Profits From Vapor Recovery

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The present and future concern of the crude oil producer is efficiency of primary and secondary oil recovery. The continued improvement of equipment and operations during all phases of oil recovery will attain the goal of maximum return on the investment. This paper will be concerned with recovery and delivery of stock tank vapor as a saleable product; the application is available in all crude oil producing fields.

During the past few years consolidation of leases, field unitization, and comingling of producing zones have contralized crude oil storage tanks, whereby the crude oil production from several former leases is processed at one location. The centralized tank battery become an ideal location for consideration of a vapor recovery unit; normally the volume of vapor loss at this location can be several hundred MCFD, with extremely high gpm content. The installation of automatic custody transfer (ACT) at the central battery has become a common installation, and the vapor recovery unit in conjunction with ACT can be an automatic control of pipeline gravity, a control merits consideration in several API gravity groups. The normal weathering loss of distallate crude vapor in storage has been effectively recovered and economic justification has been based on low fluid production rates.

A basis for consideration of stock tank vapor recovery will require electric power or a gas pressure differential for the prime mover, low pressure gas sales line, and sufficient volume of vapor to load one of several size compressors. The units should be considered unattended and components provided for this type operation, with normal safety precautions taken in the construction and selection of components.

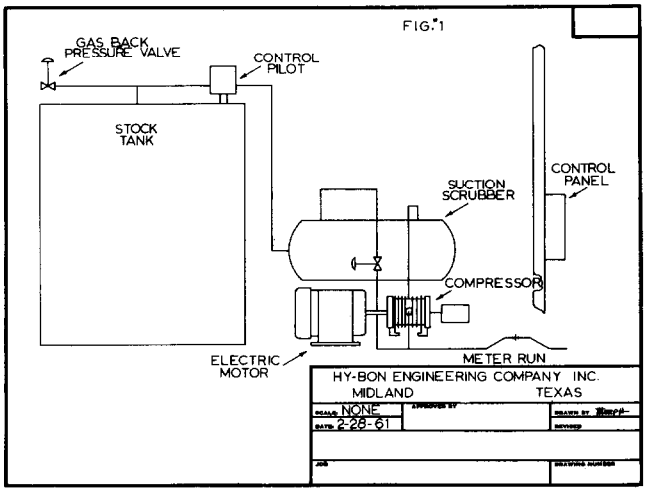
First, for proper selection of the size compressor required, an accurate measurement of the volume of vapor loss under actual flow conditions should be determined. Theoretical calculation of the vapor volume can be made with known values of similar crude oil, gas oil ratio, controlled shrinkage tests, and laboratory analysis. However, in most cases, the theorietical calculation has not been too accurate apparently because of variable treating and operating conditions; a system designed on the basis of theoretical calculation of volume should contain sufficient compressor displacement available to cover underestimating. Actual measurement of the vapor loss during operational conditions can be made with use of a recording manometer and orifice well tester, which can be installed and left for a period of time to cover the day and night cycle of ambient temperature. This cycle has been found to be quite representative of actual vapor volume loss under operating conditions.

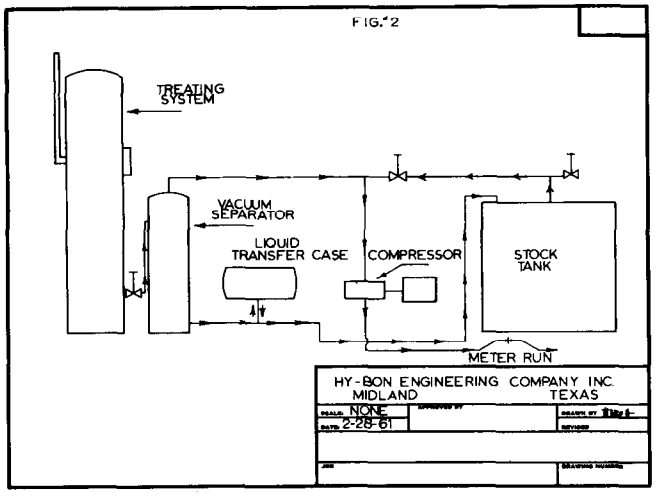
The variable of the gas sales line pressure will be of prime consideration in determining the compressor capacity and hp of the prime mover. Normally this data can be obtained from past static pressure records of the existing meter run. However, during the current low oil production rates one pressure may prevail; on the other hand, an upward trend or consolidation of oil production can produce a higher sales line pressure. But mechanical or electrical equipment can adequately overcome this if it becomes a problem at a later date.

