



FLAMELESS OXIDATION SYSTEMS

"REDEFINING ULTRA LOW NO_x"



Untouchable DRE > 99.9999%



Ultra Low NO_x < 1 ppmv



Self-sustaining for Waste Gas > 10 BTU/scf



100% Waste Gas Turndown Capability



PROCESS COMBUSTION CORPORATION

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Process Combustion Corporation's Flameless Thermal Oxidizer (FTO) systems are the best solution for applications that require the highest Destruction Removal Efficiencies (DRE) and lowest NOx emissions.

Each FTO is fully automated and engineered to accept the full range of waste gas compositions and flow rates generated by our customer's manufacturing processes.

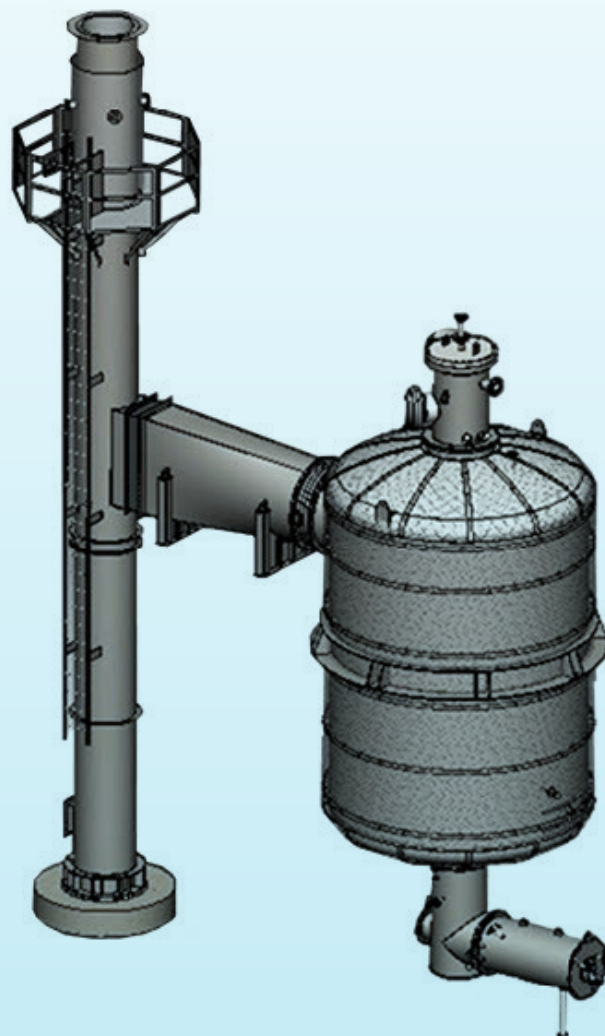
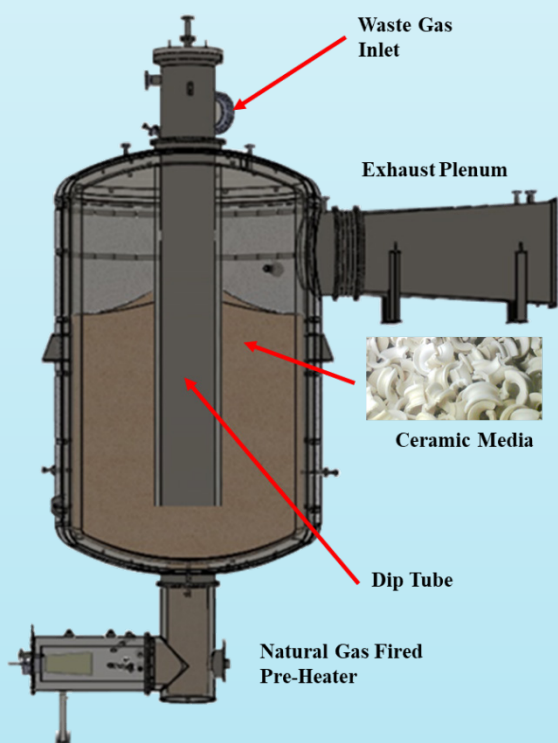
What is Flameless Oxidation?

