ELVAC

ECOTECHNICS

EMISSIONS AND IMMISIONS MEASUREMENT ▪ VOC ABATEMENT (OXIDATION) SYSTEMS
ANALYSES OF WASTE, WATER AND OTHER MATRICES ▪ ADVISORY ACTIVITY
RESEARCH & DEVELOPMENT ▪ LABORATORY SERVICES

ECOLOGICAL SOLUTIONS FOR INDUSTRY

Regenerative catalytic oxidation – RCO

The purpose of the RCO is to purify the polluted air mass from volatile organic compounds (VOC).

Principle of operation:

The RCO unit consists of two reactors, the expansion part, which balances the concentration fluctuations in the system, and a polluted air fan. Ceramic filling (Raschig's rings, ceramic honeycombs) is located in the lower part of both reactors (regeneration chamber). Above the ceramic filling, we can find a catalytic chamber filled with the layer of a catalyst (pellets or honeycomb monoliths). In the upper part, where the reactors are connected with connecting duct, are the heating chambers with electrical heating elements or with an LPG/natural gas burner.

The system operates on the basis of periodical changing of the direction of the purified air between two reactors. Polluted air flows through heated ceramic filling of the first reactor, where it's heated to the operational temperature of a catalytic reaction. Passing through the catalytic beds of both reactors, VOC are oxidized into CO_2 and H_2O emitting reaction heat. This heat is afterwards accumulated with the efficiency of 95% (it is possible to reach 97%) in the ceramic filling of the second reactor. In this direction, the ceramic filling of the first reactor is cooled and the ceramic filling of the second reactor is heated. Because of that, the flow direction is periodically switched by a time reversion generator.

The common purifying efficiency of the whole system reaches above 99%. The limit of the auto thermal operation, when the unit itself becomes self-sufficient and doesn't need to be heated externally, ranges around 0,55 g TOC/m^3 in the case of a special modification, from 0.3 g TOC/m^3. This technology is the most economically advantageous of all available for very low emission concentrations.

The system could be shut down without the need of process cooling. The unit could be immediately restarted (after a shutdown lasting less than one shift) into catalytic oxidation mode without heating to operational temperature. Accumulated heat is sufficient to start the catalytic reaction.

Area of application:

The technology is suitable for purifying low and middle volume VOC gases (around 0,3 - 3 g/m^3). Speaking in terms of the mass of purified air, the capacity of tens of thousands m^3/h could be achieved. Typical sources of such pollution are paint shops, laminate works, the surface treatment of materials and products and sources from chemical and pharmaceutical industry.

Advantages of use:

- The lowest operational costs of direct combustion in the area of its common use
- Affordable purchase price
- Robustness of the unit and operation reliability while preserving high oxidation efficiency
- Flexibility of the unit in the means of VOC concentration and air mass flow
- The possibility of even short-term shutdowns without the need operational cooling and immediate operation without the need for preheating

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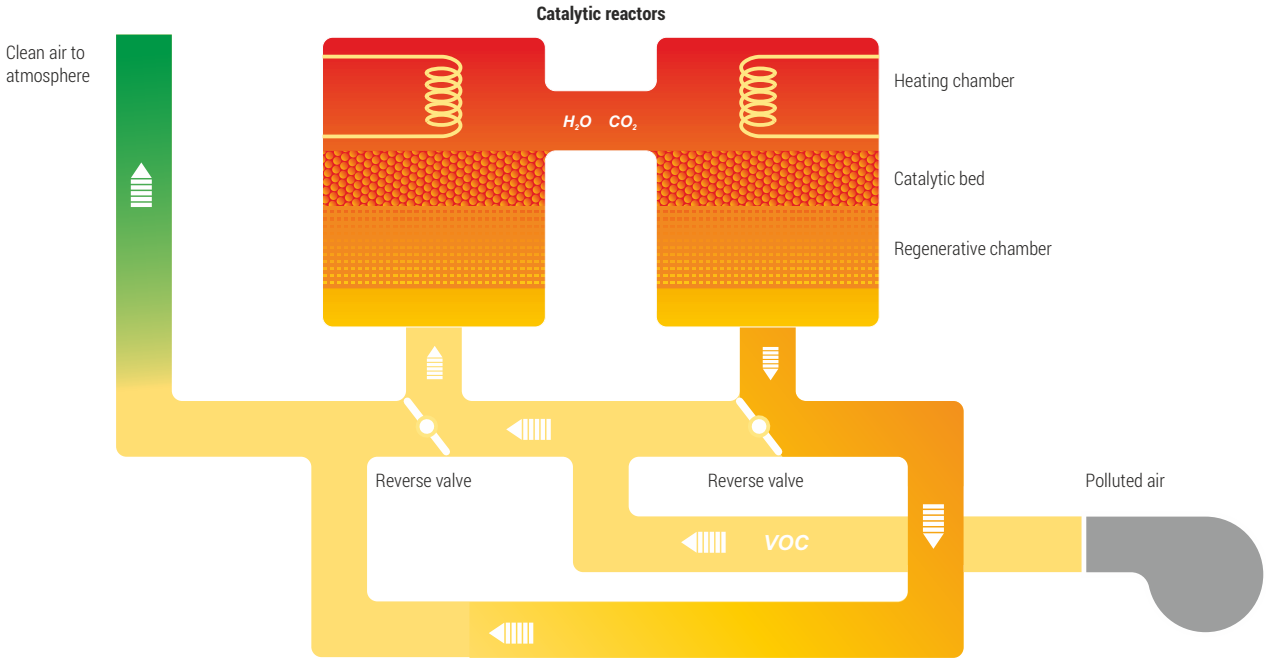
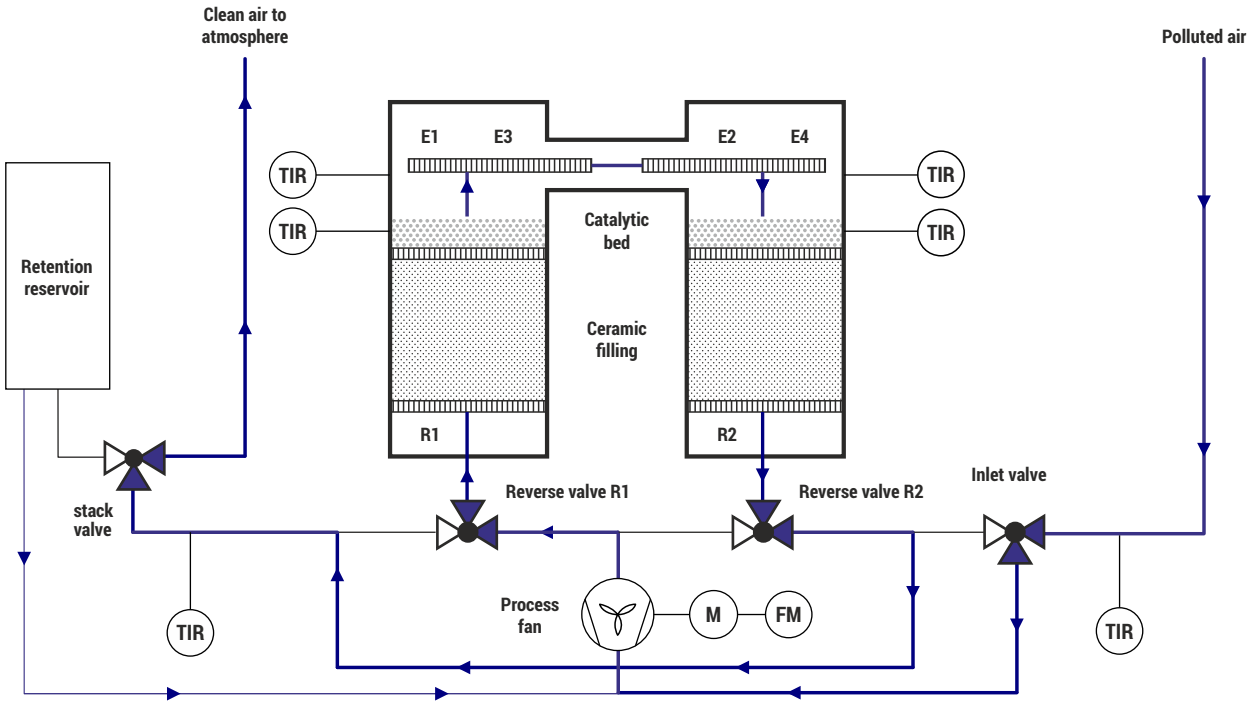

