ECONOMIC IN ECOLOGY

Catalytic waste gas and exhaust air purification

EWK UMWELTTECHNIK GMBH

The system

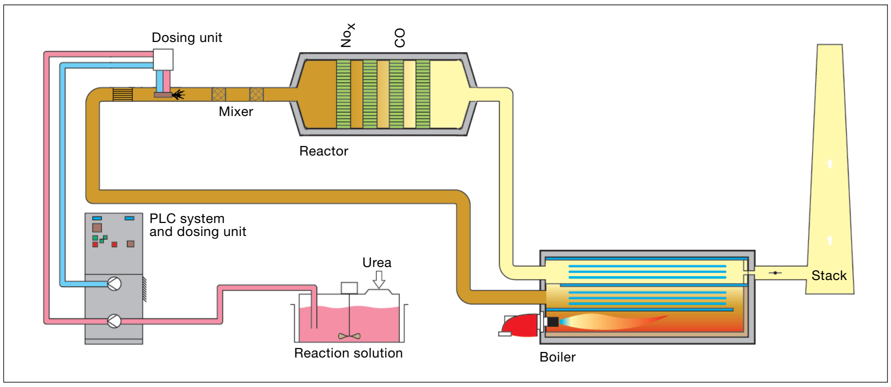
EWK Environmental Engineering has been manufacturing systems for the purification of air and waste gas for decades. In the past few years the catalytic waste gas purification method has gained more and more importance in this context.

As a result of years of tests and developments we now use the SCR (selective catalytic reduction) method successfully for the reduction of pollutants in
- process exhaust air

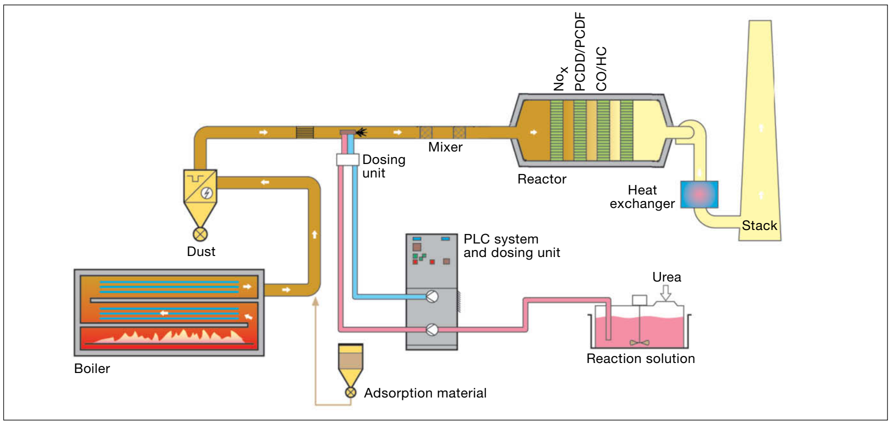
and
- combustion waste gases.

The burning of **biological fuels**, (wood, straw, biogas etc.) as well as **fossil fuels** (heating oil, natural gas, heavy oil, coal) and **industrial waste** (solvent, sewage sludge, explosive, refuse and industrial residue etc.) generates large amounts of the following substances even in the most advanced furnaces:
- nitric oxide NO_x
- carbon monoxide CO
- hydrocarbon C_mH_n
- dioxin/furan PCDD/PCDF

With the SCR catalyzer technology these air pollutants can be precipitated to a large degree and modified to N_2, CO_2 and H_2O.

