

## COMPLIANCE YOU CAN COUNT ON

### Case Study: Recuperative Thermal Oxidizer

A large midstream natural gas processing facility was in urgent need of a VOC abatement device for their newly expanded gas processing plant. The operator was expanding their operations at an unusually fast pace. In the process of bringing on new gas treating capacity, they found themselves up against the limits of their current operating permit. Any new sources would put them over their limits as defined under EPA guidelines: 40 CFR, Part 63, Subpart HH – National Emission Standards for Hazardous Air Pollutants from Oil and Natural Gas Production Facilities.



The process included treatment of four separate amine trains. The exhausts from each were combined together and ducted to one QUADRANT SR-6,000 Thermal Oxidizer. From the amine re-boiler, the vent gases were piped into a knock-out vessel where excess water and liquids are removed. The resultant gas was piped to an inlet manifold located at the QUADRANT SR-6,000 Thermal Oxidizer skid. The manifold and control dampers were constructed of stainless steel and incorporated a hot air recirculation system designed to raise the inlet temperature high enough to prevent the gas from condensing and forming additional liquids and more importantly, add the necessary amount of oxygen to allow the vent gas to sufficiently oxidize and destroy the pollutants.

After the vent gas has been heated with sufficient air (and oxygen) the gas is moved through the QUADRANT SR-6,000 Thermal Oxidizer by use of a main booster fan. The booster fan pushes the gas through the shell and tube heat exchanger. One of the primary differences that the QUADRANT SR-6,000 Thermal Oxidizer offers any user is our unique FLOATING TUBE Shell and Tube Heat Exchanger. This system is unlike anything in the industry and is custom designed to provide high thermal efficiency and long life. Unlike most shell and tube heat exchangers used in industry, the FLOATING TUBE System does not use any expansion joints. The result is long life without worry to expansion joint failure. The FLOATING TUBE Heat Exchanger raised the vent gas temperature to over 1,100 F before the gas was directed to the combustion chamber.

Once the gas has been pre-heated, it is directed into the combustion chamber where a natural gas burner adds additional energy to raise the gas temperature to 1,400 F. Efficient oxidation has to consider the three T's: Time, temperature, and turbulence. In order to meet the high destruction efficiencies necessary in modern processing facilities, all three of these primary design considerations have to be maximized. The unique design of the QUADRANT Series Thermal Oxidizer meets this challenge by incorporating a unique combustion chamber specially designed to provide even temperature uniformity, turbulent mixing of the vent gas, and a specially designed residence chamber. All three T's are specifically engineered for maximum performance.

Once the vent gas has been heated to 1,400 F and directed into the combustion chamber, the VOCs contained in the gas are oxidized. (Volatile Organic Compound or hydrocarbons are compounds that contain hydrogen and carbon and which are regulated by the EPA).

The process of oxidation can be summarized by the following reaction:



This process is exothermic, meaning heat is given off. The amount of heat is proportional to the amount of VOC. Therefore, the more VOC contained in the vent gas, the more heat is given off in the reaction. The more heat from the reaction means less auxiliary natural gas is demanded by the burner. As the VOC concentration rises, the amount of natural gas fuel needed is reduced. This is the basis for very efficient operation of the oxidizer with very low amounts of natural gas.

The vent gas is now cleaned of VOCs and other pollutants. The hot gas is directed over the FLOATING TUBE heat exchanger, where the heat is transferred to the incoming gas, and the exhaust gas is cooled prior to release to atmosphere. A portion of this hot gas is recirculated and mixed with fresh air for use in the first step of the process.

The QUADRANT SR-6,000 Thermal Oxidizer provides +99.9 percent VOC removal, very low CO and NOx emissions, and low natural gas cost. Emissions are reduced to well below applicable EPA standards.

The system is supplied from Catalytic Products International (CPI) as a fully assembled package. The unit is assembled, wired, piped, and tested in the factory. This is an important construction feature for midstream operators as their plants are located in very remote areas of the country. The installation plan is simple, unload from the trailer, assemble on the concrete pad, plug in electricity and natural gas, and turn on. Plug-and-Play is a feature that affords quick installation, commissioning, and operations.



The materials of construction are a very important design element. The system has to be designed with materials resistant to corrosion, heat, and thermal cycling. Appropriate grades of stainless steel are used throughout the design and consider corrosion and high temperature operation. The vessels are internally insulated with ceramic lining system that helps to keep shell temperature low. And the interface between the vessel shells and ceramic lining is coated to help prevent corrosion. This combination of material selections affords long term operation with the highest uptime reliability.

CPI was asked to supply this system in record time. As noted above, the operator was faced with new process equipment coming on line and no air equipment on site to satisfy EPA air permit needs. CPI worked with the operator to deliver the QUADRANT SR-6,000 Thermal Oxidizer in eight weeks. This is twice as fast as a normal project usually requires. CPI also worked with the customer to assist a expediting the site needs for the installation.

The project team at CPI helped source and supply various valves and piping auxiliaries necessary to complete the installation. When the equipment arrived on site, CPI project managers were there to assist the rigging crew with fast assembly of the system and proper re-termination of all the instrumentation. Since the system is fully assembled in the CPI factory and the system is fully wired, CPI production staff can deliver a system with 100 percent certainty of operation.

Once the process is connected, the electrical supply is plugged into the control panel, and the natural gas is piped to the combustion system, the QUADRANT SR-6,000 Thermal Oxidizer is ready to run.

### Summary

Catalytic Products International delivered, installed, and commissioned a unique Recuperative Thermal Oxidizer system in 10 weeks time. Beating the plants online goals by two weeks and saving the customer more than \$3,000 per week in potential costs for flare rental fees.

When compared to a traditional flare, the QUADRANT SR-6,000 Thermal Oxidizer provides the following benefits:

- A \$269,000 annual natural gas savings (at a gas sales cost of \$6.5/therm)
- Less than two year ROI, when compared to a traditional flare
- Nearly 3,500 tons per year of CO<sub>2</sub>-e reductions
- A 99.9 percent VOC and H<sub>2</sub>S removal efficiency



Catalytic Products International is a 45-year-old supplier of custom built VOC, HAP, CO, NO<sub>x</sub> abatement solutions and efficient energy conservation systems. CPI maintains an engineering staff made up of industry professionals that bring years of experience and valued competencies while offering a full array of service products such as: Engineering audits, layout and integration, startup, preventative maintenance plans, and emergency service. We also manufacture a complete line air pollution control systems that

include specially engineered systems for the natural gas and oil industries including Regenerative Thermal Oxidizers, Vapor Combustors, Flares, and Heat Exchangers.

Whether your application calls for quick response to a challenging application, as in the story with this case study, or longer-term design and integration of more traditional air pollution control equipment, CPI has the proven product line and expert applications staff to assist your needs.

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CATALYTIC PRODUCTS INTERNATIONAL OFFERS THE *RIGHT* ANSWERS

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