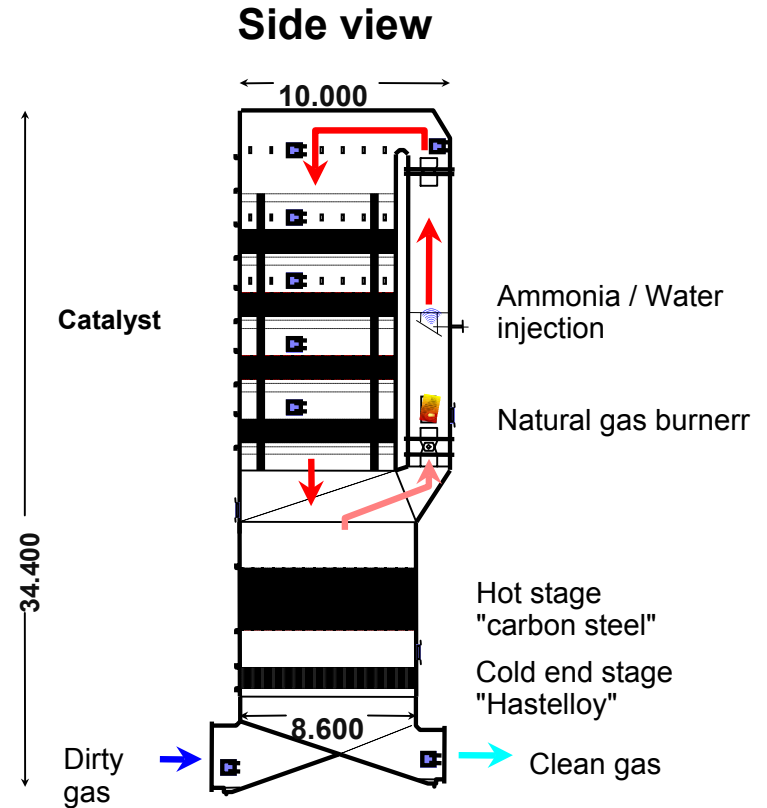
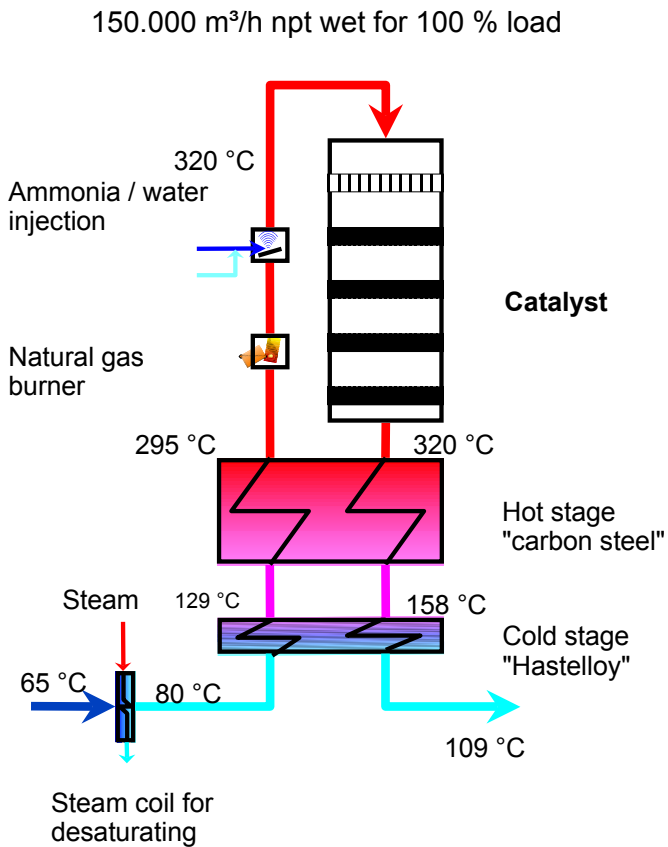