Catalytic reactors
Clean air to atmosphere
Heating chamber
Catalytic bed
Regenerative chamber
H_2O CO_2
Reverse valve
Reverse valve
Polluted air
VOC


Clean air to atmosphere
Polluted air
E1
E3
E2
E4
TIR
TIR
TIR
TIR
Retention reservoir
Catalytic bed
Ceramic filling
R1
R2
stack valve
Reverse valve R1
Reverse valve R2
Inlet valve
TIR
Process fan
M
FM
TIR

Regenerative thermal oxidation – RTO

The purpose of the RTO is to purify the polluted air mass from volatile organic compounds (VOC) through direct combustion (oxidation).

Principle of operation:

The RTO unit usually consists of three reactor chambers (the number may vary from 2 to 5), ducts with fittings and a polluted air fan. The chambers are filled with ceramic filling (pellets or honeycomb monoliths), which operates on the basis of integrated heat exchanging system. The combustion area (equipped with a gas burner) that connects the chambers is located in the upper part.

The system operates on the basis of periodical changing of the direction of the purified air among all reactor chambers. One of the chambers is always in the phase of transferring the heat (preheating the inlet air), the second one is in the phase of accumulating the heat, which is emitted by the burner and by oxidation of VOC, and the third one is being purged with the purified air.

The heat exchange rate reaches the efficiency of 95% so the temperature of the polluted air entering the combustion area reaches almost operational level. The air is therefore heated only with an auxiliary burner to the temperature of 750 – 850 °C. Under these conditions, VOC are oxidized into CO_2 and H_2O emitting reaction heat.

The common purifying efficiency of the whole system reaches above 99%. The limit of the auto thermal operation, where the unit itself becomes self-sufficient and doesn't need to be heated externally, ranges around 1,5 g TOC/m^3.

Area of application:

The technology is suitable for purifying middle volume VOC gases (around 1,5-7 g/m^3). Speaking in terms of the mass of purified air, the capacity of tens of thousands m^3/h could be achieved. Typical sources of such pollution are printing works, sources from chemical and pharmaceutical industry and the surface treatment of materials and products.

Advantages of use:

- Low operational costs of direct combustion in the area of its common use
- Affordable purchase price
- Robustness of the unit and operation reliability
- Flexibility of the unit in the means of VOC concentration and air mass flow

