



CS CLEAN
SYSTEMS®

DISCOVER THE ADVANTAGES



Exhaust Gas Treatment Products



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Exhaust Gas Treatment Products

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DISCOVER THE ADVANTAGES

With more than 25 years of experience serving the semiconductor industry, CS CLEAN SYSTEMS® is your reliable partner for exhaust gas abatement, with a primary focus on dry bed absorption. At the core of our technology are our proprietary CLEANSORB granulates, which safely convert toxic, corrosive, and pyrophoric gases to stable solid by-products. In addition to the silicon and compound semiconductor industries, we also serve the rapidly-growing photovoltaic and MEMS sectors. More than 4,000 installations worldwide testify to customer confidence in CS CLEAN SYSTEMS' unique products and services.

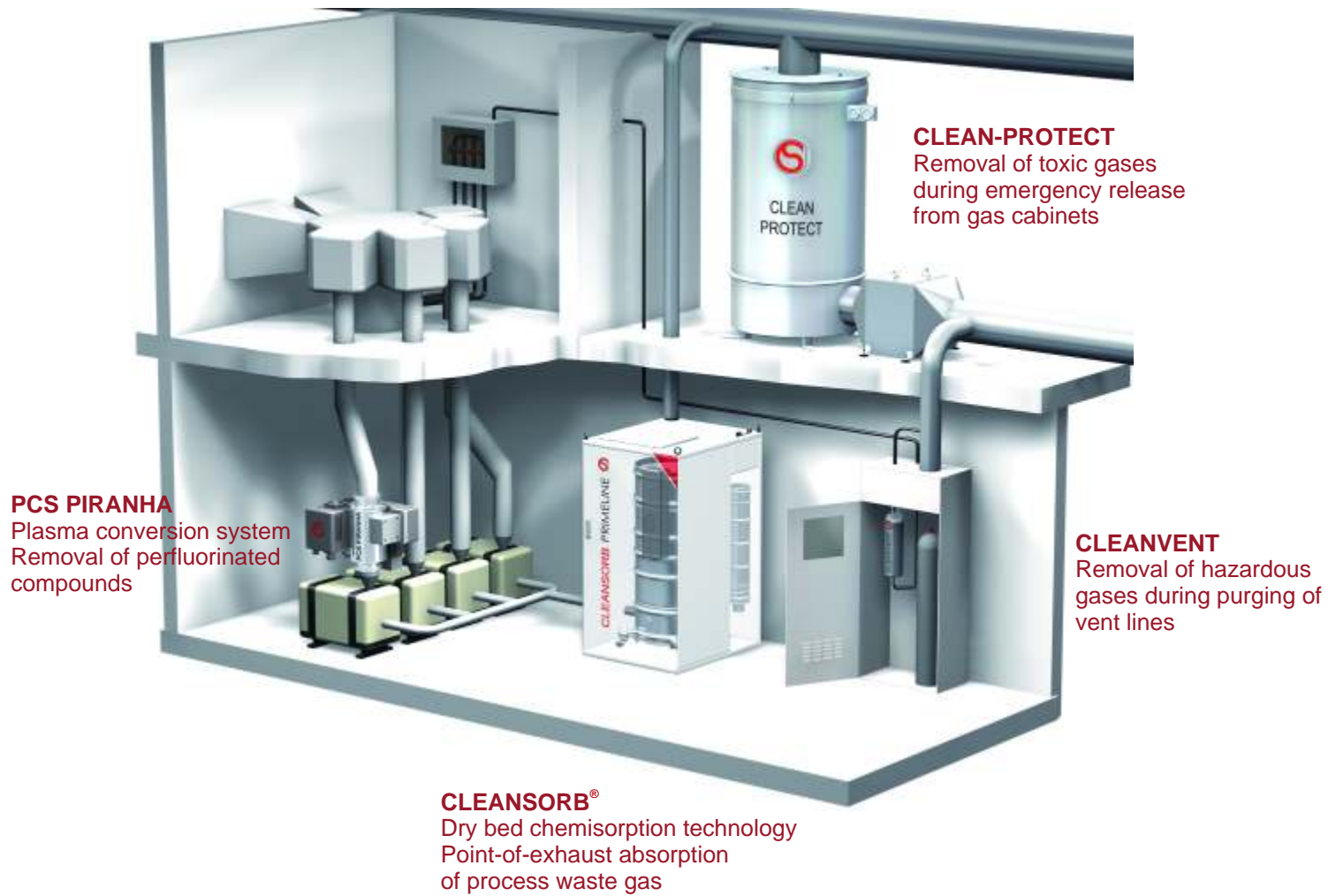
In recent years the reduction of greenhouse gas emissions has become an issue of primary concern for the semiconductor and affiliated industries. Our PCS PIRANHA foreline plasma system enables eco-friendly conversion of stable PFC gases to reactive by-products which are readily removed by dry bed absorption.

