

GAS COMPRESSION

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TRAILER-MOUNTED SYSTEMS FOR THE TREATMENT OF
NATURAL GAS AT PIPELINE COMPRESSOR STATIONS

BY DON J. FISHER

Separators and filters are utilized to treat pressurized, multi-phase flow streams to remove solid and liquid components from the vapor phase. In most applications, they are designed as permanently installed components at compressor stations, gas processing plants, cryogenic plants, production facilities, and pig launcher/receiver stations. New advances in separation system designs use these devices on portable, trailer-mounted assemblies to operate on their own or in conjunction with acoustic silencers, carbon bed adsorbers, and other accessories.

These portable, trailer-mounted systems can be moved from site to site, thereby reducing an operator's capital expense by hundreds of thousands of dollars because individual, redundant treatment units no longer need to be purchased for each and every job site. The most appropriate combination of separation devices (vanes, swirl tubes, cyclones, or filter elements) will vary based on the condition of the natural

gas being treated and the degree of downstream purity that is required. Operators also can select accessories and trailer styles to meet regional road conditions and job site accessibility restrictions.

SOLUTION #1

Custom-Designed, Trailer-Mounted Compressor Blow-Down System

Natural gas pipeline compressor stations periodically need to vent their lines before conducting maintenance on their compressors. Figure 1 shows a blow-down system utilizing four components to treat the vented natural gas so that it may be safely emitted to the atmosphere.

Vertical Dry Scrubber: The first-stage separator (shown in the foreground of Figure 2) uses a cyclone bundle within an ASME Boiler and Pressure Vessel Code¹ pressure vessel, designed to remove 100% of liquid droplets 8 μm and larger,



Figure 1: Trailer-mounted compressor blow-down systems can be parked adjacent to compressor stations.



Figure 2: Integrated piping connects the first-stage vertical dry scrubber to four carbon adsorbers running in parallel.

with a carryover volume less than 0.1 gallon per MMSCF (1.3 L per MMSCM) of gas. The vertical dry scrubber (VDS) is equipped with a magnetic level gauge to monitor the internal liquid level to alert the operator when it is time to manually drain the separated liquid. Once drained, the liquid needs to be disposed of in accordance with local regulations and industry safety standards. The VDS accepts the natural gas at pipeline pressure and it is designed to suit the operator's system, typically using ANSI 600 Class components (American National Standards Institute, Washington, DC). After passing through the separator, a pressure control valve regulates the pressure down prior to the second-stage carbon bed adsorbers.

Carbon Bed Adsorber: The second-stage carbon bed adsorber contains granulated carbon material to remove the mercaptan (odorant) and volatile organic compounds (VOCs) from the gas stream. These four vessels (shown in Figure 3)



Figure 3: Carbon bed adsorbers can be designed with bolted or quick-opening access hatches for periodic maintenance.

run in parallel and typically use ANSI 150 Class components and need periodic service to replace the carbon beds through a quick-opening closure on top of the vessel. A differential pressure indicator is located on the carbon bed adsorber to indicate when the carbon requires replacement. The typical change-out differential pressure is 15 psi (103 kPa). A rupture disc is installed to protect the carbon bed adsorbers from over-pressurization, and it is designed to burst pressure ac-



Figure 4: The final stage acoustic silencer provides direct venting of clean, odorless gas to atmosphere without disturbing nearby neighborhoods or facilities.

cording to the pipeline operator's specifications.

Acoustic Silencer: The third-stage silencer (shown in Figure 4) is the final stage of treatment before the natural gas is emitted to the atmosphere. It is designed to reduce the sound pressure level to about 85 dBA at a distance of 3 ft. (0.91 m) from the silencer outlet. The silencer can be designed to vent in excess of 25 MMscfd (707,921 m³/d) of natural gas. A globe valve at the inlet to the silencer is used to provide further trimming of the natural gas that flows into the silencer. The outlet nozzle of the silencer vents the natural gas vertically upward to the atmosphere.

Pneumatic Control System: The pneumatic control system regulates the natural gas pressure as it passes through the trailer-mounted treatment system. An additional nitrogen-pressured system, with inherent safety features, is used to open and close valves and shut down the system whenever an abnormal condition exists, such as a pressure or flow spike. Emergency buttons mounted on each side of the trailer are used for manual shut down by an operator.

Optimizing Safe Operation: The pneumatic control system is designed for fail-safe operation to prevent startup if the system detects an unsafe condition or a condition affecting separation performance of the equipment. If a potentially dangerous condition occurs, such as the loss of nitrogen gas or the fire suppression carbon dioxide (CO₂), the system makes blow-down operation inoperable.

