

Stock Tank Vapor Recovery

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FLUID VAPORIZATION

Crude oil volume may be lost from a storage tank in the form of vapor and/or gas known as vaporization. This loss of well bore volume, which is not recoverable, is normally expelled to atmosphere. The prime question to the producer of crude oil, is what are the economics of recovering the stock tank vapor?

The principles of fluid vaporization are based upon the fundamental laws of physics and will not be fully discussed at this time. Volatile liquids placed in a closed vessel, such as a stock tank, will vaporize throughout the space above the liquid until equilibrium of vapor pressure is attained. This rate of vaporization is affected by a number of operating conditions and by the type of fluid. Generally, the fundamental factor affecting the volume of vapor loss for a given fluid gravity is the ambient temperature, which is variable, and is appreciable in most areas.

Convection Currents

Fig. 1 illustrates the conditions prevailing within a stock tank containing a volatile liquid at static fluid level. The ambient temperature is induced to the fluid and vapor by conduction, the solar heat by radiation on the sunny side and roof. The sources of heat, being unbalanced in temperature, will cause the fluid and vapor to form convection currents. The velocity of the convection currents will be governed by the temperature differential throughout the fluid and vapor. Cessation occurs when the temperatures are stabilized. The induced convection currents will cause fluid agitation and resulting loss of vapor. The temperature of the vapor will increase the volume and pressure, requiring relief, and will be lost through the vent line to atmosphere. When the ambient temperature becomes less than the fluid and vapor temperatures, no radiant heating, a reverse of the convection currents occur. This will tend to induce a lower pressure within the vapor space, with a possible inflow of air. It becomes

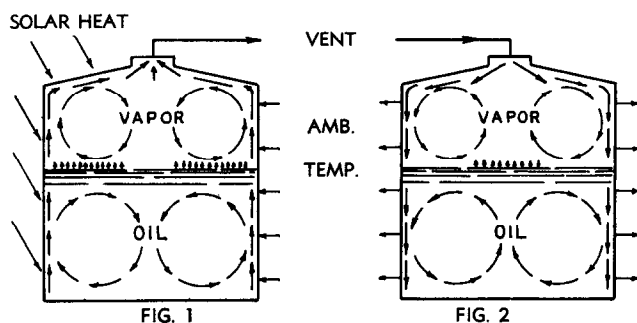


Fig. 1 STOCK TANK CONVECTION CURRENTS

evident that conditions which lead to vapor loss, and factors affecting the magnitude, are widely variable. Some of the factors affecting vaporization loss are as follows:

1. Physical properties of crude oil, gravity, saturation point and etc.
2. Ambient temperature.
3. Treating temperature and stage separation pressure.
4. Fill line entry and size of tank.
5. Wind velocity.
6. Tank fill cycle.
7. Agitation of fluid.
8. Direct loss by displacement of vapor.

Control Pilot

Fig. 2 illustrates the packaged unit available for compression of the excess stock tank vapors to a recoverable location, such as the lease gas sales line. The present stock tank vent line is connected to the gas scrubber, wherein the pressure of the stock tank is equalized. The control pilot is a field adjustable device which sets the range of pressure to be attained at all times within the stock tank. When the high pressure setting is reached, the control pilot will allow the compressor to take suction from the scrubber until the low pressure setting is reached. The control pilot can be used to cycle the prime mover or a compressor unloading valve.

When 1 inch water column or less pressure is reached within the stock tanks, external gas is bled into them to maintain at least 1 inch water column pressure. This insures a positive gas pressure within the system to eliminate a vacuum condition. A vessel is available to automatically receive liquids from the scrubber and discharge them back to the stock tank. In lieu of the variable discharge pressures encountered, several type compressors are available. The gas motor prime mover can be used when sufficient volume and pressure differential are available to develop the required horsepower. An electric prime mover is available for application, with full instrumentation for cycle or continuous operation.

Pay Out

The economics of an installation are of prime consideration. However, due perhaps to the variables such as ambient temperature, pay out may be considered misleading. It is possible to install a rental unit under actual operating conditions and determine the factual pay out. This normally will prove of value when considering stage separation, consolidation of batteries, commingling fluid, etc. The following is actual volume and monetary recovery from specific installations.

Lease A

Average ambient temperature - 50° F.
Treating system - 7 psig heated treater, 120° F.
Pipeline gravity - 43° API
Production rate - 400 B/D during tests
Stock Tank GOR - 14 scf/bbl
GPM Test of vapors - Propane 3.92; Butane 8.74;
26# gasoline 8.74
Net pay out - \$5.34/day

Lease B

Ambient temperature - 46° F.
Treating system - 180 psig, 50 psig, 5 psig elevated separator, no heat.
Pipeline gravity - 52.7° API
Production rate - 24,508 bbl/month during tests
Stock tank GOR - 11scf/bbl
GPM not available
Net pay out - \$245.66/month of January; \$0.00998/bbl oil reserves

Economics of Installations

The two leases shown could be considered rather extreme in treating compared to the normal treating

systems. 7 psig heated treating pressure is not average and elevated separation is often thought of as being the ultimate in recovering vapor and natural gas. The economics of both installations, with a 12 month operational history, should pay out in less than six months.

