SUSTAINABLE ENVIRONMENTAL PROTECTION
OUR EXPERTISE: CLEAN AIR
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“Everything, what is against nature, will not last for long.”

Charles Darwin (founder of the theory of evolution, 1809 – 1892)

RELIEF FOR THE ENVIRONMENT

A growing world population, globalization, and the quest for prosperity in the face of dwindling resources make environmental protection more important than ever. Economic and ecological concerns do not conflict here. Only by successfully reducing resource consumption and avoiding emissions will companies be able to operate profitably and thereby make prosperity and development attainable for many.

Modern system technology reduces emissions

The global ecological objective is to lower CO₂ emissions. Greater energy efficiency, the use of environmentally friendly energy sources, and CO₂ disposal will ensure that the increase in CO₂ emissions is stopped. Environmental technologies from Dürr make a key contribution to reducing emissions in diverse industrial sectors.

Dürr Clean Technology Systems offers the latest system technology, permitting efficient disposal of exhaust gases and residues, reducing energy consumption, and ensuring high process reliability.

As a system partner, Dürr combines technical know-how with global availability to support customers worldwide.

Dürr works on the advancement of technologies such as microgas turbines, heat storage and more, in order to expand their product range in the field of energy efficiency. With Dürr Cyplan we offer innovative solutions for power generation from waste heat. Whether for biogas systems, cogeneration systems or industrial processes – ORC technology dramatically increases energy efficiency.
Our environment needs air pollution control systems

Production processes produce exhaust gases and vapors that can harm the environment if not treated. In order to protect the environment, these exhaust gases and vapors must be removed from the exhaust air before the process air is released to the atmosphere.

The key tasks include:
» Cleaning the exhaust air from production processes
» Disposal of exhaust gases from the reaction processes
» Compliance with statutory guidelines for emission control while reducing the use of primary energy sources
» Odor control
PROCESS OVERVIEW

Thermal oxidation

Organic substances in process exhaust gases are oxidized at high temperatures to produce carbon dioxide and water vapor. Oxidation is the most efficient air purification process for the disposal of combustible organic pollutants.

Product:
- Ecopure® RTO / Ecopure® CTO / Ecopure® RL – Regenerative Thermal Oxidation
- Ecopure® TAR – Recuperative Thermal Oxidation
- Ecopure® VAR – Incineration of Exhaust Gases and Residual Liquids

Catalytic oxidation

Catalytic air purification is characterized by flameless oxidation of the pollutants contained in the exhaust air at temperatures between 200 and 500 °C. After the exhaust air has been heated, it passes through the catalyst and the pollutants are oxidized to form CO₂ and H₂O.

Product:
- Ecopure® HPX – High-Pressure Catalytic Oxidation
- Ecopure® LPX – Low-Pressure Catalytic Oxidation
- Ecopure® RCO – Regenerative Catalytic Oxidation
- Ecopure® SCR – Selective Catalytic Reduction

Adsorption

This is a physical process for accretion of gaseous pollutant molecules on an active surface, e.g. on zeolites or activated carbon. Depending on the application, desorption is performed with hot air, steam or inert gas. By contrast with oxidation, the pollutant molecules remain chemically unchanged. Two fundamental process principles are employed for adsorption:

» Fixed-bed adsorption, in which several adsorbers are often used alternately in adsorption mode and desorption mode

» Adsorption via constantly moving rotor systems, which serve to concentrate exhaust air with a low pollutant content for more economical treatment or disposal

Product:
- Ecopure® KPR – VOC Concentrator

Absorption

Absorption involves one substance taking in or dissolving another substance. The substance to be treated is generally gaseous, while the absorbing medium is generally liquid but can also be solid. Gas scrubbing is a typical application. In this process, undesirable exhaust gas pollutants or byproducts from combustion, e.g. sulfur oxides, halogens or their acids, as well as chemicals such as ammonia, are removed directly from exhaust gases or exhaust air. This gas scrubbing generally follows the oxidation process and sometimes precedes it.