BD Heat Recovery Div. *DeNOX / CatOx - highlights*

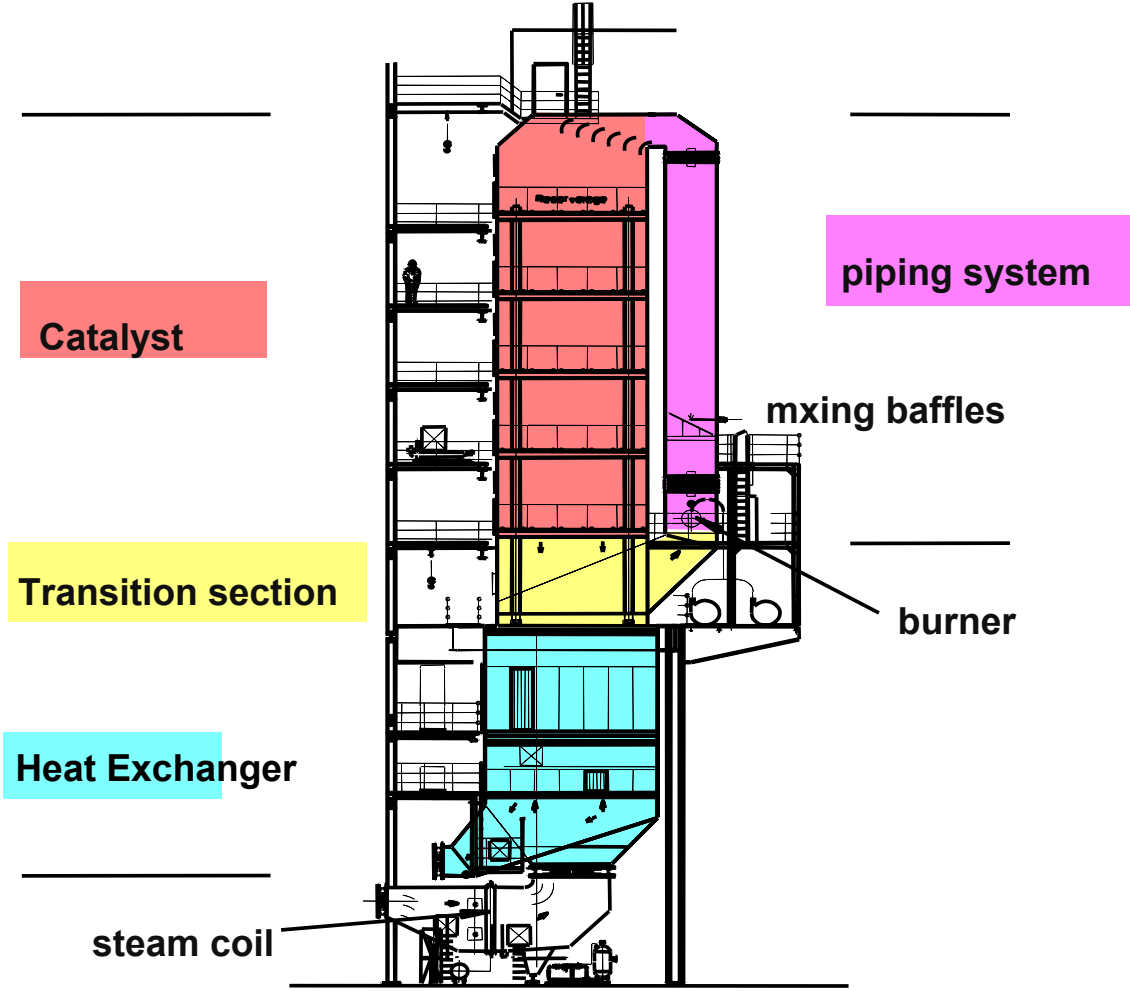
The BD. DeNO_x / CatOx system is characterised by:

- 1) High efficiency and space saving heat exchanger reheats the flue gas to the required operating temperature.
- 2) Low temperature approach (up to 15 K) reduces energy costs.
- 3) Use of aqueous ammonia (25%) instead of gaseous ammonia (NH₃) simplify storage and environmental requirements.
- 4) Use of patented Gas Mixers distribute the ammonia homogeneously in the flue gas (+/- 5%).
- 5) Few injection points of ammonia reduce operating requirements of the ammonia control system.

