



CleanAir

Exhaust Air Purification Systems

 **KBA-MetalPrint**



KBA-CleanAir – Knowledge and Experience

KBA-MetalPrint GmbH

KBA-MetalPrint GmbH, based in Stuttgart, Germany, is the world's leading manufacturer of sheet metal printing and coating machines, drying equipment and exhaust air purification systems.

The company is a subsidiary of the Koenig & Bauer Group, with its headquarters in Würzburg, Germany, which is one of the largest printing machine manufacturers in the world.



www.kba-cleanair.de

On our website, you will find the latest information and news along with our multilingual technical questionnaires.

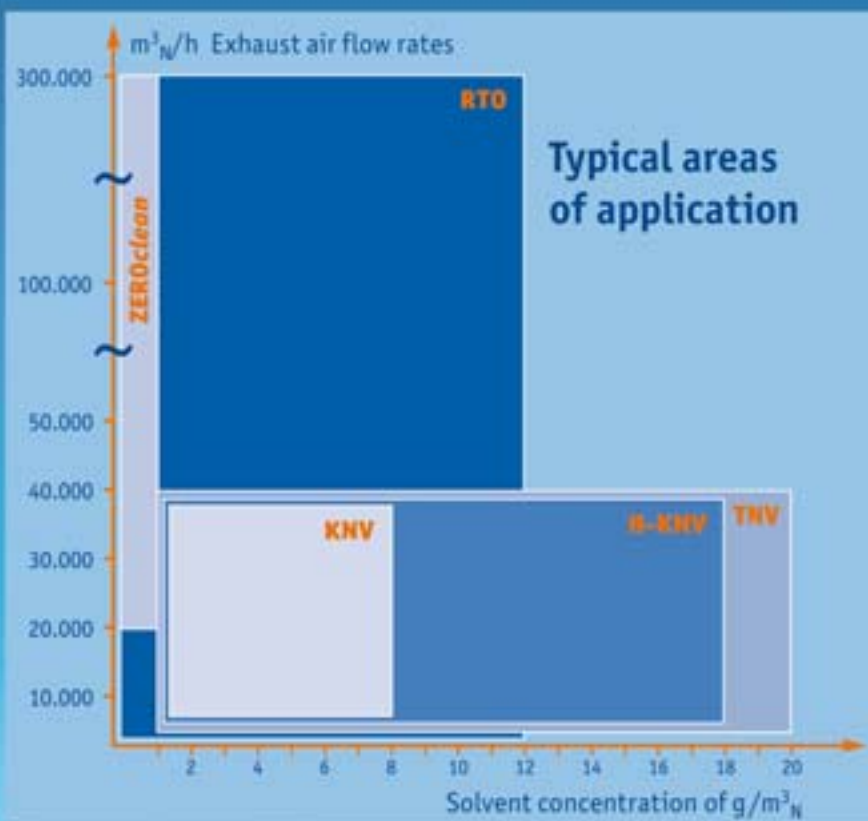
KBA-CleanAir Exhaust Air Purification Technology

KBA-CleanAir is acknowledged worldwide as having unparalleled expertise as a result of 85 years experience in the development and installation of systems in the field of air treatment and processed-air technology. This wealth of experience and extensive product range enables KBA-CleanAir

to offer clear objective advice and systems specifically designed to meet our customer's needs. Our engineers are more than just specialists in air treatment technology, they can also offer a range project management, installation, commissioning training, and after sales service.

There is no such thing as a "one size fits all" exhaust air purification system. Each customer needs a tailor made solution designed to work with their process, minimise energy consumption as well as being a safe and reliable installation and our engineers will make these objectives a first priority throughout the project from conceptual design to final acceptance. The experience and technical expertise of KBA-CleanAir's customer service staff combined with an extensive service network guarantee a rapid execution of the best solution for the customer.

KBA-CleanAir has over 1 400 exhaust air purification systems in operation around the world.





KBA-CleanAir Exhaust Air Purification Technology

Processes

Operating conditions vary greatly between companies and industries. In order to provide the customer with the best solutions both from an

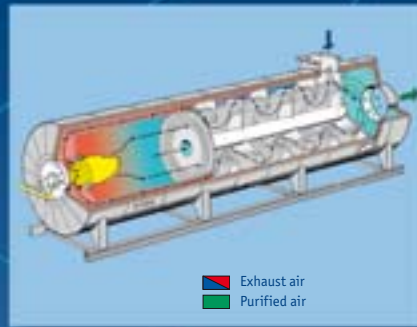
environmental and economic point of view, KBA-CleanAir offers a wide range of primary processes and auxiliary equipment:

Example Processes

- Regenerative-thermal oxidisers RTO in 1-, 2-, 3- and 5-canister design



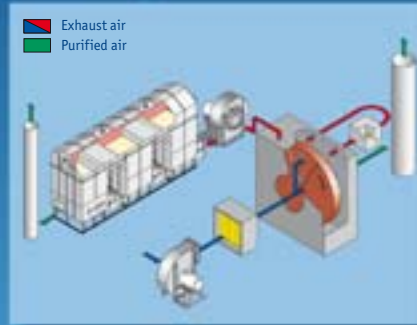
- Thermal exhaust air purification TNV



- Catalytic exhaust air purification (KNV and H-KNV)



