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A Comparison:
Gas Fired Thermal Oxidizers and Flameless Electric Catalytic Oxidizers for the Groundwater and Soil Remediation Industry

With the recent increase in energy costs, we are often asked to provide cost analysis comparison between gas fired thermal oxidizer and flameless electric catalytic oxidizer technology for remediation projects.

Advantages & Disadvantages of a Gas Fired Thermal Oxidizer

The number one complaint received from active remediation systems operating with a gas fired thermal oxidizer (for off gas control) is system shutdown.

The oxidizer is disabled any time power to the system is interrupted. Gas fired oxidizer design must adhere to strict flame safety codes as contained in NFPA 86. Its flame safety equipment is engineered to detect a power loss and immediately disable the burner system. For safety reasons, the burner requires a manual reset which can be troublesome in areas that are remote or have frequent but momentary interruptions in the power supply.

In contrast, flameless electric catalytic oxidizers can be restarted remotely using telemetry or configured to automatically restart after a power interruption.

Here's a specific breakdown of the pros and cons of each technology:

Advantages of a Gas Fired Thermal Oxidizer

- Can process VOC concentrations between 0 and 50% LEL
- Easy conversion to catalytic mode when concentrations decline to less than 20% LEL decreases operating costs
- Destruction efficiencies in excess of 99%
- Catalyst contaminates in the fume stream do not cause destruction efficiency decreases in thermal mode

Disadvantages of a Gas Fired Thermal Oxidizer

- Requires natural gas or propane fuel supply in addition to electricity to operate
- Heat exchange modules can be installed, however, they are expensive to build and have a limited life span due to the high operating temperature of the oxidizer
- System up-time can be decreased by poor gas and electrical supplies

Advantages & Disadvantages of a Flameless Electric Catalytic Oxidizer

Advantages of a Flameless Electric Catalytic Oxidizer

- Quiet operation allows for installation in noise sensitive areas
- Compact footprint requires a smaller overall area for installation

- Greater system up-time than gas fired oxidizers
- Flameless operation significantly reduces risk of detonation
- Integrated heat exchanger and low operating temperature increase energy efficiency
- Oxidizer can automatically restart after a power outage

Disadvantages of a Flameless Electric Catalytic Oxidizer

- VOC input limited to LEL of 20% or less
- Potential for catalyst poisons
- Higher relative manufacturing cost as airflow rates exceed 1000 SCFM

Oxidizer Operating Cost Comparison

The advantage of the flameless electric catalytic oxidizer is the energy return when utilizing a high efficiency heat exchanger. A heat exchanger is less costly to manufacture for the lower operating temperature of the flameless electric catalytic oxidizer. This makes the overall capital purchase cost very close to that of a thermal oxidizer without a heat exchanger.

Here's a side by side comparison of operating costs and equipment life cycle costs (operating costs with capital outlay included). It's worth noting, our field data indicates a typical average twelve month LEL concentration between 10-20%. Most remediation sites follow a common remediation cycle of higher concentrations during the initial 1-3 months of the project followed by a gradual decrease in concentrations for the remainder of the project.

The oxidizers used in the comparison below (Table 1) are:

1. Flameless electric catalytic oxidizer with 60% nominally efficient heat exchanger
2. Gas fired thermal oxidizer with catalyst insert module and no heat exchanger. Oxidizer is changed from thermal mode to catalytic mode after 3 months of operation.
3. Gas fired thermal oxidizer without catalyst insert or heat exchanger. The oxidizer is run in thermal mode for 12 months.

	1. Electric Catalytic Oxidizer	2. Gas Fired Thermal Oxidizer – Change to Catalytic Mode After 3 Months	3. Gas Fired Thermal Oxidizer – Thermal Mode for 12 Months
Per Hour (months 1-3)	$0.80	$12	$12
Per Hour (months 4-12)	$0.80	$6	$12
Per Month (months 1-3)	$584	$8,760	$8,760
Per Month (months 4-12)	$584	$4,380	$8,760
Per Year	$7,008	$65,700	$105,120
Cost Differential – (electric oxidizer as baseline)	-0-	$58,692	$98,112

Table 1: This details the operating cost over 12 months of the flameless electric catalytic oxidizer versus the gas fired thermal oxidizer used in two configurations; straight thermal mode as well as a mode change from thermal mode to catalytic mode after 3 months of operation. For the basis of our comparison we've selected an average concentration of 15% LEL and a remediation cycle of 12 months.

Please refer to Appendix A for methodology.
Please refer to Appendix B for operating cost curves.

Life Cycle Cost (Operating Cost including Capital Outlay)

The following cost analysis includes capital cost of the equipment and 12 months of continuous usage.

	Electric Catalytic Oxidizer	Gas Fired Thermal Oxidizer – Change to Catalytic Mode After 3 Months	Gas Fired Thermal Oxidizer – Thermal Mode for 12 Months
Purchase Price	$70,000	$60,000	$55,000
Operating Cost	7,008	$65,700	$105,120
Total Expense	$77,008	$125,700	$160,120

Appendix A – Methodology

Our comparison is based upon the following site and operating parameters:

Flow Rate from Wells	1000 SCFM
Process Outlet Temperature	125 degree F.
Average Vapor Concentration (LEL)	15% as Hexane
Average Fuel Cost for Natural Gas	$8.00 / therm
Average Cost for Electricity	$0.08 cents / KWH

Flameless Electric Catalytic Oxidizer with 60% Efficient Heat Exchanger

Operating Temperature	600-1100 degree F

Gas Fired Thermal Oxidizer

Operating Temperature- Thermal Mode	1400-1600 degree F

Gas Fired Thermal Oxidizer with Catalyst Insert Module

Operating Temperature- Thermal Mode	1400-1600 degree F
Operating Temperature- Catalytic Mode	600-1100 degree F

Appendix B - Operating Cost Curves

The relationship between LEL and operating cost is depicted below.