The increase in pipeline gravity was indicated from past records of each lease, up to 1.4° API. In lieu of both installations exceeding 40° API, no increase was realized from gravity stabilization. When considering tank deck corrosion, due to the presence of air and/or moisture with H₂S vapor, considerable pay out can be added to the direct pay out. When ground level gauging and vapor recovery is incorporated on "sour gas" leases, the intangible of safety from poisonous gas is accomplished.

The present trend toward tank battery consolidation, increased gas pipe line gathering systems and gas treating plants to more leases, and required supply for miscible injection are worthy reasons for considering stock tank vapor recovery. Statistics indicate the price and demand for gas products will continue in the present upward curve. This is a strong factor for considering pay out. This extra source of income, from stock tank vapors, is available in lieu of low production proration presently in force.

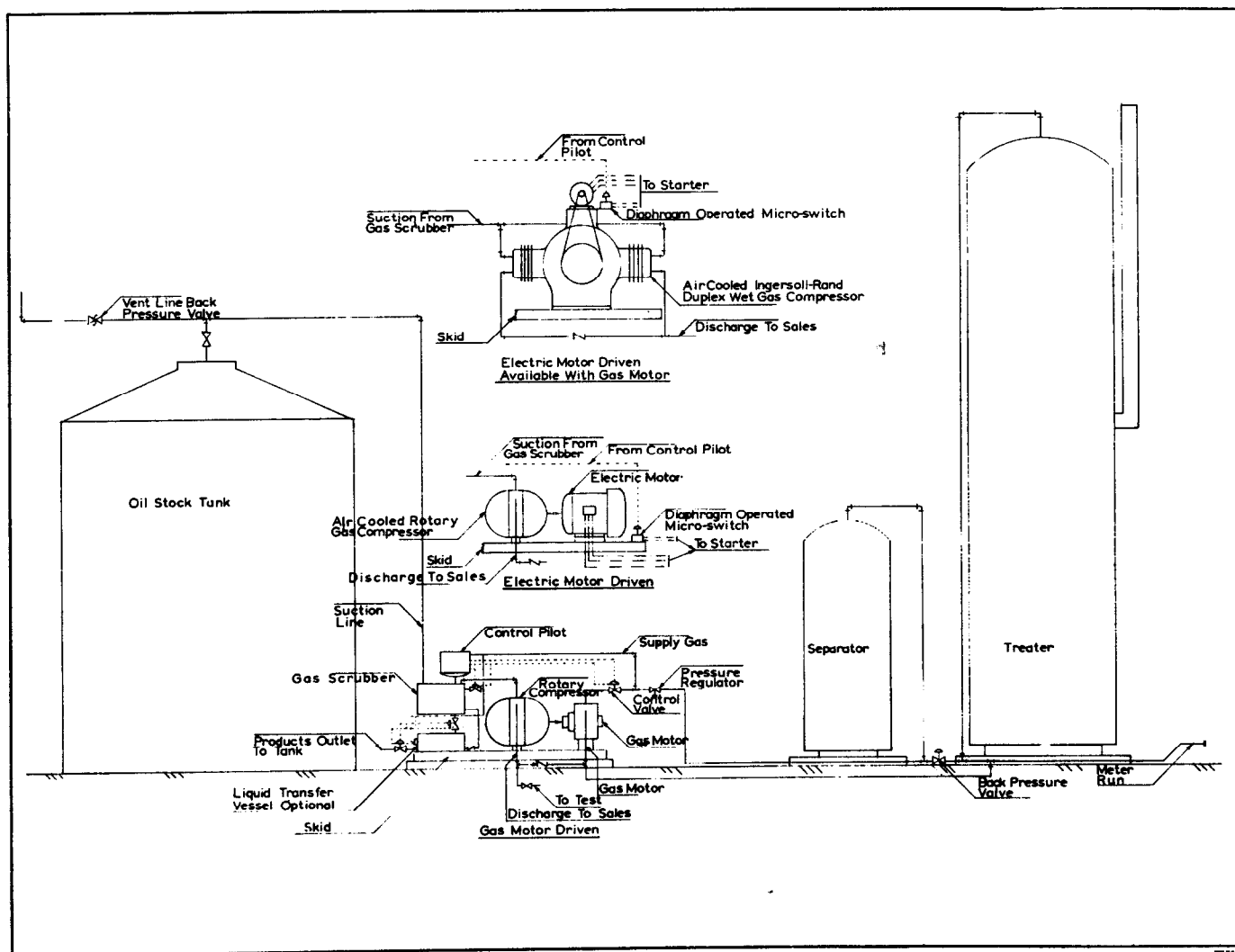


Fig. 2

AUTOMATIC-PACKAGED STOCK TANK VAPOR RECOVERY SYSTEM