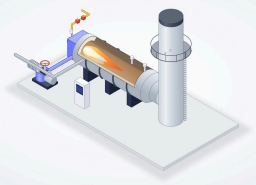
THERMAL OXIDIZERS

Engineering a Safer World

DIRECT FIRED · RECUPERATIVE · REGENERATIVE · LOW NOx ACID GAS & HALOGENATED · SULPHUR TAIL GAS

Volatile organic compounds, hazardous air pollutants, acid gases and reduced sulphur compounds cannot be vented to atmosphere without breaching air quality limits. CRA builds six thermal oxidizer types for that duty, each matched to the waste stream's composition, its flow profile and the emission limit the site has to meet.

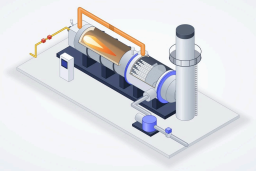
The Direct Fired unit answers fast-changing batch and emergency flows, the Recuperative and Regenerative units recover exhaust heat on continuous duty, the Low NOx unit meets strict NOx limits without a downstream catalyst, the Acid Gas & Halogenated unit handles corrosive chlorine-, fluorine- and bromine-bearing streams, and the Sulphur Tail Gas unit takes Claus and SRU tail gas.



DIRECT FIRED

760 – 1,200°C · no heat recovery

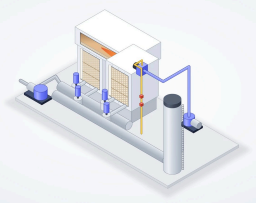
Single combustion chamber, immediate response to flow swings



RECUPERATIVE

Up to 70% heat recovery

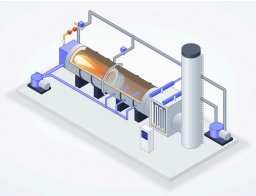
Integrated shell-and-tube or plate exchanger, no media beds



REGENERATIVE

Up to 97% heat recovery

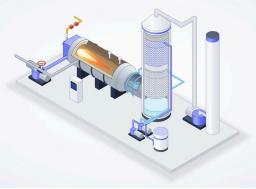
Ceramic media beds on a timed cycle for high-flow continuous duty



LOW NOX

760 – 980°C · no SCR required

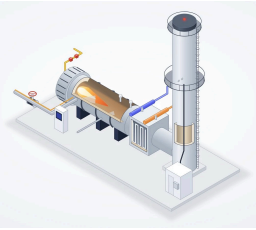
Multi-stage burners with flue gas recirculation



ACID GAS & HALOGENATED

Above 1,000°C · quench and scrubber

Chlorine-, fluorine- and bromine-bearing streams



SULPHUR TAIL GAS

650 – 1,480°C

H2S, COS, CS2 and mercaptans oxidized to SO2

APPLICATIONS + Chemical + Petrochemical + Oil & Gas + Biogas & Landfill + Wastewater + Coatings & Printing

ALSO FROM CRA

Gas Scrubbers
Open Elevated Flares
Enclosed Ground Flares
Incinerators
Flame Arrestors
Gas Line Accessories
Biogas Upgrading
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Digesters
Gas Holders

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SELECTING AN OXIDIZER

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MATCHED TO THE STREAM, THE FLOW PROFILE AND THE EMISSION LIMIT

Oxidizer	Specify it when	Heat recovery	Operating temp.
Direct Fired	The stream is high-VOC or high-heating-value, batch, or swinging in flow, and fast response matters more than fuel recovery	None	760 – 1,200°C
Recuperative	Flow is continuous and moderate, and fuel savings are wanted without media beds or flow-reversal valves	Up to 70%	760 – 870°C
Regenerative	Duty is continuous at large flow volumes and fuel cost dominates the operating life	Up to 97%	Up to 815°C
Low NOx	A strict NOx limit has to be met at source, without a selective catalytic reduction system downstream	Optional	760 – 980°C
Acid Gas & Halogenated	The stream carries chlorine, fluorine, bromine or sulphur, and dioxin and furan formation has to be prevented	Optional	Above 1,000°C
Sulphur Tail Gas	Claus SRU tail gas still carries H2S, COS and CS2, with load swings from upsets and start-ups	Optional	650 – 1,480°C

DESTRUCTION EFFICIENCY

Oxidizer	VOC / HAP destruction
Direct Fired	>99%, special units exceed 99.9%
Recuperative	>99.9%
Regenerative	>99% with 0.8 – 1.0 second minimum residence time
Low NOx	>99.9%, without a post-combustion catalyst
Acid Gas & Halogenated	>99%, reaching 99.99% to 99.9999% on complex halogenated and hazardous emissions
Sulphur Tail Gas	>99.9% across variable process loads

ENQUIRY DATA + Gas composition + Flow rate, Nm^3/hr + VOC loading + Flow profile + Emission limits + Utilities at site