CS CLEAN SYSTEMS is a truly global company with research and development, manufacturing and marketing located in dedicated centres of competence located throughout Europe, Japan, USA, and the Far East.





CS CLEAN SYSTEMS® - Product Overview



Worldwide Service



Refill cycle of spent absorber columns

Our team is committed to providing all customers with access to state-of-the-art technology and professional long-term, high-quality after-sales support. Regardless of our customers' requirements, our full support is guaranteed.

Personnel safety and environmental protection are matters of the highest priority. The majority of specialty gases used in wafer processing are pyrophoric, toxic or corrosive. Since residuals of these gases are exhausted from the process tools, fab personnel require absolute assurance of the safe and reliable removal of these waste gases. CLEANSORB point-of-exhaust treatment systems have established a proven track record of unsurpassed safety and reliability at an attractive cost-of-ownership.

CLEANSORB customers enjoy a comprehensive maintenance package comprising a unique take-back and disposal service for the spent absorber material.

Accordingly, fab technicians and engineers need not to concern themselves with the handling of hazardous process by-products, and are thereby relieved of a considerable logistics burden.

Worldwide Refill Service

Our service centers worldwide collect and sort the expended absorber granulates in full accordance with existing local regulations for the legal disposal of industrial wastes. In many cases the reacted absorber materials can be re-processed for other industrial uses. After refurbishment and refilling with fresh CLEANSORB material, the CLEANSORB columns undergo an ISO-compliant quality checkout procedure, including helium leak-test, before they are returned to the customer.

- Process application support
- Start-up support
- Installation support
- Service and maintenance
- Refill services



CLEANSORB® Technology



Application-specific granulates developed in CS CLEAN SYSTEMS' research laboratory

CS CLEAN SYSTEMS is the technology leader in dry bed chemisorption technology with over 25 years experience in semiconductor exhaust gas treatment.

Eco-friendly CLEANSORB technology safely removes hazardous waste gases without consuming energy, water, or fuel. It is the most efficient and environmentally-friendly exhaust gas purification technology available. Hazardous gas species are converted into stable inorganic solids within the dry CLEANSORB bed. The chemical conversion is irreversible, preventing any re-release back into the exhaust line. The conversion process is extremely efficient, largely independent of inlet concentration, and requires only a very short contact time. CS CLEAN SYSTEMS guarantees outlet concentrations which are typically below TLV (Threshold Limit Values) up to the end of the absorber column lifetime.

Increasing levels of device integration and shrinking critical dimensions are paralleled by the introduction of new materials for the deposition of metal-, barrier-, and dielectric layers. Today, many of the source materials used in CVD processes are likely to be in liquid form, and CS CLEAN SYSTEMS has gained extensive experience in removing these precursor chemicals

through its exposure to compound semiconductor applications.

