Sulzer Chemtech – Moving Ahead

Sulzer Static mixers for SCR DeNOx applications

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Sulzer Chemtech

S. Hirschberg

Sulzer – Company History

Salomon
Sulzer-Bernet
1751–1807

Johann Jakob
Sulzer-Neuffert
1782–1853

Johann Jakob
Sulzer-Hirzel
1806–1883

Salomon
Sulzer-Sulzer
1809–1869

1775
- Salomon Sulzer-Bernet founds the Sulzer company
- Winterthur's first brass foundry is established:
  - Pumps
  - Fire extinguishers

1834
- Jakob Sulzer-Neuffert and his two sons found the company "Sulzer Brothers"

1914
- Family business is incorporated

Sulzer – Four divisions and Sulzer Innotec

Sulzer Pumps

Pumping solutions and services

Sulzer Metco

Surface technology solutions and services

Sulzer Chemtech

Separation columns and static mixing

Sulzer Turbo Services

Service and repair for thermal turbomachinery

Sulzer Innotec

Contract research and technical services

Solutions and components for separation, mixing and dispensing technology

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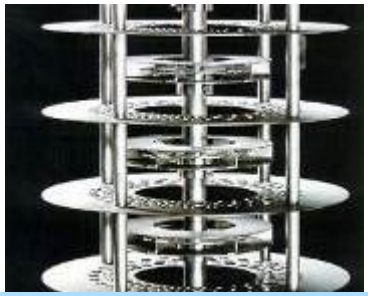


- Approx. 3’000 employees
- Sales CHF 630 Million (2009)
- Market share:

  No. 1 Static mixers
  No. 1 Two component mixing/dispensing systems

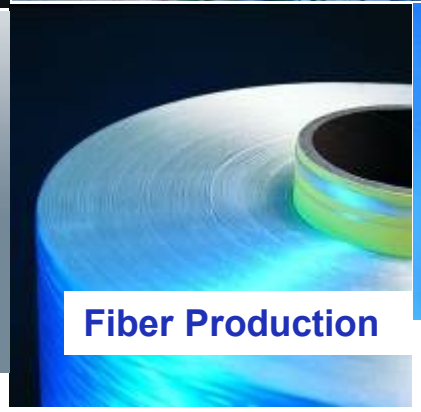
  No. 2 Components for separation columns

  No. 1 Tower field services

Products and services

- Tower internals for distillation, separation, absorption and reactive distillation processes; crystallization, extraction, evaporation and membrane process equipment
- separation units
- logy
- systems
- ngineering (process, , tower field service
- cess efficiency as for engineering, design, es
- Profound process know-how for a wide range of applications lead to low total cost
- Cost effective solutions through innovation
- Multiple manufacturing and engineering sites ensure closeness to markets on a global basis

Applications



Mixing and Reaction Technology
Broadest product portfolio in the industry

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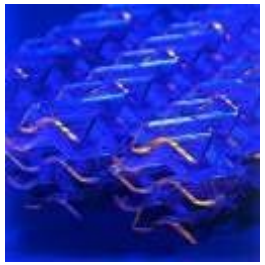
Leading in Technology

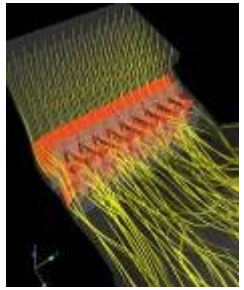


1970 Invention of Static Mixing Technology (SMV-Mixer)

1980 Introduction of SMX

1985 First SMR Reactor

1990 First PS-production plant



1995 CFD-simulation

2002 First CompaX

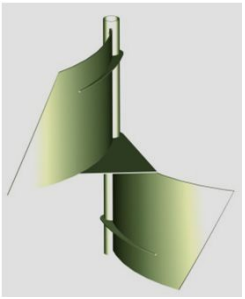
- More then 50 applied patents
- More then 36 years experience
- More then 100'000 references worldwide

