

## CASE STUDY

# Proving 99.99%+ EtO Destruction Removal Efficiency for CARULITE 500®

# PICARRO



**Figure 1.** Picarro's EtO CEMS system and Carus' CARULITE® 500 Granules are proven effective solutions for EtO emissions monitoring and abatement.

## CHALLENGE

The EPA's Subpart-O NESHAP for Ethylene Oxide (EtO) in commercial sterilizer facilities mandates up to 99.99% destruction removal efficiency (DRE) for abatement systems handling EtO process streams. For sterilizers, abatement plant manufacturers, and catalyst providers, proving compliance with this level of DRE has historically been difficult because of the sensitivity limits of legacy monitoring technologies. That's why, when Carus wanted to prove the DRE of their catalyst product, they partnered with Picarro.

## THE TECHNOLOGY

Carus, a global leader in advanced catalyst products for industrial air abatement, partnered with Picarro, a pioneer in precision gas analytics and monitoring solutions and services, to evaluate the performance of CARULITE® 500. This catalyst converts EtO into water (H<sub>2</sub>O) and carbon dioxide (CO<sub>2</sub>) at 150°C without toxic byproducts, making it an ideal solution for stringent emissions control. Key advantages of CARULITE® 500 include:

- Low-temperature destruction of ethylene oxide
- Long catalyst lifetime
- Cost-effective solution

Leveraging its advanced technology and extensive expertise in EtO monitoring and regulatory compliance, Picarro was able to provide Carus with the data they needed to prove CARULITE® 500 exceeds the EPA's 99.99% DRE requirement. Picarro's comprehensive EtO management solutions provide:

- Exceptionally robust, interference-free EtO monitoring systems
- Expert guidance that keeps pace with the changing regulatory environment
- Trusted, actionable data that ensures compliance and enhances operational efficiency

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With Picarro, we were able to measure destruction efficiencies to levels we didn't believe were originally possible.

It's been giving us a new set of data that we can bring to our customers and to the industry to help prove that the destruction efficiency requirements of the NESHAP can be met by existing technology that's already in the market.



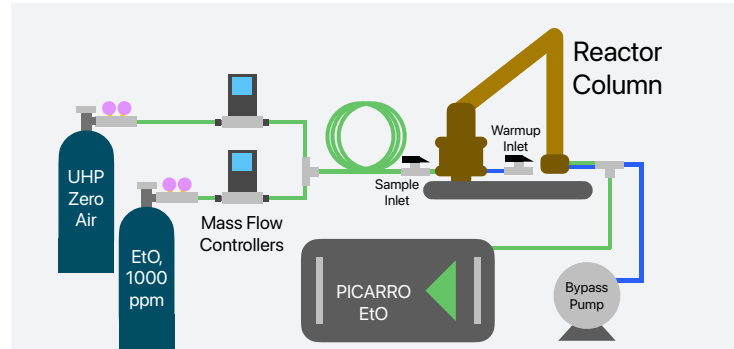
**Matthew Bodoff**

Business Development Director, Carus

## THE EXPERIMENT

Performed in a lab setting, the experiment ran EtO through Carus’s reactor column testing apparatus and to the Picarro system. The reactor column testing apparatus was designed to simulate real-world catalytic oxidizer systems. The test included:

- A reactor column heated to the recommended 150°C temperature required to remove EtO
- Blended EtO inlet concentrations ranging from 100 to 1,000 ppm
- A tracer method using CH<sub>4</sub>, H<sub>2</sub>O, and CO<sub>2</sub> to confirm flow of the process gas to the analyzer and ensure data reliability



**Figure 2.** Experimental test apparatus design, using Carus test reactor column, and Picarro EtO Analyzer measuring the column effluent to verify the destruction efficiency of the CARULITE® 500 catalyst, showing variously the warmup and sample pathways.

## THE RESULTS

The Picarro system showed that the CARULITE® 500 surpassed expectations, achieving:

- An average destruction efficiency of 99.99988%, exceeding the stringent “four nines” threshold
- Outlet EtO concentrations as low as 0.2 ppb, significantly below regulatory limits
- Stoichiometric conversion consistency for EtO into CO<sub>2</sub> and H<sub>2</sub>O, validating the process chemistry, and 100% retention of CH<sub>4</sub> tracer gas, validating process integrity

|         | Inlet EtO (ppm) | Outlet EtO (ppb) | DRE Obs (%) | DRE (%) 0.25 ppb LDL |
|---------|-----------------|------------------|-------------|----------------------|
| Step 1  | 0*              | 0**              | n/a         | n/a                  |
| Step 2  | 98.4*           | 0.02             | 99.99998    | 99.99975             |
| Step 3  | 196.8*          | 0.08             | 99.99996    | 99.99987             |
| Step 4  | 492*            | 0.25             | 99.99995    | 99.99995             |
| Step 5  | 980.4*          | 0.29             | 99.99997    | 99.99997             |
| Avg. DE | --              | --               | 99.999965   | 99.99988             |

**Table 1.** Inlet (ppm) and outlet (ppb) concentrations for the testing apparatus, with both the observed/implied destruction removal efficiency, and the destruction removal efficiency using the lower detection limit of the Picarro analyzer.

\*Inferred from MFC blending and known tank value  
 \*\*By Definition, as this is used to characterize the zero

The combination of Carus's catalyst and Picarro's CRDS technology demonstrated unparalleled reliability, even under high-inlet EtO concentrations and fluctuating test conditions.

## THE IMPACT

Carus's CARULITE® 500, validated by Picarro's precision analytics, provides abatement system manufacturers an incredibly solid core around which to build compliant systems. This collaboration offers sterilization operators a proven pathway to meeting and exceeding compliance standards and confidence in achieving emissions control goals efficiently while ensuring operational reliability.

## CONCLUSION

Carus and Picarro's partnership highlights the critical role of cutting-edge materials and measurement technologies in meeting stringent regulatory demands. Together, they provide key tools and expertise necessary for reliable, scalable, compliant EtO emissions management

## COMPANY PROFILES



Headquartered in Illinois, Carus is a leading provider of innovative chemical and catalyst solutions, supporting industries in meeting air quality and environmental regulations for over a century.

## PICARRO

Based in California, Picarro specializes in regulatory expertise, world-class service and support, and advanced EtO monitoring systems that deliver trusted data. This unique suite of EtO emissions management services and solutions allows sterilization facility operators to focus on their business while Picarro focuses on meeting, exceeding, and maintaining EtO emissions compliance.

## LEARN MORE

For more information on this experiment, download the detailed white paper: [Carus and Picarro: Proving Remarkable Catalyst EtO Removal with Cutting-Edge Measurement.](#)

## CONTACT US

Learn how Picarro and Carus can support your compliance goals. Contact Picarro for a consultation and explore tailored solutions for your facility at [eto@picarro.com](mailto:eto@picarro.com). Contact Carus for more information on their advanced catalyst products for industrial air abatement at [orders@carusllc.com](mailto:orders@carusllc.com).