- ZEROclean rotary adsorber system for solvent concentration



Areas of Application

- Printing industry (flexographic, roto-gravure, offset and screen printing)
- Surface finishing (painting, coating and laminating)
- Metal packaging industry
- Dye and paint manufacturing
- Chemical industry
- Odour elimination
- Soil decontamination
- Ceramic and brick industry
- Plastics manufacturing
- Styrene and synthetic resin processing
- Textile industry

Auxiliary Equipment and Services

- Optimisation of printing machines
- Heat recovery (thermal oil, steam, hot water and air pre-heating)
- Dust filters
- Washing systems
- NO_x reduction

Clean Air Values

KBA-CleanAir's units fulfil all requirements of the European regulations (like VOC-directive 13/1999/EG) as well as the stricter demands of the German ones, such as "TA-Luft 2002".

KBA-CleanAir provides a comprehensive consultation service.

KBA-CleanAir can provide the full range of services that may be required by our customers.

Analysis

A comprehensive understanding and analysis of the customer's problem should always be the first step. This provides KBA-CleanAir with a precise assessment of the production procedures and site conditions as well as the particular exhaust air purification needs of the customer. Where necessary, KBA-CleanAir engineers conduct on-site measurements of the exhaust air streams to obtain a more exact picture of the needs. Once obtained, this data is used to establish the most technically appropriate and cost-effectiveness solution.

Primary Steps

In order to keep capital and operating costs to a minimum for new installations, our engineers will carry out an exhaust air flows reduction exercise using air recirculation and machine optimisation techniques.

Regulatory Authorities and Permits

Throughout the project, KBA-CleanAir can assist customers to ensure that they comply with the official regulations.

Engineering/Installation

To ensure consistently high quality and performance standards, KBA CleanAir designs, manufactures, installs and commissions all of their systems from start to finish.

Maintenance and Service

The company only uses its own service staff, thus ensuring that advice and training given during installation and subsequent service support is of the highest standard resulting in a close and successful long-term relationship with our customers.

Thermal Exhaust Air Purification TNV

In this well proven and widely used process, the exhaust air is passed over a naked flame and the solvents are oxidised at 650 - 740°C (1 200 - 1 370°F) to form carbon dioxide and water vapour. The use of special in-house developed burner technology ensures that CO and NO_x emissions are kept to a minimum. At the beginning of the 1970's, KBA-MetalPrint (formerly LTG) was already building the first thermal incineration units for their own ovens and more than 1 400 of these units have been installed all over the world. KBA employs the most suitable and up to date components and can choose from a range of different designs to achieve the optimum solution for each application.



"ECO-TNV" for 12 000 m³_N/h of exhaust air from a coating line with solvent concentrations of up to 8 g/m³_N with economic stand-by mode.

Areas of Use

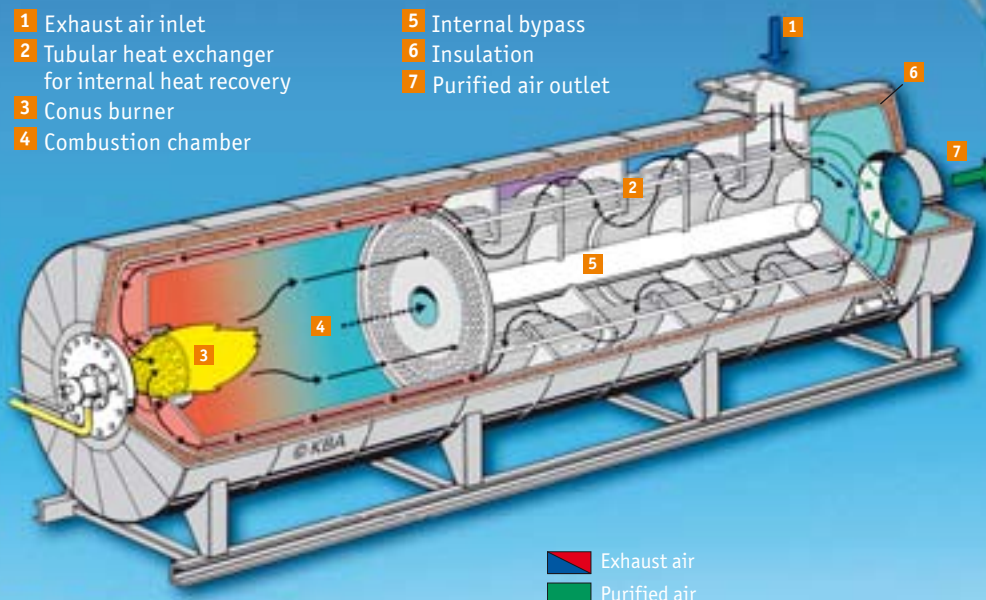
This process is especially suitable for consistently **high solvent concentrations or high waste heat requirement**. This well proven process copes well with problematic exhaust air flows with high dust loadings or condensation effects.

