HIGH PERFORMANCE GTC MEDIA FILTERS FOR HUMID CONDITIONS

AN UPGRADE TO THE CAMPULSE GTC FILTERS MAXIMIZED AVAILABILITY DURING THE CRITICAL HEATING SEASON

A Huadian plant, located in the Tianjin development zone in China, installed two GE PG9171E gas turbines in 2014. The original filtration system (installed by a global filter company) had 460 pulse filters for each intake system. One year into operation, the plant experienced frequent, unplanned shut downs during their peak load season.

THE SITE

Tianjin is located in Northern China in the Hai River delta where it drains into the Bohai Sea. It has four distinct seasons with a yearlong monsoon climate with an average annual rainfall measuring 43.3" (1100mm). In winter seasons, the region often experiences fog and haze with relative humidity (RH) routinely exceeding 90%.

The extreme environment in North China is challenging for air inlet filters, with the winter and spring seasons having the highest concentration of PM2.5 particulates, which includes sea salt. In 2015, the PM10 and PM2.5 dust concentrations averaged 83% and 65% higher than the WHO standard[1] at 116 µg/m^3 and 71.5 µg/m^3, respectively[2].

PROBLEM

The nearby industrial zone depends on the plant for their power requirements (heating) during the winter season, therefore, it is critical that the turbines operate without shutdown.

One year after installation, filter performance for both turbines started to deteriorate, with pressure drop (dP) regularly exceeding the operational threshold of 1300Pa.

Faced with expensive filter change-outs after only 2500 hours, management began searching for alternatives. "We want to lower the pressure drop, increase speed and make the air filter run for a full cycle of heating season (November 16 – February 28)," explained the Manager of Operations Department. "Now we have changed the filters after 2000-3000 of operation hours which is much lower than the design standard."

SOLUTION

Camfil recommended its high performance, humidity resistant, CamPulse Hemipleat™ GTC F9/Merv 16 pulse filters to replace the existing filters.

The GTC has proven to perform well in areas where both large quantities of dust and humidity are present. After demonstrating its performance through comparison tests with other filter suppliers, Huadian was impressed with the high efficiency and low dP. Further, success stories throughout North China convinced them to upgrade to the GTC for one of their turbines. A minor retrofit was performed on both inlets to accommodate 600 filter pairs instead of 460, resulting in lower airflow and resistance for each filter.

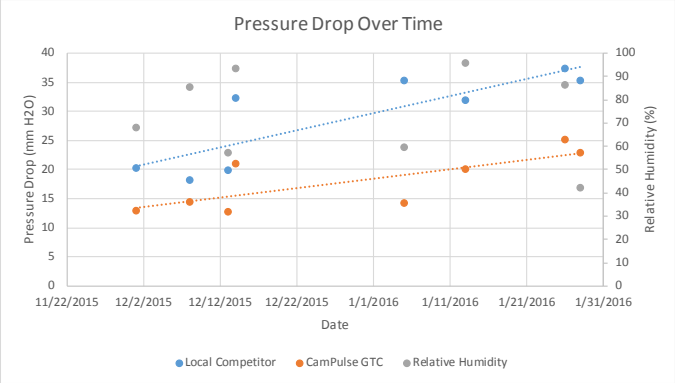
The other unit was equipped with 600 competitor F7/Merv13 class final filters. A side-by-side comparison was held to monitor the performance of the two turbines over the course of 2 months.

[1] http://www.who.int/phe/health_topics/outdoorair/databases/cities/en/
[2]http://cleanairasia.org/wp-content/uploads/2016/08/China-Air-2016-Report-Full.pdf

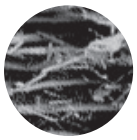
CASE **STUDY**

Power Systems

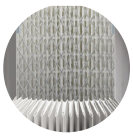
Graph 1: Two Month Pressure Drop Data



Humidity-Resistant CamPulse GTC



Non-discharging, depth-loading fiber synthetic media removes hygroscopic particles in humid areas. F9 per EN 779:2012



HEMIPLEAT

Synthetic beads hold the pleats further open and the wider spacing design gives greater media utilization and more effective filtration.

COMPARISON RESULTS

The two filtration systems were installed on December 1st, 2015. Over the course of two months, the competitive local air filter showed sharper increases of pressure drop curves as compared to the Camfil GTC. As illustrated in Graph 1, the GTC maintained a lower, more stable dP, even when relative humidity was high.

Six months after installation, the local competitor filters were changed out due to the dP exceeding the alarm value, causing an unplanned shutdown.

UPGRADE

Huadian was expecting air quality in Tianjin to worsen and decided to mitigate the risk of another shutdown during the next heating season by upgrading to the Camfil GTC filters on October, 2016.

IMPLICATIONS

The upgrade to the Camfil GTC filters assures full availability during the heating season. This is a result of low and stable dP which prevents premature filter change-out, and also positively impacts the available power output and efficiency of the gas turbine. Further, avoiding dP spikes during high humidity periods reduces the risk of the turbine tripping, and unwanted shutdown can be avoided.

What are the measurable impacts of pressure drop? Generally, 1" (25mm) of dP (250 Pa) impacts the simple cycle power output negatively by approximately 0.375% when running base load, and increases heat rate by 0.125%. In the case of Huadian, Table 1 shows that an additional power output of 595 (lower dP) + 5904 (no filter change-out needed) = 6499 MWh can be realized.

In addition to dP savings, the F9/MERV16 higher efficiency rating of the GTC filter pairs compared to the competitor filters with an F7/MERV13 rating, keeps the compressor/turbine much cleaner. This results in increased availability, reliability, and profitability as performance of the turbine is kept at a higher level, requiring less stops for washing online and offline.

BENEFITS

Although pulse filters have been supplied all around the world, they were originally designed for high dust areas. Traditional pulse filters rely on the formation of a dust cake on the media surface to optimize their efficiency. In coastal environments where salt and other hydrophilic contaminants are present and humidity spikes are frequent, particles in the dust cake can swell on the surface of the filter media, causing high dP.

The GTCs synthetic, 3-dimensional media, and its fine, water repellant fibers that are located in the central layer capture salt particles throughout the depth instead of the surface. This offers low impedance to airflow resulting in lower dP through the filter life.

In addition to the media performance, the HemiPleat™ open pleating technology in Camfil cartridges offers wider spacing, exposing more surface media to the air stream. This results in lower overall dP and more importantly, minimal dP increases in high humidity as well as improved dust release during pulse cleaning. Accordingly, low dP will provide operators with:

- Less unplanned outages
- Lower maintenance costs
- More engine availability
- Higher power output

Table 1: Increased Power Output Due to GTC Performance

Power gain due to lower pressure drop (dP)	0.375% of power per "wg (250Pa)
Average lower dP* of the GTC HemiPleat™	0.43" wg (105 Pa)
Total power gain [0.00375 x 0.43 x 123 MW]	0.1983 MW
Considered seasonal base load operating hours per year	3000 hrs
Power gain per year [0.1983 MW x 3000 hrs]	595 MWh
Power gain due to full availability (48 hrs outage*)	5904 MWh
Total Power Output Gained	6499 MWh

*Pressure Drop Over 2 Months:
- Competitor Average dP: 29mm H_2O (1.14" wg)
- Camfil GTC Average dP: 18 mm H_2O (0.71" wg)
- Calculation: 1.14 – 0.71 = 0.43

*Changing out filters at this plant requires approximately 48 hours downtime.