VOC compliance with flameless RTO

Dual chamber regenerative thermal oxidizer with 95% thermal efficiency provides reliable, cost-effective abatement

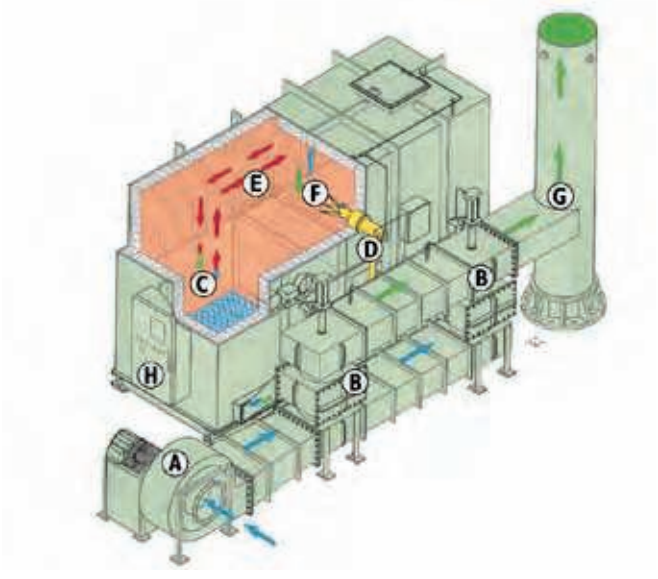
by Brian Cannon-Adwest Technologies, Inc.

A major California ethanol and biofuels recycling facility was faced in early 2005 with air pollution compliance using maximum achievable control technology (MACT) for control of volatile organic compounds (VOCs) from their expanding process fermentation and storage tank venting system. The facility was subjected to both the federal EPAMACT guidelines as well as extremely stringent South Coast Air Quality Management District (SCAQMD) standards for Southern California, which is classified as a severe non-attainment area.

After extensive review of several VOC abatement technologies, the ethanol and biofuels plant narrowed its evaluation to regenerative thermal oxidizer (RTO) technology, which provided the lowest combination of high VOC and hydrocarbon destruction, energy usage, capital cost, and minimal maintenance and component replacement cost.

A dual chamber RTO system was selected due to the extremely low energy input and flameless NOx-FREE (no nitrous oxide byproducts of combustion) operation. The RTO system was ordered in July 2005 and delivered and installed in October 2005, which provided for a rapid and early schedule of compliance with a December 2005 online startup of the RTO. The dual chamber RTO design included virtual shop assembly of all internal components, piping train and controls, which further hastened meeting the expedited compliance start-up schedule.

The dual chamber RTO with poppet valve flow control was selected for its vast simplicity and almost zero maintenance compared to complex rotary and indexing flow control design RTOs, which typically require significant amounts of mainte-



Major RETOX dual chamber RTO oxidizer components: **A.** Forced Draft Fan, **B.** Twin poppet flow control valves, **C.** Heat exchange bed #1, **D.** Burner/piping train, **E.** Combustion chamber, **F.** Heat exchange bed #2, **G.** Exhaust stack, **H.** PLC controls. Courtesy of Adwest Technologies, Inc.

nance time for rotary valve adjustments.

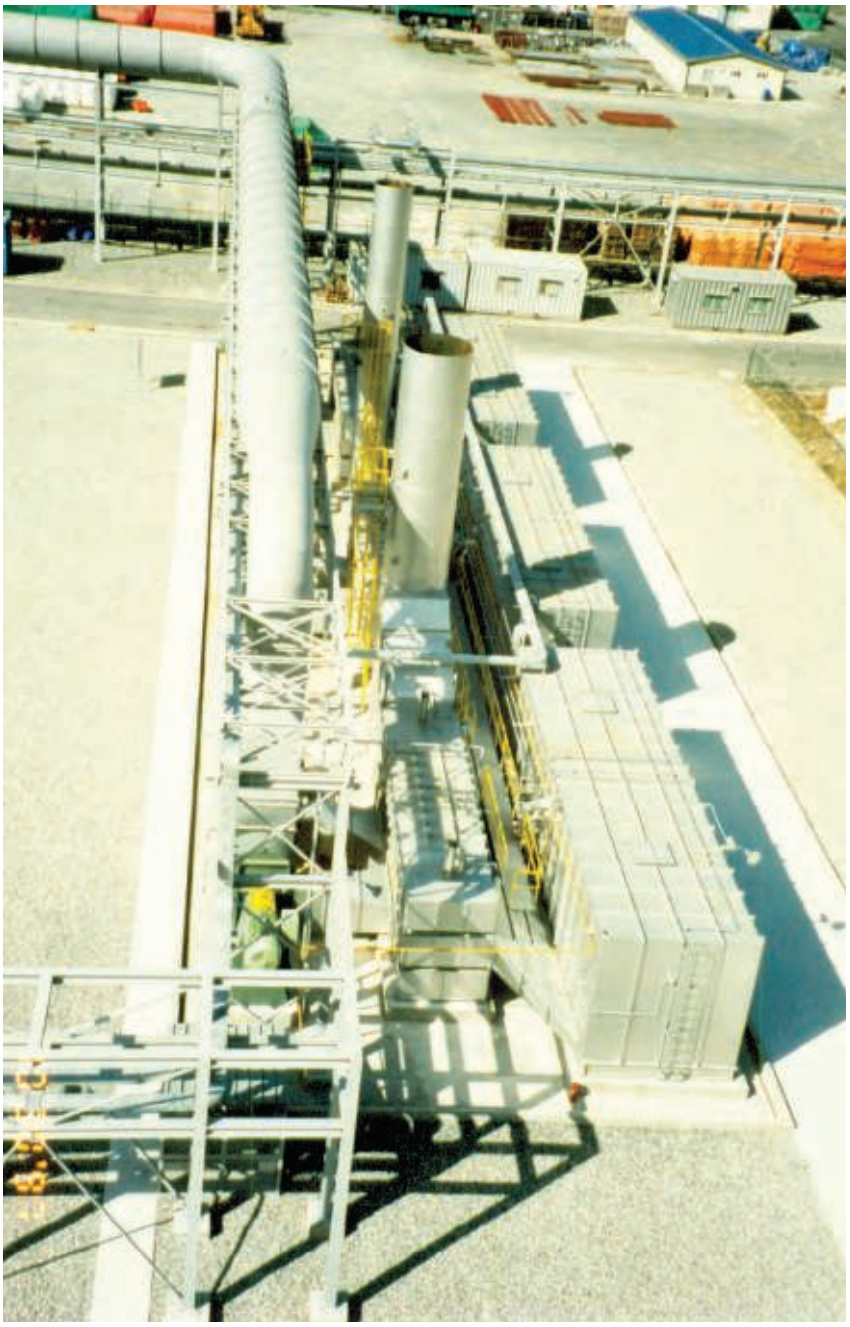
The RTO has experienced 100% run time, with the system achieving greater than 99% VOC destruction without emitting any nitrous oxide (NOx) by-products of combustion since the RTO burner is only utilized for a rapid, one-hour cold startup. After the combustion chamber is heated to 1,500 degrees F oxidation temperature, the combustion process operates fuel free at 3% LEL (lower explosive limits) and greater inlet VOC loadings from the ethanol recycling process.

