TECAM
Environment. Technology. Efficiency.

# 10 technologies for emissions treatment

## Which one is right for your plant?

Description, advantages and disadvantages of the main existing technologies.

# Index

At Tecam we are convinced that environmental sustainability is the only viable path for the future of the industry. We know that the only possible answer is to implement technologies that combine maximum efficiency in eliminating emissions and waste with the highest efficiency in its implementation and use, in order to avoid damaging the productivity of your industrial processes.

With regards to air pollution treatment, there are different technologies that are currently used and that can be installed in production plants to reduce pollutant emissions.

In order to facilitate your decision-making process, at Tecam we have compiled in this document the "10 technologies for emissions treatment" most in demand nowadays. In this document we briefly describe each of them and analyse their most relevant pros and cons.

We hope that this information will be useful to you to start the analysis of the options you have to manage the polluting emissions generated in the production processes of your plant.

Please remember that you can count on Tecam specialists at any time to help you select the technology that best suits your case. We will be happy to assist you in the analysis phase and to design a custom installation for your needs, if required.

# Regenerative Thermal Oxidizers (RTO)

## What is RTO

An RTO is equipment designed to eliminate Volatile Organic Compounds (VOC). These volatile organic compounds are mainly made up of carbon and hydrogen, so when they react with oxygen, they form carbon dioxide and water.

An RTO is basically made up of 3 ceramic bed towers where energy is recovered and a combustion chamber where the temperature is maintained for oxidation. This combustion chamber has a burner where natural gas is usually used to raise the temperature in it, although other combustible gases can be used (fuel oil, diesel oil, etc.).

## How RTO works

The polluted process air is sucked in by the main fan usually located upstream of the oxidizer. Subsequently, the fan forces the process air through the first ceramic tower. It is in this first tower where the process air is heated by the ceramic. When the air has passed through the ceramic bed, it reaches the combustion chamber, where oxidation takes place. For processes where there are high concentrations of suspended particles, the fan usually goes downstream of the oxidizer.

For gases without halogenated compounds, the temperature is usually around 800 °C - 900 °C and in gases where there are halogenated, the temperature should be 1,100 °C to ensure complete oxidation. It will depend, in any case, on the compounds to be treated.

Parallel to the process air inlet through the first chamber, the already oxidized air passes through the second ceramic tower to exchange the heat from the

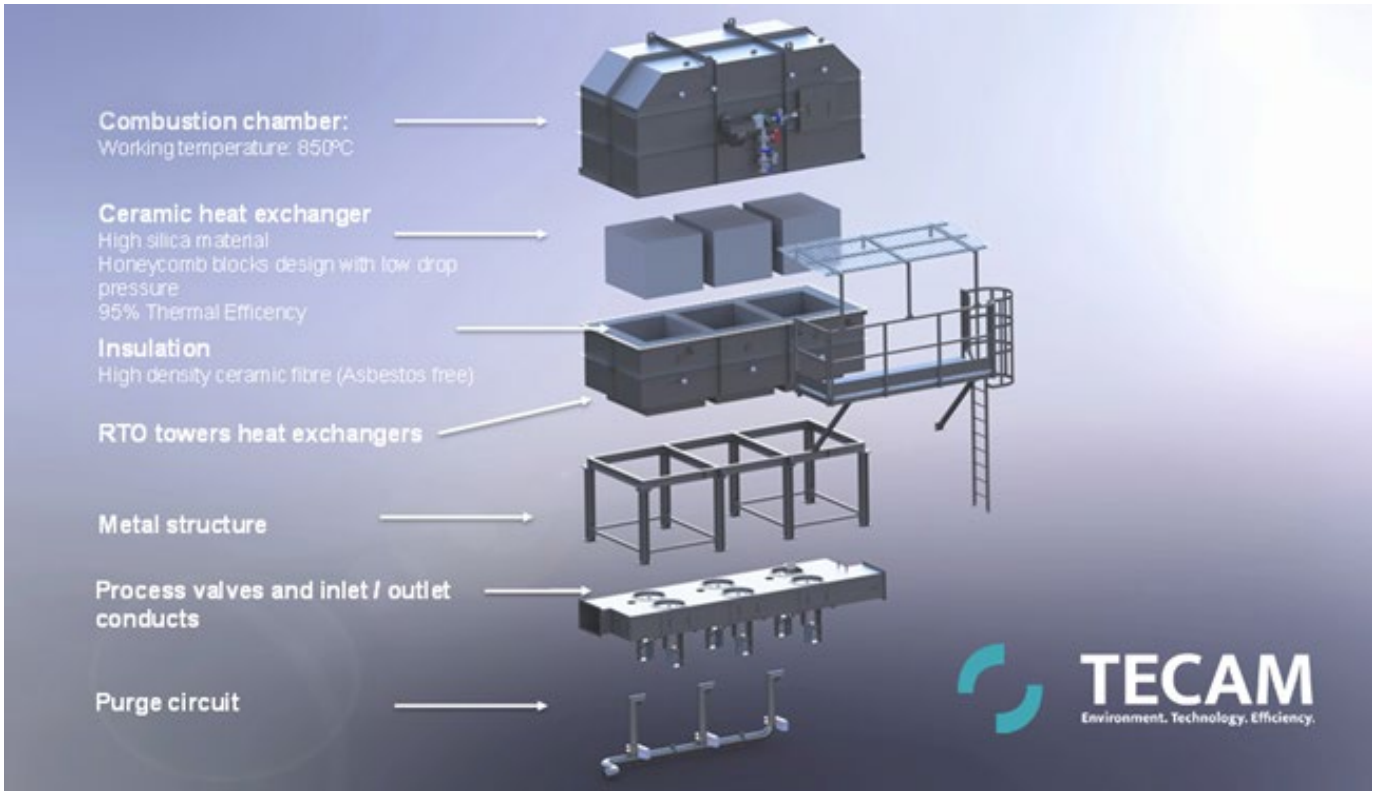
air to the tower. Thus, the gas gets cooled and the ceramic bed gets heated.