Product:
- Ecopure® FGA – Flue Gas Scrubber

Areas of application

<table>
<thead>
<tr>
<th>Exhaust air volume (Nm³/h)</th>
<th>Concentration (g / Nm³)</th>
<th>THERMAL OXIDATION</th>
<th>THERMAL, CATALYTIC OXIDATION</th>
<th>ADSORPTION, THERMAL, CATALYTIC OXIDATION</th>
<th>ADSORPTION, CATALYTIC OXIDATION</th>
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<tr>
<td>500</td>
<td>0.1</td>
<td></td>
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<tr>
<td>100,000</td>
<td>10</td>
<td></td>
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</tr>
</tbody>
</table>

- Chemical, pharmaceutical petrochemical
- Printing and coating
- Paint dryers, paint spray booths, semiconductors
- Odor
Possible applications

Regenerative thermal oxidizers are suitable for cleaning pollutant components that are combustible and that produce objectionable odors. If the pollutant burden of the exhaust air is low or only limited, external heat recovery is possible or desired, this process is superior to other thermal processes thanks to its very high internal heat recovery. Regenerative thermal oxidizers are used for exhaust air volumes greater than 2,000 Nm³/h and pollutant concentrations up to approx. 10 g/Nm³.

Various additional equipment can allow these systems to be used in almost all branches of industry:
» Hot-gas bypass for use in over-autothermal mode
» Use of special materials (e.g. stainless steel alloy) or special coatings for corrosive media
» Bake-out for cleaning deposits on regenerative heat exchange media
» Exhaust air preheating to reduce the relative humidity in the exhaust air inlet
» LEL control with controlled addition of fresh air for very high exhaust air concentrations
» Combination with fume scrubbers to eliminate acidic fume components, for example

Chemical and pharmaceutical industries, printing industry, coating industry, food industry, etc. – almost any sector can benefit from regenerative thermal oxidation.
The process

Regenerative thermal oxidizers use less primary energy compared to conventional air pollution control systems. This is achieved through the use of regenerative heat exchangers, which are highly efficient at using the energy contained in the hot exhaust gases to preheat the exhaust air to be treated. The heat exchanger consists of a ceramic heat storage material. The exhaust air to be treated flows through the hot storage material from bottom to top, heating up to nearly the combustion chamber temperature. A large part of the hydrocarbons are already oxidized here. The combustion chamber, by means of a burner, heats the exhaust air to the reaction temperature of approx. 800°C required for complete conversion. The hot treated air then flows from top to bottom through another part of the heat storage material and returns its heat to the storage material.

Thanks to the high level of internal heat recovery, the system functions “autothermally” above a pollutant concentration of approx. 1.5 g/Nm³, i.e. the energy content of the pollutants suffices to operate the system without additional fuel (e.g. gas).

The different versions:
» Ecopure® RTO
» Ecopure® CTO
» Ecopure® RL
are briefly described in the following.
Ecopure® RTO – VERSATILE AND ADAPTABLE

The Ecopure® RTO system

The Ecopure® RTO regenerative thermal air pollution control system is characterized by their cost-optimized, standardized and low-maintenance design. The modern process equipment of the Ecopure® RTO system permits efficient disposal of exhaust air containing solvents and odors, with a destruction efficiency of over 99.8%. Diverse equipment options allow it to be used almost universally.

The Ecopure® RTO uses modern, standardized components such as low-NOx burners, tight-closing and low-maintenance stainless steel valves, as well as highly efficient fans. The patented air ducting system ensures the best possible flow to the heat exchangers, combined with minimum space requirement and the greatest possible ease of maintenance.

The pre-assembly concept of the Ecopure® RTO systems minimizes installation and commissioning time.

Standard sizes are available as two- or three-tower systems, depending on the required destruction efficiency. The innovative RTO design also allows the number of heat exchanger tanks to be expanded in a modular manner to increase the capacity.

<table>
<thead>
<tr>
<th>TYPE</th>
<th>Ecopure® RTO (AS 2- OR 3-TOWER SYSTEMS)</th>
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<tbody>
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<td>55,000–76,000</td>
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<td>3080</td>
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Typical exhaust air volume range in Nm³/h approx.

