The Role of Filtration in ultra low-NOx Burner Performance in a Fuel Gas Application

Identification of the filtration technologies and facility considerations essential to ultra low-NOx burner performance

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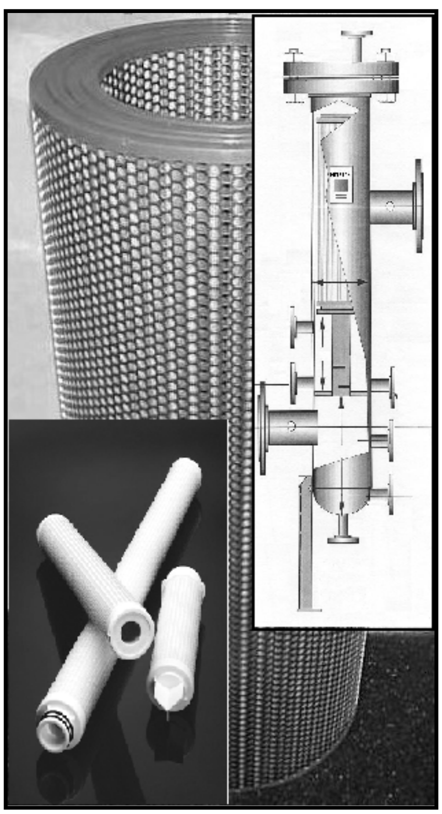
New advances in burner technology have made it possible to reduce the levels of Nitrogen Oxide (NOx) emissions not in marginal percentages but orders of magnitude. The result is that the Federal Environmental Protection Agency is in the process of placing large NOx emitters on notice that in accordance with BACT, they must begin the process of installing ultra low-NOx burners wherever possible.

Better Technology – Better Care

The use of ultra low-NOx burners on gaseous systems has one weakness that can impact not only initial performance but also long-term costs in terms of maintenance and downtime. These new burners utilize a combination of small orifices that are very susceptible to contamination from particulate and hydrocarbon aerosols. Plugging or coking of these orifices and burner tips is much more likely in an environment where the typical fuel gas contaminants get to the burner. Orifice plugging can cause premature performance failure resulting in higher NOx emissions and needless, costly downtime.



This problem can be resolved with the selection of an appropriate pre-filtration system. As with most technology advances, new approaches to related systems, like filtration, often comes into play.

Filtration Method

Ultra low-NOx burners require better filtration than older burner technology. Traditional pre-treatment of fuel gas included knockout vessels, centrifugal separators, vane separators and mesh pads to mention a few. These methods do not effectively remove contaminants at the low levels required for ultra low-NOx performance. The current technology of choice is referred to as *coalescing* – where particulate in the 0.3 micron range is removed. This technology not only removes solid particulate but also removes liquid aerosols common to most refinery fuel gas systems. This process uses microfiberglass filter media that causes small aerosol particles to stick to the glass fibers. Eventually the small aerosols combine with others to form droplets. Once this occurs gravity causes the droplets to drain out of the coalescing media. The technology is well proven and will work in refinery fuel gas environments provided that the system is properly designed.

Filter Design Considerations

The ability of micro-fiberglass to coalesce aerosols assures removal of all gaseous contaminants in the 0.3 micron range. This method is sufficient to protect ultra low-NOx burners from fouling. The filter designer must address four other variables in the application of coalescing filtration in a refinery fuel gas environment. These are:

- Pre-Filtration – Coalescing elements require pre-filtration to assure they can continue to function over a reasonable time period. Without adequate pre-filtration the coalescing element will have a very limited useful life.
- Element Sizing – the designer must size the element to provide enough flow for the system as well as enough capacity to allow for residue build-up over time within the system.
- Non-Metal Parts – the designer must address the chemical compatibility of element potting compounds, gaskets and seals with the variety of compounds found in refinery fuel gas.
- Housing Design – facility specifications often requires the filter supplier to be prepared to build a housing system that conforms to the refinery vessel and piping standard.

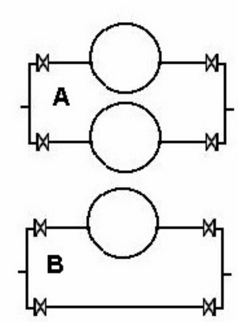
Facility Design Considerations

Assuming that the filter designer has properly designed a method to remove gaseous contaminants, the facility designer must design the installation of the filtration system to assure proper maintenance is possible. A coalescing filter system must be monitored for two critical aspects:

- Residue Build-up - The filter system must be monitored to assure that the element is changed when the differential pressure across the element approaches the limit set by the designer.
- Liquid Build-up - The filter system must be monitored to assure that the liquid is drained from the coalescing element before the fluid level interferes with the coalescing process.

These processes can be monitored manually or instrumented.

If the filter system is applied to a process that does not allow service interruption the facility designer must address the filter change-out procedure. The typical approach is to install two filter systems in a parallel configuration (figure A). The alternate approach is to install a by-pass that allows the filter system to be taken off line for a short period of time (figure B). This method reduces floor space and the cost of a second filter system. Method B will allow a slug of contaminant into the burner, significantly reducing the long-term on-line performance of the ultra low-NOx burner.



Summary

Reliable and consistent performance of ultra low-NOx burners in a refinery fuel gas application can be significantly improved by using a filtration system that accomplishes the contaminant removal task and is properly maintained.

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