www.enbion.com

The clearer, the more azure

New Environmental Technology for Air Pollution Control

The Leader for Air Pollution Control
enbion Inc.

About enbion Inc

enbion Inc

A company that leads the air pollution field of Odor and VOCs treatment through continuous technology development.

Extensive experience and advanced technology

- Biofilter
- Adsorption equipment
- Regenerative catalytic oxidizer (RCO)
- Regenerative thermal oxidizer (RTO)
- Concentrator + oxidation or recovery

Providing total solutions for environmental materials, systems and cost effective operation

History

1990s

- 1999. Established as Hantal Inc.

2000s

- 2000. 03. Awarded with Domestic New Technology KT Mark No. 0863 for bio-treatment technology.
  05. Change the company name to enbion Inc.
- 2002. 03. Established company affiliated research institute and entered the Air Pollution Prevention Facility business.
- 2007. 12. Awarded by the Minister of Environment (No. 18195).
- 2008. 01. Awarded the New Environmental Technology (No. 256).
  08. Acquired Environmental Technology verification.
- 2009. 09. Daejeon Metropolitan City Certificate of Small and Medium Business with Good Prospect.

2010s

- 2010. 01. Company office relocation to Techno Valley, Daejeon City.
  03. Certification of 'New Green Technology'.
- 2012. 12. Daejeon Metropolitan City 'Excellent Employment Company' Certification (No. 2012-4).
  12. Awarded the '5 Million Dollar Export Tower'.
- 2014. 04. Excellent Performance Certification (Biofilter).
- 2015. 10. Launched the new odor removing product 'Supirang' based on eco-friendly adsorbent materials.
- 2018. 11. Innobiz Certification (INNO-BIZ).
- 2019. 10. Certificate of 'Leading Environmental Company'.
  11. Certificate of Venture Business (No. 20190114075).

2020s

- 2020. 09. Commendation from Minister of Environment (No. 39980).
  11. Listed as a Green New Deal Promising Company 100 - Green Innovative Company.
  Acquired ISO Certification - ISO9001:2015 and ISO14001:2015
- 2021. 04. Acquired ISO Safety and Health Certification - ISO45001:2018

enbion Business Areas

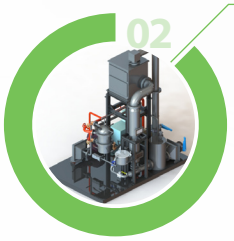
HIECO TECHNOLOGY

Highly
Improved
Eco-friendly Technology

01 VOCs and odor treatment field

- Oxidizer (TO/Thermal oxidation, CO/Catalytic oxidation).
- Regenerative Thermal Oxidizer (RTO).
- Regenerative Catalytic Oxidizer (RCO).
- RTO+SCR hybrid system
- Concentrator (Honeycomb Rotor/ Beads Activated Carbon Technology).
- Biofilter.
- Inorganic powder adsorption system.

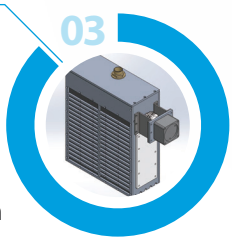
Solvent recovery field 02



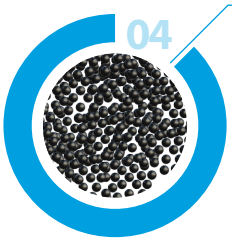
- Zeolite Rotor System.
- Beads Activated Carbon Concentration System.

03 Indoor/work environment field

- Odor removal module for air purifier.
- Small household odor eliminator.
- Harmful gas removal device for multifunctional buildings.
- Device for removal of harmful gases from the work environment.



Environmental and functional materials field 04



- High-performance Beads Activated Carbon.
- Dual Honeycomb Zeolite Rotor.
- Alumina adsorbent.
- Functional odor removing panel/ inorganic odor removing adsorbent.
- Environmental catalyst (VOCs, SCR, odor).

enbion oxidation systems

Oxidation mechanisms

Oxidation is the process where VOCs and odorous compounds are decomposed at high temperatures and harmless gases are released. Main processes: thermal and catalytic oxidation.

Thermal oxidation

$$C_xH_yO_z + O_2 \xrightarrow[(800 \sim 1000^\circ C)]{\text{Thermal Oxidation}} H_2O + CO_2$$

Catalytic oxidation

$$C_xH_yO_z + O_2 \xrightarrow[(300 \sim 350^\circ C)]{\text{Catalytic Oxidation}} H_2O + CO_2$$