Product Line

- Sizes: 1 000 - 40 000 m³_N/h (600 - 23 500 scfm)
- Compact systems with integrated tubular heat exchanger
- Systems with separate combustion chamber and tubular heat exchanger for special applications
- Mobile units
- Heat exchangers with thermal efficiencies from 30% to 70%
- Single and multi-fuel burner systems for natural gas, LPG, fuel oil and special fuels
- Heat recovery systems producing steam, thermal oil and hot water

- 1 Exhaust air inlet
- 2 Tubular heat exchanger for internal heat recovery
- 3 Conus burner
- 4 Combustion chamber

- 5 Internal bypass
- 6 Insulation
- 7 Purified air outlet



- Exhaust air
- Purified air



TNV unit for cleaning the exhaust air which contains phenol from an air filter production plant (pleating machines and paper drying kilns). The high level of internal heat recovery and downstream waste heat hot water system ensure efficient operation.

Combustion Chamber (CC) Product Line

One special version among the thermal incineration units are combustion chambers without internal heat exchanger.

These systems are designed to be used where waste heat requirements are very high or where low investment costs are crucial because of short operating periods.

- Sizes: 500 – 50 000 m³_N/h (300 – 29 500 scfm)
- Compact, rugged and steel construction
- Fitted with ceramic linings for combustion temperatures up to 1 000°C (1 830°F)
- Brick-lined version for special applications



Combustion chamber designed for an exhaust air flow rate of 50 000 m³_N/h (129 500 scfm) used in a new concept for soil decontamination. The unit is semi-mobile, allowing it to be taken from site to site. For the first time in Europe this plant combination offers thermal cleaning for contaminated soil at a rate of up to 100 tons/hour!



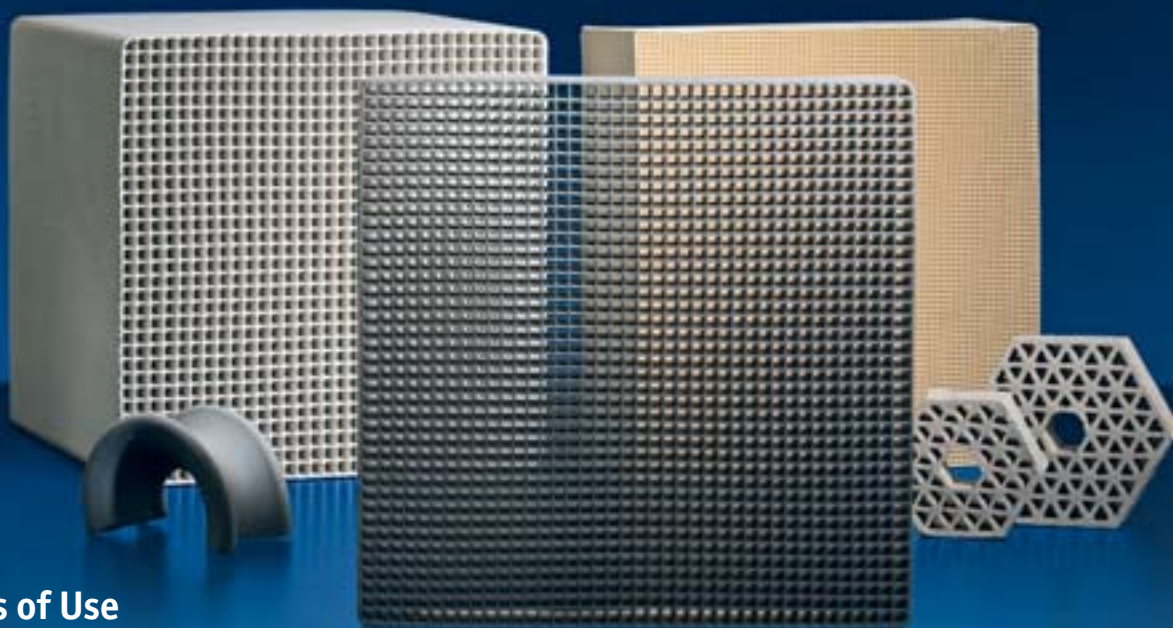
This combustion chamber CC 2000 is being used in a spice factory to deodorise the exhaust air with ppm concentrations.

Regenerative-Thermal Oxidiser RTO

Regenerative-thermal oxidisers represent the state of the art in industrial exhaust air purification applications. Moreover, they are acknowledged in many sectors as the

most economic, universally flexible and durable technology. They are also known for their high operational reliability, robust design, simplicity of operation and low maintenance

costs. Today, these systems are frequently used in continuous operation, even when treating low concentrations of noxious substances (such as odour elimination).