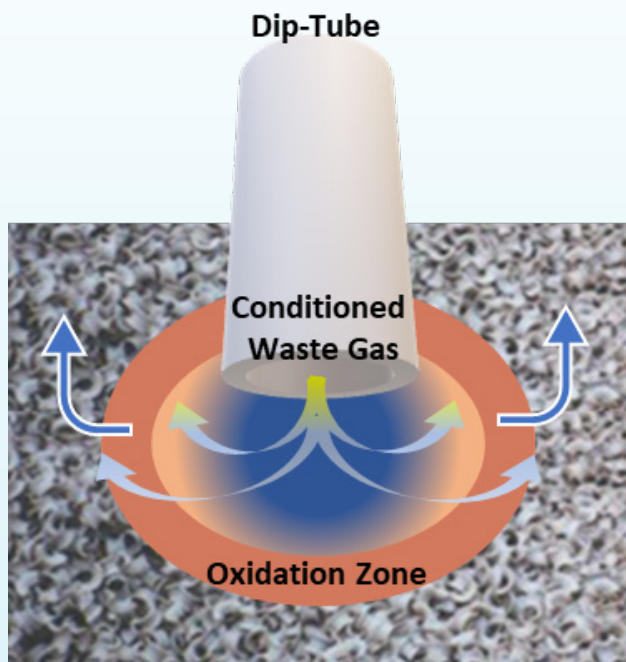
Flameless oxidation is a thermal treatment that premixes waste gas, ambient air, and auxiliary fuel prior to passing the gaseous mixture through a preheated inert ceramic media bed. Through the transfer of heat from the media to the gaseous mixture the organic compounds in the gas are oxidized to innocuous by-products, i.e., carbon dioxide (CO_2) and water vapor (H_2O) while also releasing heat into the ceramic media bed.

The reason why a flame is not generated in the media bed is because the gas mixture is kept below the lower flammability limit based on the percentages of each organic species present.

PCC's Flameless Thermal Oxidizers are designed to operate safely and reliably below the composite LFL while also maintaining a constant system flow and enthalpy (temperature).

Waste gas streams experience multiple seconds of residence time at high temperatures leading to measured destruction removal efficiencies that exceed 99.9999%. Premixing all of the gases prior to treatment eliminates localized high temperatures which leads to thermal NOx as low as 1 ppmv.





PCC's "Feed Forward" control technology, pre-mixes the Mixture of air, fume and fuel before being sent down the dip tube with a constant enthalpy and flow rate. The reaction zone is held in a fixed location as the waste gas composition/flow changes by adjusting fuel (constant enthalpy) and air (constant flow rate) flow rates and monitoring strategically located thermocouples.

PCC's FLAMELESS THERMAL OXIDIZER PERFORMANCE:

Destruction Removal Efficiencies (DRE) greater than 99.9999% are attainable. Thermal NO_x emissions of less than 1 ppmv are achievable. The system is self-sustaining for fume streams as low as 10 BTU/scf. Waste stream feed forward control ensures stability and prevents nuisance shutdowns.

The Technology behind PCC's FTO Performance:

In any Oxidation System, destruction is determined by the Three T's:

Time:	Residence Time
Temperature:	Temperature at which the oxidation reaction occurs.
Turbulence:	Premixing/Mixing (waste gas, air and supplemental fuel).

PCC's Flameless Thermal Oxidizer achieves all three of these metrics by design.

Time

The flow through a PCC Flameless Thermal Oxidizer involves multiple seconds of residence time at high temperatures. Because perfect mixing has already been achieved, high gas velocities are not required. As a result, the flow through each unit can be slower leading to longer retention times for oxidation reactions to reach completion.

Temperature

Each PCC Flameless Thermal Oxidizer operates with a completely uniform temperature profile that means the entire gas flow passes through a bed with a constant temperature profile to ensure that optimum destruction is achieved.

Turbulence

A PCC Flameless Thermal Oxidizer pre-mixes waste gas, air and fuel gas through the integration of PCC's "Feed Forward" control technology. Thorough and complete mixture of the waste components is completed before they enter the reaction vessel.

Extremely low Thermal NO_x levels are a result of a consistent, uniform operating temperature within the PCC FTO system. In a typical thermal oxidizer, the burner has hot spots within its flame, yielding temperatures in excess of 3000°F. PCC's FTO does not utilize a flame as the heat source. Maximum bed temperature of 1800°F - 1900°F ensures the minimization of thermal NO_x creation.

