

THERMATRIX®. Technology description.



Flameless oxidizer system at a petrochemical plant.

Technology beyond compliance

„A New Technology Offers Advanced Alternative For Reducing Waste And Emissions“ was reported in the Dow Chemical Newsletter published in the Brazoria Business Journal in July 2002. The article referred to the flameless thermal oxidation (FTO) units that are installed at their Texas operation. The systems, with over 100 installed units world wide, are field proven to consistently achieve VOC and HAP destruction efficiencies of 99.99% or greater. The unique features of the flameless reactor for fume and liquid abatement are rendering many traditional technologies obsolete because of its environmentally friendly high performance.

Designs for Class 1, Division 1 or 2 electrical standards allow for virtually unlimited flexibility in unit location. The inherent safety features and energy efficient design allow FTO systems to be integrated directly into many industrial processes and other applications - such as soil remediation, fugitive emissions disposal, and as an alternative to open flares.

Innovative solutions

FTO systems are modular and can be designed into various configurations depending on the needs of a particular client. From small (1 scfm) reactors designed to treat fugitive emissions, to large (100,000 scfm or more) parallel reactor systems, FTO systems treat a wide range of flows and compositions. For lower concentration fumes, internal heat recovery is built directly into the reactor so that a stable reaction is self-sustaining at 10 Btu per cubic foot of fume. In the event that supplemental energy is necessary, electricity or a wide variety of enrichment fuels can be utilized. Exhaust gases are ideal for direct heat recovery by preheating or generating steam where applicable.

As a result of corrosion resistant construction, the use of inert non-catalytic matrix, and modular scrubber packages, the technology is particularly suitable for halogenated and sulfonated hydrocarbon abatement. The technology has won awards from many sources including the California EPA, the Commonwealth of Massachusetts STEP program, and the Air & Waste Management Association. Since the operation is flameless, many environmental authorities view the technology as a non-incineration process that does not require continuous monitoring of emissions. According to Samir Serhan, Managing Director of Linde Engineering, „This non-incineration viewpoint was an important consideration in the technology selection by several major pharmaceutical and chemical companies in the United States and overseas. The crux of the matter is getting the job done and being a good neighbor.“

Technology background

Flameless Thermal Oxidation (FTO) was originally developed as a super efficient energy recovery technology. Initial development was conducted at the Lawrence Livermore Laboratories, under the auspices of the United States Department of Energy, in conjunction with the oil shale project. When that project was aborted, further refinement was supported by private funding and with the expertise of individuals originally associated with the project, later organized as Thermatrix Inc.

In 2002, Linde Engineering North America Inc. (LENA) acquired Thermatrix. The FTO technology is synergistic with the Company's thermal oxidizers, liquid incinerators, burners, and unique scrubbing systems. An operating demonstration unit is installed at the LENA Technology Center located in Conshohocken, PA.

How the FTO works

Flameless Thermal Oxidation is a process that thermally reacts waste gases and/or liquids with air to convert organic compounds to their oxidized state, and release heat without producing a flame. This is accomplished by heating the compounds above their auto ignition temperature under controlled conditions in a specially designed reactor that absorbs and dissipates the heat of reaction. A stable oxidation zone is maintained at a precise temperature and residence time sufficient to compensate for variations in waste flow and composition.

The reactor is made up of a refractory lined, cylindrical vessel (material of construction varies with application) with a centered inlet dip tube. The vessel is approximately half full of randomly packed inert ceramic media to form a uniform matrix below and around the dip tube. Electric heating elements or a preheat burner heat the ceramic matrix to the operating temperature for start up only.

Depending on the waste composition, dilution air and fuel are trimmed so the mixture never exceeds 85% of the lower flammability limit (LFL). This also ensures that the velocity of the gases flowing through the matrix equals the velocity of the reaction to maintain a stable reaction zone in the matrix. The volume of the chamber and the amount of ceramic matrix above the oxidation zone is designed to ensure a retention time of 3 to 4 seconds, at rated capacity. The system operating turndown typically ranges from 100% to 33%. The instantaneous waste flow turn down during any operating range is 100% for maximum process flexibility.

LENA's FTO technology has repeatedly demonstrated an organic waste destruction efficiency of 99.99% +, virtually undetectable NO_x and CO emissions and dioxin and furan emissions that are less than 0.1 ng/m³ TEQ. This unique performance assures regulatory compliance with a high degree of reliability.

Performance and features

- 99.99% or greater destruction of efficiency - including halogenated organics
- Low NO_x - less than 2 ppm
- Undetectable CO emissions
- Dioxins and furans emission - less than 0.1 ng/m³ TEQ
- Destructive process produces no secondary organic waste stream
- Flameless - can be installed in classified areas near the emission source
- Operates below the lower explosive limit
- Stable operation when responding to variable organic loading
- Matrix design prevents potential flashback to process
- Matrix is completely inert - no catalyst to foul
- No internal moving parts or diverting valves
- Integrated microprocessor control
- Treats batch or continuous streams
- Energy efficient operation - self sustaining down to 10 Btu/cf
- Superior turndown capability - reduces operating costs
- Easily permitted - no emission monitoring required
- Energy recovery available

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