Areas of Use

KBA-CleanAir RTO units represent the optimum solution for a wide range of applications. They are capable of handling low to very high flow rates with different solvent concentrations. Running a RTO is highly cost effective, even with very low VOC concentrations, since it has a high level of internal heat recovery in the *XtraComb*[®] heat exchanger which has been developed by KBA. At high VOC concentrations, the units can recover

energy via a hot bypass system which can divert air directly from the combustion chamber through a secondary heat exchanger in order to produce either hot oil, steam or hot water. This energy can then be used for heating the production process, the factory space or even used for refrigeration. The excess energy appears in the system when the amount of energy liberated from the solvents is greater than that needed to run the oxidisa-

tion process and so can be diverted for use in the customer's process. This usable surplus energy costs very little to recover thereby greatly reducing the customer's over-all energy consumption. By the use of special ceramic lining, stainless steel construction and external insulation on the canisters, the unit can also be used to handle problematic airstreams containing potentially corrosive elements.

Design and Operation

As with the thermal incineration system TNV, the solvents are oxidised at high temperatures (760 - 820°C (1400 - 1520°F)) in a combustion chamber to produce carbon dioxide and water vapour. The very high level of internal heat recovery is achieved by using ceramic saddles or structured honeycombs through which the incoming dirty process air stream and the hot purified air stream are passed in alternating directions for short periods resulting in a very efficient transfer of

energy between the two air flows. The switching of air streams is done by the air distribution system which has to ensure that there is no cross contamination between the incoming and outgoing flows. To achieve this, KBA-CleanAir has developed its own fast acting valves and airtight dampers which are manufactured to a high quality and are individually tested before leaving KBA-MetalPrint. The first series are still in use after more than 130 000 operating hours and almost 20 years of continuous operation.





Product Line

With its wide variety of different product lines, KBA-MetalPrint can offer optimum flexibility in designing individual systems:

- Installations of 10 000 - 500 000 m³_N/h (6 000 - 175 000 scfm) in 2-, 3- and 5-canister design
- **RTOcompact** installations in 2- and 3-canister design for air flow rates from 2 000 - 10 000 m³_N/h (1 200 - 6 000 scfm)
- Special burners with direct gas injection DGI
- Internal heat recovery up to 98% by using **XtraComb®**
- Burner systems for natural gas, LPG fuel oil or multi-fuel

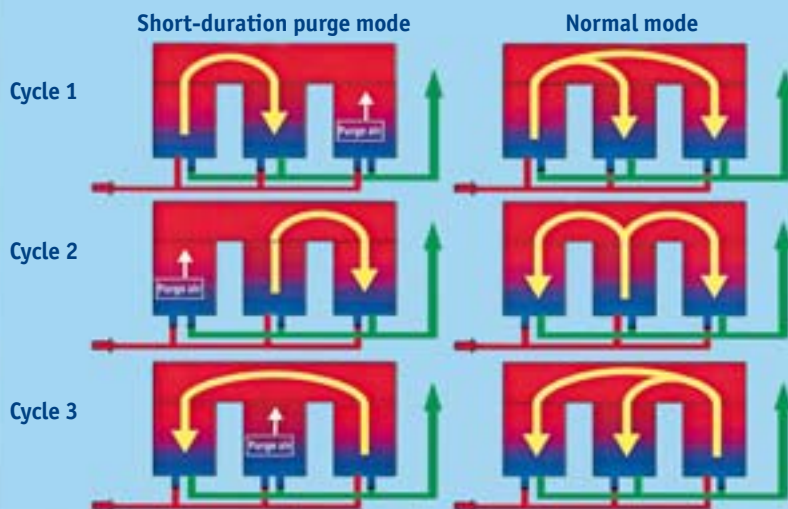


Vulcanization: RTO 40 000 with hot bypass and upstream fine dust filter for the exhaust air from plants producing rubber/metal composites. Supplied prepared for retrofitting to a waste heat hot water boiler in the hot bypass.

Features

- "Hot bypass" for high solvent concentrations
- "Burn-out" process for automatic cleaning in case of heat exchanger condensate build up – this process can be supplied in either online or offline configurations
- Buffer system for 2-canister units used to prevent emission peaks
- Special internal insulation with protection layers for aggressive compounds such as fluorine or chlorine
- Integrated or downstream heat recovery systems for steam, thermal oil or hot water
- Burner lances for injecting distilled waste liquid, solvent residues

Operating cycle of a KBA-CleanAir 3-canister installation



RTOcompact Series



Automotive: RTOcompact 5/2T for purification of exhaust air from a painting plant for pressed sheet-steel components for a car component manufacturer in the Czech Republic.



Surface coating: RTOcompact 7/3T for cleaning of concentrated exhaust air delivered through a rotary adsorber in the sector of paint finishing.

System Concept

The RTOcompact series developed by KBA-CleanAir was designed for purifying low flow rates directly or downstream of a concentration system giving low investment and operating costs. The XtraComb® heat storage system used by KBA-CleanAir enables the achievement of low autothermal operating points resulting in fuel cost savings. The simple, durable and compact design requires only short assembly and commissioning times combined with low maintenance costs.

