FLUE GAS CLEANING
WE ARE THE RIGHT TEAM FOR SPECIAL CHALLENGES!

Upgrades to existing flue gas cleaning systems and retrofits of state-of-the-art equipment for sulphur dioxide, nitric oxide, mercury and dust removal are our day-to-day business – and this is reflected in our extensive reference list and by the satisfaction of our customers.

OUR KNOWLEDGE AND EXPERIENCE HELP YOU TO MEET CURRENT ENVIRONMENTAL REQUIREMENTS IN THE MOST COST-EFFECTIVE MANNER!

Protection of our natural resources for the sake of future generations motivates us to constantly improve our technical solutions to control the emission limits of industrial facilities. Furthermore, emission limit values for dust, NOx and SOx for such facilities are constantly being revised by legislation.

RELY ON GOOD EXPERIENCES AND MEET YOUR EMISSION REQUIREMENTS

TURN OUR EXPERIENCE INTO YOUR ADVANTAGE!

CONTACT
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Department Manager
Eastern Europe

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### FLUE GAS CLEANING

#### NOx REDUCTION SYSTEMS

![Image of SCR Catalyst]

**RETROFITTED SCR FOR LOW NOx EMISSIONS**

<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>TECHNICAL DATA</th>
<th>SCOPE OF SUPPLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Plants and Industrial Boilers</td>
<td>Emissions:</td>
<td>Consultancy</td>
</tr>
<tr>
<td>Low NOx Burners (LNB)</td>
<td>• NOx &lt; 50 mg/m³ (STP)</td>
<td>• Process engineering</td>
</tr>
<tr>
<td>Selective catalytic reduction (SCR) with honeycomb catalyst with plate catalyst</td>
<td>• NH₃ slip &lt; 1 mg/m³</td>
<td>• Mechanical design</td>
</tr>
<tr>
<td>Selective non-catalytic reduction (SNCR) e.g. in the cement industry</td>
<td>Fuel Type:</td>
<td>• CFD simulations</td>
</tr>
<tr>
<td>Benefits:</td>
<td>• Bituminous coal</td>
<td>• Supply &amp; Installation</td>
</tr>
<tr>
<td>Reduction of NOx and NH₃ emissions</td>
<td>• Heavy fuel oil &amp; residues</td>
<td>• Optimization between LNB and SCR / SNCR</td>
</tr>
<tr>
<td>Extension of fuel range</td>
<td>• Waste/Sludge</td>
<td>• Adaptation of boiler and water-steam cycle</td>
</tr>
<tr>
<td>High availability</td>
<td>• Lignite</td>
<td>• Adaptation of heating surfaces</td>
</tr>
<tr>
<td>Increase of operational flexibility</td>
<td>• Biomass co-firing</td>
<td>• Optimization of flue gas distribution and NH₃ injection</td>
</tr>
<tr>
<td>Reduced NH₃ consumption</td>
<td></td>
<td>• Commissioning</td>
</tr>
</tbody>
</table>