Classification of Oxidation System

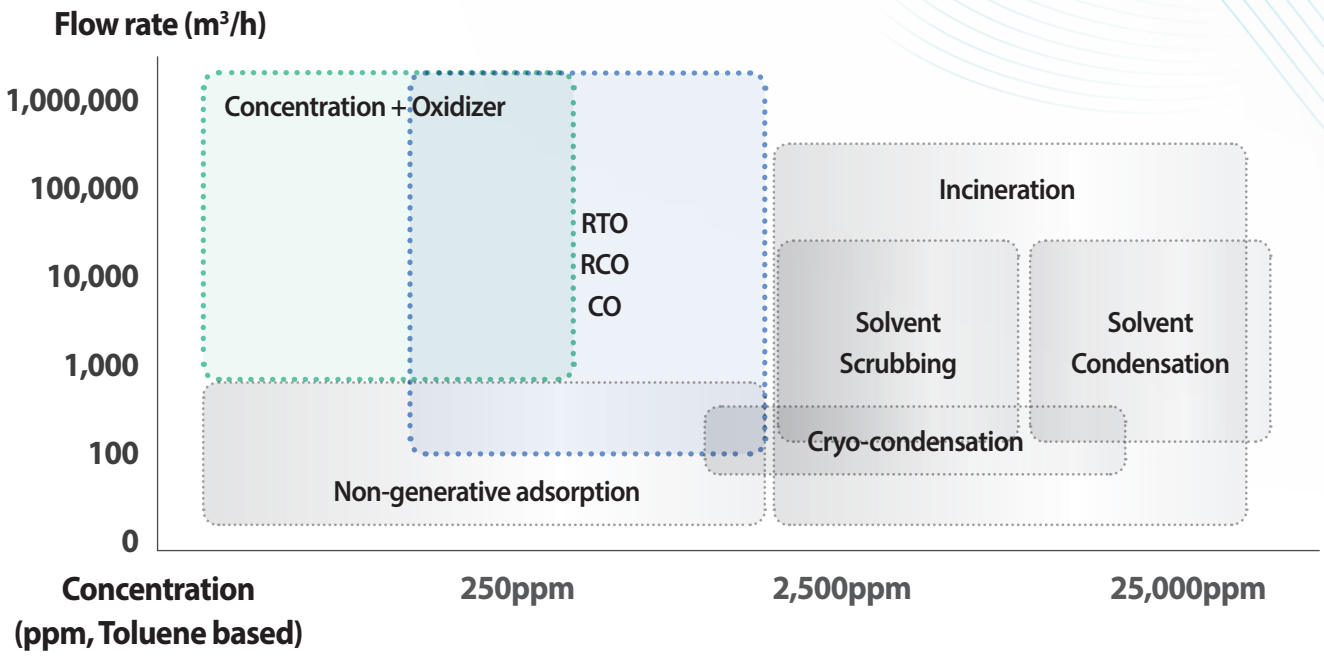
Item	Heat recovery method	Catalyst	Temperature(°C)
Thermal Oxidizer (TO)	Recuperative heat exchanger	×	800~1000
Catalytic Oxidizer (CO)	Recuperative heat exchanger	○	300~350
Regenerative Thermal Oxidizer (RTO)	Regenerative heat exchanger	×	800~1000
Regenerative Catalytic Oxidizer (RCO)	Regenerative heat exchanger	○	300~350

Oxidation System Selection Criteria

Characterization Analysis	Composition and concentration of off-gas. Characteristics of contained organic compounds.
Operating conditions	Operating time, Utilization, load factor, etc.
Utility	Availability of water, electricity, steam, fuel, and structures. Cost of fuel, energy, water etc.
Cost evaluation	Initial investment cost, maintenance cost.
Others	Installation location, explosion-proof specifications. Compatibility with existing facilities

→ **Optimal oxidation equipment**

Oxidation System Application Range

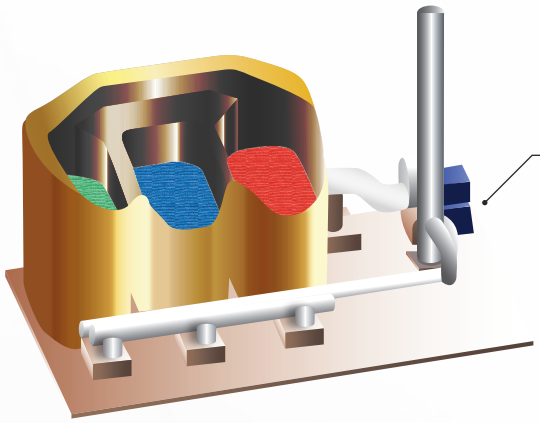


System Field

Regenerative Oxidation Systems (HIECO-RTO/RCO)

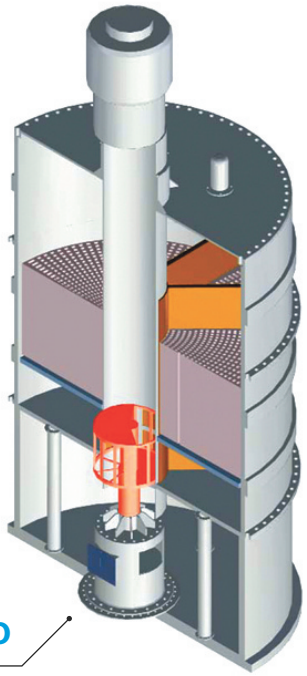
Regenerative oxidation systems Principle

RTO systems are energy-saving equipments that can destroy VOCs and odorous emissions at high temperatures, 800°C or higher, by using ceramic media heat exchangers for heat recovery. RCO systems operate based on similar principle as the RTOs but at lower oxidation temperatures by using the catalyst. Both systems can reach destruction efficiencies up to 98% and heat recovery rates up to 95%. At conditions of high VOCs concentration in waste inlet gas (> 350ppm Toluene or > 1,000ppm THC), these systems can operate in auto-thermal mode (no auxiliary fuel needed).



Bed type RTO

Basically consisting of 2 or more beds filled with ceramic heat exchanger media that can reach high VOCs destruction efficiencies, > 99%. Waste gas stream is diverted alternatively through beds using valves or dampers to increase heat recovery rate.



One-Can Rotary Valve RTO

Compact arrangement of structural ceramic media and small size rotary valve can reduce the pressure fluctuations and reach high VOCs destruction efficiencies >99%. Gas flow direction is seamlessly changed by applying a centrally installed rotary valve.