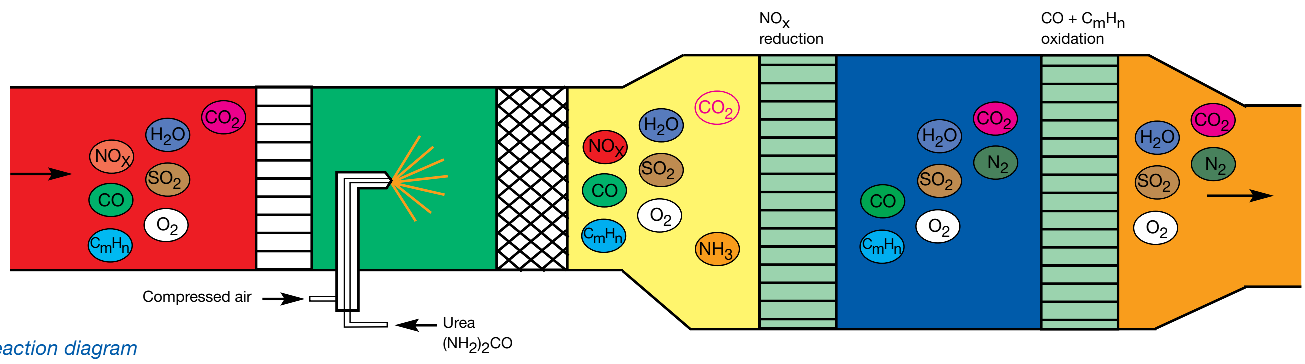


Catalytic waste gas purification for oil (heavy, extra light) or gas furnace



Catalytic waste gas purification for thermal waste utilization

NO_x reaction with ammonia NH_3	für NO für NO_2	$4\ NO + 4\ NH_3 + O_2$ $6\ NO_2 + 8\ NH_3 + O_2$	→ →	$4\ N_2 + 6\ H_2O$ $7\ N_2 + 12\ H_2O + O_2$
NO_x reaction with urea $(NH_2)_2\ CO$	für NO für NO_2	$4\ NO + 2\ (NH_2)_2\ CO + 2\ H_2O + O_2$ $6\ NO_2 + 4\ (NH_2)_2\ CO + 4\ H_2O$	→ →	$4\ N_2 + 6\ H_2O + 2\ CO_2$ $7\ N_2 + 12\ H_2O + 4\ CO_2$
SO_2 secondary reaction		$2\ SO_2 + O_2$ $SO_3 + NH_3 + H_2O$ $SO_3 + 2\ NH_3 + H_2O$	→ → →	$2\ SO_3$ NH_4HSO_4 $(NH_4)_2SO_2$
CO reaction		$2\ CO + O_2$	→	$2\ CO_2$
C_mH_n reaction		$\ldots C_mH_n + O_2$	→	$\ldots CO_2 + \ldots H_2O$



Reaction diagram

The different methods

Reduction catalyzers

NO_x
The combustion in furnaces, motors and turbines generates large amounts of toxic nitrogen oxides (NO_x), depending on temperature and fuel-bound nitrogen.
With the help of a reduction solution in the form of monatomic nitrogen compounds (urea, ammonia) NO_x can be converted (reduced) to harmless nitrogen and water vapor.
For that purpose an urea solution is sprayed into the crude gas flow and thermolyzed to NH_3.
In the static mixer NO_x is thoroughly mixed with the NH_3.
The reduction of NO_x to N_2 and H_2O occurs in the DeNO$_x$ catalyzer. Honeycomb catalyzers made of homogenous ceramic base material with integrated active catalytic material are commonly used.

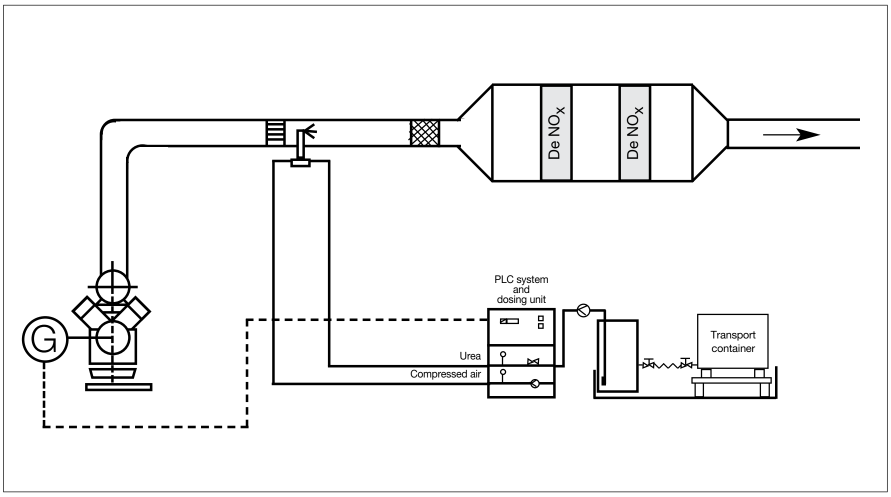
Oxidation catalyzers

Flammable, partially toxic and odour-intensive waste gases can be burned (oxidized) by thermal or catalytic methods. A suitable **catalyzer** allows an almost complete combustion **at significantly lower temperatures**. The catalyzer supports the chemical reaction of the gases **without additives** and without changing itself.

Co/C_mH_n
Additional by-products of combustion or other industrial processes, carbon monoxides (CO) and hydrocarbons (C_mH_n), are converted in the oxidation catalyzer.
In the process CO is oxidized to CO_2 and the hydrocarbons burned to CO_2 and H_2O.
Honeycomb catalyzers made of a ceramic base material with a coating of precious metal are commonly utilized.

