

RNG WORKS



TECHNICAL WORKSHOP & TRADE EXPO

SEPTEMBER 12-14, 2023

MUSIC CITY CENTER, NASHVILLE, TN

Emission Abatement Technologies & Techniques for Renewable Natural Gas Processing

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Anguil Environmental Systems, Inc.



Agenda:

Abatement Technology Overview
RNG Industry Applicability
New Techniques and Technology Considerations

ANGUIL
Environmental Solutions for
Cleaner Air & Water



Products/Services:

- Air Solutions
- Water Solutions
- Energy Recovery Solutions

Capabilities:

- Engineering
- Equipment
- Aftermarket Services



1978

FOUNDED BY GENE
ANGUIL



Milwaukee, WI

CORPORATE
HEADQUARTERS



>\$100 Mil

ANNUAL GLOBAL REVENUE



200+

PRIVATE EMPLOYEES



5

GLOBAL LOCATIONS



2300+

INSTALLATIONS
WORLDWIDE

The Role of Emission Abatement Technologies in RNG:

- Monetize Waste Streams
- Further Reduce Carbon Footprint
- Regulatory Compliance
- Clean Energy Requirements
- Create Economic Development



What is oxidation?



Three “T”s: Time, Temperature & Turbulence



Technology Selection Criteria

Properly characterize, identify & measure process conditions.

Less CFM \Rightarrow Smaller Oxidizer \Rightarrow Lower Operation Costs



CONTAMINANTS



CONCENTRATIONS



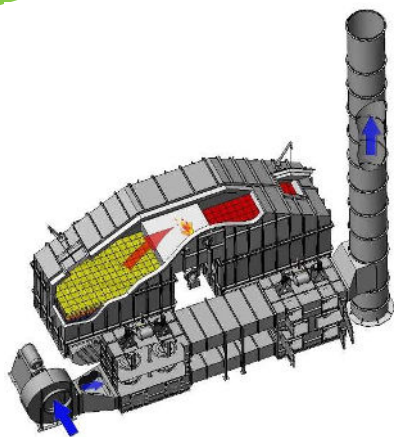
TEMPERATURE



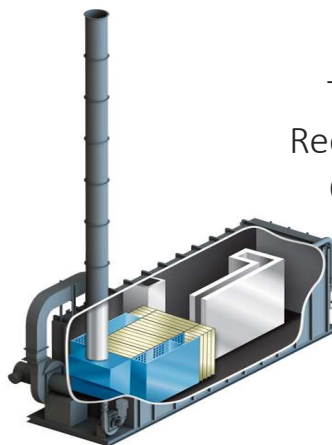
AIRFLOW



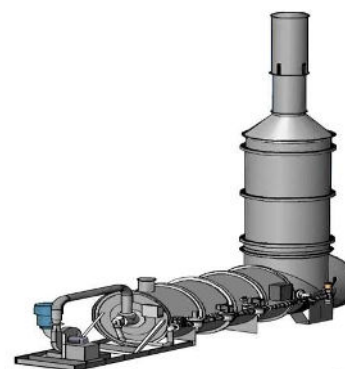
Thermal Abatement Technology Overview



Regenerative
Thermal Oxidizer
(RTO)



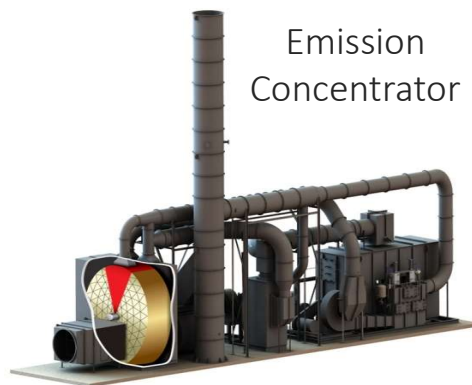
Thermal
Recuperative
Oxidizer



Direct-Fired
Thermal Oxidizer
(DFTO)