PCC's Flameless Thermal Oxidizer (FTO) Models

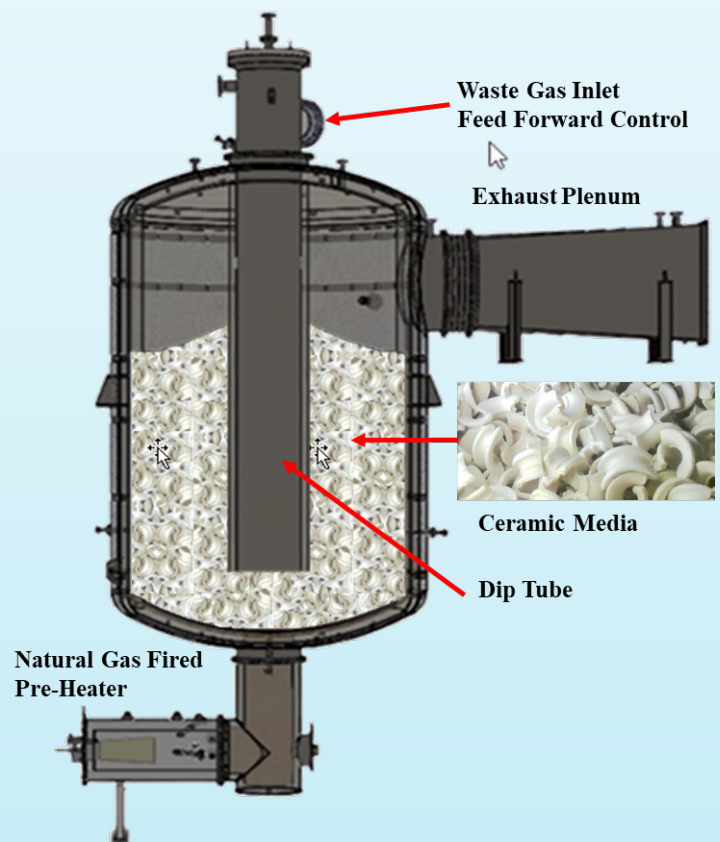
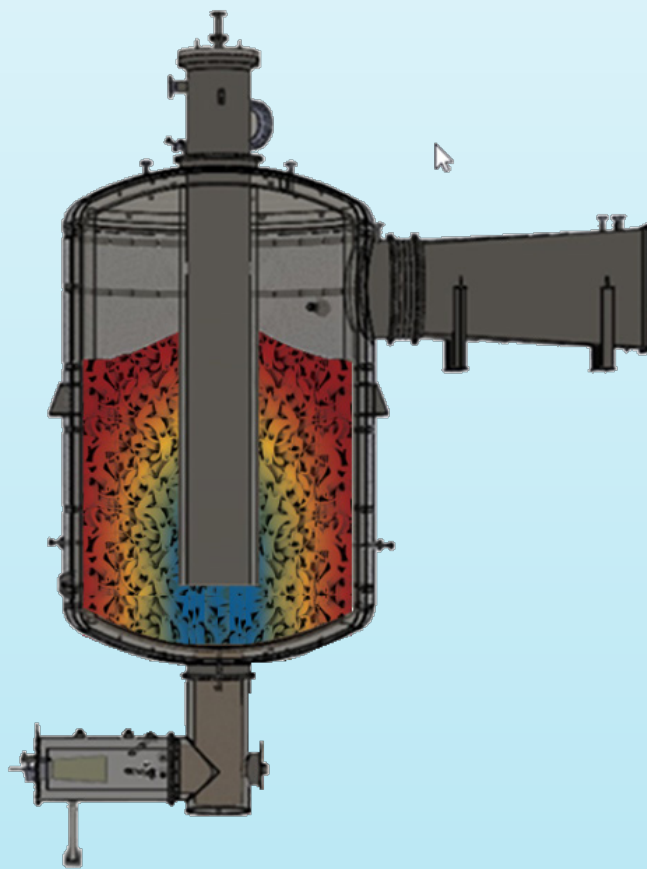
PCC offers three different types of Flameless Thermal Oxidizer models based on the volume of waste gas being treated:

Model	Treatment Capacity (scfm)
Electric FTO	0 to 100
Planar FTO	100 to ~5,000
Elliptical FTO	750 to 100,000+

Elliptical FTO

The Elliptical model is a refractory-lined cylindrical vessel partially filled with ceramic media. A natural gas burner is located at the bottom of the vessel and is used to preheat the ceramic media bed.

