CTP-AIRPOLLUTIONCONTROL.COM

RECUKAT

CTP-TECH OXIDATION

RECUPERATIVE CATALYTIC
OXIDATION OF GASEOUS STREAMS

RecuKAT in the formaldehyde production

RECUKAT

ECONOMICAL INDUSTRIAL AIR POLLUTION CONTROL FOR HIGH AND LOW POLLUTANT CONCENTRATIONS

CTP's customized catalytic oxidizers are well suited for the highly efficient cleaning of pollutants at low reaction temperatures of around 200°C. In addition, they can be operated at extremely low cost. CTP's RecuKAT is being used successfully for a number of industrial applications of various pollutant concentrations. In some cases, catalytic oxidation is the only sensible solution. Some examples for such cases are:

- Inert gases (oxidation at low O_2 content)
- Oxidation of nitrogenous gases without additional DeNOx processes
- Conversion of chlorinated hydrocarbons without dioxin formation
- Oxidation of pressurized waste gases (pressure application)
- Oxidation of waste gases, whose temperature lies within the range of the reaction temperature

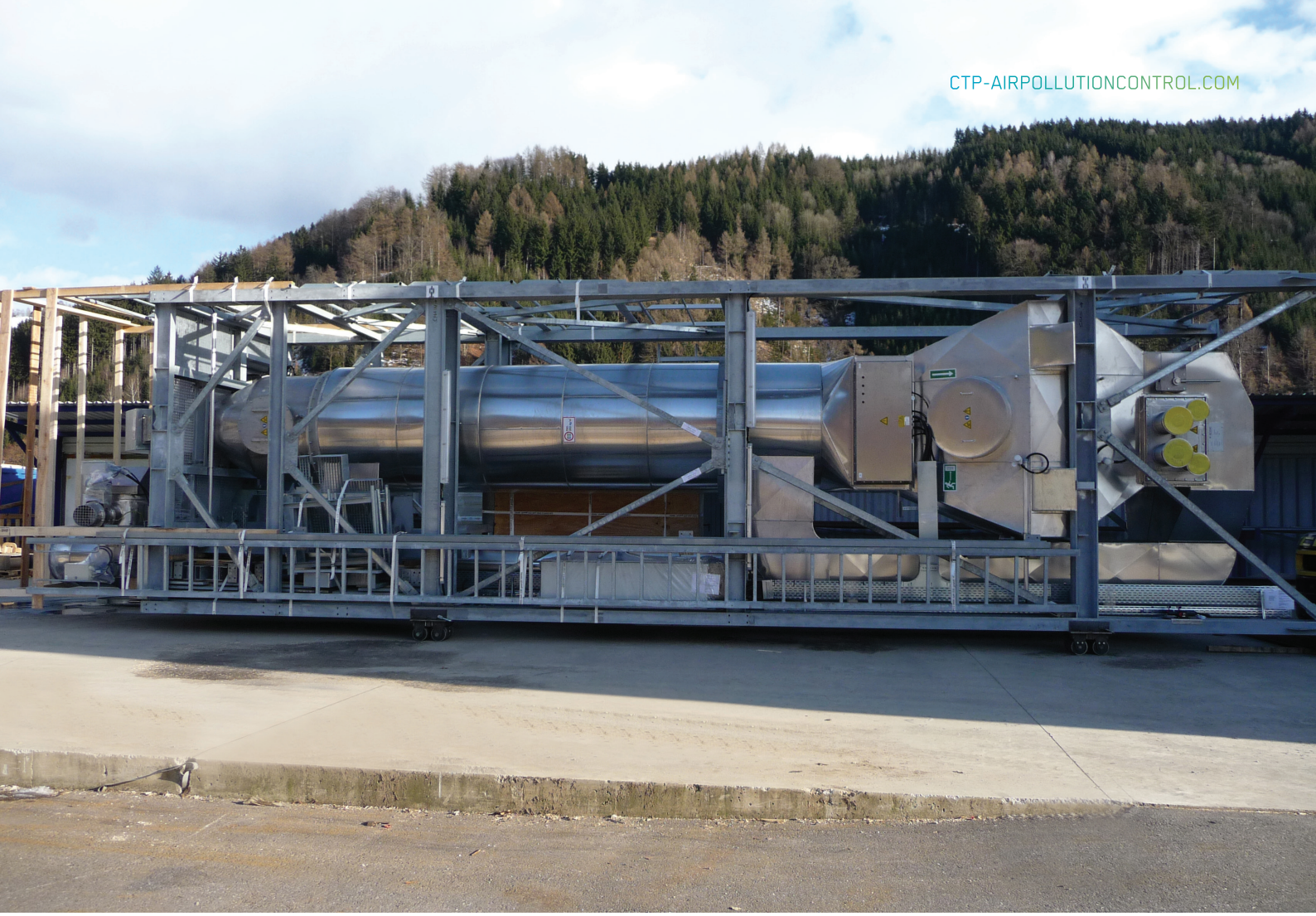
It is essential that no catalyst poisons are present in the raw gas or in its oxidation products.