Catalytic
Recuperative
Oxidizer

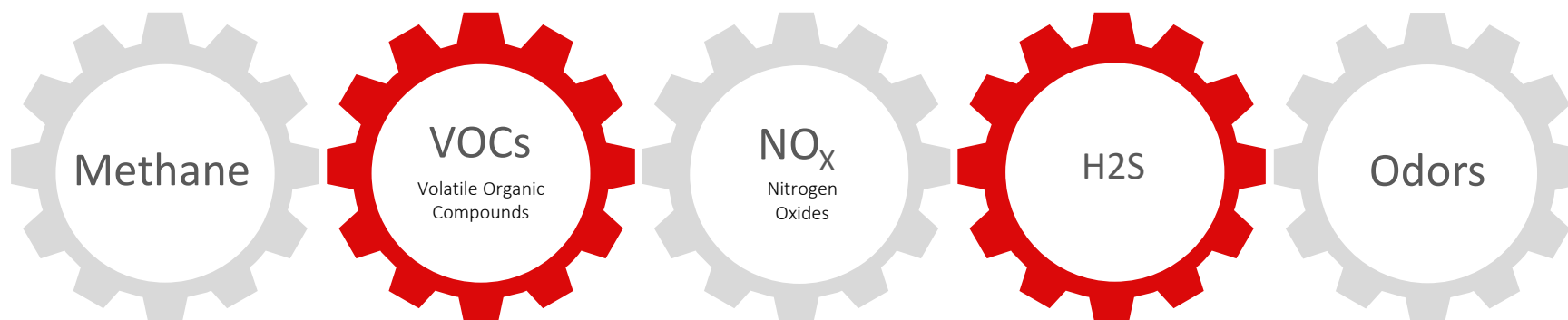


Emission
Concentrator



Vapor
Combustor /
Flare

Renewable Natural Gas Applications



Application Characteristics

- Varying Concentrations
- Purification Processes Differ
- Unique Site Requirements

Applicable Technologies

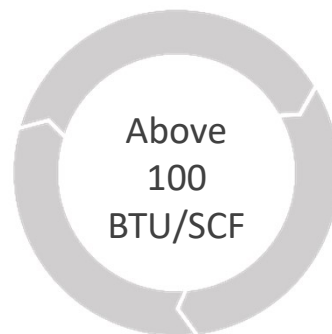
- Vapor Combustors and Flares
- Direct Fired Thermal Oxidizers
- Thermal Recuperative Oxidizers
- Regenerative Thermal Oxidizers

Vapor Combustors and Flare Overview

AIR FLOW & CONCENTRATION RANGE



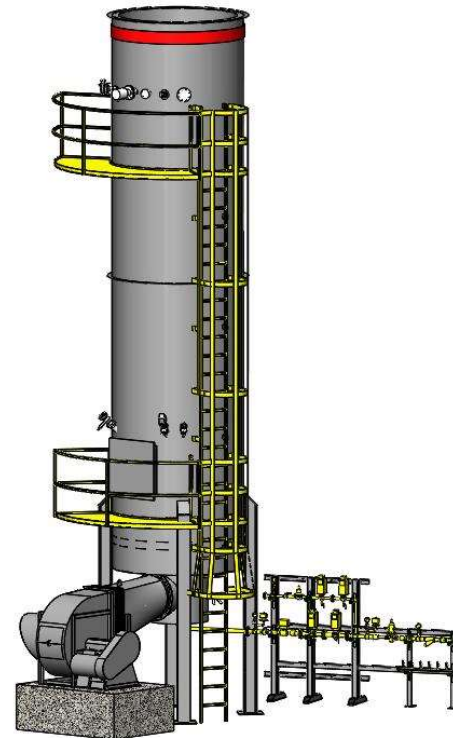
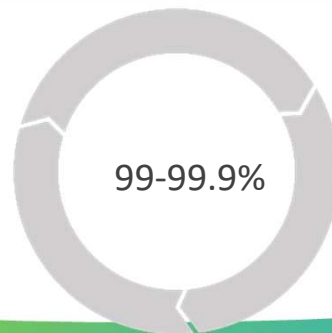
HIGH CONCENTRATIONS



TURNDOWN CAPABILITIES



DESTRUCTION RATE EFFICIENCY (DRE)



