Lease-Type Packaged Gasoline Plants

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Many oil or gas leases are deveolped where the use of a lease-type gasoline plant would be very profitable for the operator. Due to the size of this type plant, it should be considered when some of the first wells are brought in to recover the light end products, while the field is developed and the actual size and type of plant is determined. Many times field development takes one to three years. Payout and additional income could be realized by a plant of this type.

With the existence of gas gathering and distribution lines extending throughout the oil country, almost all production has access to gas sales. The income from gas sales coming from an oil-well lease equipped with separators and treaters will, in most cases, pay for compressors to get the gas into a sales-gas line. It is this case and that of the high-pressure separator that the lease-type gas plant can be used.

A packaged-type gasoline plant should be installed to remove the hydrocarbons from the sales gas if the contract will allow the removal of the liquids. There are many leases on which the sales gas is stubbed into transmission lines at points where the gas company does not have an opportunity to run the gas through a gasoline plant. The removal of much of the propane, butane, and natural-gasoline products from the lease gas will still leave the gas with a rich BTU content. Generally the pipeline will require that the gas have a minimum BTU content of 1050/Mcf.

The lease-type plant is usually a refrigerated type. This type will offer the gas company two advantages:

(1) The removal of much of the hydrocarbons that would otherwise condense and collect in the lines. This condensation will cause erratic gas flow, reduced capacity of the pipeline due to the liquids occupying space in the line, and the use of more compression horsepower to handle the desired volume.

(2) The second advantage is that the gas leaving the plant is a dehydrated product. The plant, by glycol absorption, reduces the water saturation. The water removal will reduce corrosion and a line-freezing problem. The condensation of water also causes reduced pipeline capacity and increases horsepower requirements.

In many cases the gas transmission company will welcome the installation of a lease-type gasoline plant.

In the past few years there have been several types of lease packaged plants installed in gathering systems with gas supplied by heater-treaters, low-pressure separators and gas produced from gas-condensate wells through high-pressure separators. Sometimes these plants are referred to as "portable gasoline plants". The refinement with which the manufacturers have designed and packaged the plants make them portable. They require very little, if any, interconnecting piping and external tower foundations for assembly. All of the plant components are packaged and pre-piped on a skid. Depending upon the size of the plant, the entire process plant—including the gas compressor (not considered part of the plant)—in most cases could be loaded on four trucks. The plant design has become almost standard; and the same plant, with little modification can be made to process lease gas in volumes from 500,000 scf to 3,000,000 scf/day.

The amount and type product recovered is dependent upon the design of the plant. This plant is a one-product plant and generally makes a 12-lb gasoline, 35-40-lb mix, or a 150-lb mix. The design of the plant will be determined by the market the operator has for the product. A plant of this type making a straight 12-lb product could market to a crude-oil blending station which uses the mix to raise the API gravity of low-gravity

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crude. The 150-lb LPG gasoline mix is usually taken to one of the larger plants in the area to make into propane, butane, and gasoline.

The "small" packaged plant is usually designed to recover a de-ethanized one-product mixture. The amount of recovery will depend upon the design of the plant, and the inlet gal/min content of the gas stream. If the gas is not a high-pressured gas, the system of liquid recovery is done by compressing the lease gas to a pressure of 250-300-lb, or to the sales-gas line pressure. The gas stream is then chilled to a temperature of 0°, or −20F. The colder the gas, the more propane, butane, and natural gasoline will be recovered from the gas. The extremely low temperature will recover more propane in the mixture; and the higher the vapor pressure of the product, the more volume recovered.

Lease-type refrigeration plants are designed to recover, at +20°F operating temperature, 10-15 per cent propane, 60-70 per cent butanes, 85-90 per cent pentanes plus. By lowering the gas temperature to −20°F, the maximum recovery of this type plant is increased to 48 per cent propane, 76 per cent butanes, 96.5 per cent pentanes plus. General averages of the gal/min content of gas-distillate wells produced into a high-pressure separator containing between 1.8 and 2.15 gal/min, are:

Propane	1.16
Iso-Butane	.21
N-Butane	.39
Iso-Pentane	.09
N-Pentane	.10
Hexane Plus	.20
	2.15

The maximum recovery of this type plant would be 1.41 gal/min on 1410 gal. per million feet of gas. The product would be a 150-lb mixture.