CS CLEAN SYSTEMS has a dedicated R&D team focussed on the development of new CLEANSORB granulates and waste gas treatment equipment. Our chemisorber materials are continually optimized to keep pace with new process chemistries and applications. Solar industry and photovoltaics, as well as MEMS, are new emerging markets, which we serve with competence.



- Safe, non-combustible inorganic medium (no charcoal)
- Highest capacities
- Unique customised material compositions
- No consumption of electricity, city water, oxygen, nitrogen
- No secondary emissions to the environment
- Excellent Cost-of-Ownership
- Irreversible conversion of hazardous gases to stable inorganic solids at ambient temperature

CLEANSORB® Columns



After removal from the CLEANSORB cabinet, the column is ready for shipment to the nearest CS CLEAN SYSTEMS Refill and Service Centre. There, the expended absorber granulates are collected and sorted in accordance with the national regulations for the classification and disposal of wastes. Where possible, the spent materials are re-processed for recovery of metals, or for other industrial uses.

CLEANSORB dry scrubbing columns are also UN-approved reusable transport containers for the transportation of dangerous goods. They are manufactured from high quality 316L stainless steel to ensure long working life, even on harsh process applications.

One column of CLEANSORB granulate typically binds several thousand liters of hazardous gas into safe, solid by-products. Used CLEANSORB columns are not discarded, but refilled with fresh absorbent with minimal generation of waste material.

The inlet and outlet connections to the patented CLEANSORB absorber columns are made via valves which are integrated within the column itself. This ensures that the customer never comes into contact with the spent absorber material, ensuring maximum safety and ease of handling.



CLEANSORB® columns

- Reusable
- UN-approved for transportation
- Local disposal service worldwide
- Maximum operational safety
- No exposure to chemicals
- Hermetically sealed modules



Clean Environmentally-Friendly Technology



In contrast to many market-available scrubber products where the scrubbing efficiency is expressed in terms of percent waste gas removal, CS CLEAN SYSTEMS guarantees absolute outlet concentrations for its dry bed absorbers - typically the TLV value for the particular process gas.

- No consumption of water resources
- No generation of waste water
- No secondary emissions
- Room temperature operation
- No pressure drop over column lifetime
- Safety bypass
- Guaranteed outlet concentrations below TLV
- Passive operating principle
- Applicable to all hazardous gases

Dry Bed Abatement of Process Waste Gas

The majority of speciality process gases used in wafer processing, solar and MEMS manufacturing are either pyrophoric, toxic, or corrosive. Safety of personnel and protection of the environment are the essence of our products.

The CLEANSORB waste gas abatement system removes hazardous process gases on the basis of chemical conversion (chemisorption) to stable solids at ambient temperature. No external heating, moisturisation, or other facilities are required for operation. Hence the CLEANSORB system is fully passive, and is permanently on stand-by, even in the event of a power outage or other facilities failure.

A wide range of CLEANSORB model sizes are available to meet the needs of all our customers, from small-scale university researchers to round-the-clock fabrication.



CLEANSORB® Dry Bed Absorber Models

Dry Bed Chemisorption Technology
Point-of-Exhaust Absorption for Process Waste Gas



CLEANSORB LABLINE

The CLEANSORB LABLINE is the laboratory-sized dry bed absorber in a compact cabinet. The passively-operating unit is permanently on ready and does not have to be started up before each new experiment is run. This makes it perfectly suitable for sporadic R&D work. Long absorbing lifetimes, often ranging into years, are typical.

CLEANSORB BASE LINE

The CLEANSORB BASE LINE is a streamlined version of CS CLEAN SYSTEMS' well established CLEANSORB SC- and DC-Series. Manually operated, the BASE LINE system provides an economical solution to a wide variety of waste gas abatement applications. A smart, hardwired design eliminates the requirement for control electronics.

CLEANSORB SC and DC-Series

The CLEANSORB SC- and DC-Series is the standard product range for industrial applications. The model designation of a CLEANSORB system indicates the column size, and whether the cabinet houses a single column (SC) or two columns (DC).