After passing through the second tower, the air is sent to the stack with the pollutants already removed.

The third ceramic tower is used to recirculate the purge, since in the sequence of valves it must be ensured that all the air is oxidized. This sequence is repeated every so often, between 45s and 90s, to ensure that each tower works the same way.

This system of 3 ceramic towers is the most used nowadays, although there are also RTOs with 2 towers and even with 5 towers. In the 3-tower RTO, thanks to the purge circulation system, it is ensured that all gases pass through the combustion chamber.

The 5-tower RTOs are usually equipment for high flows.




## Most relevant applications of RTO

An RTO can be installed for a wide variety of industrial applications, such as in the chemical and pharmaceutical sectors, in storage tank farms, in the petrochemical and oil & gas industry, in the painting, coatings, construction industries, etc.

## Main advantages of using RTO

The advantage of installing an RTO is that a very high energy recovery can be achieved while maintaining the same VOC removal efficiency. This use is due to the fact that the ceramic towers store a large amount of energy in each sequence, a fact that makes the air or process gas heat up. Thus, there are thermal efficiencies of around 90 to 95 %. This implies that under normal operating conditions, fuel gas is not consumed since the process

is autothermal. An autothermal process means that, without the input of external energy in the form of fuel in the burner, the combustion chamber maintains the operating temperature. This is because the energy released by the VOCs when oxidizing is sufficient to keep the chamber at a high temperature.

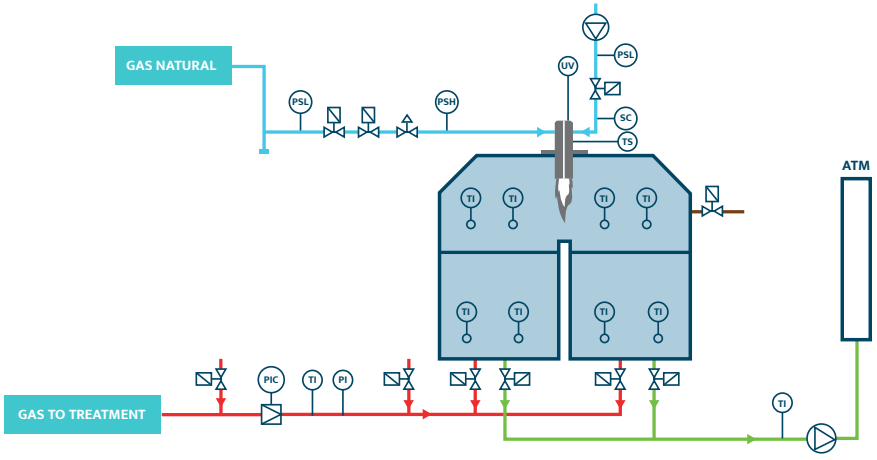
## In which cases it is not advisable to use an RTO

The Regenerative Thermal Oxidizer system is not recommended as an ideal isolated solution in those cases in which the polluted air flow contains low concentrations of VOCs, but would need a Zeolite rotorconcentrator alongside to concentrate the air flow and convert it at a lower flow rate and with a higher VOC concentration, to be treated in the RTO in an efficient way.

# Regenerative Catalytic Oxidizers (RCO)

## What is RCO

A Regenerative Catalytic Oxidizer (RCO) system is equipment dedicated to the removal of volatile organic compounds. An RCO is made up of 3 ceramic bed towers where energy is recovered, a catalytic bed located at the top of each tower where the oxidation reaction is accelerated, and a combustion chamber where the temperature is maintained for oxidation.




Process diagram of the operation of an RCO system

Organic compounds are made up mainly of carbon and hydrogen, so when they react with oxygen, they form carbon dioxide and water. In the combustion chamber, there is a burner that usually uses natural gas to raise the temperature in the chamber, although other combustible gases such as fuel oil, diesel oil, etc. can also be used.

In the case of RCO, and to minimize fuel gas consumption, a catalytic bed is installed in the upper part of the ceramic towers that lowers the operating temperature in the combustion chamber, ensuring total oxidation thanks to the catalyst.

