



WHITE PAPER

Reduced Energy Costs, Increased VOC Destruction Efficiency Among Benefits Of Retrofitting Older Oxidizer Systems

In light of today's more stringent air pollution control regulations, a variety of companies that emit harmful emissions into the atmosphere are faced with either installing new air pollution control equipment or updating their current equipment with more modern, efficient systems or face the possibility of stiff non-compliance fines.

To help balance the need for profitability with the need to meet current EPA guidelines, many companies with an oxidizer system more than 8 to 10 years old are looking into retrofitting as a way to achieve significant energy savings and improved VOC destruction efficiency.

Higher Thermal Efficiencies Help Reduce Rising Energy Costs

Today's modern air pollution control systems not only exceed all USEPA, state and local regulations by destroying in excess of 99+% of a facilities air pollutants, but they are also extremely energy efficient. Modern regenerative thermal oxidizers can provide up to 97% thermal efficiency while recuperative thermal or recuperative catalytic units typically provide up to 70%.

Historically, air pollution control systems had been designed using integrated air-to-air heat exchanger units with thermal efficiencies ranging from 40% to 70%. Therefore these older units were only able to capture and reuse 40% to 70% of the heat required to thoroughly destroy the volatile organic compounds (VOCs) and/or hazardous air pollutants (HAPs) found in process air streams. To meet EPA pollutant destruction requirements, catalytic oxidizers typically operate at 650°F, while thermal oxidizers operate at temperatures ranging from 1,400°F to 1,800°F. Depending upon the air pollution control system design, exhaust stack temperatures can vary between 250°F and 1,500°F.



As energy costs increase, the importance of operating an energy efficient system becomes even greater. While achieving higher thermal efficiency by design has been possible for many years, it was typically considered to be cost prohibitive as a capital purchase. However, advances in pollution control technologies have made highly energy efficient systems more practical and a financial payback analysis now clearly favors a change.

For example, an RTO originally designed with random packed media for heat recover can be retrofitted to use high efficiency, modern structured media. Since structured media requires less system pressure drop, this saves tremendous fan horsepower and substantially reduces electrical costs. Upgrading media can also increase thermal heat recovery, providing additional savings in natural gas.

High efficiency natural gas-fired burners with high turndown rates and temperature distribution can further reduce fuel costs. A system using a volume control damper can be refitted with a variable frequency drive for more economical air-flow. The use of premium, high-efficiency electric motors can also yield substantial savings, especially for a 24/7 operation. Using A.C. variable frequency drives provides a company with both operational flexibility and lower electrical consumption.

Regenerative Thermal Oxidizer Reduces Natural Gas Costs By Over 50%

For companies that have replaced older air pollution control systems with new, energy efficient technology, the results have more than justified the initial investment. For example, to handle a steadily increasing business volume, an experienced heat set and cold web commercial printer in the Midwest added two new printing lines.

However, expanding their pressroom also meant using more printing ink in the presses and adding to the amount of VOC laden exhaust emissions that had to be controlled. The company's existing catalytic oxidizer originally installed on the roof of the building many years ago was in no shape to handle the increased emissions. In addition, there was mounting concern over additional maintenance requirements and the rising cost of natural gas.



After a thorough review of the technology options available to them, the company decided to install a regenerative thermal oxidizer. Since its installation, the unit has been tested at destroying over 99% of the VOC emissions generated from the company's printing operations. More importantly, the modern, energy efficient design of the RTO has reduced the company's monthly gas consumption by over 50% - despite the addition of two printing lines.

Secondary Add-On Systems Utilize Exhaust Heat To Reduce Energy Costs

If an even greater level of efficiency is desired, secondary add-on energy saving systems can be retrofitted into an existing system. Secondary recovery systems use the heat energy that the oxidizer would normally exhaust directly into the atmosphere. The easiest way to capture heat from the exhaust stack is with an air-to-air heat exchanger. The heat exchanger can be designed for minimal pressure drop so as not to affect the operation of the oxidizer while returning temperature controlled fresh air for a variety of uses. This heated fresh air can be used for building comfort heating, process make-up air (ovens/dryers, kilns, curing zones, etc), or in some cases, can completely replace the need for natural gas fired burners in the manufacturing process itself.

Using the same idea of capturing heat from the exhaust stream, a hot water or thermal oil heat transfer coil can be installed in the oxidizer exhaust stack. Hot water can again be used for building comfort heating or can be returned to the process for use (air preheat, condensation control, etc.) This coil could also be used as a preheat section to preheat cool water for a steam generator. Thermal oil is used as a main process heat source where direct flame heating is not desired. Adding a coil in the exhaust stream can reduce or even remove the heat load required from the thermal oil heating system.

Depending on the stack temperature, the exhaust from the oxidizer could be routed directly to a low-pressure steam generator. If the plant uses steam for any reason (carbon bed regeneration, humidity control, etc.), this system could supplement steam production capacity anytime the oxidizer is running. In an ideal situation, the steam produced from the oxidizer exhaust would allow the main steam generator to function as a back-up system.



Retrofitting Regenerative Thermal Oxidizers Into Regenerative Catalytic Oxidizers

Another retrofitting technology option combines the advantages of catalytic oxidation with the high efficiency of regenerative heat transfer. Development of inexpensive and long-living catalysts for VOC oxidation make it possible to combine the lower temperature of catalytic oxidation with the high thermal efficiency of regenerative heat exchange in a regenerative catalytic oxidizer (RCO).

Retrofitting a regenerative thermal oxidizer into a regenerative catalytic oxidizer involves placing a bed of catalyst on top of the existing ceramic media in each RTO canister or removing a portion of the ceramic packing and then adding catalyst. The catalyst beds then serve as additional regenerative heat exchangers that accelerate VOC oxidation and improve thermal efficiency. Adding the catalyst does not increase the system pressure drop since the lower operating temperature of 650 to 750 degrees Fahrenheit reduces the actual air-flow velocity through the RCO. Depending upon user requirements, the lower operating temperature can provide the retrofitted unit with an increased overall capacity and/or allow it to operate using less energy.

Successful retrofitting of an RTO to an RCO requires both careful catalyst selection and in-depth process design. Catalyst selection should be based on factors such as thermal stability and tolerance to poisoning and masking. Base metal catalysts that are extruded, not wash-coated, contain more active centers than noble metal catalysts containing platinum and typically offer better resistance to poisoning or masking. Process design should take into account concerns such as reaction kinetics, heat, mass and momentum transport that help to identify the optimum catalyst bed parameters and process conditions.

In summary, as the cost of energy continues to rise, companies should consider all available options to help reduce the energy costs associated with operating their air pollution control systems. Retrofitting a secondary recovery system to an older air pollution control unit or adding a bed of catalyst on top of the existing ceramic media in a regenerative thermal oxidizer can generate significant energy savings. Replacing an older system with one of today's high efficiency systems now offers a short-term payback on a company's capital investment. Either a retrofit or an upgrade to a new system could provide substantial operating savings and have a positive impact on a company's bottom line.