2009 Introduction of SMX plus

2008 First sold PLA production plant

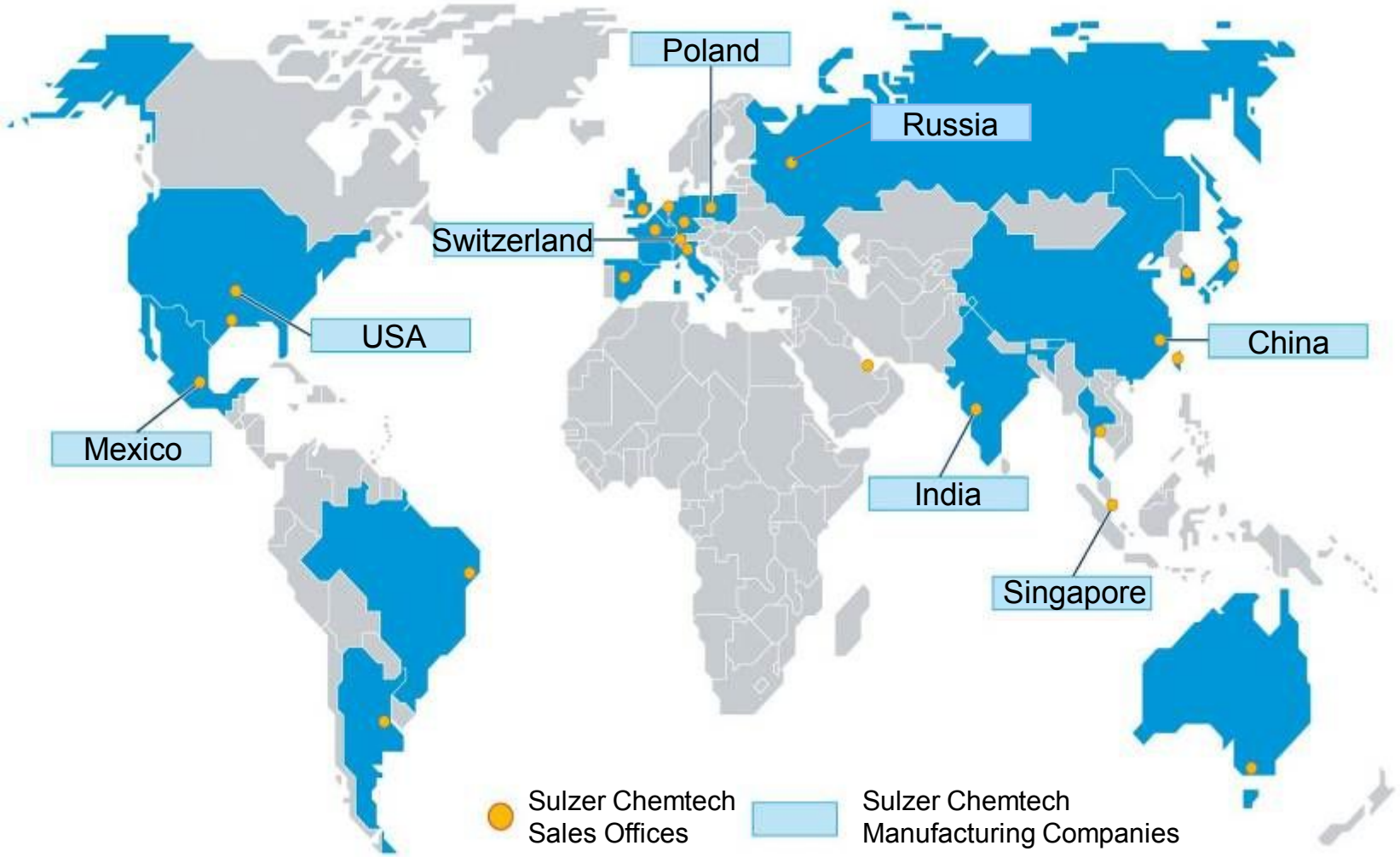
2007 Introduction Optifoam Extrusion

2006 First EPS-production plant



2004 First Contour

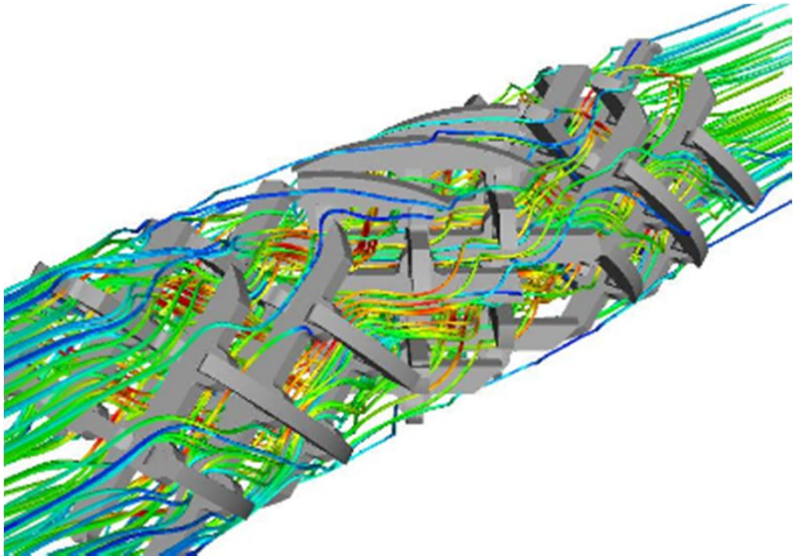
Global customer support and global manufacturing