## How RCO works

Polluted process air is sucked in by the main fan. Subsequently, the fan forces the process air through the first ceramic tower. In the first tower, the process air is warmed up. When the air has passed through the ceramic bed, it reaches the catalytic bed where oxidation takes place at about 350 °C - 400 °C, depending on the organic compounds contained in the air flow. Parallel to the process air inlet through the first chamber, the already oxidized air passes through the second ceramic tower to exchange the heat from the air to the tower. Thus, the gas gets cooled and the ceramic bed gets heated. After passing through the second tower, the air is sent to the stack with the VOCs already eliminated. The third ceramic tower is used to recirculate the purge, since in the sequence of valves it must be ensured that all the air gets oxidized. This sequence is repeated every so often, between 45s and 90s, to ensure that each tower works the same way.

## Most relevant applications of RCO

The most common applications where an RCO system is recommended is for cases where there are polluted air flows with low VOC concentration (<0.5 g / Nm3), such as in some paint applications in the automotive auxiliary industry.

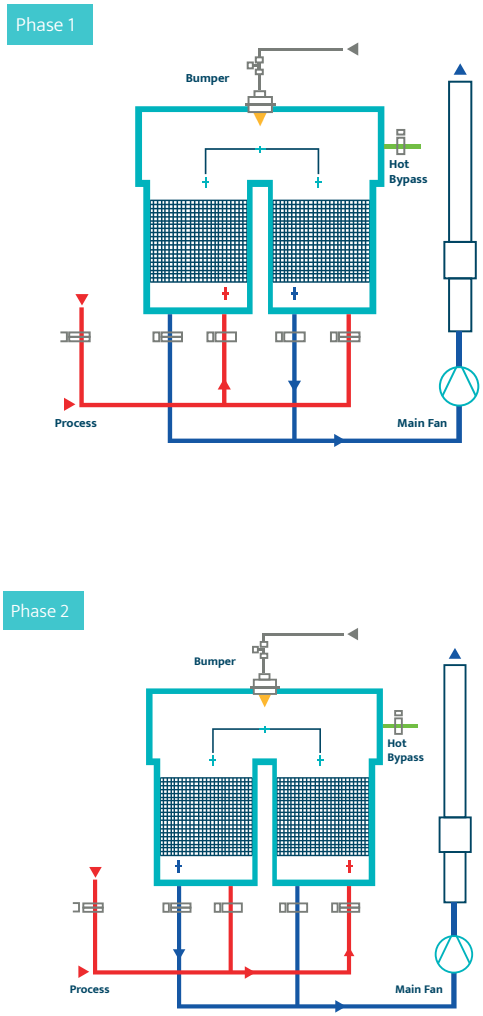
## Main advantages of using RCO

The advantage of installing an RCO system resides in that the efficiency of VOC removal can be achieved with lower temperatures, due to the catalytic process.

This lower oxidation temperature (it usually works around 350 °C - 400 °C) results in a lower consumption of natural gas.

## In which cases RCO is not recommended

RCO systems are not recommended for high air flow rates. It should also be noted that in the case of RCO units, VOCs should not contain heavy metals, as they could cause poisoning to the catalyst.




Scheme of the operating phases of an RCO system

# Thermal Oxidizer (TO or DFTO)

## What is a TO or DFTO

A TO is a Thermal Oxidizer, also called DFTO (Direct Fired Thermal Oxidizer). It is an equipment for the elimination of gaseous pollutants, mainly Volatile Organic Compounds.

The operating principle of this equipment is based on combustion at high temperatures with a large excess of air, oxidizing the pollutants. It is made up of a combustion chamber and a burner. The combustion chamber is where the gas contaminated with VOCs is injected, and through a certain residence time (usually between 1 and 2 seconds) and with operating temperatures between 800 ºC and 1,100 ºC oxidation and elimination of the compounds is achieved. The operating temperature varies depending on whether the process air contains halogenated compounds (Cl, Br, F, etc.) in the VOCs. In case of containing said halogenated compounds, the operating temperature should be 1,100 ºC.

In this case, the TO does not recover energy through a ceramic bed, so the outlet gas has the same temperature as in the chamber.

## Operation of a TO or DFTO

The operation of the direct Thermal Oxidizer consists of injecting the process air into the combustion chamber and with the help of a gas or combustible liquid burner it is possible to reach high temperatures in the combustion chamber, a fact that causes the oxidation of VOCs.

The combustion chamber is designed with sufficient volume so that the combustion gases have a minimum residence time to ensure complete oxidation.

It is designed to work from 800 ºC to 1,100 ºC. The temperature of the gases is raised, in a controlled and homogeneous way and even under the most unfavourable conditions, to the minimum necessary for thermal oxidation.

## Most relevant applications of a TO or DFTO

The most common application of a TO system is when there is a polluted stream of VOCs with high concentration and/or high calorific value. In these cases, having a gas with a lot of energy makes regenerative operation (RTO type) difficult.

## Main advantages of using a TO or DFTO

The advantages of installing direct thermal oxidation equipment is that high temperatures are achieved at the combustion chamber outlet, a fact that can be used for heat recovery systems in the form of superheated or saturated steam or hot water. Even in the case of generating steam, it can be used later to generate electrical energy in a turbine.

TO systems have a high pollutant destruction efficiency. 99.9 % destruction of VOCs is guaranteed with a residence time of 1 second in the combustion chamber.

Installing a TO or DFTO is a reliable operation and has a long life cycle.

They also have a light thermal insulation, they are quick to start and their investment is low economically speaking.

