



## Pall's Coreless Filter Technology Improves the Removal of Black Powder

### Application

Black Powder is a general term used to describe a host of corrosion related contaminants that are very commonly found in pipelines that transport natural gas, hydrocarbon condensate and LPG. Black Powder is easily transported in pipelines until it reaches the end-user plant or receiving terminal.

A Middle East petrochemical company is receiving natural gas ('sales gas') from the gas grid. The plant uses the gas for several purposes: as a process gas (it must be compressed prior to further processing), and as a fuel gas to feed a gas turbine and burners.

Prior to entering the equipment, the total natural gas flow passed through a knock-out (KO) drum equipped with a demister pad to remove liquids, then through filters to remove solid contaminants. Each filter vessel was equipped with (27) non-Pall 12.1 cm (4 3/4 in) diameter, cylindrical surface type filter cartridges, with a removal rating of 10 microns nominal as per supplier data. The gas supply was 95 MMSCFD (112,000 Sm<sup>3</sup>/hr).

### Problem

Since 2003 the plant had been reporting several operational and maintenance issues (mainly on the compressor) including:

- Impeller of the compressor had broken once during operation, which had caused damages on the casing and other internal parts
- Control valves were blocking
- Heavy black deposits were found in the compressor
- In the inlet KO drum, significant quantities of black materials were collected (approx. 2000 kg/4400 lb in 2003 and 1600 kg/3530 lb in 2004), and the demister pad appeared to be severely damaged
- Filters were fouling very frequently, on average every second week but sometimes every two days

Eventually these issues were related to Black Powder contamination transported with the gas. Analyses of deposits revealed that contamination was mainly made of iron sulfide particles.

The consequences of Black Powder were numerous:

- High maintenance costs due to recurrent cleaning and repair of the machinery
- High operating costs due to filter consumption
- Heavy maintenance due to the frequent replacement of filters, and due to the special procedure for handling this pyrophoric powder

The plant concluded that existing nominal 10 micron rated filters were not efficient enough to remove the Black Powder properly. The plant initially wanted to retrofit the existing 10 micron filter with 1 micron rated cartridges, and to install a new 5 micron rated filter upstream as a pre-filtration stage.

### Solution

In order to minimize the investment cost, and to optimize the filtration sequence, Pall convinced the plant to consider a single stage filtration system equipped with Pall's Coreless filter cartridges with a depth, graded pore structure filter media.

Pall supplied a dual housing filter system for standby capability. Each vessel had a diameter of 132 cm (52 in) and is equipped with (30) Coreless cartridges. During the sizing process, attention was given to the flow distribution around the filter elements in order to get favorable conditions for the formation of a filter 'cake' around each cartridge, thus increasing the solids removal capacity of the filter and its service life.



*Pall's Coreless filter systems supplied to the customer*

### Operating Feedback

Pall's filters were put on stream at the end of 2006. After 20 months of successful operation, the dirty filters were replaced (in mid 2008) with no maintenance requirement on the downstream compressor.

In 2007, after 6 months of operation, performance tests were run at the request of the plant, in order to measure the solids content upstream and downstream of the filters. Tests confirmed the good performance of the filters, with an outlet solids content of <0.01 ppmw, while the inlet solids content was 0.61 ppmw at the time of testing.

At the opening of the filter vessel in 2008, the filter elements were found to be in very good condition. The Black Powder appeared to be dry. As expected, the finest particles had been trapped within the depth of the filter media, while the dry Black Powder had formed a 3-10 mm (0.12-0.39 in) thick 'cake' on the outer circumference along the cartridges, which represented an additional dirt removal capacity to the filter elements.



*Pall's Coreless filters after a successful run of 20 months*

### Benefits

- Reduction in maintenance costs as a result of better protection of the downstream equipment
- Reduction in operating costs, average filtration cost is less than \$10/100 MMSCFD (118,000 Sm<sup>3</sup>/hr) representing a reduction of about 10 times compared to previous filtration costs
- Reduction in volume of waste and associated disposal costs

### Conclusion

Black Powder particles are very fine particles that tend to agglomerate into particles in the micron range. Although they are very fine, they are also very detrimental to the pipeline components and to the machinery and equipment at the end-user's plants. These fine particles are difficult to remove efficiently. Filters with a poor construction, a poor sealing, or with a nominal rating are not appropriate for this application.

Pall's Coreless filters are well suited for gas filtration. Due to their depth and graded pore construction, Pall's filters can remove very fine particles while providing a long service life. Black Powder removal applies to the Oil & Gas, petroleum refining, petrochemical industries, and power generation plants. Contact your local Pall representative for more information.



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