RECUPERATIVE CATALYTIC OXIDATION (CO)

CTP's recuperative catalytic oxidation system is the result of many years of catalyst experience in industrial applications as well as continuous development. The recuperative catalytic oxidation system consists of a recuperator and a reactor, where the catalyst is positioned. After entering the system, the contaminated raw gas is routed through the recuperator toward the reactor and is thus being preheated. If the contaminated raw gas is not heated sufficiently to reach the required reaction temperature, which means if the concentration of pollutants is too low, additional heating is needed to provide the remaining energy in order to start the catalytic reaction process.

From here, the waste gas flows into the catalyst where oxidation occurs. Depending on the concentration and the caloric content of the pollutants, the gas temperature rises and the hot gas leaves the reactor. The purified gas then flows into the other side of the recuperator and transfers its heat to the cold, inflowing waste gas. After passing the recuperater, the cool purified gas is exhausted via the stack.

Recuperative Catalytic Oxidation (CO)



UNIQUE ADVANTAGES OF THE CTP SYSTEM

OUTSTANDING PERFORMANCE

- Maximum removal efficiencies for CH_4, VOC, NH_3, CO, H_2 (> 99.9%)
- No formation of secondary products (NOx, dioxin)
- Low pressure drop
- Efficient heat recovery
- Can handle high concentrations

FUNCTIONAL DESIGN

- Compact construction
- Horizontal or vertical configuration available
- Small footprint (with vertical configuration)
- Excellent accessibility for easy inspection and maintenance

SAFE AND RELIABLE OPERATION

- Fail-safe Programmable Logic Controller (PLC)
- Field-proven advanced software
- Most spare parts in stock
- On-site and online support

SHORT PERIOD OF INSTALLATION AND COMMISSIONING

- Pre-assembled delivery for fast, easy installation
- Complete wiring and testing at manufacturing plant assures trouble free start-up