Direct-Fired Thermal Oxidizer (DFTO) Overview

AIR FLOW RANGE

100-100,000
SCFM

CONCENTRATION RANGE

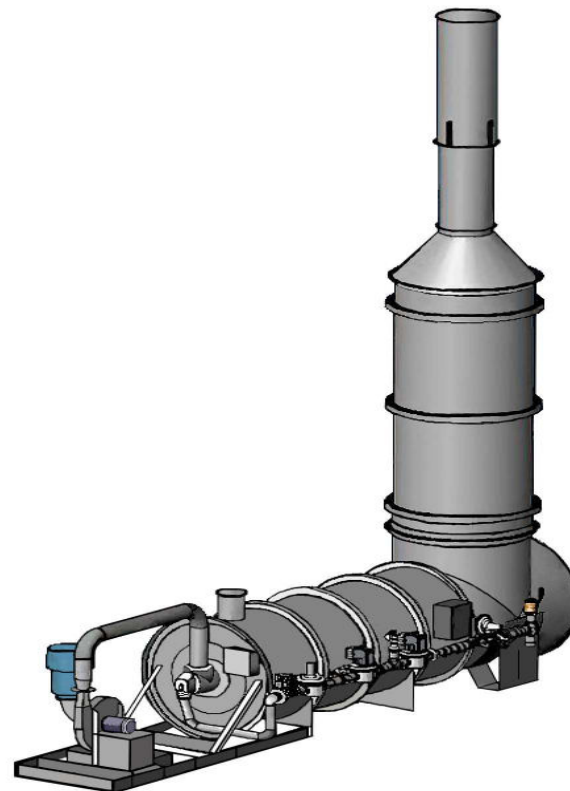
15 – 50%
LEL

THERMAL ENERGY RECOVERY

None
Without
secondary heat
recovery

DESTRUCTION RATE EFFICIENCY (DRE)

99.9%+

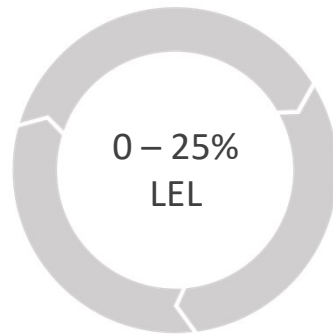


Thermal Recuperative Oxidizer Overview

AIR FLOW RANGE



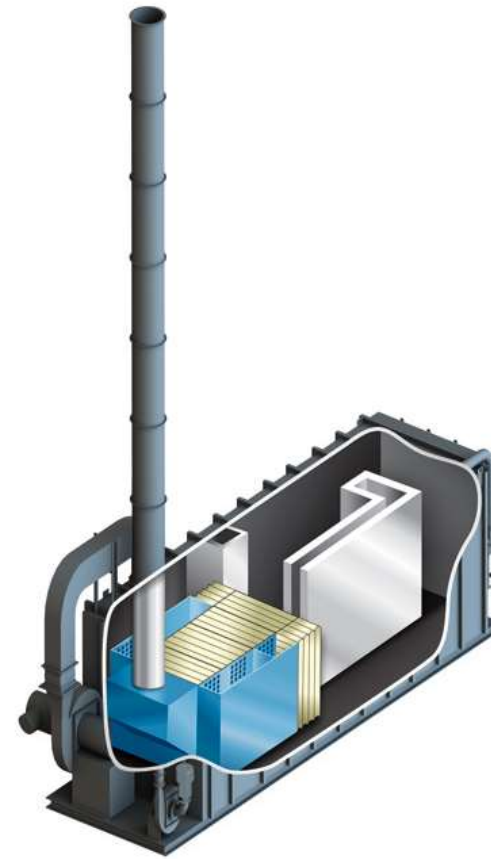
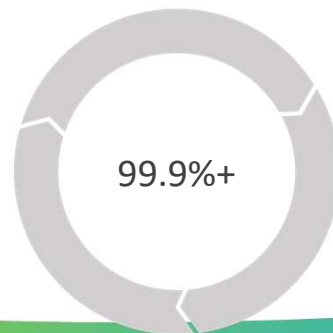
CONCENTRATION RANGE



THERMAL ENERGY RECOVERY



DESTRUCTION RATE EFFICIENCY (DRE)