Type RTOcompact	Max. flow rate [m³ _N /h]	Fan power [kW]	Burner power [kW]	Dimensions LxWxH without control cabinet
5 / 2T	5 000	15	100	4.3 x 1.8 x 3.4
7 / 2T	7 500	22	150	4.5 x 2.1 x 3.5
10 / 2T	10 000	30	230	5.5 x 2.1 x 3.8
5 / 3T	5 000	15	100	6.6 x 1.8 x 3.4
7 / 3T	7 500	22	150	6.9 x 2.1 x 3.5
10 / 3T	10 000	30	230	8.5 x 2.1 x 3.8



Automotive: Numerous spray booths in the automotive sector are equipped with this RTOcompact 7/3T.

RTO 2-Canister Series



Rotogravure printing: RTO 2-canister 55 000 for treating the exhaust air from 3 rotogravure printing machines. In this project, KBA also carried out the printing machine optimisation to reduce the exhaust air volume.

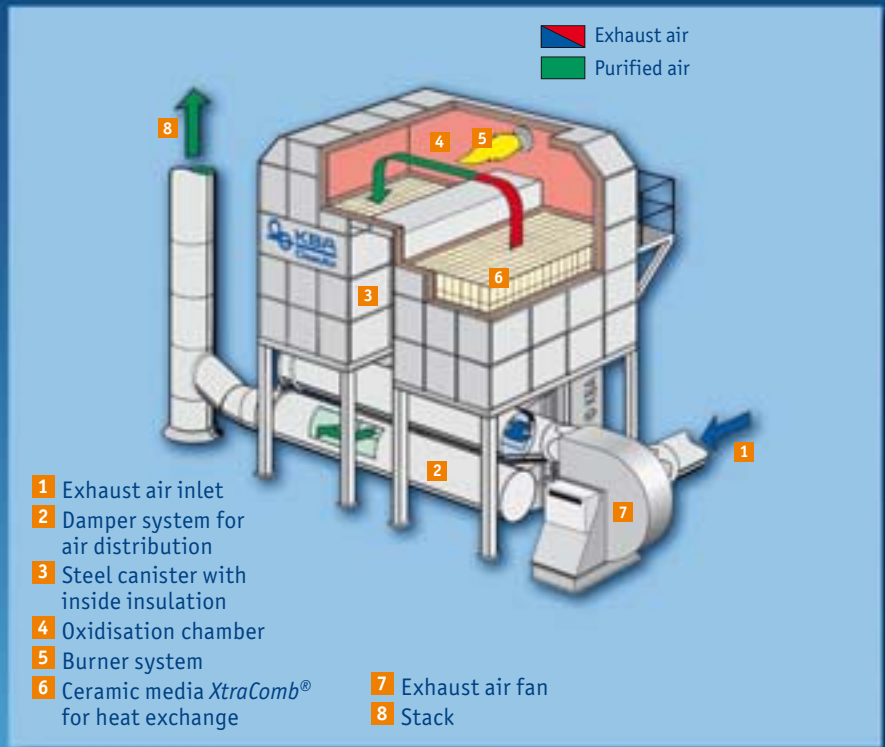


Metal packaging: RTO 15 000 for purifying the exhaust air from 2 metal printing and coating lines.

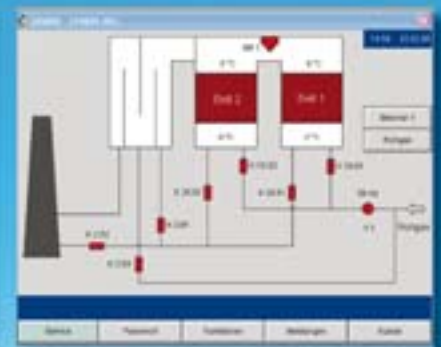
System Concept

The economical 2-canister version was developed for applications with low solvent concentrations up to approx. $4 \text{ g/m}^3_{\text{N}}$ and low capital investment requirements.

As the 2-chamber system does not have the purge canister, the air stream is only cycled between the two canisters. Fast acting air tight dampers guarantee that average levels of VOC in the outgoing purified gas comply with the regulations. The use of a buffer system (if necessary) reduces the peaks which occur during the damper switching phase of the cycle.



Flexographic printing: RTO 2-canister unit with the third canister used as buffer for $30\,000 \text{ m}^3_{\text{N}}/\text{h}$ of exhaust air from a flexographic print operation. If the process changes at a later date and the solvent concentrations are higher, the RTO can be converted to a full 3-canister RTO system.



Schematic diagram of the RTO functions using the KBA standard touch-panel visualisation system.

RTO 3-Canister Series



Decorative printing: Exhaust air purification system RTO 60 000 for 2 decorative rotogravure printing machines with burn-out, drying process and purified air recirculation for energy reduction.