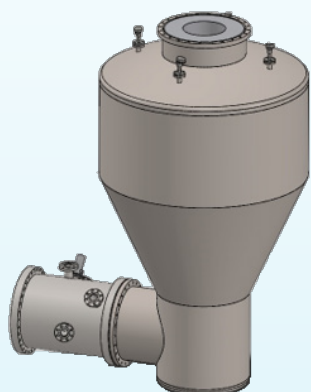
A dip tube is located in the center of the vessel and is used to direct the flow of the waste gas into the reaction vessel.



Utilizing PCC's "Feed Forward" technology, waste gas, ambient air, and natural gas are premixed based on a specified BTU value and delivered to media bed through use of the central dip-tube.

A reaction zone is established based on several factors. The waste gas is oxidized and then passes through the remainder of the media bed prior to exiting through the exhaust plenum.-

The PCC Planar FTO is a refractory-lined, inverted cone vessel filled with ceramic media. The media is preheated through the use of a small auxiliary natural gas burner.



The burner is only used to preheat the system during the initial start-up phase or at times the media temperature falls below the lower operating limit.

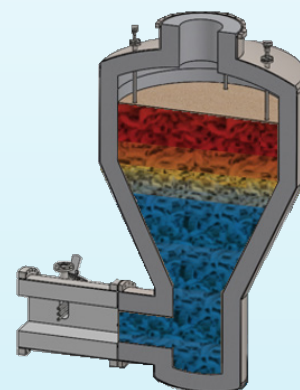
Waste gas, ambient air and natural gas enter the bottom of the vessel through a gas distribution plate.

The waste stream is forced up through the bed. An initial cooling effect occurs within the media bed, due to the ambient temperature of the waste stream.

As the waste gas is heated, as a result of its interdispersion with the heated ceramic media, it reaches the temperature at which oxidation occurs. This is known as the Reaction Wave. The waste stream is fully oxidized and then continues up through the remaining bed. It then exhausts through the exhaust port located on the top of the unit.

The PCC Electric FTO consistently treats Volatile Organic Compounds (VOCs) in waste gas streams yielding removal efficiencies of 99.9999%. The thermal oxidation is accomplished at 1800°F to avoid production of thermal NO_x and to minimize operating costs. Thermal NO_x levels are < 1 ppmv. High Destruction Efficiency, Low NO_x, Electrically Heated.

The PCC Electric FTO consists of a carbon steel, refractory-lined oxidation vessel. The vessel contains three spiral-wound electric resistance heater elements in 310SS protection tubes surrounded by a bed of randomly packed inert ceramic saddles. The PCC Electric FTO is fully automatic and there are no moving parts in the oxidizer. Alternate materials of construction are available as required based on the waste gas composition. A typical system requires 480V 3 phase 100 amp, 120V 1 phase 20 amp, and 5 scfm of instrument air at 80 psig.-----



How the PCC Electric FTO Works

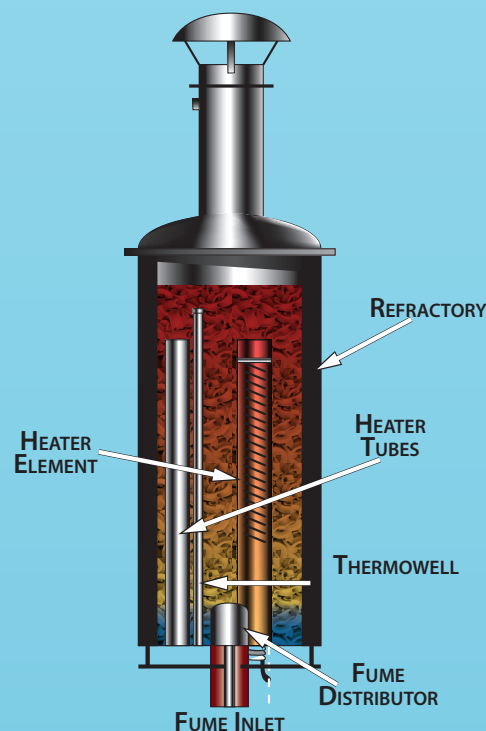
The PCC Electric FTO consists of a vertical, refractory-lined vessel filled with ceramic media. The ceramic media is pre-heated to a calculated temperature through the use of an electric resistance heater. Electrical energy is only required as a supplement to the heat content of the fume and to preheat the ceramic bed during start-up.