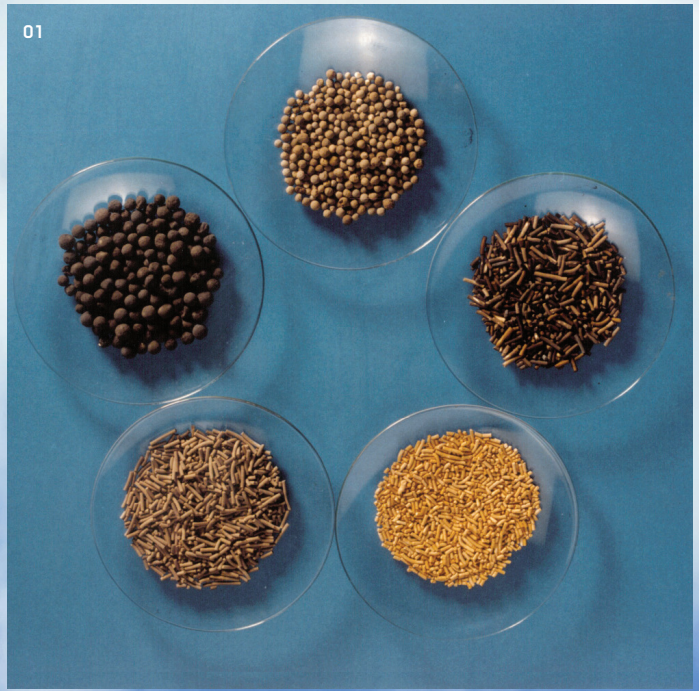
HIGH-END TECHNOLOGY

- Efficient recuperative heat exchanger
- Customized CTP high performance catalysts with high longevity
- Operation at lowest oxygen content (residual oxygen control)
- Various fuel choices for the additional heating (gas, electricity)
- Available for low and high pressure processes up to > 25 bar (g)

THE SYSTEM

The catalytic CTP oxidation system in its basic design consists of:

- **Main fan with Variable Frequency Drive (VFD)**
- **Fixed bed reactor with additional heating**
- **Catalyst**
- **Internal heat recovery (recuperator)**
- **Stack**
- **Sensor package**
- **Control and power distribution panels**
- **Automated control system**

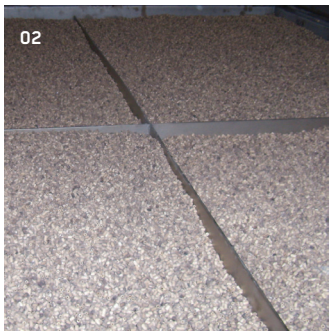


The **MAIN FAN** is continuously controlled by a VFD. A specific amount of waste gas is fed into the RecuKAT where it is safely and economically purified.

The **FIXED BED REACTOR** consists of a heater and a catalyst. The gas enters the reactor and is heated to reaction temperature by the additional heating. The additional heating is only activated, if the pollutant concentration in the raw gas is too low. The pollutants are oxidized and, in the case of VOC, converted to water vapor and carbon dioxide. Depending on the concentration and the caloric content of the pollutants, the gas temperature rises and the hot gas leaves the reactor.

The range of **CATALYSTS** developed by CTP and produced in-house enable an optimum adaptation of the process to deal with the individual emissions from the customer's production process.

The high thermal efficiency (approx. 80%) of the **CTP RECUPERATOR** reduces the heat loss to a minimum which helps to minimize the operating costs of the system.



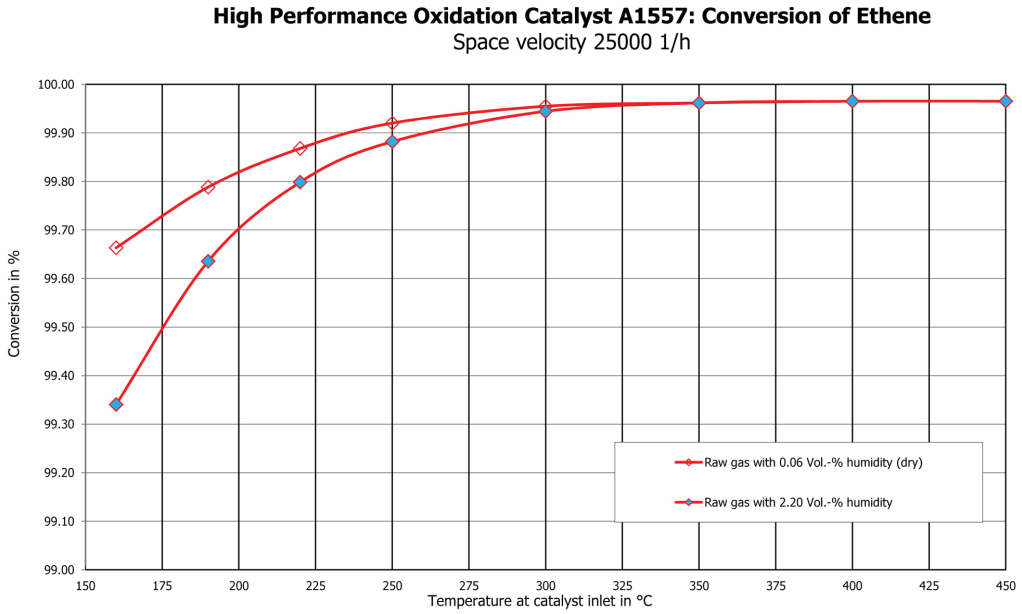
01 Pellet catalyst
02 Catalyst bed (reactor)
03 Heat exchanger (shell tube)
04 Electric heating

