



WHITE PAPER

Regenerative Thermal Oxidizers...What You Should Know.

A comprehensive review of components to evaluate when considering the purchase of a regenerative thermal oxidizer system.

Within industry today, the use of an Air Pollution Control System (APCS) to control harmful air pollutants is not new. In response to Congressional guidelines passed in the 1970's, a number of companies that generate VOC emissions have been operating air pollution control systems of one type or another for 30 years or more. These guidelines have been revised and added to as the years progressed, making it necessary for companies in a wide range of industries to meet stringent new local, state or federal clean air regulations.

Although general guidelines regarding the control and/or destruction of Volatile Organic Compounds (VOCs) and/or Hazardous Air Pollutants (HAPs) are somewhat consistent within many industries in the United States, a company's individual requirements and desires can vary greatly. When choosing a control technology that best fits their specific needs, companies should realize there are many factors that can influence the type of APCS they may wish to install and operate. Today, because of product design evolution, energy saving features and competitive pricing, the regenerative thermal oxidizer (RTO) has become a popular option.

Unfortunately, it can be difficult to understand the bona fide differences between oxidizer manufactures. When a decision is made to purchase a regenerative thermal oxidizer, very specific oxidizer design details should be gathered and evaluated since there is no real product testing that can be done and no sample production to be reviewed. Purchasing decisions are typically made by relying on the assembled design data and the vendor's credibility.

Which Components To Evaluate

The following is a comprehensive list of regenerative thermal oxidizer design specifications, major components and related vendor services along with a brief explanation as to why each item should be evaluated when purchasing an RTO system.



Maximum and minimum design airflow.

The oxidizer should be sized to handle your maximum exhaust rate, but should include provisions for sufficient turndown to idle and operate any one process independently. Typical volumetric turndown ratios range from 4:1 to 6:1.

Ceramic media type and design.

There are two basic types of ceramic media. Both have advantages and disadvantages.

Loose fill media is a random packing that forces the VOC laden air in many different directions while it is traveling through the bed. This increases mixing and turbulence, but increases the pressure drop through the bed, i.e. increased fan horsepower. Also, any particulate will get trapped in the media bed. Random media does have less of a chance of cracking due to thermal stress since the pieces are quite small.

Structured media is made in a block shape with channels for the VOC laden air to pass through. This easy flow path allows more air to pass through a smaller area with less pressure drop. Small dry particulate will pass through the channels and not plug up the media beds. Since these are large blocks of ceramic, thermal stress will crack them cosmetically after time, but their performance will not be degraded.

Ceramic media supplier.

Since there are a number of suppliers available, it would be wise to verify that your oxidizer vendor is providing ceramic media from a proven source that will allow the end user to purchase replacement media directly from the manufacturer if it ever becomes necessary.

Ceramic media life expectancy.

Each type of media can be made of different types of ceramic. Alumina porcelain, cordierite, mullite and saponite are just a few of the types available. Each type has different properties, making one or the other more or less suitable for any given application. Some are highly shock resistant. Some are highly chemical resistant. Some are “general purpose” and have good properties for a wide range of applications. In short, if the media is matched to the process, the life expectancy is indefinite.



Ceramic media cleaning capabilities.

Ceramic media can be cleaned, but it depends on the contaminant. An organic substance can be removed through a bake-out sequence, where the media is heated all the way to the cold face to burn off the material. An inorganic material can sometimes be removed by washing with water. A sticky inorganic material that cannot be burned or washed off should be filtered out before it reaches the oxidizer.

Combustion chamber temperature requirements.

Low temperature set point requirements have two obvious advantages: the lower the set point, the lower the operating costs; and a lower temperature set point allows the oxidizer to operate at higher solvent load levels without risking an over temperature shutdown situation. As mentioned before, time, temperature and turbulence are the factors for VOC destruction. A longer residence time allows for a lower operating temperature, or vice versa.

Maximum oxidizer operating temperature capabilities.

Typical ceramic fiber insulation and ceramic media can withstand 2000^o+F. As a safety, many oxidizers are limited to 1800^o-1850^o F. If the VOC load will push the combustion chamber past this point, a hot side bypass damper can be added at an additional cost.

Heat recovery efficiency.

Obviously, the higher the heat recovery efficiency, the lower the operating costs. RTOs generally achieve 85-95% heat recovery, and up to 97% heat recovery is possible. Recovery efficiencies of less than 85% are generally not recommended since cold face temperatures can exceed set limits.

Internal insulation and external surface temperatures.

The amount and type of internal insulation will determine heat loss through the shell of an oxidizer. A sufficient amount of insulation should be used to minimize heat loss, thus reducing operating costs, and also to reduce outside skin temperatures for obvious safety reasons.



Construction materials.

The type and thickness of materials used in manufacturing the oxidizer will have a major impact on the life expectancy. The exteriors of higher quality regenerative thermal oxidizers are typically manufactured of .25" and .375" carbon steel plate and painted with a suitable outdoor corrosion-resistant paint. Other portions can be insulated and clad with aluminum and sealed against weather. Equipment skid bases are manufactured of heavyweight structural steel.

Access doors to the inside of the unit.

A regenerative thermal oxidizer should not require much maintenance, but when the need arises, there should be enough access doors so that every major component can be reached inside the unit. The access doors should be designed in a way that they are large enough for an average size man to enter and also seal tight.

Burner manufacture and design.