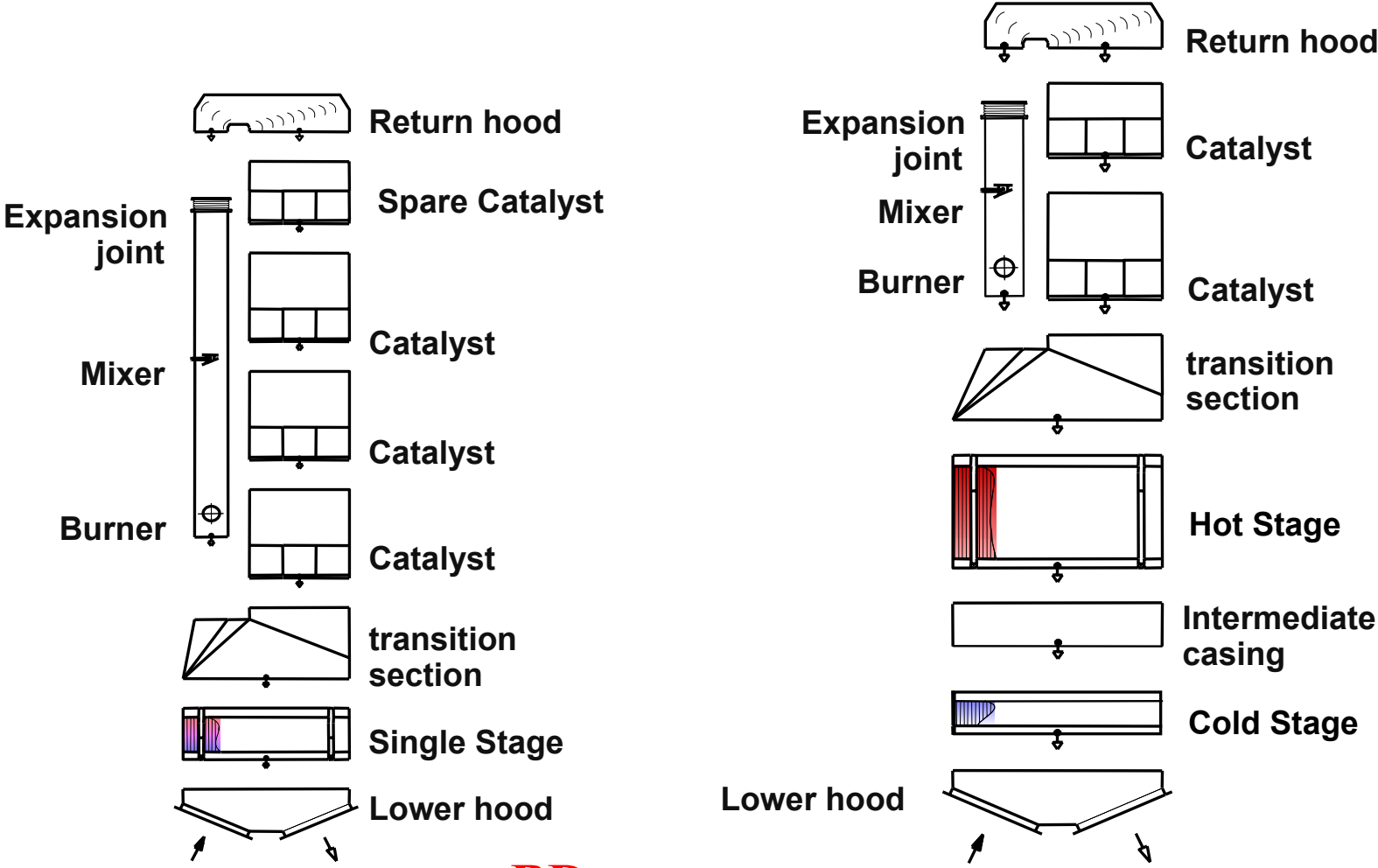
Typical process diagram



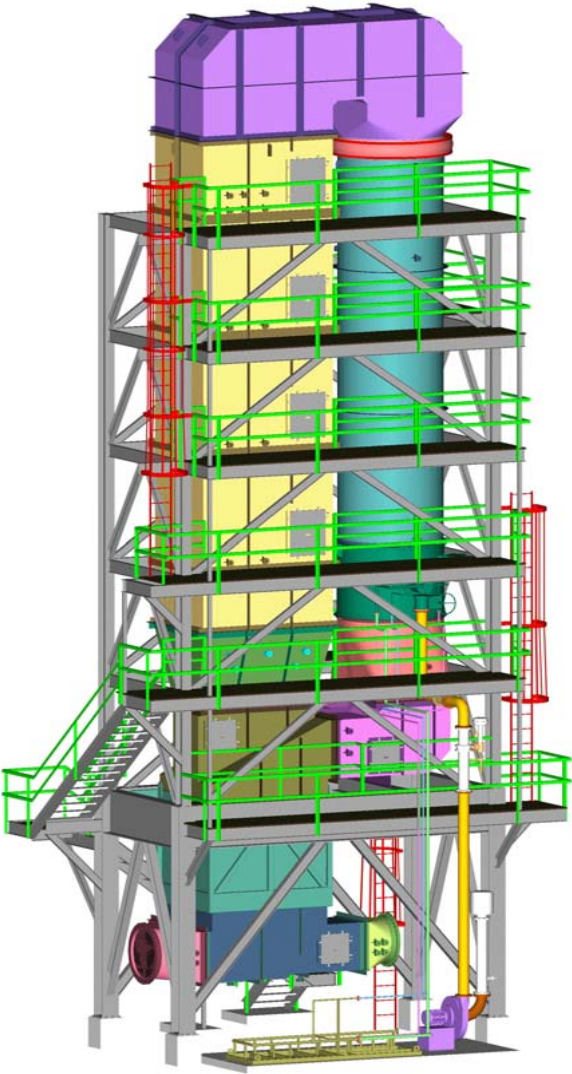
COMPACT DENOX - Sketch



COMPACT DENOX - assembly in modular units

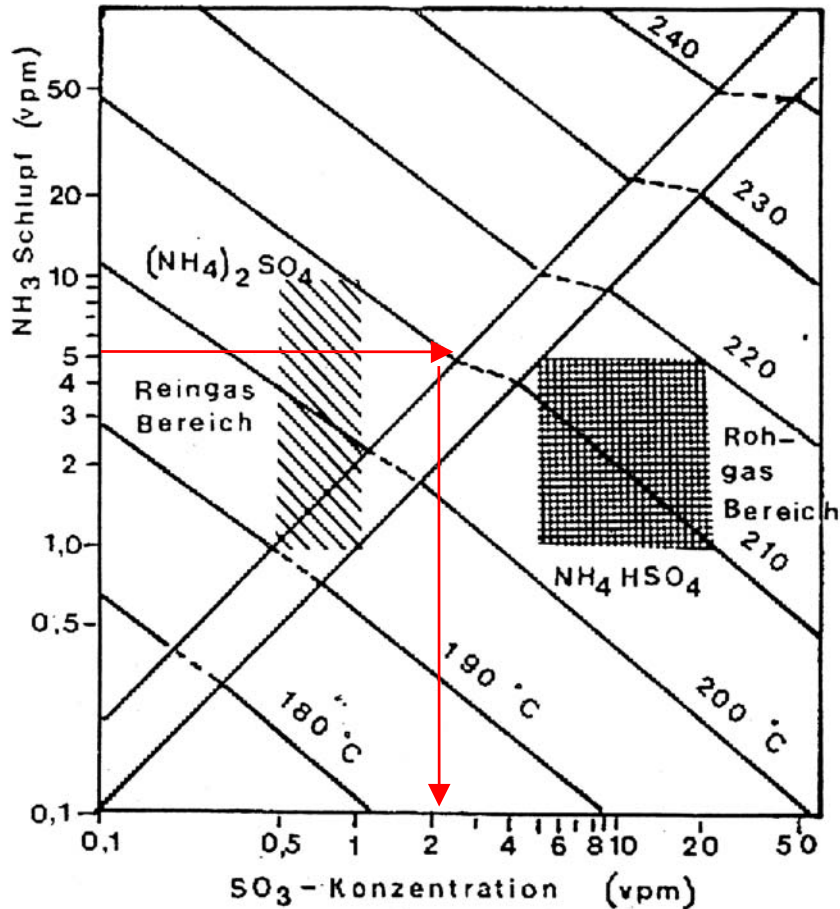


Typical CatOx System



COMPACT DENOX - Ammonium sulfate formation

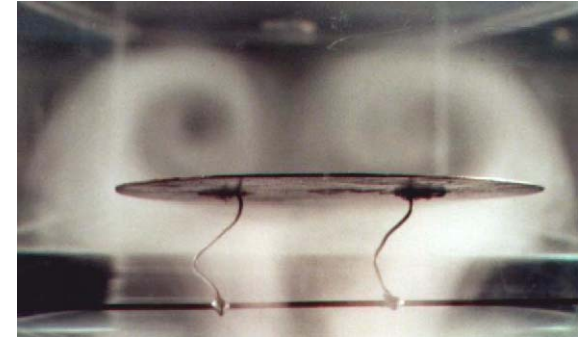
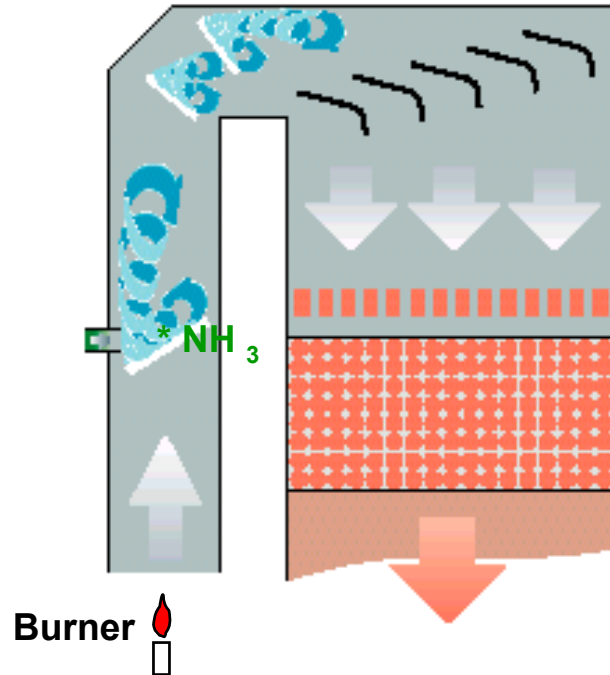
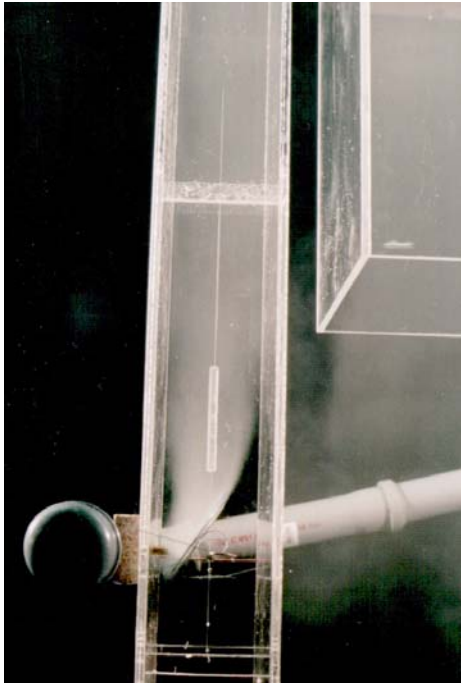