General averages of the gal/min content of low-pressure separation, operating at 15-30 lb at 70-80 deg are:

Propane	2.44
Iso-Butane	.25
N-Butane	.80
Iso-Pentane	.23
N-Pentane	.24
Hexane Plus	.57
	4.53

Maximum recovery of product of this type inlet stream would be 3.01 gal./min or 3010 gal. per million cubic feet.

General averages of the gal./min of heater-treater gas operating at 12-15 lb at 120 deg are:

Propane	4.79
Iso-Butane	.67
N-Butane	2.09
Iso-Pentane	.53
N-Pentane	.53
Hexane Plus	.59
	9.20

Maximum recovery in this type plant would be 6.07 gal./min or 6070 gal. per million cubic feet.

The lease-type packaged plant, for all practical purposes, is an unattended operation. Lease switchers operate the plant as the equipment and machinery used in the plant has the same type controls, valves, burners, pumps, and thermostats, and is no more complicated than the equipment used on some of the more complex low-temperature gas separation equipment. The only equipment used in the plant that is not standard to a lease operator is the refrigeration equipment. The refrigeration equipment is a compressor which is able to handle straight propane, ammonia, or freon.

Figure 1 is a photograph of a complete skid-mounted plant. All equipment of the plant is complete on this portable unit.

Please refer to Fig. 2—Plant Flow Sheet. Inlet gas from the compressor or high-pressure separator enters the plant into an inlet scrubber. The liquid product from this scrubber is taken back to a lease separator or to stock tanks or to a pit.

Downstream from the scrubber, lean glycol is injected into the gas stream to prevent hydrate formation. The gas is then taken to a gas-to-gas heat exchanger, which uses the cold gas from the cold separator to do a large amount of cooling. This exchanger reduces the amount of refrigeration load of the plant. The pre-cooled gas enters the chiller.

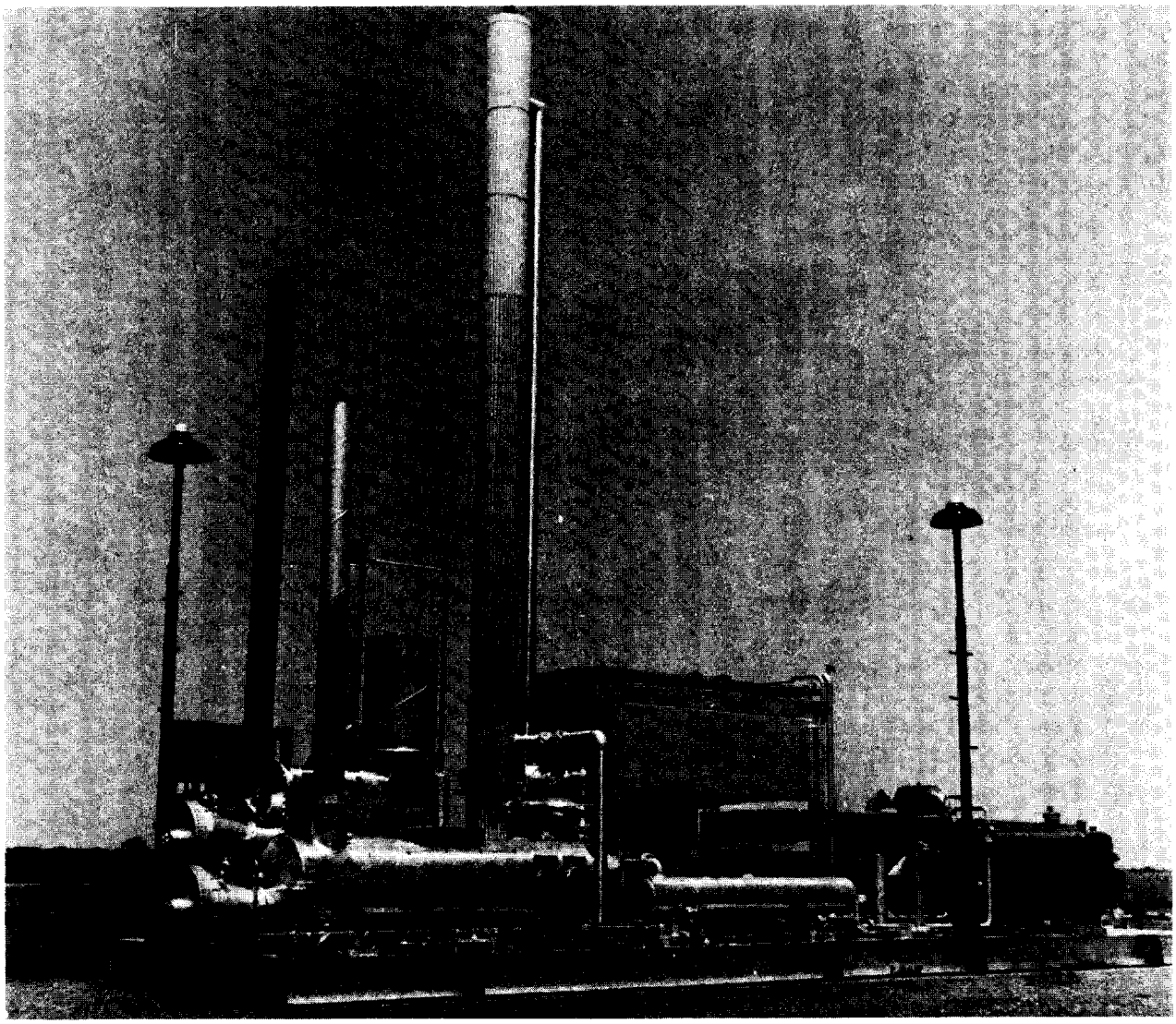
The chiller provides enough cooling to reduce the gas-stream temperature to the design operating temperature. At this temperature and an operating pressure 250 lb or higher, the entrained liquids will fall out. The gas stream, with the condensed liquids, is passed on to a cold separator.