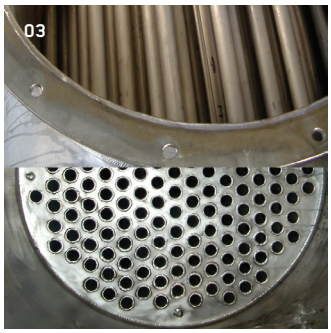
The cleaned waste gas leaves the RecuKAT through the **STACK**, which is attached directly to the recuperator, if it is vertically positioned.

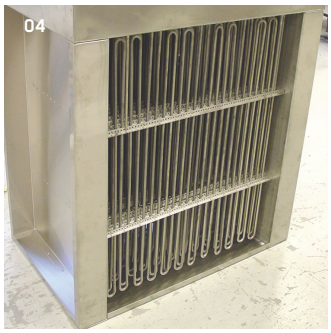
Our extensive **SENSOR PACKAGE** is capable of measuring all necessary process variables such as temperature, pressure, differential pressure, and flow.

The **CONTROL AND POWER DISTRIBUTION PANELS** are located next to the reactor. These provide a fully automated control system that includes a PLC and operator inferface. CTP's standard program, which has been refined over many years, enables automatic adjustment of the system to diverse process conditions and customer's specifications.

THE KEY COMPONENTS







HEAT EXCHANGER

The high thermal efficiency of CTP's shell tube heat exchangers reduces the heat loss to a minimum which helps to reduce the operating costs of the system.

ADDITIONAL HEATING

The standardized burner system is available for different gaseous fuels. As an option to the burner system, energy can be supplied via an electric heating unit.

CTP CATALYST

The CTP pellet catalyst is characterized by its excellent performance in converting organic hydrocarbons as well as hydrogen, carbon monoxide, ammonia etc. The catalyst is specifically selected for each application and thus offers the ideal customer-specific solution for the respective waste gas problem. Available as metal oxide or platinum catalyst, it still performs excellently with lowest oxygen content.

Nitrogenous raw gases are oxidized almost without NOx formation and therefore without any additional DeNOx processes required. Chlorinated hydrocarbons are converted without dioxin being formed even in the presence of aromatic hydrocarbons.

For converting methane, ethene and other short-chained hydrocarbons, the CTP catalytic oxidizer is the first choice. The combination of different catalyst models to a multilayered catalyst bed guarantees an excellent conversion of various pollutants.

ADDITIONAL OPTIONS

O_2 measurement for residual oxygen control

RECUPERATOR BYPASS (HOT BYPASS)

If higher concentrations exist, a bypass is added to the recuperator to avoid overheating of the catalyst. A partial flow of the hot purified gas bypasses the recuperator thus reducing the preheating temperature of the waste gas. In this way, the catalyst outlet temperature can be controlled and kept at a set level.

HEAT RECOVERY

For high concentrations of pollutants, the excess energy can be efficiently recovered and used for other purposes such as for steam production and preheating of thermal oil. Due to the high thermal output of the heat exchanger, additional heat recovery can be installed immediately downstream of the catalyst and upstream of the recuperator. This allows the heat exchanger to be dimensioned smaller and operate at higher temperature (e.g. resulting in higher steam temperatures which in turn creates higher steam pressure). This concept proves to be especially economical by combining the purification of waste gases with energy production through the combustion process of the pollutants. In some cases, the customer even realizes a commercial profit which compensates the investment costs.