The CLEANSORB SC point-of-exhaust abatement is the standard model for both pilot- and production scale waste gas removal. Operation is simple with very little operator training and minimal facilities requirements. The system is practically maintenance-free.

The CLEANSORB DC design allows interruption-free processing: one column can be taken off-site for refilling while the other remains on duty. The system has a 100% record for reliability, even on the harshest of process applications.



CLEAN-PROTECT

Removal of Toxic Gases During Emergency Release from Gas Cabinets



Safeguard Against Emergency Gas Release

Hazardous release from gas cylinders poses a serious threat to environment and safety, owing to the high quantity of pressurised gas usually present in concentrated form. Gas leakages are known to have occurred: during storage of fresh cylinders; due to improper connection of fresh cylinders in gas cabinets; component failure, e.g. rupture of pressure regulator diaphragm; during storage of empty cylinders.

The CLEAN-PROTECT product line was specially developed to safely absorb large quantities of toxic, corrosive or pyrophoric gases during an emergency gas release incident. Active and passive models are available within the CLEAN-PROTECT series.

Active systems are equipped with an automatic bypass line. When a hazardous gas concentration is detected by a gas sensor in any of the connected gas cabinets, the CLEAN-PROTECT controller automatically closes the bypass valve and opens the isolation valve to divert the contaminated exhaust through the

CLEANSORB absorber bed where it is detoxified.

Passive systems are installed with the gas cabinet extract air flowing continuously through the chemisorbent bed. This safety installation guards against uncontrolled escape of those gases from up to ten gas cabinets.



Passive CLEAN-PROTECT CP1000 model

- High flow rates. Up to 3600m³/h
- Absorption of toxic gas cylinder release
- Low pressure drop
- Permanently online
- Suitable for multi-cabinet installations
- Passive operating principle
- Applicable to all hazardous gases

CLEANVENT Cartridge

Removal of Hazardous Gases During
Purging of Vent Lines



Mini Cartridge for Gas Cabinet Vent Lines

Before a fresh gas cylinder is put on-line within a gas supply cabinet, a small, but nevertheless significant amount of process gas remaining from the previous cylinder must first be removed.

The residual gas is likely to be a highly concentrated toxic, pyrophoric, or corrosive gas, resulting in a potential safety hazard.

The CLEANVENT cartridge was developed for installation within gas cabinets or supply panels for speciality gases. The cartridge is mounted directly within the gas supply cabinet, typically up-stream of the Venturi vacuum generator.

Purge gases are evacuated through the CLEANSORB absorber bed of the cartridge where hazardous gas concentrations are removed. Cartridge types are available for a broad range of hazardous process gases.

CLEANVENT cartridges can be employed on both low and high pressure applications.



Installation of a CLEANVENT Cartridge

- At-source removal of purge gases
- Gas cabinet installation
- Applicable to all hazardous gases



Plasma Conversion System PIRANHA Series

Removal of Greenhouse Gases (PFCs)



The optional Control and Interface Box (CIB2000) acts as a signal interface to the etcher tool and allows push-button selection and display of all important process parameters. The CIB2000- and High Voltage Supply (HVS2000) boxes are usually housed as a pair - for instance rack-mounted on the cabinet roof of a CLEANSORB system, or in a separate rack cabinet for an etch tool with multiple chambers.

The reactive by-products are best removed using a CLEANSORB dry bed chemisorber.

