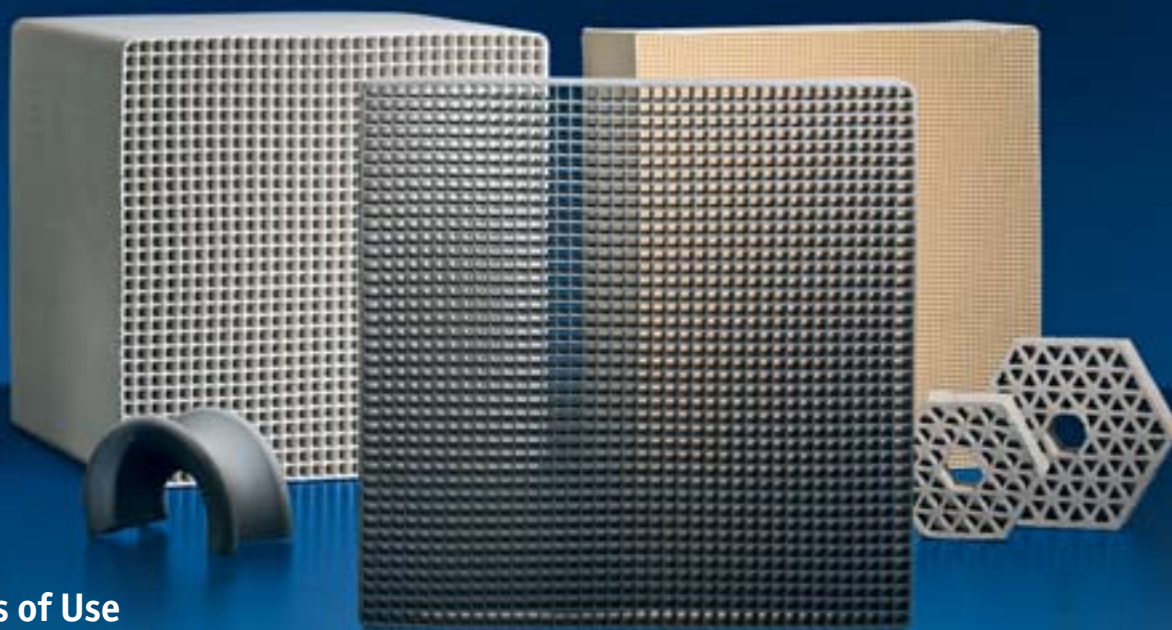


# Regenerative-Thermal Oxidiser RTO

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*<sup>®</sup> 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 m<sup>3</sup><sub>N</sub>/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 m<sup>3</sup><sub>N</sub>/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

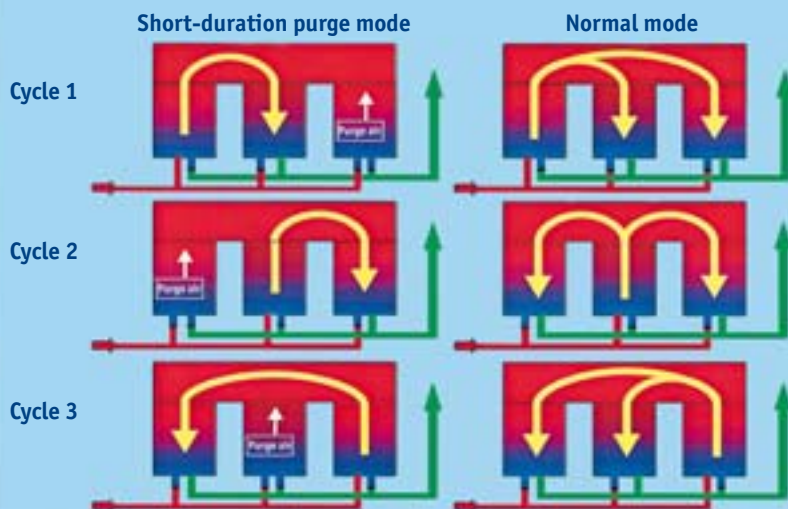


**Vulcanization:** RTO 40 000 with hot bypass and upstream fine dust filter for the exhaust air from plants producing rubber/metal composites. Supplied prepared for retrofitting to a waste heat hot water boiler in the hot bypass.

## 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 <sub>N</sub> /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.