Exhaust air volumes >100,000 Nm³/h are realized by modular expansion of the number of tanks.
The Ecopure® CTO system

A “Lean Line” concept based on the Ecopure® RTO was developed especially for industrial operations with lower exhaust air volumes. The result is the compact Ecopure® CTO system, designed for lower exhaust air flow rates and minimizes investment and operating costs.

Mechanically and electrically, the Ecopure® CTO is completely pre-assembled and skid mounted. The system arrives onsite “ready to connect” and can be installed at in a 1/2 day.

After installation of the CTO, only exhaust and clean gas ductwork and operating facilities for gas, compressed air, and electrical power have to be connected before commissioning.

Our special Ecopure® Compact Thermal Oxidizer (CTO) can be transported in one piece, prefabricated and installed.

Another benefit of our Ecopure® CTO System is the small dimension. Due to this unique feature the system is perfect for production sites with limited space.

The Ecopure® CTO system is available in three sizes with cleaning capacities from approx. 5,000 to approx. 19,000 Nm³/h exhaust air.

Each size is available both as an especially economical two-tower version and as a three-tower version for higher cleaning efficiency.

<table>
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<td>3008</td>
<td>5,000 – 10,000 Nm³/h approx.</td>
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<td>3012</td>
<td>10,000 – 14,000 Nm³/h approx.</td>
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<tr>
<td>3016</td>
<td>14,000 – 19,000 Nm³/h approx.</td>
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</table>
The Ecopure® RL RTO system

The Ecopure® RL RTO is unique in having a single special rotary valve with state-of-the-art process equipment in a robust and rugged design. It is used particularly in situations with little available space.

Diverse equipment variants also allow it to be used almost universally. The Ecopure® RL is equipped standard with state-of-the-art burner control technology, a burner with low NOx emissions and an exhaust air fan that is also available as a treated-air fan. The RL system is pre-assembled on transportation frames and shipped in as few sections as possible for reduced installation time and costs. The compact, standardized Ecopure® RL, in which the process steps are realized in only one tower thanks to the special air ducting system via a rotating diverter valve, and is available in various sizes for disposing of volume flow rates of 90,000 – 125,000 Nm³/h.

<table>
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</tr>
<tr>
<td>RL80</td>
<td>90,000 – 125,000</td>
</tr>
</tbody>
</table>
Possible applications

The Ecopure® TAR recuperative oxidizer, has proven its worth for over 40 years as a system for cleaning numerous pollutants in exhaust air. The Ecopure® TAR recuperative oxidizer is generally suitable for exhaust air volume flow rates starting at 1,000 Nm³/h. This process is economical, especially in applications in which heat energy obtained from the treated gas by downstream heat recovery systems can be simultaneously tapped again in the production process. This is why the Dürr Ecopure® TAR is used particularly in air purification of drying processes. Examples include nearly all painting processes worldwide on car bodies through small parts to coating systems for floors or wallpaper. Since coating materials containing silicone are frequently used in these types of processes, relative insensitivity of the Ecopure® TAR to SiO₂ deposits is advantageous.

The process

As in all thermal processes, the exhaust air is heated enough to oxidize the hydrocarbons to produce mainly water vapor and carbon dioxide. In the Ecopure® TAR, the polluted air is initially heated by the hot treated air in the integral (recuperative) heat exchanger. This allows a large portion of the combustion heat to be recovered.

When the air enters the combustion chamber, the burner heats it further to more than 700 °C and thereby initiates oxidation of the pollutants, which is completed after they have passed through the chamber. The hot treated air now flows into the exhaust-air heat exchanger to preheat the incoming exhaust air.
Before the treated exhaust air is released to the atmosphere, its residual heat is used in most cases in downstream heat recovery systems to heat thermal oil, water and air or to produce saturated steam.

The consumption of primary energy in the oxidation process is typically highly dependent on the quantity and calorific value of the pollutants. Therefore, natural gas, liquid gas, extra light fuel oil or other organic fuels can be used as additional fuels in the Ecopure® TAR.
The Ecopure® TAR recuperative oxidizer system

The TAR compact unit essentially consists of the combustion chamber, the burner and the integral heat exchanger, which serves to preheat the exhaust air. Interior and exterior damper systems direct the process air and control the outlet temperature of the treated exhaust air. The special, readily expandable design of Dürr TAR systems results in a long service life and minimum maintenance effort. All components are manufactured and completely factory pre-assembled inhouse.