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DIRECT FIRED & LOW NOX

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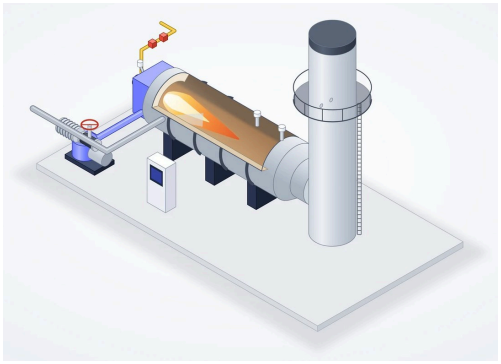
DIRECT FIRED OXIDIZER

Single-chamber combustion · 760 – 1,200°C · >99% destruction

Waste gas streams carrying volatile organic compounds and hazardous air pollutants cannot be vented to atmosphere without breaching air quality limits. Batch operations, emergency vents, and high-VOC streams add a second constraint: whatever destroys the pollutant load has to respond as fast as the process does.

The DFTO burns waste gas directly in a single combustion chamber, supplemented with fuel and air, at temperatures between 760°C and 1,200°C. Residence time is engineered to hold the gas at temperature long enough to reach the required destruction efficiency before it exits the chamber. Carrying no heat exchanger or media bed, the design responds immediately to swings in flow and concentration.



FEATURES

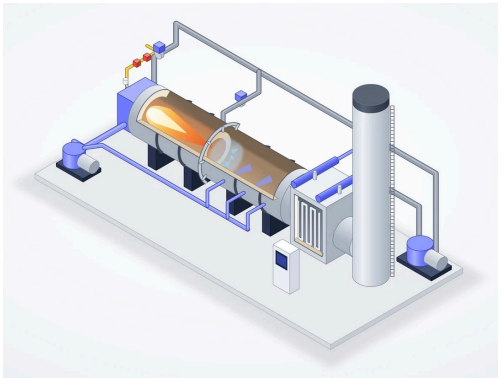
+ Immediate Response To Flow Swings
+ Gas, Liquid And Particulate Streams
+ Combined Multi-Vent Streams
+ Lowest Capital Cost Of The Range
+ No Heat Exchanger Or Media Bed
+ Skid Mounted, ISO 9001 Built

LOW NOX OXIDIZER

Multi-stage burners · flue gas recirculation · 760 – 980°C

Meeting a strict NOx limit with a conventional thermal oxidizer usually means adding a selective catalytic reduction system downstream, bringing catalyst cost, ammonia handling, and another maintenance-intensive component onto the skid.

The LNOx TO combines multi-stage burners with flue gas recirculation and precision controls to limit thermal NOx formation at the source. Fuel and combustion air enter in controlled zones, limiting peak flame temperature, while cooled exhaust recirculates into the combustion zone to lower oxygen partial pressure. Residence time at 760-980°C stays sufficient for complete VOC oxidation, independent of the NOx control strategy.



FEATURES

+ NOx Limited At Source
+ No Ammonia Handling On Skid
+ Meets EPA, EU & Regional Limits
+ No Post-Combustion Catalyst
+ >99.9% VOC/HAP Destruction
+ Precision Combustion Controls

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RECUPERATIVE & REGENERATIVE

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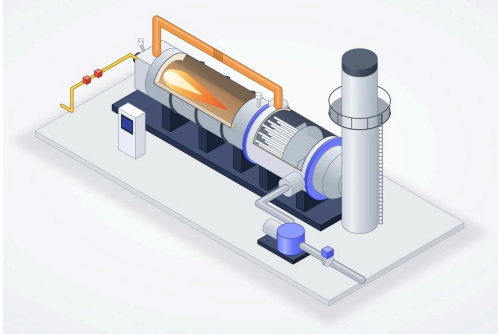
RECUPERATIVE OXIDIZER

Integrated heat exchanger · up to 70% recovery · 760 – 870°C

A direct-fired unit burns through fuel with nothing to show for the exhaust heat, while a regenerative unit recovers that heat but carries the capital cost, footprint, and valve maintenance of a full media-bed system. Continuous, moderate-flow streams need a middle path.

The Recuperative Thermal Oxidizer integrates a shell-and-tube or plate heat exchanger directly into the oxidizer, using hot combustion exhaust to preheat incoming process gas before it reaches the burner. The preheated gas arrives near the chamber's 760-870°C set point, cutting the auxiliary fuel needed to close the remaining gap.