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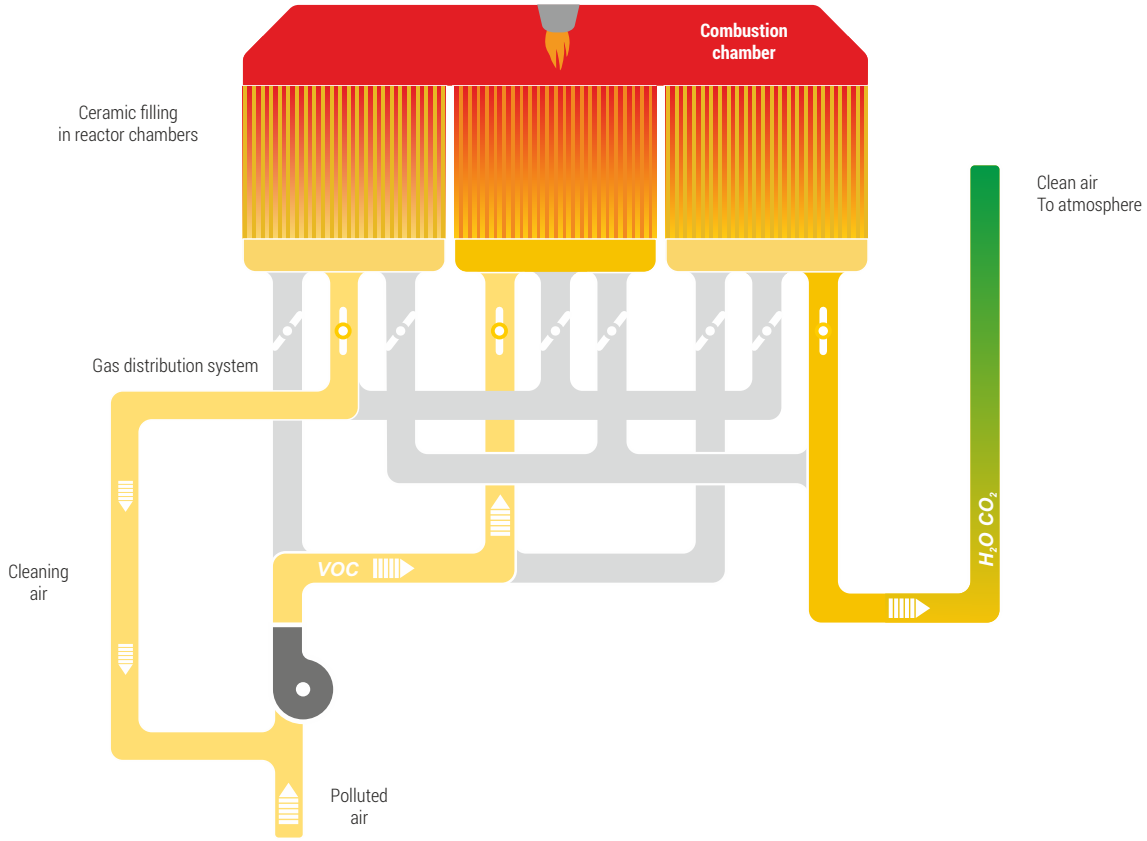
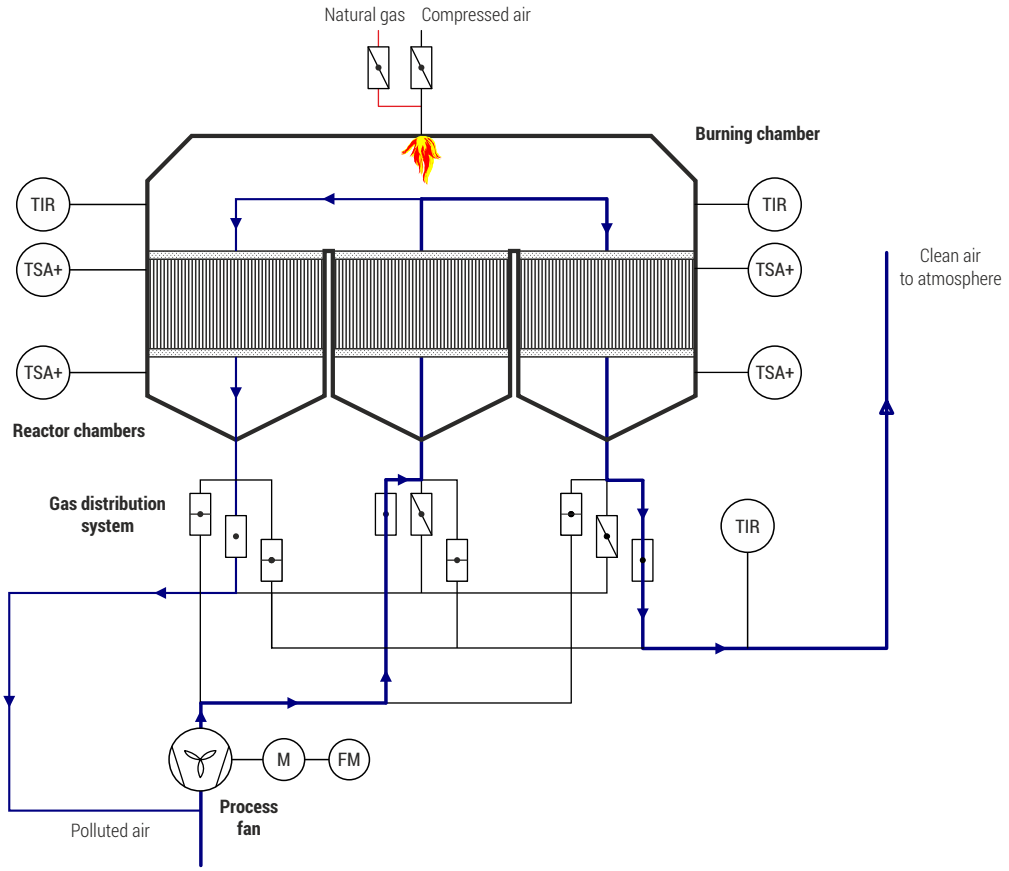
Regenerative thermal oxidation – RTO





Recuperative catalytic oxidation

The purpose of the recuperative catalytic combustion is to purify gases (usually the polluted air mass) from volatile organic compounds (VOC).

Principle of operation:

The unit consists of a catalytic reactor with an embedded catalytic layer (pellets or honeycomb monoliths), the front-end exhaust gas heat exchanger, the heating chamber and a polluted air fan.

At first, the processed air mass goes through the heat exchanger, where it is preheated. Then it passes through the heating chamber (embedded with electrical heating elements or a gas burner), where the air is heated, if it is needed, to the operation temperature of a catalytic reaction, usually above 300 °C. Passing through the catalytic beds of the reactor, VOC are oxidized into CO_2 and H_2O emitting reaction heat. The catalytic reaction proceeds under low temperatures and thus no nitrogen oxides are emitted. Also, heat is emitted during the catalytic reaction and is afterwards transferred to the upcoming polluted air mass (efficiency of heat recovery is 65 – 70%).

The common purifying efficiency of the whole system reaches above 99%. It is possible to modify the unit in order to reach the efficiency up to ten times higher. The limit of the auto thermal operation, when the unit itself becomes self-sufficient and doesn't need to be heated externally, ranges around 2 g TOC/m^3.

Area of application:

The technology is suitable for purifying high and middle volume VOC gases (around 2-6 g/m^3). Speaking in terms of the mass of purified air, the capacity of tens of thousands m^3/h could be achieved. Typical sources of such pollution are printing works, sources from chemical and pharmaceutical industry and the surface treatment of materials and products.

Advantages of use:

- Relatively low operational costs in relation to the volume of purified air
- Robustness of the unit and operation reliability
- Flexibility of the unit in the means of VOC concentration and air mass flow
- High efficiency of VOC abatement
- Catalytic oxidation takes place at such low temperatures that nitrogen oxides are not formed
- Extremely low operational costs while operating above the limit of auto thermal operation