The Ecopure® TARCOM burner

The latest Ecopure® TARCOM burner technology from Dürr leads the market and features a hollow-cylinder flame technology to achieve better treated-air values and lower combustion chamber temperatures compared to conventional burner systems. The gas nozzle geometry specially developed for use on the TAR ensures very thorough mixing of combustion gas and process air. An integrated thermal protection system prevents temperature migration and leads to a perceptibly cooler surface temperature on the burner exterior. The Ecopure® TARCOM burner is available as a gas burner, as a combination burner for two types of gas, and as a gas-oil combination burner.

The adjustable heat exchanger Ecopure® TARmodLEP

With the Ecopure® TARmodLEP heat exchanger system, the outlet temperature of the treated exhaust air can be adjusted independently of the combustion chamber temperature. The system can adapt the treated-air temperature to the respective heat requirements of connected consumers in production without reducing the residence time. The Ecopure® TARmodLEP system operates at a constant combustion chamber temperature and uses the entire reaction volume, thus keeping the treated-air values constant, even during temperature reduction mode.

<table>
<thead>
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<td>25,000 – 42,000</td>
</tr>
<tr>
<td>1140</td>
<td>35,000 – 48,000</td>
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</table>

Exhaust air volume range in Nm³/h approx.
The multi-function bypass

The Dürr bypass system compensates for process-air variations of exhaust air volumes, temperatures, pollutant concentrations and heat outputs over a broad variation range. As a result, the Ecopure® TAR responds to the respective process situation in production very flexibly.

The roller bearings

A technically sophisticated system of rollers serves to compensate for thermal expansion. Unlike the inexpensive solution with sliding rails, this system minimizes the expansion forces in the material during heating and cooling. This significantly increases the service life, especially in case of high loads and daily startup and shutdown. The Ecopure® TAR also feature a high-temperature-resistant heat exchanger head. Highly temperature resistant grades of stainless steel, individually selected for the respective application, guarantee the greatest possible insensitivity to thermal loads.
Ecopure® VAR – AN IDEAL OXIDIZER FOR EXHAUST GASES AND LIQUID RESIDUES

Possible applications

The pharmaceutical, chemical and petrochemical industries in particular, as well as carbon-fiber production and recycling systems, produce exhaust gases and residual liquids with high or low calorific values. These wastes can include problematic, environmentally hazardous constituents such as halogenated hydrocarbons, sulfur, phosphorous, and NOx, etc., and could be present in the form of explosive mixtures. The Ecopure® VAR direct fired thermal oxidizer is designed for cleaning and incinerating such gases and residues.

The process

Waste gases and residual fluids are fed into a combustion chamber equipped with a high-temperature-resistant lining. Gaseous wastes are injected via double or multiple lances, while liquid wastes are atomized via ultrasonic nozzles. The hydrocarbons are converted mostly into water vapor and carbon dioxide at temperatures from 800 to 1,300 °C. Substances such as HCl and SO2, which can also be formed during combustion, are eliminated in downstream arranged fume scrubbers when necessary. Heat can be recovered by producing hot air, hot water, steam or thermal oil. When substances forming NOx are disposed, a SNCR (Selective Non-Catalytic Reduction) process integrated in the combustion chamber or the SCR process downstream of combustion will be installed.

The Ecopure® VAR system

The Ecopure® VAR combustion chamber forms the heart of the VAR system. It can be upright or horizontal, straight, L- or U-shaped. At the front side, heat and additional energy is produced by the Dürr VARCOM burner. It can be used as a gas, oil or multi-fuel burner. Exhaust gases are introduced tangentially in the rear area of the burner flame through air-cooled double or multiple lances or exhaust air devices. This generates a swirling flow to ensure thorough mixing. Fluids with low calorific values are also injected in this area, but fluids with high calorific values are introduced via the VARCOM burner. If necessary, secondary air is introduced in a second stage to provide sufficient oxygen for combustion and to lower the combustion chamber temperature in case of exhaust gases with a high calorific value. The dwell time dictates the required combustion chamber size.