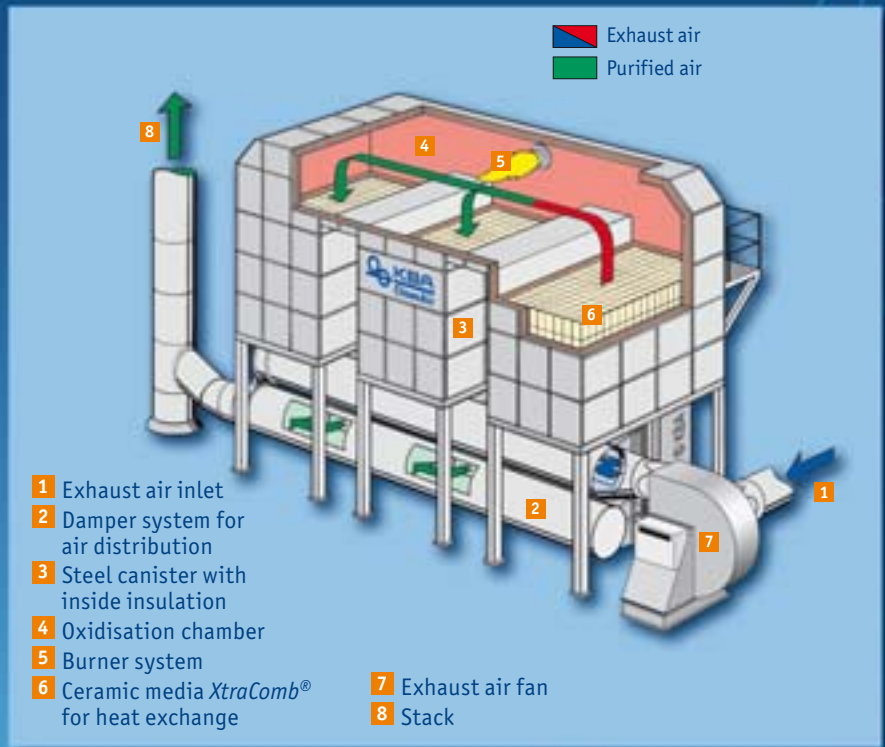


Metal packaging: This RTO 20 000 with special burn-out system is used to purify the exhaust air from 2 curing ovens.

System Concept

The most well-known regenerative design is the 3-canister version with two operation canisters and one purge canister. This design is used to satisfy the highest emission standards. With the extensive range of options available, this process can be employed in the most difficult operating conditions.

In the three canister system, the canister handling the incoming dirty air is put into a purge mode before it becomes a clean outgoing canister thus avoiding the release of un-purified air to atmosphere. This ensures a very high level of destruction of the contaminants which is essential to meet current and future regulations particularly where there is a high ingoing solvent concentration. Special controllers and an advanced damper timing sequence minimise the pressure drop in the system saving electrical energy and reducing the overall operating costs of the units.



Tube production: Special RTO 20 000 in 3-canister design for 7 printing and coating lines producing metal tubes.

Customer Applications



Odour elimination from a foundry: 5-canister RTO version purifying 200 000 m³_N/h of exhaust air from a Bavarian car manufacturer's light-metal foundry.



Consumer products industry surface finishing: 3-canister 60 000 m³_N/h RTO for a shaver production plant with energy consumption minimised using **XtraComb**[®] and an energy saving air pre-heating system for the process dryer.



Car interior surface finishing: The 100 000 m³_N/h of exhaust air from spray booths is purified using this **XtraComb**[®]-RTO. The RTO is now the preferred method due to its low energy consumption and high versatility which means it is applicable for a variety of different coatings being used by the customer.



Rotogravure, cigarette packaging industry: A 45 000 m³_N/h RTO with hot bypass purifying the exhaust air from 2 rotogravure printing machines.



Construction material coating: A 26 000 m³_N/h RTO with hot water heat exchanger for cleaning the exhaust air from bitumen coating of construction materials.

RTO Innovations and Patents



Odour elimination in the aroma industry: Two stainless steel RTOs operating in parallel with special online burn-out for purifying 28 000 m³_N/h of contaminated exhaust air from an aroma manufacturing facility.

XtraComb®

KBA-CleanAir has enhanced and optimised ceramic heat exchanger technology. The optimum energy utilisation under all operating conditions has been achieved with KBA-CleanAir's own tailor-made, individual geometry, material and coating combinations – the system **XtraComb®**.

XtraBalance®

Flow rates and solvent concentrations are subject to enormous fluctuations. This produces constantly changing energy inputs into the RTO system resulting in different temperature and energy profiles in each heat exchanger bed. The effect is increased by energy from the solvents and can lead to shutdown of the plant on safety grounds.

The development of **XtraBalance®** has been based on years of experience with many installations in various industries. Sensors record the temperature profiles of the individual heat exchangers and these are used to calculate the energy difference between the canisters. The results of this monitoring are used to automatically adjust the heat balance via the intelligent energy management system.

XtraControl™

Depending on the type and composition of the solvents, a large part of the oxidation process takes place in the incoming ceramic heat exchanger bed. Even at low solvent concentrations (from 2.5 g/m³_N), the temperature in the heat exchanger can be higher than that in the combustion chamber – a situation which is known as “reverse heat exchange”. In this case the bed temperatures can reach 1 000°C (1 830°F) which leads to unwanted malfunction shutdowns.



