installed on any tank battery gathering lines. For example, distortion to tank battery pressures can cause the VRU to run excessively, when there is no gas available.
Another simple but important concern for VRU applications is proper tank hatch and relief valve maintenance. All hatches should be checked periodically for worn seals and also for any buildup (dirt/oil) that may keep the tanks from sealing properly. Enardo valves also need to be checked periodically, as seals will also deteriorate over time. All hatches and Enardo valves need to be configured to allow positive and negative relief. If for example, there is a bad transmitter allowing the VRU to pump in the absence of gas, it is very possible to "pull in" a standard stock tank.

CONCLUSION

VRU's, if applied and maintained properly, can increase the revenue stream of any tank battery. Secondly, capturing and selling tank vapor emissions will certainly have an impact on any existing or future environmental concerns.

FIGURE 1

SSU Tracts 51, 68, & 69			SSU Tracts 51, 68, & 69 VRU	
	MOL %	GPM	MOL %	GPM
Hydrogen Sulfide	0.0		0.0	
Nitrogen	2.46		3.26	
Carbon Dioxide	0.22		0.30	
Methane	72.47		30.63	
Ethane	12.01	3.192	17.64	4.689
Propane	8.63	2.363	28.13	7.703
ISO Butane	0.68	0.221	3.01	0.979
NOR Butane	2.22	0.696	10.92	3.424
ISO Pentane	0.39	0.142	2.20	0.801
NOR Pentane	0.38	0.137	2.15	0.774
Hexane	0.31	0.134	1.34	0.578
Heptanes+	0.23	0.099	0.42	0.181
TOTAL	100	**6.984**	100	**19.129**

FIGURE 2

SSU Tracts 51, 68, & 69 WGR Station	#94702373	$9.378/MCF
SSU Tracts 51, 68, & 69 VRU WGR Station	#94703034	**$14.55/MCF**

FIGURE 3

Unit Cost and Installation	$35,000
Test Volume	14 MCF/D
MCF Price (figure 2)	$14.55
Average Monthly Revenue	$6192.48
Payout	**5.7 months**

FIGURE 4