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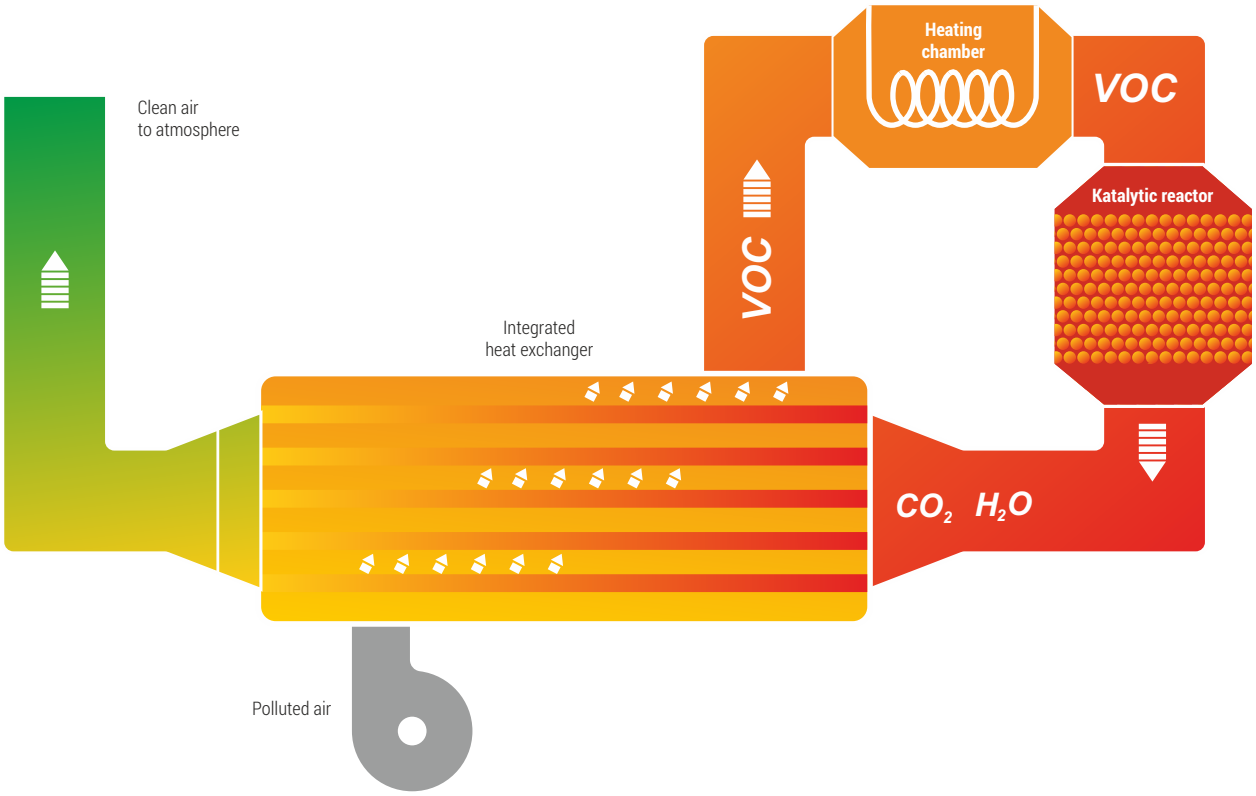
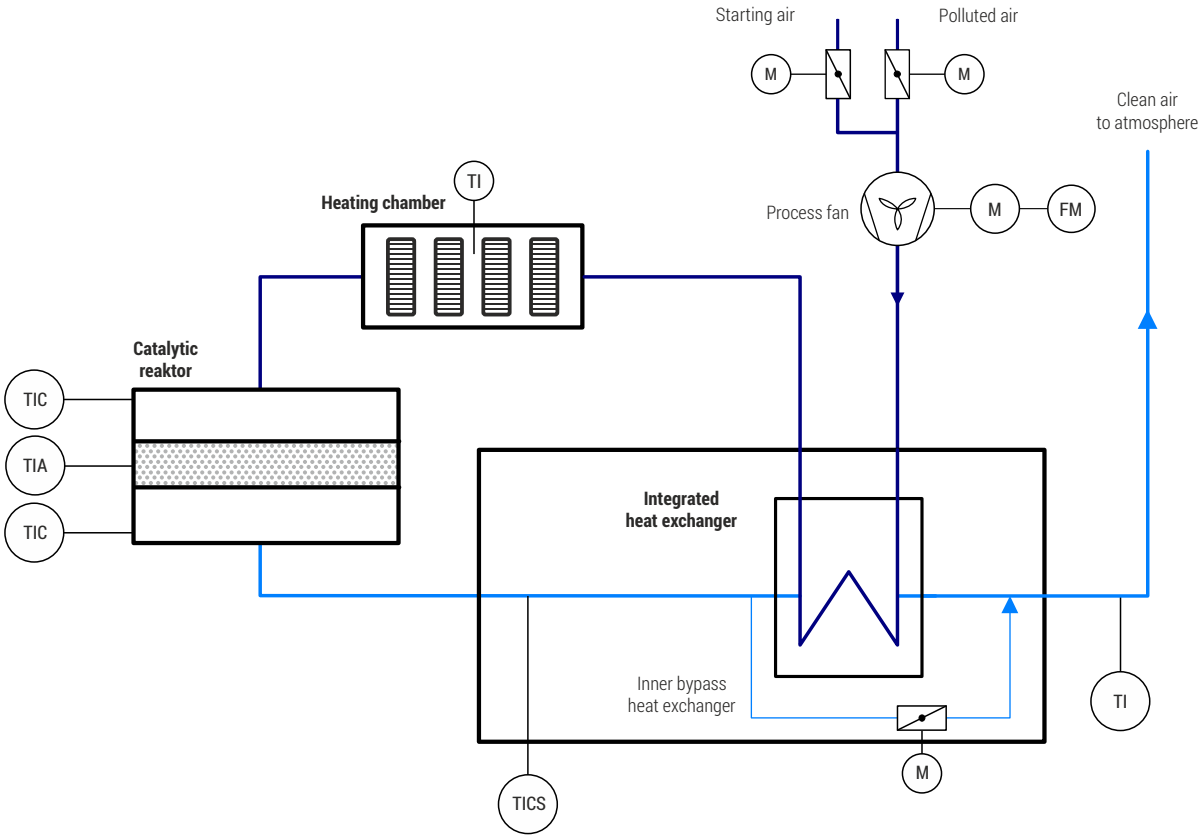
Recuperative catalytic oxidation





Recuperative thermal oxidation

The purpose of the recuperative thermal oxidation is to purify gases (usually the polluted air mass) from volatile organic compounds (VOC) using direct combustion.

Principle of operation:

The unit consists of the central steel combustion chamber embedded with a gas burner, an integrated air/air heat exchanger with cylindrically structured heat pipes and a polluted air fan.

At first, the processed air mass goes through the integrated heat exchanger, where it is preheated. Then it enters the combustion chamber (embedded with a gas burner), where the air is heated to the reaction temperature, usually between 700 – 800 °C. The size of the chamber is designed to keep the purified air retention time for the minimum of 1 second. In the chamber, VOC are oxidized into CO_2 and H_2O emitting reaction heat, which is afterwards transferred to the upcoming polluted air mass (efficiency of heat recovery is 65 – 70%). The common purifying efficiency of the whole system reaches above 99.9%.

Area of application:

The technology is suitable for purifying high and middle volume VOC gases (around 3-10 g/m^3). However, it can be operated economically only if there is a possibility of subsequent use of waste heat (heat oil, water, air). Speaking in terms of the mass of purified air, the capacity of tens of thousands m^3/h could be achieved. Typical sources of such pollution are printing works, sources from chemical and pharmaceutical industry and the surface treatment of materials and products.