One-Can Valve RTO

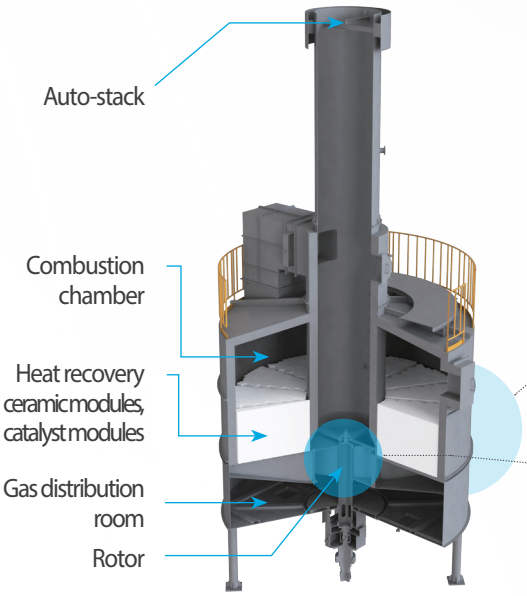
Similar to the rotary type, but instead of one central rotor valve, each of the beds is operated by a single poppet valve. VOCs destruction efficiencies of > 99% can be achieved.

HIECO-RTO/RCO Characteristics

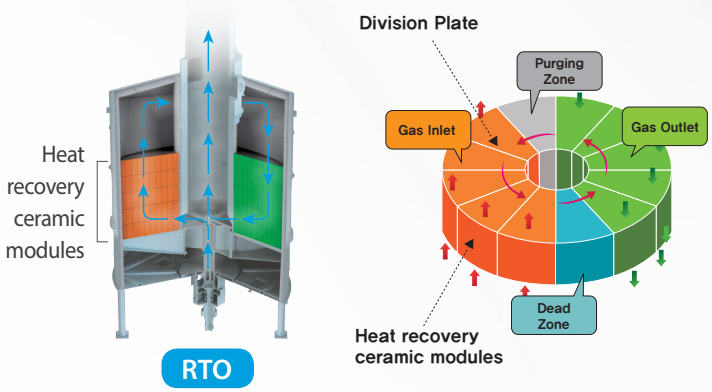
These systems are characterized by compact arrangement and small size rotor which separates the inlet and outlet streams. Improved VOCs destruction efficiency by forming turbulence and increasing waste gas residence time inside the combustion chamber. Maximized destruction efficiency by applying air sealing technology. Small size rotor enables large capacity waste gas processing. Easy to maintain the ceramic heat recovery media and rotor. Compact arrangement with auto-stack.

Regenerative Thermal Oxidizer system patent

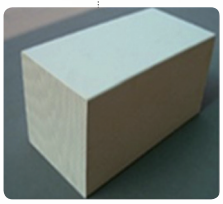
- Korean Patent : No. 10-0704639
- International patent : US 7.762.808.B2, Japan 4149482, China ZL.200380110580, Germany 603.46.598.6

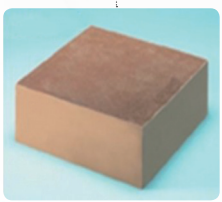


Air Flow Pattern




Rotor


Heat recovery ceramic modules


Ceramic modules

Applications

Industry	Equipment	VOCs and Odors
Automotive and Steel	Paint booth	Toluene, xylene, alcohol, ester
Semiconductors and displays	Cleaning and Cleanroom	Alcohol, ketones, amines
Petrochemicals and Oil Refinery	Production process and storage tank	Aromatic hydrocarbons, organic acids, aldehydes, alcohols
Print	Printer and dryer	Toluene, xylene, alcohol, ester
Chemicals (Chemicals, Pharmaceuticals)	Production process and storage tank	Aromatic hydrocarbons, organic acids, aldehydes, alcohols
Tires and tire cord paper	Refining and vulcanization process	Toluene, xylene, alcohol, ester
Plywood & Furniture	Drying and bonding	Styrene, aldehydes, ester

Flow rate (m^3/min)	200	500	700	1,000	2,000	2,500
RTO Size	Ø3,600 x 7,950H	Ø4,900 x 8,900H	Ø5,600 x 9,300H	Ø6,400 x 9,900H	Ø8,500 x 11,200H	Ø9,000 x 12,000H
Required lot space	5.5m x 9m	6m x 10m	9m x 10m	10m x 15m	13m x 17m	15m x 18m

System Field | Concentration System (HIECO-DRS)

DRS : Dual Rotor System

Concentration System Characteristics

It is an energy-saving system that absorbs odors and VOCs gases with a rotating adsorption material, discharges them into clean air, and desorbs the adsorbed contaminants with a small amount of gas, which is then completely treated with a combustion facility downstream the concentrator.

Advantages of the Concentration System

- Optimum operation in various operating conditions and VOCs.
- Low risk of fire due to flame-retardant material.
- Economical due to low pressure loss and low energy consumption.
- Depending on the inflow waste gas conditions, the VOCs can be concentrated 5 to 20 times of the inflow volume.
- Non-fuel (auto-thermal) operation of downstream oxidizer.

3-Step Waste Gas Treatment Process

1st Adsorption

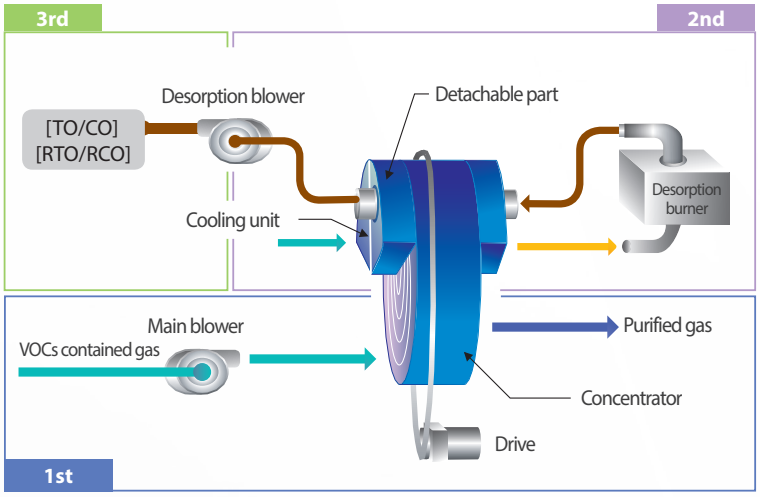
Adsorption treatment of large air volume and low concentration VOCs in the concentrator.