Regenerative Thermal Oxidizer (RTO) Overview

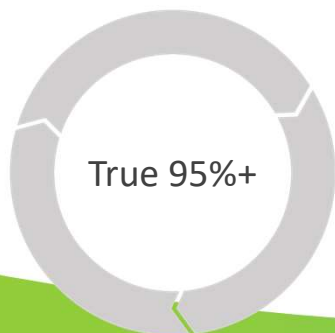
AIR FLOW RANGE



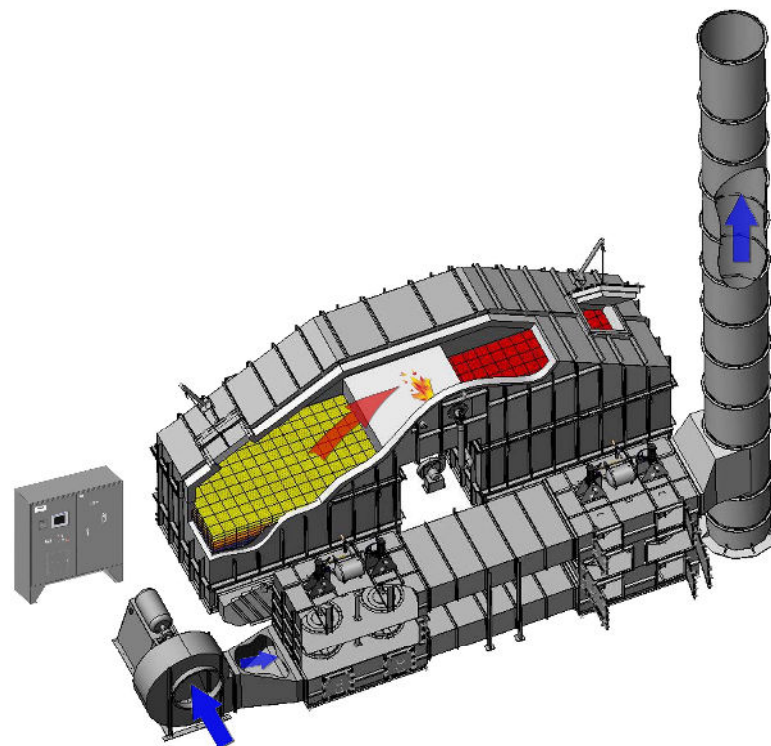
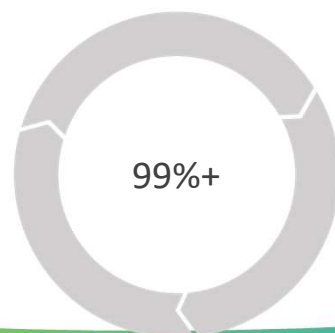
CONCENTRATION RANGE



THERMAL ENERGY RECOVERY



DESTRUCTION RATE EFFICIENCY (DRE)



Acid Gas Scrubber Overview

HALOGENS

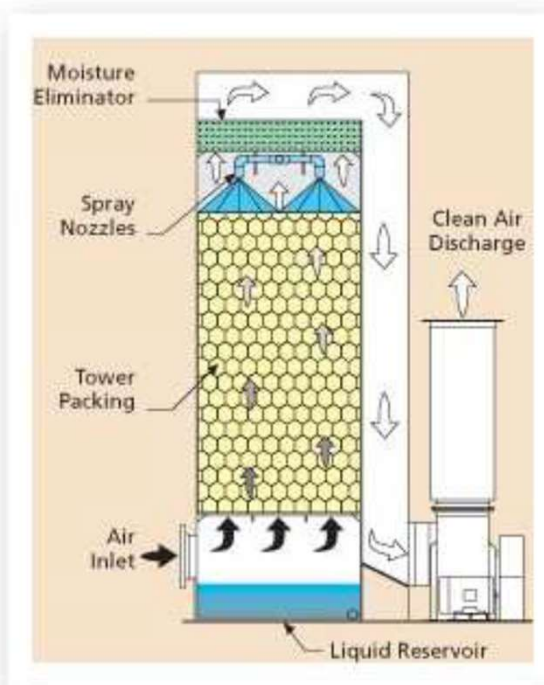
- Chlorine
- Bromine
- Fluorine

ACIDIC STREAMS

- Carbonic acid (formed from carbon dioxide and water vapor)
- Sulfuric acid (oxidation of H₂S and other sulfur containing compounds)
- Acetic acid and other organic acids



Many of these applications contain halogens or acidic compounds



What's on the horizon?

Consider Heat and Energy Recovery

- Air-to-Air Heat Exchangers
- Air-to-Liquid Heat Exchangers
- Heat-to-Power / Cogeneration
- Energy Evaluations

Typical Applications Include

- *Recover exhaust stack heat for use in other processes*
- *Recover exhaust stack heat for other plant and/or process heating applications*
- *Upgrade Heat Efficiency of existing VOC control equipment*



What's on the Horizon?

Alternate Energy Sources for Operation

- Electric, Hydrogen, Syngas, Thermal Storage

Waste Heat Utilization

- Lower Plant Operating Expenses
- Leachate Evaporation

CO₂ Capture & Sequestration

- Lower Carbon Score

Strategies for Operating Cost Reduction

Lowest Cost Of Ownership Strategies



- Know your **estimated and actual operating costs** for gas usage and electrical consumption.
- Pay attention to **percentages**.
- Monitor your **emission loading**. Determine what type of system would be specified today.
- State and federal **grant money**
- Focus on **combustion air**
- Improve **primary heat recovery**
- Consider **secondary heat recovery**
- **Properly maintain** existing systems

Thank You!

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ANGUIL



See Us In
Booth #205

Committed
to Cleaner
Air and
Water

We Don't Walk Away.