Advantages of use:

- Robustness of the unit and operation reliability
- High flexibility of the unit in the means of VOC concentration

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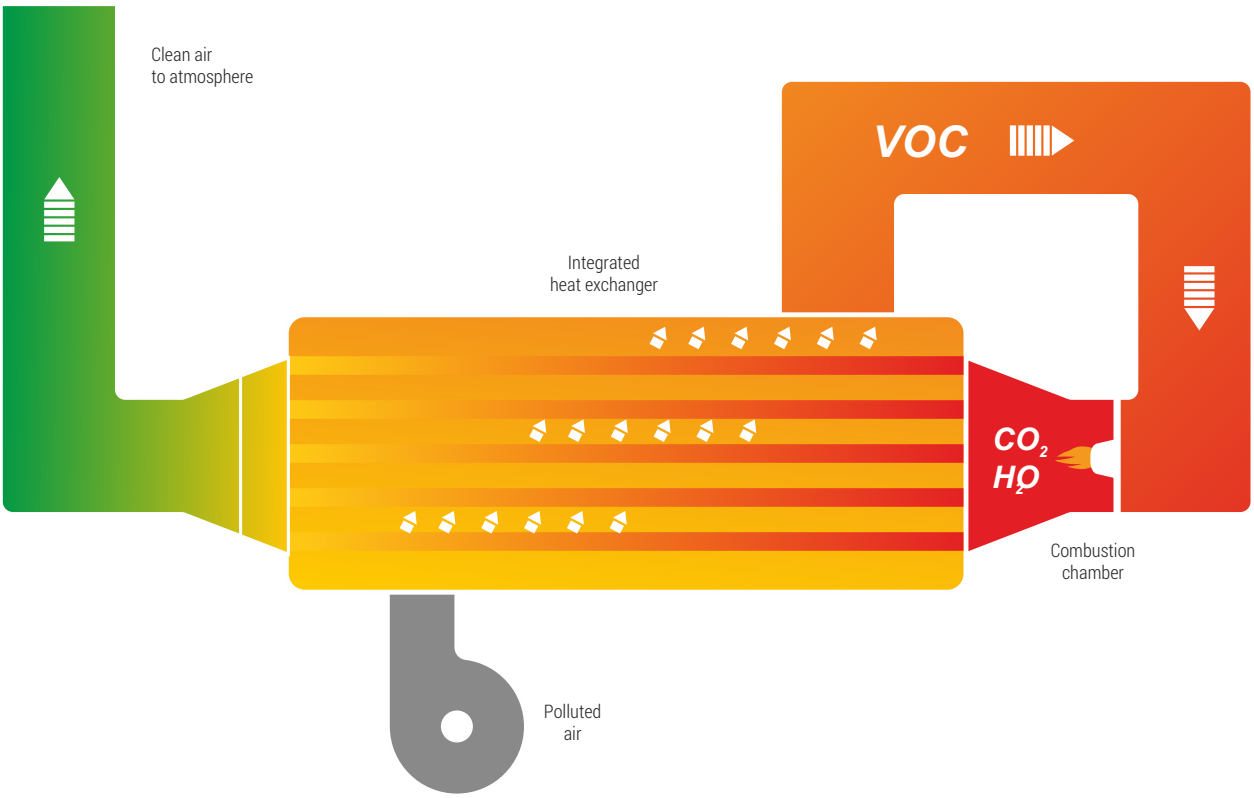
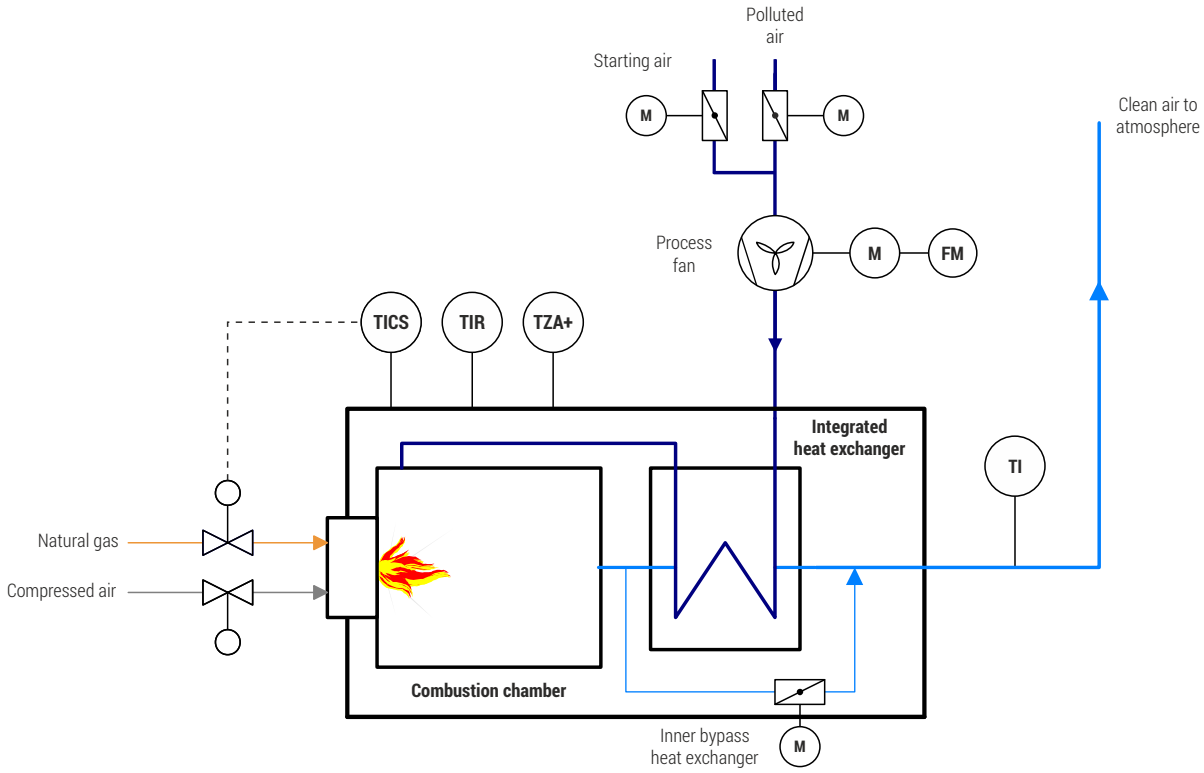
Recuperative thermal oxidation





Zeolite rotary concentrator

The purpose of the zeolite rotary concentrator is to concentrate dilute gaseous VOC in a large air volume into a smaller air volume with high VOC concentration.

Principle of operation:

The large polluted air volume passes through a rotary disc adsorber (rotor). The disc is divided into three round sectors: adsorbing (the largest area, about 80% of the disc), cooling and desorbing. In the adsorbing sector the VOC are adsorbed on a zeolite layer (synthetic aluminosilicate ceramic adsorbent), which is dashed on mineral fiber honeycombs. The purified process air is then exhausted into the atmosphere. The efficiency value of VOC capturing is about 95%.

Part of the processed air is separated from the main flow and is used firstly as cooling air for cooling the zeolite filling (before reusing the filling – cooling sector) and secondly, after passing through the desorption heat exchanger, is used as desorption air to displace the VOC from the zeolite layer (the desorption sector).