Ammonium sulfate area:
powdry and non agresiv



Ammonium Hydrogen sulfate:
sticky and agresive

The operating point of the catalyst is outside of the condensation area of ammonium hydrogen sulfate.

COMPACT DENOX - Ammonia distribution

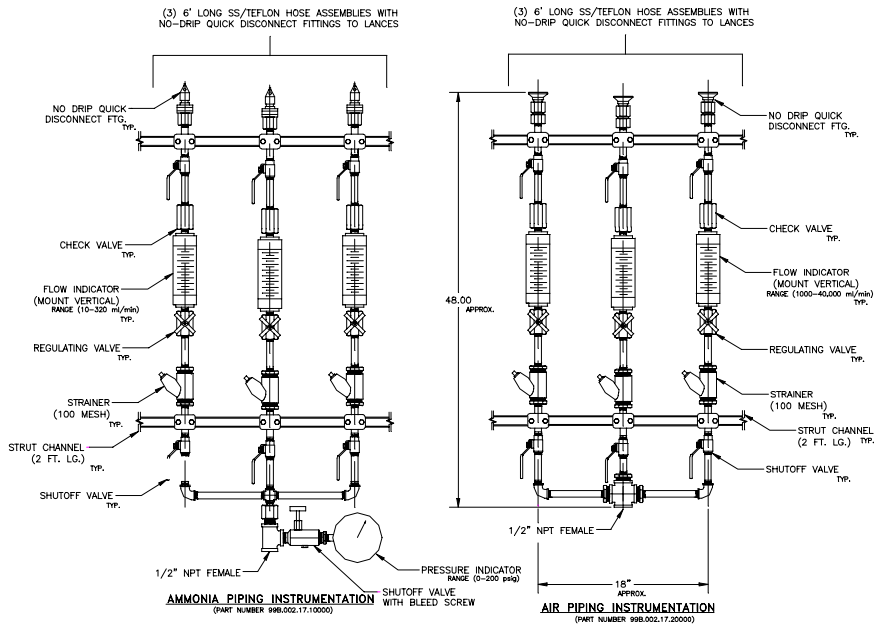


The distribution of the aqueous Ammonia in the flue gas is obtained by patented Static Gas mixers.