R&D and testing facilities

Capabilities

- Development / optimization of mixer geometries and designs
- CFD - flow modeling
- Laser Induced Fluorescence (LIF) for characterization of mixing performance
- Measurement of homogeneity, residence time distribution, pressure drop etc.



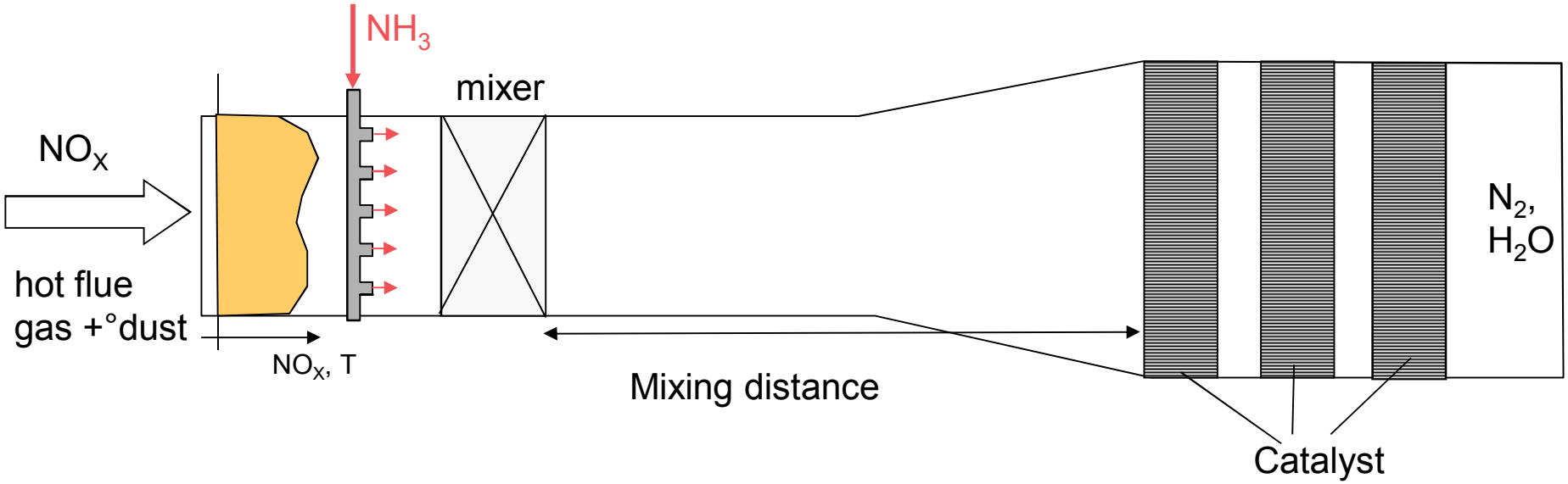
Pilot plants and test rigs for:

- Reaction and degassing of polymers
- Admixing of additives into highly viscous melts
- Injection molding and extrusion including foaming with physical blowing agents
- Dispersion of immiscible liquids and gas/liquid
- Mixing of liquids, gases and gas liquid

Sulzer products and services

- Static mixers for different installation sizes
  - Round ducts: **Sulzer CompaX™, Sulzer SMI™, Sulzer SMV™**
  - Rectangular ducts: **Sulzer Contour™, Sulzer SMV™**
- Ammonia Injection grids optimized for the static mixer to be used
- Wear protection coating for mixers and duct internals for operation with difficult dust (in cooperation with Sulzer Metco)
- CFD analysis and optimization of duct with AIG, mixers, turning vanes, flow rectifiers is part of the solution provided
- Physical flow modeling
- Development of static mixer configurations for equalization of dust distribution over the catalyst surface using CFD
  - For increase of catalyst life time
  - For prevention of fine dust clogging parts of the catalyst
- General analysis of large gas ducts for potential of pressure drop reductions as a service
- Performance guarantees