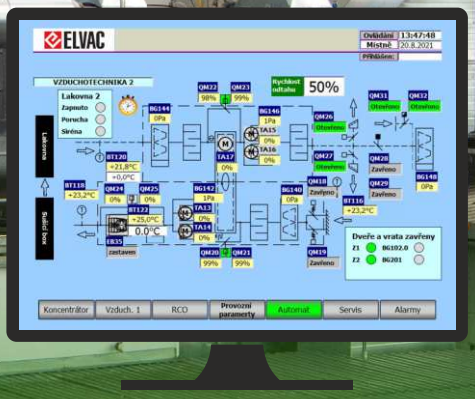
This air with a high volume of VOC (g/m^3 unit) is lead into the thermal or catalytic oxidizer. The heat, emitted by the burner and VOC combustion is partially used to preheat the inlet air mass. Afterwards, it is used in the desorption heat exchanger to heat the desorption air.

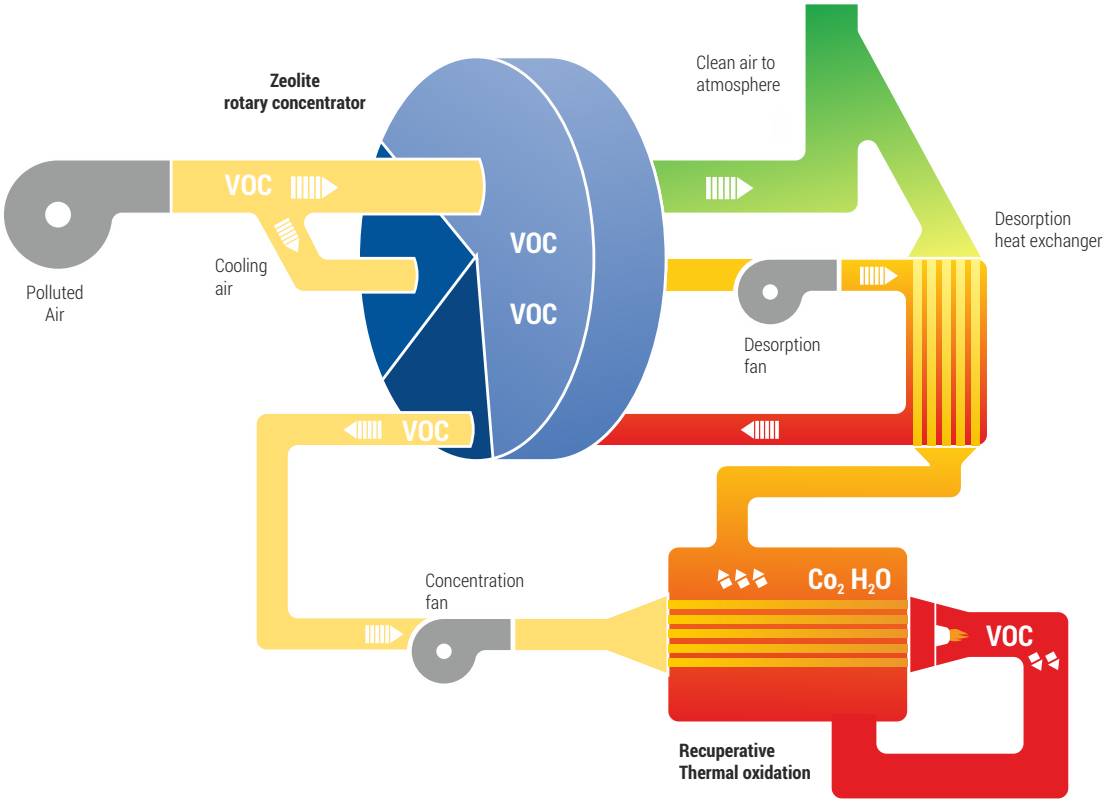
Area of application:

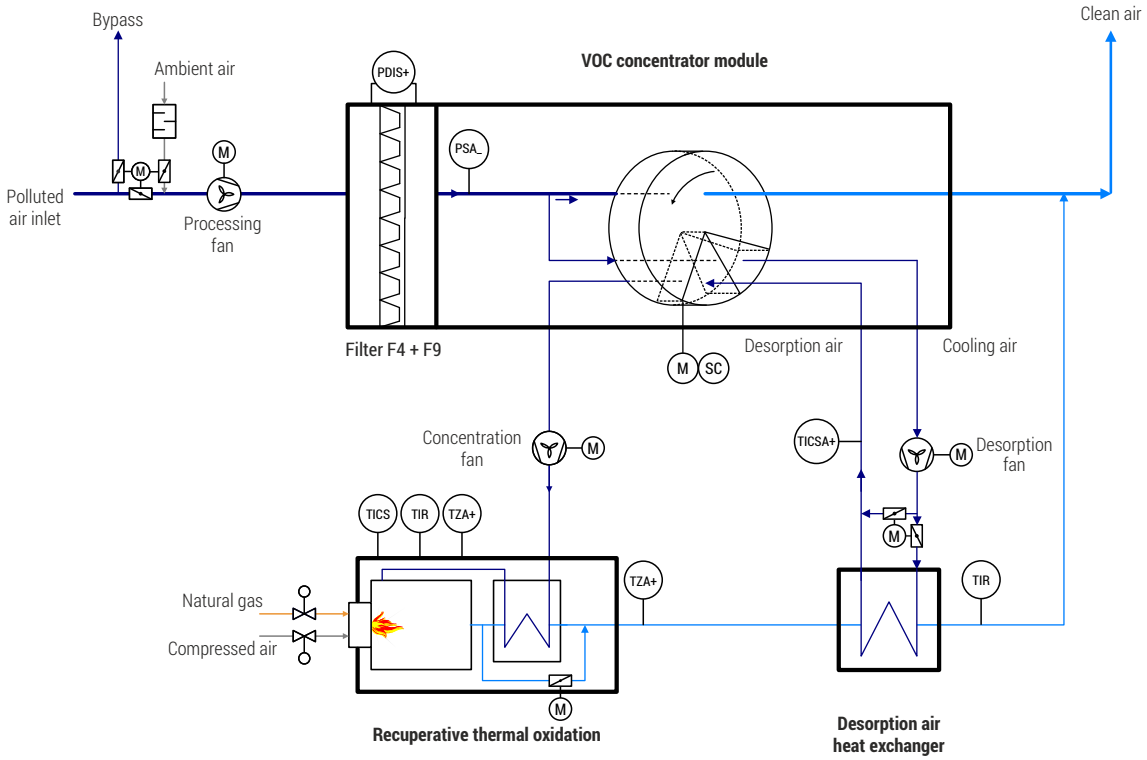
The technology is suitable for purifying low volume VOC gases (around 50 - 500 mg/m^3) and high volumes of purified air (tens to hundreds of thousands m^3/h). Typical sources of such pollution are paint shops, laminate works. Another restrictive parameters are the high humidity of inlet air, the high temperature of outlet air and the volume of dust particles. These problems have to be solved before the actual usage of this technology.