Only 2-3 injection points are required compared to a multi-nozzles grid injection system.

The position of the gas mixer is defined in a plexiglas test flow in a scale of approx. 1:30

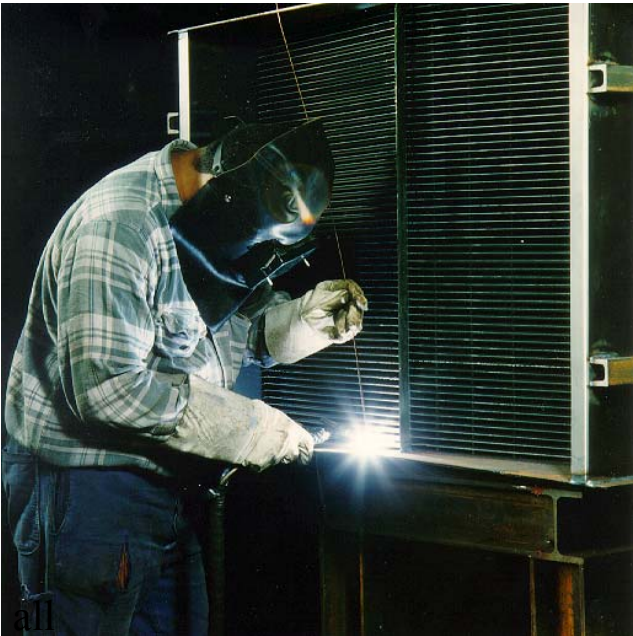
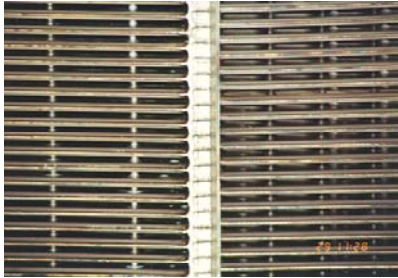
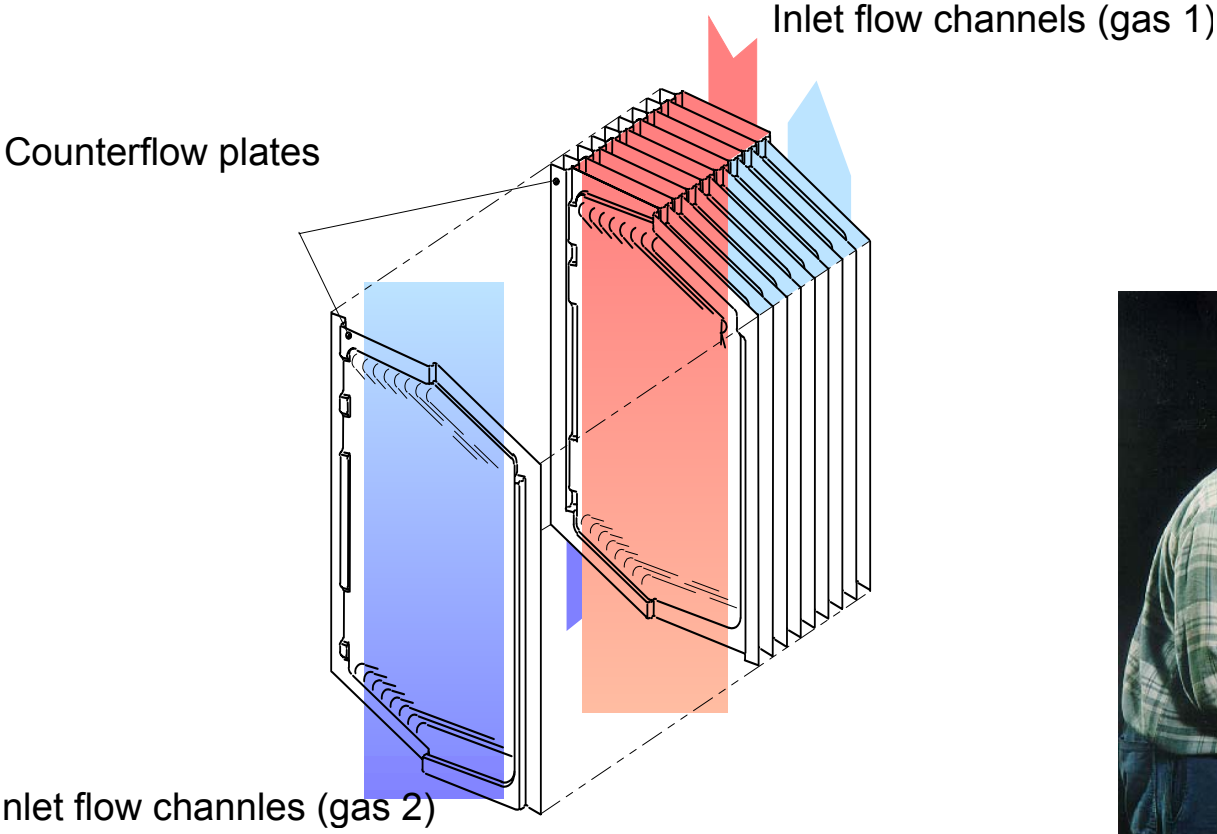
COMPACT DENOX - Ammonia injection



The aqueous ammonia (25 %) is atomised with pressurised air (approx. 100 psig).

Only 2-3 injection points are required compared to grid injection systems with multi-nozzles.

COMPACT DENOX - Heat exchanger principle



completely welded plates

The counter flow design offers the highest thermal recovery among all heat exchanger types. Modular construction, welding know-how and adequate material permits a large range of application for REKUGAVO.