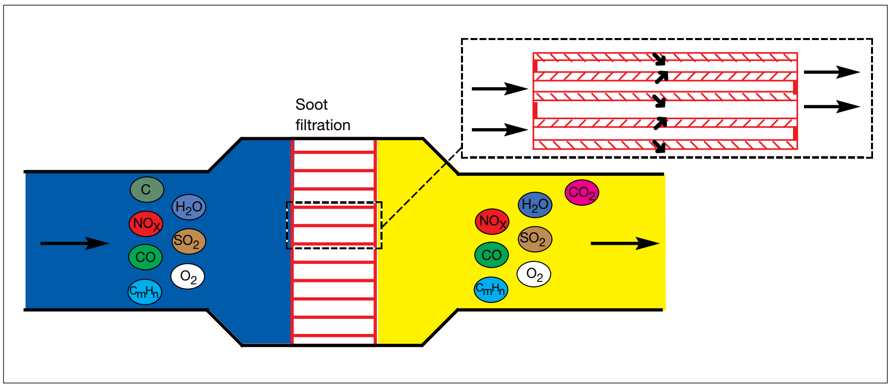
Dioxin/furan
Primarily in the burning of residual waste, but also in process waste gases, frequently present annular hydrocarbons can form dioxins and furans when they combine with chlorine. In an oxidation catalyzer, made of homogenous ceramic base material with integrated active catalytic material, the highly toxic pollutants are split up into harmless constituents.

Fiber filter catalyzer
To precipitate the micro dust (soot) of combustion engines fiber cartridge filters are used.
Due to the catalytic coating of the fibre the soot oxidizes at temperatures between 360 - 480 °C.



SCR catalytic converter for engines

DeNox catalyzer unit for gas-fired glass smelting process
130,700 Am³/h



Reaction diagram of fiber filter catalyzer

Data and facts

Precipitation of catalytic systems for boiler and engine units

	Typical crude gas value	Obtainable clean gas value	Typical crude gas value	Obtainable clean gas value	Typical crude gas value	Obtainable clean gas value	Typical crude gas value	Obtainable clean gas value
Fuel	NO_x		CO		C_mH_n		Dioxin/Furan	
	mg/Nm³		mg/Nm³		mg/Nm³		ng/Nm³	
Heating oil, heavy	800	80	40	-	20	-	-	-
Heating oil, extra light	400	50	15	-	10	-	-	-
Natural gas	250	30	10	-	100	30	-	-
Wood, waste, old timber	500	35	1000	100	300	50	0,3	<0,1
Residual waste incineration	200 - 4000	<100	1000 - 5000	<100	300 - 800	<50	8	<0,1
Diesel engine	2000 - 4000	<100	800	<100	50	<20	<20	<20
Natural gas engine	800	<100	1000	<100	<500	<50	<50	<50
Efficiency	90 - 98%		92 - 98%		65 - 90%		80 - 95%	

Temperature ranges

Our catalyzers are marked by
- low starting temperature and
- wide temperature range

with the middle value indicating the optimum operating level.

NO_x	250 - **300** - 500 °C
Dioxin/Furan	220 - **300** - 420 °C
CO	180 - **260** - 600 °C
C_mH_n	120 - **x** - 600 °C
C	360 - **420** - 480 °C

x: For hydrocarbons the optimum operating temperature depends strongly on the pollutant composition.

Advantage

- Urea is nontoxic, transportation and storage hold no risks
- NO_x conversion rates of over 98% are possible
- No or neglectable reaction by-products such as nitrous oxide, hydrocyanic acid, isocyanic acid
- All furnaces can be upgraded with SCR catalyzers
- Low MSR effort required
- Low ammonia slip

Applications

- Thermal power station
- Waste incinerators
- Waste wood incineration
- Explosives incineration
- Gas/Diesel engines
- Gas turbines
- Crematories
- Solvent disposa
- Chemical/pharmaceutical industry
- Textile/paint/varnish industry
- Stainless steel pickling plants
- Various process air purifications
- Thermal residue utilization
- Cogeneration systems
- Greenhouses

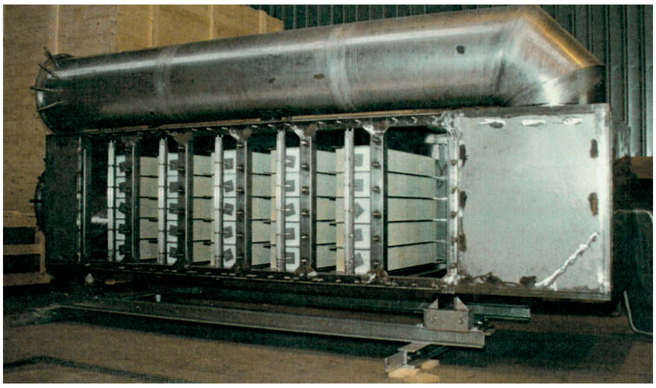
Modular construction

- The reactor casing is constructed of stainless steel in a modular system with integrated insulation
- This allows an individual line-up of components depending on type and concentration of pollutant
- Single and multi-stage catalyzer layout as required
- Adjustments to structural conditions possible any time
- Compact and economical construction possible