The three-phase cold separator will separate the gas-distillate and water-glycol mixture. The cold gas from the separator is passed back to the heat exchanger to cool the incoming gas to the chiller. The gas, after passing through the exchanger, is then delivered to the sales-gas line. The cold-gas separator has a side-stream heating coil which will supply enough heat to the liquid to separate the hydrocarbon liquids from the water-glycol mixture.

The water-glycol mixture is fed back to a standard glycol reconcentrator where the excess water is cooked out of the glycol. In this unit the glycol is brought back to specifications and then stored in a surge tank, ready for pumping back into the wet-gas stream.

The hydrocarbon liquids are dumped from the cold separator into a heat exchanger that exchanges with the refrigerant and then into the top of the cold feed stabilizer. The liquid is cold enough that it acts as the top reflux for the stabilizer column.

The stabilizer is operated at a back pressure on the top and at a temperature on the bottom to make the desired vapor pressure product that can be sold. The overhead gas from the stabilizer that is flashed off is used for fuel in the glycol reconcentrator, stabilizer reboiler, and the gas



Complete Skid-Mounted Packaged Plant

FIGURE 1

engine of the refrigeration compressor. The stabilizer is a bubble-cap tray or a packed tower that will make a constant vapor pressure product. The liquid vapor pressure can be very closely controlled. Part of the hot liquid out of the stabilizer bottom is used as a side stream to heat the base of the cold separator in order to separate the glycol-water mixture and the liquid hydrocarbons. All of the hot liquid stream is then passed to one bank of an aerial cooler, where the temperature of the product is reduced to atmosphere, and from there taken to product storage. This plant can make any one product from 8-12-lb gasoline up to a 150-lb LPG mixture. The type product made by the plant would determine the working pressure of the stock tank storage.