COMPACT DENOX - Counterflow plates



Repartition 1/2 - 1/2
For clean fuel

Repartition 1/3 - 2/3
For dirty fuel



Plate profile
Gap = 6 mm

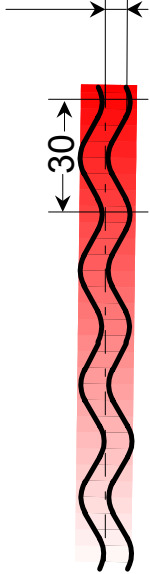


Plate thickness
0,37 to 1,0 mm

Plate profile
Gap = 8 mm

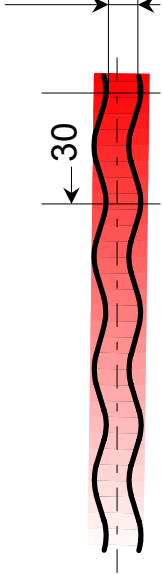


Plate thickness
0,37 to 1,0 mm

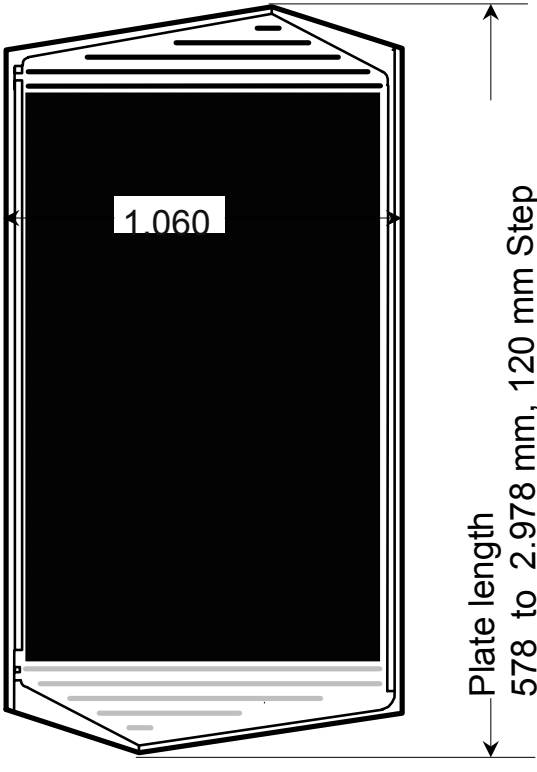


Plate length
578 to 2.978 mm, 120 mm Step

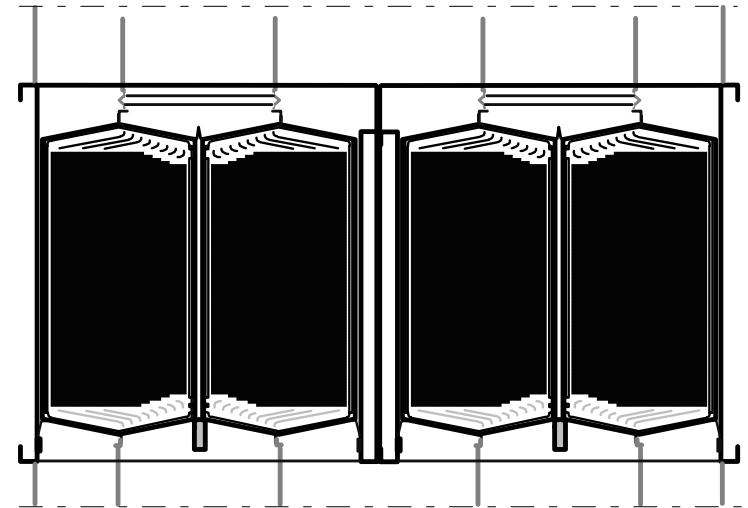
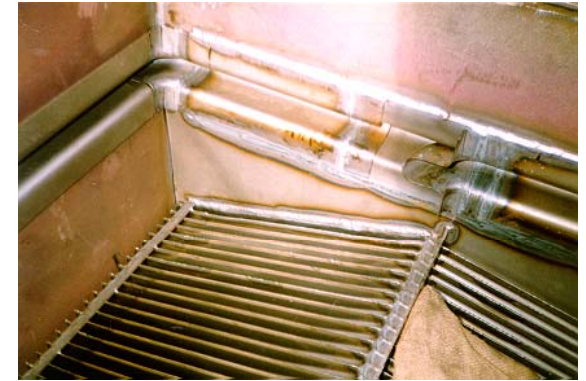
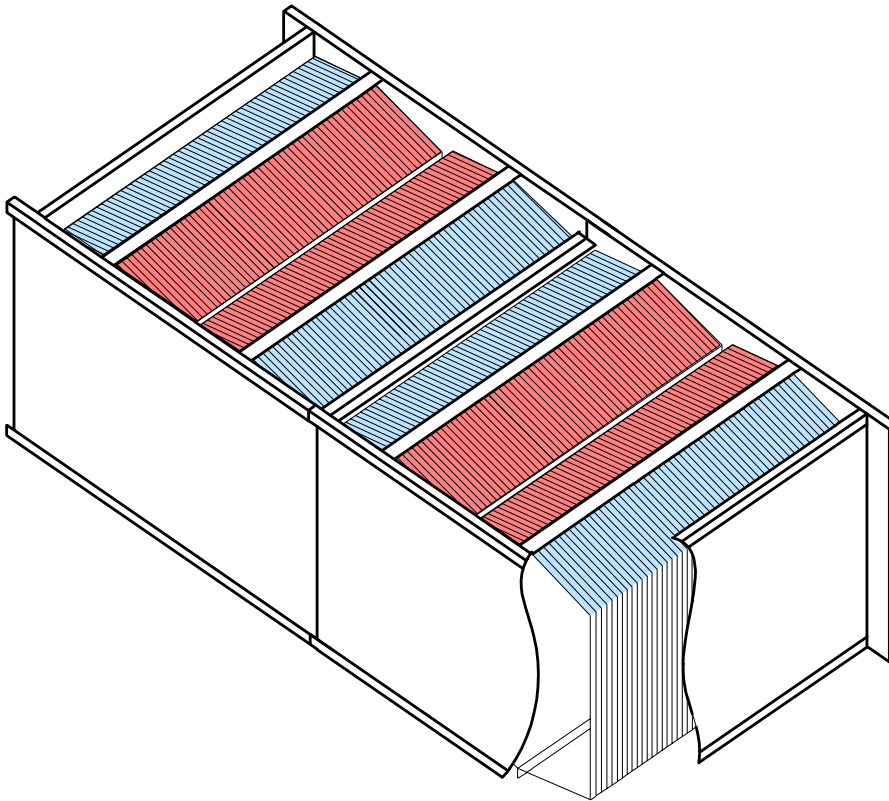
COMPACT DENOX - Thermal expansion

