



■ This VRU being built for a major energy company's plant located in northern Alberta, Canada, recovers and compresses vapors from various storage tanks. Large tanks are used to hold production from SAGD (steam assisted gravity drainage) wells. The vapors in the tanks are often saturated with steam, water and hydrocarbons from the production process. The package is 72 ft. long by 24 ft. wide (21.9 by 7.3 m) and weighs approximately 100 tons (90.7 tonnes).

EVERYTHING IS BIG IN THE OIL SANDS!

HC Piper Manufacturing's Liquid Ring Vapor Recovery Units Are a Big Aid in Producing SAGD Wells in Fort McMurray, Alberta, Canada

By Neil Purslow

Recovering hydrocarbon vapors from storage tanks is good for the environment, protects equipment from damage and is economically wise. But what if the vapors are wet, dirty or corrosive? The cost-effective recovery of these types of vapors can be a challenge.

"For most vapor recovery units (VRUs), these undesirable constituents must be removed from the vapor for compressors to operate properly," said Charles Dean, president of HC Piper Manufacturing Inc. of Calgary, Alberta, Canada. "Our HC Series 5 Vapour Recovery Units use liquid ring (LR) compressors, which are designed to reliably handle gas vapors created in harsh operating environments. These compressors, along with our highly engineered packages, eliminate the need for gas conditioning before compression. In fact, it is the compression system that cleans the tank vapors before the compressed gas is delivered to another process."

One such harsh environment is located in northern Alberta. HC Piper is currently fabricating several large VRUs to handle the gas vapors com-

ing from the bitumen storage tanks for a major oil producer's operation in the Fort McMurray area. In this operation, bitumen reserves are produced using steam-assisted gravity drainage (SAGD) technology. This technology utilizes a pair of stacked horizontal wells that are positioned near the base of the reservoir. Steam is injected into the upper well, with the hot bitumen, steam and water flowing into the lower horizontal well. The well effluent is pumped to a primary processing facility and then

into large storage tanks at the plant. The crude is later shipped to an upgrading facility located about 25 mi. (40 km) away.

In the storage tanks, natural gas is injected into the void space between the top of the tank and the well production pumped into the tank. The natural gas acts as a blanket over the crude to prevent oxygen from entering the tank and creating an explosive environment. The gas blanket soon becomes saturated with steam/water and other condensable hydrocarbon constituents.



■ On this VRU, a Garo liquid ring compressor is directly coupled to an electric motor. Series 5 units run at either 1200 or 1800 rpm, although other fixed speeds are possible. Variable speed is not generally used because a minimum speed is required to maintain the liquid ring in the compressors.



■ At an SAGD facility near Fort McMurray, Alberta, a VRU has been provided with a building to protect the equipment during cold weather. In winter, temperatures can be as low as -40°F (-40°C) for weeks at a time. This unit is rigid enough for a four-point lift to move the unit into position.

The blanket is maintained at a pressure slightly higher than atmospheric.

When the crude oil is pumped into the storage tanks, the void space diminishes, resulting in an increase in the blanket's pressure. "VRUs maintain the pressure of the gas blanket by removing excess vapors through the top of the tank," said Dean. "Our units automatically sense the increase in pressure and remove the required vapor to maintain the tank's pressure. We then create useable products from the vapors that have been removed. These products are generally used in other plant processes, such as fuel for burners."

Turning vapors into useable products begins with the compressor. Liquid ring compressors belong to the positive displacement family of compressors, and use as their compression element a li-

quid that is centrifuged in an oval-shaped housing. The liquid can be water, sulphuric acid, crude oil, gasoline or any other liquid that does not react with the product being compressed. In the case of SAGD plants, water is used for the liquid ring.

When the compressor runs, an impeller rotates inside the housing. The centrifugal force created by the rotation of the impeller causes the water inside the compressor to line the inner wall of the housing. The water seals the space between the impeller and the compressor's casing, which is why it is often referred to as "seal liquid."

Process gas enters the compressor through a conical distributor fixed to the front cover of the compressor. The distributor has two suction and two discharge ports opposite each other. During the first quarter-turn, gas is

pulled into both suction chambers of the housing. In the second quarter-turn, gas is compressed and pushed out the two discharge ports. During the third and fourth quarter-turns, the cycle is repeated. In each complete turn of the impeller, gas is pulled in, compressed and pushed out twice. With the ports opposite each other, the compressor produces a balanced operation.

The inner wall of the casing has been designed using a double eccentric shape. The narrow side of the shape is located at the discharge ports. This design, combined with the high-pressure discharge ports being smaller than the low-pressure suction ports, compresses the gas. In addition, as the vapor travels between the inlet and discharge ports, the centrifugal force of the impeller pushes any particulate, water/steam and other condensable constituents outward, enabling them to be absorbed by the seal liquid. Seal liquid also removes the heat created from the compression process.

With each compression cycle, a portion of the water is removed from the compressor through the discharge port. The remaining water continues to travel around the inside of the housing to maintain the seal between the impeller and housing. The discharged water and gas is delivered to a proprietary three-phase separator for processing. From the separator, vapor exits the top, condensate and other hydrocarbon products leave from one end, and water discharges from the other end. The water is then



■ HC Piper's Series 5 VRUs are highly engineered units. The compressors on the packages start, stop and switch to bypass control automatically. The packages run without operator intervention, other than the periodic maintenance of the compressors' mechanical seals and bearings.