## In which cases a TO or DFTO is not recommended

One of the major disadvantages of this system is that to achieve the VOCs elimination efficiency it has to operate at high temperatures, and this entails a high operating cost due to fuel consumption.

# Scrubbers

## What is a Scrubber

In the emissions removal process, and generally before an RTO system, there may be a scrubber unit to eliminate acid gases.

A scrubber is a gas cleaning system for atmospheric emissions made of a packed column where the polluted gas is treated and a liquid is put in contact (usually countercurrent) that will adsorb the pollutant. It is a non-destructive technology. In addition to the tower, the scrubber system consists of a column, which is a recirculation pump that will recirculate the adsorbent solution. Usually a collection tank is installed and from time to time this solution must be purged, since the neutralized products will accumulate. With a level control system, water and adsorbent fluid will be added to continue with the operation of adsorption.

Adsorption is a physical phenomenon that consists of diffusing the pollutant from the gas to the liquid phase. It is normally indicated for gases with acidic (HCl, HF, H2SO4, etc.) or basic (NH3, etc.) pollutants. In the case of acidic contaminants, the liquid solution used will be a strong base for neutralization. In the case of basic contaminants, an acid solution will be used for neutralization.

Scrubbers can also eliminate odours.

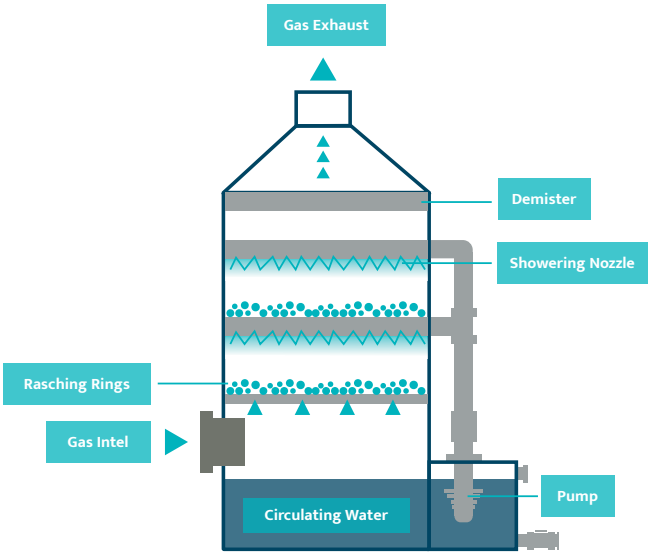
In cases where the process air contains halogenated compounds and they are oxidized in an RTO or RCO, these halogenated compounds recombine with hydrogen and form the associated acid. In the case of chlorine (Cl), when it combines with hydrogen, hydrogen chloride (HCl) is formed. This fact means that a scrubber with basic adsorbent fluid must be installed at the oxidizer outlet, for example, a solution of caustic soda (NaOH).

# Operation of a Scrubber

The polluted gas is injected through the bottom of a column with a fixed bed. In this bed it is possible to increase the contact area of the contaminated gas with the adsorbent fluid, which must be able to neutralize the contaminant in question. This liquid will be recirculated by means of a pump that will send the liquid in the upper part of the column, and through showers, some sprays will diffuse the liquid through the bed. Thus, homogenization is achieved.

This technology consumes chemical reagents to neutralize pollutants.

The air flow to be treated is introduced into the Scrubber, which is shaped like a silo or cylindrical tank. The Scrubber captures the gas, and thanks to a liquid that can be water, a chemical reagent or a mixture of both, it neutralizes the polluting components present in the gas. Thus, once the pollutants have been neutralized, the clean gas can be emitted into the atmosphere, completely safe for people and the environment.




Operation diagram of a Scrubber

Nitrogen derivatives can be absorbed in an acidic medium, while sulphur derivatives can be removed by alkaline or oxidizing means. There are even some pollutants that are very soluble in water that do not need chemical reagents in the gas cleaning process.

Prior to the RTO system, the adsorption of the pollutant gas takes place in counter flow within the scrubber and within spaces that are filled with large specific areas of contact with elements. That is combined to obtain an optimal contact of the gas / liquid stages and a constant distribution of both fluids throughout the process where the washing liquid is dispersed and evenly distributed by means of high performance full cone nozzles, easily removable for revision or change.

The retention of the drops originated by the liquid distribution system will be carried out inside the tower by means of a high efficiency vertical flow defroster and low pressure drop that avoids the entrainment and emission of drops into the atmosphere, as well as any loss of wash solution.

The washing liquid contained in the bottom of the scrubber is recirculated through a high-performance centrifugal pump (both chemical and mechanical).

All elements of the scrubber are usually made of polypropylene, polyethylene, fiberglass resin, stainless steel, and are insulated and heated to avoid problems in winter periods. This insulation is usually made of 40 mm thick polyurethane finished with fiberglass, or mineral wool with an aluminium coating.

The level of the washing liquid is kept constant by a water inlet through a solenoid valve controlled by a 3-contact level indicator.

Usually after the RTO equipment, a cooling system can be installed to lower the gas temperature. The cooling system also has a neutralizing solution to be used as a first-stage neutralizing system, using the same liquid solution that is washed into the scrubber.

Scrubbers are the most suitable solution to eliminate acid gases from production processes.