Automotive: 3-canister RTO purifying 30 000 m³_N/h of exhaust air from numerous extraction sources in the manufacture of engine seals. With hot bypass and **XtraComb®** ceramic heat storage media, **XtraBalance®** and **XtraControl™** optimise internal heat recovery resulting in low energy consumption.

As a result of its numerous innovations and patents, KBA-CleanAir has become one of the leading suppliers of RTO exhaust air purification systems. In particular, these include:

- **XtraComb®**
- **XtraControl™**
- **XtraBalance®** (patented)
- Direct gas injection (pulsed or regulated)
- Offline and online burn-out
- Patented 1-canister reactor
- Rotary control valve
- Special insulation design for problem substances

The control mode **XtraControl™** acts to prevent this phenomenon. Sensors in the heat exchangers and the combustion chamber define the “average system temperature”, so the combustion chamber temperature is regulated according to a sliding value rather than a fixed value. This ensures that the energy from the oxidised solvents is fully utilised to reduce operating costs. As well as greatly increasing operational reliability, it also allows the system to optimise the use of the energy saving hot bypass.

Concentration System ZEROclean



Solvent Concentration with Thermal Post-Treatment

Using a combination of concentration followed by thermal oxidation is a particularly cost-effective way of purifying high volume exhaust air flows containing low solvent concentrations. By combining the systems, the total investment and, in particular, the operating costs can be significantly reduced when compared with direct thermal incineration.

Areas of Use

- Painting industry
- Semiconductor industry
- GRP industry



Car interior finishing: A ZEROclean concentration system handling 50 000 m³_N/h of exhaust air followed by a RTOcompact 5 000.

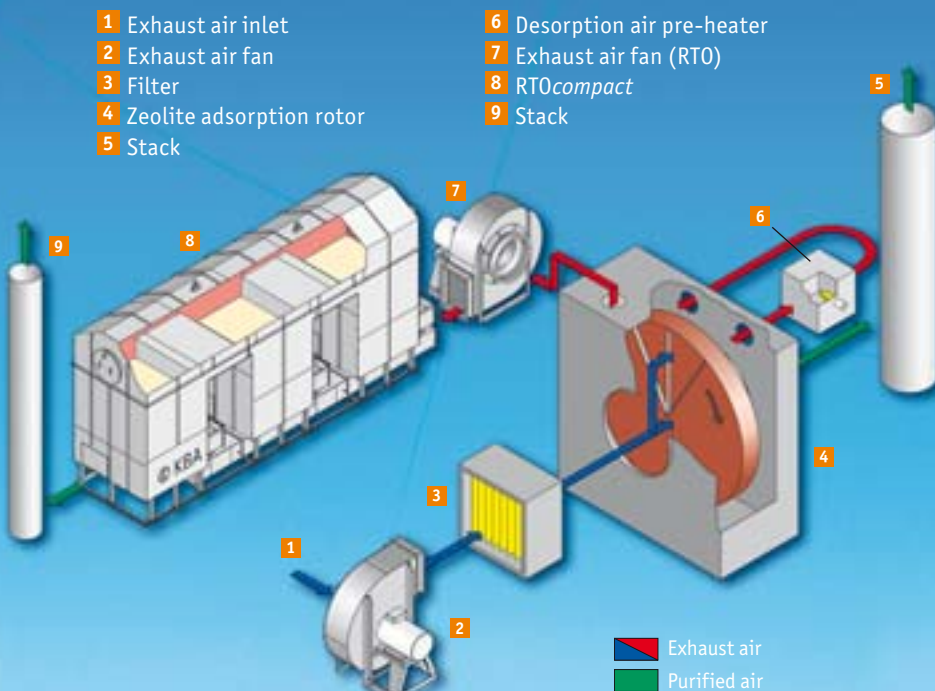
Typical Areas of Application

- For flow rates from approx. 25 000 - 300 000 m³_N/h (14 700 - 177 000 scfm)
- At low solvent concentrations < 1 g/m³_N
- At low exhaust air temperatures < 40°C (104°F)
- Concentration ratios up to 1:20

Description of the Process

This process is ideal for treating low levels of solvents by adsorbing the VOCs into a rotor containing hydrophobic zeolite. After adsorption, the solvents are then subsequently desorbed into a much lower volume of hot air. This air containing the concentrated, high solvent loadings is purified using the most appropriate thermal oxidation method (TNV, KNV or RTO).

The air going into the concentrator can be pre-heated via an air to air heat exchanger using the energy from the clean exhaust flowing out of the oxidiser thus further reducing the running costs.



Catalytic Exhaust Air Purification KNV and H-KNV

Catalytic exhaust air purification units have been part of the KBA CleanAir product range for over 40 years. By using heavy-duty catalysts based on mixed oxides or precious metals, it is possible to use catalytic systems in a variety of applications with operating lives in excess of 30 000 hours. The operating temperature is 270 to 320°C (515 to 610°F), which means that the primary energy requirement is much lower compared with a thermal system. The units are used for conventional VOC reduction and special applications such as NO_x reduction, purification of exhaust air from stationary engines and for carbon monoxide (CO) removal from exhaust air flows.