The Ecopure® VAR direct fired thermal oxidizer is available in various versions, depending on the composition of the pollutants:

Nitrogen containing substances

Exhaust gases or liquids containing organics with bound nitrogen are known to form NOx. In order to destruct the formed NOx, the chamber can be equipped with a SNCR reactor stage (Selective Non-Catalytic Reduction). Ammonia or urea will be injected to the reactor, which is operated at a temperature range of 900 to 1,050 °C.

SCR process – Selective Catalytic Reduction (see chapter entitled “Ecopure® SCR”)

Selective catalytic reduction (SCR) is used to reduce exhaust emissions of nitrogen oxides (NOx), when a high removal rate is required. It is typically needed when upstream combustion processes oxidize organic compounds containing nitrogen, like amines. An SCR system introduces a reducing agent, typically anhydrous or aqueous ammonia, into the exhaust stream. The exhaust stream is then exposed to a catalyst media at 200 to 350°C where the NOx and ammonia are reacted to N2 and H2O. If the SCR system is downstream of a flue gas scrubber, it will be necessary to reheat the exhaust gases.
Acid recovery

If the exhaust gases or residual liquids introduced to the combustion chamber contain a high content of halogens such as chlorine or fluorine, these can be recovered as concentrated halogen hydracids. For this purpose, the hydrogen halides formed in the combustion chamber are scrubbed from the exhaust gases with pure water in an absorber. Depending on the halogen concentration in the exhaust gases, a concentration of up to 30% can be achieved in the scrubbing acid.

Inorganic constituents  
(e.g. HCl, SO2, or Dust)

Particles are separated using filtering separators such as baghouse filters or electrostatic precipitators. Dry and wet processes are available for separating gaseous constituents of exhaust gases. In many cases, wet flue gas scrubbers are installed and equipped with a quench for flue gas cooling as well as single or multi stage scrubbing columns.

Salty wastes

The disposal of salty wastes may form salt slags in the combustion chamber. To be able to drain the salt slags, the chamber will be arranged vertically.

Salty waste incinerators are typically equipped with a submerged quench, which allows dissolving of the salts in water. Remaining salt particles in the cooled flue gas will be removed by venturi scrubbers or electrostatic precipitators.

Salt may cause damage to the refractory lining material of the combustion chamber. In order to optimize the lifetime of the lining material, special attention must be paid to the operating conditions and the selection of the lining material.
Explosive exhaust gases

If the exhaust gases fed to the combustion chamber are assigned to an explosion-hazard zone, additional safety equipment must be provided in the exhaust gas supply system to prevent backfiring from the combustion chamber. This equipment generally comprises deflagration and detonation flame arresters, immersion arresters or dynamic flame arresters in the form of high-speed backfire-proof injection.

Acid-forming constituents

If acid-forming constituents such as sulfur or halogens are fed into the combustion chamber, the wall temperature in the combustion chamber must be kept in a range from 200 to 300°C to avoid corrosion. This is generally achieved through exterior insulation matched to the interior lining.

Heat recovery

The hot flue gases from a Ecopure® VAR system can be used for production processes. For this purpose, the flue gases are cooled in suitable heat exchangers and their thermal energy is used to produce steam, hot water or electrical energy or to heat thermal oil or air.

ADVANTAGES OF THE SYSTEM

» Universal usage
» No restrictions in terms of pollutant type or quantity
» Efficient, safe, and economical disposal of explosive gases
» Incinerates residual organic liquids
» Heat recovery options

NOTES FOR OUR CUSTOMERS

» Higher fuel requirement for exhaust gases with low calorific value
» Complex safety equipment may be necessary
Ecopure® SCR – SELECTIVE CATALYTIC REDUCTION EFFICIENCY AND EXCELLENCE

Ecopure® SCR – Selective Catalytic Reduction

Possible applications

The Ecopure® SCR serves to reduce nitrous oxides (NOₓ) from flue gases or process gases if high nitrous oxide conversion rates are required. The Ecopure® SCR can be used either as part of the flue gas purification system in a VAR system or as a stand-alone unit (see chapter entitled “Ecopure® VAR”). It has proven its worth in the following applications:

- Combustion of NOₓ-forming pollutants
- Flue gas purification behind directly fired steam generators
- NOₓ reduction in the chemical industry for power systems

The process

The SCR process converts nitrous oxides on a catalyst at temperatures from 200 to 390 °C. A heating stage is not necessary if the flue gas is already at the required catalyst operating temperature. If the temperature is too low, the flue gas is first heated via an air-to-air heat exchanger. The air is then heated further to the necessary catalyst operating temperature by a burner or other heating media. Finally, the necessary reducing agent – gaseous ammonia, ammonia water or urea – is injected into the flue gas. After conversion of the nitrous oxides on the catalyst, the energy of the purified gases is extracted by an air-to-air heat exchanger and used to preheat the untreated flue gas.

The Ecopure® SCR system

The Ecopure® SCR essentially consists of the catalyst with housing, the burner or heater, the integral heat exchanger to preheat the exhaust air, and the reducing agent injectors. The SCR process is characterized by high conversion rates, low pressure loss and low operating temperatures.

ADVANTAGES OF THE SYSTEM

- High cleaning efficiency > 99% possible
- As stand-alone applicable, e.g. for power generation systems
- As flue gas cleaning stage after the oxidation

NOTES FOR OUR CUSTOMERS

- Catalyst can be poisoned reducing its efficiency/ activity
- Depending on application bigger size necessary
- Size 1,500 Nm³/h and larger

DSM SCR system in Linz, Austria
Ecopure® HPX – SUPERIOR PERFORMANCE UNDER PRESSURE

Ecopure® HPX – High-Pressure Catalytic Oxidation

Possible applications

The Ecopure® HPX high pressure catalytic oxidation system is used in the production of purified terephthalic acid (PTA) and other applications in which exhaust gases with organic compounds are produced under high pressure. These exhaust gases can be treated directly, without prior depressurization.

The process

The flue gas from the process is heated by means of a heat exchanger, which is operated on steam or preheated air, and by means of a purified-air-heated air-to-air heat exchanger that produces the required catalyst operating temperature. After conversion of the pollutants on the catalyst, the purified exhaust gas is cooled and the heat is recovered in the air-to-air heat exchanger. Depending on the configuration of the components and their integration into the production process, thermal efficiency values of more than 70% can be achieved. Thanks to the sufficiently high pollutant concentration in normal operation, the Ecopure® HPX can be operated autothermally, i.e. without the use of additional energy. The treated flue gas, which is still under pressure, can then be used for energy recovery via an expander installed on the catalyst unit outlet.

The Ecopure® HPX system

The Ecopure® HPX is characterized by a design that is pressure resistant and corrosion proof if necessary. Due to its modular design, the Ecopure® HPX can be tailored precisely to a customer’s requirements and the available operating equipment.

ADVANTAGES OF THE SYSTEM

» Energy recovery through depressurization of the purified process gas [e.g. in a turbine]
» Autothermal operation
» Corrosion-proof version possible
» Variable setup depending on existing operating equipment / energy supply

NOTES FOR OUR CUSTOMERS

» Catalyst can be poisoned reducing its efficiency / activity
Ecopure® LPX – CLEANING AT LOW PRESSURE

Ecopure® LPX – Low-Pressure Catalytic Oxidation

The process

With the Ecopure® LPX, pollutants are converted at near-ambient pressure. The exhaust air from the production facility is heated by an air-to-air heat exchanger. The air is then heated further to the necessary catalyst operating temperature by a burner, thermal oil, electrical heater or steam. The heat generated during the pollutant conversion process is transferred to the untreated exhaust air from the production facility. Above a certain pollutant concentration, the exothermic reaction produces more heat than required for preheating. This excess heat can be recovered or routed via a heat exchanger bypass directly to the stack.

Possible applications

The Ecopure® LPX low pressure catalytic oxidation system is suitable for a wide range of applications in exhaust gas purification. Use of this system is limited only by existing catalytic poisons and substances that cannot be effectively converted by the catalyst. The efficiency of the process increases the more closely the exhaust air temperature approaches the required purification temperature.

The Ecopure® LPX system

The Ecopure® LPX essentially consists of the catalyst with housing, the burner and the integrated heat exchanger for preheating the exhaust air.