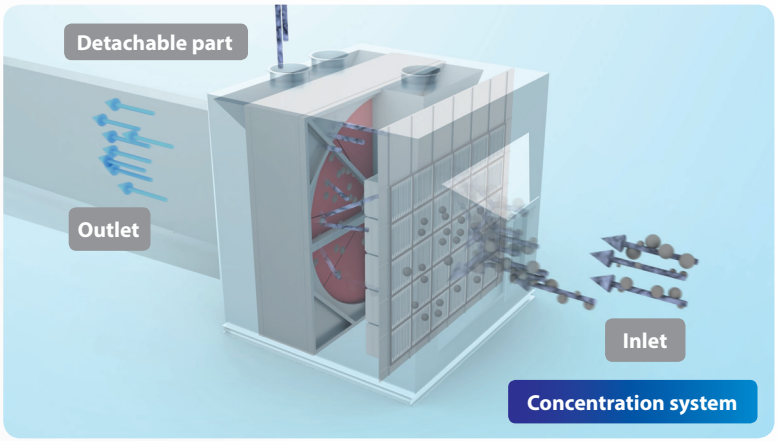
2nd Concentration

Desorption of VOCs with high-temperature low volume gas.

3rd Oxidation

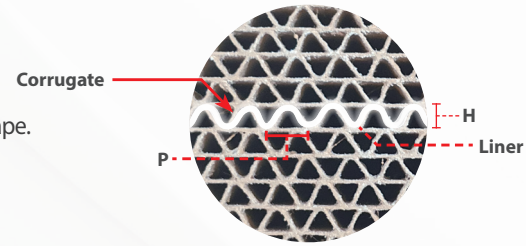
Oxidation treatment of desorbed high-concentration gas.





Concentrator Structure

- Manufactured by impregnating honeycomb sheet with zeolite.
- Formed into honeycomb shape using corrugate shape + liner shape.
- Various types of concentrators can be used according to gas composition and characteristics.

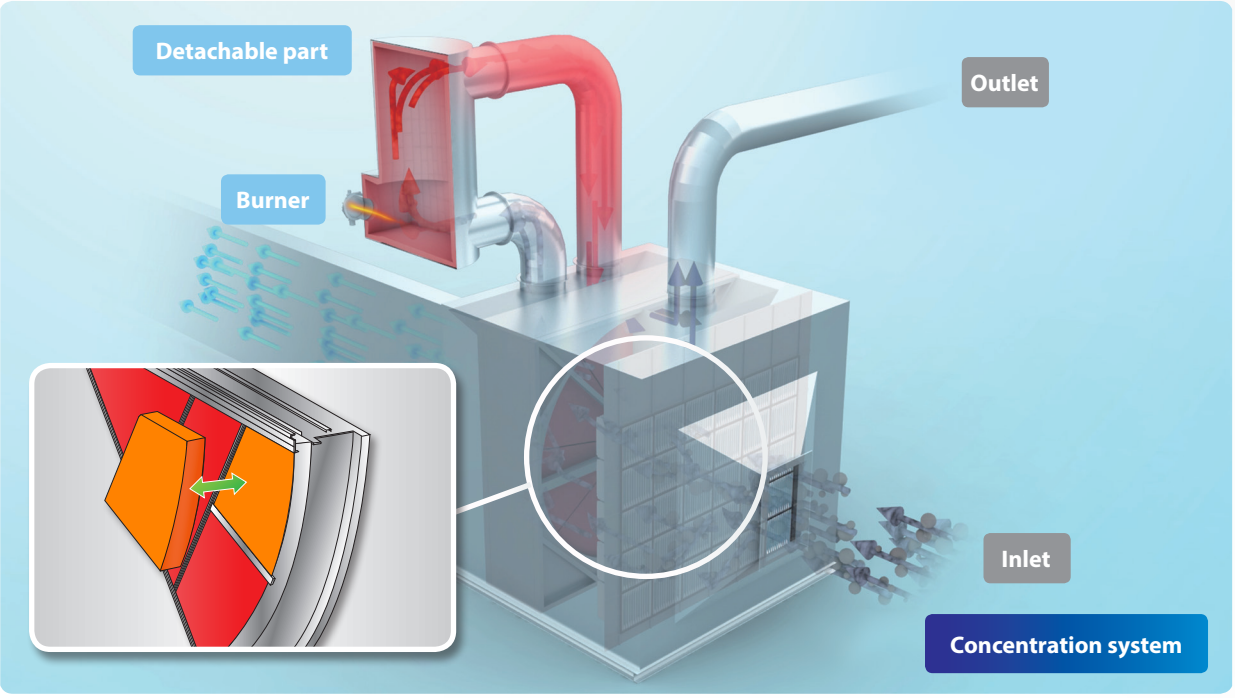


HIECO-DRS Principle

Dual rotor system (DRS) is designed to pre-treat various gas components and by applying cartridge modules it is easy to replace the contaminated parts for optimal concentrator utilization.

Advantages of dual type concentrator

- Suitable for treatment of complex inorganic and organic gases.
- Partial replacement of the concentrator possible.



