PRODUCTION EQUIPMENT EFFECTS ON GAS MEASUREMENT

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American Gas Association states that measurement of natural gas by an orifice meter requires a single-phase hydrocarbon through the metering area, which allows an accurate measurement of differential pressure across the orifice plate, flowing temperature, and component analysis at a metering station. Some gas contracts state that the producer shall condition the gas for metering which would allow accurate measurement of gas flowing through the metering station. To meet the AGA and Contract requirements personnel need to have a knowledge and operational understanding of production equipment used to condition gas prior to the point of measurement. To achieve this condition, field personnel should have an operational understanding of production equipment by which they can perform maintenance on and make adjustments to achieving an optimum flowing condition within the metering tube.

Typical natural gas well production equipment may consist of a WATER BATH HEATER and SEPARATORS, PRODUCTION UNIT, or HEATER TREATER.

The following is a review of production equipment and its basic operating functions.

HEATERS

The heating of natural gas, condensate, and crude oil is an essential step for nearly every oil and gas production lease of processing facility. Water bath indirect heaters have a long history of successful application in the oil and gas industry. They have been applied to a variety of operations, ranging from the heating of natural gas to the heating of sour crude. The heater consists of three basic elements; the firebox, shell, and flow coil. All heaters have standard accessories such as burners, regulators, relief valves, thermometers, temperature controllers, etc. The firebox is designed to transfer rapidly the heat released by the burning fuel to the water bath. The flow coil is designed to safely contain the process fluid and transfer the required heat from the water bath to the process streams. Indirect heaters transfer heat to the process stream through a heat transfer medium, surrounding both the firebox and the process flow coil with an operating temperature of 60°F to 190°F.

Applications

Water bath indirect heaters have been used for a wide variety of applications in the oil and gas industry. A few of the more common applications are as follows:

(1) Heating natural gas prior to regulation to prevent the formation of frost rings around the buried line downstream of the regulation station.

(2) Heating high-pressure natural gas prior to pressure reduction to prevent the formation of natural gas-water hydrates in the line downstream of the choke or regulation process.

(3) Heating a natural gas-condensate well stream prior to separation, with or without an associated pressure reduction to control the separation temperature, prevent the formation of hydrates, and assure good gas-liquid separation.

(4) Heating of crude oil to maintain its temperature above the pour point to reduce its viscosity for easier flow in other lease processing.

(5) Heating a natural gas well stream to maintain it above its hydrate-forming temperature from the well to the processing point, even though reduction of well stream pressure is minimal.

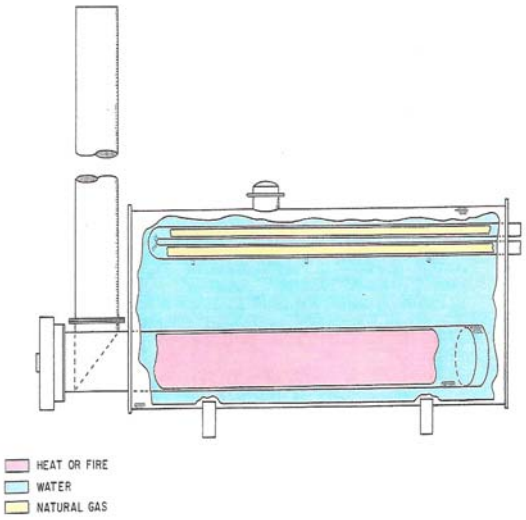

Figure 1. Water Bath Indirect Heater

SEPARATORS

Separators are mechanical devices for removing and collecting liquids from natural gas. A properly designed separator will also provide for the release of entrained gases from the accumulated hydrocarbon liquids.

All separators have at least three and usually four sections comprising the separation process. These are:

(1) The primary separation section.

(2) The secondary separation section.

(3) The liquid accumulation section.

(4) The mist extractor section.

FUNCTIONS

A well stream separator must perform the following:

(1) Cause a primary-phase separation of the mostly liquid hydrocarbons from those that are mostly gas.

(2) Refine the primary separation by removing most of the entrained liquid mist from the gas.

(3) Further refine the separation by removing the entrained gas from the accumulated liquid.

(4) Discharge the separated gas and liquid from the vessel and insure that no re-entrainment of one into the other takes place.

VESSEL TYPES

Separators are manufactured in three basic shapes – vertical, horizontal, and spherical. Each has specific advantages and the selection is usually based on which will accomplish the desired results for the lowest cost.