Výhody použití

- Low operational costs in relation to the volume of purified air
- Long lasting lifetime of the adsorbent material
- Flexibility of the unit in the means of VOC concentration and air mass flow
- The lowest operational costs of direct combustion in the area of its common use
- Fire safety (in contrast with charcoal)




Zeolite
rotary concentrator
Clean air to
atmosphere
VOC
Cooling
air
Polluted
Air
VOC
VOC
Desorption
heat exchanger
Desorption
fan
VOC
Concentration
fan
Co2 H2O
VOC
Recuperative
Thermal oxidation


Bypass
Ambient air
Clean air
PDIS+
VOC concentrator module
PSA_
Polluted
air inlet
Processing
fan
Filter F4 + F9
Desorption air
Cooling air
M
SC
Concentration
fan
TICSA+
Desorption
fan
TICS
TIR
TZA+
TZA+
TIR
Natural gas
Compressed air
Recuperative thermal oxidation
Desorption air
heat exchanger

Mobile recuperative catalytic oxidation unit

To accommodate the temporary needs related to emissions of volatile organic compounds (VOC), **ELVAC EKOTECHNIKA** Company has developed and constructed the mobile recuperative catalytic oxidation unit.

Parameters

- Up to 300 g/m^3 of organic compounds in polluted gas
- Maximum flow rate is 5 000 m^3/h
- Autothermal operation without external energy source for oxidation with organic compound concentration from 2 g per 1 m^3
- 99,5 – 99,9% incineration efficiency of organic compounds contained in emission gases

Description of function

- Based on recuperative catalytic oxidation
- Combustion of explosive concentrations
- Ratio of input dilution up to 1 : 100
- Process control with an FID analyzer
- 3 independent safety circuits:
  - LEL (Lower Explosive Limit) detector
  - TOC (Total Organic Carbon) continual analyzer
  - Control of thermal process

Examples of application

- Fuel storage, petroleum product storage
- Chemical plants
- Oxidation of desorbed VOC from underground waters or contaminated soils

Application and its advantages

- High mobility, fewer than 2 days' time for assembling and putting into operation
- Application within a period of days, weeks, or maximally months
- Independence from an energy source (uses its own one)
- Low operation costs thanks to autothermal operation
- Ability to clean higher volumes of gases than usual technologies