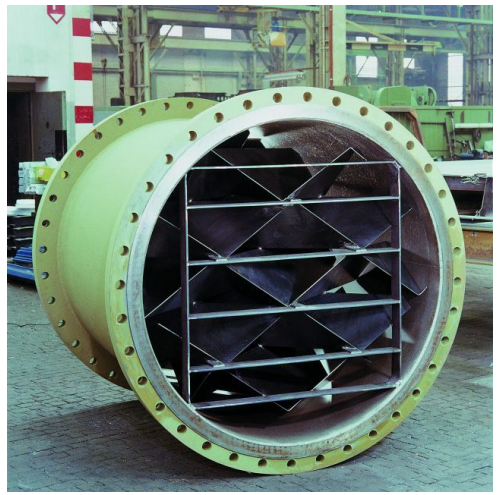
DeNOx system with SCR reactor

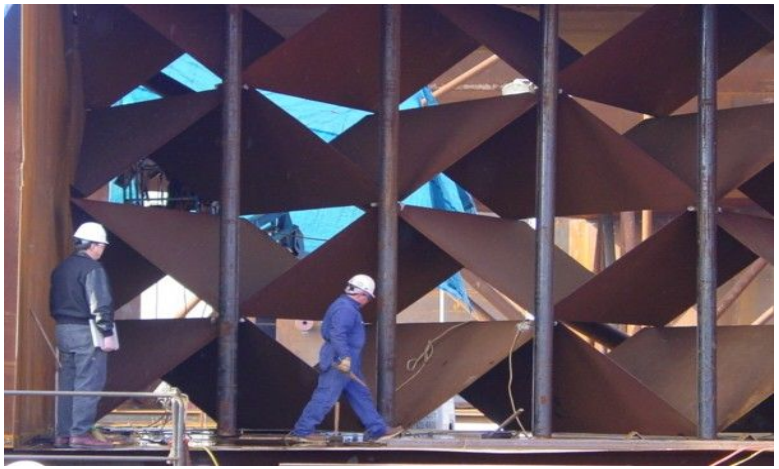


- Addition of stoichiometric amount of NH_3 to flue gas
- Generation of homogeneous distribution of NH_3/NO_X ratio
- Generation of homogeneous temperature distribution (no cold spots)
- Distribution of dust to reduce peaks in erosion
- No NH_3 slip

Sulzer SMV™ gas mixer

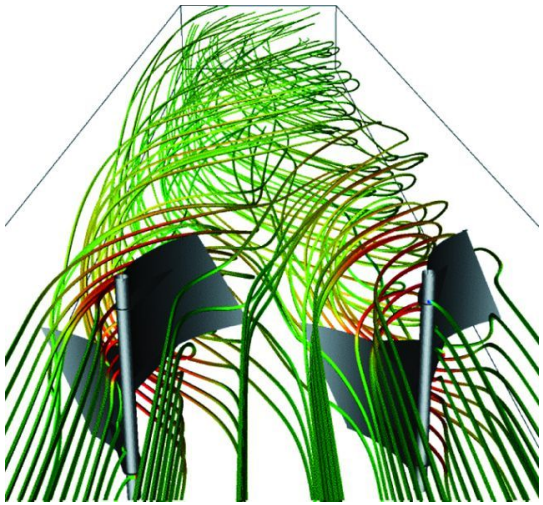
- Proven mixer technology
- Used in first large DeNOx applications realized in Germany in the 1980‘s. Many recent US references
- Compact design
- Very short mixing length possible with specially adapted ammonia injection grid (AIG)
- Mixing process already starts within the mixer
- Low pressure drop
- Standard design includes 2 mixers
- Well suited for dust distribution
- Erosion protection by coating critical parts of the mixer as an option