Sizes designed to handle flow rates up to 9 000 m³_N/h are delivered pre-assembled on a base frame (see sectional diagram); larger units are assembled on site.

Areas of Use

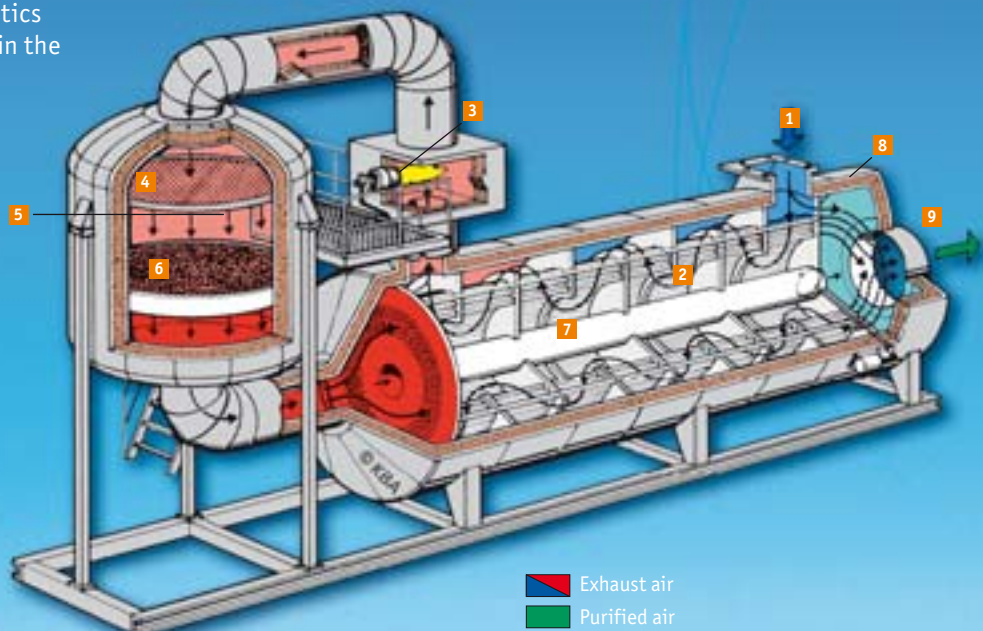
The catalytic process is particularly suitable for widely fluctuating concentrations of solvents and for applications with little need for waste heat. The H-KNV series can be used for high concentrations up to 18 g/m³_N (respectively up to 50% LEL) as well as exhaust air streams containing chlorine without the risk of producing dioxin. Other typical areas of application are the plastics industry and odour elimination in the food industry.

Special Application – Ozone

Industrial ozone emissions, such as those produced by UV dryers or corona systems for increasing adhesion properties have increasingly to be collected and purified. For this reason, the modular catalytic series

OzoneCat has been developed to handle exhaust air flows from 500 to 5 000 m³_N/h (300 - 3 000 scfm). It operates at ambient temperature, has virtually no wear parts and is especially suitable for retrofitting to existing installations.

For detailed information, a special brochure is available.



- 1 Exhaust air inlet
- 2 Tubular heat exchanger for internal heat recovery
- 3 Burner
- 4 Air distribution grid
- 5 Inspection opening
- 6 Catalytic oxidation chamber
- 7 Internal bypass
- 8 Outer shell insulation
- 9 Purified air outlet



Product Line

Individual solutions are based on the following three series:

- Sizes: 500 - 40 000 m³_N/h (300 - 24 000 scfm)
- Compact KNV units with plate heat exchanger for exhaust air flow rates from 500 - 8 000 m³_N/h (300 - 4 700 scfm)
- Compact KNV units with regenerative rotary heat exchanger for exhaust air flow rates up to 12 000 m³_N/h (7 000 scfm) and limited space
- Units with tubular heat exchanger (thermal efficiency 45 - 70%) for exhaust air flow rates from 1 000 - 40 000 m³_N/h (600 - 24 000 scfm)
- Special designs with regenerative heat exchangers (thermal efficiency up to 96%) for exhaust air flow rates from 5 000 - 40 000 m³_N/h (3 000 - 24 000 scfm)

Individual designs include:

- Units for solvent concentrations up to 18 g/m³_N
- Pellet and honeycomb catalysts in various forms and compositions
- Integrated or downstream heat recovery systems for steam, thermal oil, hot water or clean air heating
- Pre-heating via natural gas, LPG or electrical heat exchangers
- Injection systems for waste solvents
- Mobile and trial units



Service

When the catalyst has to be replaced, this is carried out quickly and safely by our customer service department. This also includes the special suction device for clean removal and the return and proper disposal of the spent catalyst material.



A catalytic system type H-KNV 3 000 handling a very high concentration of exhaust air from a coating plant. The unit is heated electrically and has an integrated thermal oil heat exchanger for heating the dryer system.