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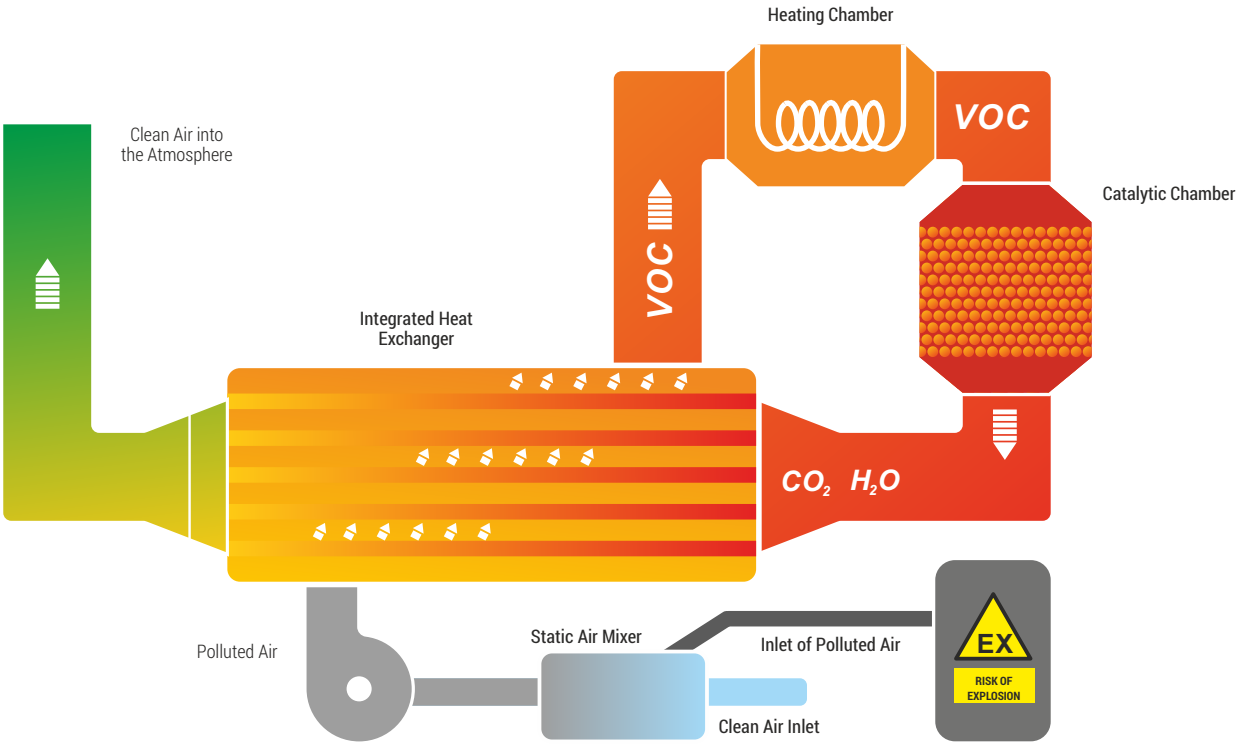
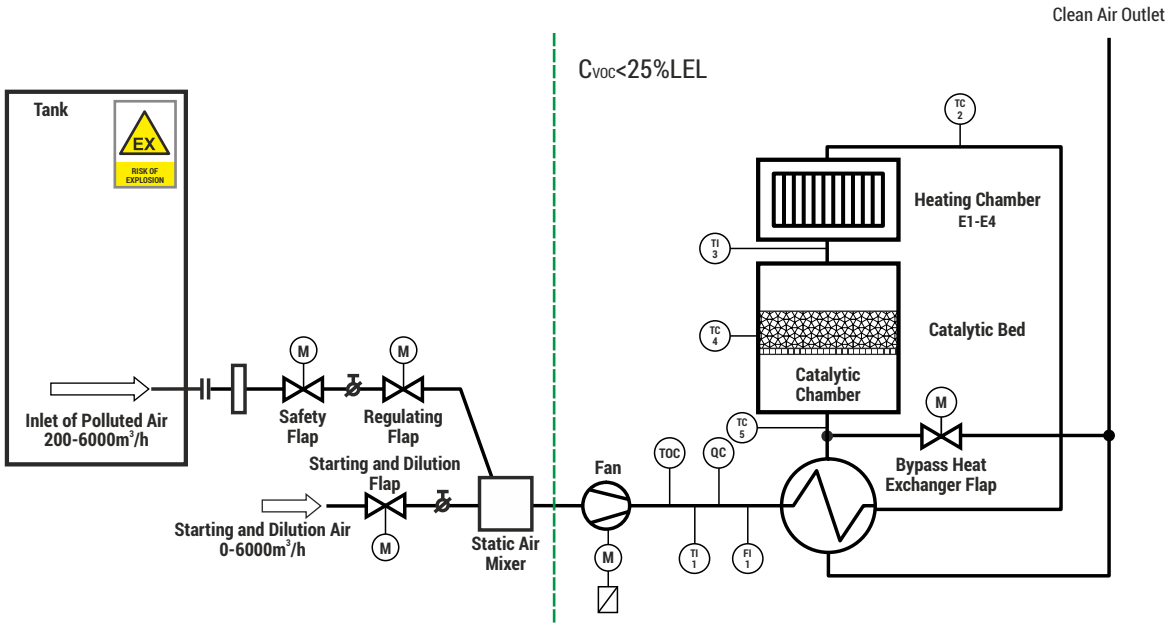
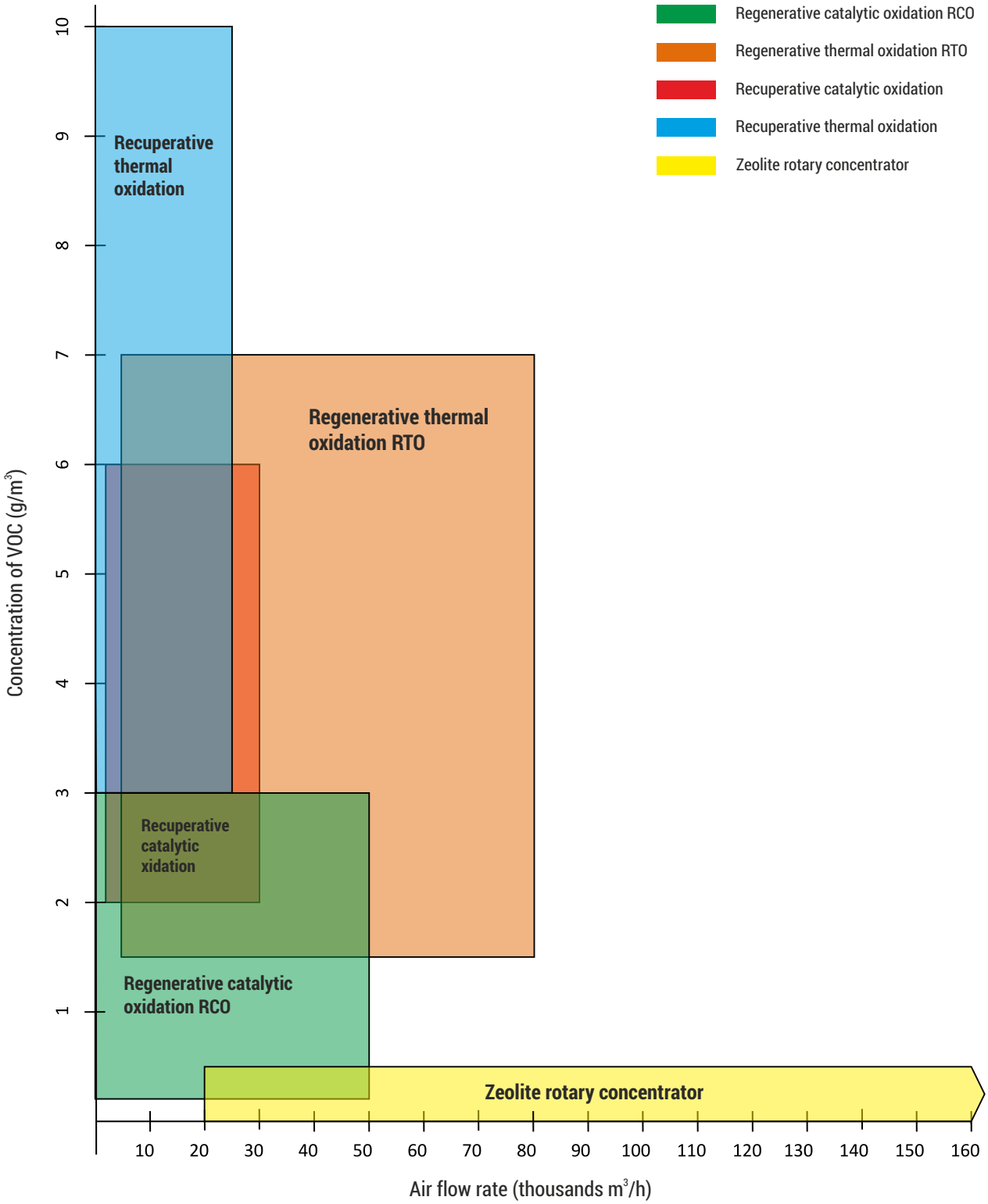
Mobile recuperative catalytic oxidation unit





Typical Areas of application of VOC abatement technologies



MEASUREMENT OF VOC EMISSIONS and PHYSICAL AND CHEMICAL LABORATORY

Correct input is key to designing the optimal technology with respect to the required limits as well as operating and investment costs.

Our company has its own accredited and authorized laboratory for measuring emissions of volatile organic substances. In addition to the standard activity of authorized emission measurement, we also carry out technological measurements in order to create a precise specification for the design of VOC liquidation technology. We analyze the collected samples in our own accredited physical and chemical laboratory.

- emissions measurement for the purpose of technology design
- the participation of a disposal equipment technologist
- coordination of measurements with the resource operator
- modeling of maxima, minima and average state in terms of VOC concentrations
- flow rate modeling
- sampling of potentially hazardous compounds, solids etc.
- analysis of the samples taken
- processing of the results in the protocol from the technological measurement
- general technological proposal
- selection of the most suitable VOC disposal technology
- optimization of production processes in binding on investment and operating costs

SERVICE DEPARTMENT

Service department of **ELVAC EKOTECHNIKA** offers comprehensive service services with a very wide range of activities and national and international scope.

We carefully monitor all the equipment we supply. We provide **warranty and post-warranty service, including technical support and service readiness.** Our service department has trained technicians, modern equipment, a strong technical background and a warehouse of spare parts.

To speed up and improve the quality of service interventions, we offer our customers the option of concluding a service contract. We also offer immediate service intervention or online advice thanks to remote access.

We are also able to carry out more complex **reconstructions, repairs and modernization of our equipment as well as the equipment of other suppliers.**

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