Unsafe operating conditions include, but are not limited to:

- High temperature in the silencer
- Low CO₂ pressure in the fire suppression lines

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Figures 5(a) and (b): The Solution #1 compressor blow-down system in operation at a New England compressor station.

- Low N_2 pressure in the pneumatic control lines
- Excessive natural gas pressure in the downstream of the VDS
- Excessive natural gas pressure in the downstream of the carbon bed adsorbers
- High liquid level in the VDS

SOLUTION #2

Custom-Designed, Trailer-Mounted Slug Catcher

Natural gas pipeline launcher/receiver stations allow for the insertion and removal of “pigs.” Pigging is a process that involves inserting a device into a pipeline to monitor pipeline integrity or to clean the pipe of liquids and solids that have accumulated between compressor stations. This bypass treatment system allows the pig receivers to be opened safely to remove the pig without spilling large amounts of oil and other liquids that have accumulated during pigging operations.

This slug catcher trailer utilizes a horizontal single barrel separator (HSBS) to remove liquids from the pipeline while routing the natural gas downstream at pipeline pressure. The HSBS has an internal vane unit to extract 100% of all entrained liquid droplets 8 μ m and larger. Other internal components within the HSBS assist with removing large liquid slugs and managing sudden liquid volume fluctuations without hampering separation performance.

Existing systems have been designed to collect liquid slugs up to 500 gallons (1892 L), while maintaining entrained mist separation. Flexible, high-pressure, interconnecting hoses are used to connect the HSBS inlet and outlet nozzles to the pipeline. Multiple ANSI 600 drain lines with valves are used for draining the separated liquid to an external drain tank. A gauge glass enables the operator to manually check the liquid level inside the vessel and drain tank.

As the clean and dry outlet gas stream feeds back into the pipeline at pipeline pressure, there is no need to consider acoustic silencing or mercaptan (odorant) removal with this system.

ACCESSORIES AND OPTIONS

It is possible to custom-tailor a trailer-mounted system to be used safely across multiple sites. Nine-ft. (2.7-m)-wide trailers are standard with length options from 18 to 40 ft. (5.5 to 12 m). Pintle, goose neck, and semi-truck hitches are available. Common accessories include:

- High-pressure, flexible hoses with various flange sizes and pressure ratings
- Automatic dump valves
- Flow meters for vapor and liquid phases
- Fire extinguishers
- Grounding reels
- Level gauges/site glasses
- Trailer registration services (state license plates and paperwork)
- Pipes/fittings/flanges/elbows/couplings/gaskets
- Ladders/tool boxes

SOLUTION #3

Custom-Designed, Trailer-Mounted Slug Catcher And Vent Silencer

Designed similarly to Solution #2, this offering combines the first-stage liquid separator with a vent discharge acoustic silencer. Designs can be customized. However, in this case, the system is attached to 36-in. (0.91-m)-diameter pipelines with 20 miles (32 km) of upstream pipeline volume.


This separator trailer also uses an HSBS to remove liquids from the pipeline, handling both entrained mists and sudden slugs of liquid. An internal vane unit extracts 100% of all entrained liquid droplets 8 μ m and larger. Other internal

components within the HSBS assist with removing large liquid slugs and managing sudden liquid volume fluctuations without hampering separation performance.

After the HSBS, the clean gas (still at pipeline pressure) travels through a series of orifice plates to reduce the pressure before entering the final stage blow-down vent silencer. The vent silencer safely discharges the gas to atmosphere with a noise below 85 dBA at a distance of 3 ft. and from the silencer outlet.

CONCLUSIONS

Portable, trailer-mounted gas treatment systems can be custom-designed to suit a variety of applications, whether the application requires the venting of pressurized gas to atmosphere or whether the treated gas returns to a pressurized line. Different types of separators, such as vanes, swirl tubes, and cyclones, can be combined with filters, acoustic silencers, carbon bed adsorbers, or other process equipment to serve a variety of natural gas applications.

Operators can benefit by using the same trailer-mounted system at multiple sites, reducing the capital expense of original equipment and eliminating civil foundation works at the job site. The ability to mix and match components within a system allows even greater flexibility to treat wet gas, dry gas, or other process streams. As shown in Figures 5(a) and (b), operators also benefit by safely treating their pressurized gas streams in populated areas without disturbing those who live nearby. 

REFERENCE

¹ASME Boiler and Pressure Vessel Code (BPVC), 2017 ed. (New York, NY: ASME, 2017).

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