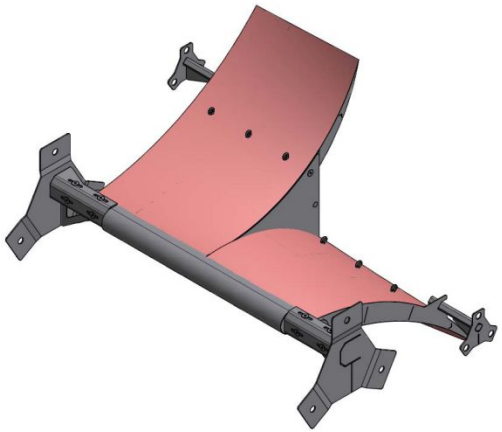


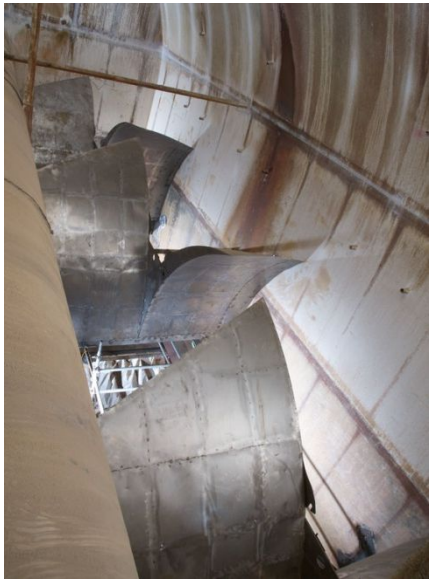


Sulzer Contour™ mixer

- New mixer with optimized streamlined design (no flow detachment)
- Extremely low pressure drop
- Very good homogeneity possible (below 1% RMS if required)
- Very short mixing length possible
- Cross flow mixing over large distances
- Customizable to the mixing problem at hand
- Ideal for applications both with liquid atomized NH4OH or vaporized dosing
- Erosion protection through coating as an option
- Low weight
- On site assembly from a number of compact parts for installation in existing flue gas ducts







Sulzer Contour™ mixer

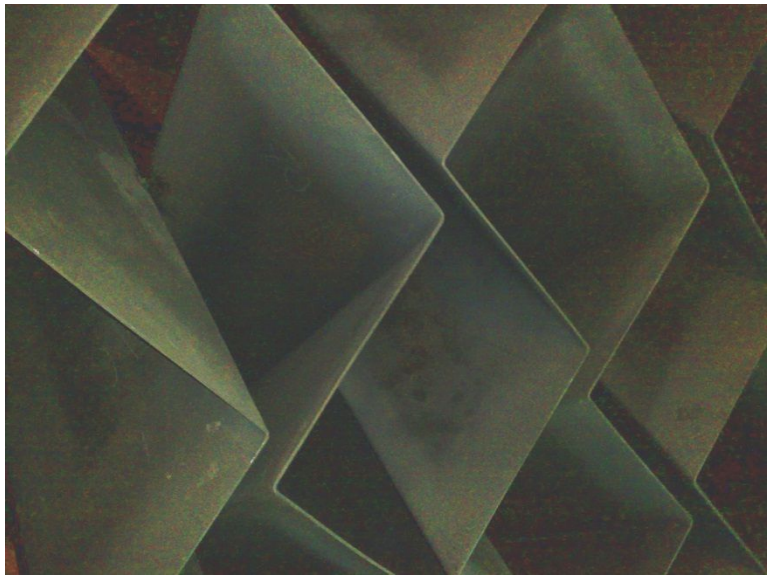
Sulzer Contour™ mixer

Highly optimized solution for admixing and homogenizing tasks in large rectangular gas ducts. Very good homogeneity achieved at lowest pressure drops.

Example shows admixing of ammonia in front of SCR catalyst in a SCR DeNOx flue gas treatment unit of a large fossil powered thermal power plant. Experimental visualisations and CFD

Erosion protection coating

- Thermal spray coating
- Arc wire based coating process
- General coating properties:
  - hard
  - ductile
  - good adhesion to substrate
- Properties of coating developed for this application
  - Hardness > 850 [HV 0,3]
  - Operating temperatures > 550°C
- Coating can be applied in the workshop (mostly automated) or on site
- Significantly increased service life time for coated surfaces even in severely abrasive environments