Applications

Industry	Equipment	VOCs and Odors
Automotive and Steel	Paint booth	Toluene, xylene, alcohol, ester
Semiconductors and displays	Cleaning and Cleanroom	Alcohol, ketones, amines
Shipbuilding and Construction Machinery	Paint booth	Toluene, xylene, alcohol, ester
Print	Printer and dryer	Toluene, xylene, alcohol, ester
Chemicals (Chemicals, Pharmaceuticals)	Production process and storage tank	Aromatic hydrocarbons, organic acids, aldehydes, alcohols
Tires and tire cord paper	Refining and vulcanization process	Toluene, xylene, alcohol, ester
Plywood & Furniture	Drying and bonding	Styrene, aldehydes, ester

Flow rate (m^3/min)	500	750	1000	1300	2000	2300
Concentrator size	Ø1,940	Ø2,450	Ø2,950	Ø3,250	Ø3,950	Ø4,250
Chamber size	2.0mW x 2.2mL x 2.3mH	2.1mW x 2.7mL x 2.8mH	2.1mW x 3.3mL x 3.4mH	2.1mW x 3.6mL x 3.8mH	2.1mW x 4.4mL x 4.6mH	2.1mW x 4.7mL x 4.9mH

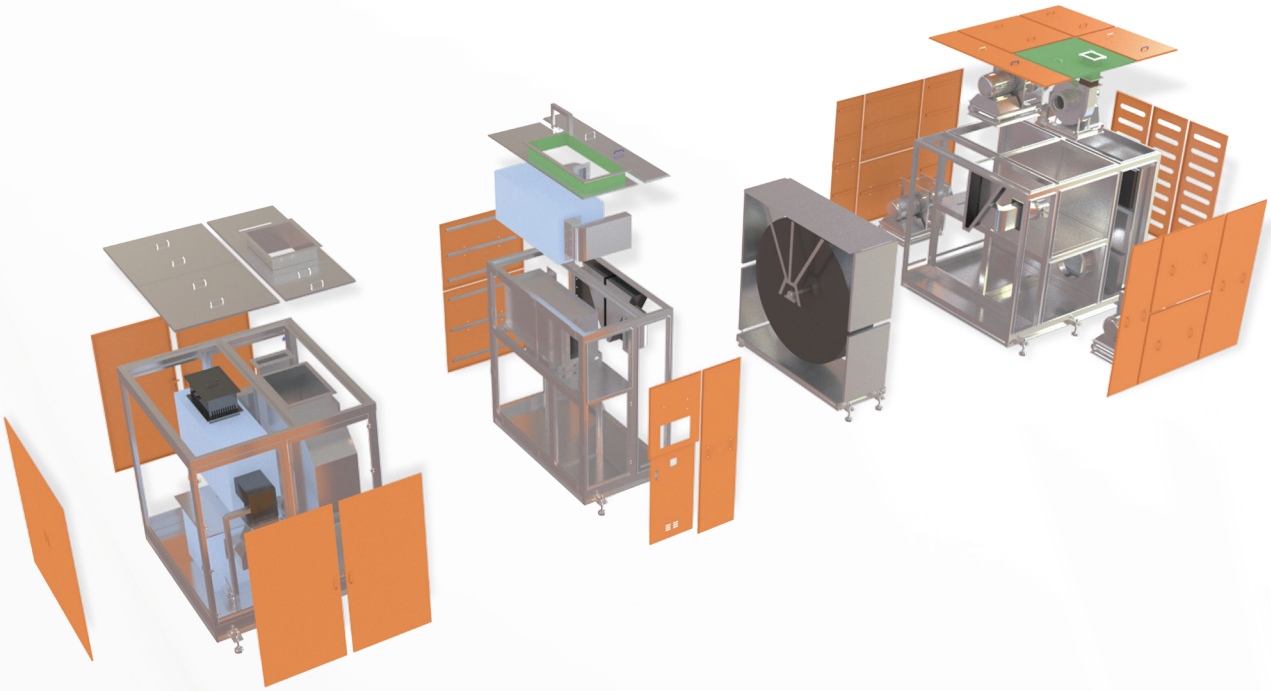
System Field

High Efficiency Hybrid Concentration/ Catalytic Oxidation Package (HIECO-PAC)

PAC : Package

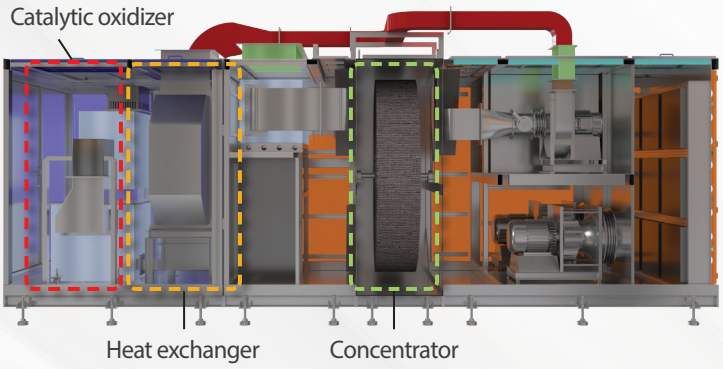
HIECO-PAC Characteristics

Compact design of the system allows easy installation directly on the site. With its small footprint this system is suitable for removal of odor and VOCs from work environment and treatment of complex VOCs compounds under high humidity conditions. Catalytic oxidizer can operate in auto-thermal mode using the concentrated VOCs.

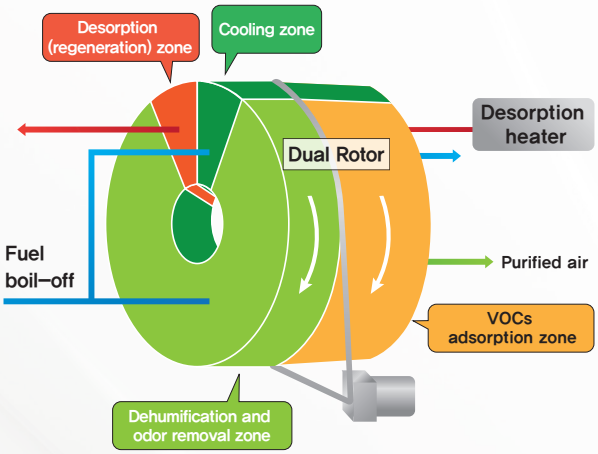


HIECO-PAC Characteristics (Innovative product certification number No. 2020-124)

- Optimal treatment of harmful volatile gases generated on site. VOCs destruction efficiency of >98%.
- Dual rotor concentrator can treat odors and VOCs at high efficiency.
  Protection of the VOCs concentrator by upstream dehumidification of waste gas and odor removal.