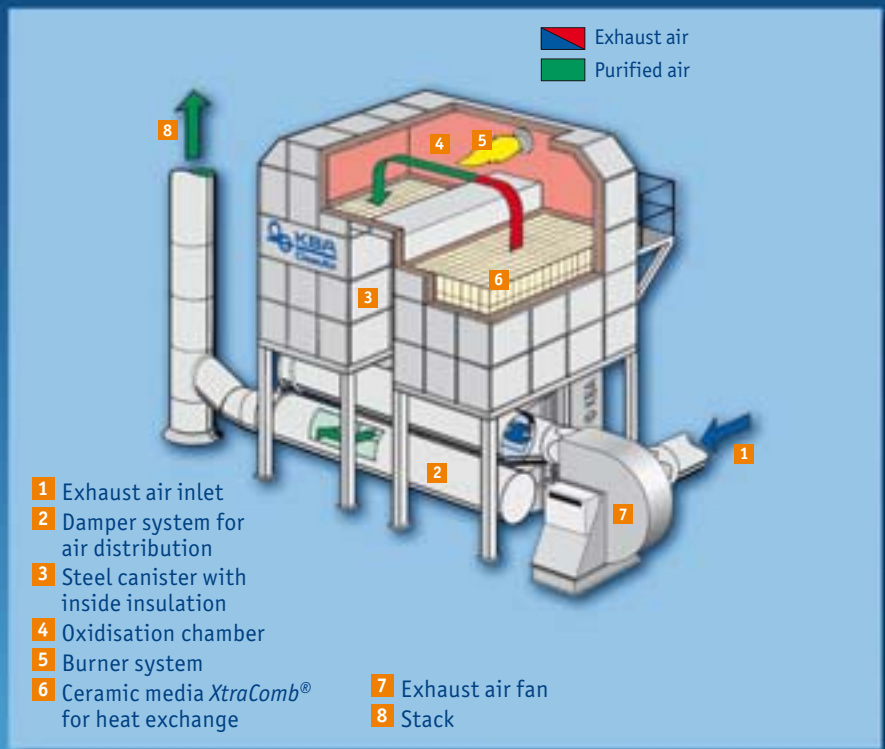


**Metal packaging:** RTO 15 000 for purifying the exhaust air from 2 metal printing and coating lines.

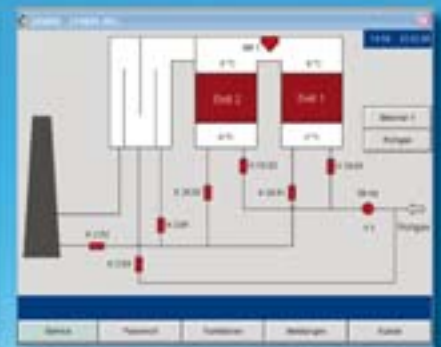
## System Concept

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.

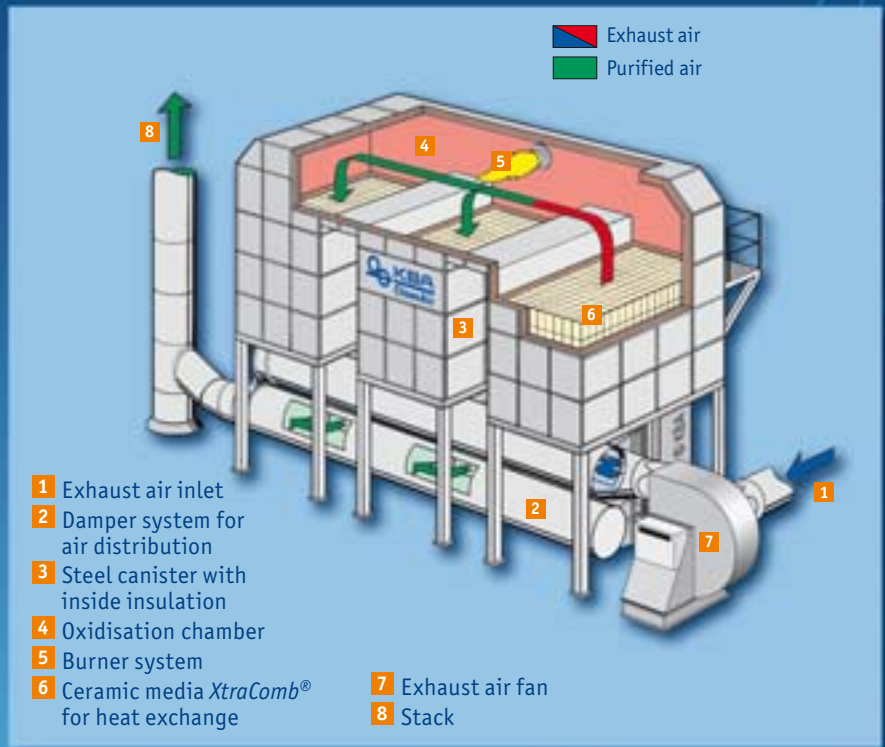


**Metal packaging:** This RTO 20 000 with special burn-out system is used to purify the exhaust air from 2 curing ovens.

## 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 m<sup>3</sup><sub>N</sub>/h of exhaust air from a Bavarian car manufacturer's light-metal foundry.



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



**Car interior surface finishing:** The 100 000 m<sup>3</sup><sub>N</sub>/h of exhaust air from spray booths is purified using this **XtraComb**<sup>®</sup>-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 m<sup>3</sup><sub>N</sub>/h RTO with hot bypass purifying the exhaust air from 2 rotogravure printing machines.



**Construction material coating:** A 26 000 m<sup>3</sup><sub>N</sub>/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 m<sup>3</sup><sub>N</sub>/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/m<sup>3</sup><sub>N</sub>), 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 m<sup>3</sup><sub>N</sub>/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.



## Product Line

Individual solutions are based on the following three series:

- Sizes: 500 - 40 000 m<sup>3</sup><sub>N</sub>/h (300 - 24 000 scfm)
- Compact KNV units with plate heat exchanger for exhaust air flow rates from 500 - 8 000 m<sup>3</sup><sub>N</sub>/h (300 - 4 700 scfm)
- Compact KNV units with regenerative rotary heat exchanger for exhaust air flow rates up to 12 000 m<sup>3</sup><sub>N</sub>/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 m<sup>3</sup><sub>N</sub>/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 m<sup>3</sup><sub>N</sub>/h (3 000 - 24 000 scfm)

### Individual designs include:

- Units for solvent concentrations up to 18 g/m<sup>3</sup><sub>N</sub>
- 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.*