Global Warming Gases

In semiconductor manufacturing perfluorinated compounds are used in dry plasma etching and for the cleaning of CVD chambers. PFC gases have high global warming potentials (22,800 l CO₂ for SF₆)

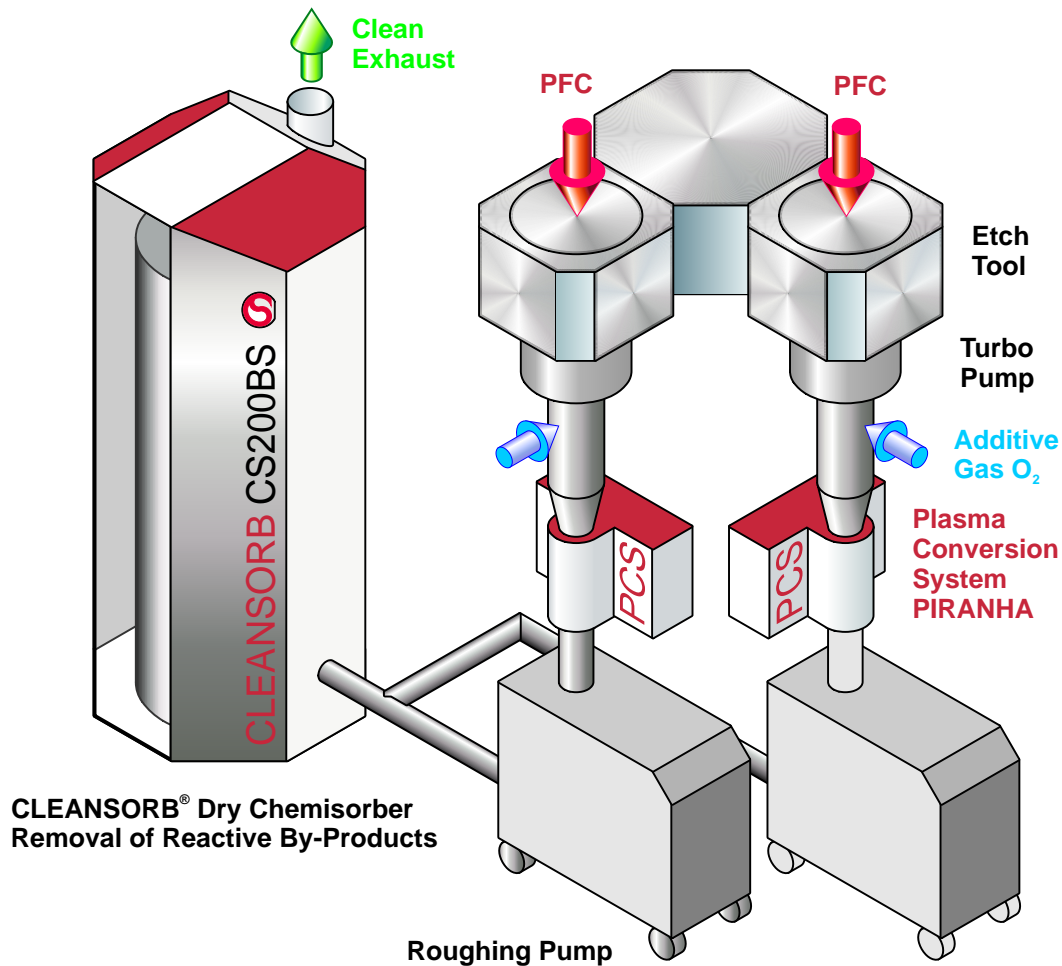
The PCS PIRANHA 2000 foreline plasma conversion systems are designed to destroy PFCs that are emitted from semiconductor etch processes. The PCS PIRANHA 2000 is installed in the vacuum foreline of the etch chamber for maximum efficiency.

In contrast to downstream installations the PFCs are not diluted with N₂ pump ballast. The system is particularly eco-friendly due to its low energy consumption corresponding to a reduced CO₂ output. Moreover, no nitrogen oxide compounds are created.



Microwave Applicator PCS PIRANHA

Installation Schematic of PCS PIRANHA



Optimized Tool Up-Time and Maintenance

Even in the event of system failure, the PCS PIRANHA constitutes an open tube within the exhaust line and will not trip the tool or necessitate process interruption. The ceramic chamber liner and other components of the PIRANHA can be changed out on-site. There is no requirement for speciality off-site adjustment or re-calibration.