Applications of static mixing technology in thermal power stations

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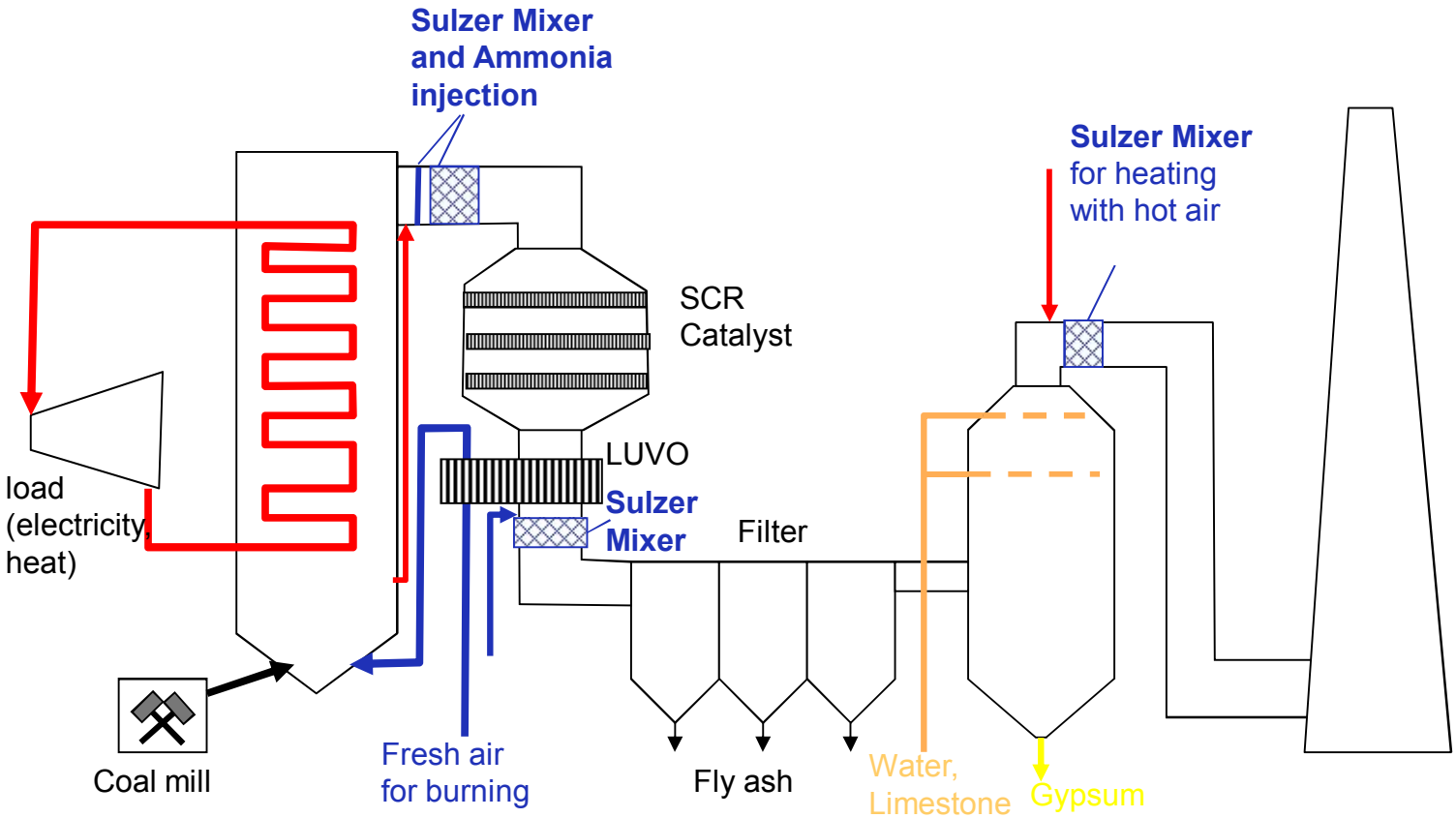