ADVANTAGES OF THE SYSTEM

» Low consumption values
» Compact design possible
» Autothermal operation at > 1 g/Nm³ VOC
» Also suitable for low volume flow rates and low concentrations
» Various catalyst materials can be used

NOTES FOR OUR CUSTOMERS

» Catalyst can be poisoned reducing its efficiency/activity
» Size 1,000 Nm³/h and larger
Ecopure® RCO – THE CATALYTIC RTO

Possible applications

Ecopure® RCO systems combine the advantages of regenerative heat exchangers with those of catalytic oxidation. They are used to reduce pollutants in slightly contaminated exhaust air flows and odor control.

The process

As with an RTO, the air is heated regeneratively via a ceramic heat exchanger. The VOCs are then converted on the catalyst at low temperatures of approx. 300 °C. To ensure that this principle works reliably, the Ecopure® RCO works with at least two ceramic heat exchangers, which are interconnected by a combustion chamber and alternately emit and absorb the energy.

Advantages of the system

- Low combustion chamber temperature
- Low fuel consumption
- Autothermal operation at approx. 1 g/Nm³ VOC
- Various catalyst materials can be used

Notes for our customers

- Catalyst can be poisoned reducing its efficiency/activity
ADSORPTION
Possible applications

Dürr Ecopure® KPR concentrator is a continuous adsorption process with downstream thermal or catalytic oxidation stage. With regard to the cost/benefit ratio, it is particularly advantageous for treating large volume flow rates combined with low pollutant burdens that would be uneconomical to treat directly, e.g. in a regenerative thermal air purification process. Thanks to its versatility, the Ecopure® KPR has already proven its worth numerous times in the most diverse applications for treating process exhaust air in:

» Painting processes
» The printing and coating industries
» The semiconductor industry
» The chemical industry
» The plastics and composites industry
» Foundries

More than 50 bn. m³ of air are hourly concentrated in Dürr KPR systems worldwide.

The process

The solvent-laden exhaust air volumes (VOC) are concentrated by an adsorption rotor and then treated in an oxidation system. Alternatively, depending on the value of the solvents or any costs for their treatment, they can also be recovered via a condensation system.

With its particularly innovative process concepts, the Dürr Ecopure® KPR can concentrate the exhaust air flow to be treated up to max. 40:1 of the original volume, thus permitting especially economical treatment of the concentrated air.
stages provide the necessary protection for the adsorber material against clogging or blocking by dust or paint particles, etc., making an important contribution to the system’s long service life.

The adsorption rotor is subdivided into an adsorption zone and a much smaller desorption and cooling zone. In the adsorption zone, the solvents are taken up from the exhaust air flowing from the outside to the inside. The continuous rotation of the rotor then transports the adsorbed solvents from the zeolite segments into the desorption zone, where they are desorbed (driven out) by the hot desorption flow, which is much smaller in volume, from the inside to the outside. The concentrate air flow emerging from the rotor carries a correspondingly high solvent burden and subsequently undergoes efficient cleaning in the downstream air pollution control system.

The Ecopure® KPR concentrator system

The various standardized modular designs of concentrators feature a core comprising either an upright rotor divided into segments or a rotary carousel system with two adsorber blocks arranged one after the other in the direction of flow. The Ecopure® KPR technology thus offers maximum flexibility in selecting the suitable process and the most suitable adsorber. The proven rotary carousel technology also allows the use of special carbon-fiber adsorber blocks or special zeolithe material, which have demonstrated their suitability in the chemical industry in particular.