The waste gas and air are pre-mixed at the bottom of the vessel and introduced into the unit. The organic compounds found in the waste gas are oxidized and discharged into the atmosphere via a stack extension on the top of the unit.

The PCC Electric FTO operates well below the Lower Flammable Limit (LFL) eliminating the possibility of a flame within the system. The fume oxidizes as it passes through the oxidation zone releasing heat, which is transferred into the surrounding ceramic matrix thus maintaining the operating temperature of the bed without the need for supplemental heat via the electric heaters.

Simplicity of Design






The PCC Electric FTO's simplicity of design and portability made it a multipurpose piece of equipment for multiple low volume waste gas treatment applications. The PCC Electric FTO's standardized design requires minimal customization. The modular configuration makes it simple to install.
















MISSION STATEMENT...PCC's mission is to apply our know-how with confidence to design, supply and service high-tech, energy-efficient, dependable combustion and pollution control systems that provide cost effective environmental solutions for our global customers.

We will work hard together to achieve mutually rewarding, long-term relationships with our clients and suppliers, and we will continuously develop new technologies to meet emerging market needs.

Our Core Values

-  **Know-How** - Experienced, Knowledgeable & Competent - PCC's #1 Core Value
-  **Hardworking** - Working Hard Together to Get the Job Done
-  **Confidence** - Our Confidence in Our Abilities = Customer Confidence
-  **Customer Focus** - Custom Design with a Friendly, Willing Spirit
-  **Dependable** - Meeting Commitments to Our Customers & Owners

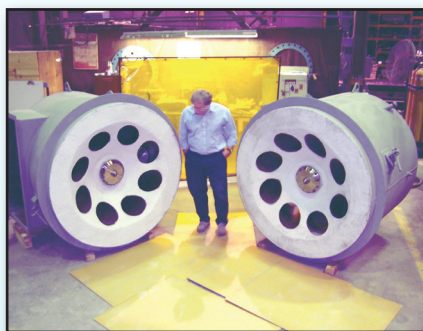
For over 50 years, Process Combustion Corporation (PCC) has designed, supplied & serviced combustion, heat transfer & pollution control systems worldwide. Headquartered in Pittsburgh, PA, USA; with offices in Beijing, China; and London, England; PCC is recognized as a global leader in pollution control systems. Our creative designs minimize system costs, especially energy consumption, while meeting environmental regulations. Our capabilities include:

-  **Thermal Oxidizer Systems**
-  **Regenerative Thermal Oxidizers**
-  **Flameless Thermal Oxidizers**
-  **Bio-Oxidation Systems**
-  **Wet Scrubbers**
-  **Activated Carbon Adsorption**
-  **Air Heaters**
-  **Specialty Burners**
-  **Specialized Combustion Systems**
-  **Low NO_x, SCR/SNCR Systems**
-  **Landfill Gas Thermal Oxidizers**
-  **Service & Installation**
-  **Engineering Studies**
- **Turnkey Projects**



Located in the South Hills of Pittsburgh, PA, PCC's Administration, Sales, Engineering, Manufacturing and Research & Development are housed in one location.

PCC has enjoyed successes working with the following companies (partial list) over the years. Our goal is always to be sure our customers are satisfied with quality, custom-designed and engineered, reliable products and services.



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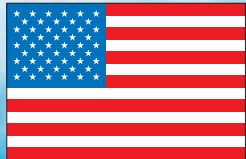
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Representatives are located in major US Cities, Canada, Asia, and selected countries, visit www.pcc-group.com to find your local agent.



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