Sketch of a flue gas cleaning system with high dust SCR

Applications of static mixing technology in thermal power stations

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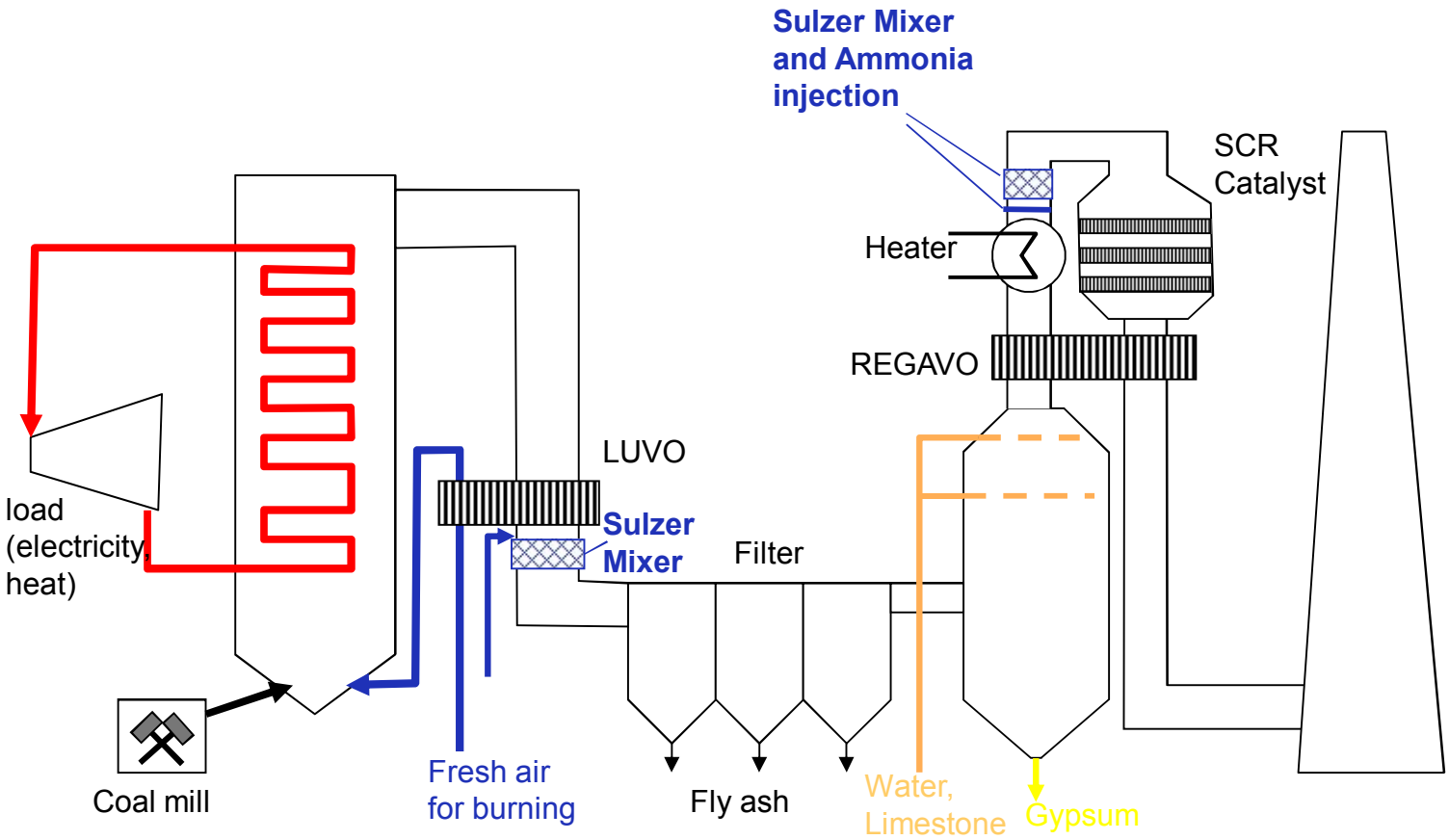
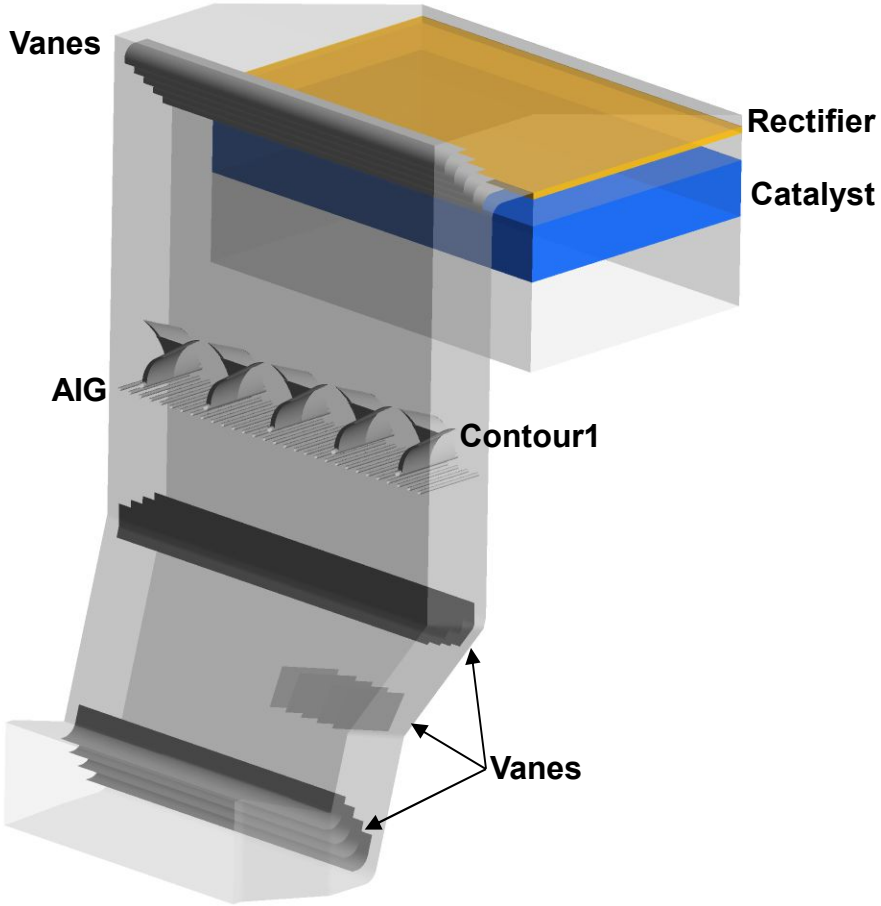