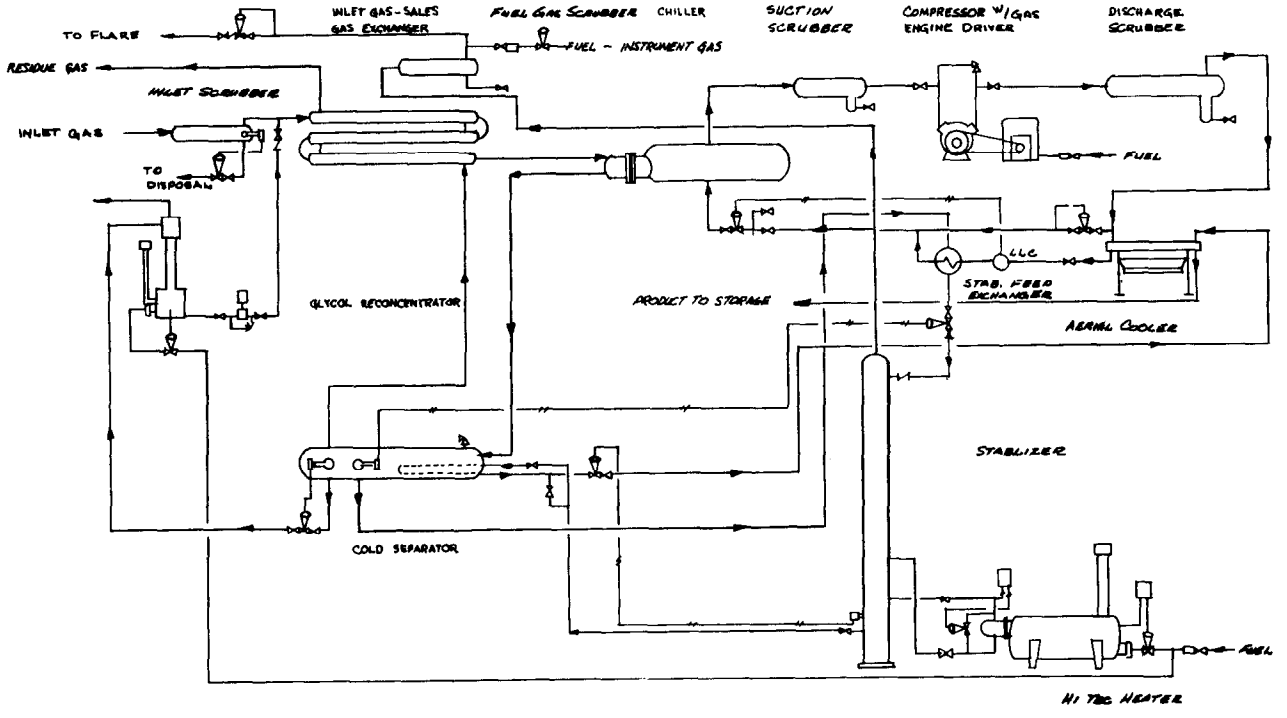
Heat for the stabilizer is furnished by a steam generator or a Hi-Tec salt-bath heater of a size required to bring the stabilizer bottom to a temperature of 250°-350°F.

The refrigeration system is a closed cycle. Propane, ammonia, or freon is used in the chiller; and, as the pressure in the chiller is reduced, the vaporization of the refrigerant cools the gas. From the chiller the refrigerant is picked up as a vapor in a suction scrubber on the inlet to the compressor. The refrigerant compressor will boost the gas to a pressure which, after cooling in a separate bank of the aerial cooler, will condense back to a liquid. Additional cooling in a liquid-to-liquid heat exchanger assures that the refrigerant is a liquid. As the refrigerant is required in the chiller, by means of liquid-level control and valve it is fed back in completing the closed system.

The self-contained portable plant needs only electrical power for the aerial cooler. The installation cost and time are minimum because of the packaging of the plant. The type plant can be utilized on various inlet gal/min gas streams and volumes, and still do a very good product-recovery job.

The two general types of product of this plant have a ready market. The high vapor pressure 150-lb mix would be sold to another plant which could break it into propane, butane, and gasoline. The 35-40-lb gasoline mix can be sold as a blend stock to mix with low-gravity crude to increase the value of the API gravity.

Because of expanding gas markets, gas-lift, or repressuring projects, operators are finding many applications for the portable plant.



PLANT FLOW SHEET

FIGURE 2