<HIECO-PAC system assembly>



Applications and Specifications

- On-site VOCs and odor treatment under high humidity conditions, improvement of indoor/working environment, etc.

System Field

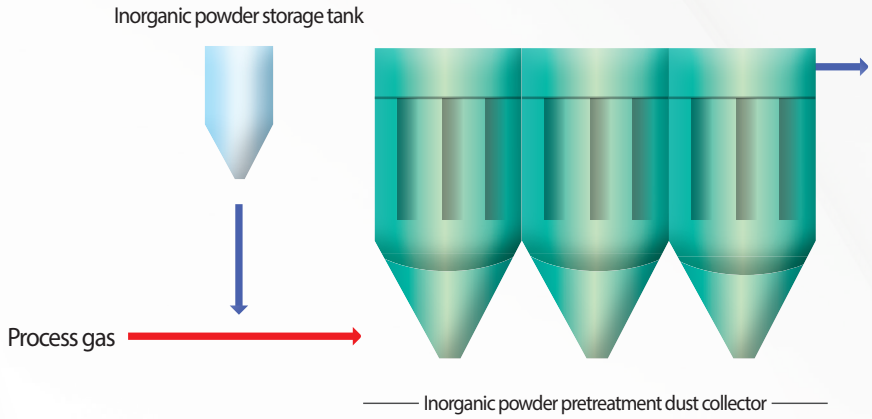
Inorganic powder adsorption system (HIECO-PCF)

PCF : Powder Coated Filter

HIECO-PCF Characteristics

Special dust collector system with inorganic powder coated on the outer surface of the filter bags for treatment of particulate and gaseous pollutants. In particular, this system is beneficial for removal of sticky substances and oil aerosols upstream the oxidation systems. Contaminated powder particles are collected in the hopper and then discharged from the system.

[Configuration of inorganic powder pretreatment dust collector]



HIECO-PCF Applications

- Tire manufacturing process.
- Adhesive Manufacturing Process.
- Battery testing process.
- Plastic manufacturing process.

Product Specification

Air flow rate (CMM)	Body size (mW x mL x mH)	Site area (m x m)	Power (kW)
200	1.7 x 2.5 x 8.8	7 x 4	30
500	2.5 x 5 x 10	9 x 8	60
1,500	2 x 8 x 12	15 x 9	180
2,000	2.5 x 6.5 x 12	16 x 10	235
2,500	6.5 x 9.3 x 12	16 x 13	325

System Field | Biofilter (HIECO-BIO)

BIO : Biofilter

Biofilter System Principle

It is a biological treatment system that decomposes gaseous pollutants such as odors and VOCs into water, carbon dioxide and harmless salts using the metabolic activity of microorganisms immobilized on the carrier.

Malodorous substances

Ammonia, hydrogen sulfide, mercaptans, amines.

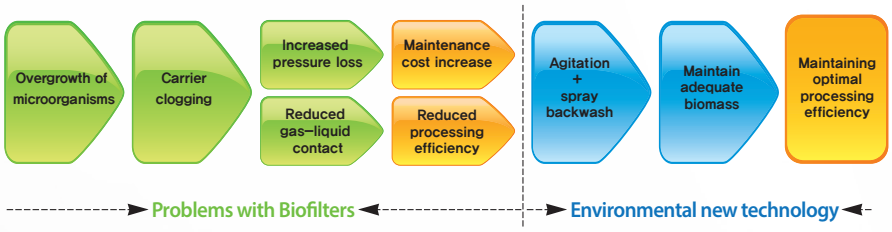
VOCs Substances

ketones, aldehydes, acetones, alcohols etc.

+ O_2

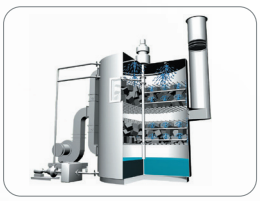
→ H_2O CO_2 Salts

HIECO-BIO Characteristics



Maintaining Optimal Processing Efficiency

New Environmental Technology No. 128, Certificate No. 256



Biofilter Patent

- Manufacturing technology of organic/inorganic composite carrier for odor and VOCs treatment. Korea Good Technology by Ministry of Education, Science and technology, No. 0863
- Method for manufacturing of carrier for biological treatment of odors and VOCs. [Patent No. 0302019]
- Methods for biological treatment of waste gases. [Patent No. 0321197]