To obtain maximum efficiency from a vapor recovery unit, a closed system operating under known conditions is required. The installation of such a system can be made with a minimum renovation to the present stock tank battery, and an ideal installation for conservation of crude oil is made in conjunction with ACT. The control of vapor pressure in the surge tank will tend to stabilize the crude oil under all ambient temperature conditions and allow the pipeline metering device a minimum range to correct for temperature, BS&W, and specific gravity variations.

The normally installed closed vapor recovery system is best illustrated by Fig. 1. This skid mounted system is located at a convenient distance from the existing stock tank and requires installation of the vapor suction and discharge piping, electrical service, and control circuits. The suction line is connected from the existing gas vent line to the suction scrubber inlet, and this line is elevated to allow liquid drainage to the suction scrubber. The compressor unit suction line is interconnected to the appropiate nozzle in the scrubber; the discharge line is connected to the gas sales line. Normally an unloading valve system is used whereby control of the compression cycle is operated by the unloading valve, and, except for safety shutdown features, operation of the compressor is continuous.

The control of this system is derived from a control pilot, pneumatically or electrically actuated and functioning from the vapor pressure of the stock tank. However to eliminate overriding of the safety shutdown features, manual control is not incorporated in the control system. The control pilot is responsible for control of precise pressure variations in the magnitude of fractional in. water column pressure; thus repeatability and positive calibrated preset pressure settings must be obtained. The control pilot, operating with dead weights for preset calibration, has been very reliable in the past four years. The standard control pilot has three functions: to cycle ON compressor or compression cycle at preset high vapor pressure; to open unloading valve for compression cycle OFF at preset vapor presure; to shut down prime mover at preset safety shutdown pressure. Except the control pilot switch contacts,





the control panel is self containing for all electrical components used in the system.

The use of this basic system for crude oil gravity reduction and stabilization has been innaugurated. In Fig. 2 a graphic flow sheet illustrates the system as used for crude oil gravity reduction and vapor recovery of the ACT run tank. However, the automatic control system was rather complex, and, for this paper, discussion of it is omitted.

The total crude oil production from the treating system is discharged into a vacuum separator operating at preset vacuum pressure limits; control of the crude oil temperature leaving the treating system is adjustable. Further, the vapor flashed in the vacuum separator is recovered and compressed into the gas sales line. An adequate control pilot system contains the ACT run tank to positive preset vapor pressure, and excess vapor from the runt tank is recovered in the vacuum system and compressed to sales gas pressure. This system in unique in design and is skid mounted for ease of fabrication in the field. The obvious economics of this system will be worthy of serious consideration wherever high gravity crude oil and pipeline gravity penalty prevail.

To illustrate the economics of actual installations, operating in separate fields, Fig. 3 indicates what can be representative. The data obtained was for the month of December 1960, which, according to the local weather bureau, had a mean average ambient temperature of 49° F. The vapor loss of stock tanks is proportional to the ambient temperature; thus to illustrate the least volume available during a seasonal cycle, would be the most conservative approach. The volume of vapor would increase up to 30 per cent with an ambient temperature of 80° F. for the specified lease installations. The monthly income was based on a standard casing head gas contract, and the dollar value represented actual income credited to the lease. The liquid recovered was sold as pipeline oil and considered at the lease crude oil gravity posted price. However, the amount of liquid to be recovered is rather difficult to compute and becomes a factor prevailing on application. In some installations the amount of liquid collected is of sufficient volume to transfer and sell as condensate allowable; the economics of this product can be readily seen.

In summary the economics of a vapor recovery system is derived from the sale of recoverable residue gas and products, lease safety by collection and disposal of lethal gas, reduction in tank deck corrosion by air elimination, crude oil gravity stabilization or upgrading, sale of liquids as condensate allowable, and control of lease gas for townsite tank batteries. This system is á fully automatic and unattended operation and is field proven by several years. And sufficient data are available from experience to determine the most economical system for all applications.

Fig. 3

LEASE	A	B	C	D
LIQUID RECOVERED	226	187	118	none
CORRECTED gpm	5.32	8.36	5.98	8.37
MCF/Month	5425	2573	2690	1581
PRODUCTION RATE	4000	2200	1950	510
CRUDE OIL GRAVITY	35 deg.	47 deg.	49 deg.	59 deg.
PRODUCING FORMATION	Yates	Ellenberger Devonian	Strawn	Strawn
MONTHLY INCOME	$840.00	$1486.00	$1020.00	$618.00