SCR catalyzer technology

is characterized by
- long life span
- high quality standard
- simple operation
- high operating safety
- low maintenance effort
- low operating costs
- wide temperature range, 120-520°C, depending on pollutant
- high conversion rate of up to 98%
- low ammonia slip
- existing systems are easily upgraded

Examples of SCR technology

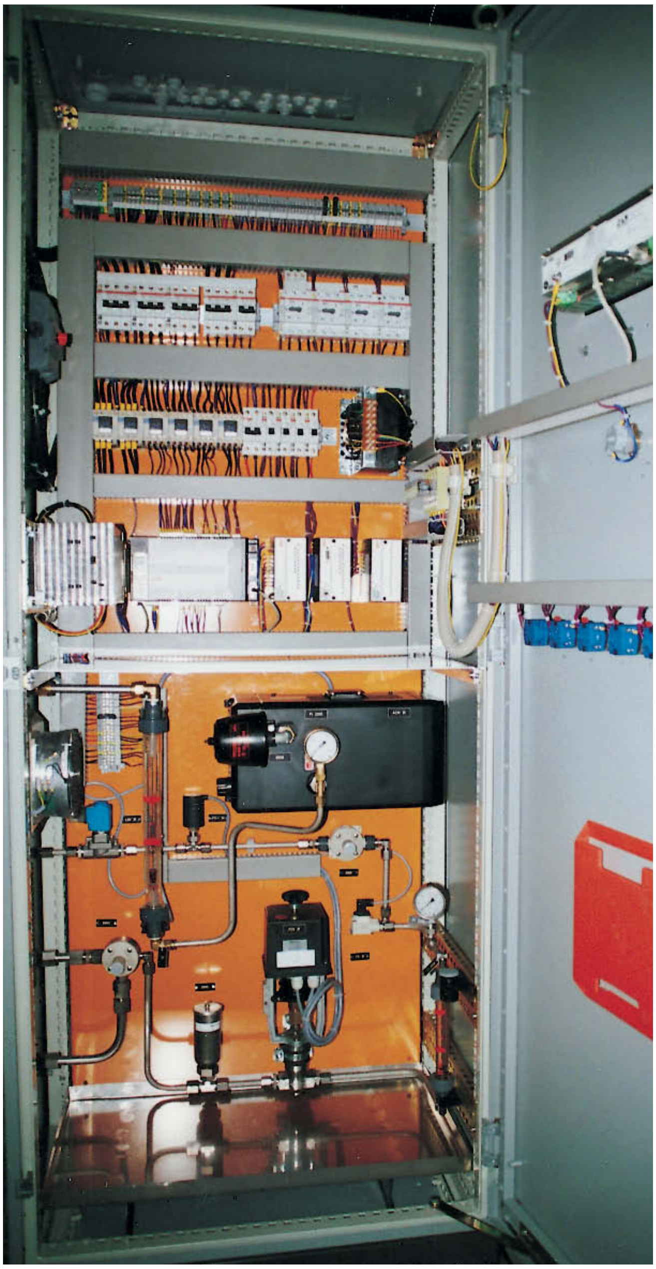

Catalytic reactor with 6 rows of catalyzers for pickling plant


DeNO$_X$ catalyzer unit for diesel engine 14,300 m^3/h


Catalytic convertor for NO$_X$, Dioxin, CO and HC behind incineration of explosives, 28,500 m^3/h


2 Dual-DeNO$_X$ catalyzer units for heavy oil fired boiler, 56,000 Am^3/h each


Dual-DeNO$_X$ catalyzer unit for glass smelters 304,600 m^3/h


Control panel with PLC system and dosing unit
Top: electrical control unit with PLC
Bottom: dosing unit for compressed air and reactant

Environmental protection is a tradition at EWK Environmental Engineering. Our plants, proven throughout the world in decades of operation, are the best evidence.

With this experience we develop and offer innovative technologies.

- Plant design
- Engineering
- Production
- Assembly
- Commissioning
- Maintenance/service

for:

- Electrostatic precipitators
- Fabric type filters
- Wet absorber/scrubbers
- Catalytic gas cleaning systems
- Heat recovery systems
- Water cooling towers
- System combinations

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