System Field

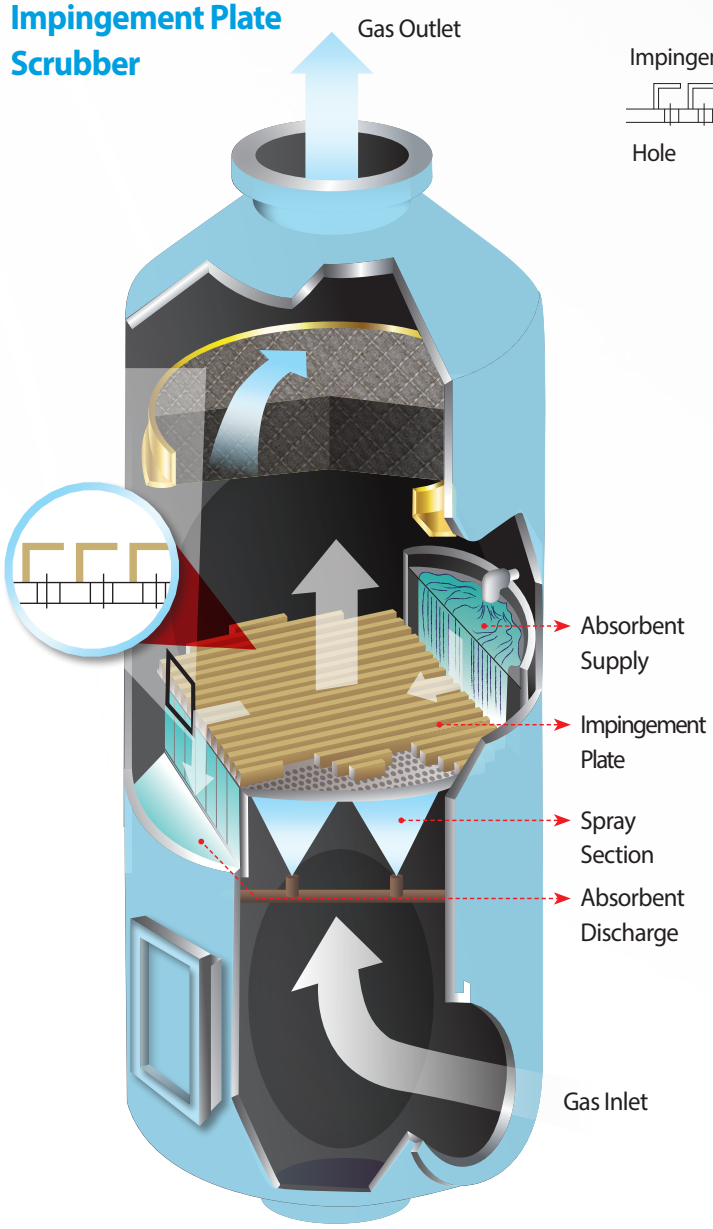
Impingement Plate Scrubber (HIECO-IPS)

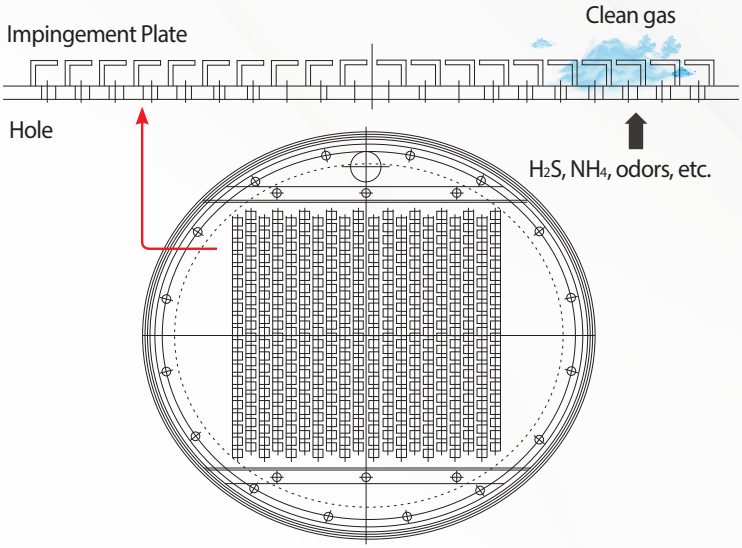
IPS : Impingement Plate Scrubber

HIECO-IPS Principle

Possible to achieve high process gas removal efficiency and dust collection efficiency by absorbing pollutant mixture as the waste stream passes through the impingement plate at high gas velocity.

Impingement Plate Scrubber





- Increased mass transfer due to close contact between gas and liquid.
- Low pressure drop.
- Uniform distribution of gas inside the scrubber.
- Reduction of chemicals and water consumption.
- Suitable for applications with temperature fluctuations
- Removal of gaseous and particulate pollutants simultaneously.
- Easy maintenance of impingement plates.

Applications

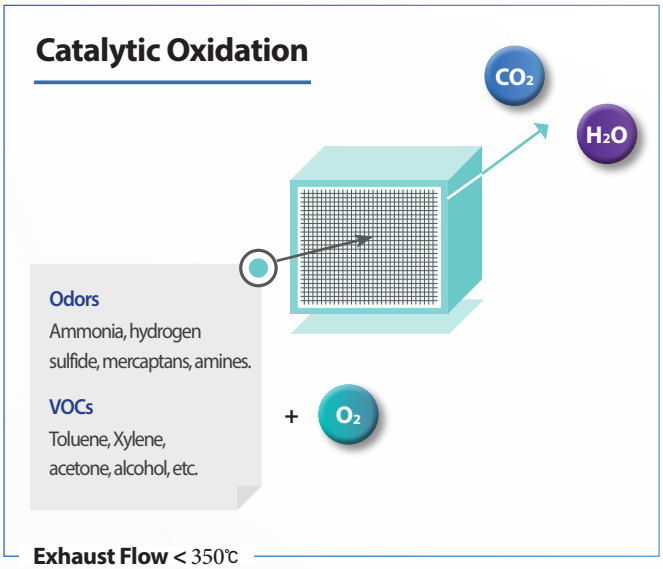
- Sewage treatment plant, sewage sludge treatment process, wastewater treatment plant, feed plant, livestock wastewater and manure treatment plant, composting facility.
- Food waste treatment process, tobacco manufacturing plant, food processing plant.
- Petrochemical manufacturing, refinery waste and treatment facilities, agricultural and fishery wholesale markets and public markets.

