Pall Corporation

Case Study

Field Tests Demonstrate Limited Performance of Conventional Liquid/Gas Separators

Application

Many separation steps are used in the oil & gas industry to remove liquids from natural gas. Liquids are considered contaminants to all gas treating units (e.g. Acid Gas Removal Unit (AGRU), TEG dehydration unit, molecular sieve driers, etc.) and equipment (gas turbines, compressors) in the sense that they can adversely affect operations.

Many different technologies exist to separate liquids from gases - vane packs, demister pads, filter-separators, cyclonic separators, and conventional cartridge coalescers are all commonly used in the industry. However, most commodity-type separators are unable to efficiently remove the fine liquid droplets or "aerosols." Typically, most separators can only separate droplets down to 5-10 micron. Consequently, the finest aerosols pass through, causing equipment to be subject to liquid carryover. Field measurements and plant surveys carried out by Pall downstream of existing separators confirmed these findings. Results of three site surveys performed in the Middle East **downstream of horizontal filter-separators** are shown in the table below.

Problem

The Acid Gas Removal Unit is a critical step of the gas treatment process that removes acid gases (H_2S, CO_2) from the sour gas. This unit requires an efficient protection to prevent the ingression of liquid and solid contaminants inside the absorber with the sour gas. Liquid hydrocarbons and solid particles are strong foaming promoters because they lower the surface tension of the amine and they stabilize foam skins. Consequently, it is critical to effectively remove them down to very low levels prior to entering the contactor.

Even very small contaminants with sizes in the micron range can be extremely detrimental as they can cause severe operating issues such as foaming in the absorber, reduced flow capacity, loss of amine due to carryover, excessive use of anti-foams, process upsets in the sulphur plant, etc.

The filter-separator is a two-stage liquid/gas separator that is usually configured horizontally. The first section consists of cartridges aimed at coalescing the liquid aerosols and at removing solid particles. The second section consists of a vane pack or a demister pad aimed at separating the liquids. Liquids removed in both compartments are collected in a separate horizontal barrel located underneath the housing.

Filter-separators have proven to be inadequate for efficient liquid removal. In general, given the type of internals they are made of, their overall performance should not be better than that of a vane pack or a demister pad. Nonetheless, filter-separators have been used in the oil & gas industry for decades. However, the industry now acknowledges that critical applications require the use of more efficient technologies.

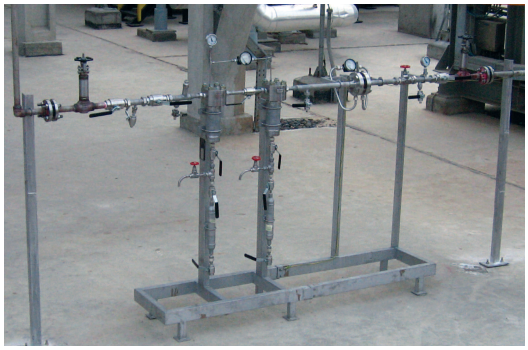
Over the past years Pall has conducted several site surveys in the Middle East to help plants understand the root causes of the problems experienced in their AGRU. In the three cases shown below, all plants were facing severe foaming issues in the absorber, forcing Site A for example to operate with a 20-30% lower capacity. Such problems were experienced despite the fact that the absorber was protected by one or more (three at Site C) horizontal filter-separators.

Table 1: Site Survey Results

Site	A	B	C
Flow rate MMSCFD (Sm^3/hr)	475 (561,000)	590 (696,000)	270 (319,000)
Pressure bar (psig)	38.6 (560)	62.1 (900)	67.6 (980)

Field test results

The site surveys were carried out by Pall's engineers from its Scientific & Laboratory Services (SLS) team, which provides local technical assistance. SLS mobilized test equipment for on-line measurement of liquid and solid contamination. Measurements were made at different locations including downstream of the existing filter-separator (i.e. upstream of the absorber). The test unit used to assess the liquid content in the gas is shown on next page.



Pall's test unit for assessing liquid content in gas

Sample taken from Pall's test unit

Table 2: Test results downstream of filter-separator

Site	A	B	C
Liquid content (ppmw)	150-990	80	1200
Nature of liquids	Water + HC	HC	Water + HC
Solid content (ppmw)	0.06	0.09	3.3
Nature of solids	Iron Sulfide	Iron Sulfide + Silica	Iron Sulfide & Iron Oxide
Cumulative solid Particle size distribution (PSD)	16% <3µ 78% <5µ 90% <10µ	20% <3µ 76% <5µ 90% <10µ	97% <2µ 99% <10µ

At each of the three sites liquid carryover was detected. The corresponding volumes extrapolated to the flow rate of the plant were huge:

- Site A: 2-14.5 m^3/day (3-21 ft^3/hour)
- Site B: 2.5 m^3/day (4 ft^3/hour)
- Site C: 7.5 m^3/day (11 ft^3/hour).

These large volumes of liquids entering the absorber can explain the foaming issues faced by the plant. The presence of solids was also measured downstream of the filter-separator. It was found that solid particles greater than 10 micron were not removed at Sites A & B.

Conclusion

Liquid contaminants, or aerosols, present in gas streams are very fine in size, typically in the micron and sub-micron range. Although they are fine, they are detrimental to all gas treating units and they must be removed effectively before entering the equipment. All incoming liquids are absorbed by the liquid phase (amine solution, TEG) or by the desiccant or the catalyst, regardless of their size. Conventional separators such as filter-separators may not be able to remove fine aerosols and may not protect the equipment properly, causing severe operating issues leading to reduced plant capacity and loss of revenue.

Pall's SepraSol™ Plus coalescers are capable of separating both the large droplets and the sub-micron size aerosols, and are a proven solution for the numerous critical liquid/gas separation applications found in the oil & gas industry.

Pall has scientific and laboratory capabilities to support its customers locally in the Middle East and North Africa regions through its SLS department. Locally-based mobile test equipment and field engineers can be mobilized to any plant to assist in optimizing the operation of their critical assets.

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