Wet scrubbers get their name from the fact that liquids are used as the scrubbing medium and the by-products of the scrubber system are the liquid solution or suspension. Wet scrubbers can perform two functions simultaneously: particle collection and acid gas control.

Gas emissions are absorbed in columns of devices that attempt to maximize liquid-to-gas contact to achieve maximum adsorption of pollutants in the liquid phase.

## Most relevant applications of a Scrubber

The typical application for a scrubber is when there are concentrations of acidic or basic gases, usually generated with halogenated volatile organic compounds.

That is why they are used as purification systems that specifically eliminate the emissions of acid gases (SO2) produced in the combustion of pollutants. Scrubbers can also be installed for odour treatment.

## Main advantages of using a Scrubber

The advantages of a scrubber are the neutralization of contaminants in an atmospheric system and at room temperature. High pollutant removal efficiencies are achieved since they are usually adsorption with acid-base neutralization reactions that help remove pollutants.

## In which cases a Scrubber is not recommended

Since a scrubber is used to treat acidic compounds, it is not recommended in cases where these types of compounds do not exist.

# Baghouse filters

## What is a baghouse filter

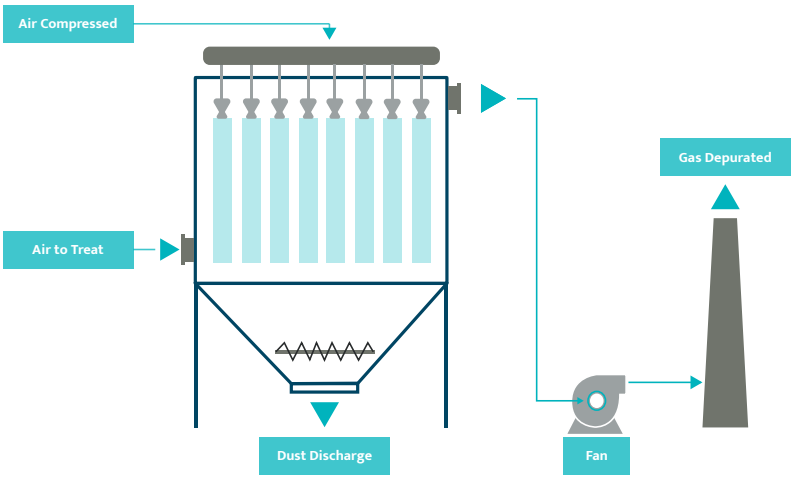
Baghouse filters are devices that separate solid particles in suspension from a gaseous stream by passing them through a piece of fabric. They are used in various industrial sectors such as pharmaceutical, chemical, petrochemical, mining, etc. when high filtration efficiency is required, as they are capable of removing submicron particles with an efficiency of 99.9 %.

## How a baghouse filter works

A bag filter is made up of rows of fabric bags that trap particles and are automatically cleaned by high pressure compressed air.

The gas stream laden with pollutant particles is introduced into the bag filter and filtered through the fabric. The separated powder is collected in hoppers and is removed.

The particles carried by the air stream pass through the fabric sleeves and remain deposited on the outside of said sleeves. At adjustable intervals, depending on the degree of soiling of the sleeves, countercurrent compressed air is applied to each of the sleeves so that the dust particles are detached from the fabric and fall into the lower hopper where they are collected for treatment.




Functional diagram of a baghouse filter

## The choice of the filter fabric

The filter fabric to be used in the bag filter deserves special mention, as it is essential to obtain the best performance. Its choice will allow the efficient use of the system. The type of dust and the desired emission level must be taken into account (the fabric wearing will be determined by the chemical composition of the gaseous stream and the particles, as well as their temperature and humidity).

There are materials on the market made from a wide range of synthetic fibers and treated to provide high-quality performance.

| Generic name of the tissue | Chemical resistance to: | | Continuous operating temperature in moist heat (°C) | Continuous operating temperature (°C) | Maximun temperature (°C) | The material supports combustion |
|---|---|---|---|---|---|---|
| | Acids | Bases | | | | |
| Polyester | Good | Regular | 94 | 150 | 150 | Yes |
| Acrylic copolymer | Good | Regular | 110 | 130 | 130 | No |
| m-Aramid | Good | Good | 177 | 240 | 240 | No |
| Polyphenylene sulfide | Excelent | Excelent | 190 | 232 | 232 | No |
| Ethylenechlorotrifluoroethene | Excelent | Excelent | 177 | 190 | 190 | No |
| Polytetrafluoroethene | Excelent | Excelent | 260 | 290 | 290 | No |
| Polyimide | Good | Good | 240 | 280 | 280 | No |
| Glass | Very good | Regular | 260 | 290 | 290 | No |
| Stainless steel | Good | Excelent | 550 | 600 | 600 | No |
| Ceramic | Very good | Good | 760 | 1204 | 1204 | No |

Source: BAT, Integrated Pollution Prevention and Control (IPPC) series, BREF document

## Most relevant applications of a baghouse filter

They are used in numerous industrial processes in different sectors and with various products, such as: automotive, petrochemical, mining, chemical, cement, plaster, iron, aluminium, ceramic, rubber, coal, etc.

