Controlling Emissions and Saving Money with Highly Engineered Cartridge Filter Technology

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Introduction

Over the last number of years Clear Edge™ has been advancing and developing its range of cartridge technology for the de-dusting and the hot gas filtration markets.

The solutions have been driven by market demand and the pressing need for industrial processes to control emissions both in-line and with end of pipe technology.

As global emissions in the developed world are tightening from PH10 to PM 2.5 (particulate matter 2.5 micrometers (µm)) Clear Edge have been developing and testing both Compact Filters and Hot Gas Filter in a range of industrial processes to meet even tighter emission limits while maintaining high flow rates and energy efficiency systems. This article outlines some of the new technology in this family and the next generation of filter products offering commercial competitive Air Pollution Control (APC) solutions.

Compact Filter Elements (CFE™) – cost effective de-dusting systems for the industrial processes

Clear Edge compact filter elements are highly engineered flat panel pleated filter units. The construction is entirely self-supporting and does not require a support cage (see examples in figure 1).

Clear Edge CFE, which were designed and launched in the late 80’s, combines the advantages of filter bags (horizontal installation) and cartridges (high filtration area).

CFE can handle a high dust load and can be cleaned efficiently by reverse pulse cleaning. The whole filter area is therefore continuously available. In recent years the range and size of these elements has been expanded up 6M2 per element (approx. 65ft2).

Dependent on the application Clear Edge can produce filter elements with different finishes e.g. oleo- and hydrophobic, temperature resistant, microporous coated, PTFE-membrane surface, antistatic and many more.

During the last 22 years thousands of filter elements have been installed all over the world covering practically all industrial de-dusting duties.

The main key features and benefits of CFE are;

- Up to 3 times more filter area compared to conventional filter bags
- Can reduce filter house volume by up to 70% (see figure 2) saving up to 40% on running and energy costs.
- High efficiency - in most plants lower than 1mg/Nm³ emissions (0.0004 grains per scfm)
- Long service life (circa 3-5 years)
- Excellent cake removal achieved with reverse pulse cleaning
Simple, quick and clean to install and replace
Can be retrofitted into existing units
CFE are much smaller in height, making indoor installations possible

Clear Edge has many years of experience designing and using CFEs and typical applications include:
- Welding fumes especially in laser cutting
- Automotive including paint shop spraying
- Construction and mining for example tunneling
- Milling especially powder handling

In conclusion CFE are an alternative to bags and traditional cartridges especially where space or height is at a premium. Due to the unique design CFE can be cleaned and maintained more easily that traditional cartridges offering longer service life. In addition CFE can be used where high or difficult dusts from industrial processes saving you energy costs and money.

Figure 1 – examples of a range of Compact Filter Elements (CFE™) from Clear Edge

Figure 2 – Sizing of the CFE in comparison to filter bags and sleeves offering space and energy savings
**Cerafil™ – hot gas filters – controlling emissions and treating gaseous pollutants in one step**

Cerafil, from Clear Edge, is a family of low density ceramic filter elements which are employed in filter plants in much the same way as filter bags except at higher temperatures. Typically Cerafil is used in the range from 200 - 800°C (392-1,472°F), thereby avoiding acid and water dew points and allowing for application at the temperature that best suits the duty. In addition Cerafil elements are extremely efficient and corrosion resistant and can be used in the most difficult gaseous conditions.

First developed in the 1990s Cerafil is a monolithic low density ceramic element which is highly effective and efficient at handling sub-micron particles in industrial gas processes. The product family has been expanded to three Cerafil product lines which are available in a range of sizes up to 3m (10ft) in length and 150mm (6”) diameter.

The duties of this Best Available Technology include Air Pollution Control (APC), Product Collection and Product Recovery. The one piece element is self-supporting and tolerant to a variety of conditions, has potentially long life, highly porous and future proofed for tighter environmental legislation (capable of filtering gas <2mg/m3).