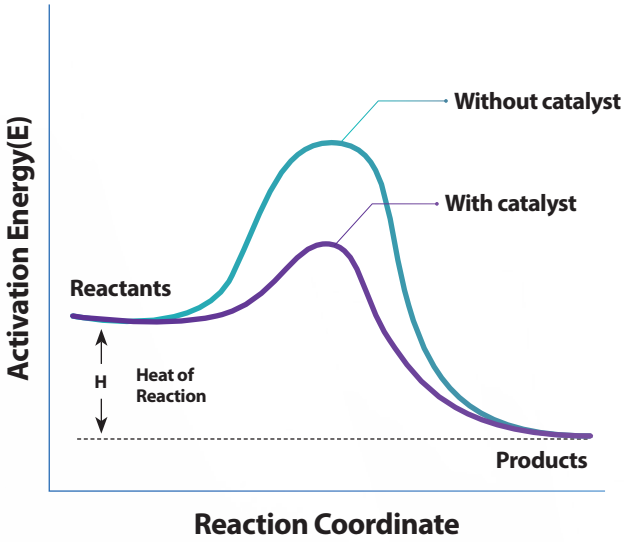
Material Field | High Activity/High Durability Catalyst (HIECO-CAT)

CAT : Catalyst

HIECO-CAT Principle

In the presence of catalyst, oxidation of VOCs and odors can be realized at low temperatures due to lower activation energy.





HIECO-CAT Characteristics

- Low pressure drop and high efficiency of >98% with honeycomb substrate coated with precious metals.
- High throughput at low temperature of 300°C and high catalyst durability even at high temperatures up to 800°C.
- Resistant against sulfur components and organic silicon materials.

System \ VOC	Styrene	Toluene	Acetone	Methanol	Xylene	Phenol	butanol	MEK	MIBK	Acetic acid	Ammonia
Thermal oxidation temperature (°C)	-	552	650	464	343	700	343	516	-	427	651
Catalytic oxidation temperature (°C)	-	160	130	120	150	180	150	145	170	217	210
Complete catalytic oxidation temperature(°C)	280	240	250	150	250	330	250	300	320	300	240

<Oxidation temperature by VOCs>

Applications and Specifications

- Structured catalyst for recuperative/regenerative catalytic oxidizers.
- Standard size : Treatment temperature: 350°C or less, GHSV: 25,000~50,000h^{-1}.

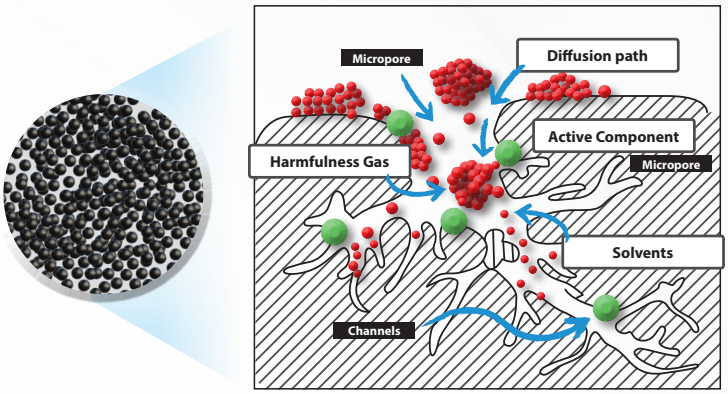
Material Field

High Performance Carbon Adsorbent (HIECO-BAC)

BAC : Bead-shaped Activated Carbon

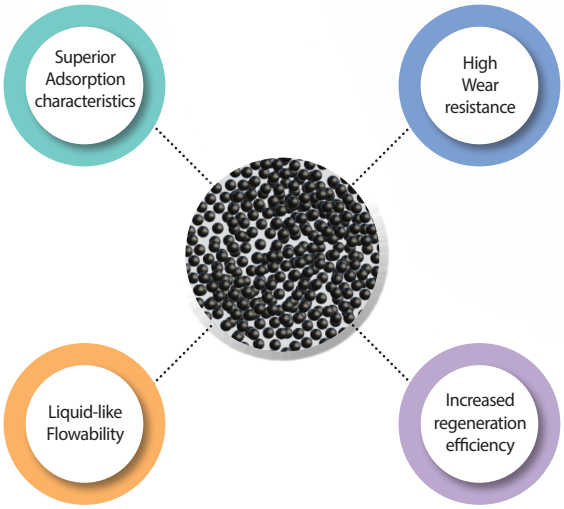
HIECO-BAC Principle

The high-functional carbon adsorbent has very well developed micro-pores, and exhibits excellent adsorption performance for various VOCs and odors.



HIECO-BAC Characteristics

- There is little or no loss during particle friction.
- Excellent adsorption performance with high specific surface area (1,000 to 1,800m²/g).
- Suitable for fluidized bed adsorption systems that require liquid-like behaviour.
- Suitable for continuous adsorption/regeneration and solvent recovery.



Item	Contents
Shape	Spherical (400~600um)
Packing density	More than 0.61g/ml
Specific surface area	1,000 - 1,800m²/g
Strength	99.6kg/mm²
Benzene equilibrium adsorption	0.3g/g-BAC
Wear rate	0.1% or less

<HIECO-BAC Specifications>

Customized Beads Activated Carbon

- Beads Activated Carbon with customer-tailored surface properties.
  - Hydrophobic bead activated carbon: for removing VOCs via adsorption under high humidity conditions.
  - Hydrophilic bead activated carbon: for adsorption and removal of polar substances.
- Beads Activated Carbon for Special Gas Removal
  - S series (H_2S, CH_3SH, DMS, DMDS), N series (NH_3, (CH_3) 3N, NMP) for odor removal and solvent recovery.

The Best Technology

The Best Company

The Leader for Air Pollution Control

enbion Inc.

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