They are used as an alternative to electrostatic precipitators. Bag filters are suitable for collecting low sulphur coal fly ash or fly ash containing high levels of unburned carbon.

## Main advantages of using a baghouse filter

The main advantages of a baghouse filter are that it has high purification performance and can operate with a wide variety of dust (both coarse and fine particles). It allows a modular design, thanks to which they can be used for a very wide range of gas flow rates to be cleaned. It filtrates in continuous mode, and as it does not have internal moving parts, it is very easy to operate and maintain. It also has a pressure drop and moderate power consumption.

## Disadvantages of a baghouse filter

The disadvantages that we find in the baghouse filter is that it does not admit wet or sticky dust, it does not eliminate pollution by VOCs and depending on the filter fabric used it may have limitations in use due to high temperatures.

# Active Carbon Filters (ACF)

## What is an active carbon filter (ACF)

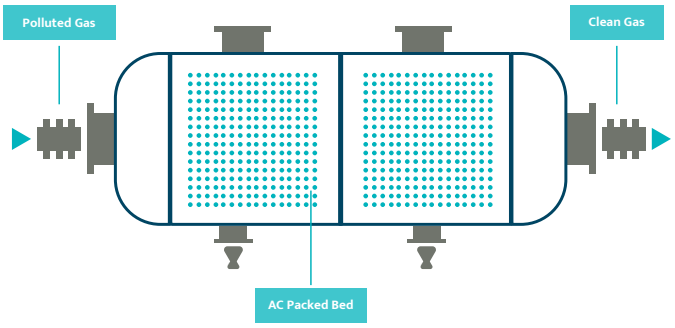
An active or activated carbon filter is an adsorption system that captures and adsorbs contaminants from the process gas and adheres them to the solid phase. The air passes through the fixed bed of activated carbon and adheres to the pores on the surface. By having a large transfer area per unit volume, the adsorption of the pollutant is favoured.

## How ACF works

The polluted gas passes through the carbon bed, and as it passes, the pollutant adheres to the surface of the filter.

## Most relevant applications of ACF

The applications of activated carbon filters are wide. For example, they control emissions in painting booths, eliminate dioxins and furans generated during the incineration of municipal solid waste (MSW), eliminate VOCs (Volatile Organic Compounds), eliminate H2S in biogas plants, NH3 and amines, mercury vapours, acid vapours (lactic, acetic, muriatic), etc.




Scheme of an active carbon filter (ACF)

## Main advantages of using ACF

One of the advantages is that active carbon filters are very selective with the pollutants to be adsorbed and they are ideal for minimizing VOC emissions in intermittent processes, as well as in the treatment of odours.

## Disadvantages of ACF

The disadvantage of the activated carbon filter is that because it has a limited area, the activated carbon becomes clogged to a point that loses its efficiency, and the carbon bed must be replaced in order for its use to be effective again.

# SCR/SNCR

## What is SCR

Selective Catalytic Reduction (or SCR) is a method of converting nitrogen oxides (NOx) with the help of a catalyst into nitrogen (N2) and water (H2O).

SCR is one of the best nitrogen oxide control systems, as it is capable of achieving up to 95 % NOx reduction in combustion processes, complying with the strictest environmental requirements and legislation.

## Operating of SCR

Selective catalytic reduction converts NOx into nitrogen and water. To achieve that, a reagent (anhydrous ammonia, aqueous ammonia or urea solution) is added to a stream of exhaust gas and adsorbed on a catalyst.

The use of a reagent is required where the reducing reaction takes place on a bed of several layers of porous catalyst.

For the SCR to function optimally, an optimal design of the catalyst size, location, and shell design must be carried out.

## Most relevant applications of SCR

SCR equipment is commonly used in power plants (coal, biomass, gas, oil, etc.). They are also a good solution in industrial plants such as oil, pulp and paper plants, steel plants and in power plants made from municipal, hospital, industrial and hazardous waste.

This technology is suitable for:

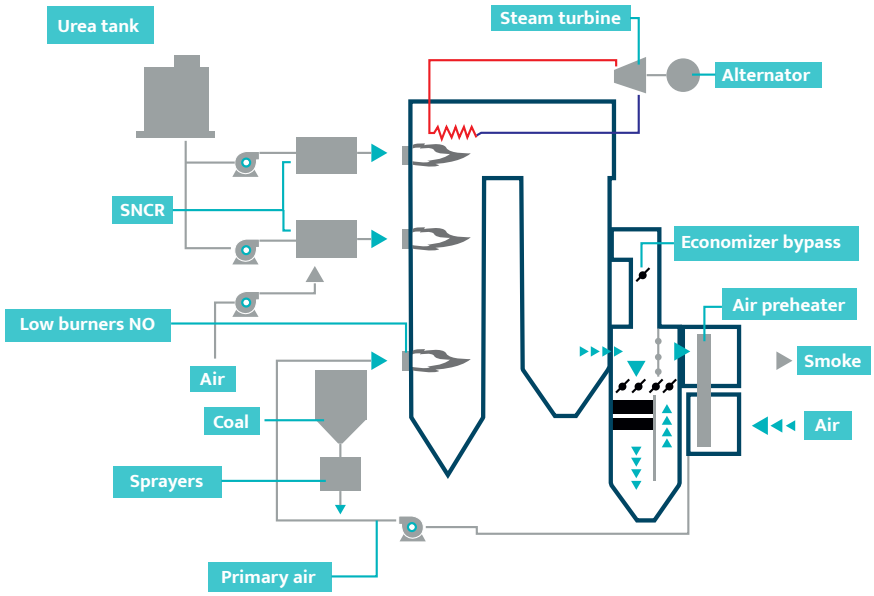
- Alternative heat engines.
- Fire heaters.
- Electric coal, oil or gas boilers.
- Ovens.
- Simple cycle turbines.
- Combined cycle turbines and heat recovery units.
- Waste incinerators.