SELECTIVE PRE-SEPARATION OF SULPHUR COMPOUNDS

In order to protect the catalyst from sulphur contamination, sulphur has to be separated before entering the RecuKAT. A pre-separation system (also used for fuels containing sulphur) is capable of reducing the sulphur concentration.

LEL SAFEGUARD AND SYSTEM BYPASS

If equipped with an LEL (Lower Explosive Limit) monitor, the RecuKAT can protect itself against high inlet concentrations engaging a bypass system.

RESIDUAL OXYGEN CONTROL

Low oxygen waste streams can be processed by adding an oxygen control loop with small amounts of excess oxygen.

MATERIALS

The RecuKAT system can be manufactured in a range of different materials depending on the customer's needs. Standard materials are S235 (ST-37), 1.4301 and 1.4571.

CO_2 RECOVERY

CLEANING AND RECOVERY OF CO_2 AT LOWEST O_2 CONCENTRATIONS

CO_2 cleaning at ambient pressure

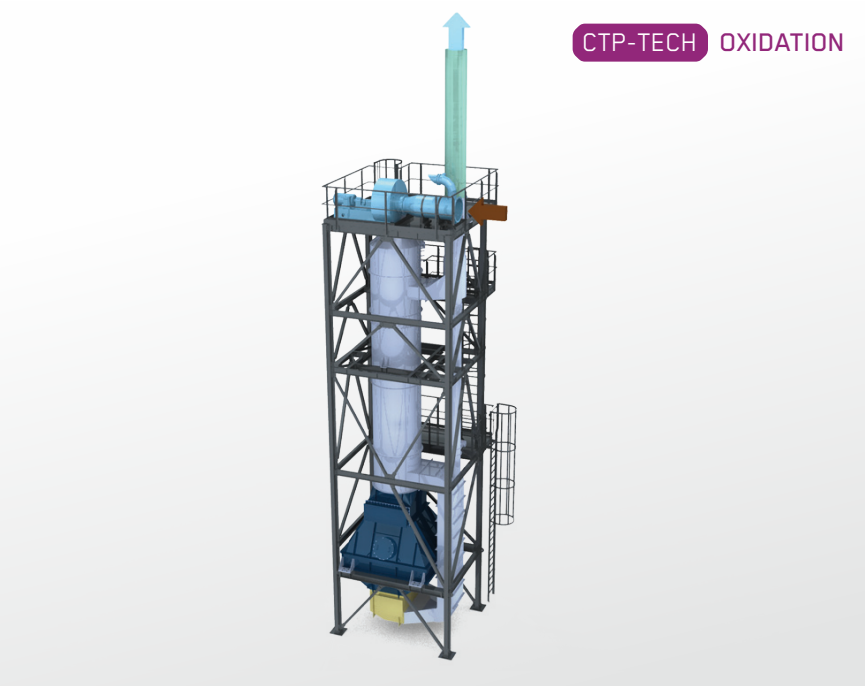
CO_2 cleaning at 1.5 bar

Pure CO_2 is a valuable raw material and can be widely used. Its applications include beverage production, welding, refrigerant (R744), fire extinguishing, greenhouses, solvent extraction at high pressure as well as the chemical industry (urea, carbonates, polymers).

There are numerous processes in the chemical industry generating waste gas flows consisting of impure CO_2. In all cases the gas flows need to be purified to meet the imposed emission limits for organic and inorganic contaminants, in the CO_2 being emitted to the atmosphere.

To obtain CO_2 with a technical or even a food grade quality, CTP's RecuKAT is the best solution. CTP's RecuKAT has the highest cleaning efficiency (> 99.9%) and is able to operate at very low oxygen levels (< 0.2 vol.%). CTP's RecuKAT can also be operated at excess pressure up to 25 bar.

RECUKAT



The extent of the flow defines which RecuKAT model is suitable. The system meets the customer's specific requirement for a defined flow.

SPECIFICATION

Type	RecuKAT series [Nm³/h]
Min. nominal flow (Nm³/h)	5,000
Max. nominal flow (Nm³/h)	25,000

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