FEATURES

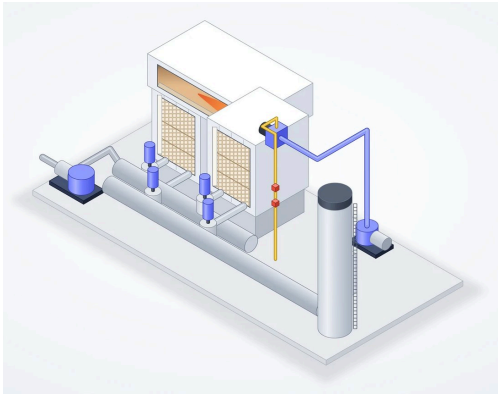
+ Up To 70% Exhaust Heat Recovered
+ >99.9% VOC/HAP Destruction
+ No Media Beds Or Reversal Valves
+ Shell-And-Tube Or Plate Exchanger
+ Compact Skid Versus An RTO
+ Continuous, Moderate-Flow Duty

REGENERATIVE OXIDIZER

Ceramic media beds · up to 97% heat recovery · up to 815°C

Continuous-duty VOC control at large flow volumes turns fuel cost into the dominant line item over an oxidizer's operating life. A technology that discards exhaust heat instead of reusing it compounds that cost year after year.

The RTO runs process gas through two or three ceramic media beds that alternate roles on a timed cycle: one bed preheats incoming gas using heat stored from the previous cycle, while the other captures heat from the outgoing exhaust. The preheated gas combusts in the central chamber at up to 815°C, with a minimum residence time of 0.8 to 1.0 seconds ensuring VOCs and HAPs fully oxidize.



FEATURES

+ Up To 97% Heat Recovery
+ Two Or Three Ceramic Beds
+ 0.8 – 1.0 Second Residence Time
+ Timed Valve Flow Reversal
+ High-Flow Continuous Duty
+ Lowest Fuel Cost Per Nm^3

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ACID GAS & SULPHUR TAIL GAS

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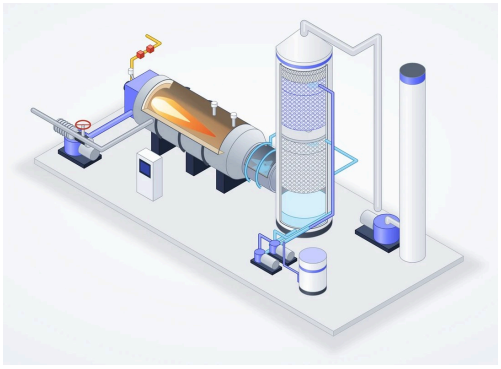
ACID GAS & HALOGENATED

Above 1,000°C · integrated quench · wet scrubber for HCl, HF, SOx

Chlorine-, fluorine-, bromine-, and sulphur-bearing waste streams destroy conventional refractory and duct materials on contact, and combustion itself creates a second hazard: dioxins and furans that can re-form as the flue gas cools through a specific temperature band.

This oxidizer combusts waste gas above 1,000°C, with residence time and turbulence engineered to destroy the regulated halogenated compounds in the stream. Temperature stays above the dioxin formation window throughout combustion and during cooling. Hot flue gas discharges into an integrated quench system, then a wet scrubber downstream removes HCl, HF, and SOx before the gas reaches atmosphere.



FEATURES

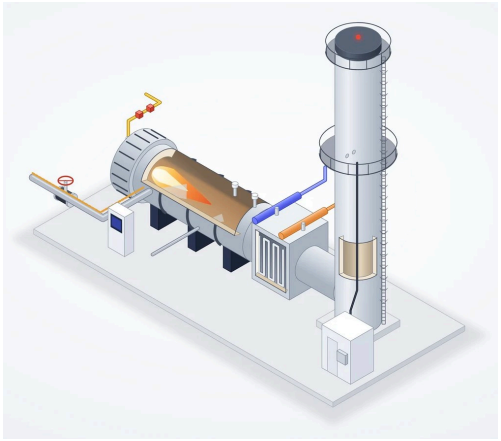
+ Dioxin & Furan Formation Prevented
+ Integrated Quench System
+ Wet Scrubber For HCl, HF & SOx
+ Corrosion-Resistant Materials
+ Up To 99.9999% On Complex Streams
+ Combined Scrubbing & Combustion

SULPHUR TAIL GAS

650 – 1,480°C · Claus and SRU tail gas · >99.9% destruction

Claus tail gas still carries H2S, COS, and CS2 after the SRU's reaction stages have finished extracting elemental sulphur, and none of it can be discharged directly to atmosphere. SRU upsets, start-ups, and shutdowns swing that load further.

The Sulphur Tail Gas Thermal Oxidizer burns tail gas between 650°C and 1,480°C, set according to sulphur load and process design, with residence time engineered to fully oxidize H2S, COS, CS2, and mercaptans into SO2 before the gas exits the chamber. Corrosion-resistant materials and high-integrity refractory linings hold up under the sulphur load.



FEATURES

+ H2S, COS, CS2 & Mercaptans To SO2
+ Stable Through SRU Load Swings
+ High-Integrity Refractory Lining
+ Optional Heat Recovery Stage
+ Pre- Or Post-Combustion Scrubbing
+ Thermal Modelling & Materials R&D

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