- Unmatched performance on Etch applications with high PFC flows
- Easily retrofitted to all existing etch tool installations
- High conversion efficiency prior to rough pump dilution (no NO_x)
- Energy and water efficient: environment friendly
- Improved fab safety with no flames or fuel usage
- Low Cost-of-Ownership



CS CLEAN SYSTEMS Abatement Solutions for a Wide Range of Applications

Process Application - Typical Gases or Liquid Precursors Used

Plasma Etch

Metal Etch	Cl ₂ , BCl ₃ , HCl, CF ₄ , SF ₆
Poly Silicon Etch	Cl ₂ , HBr, Br ₂ , SF ₆ , CF ₄ , NF ₃ , C ₄ F ₈
Nitride Etch, Oxide Etch	CF ₄ , CHF ₃ , C ₂ F ₆ , C ₃ F ₈ , C ₄ F ₈ , CH ₂ F ₂ , NF ₃ , SF ₆ , O ₂
Tungsten Etchback	SF ₆

Ion Implantation

High, Medium, Low	AsH ₃ , PH ₃ , BF ₃ , P, As, Sb, Sb(CH ₃) ₃ , GeH ₄ , GeF ₄
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ALD, LPCVD, PECVD, HDP-CVD

TEOS, undoped	TEOS, O ₂ , O ₃
BPSG	TEOS, O ₃ , TMP, TMB, SiH ₄ , PH ₃ , B ₂ H ₆
Poly Si (doped)	SiH ₄ , (AsH ₃ , PH ₃)
Silicon Germanium	SiH ₄ , GeH ₄
Oxide	SiH ₄ , O ₂
Nitride (doped)	SiH ₄ , NH ₃ , (TMP, TMB, SiH ₄ , PH ₃ , B ₂ H ₆)
Oxynitride (doped)	SiH ₄ , NH ₃ , N ₂ O, (TMP, TMB, SiH ₄ , PH ₃ , B ₂ H ₆)
Low-k dielectrics	1MS, 2MS, 3MS, 4MS, DMDMOS
High-k dielectrics	TMA, TEMAH, TDEAH, TAETO, PET
Gate Electrodes	MPA, Ru(Etcp) ₂ , PEMAT
Copper CVD	Cu(hfac)(TMVS)
Tungsten (Silicide)	WF ₆ , SiH ₄ , H ₂ , (DCS)
Barrier Layers	TiCl ₄ , NH ₃ , TDMAT, PDMATa, PDEATa, TAETO, W(CO) ₆

Chamber Clean

PFC plasma	C ₂ F ₆ , C ₄ F ₈ , NF ₃
Remote NF ₃ plasma	F ₂

Epitaxy

Silicon (doped)	DCS, TCS, SiH ₄ , HCl, (AsH ₃ , PH ₃ , B ₂ H ₆)
Silicon-Germanium	SiH ₄ , GeH ₄ , CBr ₄ , 1MS, 2MS, 3MS, HCl
Silicon Carbide (SiC)	SiH ₄ , CH ₄ , C ₃ H ₈ , TMA, HCl

Compound Semiconductors, Optoelectronics, III-V on Si

GaAs, InP OMVPE (MOCVD)	TMGa, AsH ₃ , TBA, TMIn, PH ₃ , TBP
GaN OMVPE (MOCVD)	TMGa, NH ₃ , UDMH
MBE (MOMBE)	As, P, AsH ₃ , PH ₃
III-V Etch	Cl ₂ , BCl ₃ , HBr, SiF ₄ , SF ₆ , CH ₄ , GaCl ₃ , InCl ₃ , AsH ₃ , O ₂

Photovoltaics

Concentrator Photovoltaics	PH ₃ , AsH ₃ , metalorganics, SiH ₄ , GeH ₄
CIGS	H ₂ S, H ₂ Se

Consult us regarding applications not listed above at www.cscleansystems.com

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