The burner/fuel train assembly must be designed to comply with all necessary NFPA regulations as well as those that may be set forth by the customer's insurance carrier. The burner (maximum btu/hr) should be sized in such a way that it could maintain the oxidizer's set-point temperature at a full exhaust rate with no solvents present in the air stream.

Gas pressure requirements.

The oxidizer's gas pressure requirements could determine whether an expensive gas booster or even a new gas service is required. Check the pressure requirements against available pressure.

Fuel train installation.

The oxidizer manufacturer should have the ability to pre-pipe, pre-wire and install the fuel train at the factory. This can save both time and installation costs on the job site.

Thermocouple number and locations.

Thermocouples are used to control and monitor temperatures at strategic points within the oxidizer. If you are required to record temperatures with a chart recorder, make sure the vendor installs dual element thermocouples in the combustion chamber. Other points of interest (inlet, outlet, cold face) may be displayed as well.



Start-up time from cold start.

Since there is a large amount of ceramic (that acts as a heat sink) to heat-up, start-up time is typically 2-4 hours. This controlled heat up prevents much of the thermal stress in the oxidizer. Most quality oxidizers will have a built-in temperature ramp controller that restricts the change in temperature allowed per minute and brings the unit up to temperature slowly.

Airflow volumetric control.

Depending upon the size (volume) of the oxidizer and the number of processes connected to it, the airflow volume should be controlled either by means of a volumetric control damper or with an alternating current (AC) variable-speed drive connected to the supply fan motor. Either volume control system allows the oxidizer a method of turndown to treat only the air volume as required by the process at any given time. As the airflow volume from the processes fluctuates, so should the air volume being treated by the oxidizer. A volume-control system will save fuel and reduce operating costs. The AC drive unit will save electricity and further reduce operating costs.

Airflow dampers/actuators provided.

Manual balancing dampers (one-time setup) should be strategically placed at various locations throughout the system. Control dampers with automated actuators should be installed to allow the oxidizer to purge and idle. Bypass dampers allow the process to purge to atmosphere as necessary. If an AC drive is not used for volume control, a damper with an automated actuator would also be used for volumetric control. If it is an outdoor installation, electric actuators are preferred even though they can be more costly.

Supply and control voltage requirements.

The oxidizer's fan motors will operate at a different voltage than the control circuits. The equipment manufacturer should install a transformer to alter the control voltage inside the control cabinet. This will eliminate the need and additional cost of separate power supply wiring in the oxidizer cabinet.

Method of operation start-up/operator interface.

Look for a start-up procedure that is fully automated and requires minimal operator interface. A start-up procedure of pushing no more than one or two buttons can be easily achieved. The control panel should also be designed in a way that the operator can understand what's happening with the oxidizer with just a glance. Electrical troubleshooting can be made easier if the unit utilizes a programmable controller and a message display panel.

Temperature recorder.

A continuous temperature recorder to document the combustion chamber temperature (at a minimum) should be an integral part of the control panel. Additional points may be recorded if desired. Many recorder types are available, but look for a design that offers a 30-day chart or a paperless model, as this makes record keeping easier.

Number of pieces for site assembly.

Depending on the flow rate and destruction efficiency required, RTOs can generally ship in 1 to 4 major pieces. Small units (<20,000 SCFM) with no valve switch purge containment chamber can be completely manufactured in the factory, tested, and shipped to the job site in one major piece. This has some advantages as the manufacturing quality can be controlled better in the plant. It also minimizes site installation time and costs. Large units (>20,000 SCFM) or units with a valve switch purge containment chamber will ship in multiple pieces

Installation time.

Review the vendor's projected schedule for installation and try to plan your production schedule accordingly. A typical regenerative thermal oxidizer installation should take no more than two to four weeks depending upon the size of the job

Operator/maintenance manuals.

Ask for at least two sets of operator and maintenance manuals, then keep one set in a safe place. You should also receive two full sets of drawings and one set of cut sheets from all major components. The manuals should be shipped before or with the oxidizer so they are available for installation, start-up and training.



Start-up and training included.

It is important that a customer utilizes factory trained service technicians to start-up the equipment and to provide operator training. Make sure the vendors include the costs of start-up service in your proposal. Typically, if an oxidizer start-up takes more than five to seven days, the service technician is troubleshooting factory problems that may not be specific to your project

Spare parts package.

A limited spare parts package should be purchased with the equipment. Some parts should be considered consumables and others should be stocked for emergency situations. Have the vendors include spare parts with their proposal.

Cost of freight.

The vendor can include the cost of all freight to the job site. This should include all shipments including the equipment, ductwork and spare parts that may be shipped separately.

Cost of turnkey installation.

If you are seeking a full turnkey installation, ask the vendors to offer a firm turnkey price for the entire project. Special efforts will be required on your part to understand the offering and to be sure that all aspects of the job have actually been included. If you receive a firm turnkey price, hold the vendor to it.

F.I.D. testing at start-up.

Qualified vendors can include the cost of performing an F.I.D. destruction test at the time of start-up. The test will provide immediate results so the customer knows that the vendor met the VOC destruction requirements before the installation is even considered complete.

Check references.

Ask for vendor references and call the contacts listed. Ask about problems that may have occurred at the job site. Installing an oxidizer can be a complicated project and problems can sometimes surface. You can often judge a vendor on how they solved these problems and how they reacted to different situations as they arose.

It can be difficult to make a fair comparison between one RTO manufacturer's proposal and another's. However, if a company intends to purchase a regenerative thermal oxidizer that will provide many years of trouble-free service, one should have a thorough understanding of each major component and its function.