In most cases, however, the adsorbers consist of a honeycomb ceramic-covered carrier material with permanently impregnated zeolites. The advantage of zeolites over carbon is that this ceramic material is temperature resistant and incombustible. The “honey comb” structure of the zeolite blocks minimizes the system’s pressure loss and therefore its power consumption. One or more integrated filter
The VOC concentration and oxidation systems designed and delivered by Dürr consist of the following main components:

» Modular Ecopure® KPR adsorption rotary carousel with integrated filter compartment
» Central exhaust air extraction fan
» Downstream air pollution control system (Ecopure® TAR, RTO or LPX) for final treatment of the concentrated air flow and heat recovery and for heating the desorption air

**ADVANTAGES OF THE SYSTEM**

» Low CO₂ emissions and low operating costs creates high concentration of up to 40:1
» Continuous desorption and treatment of pollutants without pressure fluctuations
» Long service life attributed to high desorption temperature up to 200 °C
» No moving parts except for the rotor – low maintenance and high reliability
» Modular design mounted on skids – rapid, trouble-free assembly
» Combinable with various oxidation technologies from Dürr
» Customized Oxidation Systems also possible without additional fuels
» Process-integrated heat recovery

**NOTES FOR OUR CUSTOMERS**

» Exhaust air temperatures > 40 °C may require pre-cooling
» Not suitable for pollutant concentrations > 2g/Nm³
» Not suitable for formaldehyde, methanol, methyl chloride, highly acidic or alkaline inorganic components, sulfur compounds, halogens, heavy metals, plasticizers or oil mist
» From approx. 85% relative humidity, pre-drying is required
EFFICIENT SYSTEM FOR THE ENVIRONMENT
EcoPur

Dürr conducts research for greater efficiency

Topics such as flexible production, energy efficiency and material productivity are daily concerns for our product managers and R&D specialists. Our experts’ sole objective is to make air purification even more efficient while lowering operating costs. Pioneering concepts and solutions are being developed and tested at the R&D Center on the Dürr Campus in Bietigheim-Bissingen. Industrial processes can be experienced first hand, and customer-specific tests can be carried out.

The right energy balance

We at Dürr pay attention to heat recovery and lower consumption of primary energy in all of our products. Waste heat produced in exhaust air purification and other production processes to be used for process heating, cooling, or generation of electricity.

We are working on innovative technologies for the use of industrial waste heat, e.g.: micro gas turbines, the Organic Rankine Cycle (ORC) technology, resorption systems, heat storage and absorption chillers, to name just a few examples.

Dedicated to the environment with EcoPure

EcoLogic Exhaust Gas Purification products

We pay attention to economical operation and minimum energy consumption in all of our systems.

We guarantee safe purification of exhaust gas and air while complying with specified limit values.
AS SERVICE SPECIALISTS, WE WORK DAILY FOR YOUR SUCCESS

System assessment
» Expert and thorough knowledge of complete systems
» Complete diagnostic assessment of system’s current condition
» Assessment focus can be tailored to operational objectives
» Additional consultation and planning of measures

Start-up and production assistance
» Support in the introduction of new systems, series, products, or technologies
» Provision of specialized experts
» On-the-job training
» Fast, qualified help in the event of malfunctions

Engineering
» Design and planning of new production and system solutions
» Detailed solutions based on assessment results
» Customized adaptations and solutions for processes and equipment

Modification and conversion
» Design and planning of new production solutions
» Upgrade of existing plants to the latest state of the art technology
» Capacity expansions and reduction in unit costs and energy costs

Service locations
» Global presence near customer
» Individual consultation for processes, technology, and economy
» Initial point of contact for all Dürr services

Energy management
» Development of concepts for lower energy consumption

Training courses
» General training courses for application, processes, and environmental technologies
» Specific, practical, and customized courses available
» Professional trainers and proven concepts
» Fully-equipped training center available

Spare parts
» Genuine and proprietary spare parts
» Simple ordering and rapid delivery worldwide
» Original equipment and emergency packages
» Qualified repair and installation
» Consultation for ideal spare parts management

Inspection and maintenance
» Preventative inspections and services
» Expert troubleshooting and fault correction
» Service hotline
» Remote diagnostics
OUR LOCATIONS AT A GLANCE

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Dürr – Leading in Production Efficiency

Five divisions, one goal: maximum production efficiency for our customers

- **Paint and Final Assembly Systems**: paint shops and final assembly systems for the automotive industry
- **Application Technology**: robot technologies for the automatic application of paint as well as sealants and adhesives
- **Measuring and Process Systems**: balancing systems as well as assembly, testing and filling technology
- **Clean Technology Systems**: exhaust-air purification systems and energy-efficiency technology
- **Woodworking Machinery and Systems**: machinery and systems for the woodworking industry