Clear Edge has many years of experience in hot gas filtration in applications such as;
Glass furnaces (both bottle and float lines)

Incineration, include most type of waste & biomass processes

Cement kilns

Metallurgical (ferrous/non-ferrous)

Transportation, including marine diesel engines

Chemicals including carbon black manufacture

Some of the key features and benefits of the Cerafil technology are;

• High efficiency
  – less than 2mg/m³ emissions (0.0008 grains per scfm)
  – Easily handles sub-micron particles and PM2.5’s

• High temperature capability
  – temperature resistant up to 900°C (1650 °F)
  – Normally used up to 500°C (932 °F)

• Corrosion resistant
  – is almost chemically inert
  – Can tolerate changes in chemical conditions and temperature

• Range of products and sizes
  – Up to 3m long 150mm diameter (10’ long x 6” diam)
  – Normally new plant design but can be retrofitted to existing problem bag filter plants

Figure 3: a typical plant configuration for Cerafil in hot gas filtration application
Many industrial processes, and in particular, high-temperature processes, emit off-gas streams of mixed gas laden with particulate matter that has a variable composition. Managing these off-gas streams is a necessary part of the industrial activity. Air emissions from an industrial plant can involve a broad range of species, including particulate matter, oxides of nitrogen (NOx), oxides of sulfur (SOx), hydrogen chloride, volatile organic compounds (VOCs), polychlorinated biphenyls/dibenzo furans (dioxins), nitrous oxide (N2O) and heavy metals. The abatement regime is required to reduce these pollutants to below the regulated limits. The Environmental Protection Agency (EPA) is currently looking and enacted legislation to control these mixed pollutants across a number of industries including glass, carbon black manufacture, cement kilns and coal production.

A number of established and emerging technologies have been developed to meet regulated emission limits. These include barrier filters, dry, semi-dry and wet scrubbing, cyclones, electrostatic precipitators and catalyst-conversion processes. These clean-up processes are used, often in combination, to achieve at least the regulated emission limits. Process choice is affected by many factors, apart from the regulations in force, not least of which are economics and reliability.

However in order to meet tighter legislation and permit limits these technology need to be used sequentially and sometimes in various steps of the process flow diagram to bring the emissions below furture requirements.

In recent years Clear Edge has expanded the technology further and gone on to developed Cerafil TopKat™, a pioneering breakthrough technology combining the advantages of Cerafil with an incorporated active catalyst for the removal of example Nox, Dioxin, Sox, Rox and VOCs. This patent pending technology protects the catalyst from poisoning by incorporating it in the wall of the filter element (a common problem with Selective Catalytic Reduction (SCR) technology), see figure 4.

Clear Edge has been researching & developing this Cerafil TopKat technology for over 10 years and has built up many years of experience in this newly emerging technology area. A typical plant layout is shown in Figure 5 and Clear Edge has 1000s of filter elements in many applications worldwide covering a variety of industrial uses.

The main features and benefits of Cerafil TopKat include;

- The dual purpose filter consolidates the equipment train which save on capital (Capex), footprint, energy cost and simplifies the flow diagram.
- Maintain gas temperatures and plant buoyancy for downstream processes or energy recovery
- Removes Particulate Matter below 2mg/m³ dust
- Removes or minimises the following gaseous mixed pollutants to the following levels:
  - c. 95% HCl removal
  - c. 80% SO₂ removal
  - reduce NOx with efficiency of up to 95%,
  - reduces dioxin to a >99% removal level
- Can replace and combine your inefficient Electrostatic Precipitator (ESP), SCR and conversion process into a one step process.

In conclusion Cerafil offers customers future proof technology in terms of stricter emissions legislation, a simplify abatement train in terms of Cerafil TopKat, lower total cost of ownership, the ability to recover energy from your process and multi pollutant clean-up.

Figure 4: Cross section of the wall of a Cerafil TopKat element showing the nano catalyst embedded into the wall of the element.

Figure 5: Typical plant layout incorporating Cerafil TopKat and typical performance data
Mixed pollutants to treat:
- Dust
- HCl
- SOx
- NOx
- dioxin

- < 2mg/m³ dust
- c. 95% HCl removal
- c. 80% SO₂ removal
- up to 90% NOx removal
- > 99% dioxin removal

Injection of
- NaHCO₃
- +NH₃
- + support air