

AERZEN USA: FLARE GAS CASE STUDY



History:

Flaring gas is the process of burning off unwanted gas from hydrocarbon processing plants, refineries, and gas wells. It is recognized as a major environmental problem by the EPA and the IPCC. Approximately 150 billion m³ of waste gas is flared globally, which contributes to contaminating the environment by 400 Mt CO₂ per year (1). Flare gas is identified as any gases that are burned off into the atmosphere. By 2018, in the USA, the EPA has mandated that all 142 refineries nationwide will need to comply with reducing toxic air pollutants to 5,200 tons per year and 50,000 tons per year of volatile organic compounds. This will result in a reduction in greenhouse gases equivalent to more than 660,000 tons per year of carbon dioxide (2).

Flare Gas Recovery (FGR) allows this wasted gas to be reclaimed. It provides a direct reduction in emissions and addresses the growing environmental, commercial, and public relations concerns with flaring and its emissions. Regardless of environmental benefits, there is a significant commercial one. The gas released to the flare is sufficiently rich and in such a quantity that a flare gas recovery system pays for itself, in many cases within one year.

Problem/Challenge:

In 2005, Aerzen was presented with a challenge to provide a reliable compressor package for flare gas recovery for a refinery located in Freeport, TX.

Sliding vane and liquid ring compressors are used for many FGR applications. While these compressors may often be the best solution, there are significant drawbacks with both technologies. Sliding vane compressors are simple compressors with a single shaft off-center in a cylindrical housing. The vanes are wear parts that slide in and out of the rotor and are in contact with the housing as they rotate. Even for low pressure, clean gas applications, they require frequent repair and replacement. Most sliding vane compressors inject oil into the process for lubrication of the vanes. They are not very reliable when dirty gas, dust and/or liquid is ingested in the machine. This prevents the vanes from sliding back-and-forth in the rotor slots and results in accelerated wear and premature failure. While overhauls are frequent, they are relatively inexpensive and easy to perform. For a system with installed spare or low duty requirements, these may be acceptable.

Liquid ring compressors are also simple machines. Their principle of operation is very similar to that of sliding vane compressors with the exception that a ring of liquid, generally water, is used instead of vanes that slide radially to trap and

Process	Flare Gas Recovery
Problem	Prevent hazardous product from polluting atmosphere, varying flowrates
Solution	Oil-free screw compressor with oil-purged double mechanical seal
Results	High reliability, efficient, quick return on investment

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compress the gas. Liquid ring compressors are therefore well suited for wet and dirty gas applications. These compressors are available in a variety of materials to handle a wide range of gases. Relative to other compressor technologies, liquid ring compressors are not as energy efficient, as it takes power to maintain the liquid ring in proper motion under all operating conditions.

Moreover, the liquid will scrub and cool the gas - thus collecting any condensable components, particulates, tars, paraffin's, etc. from the process. This requires the liquid to be treated as hazardous waste before being discharged. Many times, large amounts of water are not available, and special measures may have to be taken in cold climates. Care must be taken downstream of the liquid ring compressor because the discharge gas will be fully saturated with liquid.

Solution:

AERZEN VM series oil-free rotary screw compressors are a great fit for many FGR applications. Like other positive displacement technologies, the oil-free screw has the ability to handle wide swings of mole weight and changes in operating conditions, including gas composition. Oil-free screw compressors are unique in their ability to handle contaminants. These machines are very simple, can reach high compression ratios in a single stage, and achieve high-efficiency levels. Additionally, the cost of the VM series is competitive with flare gas solutions using liquid ring compressors.

In this project, a VM 20 was selected. The driveshaft sealing arrangement was upgraded to include a Flowserve oil-purged double mechanical seal. The double mechanical seal was used to ensure that the flare gas was fully contained, and to prevent the hazardous product from polluting the atmosphere.

The VM screw compressor package was designed specifically to meet the petrochemical client's needs. The package included the compressor with an integral step-up gear, double mechanical oil-purged seal at driveshaft, carbon ring seals at the conveying chamber, inlet silencer, discharge silencer, external lube oil system, N2 purge system, pressure relief valve, sound enclosure, coupling, coupling guard, drive motor, and structural base frame all rated for hazardous area.

The VM compressor package was installed at the customer site in Freeport, TX in 2005 and has been running reliably since then. With proper maintenance and process controls, many of these oil-free VM compressors run 5 to 10 years without an overhaul and have service lives of more than 30 years.

Experience:

Aerzen began supplying oil-free screw compressors for waste gas recovery 75 years ago, in 1943. The compressors for this application have ranged in size from 500 cfm and 5000 cfm with typical discharge pressures of 30 to 190 psig.

While AERZEN has sold flare gas compressors into Europe since the 1940's, the oldest AERZEN flare gas recovery installations in North America are in Canada. Starting in 1981 and continuing in the decades since, several refineries, at the time operated by Gulf Canada – nowadays Petro-Canada – were equipped with Aerzen VR series (API 619) dry screw compressors for the compression of flare gas. The first installation in 1981 paid for itself within the year and had significantly higher availability and uptime than the 2x 100% reciprocating compressors in a competing system. Capital cost was also significantly lower than a reciprocating compressor solution.

Including the VM and VRa compressors, Aerzen offers a range of oil-free screw compressors which meet the requirements for Flare Gas Recovery applications.



Sources:

- (1) <http://large.stanford.edu/courses/2016/ph240/miller1/docs/emam.pdf>
- (2) http://www.nola.com/environment/index.ssf/2015/09/new_epa_rules_will_cut_visible.html
- (3) Aerzen flare gas podcast



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