VERTICAL SEPARATORS

Vertical separators are capable of handling large slugs of liquid and are most often used on low to intermediate gas-oil ratio well streams. They are ideally suited as inlet separators to processing plants since they can smooth out surging liquid flows.

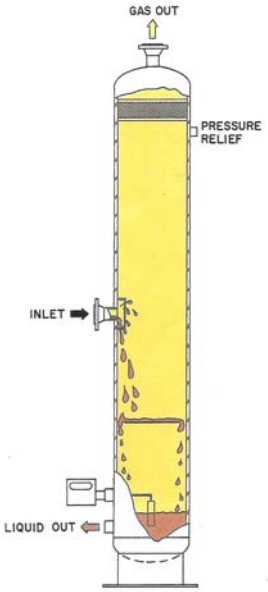

Figure 2. Cutaway View of Smith Three-phase Separator

THREE-PHASE OPERATION

Three-phase operation in vertical and horizontal separators requires different internal construction to assure dependable operation. Experience has proven that it is wise to use a longer retention time to obtain better water-oil separation. The standard retention time for a three-phase separator design is three minutes. This results in a reduction of the overall liquid capacity for any given size separator as compared to a two-phase operation, which is

based on a one-minute liquid retention time. Separation of the water and oil is simple due to the specific gravity difference of the two liquids. A separator cannot separate water and oil that exists as an emulsion. The water and oil must be as free liquids in the separator.

In the vertical separator, three-phase operation is similar to the two-phase operation previously discussed, except that all the separated liquid drops onto a divider or isolation baffle located above the liquid accumulation section. From this baffle, the liquids flow through a down-comer into the liquid section where the water and oil are released below or near the water-oil interface. This assures that the water does not have to settle through the separated clean oil, thereby providing efficient oil-water separation

SPARATOR ACCOMPLISHMENTS

(1) Control and dissipate the energy of the well stream as it enters separator.

(2) Minimize turbulence in the gas section of the separator and reduce velocity.

(3) Eliminate re-entrainment of the separated liquid into the gas.

(4) Accumulate and control froths and foams in the vessel.

(5) Provide outlets for gases and liquids with suitable controls to maintain preset operating pressure and liquid levels.

(7) Provide relief for excessive pressure.

(8) Provide equipment to check visually the separator for proper operation.

(9) Provide opening at points where solids will accumulate when solids are present in the inlet stream.

TREATERS

West Texas type treaters are designed to give maximum performance in treating loose to moderate emulsions where the coalescing properties of a filter section are not required.

How It Works

The well stream mixture of oil, emulsion, water, and gas enter the separation section at the top of the treater. The inlet diverter deflects the liquid outward against the treater shell and causes it to spread in a thin film so both free gas and solution gas are released quickly. The oil, water, and emulsion are collected on the diaphragm plate and they then flow through the down-comer pipe to the spreader underneath the firebox. The free-water immediately separates from the oil and is discharged from the treater bottom section through the outside adjustable siphon.

The oil and emulsion is broken into small streamlets by the perforated tray spreader and moves up through the hot water section surrounding the firebox. This action breaks the larger part of the emulsion. The water released settles to the bottom of the treater, where it is discharged with the free water. The final traces of water are separated by gravity in the quiet settling section. The treated oil exits the treater through the oil outlet at the top of the settling section and passes through the oil valve to the storage tank.

Warm vapors from the settling section enter the gas separation section through the equalizer pipe and mix with the cool inlet well stream gas. This causes condensation of valuable heavier fractions in the gas, which are recovered in the oil. The gas also passes through a vaned demister where entrained large liquid droplets are removed and returned to the oil.

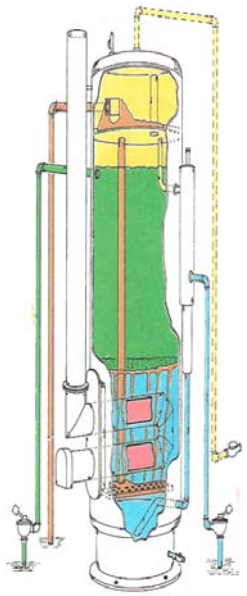

Figure 3. West Texas Treater

In closing remember if field personnel understand how each of the above pieces function and contribute to the conditioning of natural gas the result is accountable measurement of natural gas produced by a well.

REFERENCE

Smith Industries, Inc.