## Main advantages of using SCR

The main advantage of SCR is that it achieves a reduction of up to 95 % of NOx without producing any by-product or residue. It operates at temperatures of 350 °C - 500 °C and is also applicable to sources with low concentrations of NOx.

## Disadvantages of SCR

As a disadvantage, we can say that selective catalytic reduction uses large amounts of reagent and catalyst, which makes capital and operating costs higher.




Process diagram of the operation of a mixed SCR/SNCR system

## What is SNCR

Selective Non-Catalytic Reduction (SNCR) converts nitrogen oxides (NOx) to molecular nitrogen (N2), carbon dioxide (CO2), and water (H2O) with a reducing agent.

## How SNCR works

To reconvert NOx into nitrogen and water, a reducing agent must be injected directly into the boiler after combustion, and it is necessary to do this at various injection levels to obtain an optimal result.

It is in the combustion chambers, which often work at more than 1,000 °C, where these types of substances are generated. These combustion gases are usually diverted to energy recovery systems, such as recovery boilers, steam generation boilers or hot water, and it is there where the ammonia or urea solution can be injected so that they can be neutralized.

## Most relevant applications of SNCR

SNCR systems are suitable in electric power generation plants that burn biomass, waste, coal and oil; in cement plants, waste incinerators, etc. They are very effective in biomass and waste power plants.

## Main advantages of using SNCR

SNCR units have low costs compared to other technologies, they do not require much space and their maintenance is minimal. They have easy installation and operation. They operate without catalyst at high temperatures, 850 °C - 1,100 °C and accept waste gas streams with high levels of PM (Particulate Matter).

## Disadvantages of SNCR

Its main disadvantage is that its effectiveness becomes moderate, since it is only capable of reducing up to 70 % of NOx.

Furthermore, this technology is not applicable to sources with low NOx concentrations such as gas turbines, and it is always necessary to have a high temperature of the gases to be cleaned at the injection point (between 850 °C and 1,100 °C ).

# Criocondensation

## What is Cryoncondensation

The cryocondensation method consists of the condensation of polluting emissions by cooling, at very low temperatures, through the use of liquid nitrogen. It is a clean and non-destructive technology.

## Operation of Cryocondensation

This technology consists of a condensation column, through which the air stream polluted with VOCs passes, and a flow of liquid nitrogen circulates against the current, which cools the air and produces the freezing of moisture, thus obtaining the liquid product that can return to be used in the process.

Pure volatile organic compounds are recovered without any waste with this technology, so cryocondensation is an effective method if we want to reuse the recovered VOCs.

## Most relevant applications of Cryocondensation

Cryocondensation applications are usually indicated for those industries using solvents in their production processes, since it allows them to be treated and also recovered. The solvents recovered with this technique are: toluene, acetone, methanol, chlorinated derivatives, hydrocarbons, etc.

## Main advantages of using Cryoncondensation

The cryocondensation technique has low operating costs, since the liquid nitrogen used can be used for other processes: for example, inerting. It is a clean and non-destructive method with low investment costs and it is also effective for treating gases with medium or high concentrations of VOCs.

## Disadvantages of Cryocondensation

Its main disadvantage is that it can only handle low gas flow rates without skyrocketing operating costs. When treating high flow rates, the operating cost increases enormously due to the excessive use of liquid nitrogen.

# Cyclones

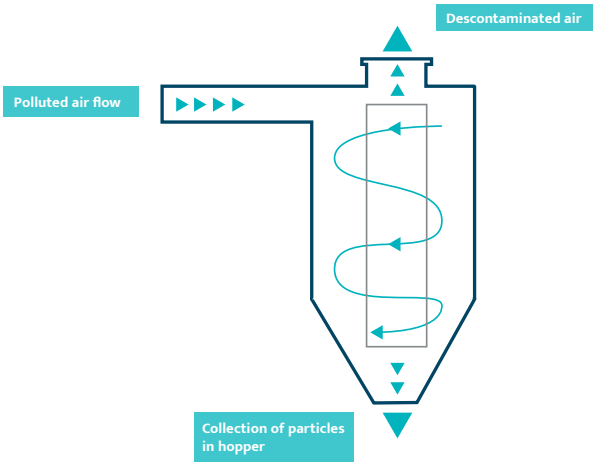
## What are Cyclones

Cyclones are collection and separation systems that use the principle of inertia to remove particles from the combustion gases. This technology captures particulate matter larger than 10 µm; that is why they are also called pre-filter systems. We can find high-efficiency cyclones designed to capture smaller particles, between 2.5 -5 µm. When the size of the particles is greater than 200 µm, cyclones are not an effective method.