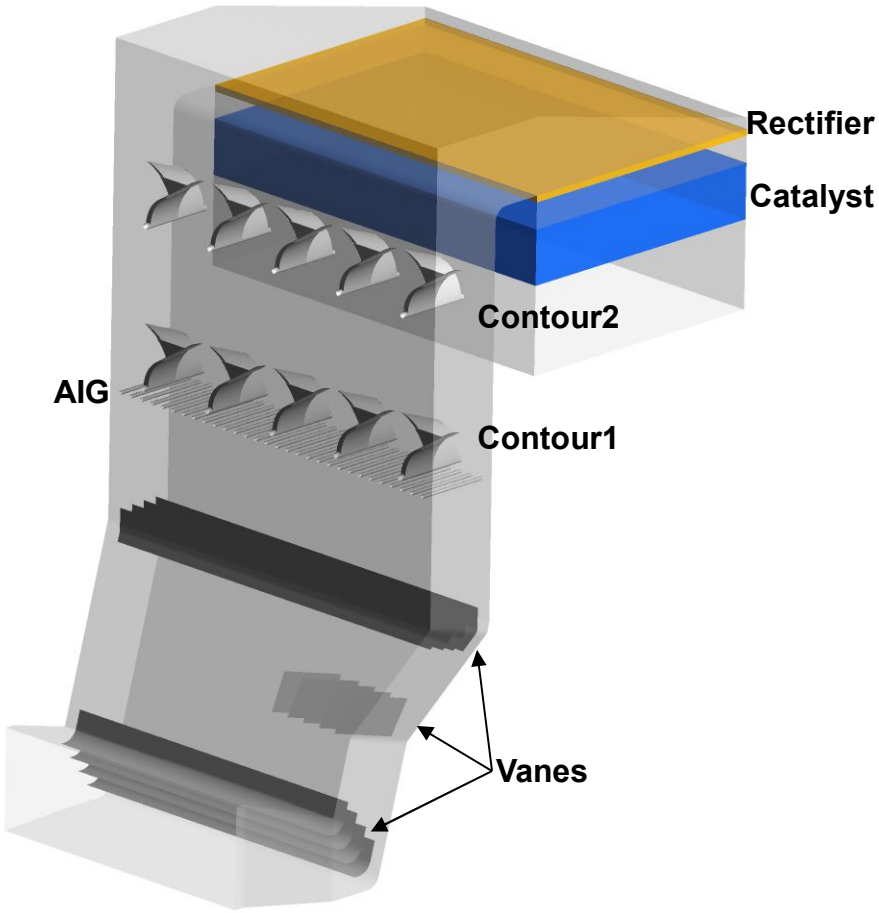
Sketch of a flue gas cleaning system with tail end SCR

SCR system: Mixer configurations

- 1 row of Sulzer Contour™ mixers



- 2 rows of Sulzer Contour™ mixers



- Geometry size: 1/12 model
- Inlet massflow flue gas: 9.5125 kg/s
- Total NH_3 massflow: 2.473E-03 kg/s