As illustration 1 shows, the ethanol process VOCs enter the dual chamber RTO through the fan inlet and are ducted to a zero leakage metallic poppet valve flow control system that alternates the inlet VOCs through beds 1 and 2 approximately every 4 to 6 minutes.

The solvent heat of combustion that is liberated in the combustion chamber of the RTO then remains centered in the combustion chamber and stabilizes temperatures throughout each of the two low-pressure drop ceramic heat recovery beds. Each bed utilizes a custom-engineered blend of random packing ceramic media, which provides for an exceptionally low RTO pressure drop at 95% thermal efficiency. This allows for lower main RTO fan motor electric and horsepower usage.

The RTO system operates virtually automatically with a PLC control system that is integrated with the facility data management and process control system. Remote telemetry service diagnostics and/or RTO set points can be changed online 24 hours a day, seven days a week, if needed. Further maintenance flexibility is provided by the unique low-profile RTO design, which allows access to all major components from grade level without the need to have access ladders or stair towers.

The RTO also has an integral offline "bakeout" feature that operates similar to a self-cleaning oven and allows the plant engineering team to burn off and volatilize any organic condensables that may build up in the heat recovery beds. To date, the facility has not needed to utilize this feature and the RTO system has operated at very low pressure drops with no condensable buildup.



3 Module RETOX RTO System for 120,000 scfm Ethanol Chemical Processing

ASSESSING RTO DESIGN

This installation clearly demonstrates that dual chamber RTOs can provide the most reliable and cost- effective VOC abatement technology for ethanol and biofuels air emissions compliance while requiring little or no maintenance. Also, since all RTO thermal oxidizers are not created equal, it is very important to evaluate the following points for each RTO supplier to assure you obtain the most cost-effective RTO design for your specific biofuels application:

For more information, see Page 90.

A dual chamber RTO oxidizer with 95% primary heat recovery.

- RTO energy costs, including natural gas and fan electric horsepower requirements;
- Maintenance requirements and simplicity of each RTO;
- RTO flow control design and replacement cost and time-rotary valves are substantially more complex and costly to replace than poppet valves;
- Installed base & vendor RTO compliance experience: Does your vendor have hundreds of RTOs or are you unit number four or five on your vendor's list?
- How experienced are your RTO vendor's engineering, project management and service personnel? Does your vendor have a deep technical team to assist you or are you dealing with a one-man organization?
- RTO heat recovery media: What are the RTO pressure drop as well as replacement cost and time if you ever have to replace the HX media in the future?
- RTO service: Who services your RTO, a third party or the RTO supplier's own in-house service team? Are remote telemetry diagnostics available?
- Does the RTO utilize flameless no-NOx operation with energy saving natural gas injection (NGI) or are the burner and combustion air blower required to operate all the time, thus using 45% or more natural gas and generating nitrogen oxide products of combustion?

Taking the time to evaluate these key points can help assure that your RTO system has the highest reliability and cost-effectiveness for your specific biofuels and ethanol facility. Each biofuels facility requires a custom solution to air compliance, and dual chamber RTOs can provide the flexibility to meet each facility's VOC control needs in a cost-effective and efficient manner. BB

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CECO Abatement 40,000 scfm RTO for ethanol VOC

RETOX 5,000 scfm RTO for Wine and Brandy Ethanol VOC Control

CECO Abatement 7 and 3 Bed RTO Oxidizers at Midwest Ethanol Plant