Standard containers build up to REKULUVO of any size

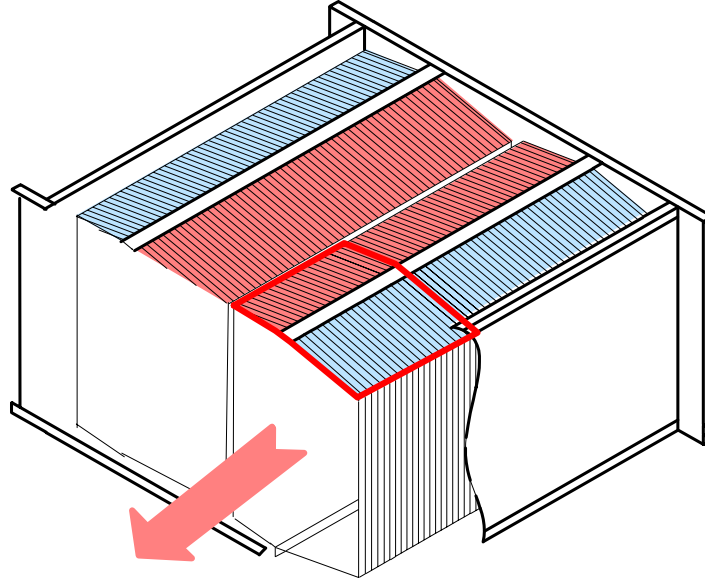
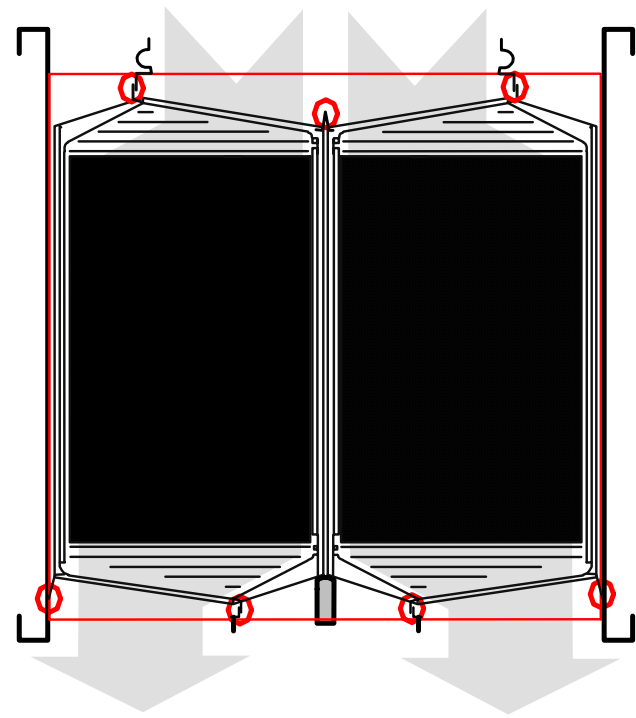
The system of standard modules is suitable for volume flows of approx.:

5.000 to 2.000.000 m³/h npt wet
with a space requirement of approx.:

1 bis 400 m²

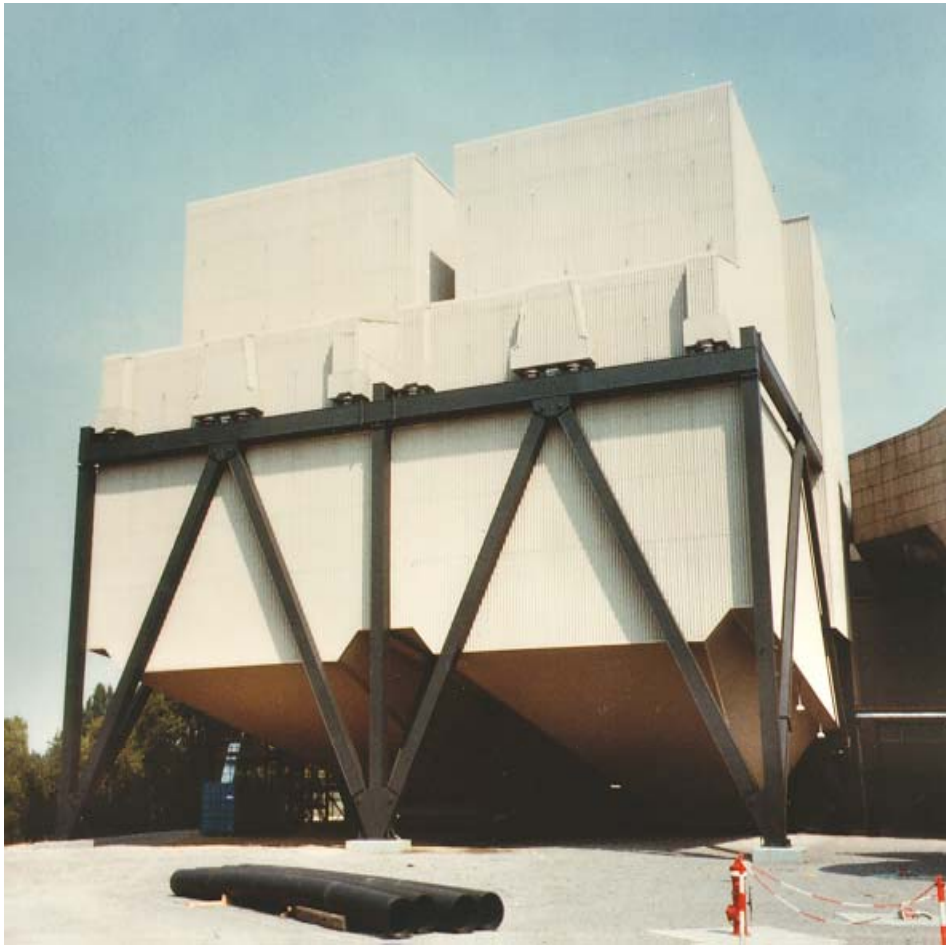


COMPACT DENOX - replacement of plate packs



The plate packs can be replaced in the same manner as during their installation. No special crane, space or tools are necessary for this action. Dismantling of ducts or piping for space reason is not necessary anymore.

COMPACT DENOX - reference Westerholt



- **Westerholt power station:**
 - Output per unit 300 MW
 - Volume flow 1.421.000 m³/h n.p.t.moist
- **Temperatures:**
 - Untreated gas 80 to 293 °C
 - Treated gas 320 to 105 °C
- **Output data:**
 - REKUGAVO 119.000 kW
 - Pressure drop incl. catalyzer 35 mbar
 - Thermal efficiency 88 %
- **Dimensions of overall plant:**
 - Width, length, height (35 x 31 x 31) m
 - Exchange surface 240.000 m²
 - Total weight 4.200 t

The largest plate type exchanger of the world with 240.000 m² and approx. 4.000 t weight. In operation since 1989.

COMPACT DENOX - reference Krefeld



- **Waste and sewage sludge incineration plant, Krefeld**
 - Incineration capacity 340.000 t/a
 - Volume flow 3 x 100.000 m³/h n.t.p.moi
- **Temperatures:**
 - Untreated gas 80 to 290 °C
 - Treated gas inlet 320 to 115 °C
- **Output data:**
 - REKUGAVO 3 x 8.500 kW
 - Pressure drop incl. catalyzer 30 mbar
 - Thermal efficiency 87 %
- **Dimensions of overall plant:**
 - Width, length, height 3 x (4,6 x 6,5 x 32) m
 - Exchange surface 3 x 11.600 m²
 - Total weight 3 x 330 t

Operating since 1994 on three different line. The lower stage is made of Hastelloy C-22.

COMPACT DENOX - Reference list

PLANT	FLOW	CUSTOMER	Temp.app	Op.
PP Westerholt	2 x 710.000 Nm ³ /h	E.ON	30 K	1990
Krefeld	3 x 102.500 Nm ³ /h	Municipality	30 K	1995
Niederrhein	4 x 165.000 Nm ³ /h	Municipality	35 K	1995
Ruhleben	4 x 148.000 Nm ³ /h	Municipality	28 K	1995
Bielefeld	3 x 165.000 Nm ³ /h	Municipality	25 K	1995
Weisweiler	3 x 97.000 Nm ³ /h	Municipality	30 K	1996
Hamburg	2 x 78.000 Nm ³ /h	Municipality	20 K	1997
Bamberg	3 x 41.500 Nm ³ /h	Municipality	25 K	1997
Neustadt	1 x 70.000 Nm ³ /h	Municipality	25 K	1997
Göppingen	2 x 124.000 Nm ³ /h	Municipality	32 K	1997
FISIA	2 x 65.000 Nm ³ /h	Fiat	30 K	1997
Euroftal	1 x 160.000 Nm ³ /h	Euroftal	150 K	1997
DistriGas	2 x 65.000 Nm ³ /h	Kvaerner	25 K	2001
OxyChem	4 x 32.000 nm ³ /h	Parsons	40 K	2001

COMPACT DENOX - advantages

1) Space saving concept

Vertical arrangement with high efficiency heat exchanger allows to retrofit a DeNOx in almost every situation

2) High efficiency

The high efficiency counter flow heat exchanger reduces the temperature approach and helps to save foreign energy input.

3) Leak free

Tightness guarantee of 99.9 % help to save catalyst volume.

4) Local content

The plate packs of the REKULUVO are manufactured in Ratingen / Germany. All other components can be manufactured almost everywhere else in the world.

5) Flow testing

Flow test analysis prior to execution gives the guarantee for flow and NH/NOx distribution.