## Operation of Cyclones

Cyclones take advantage of the centrifugal force to collect the particles to be eliminated suspended in the combustion gases. The path of the filtered gas comprises a double vortex, where the gas draws a downward spiral on the outer side, and upwards on the inner side. By increasing peripheral speed and centrifugal forces, they cause coarser particles to hit the inside walls of the container and fall into a collection hopper. Its shape is an inverted cone to promote the collection of these particles in the bottom of container. Clean air comes out of the top.

The size of the cyclones is variable (1 - 1.5 m to 9 m) and depends on the amount of flue gas to be filtered. When there is a need to filter large gas flows, multiple small diameter tubes can be built in parallel, each of which acts as a small cyclone; they are called multicyclones.




Process diagram of a cyclone operation

## Most relevant applications of Cyclones

Cyclones are very effective as a pre-treatment to eliminate particles larger than 10 µm, which is why in many cases they are used as pre-collectors for baghouse filters.

In general, they are usually used by industries that generate dust during their production processes: refineries, cement, metal works, wood, plastic, rubber, etc.

## Main advantages of using Cyclones

Cyclones remove 50-99 % of all particulates in combustion gases, and are capable of operating with gases at high temperatures.

Their installation costs are low, since they are simple constructions. They require little space for installation and their maintenance and operation are simple because they have no moving parts.

Cyclones are more efficient than sedimentation chambers (very efficient when particles are greater than 200 µm) but less than baghouse filters or electrostatic precipitators.

## Disadvantages of Cyclones

The main disadvantages of cyclones are that they have poor performance when very small particles have to be removed, they are not suitable for sticky or clumping materials and they have high pressure drops (in high efficiency units).

# Electrostatic Precipitators (ESP)

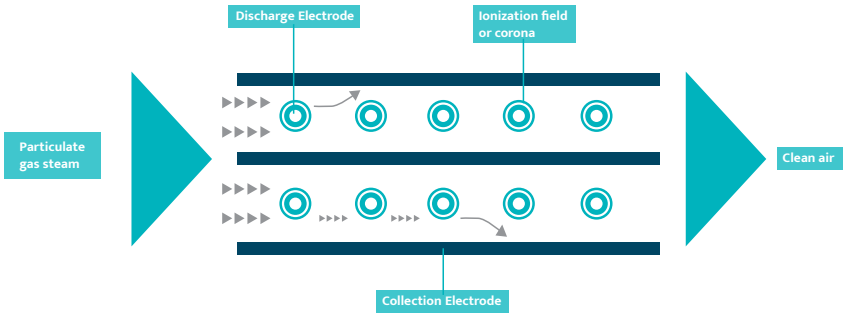
## What is an Electrostatic Precipitator

An Electrostatic Precipitator (ESP) is a particle control device that, through ionization, draws pollutant particles out of the gas stream, so that it is flushed clean of pollutants.

## How Electrostatic Precipitators work

Once it has captured and charged the particles by means of electricity, it attracts them to metallic plates with opposite charges (electrodes) that are in the precipitator. The particles are removed from the plates into a hopper from where they are evacuated.

Some precipitators remove particulates with intermittent or continuous water washes. The most common is to collect them by hitting the plate.




Process diagram of the operation of an Electrostatic Precipitator

## Most relevant applications of Electrostatic Precipitators

The application of electrostatic precipitators is a good solution in combustion facilities such as thermal power plants, electricity generation facilities that use coal or oil, steam boilers, refineries, cement kilns and sectors such as mineral products.

## Main advantages of using Electrostatic Precipitator

Their efficiency is high; they remove up to 99 % of polluting particles under normal circumstances. They can operate under high pressure or vacuum conditions and have a wide gas temperature range.

They are capable of collecting dry pollutants (e.g. ash or cement particles) and wet contaminants (e.g. resins, oils, paint, tar) and are handled effectively even at medium-high flow rates.

Its operating costs and energy requirements are low.

## Disadvantages of Electrostatic Precipitators

The disadvantages of ESPs are that they have a high initial cost and require a large space to be installed. Also, once installed they have no flexibility in capacity or change of location.

Furthermore, they cannot collect gaseous pollutants and are very sensitive to fluctuations with respect to gas stream conditions (flow speed, temperature, gas composition, particle composition, etc.).

Sources: Department of Engineering and R&D of Tecam; BAT, Integrated Pollution Prevention and Control (IPPC) series, BREF document; Cantabria Nautical Higher Technical School; Wikipedia; School of Engineering of the University of San Carlos in Guatemala; University of Calgary in Canada, Energy Education; Business School (EOI), Environmental Management; Seville School of Engineers, Sergio Hurtado Melo.

## About Tecam:

Tecam is an environmental technology company focused on developing custom-made solutions for emissions treatment and hazardous waste valorization for large companies.

We design and implement customized turnkey projects aimed at minimizing the environmental footprint generated during production processes.

We are specialists in sectors with great environmental needs such as chemical, petrochemical, pharmaceutical and Oil & Gas.

Our work philosophy is based on long-term co-operation. With Tecam, you will always have a team of environmental technology experts at your disposal to provide the solutions your business needs, wherever you need them, whenever you need them.

Call us and tell us about your needs. We will help you with the best technology and service.

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