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<th></th>
</tr>
</thead>
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<td>Commissioning</td>
<td></td>
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<tr>
<td>Licensing</td>
<td></td>
</tr>
</tbody>
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<th></th>
</tr>
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<tr>
<td>Feasibility study for retrofit of an SCR plant, Heide Refinery, Germany</td>
<td>Raffinerie Heide GmbH, Hemmingsedt, Germany</td>
</tr>
<tr>
<td>Study for upgrade options of air pollution control equipment in answer to BREF 2017, Lignite, 227 MWel, Maritza East 3, Maritza, Bulgaria</td>
<td>ContourGlobal Maritsa East 3, Sofia, Bulgaria</td>
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<td>Feasibility study for co-firing of petcoke, 200 t/h, Heavy Fuel Oil and Low-Pressure Gas, Shell Wesseling, Germany</td>
<td>Shell Deutschland Oil GmbH, Wesseling, Germany</td>
</tr>
<tr>
<td>Engineering and supply of an SNCR test plant to optimize the existing SNCR, Cement Plant Rüdersdorf, Germany</td>
<td>CEMEX Zement GmbH, Rüdersdorf, Germany</td>
</tr>
<tr>
<td>Concept design study: assessment, comparison and selection of feasible NOx reduction technologies and concept engineering for a total of 10 bituminous coal fired power stations, South Africa</td>
<td>Eskom Enterprises, Johannesburg, South Africa</td>
</tr>
<tr>
<td>Supply and implementation of a new oil and gas firing system at a steam generator plus retrofit of a catalytic NOx system, 200 t/h, Heavy Fuel Oil and Low-Pressure Gas, Shell Wesseling, Germany</td>
<td>Shell Deutschland Oil GmbH, Wesseling, Germany</td>
</tr>
<tr>
<td>License and know-how transfer agreement for catalytic DeNOx system, China</td>
<td>Guizhou XingYun Environment Protection Co. Ltd., Guiyang, P.R. of China</td>
</tr>
<tr>
<td>Owner’s engineering for 3 SCR installations, modification of 5 steam generators, 75 t/h, 110 t/h, 150 t/h, firing Refinery Residues, Oil and Gas, Mineral Oil Refinery Oberrhein (MIRO), Germany</td>
<td>MIRO Karlsruhe, Germany</td>
</tr>
<tr>
<td>Engineering and retrofit of an SCR-DeNOx plant, 200 t/h, Heavy Fuel Oil and Low-Pressure Gas, Shell Rheinland Refinery, Germany</td>
<td>Shell Deutschland Oil GmbH, Wesseling, Germany</td>
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### LEGEND

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<td></td>
<td></td>
<td></td>
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<tr>
<td>Selective Catalytic Reduction</td>
<td>Standard Temperature and Pressure</td>
<td>Flue Gas Cleaning</td>
<td>Novel Catalytic SCR Technologies</td>
<td></td>
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</tbody>
</table>
### Fields of Application
- Power plants
- Industrial plants

### Benefits
- Reduction of pollutant emissions (SO₂, SO₃, mercury, dust)
- Increase of operational flexibility
- Optimized consumption of limestone
- Optimized distribution of oxidation air
- Reduction of auxiliary energy consumption

### FUEL TYPE
- Bituminous Coal
- Lignite
- Biomass co-firing
- Waste / Sludge
- Oil

### Technical Data
- SOₓ < 100 mg/m³ (STP) corresponding to removal efficiencies > 99 %
- Dust < 3 mg/m² (STP)
- Upgrade with neutral pressure drop design possible

### Scope of Supply
- Retrofits, Revamping, and New-Built FGDs
  - Supply & installation (EPC) of tray for BREF compliance
  - Process engineering
  - CFD simulations
  - Mechanical design
  - EP for core process equipment
  - Optimization concepts
  - Commissioning

### Application

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<td>Engineering for optimization of absorber, 5.2 MWeL, Sewage Sludge, Hamburg Wasser, Germany</td>
<td>Hamburg Stadtentwässerung AöR, Hamburg, Germany</td>
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<tr>
<td>Detail engineering and supply of 23 additional tray baskets, 480 MWeL, Bituminous Coal, Mannheim PS Unit 8, Germany</td>
<td>Grosskraftwerk Mannheim AG, Mannheim, Germany</td>
</tr>
<tr>
<td>Engineering and supply of a tray level for wet FGD, 22 MWeL, Herten Waste-to-energy plant Unit IM 1, Germany</td>
<td>AGR Betriebsführung GmbH, Herten, Germany</td>
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<td>Study of upgrade options for air pollution control equipment in answer to BREF 2017 Lignite, 227 MWeL, Maritza East 3, Maritza, Bulgaria</td>
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<td>Engineering for the conversion of absorber from lime to limestone, 35 t/h, Lignite, Plant Brottewitz, Germany</td>
<td>Südzucker Plant Brottewitz, Germany</td>
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<td>Licence for dry CFB-FGD technology, 6 × 686 MWeL, Bituminous Coal, Kendal PS, South Africa</td>
<td>Eskom Enterprises, Johannesberg, South Africa</td>
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<td>Retrofit of a tray for FGD scrubber upgrade, 2 × 110 MWeL, Lignite, Novaky PS, Slovakia</td>
<td>Slovenske elektrarne a.s., Bratislava, Slovak Republic</td>
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<tr>
<td>Feasibility study for the retrofit of a flue gas desulphurization plant, 3 × 50 MWeL, Bituminous Coal, International Paper Kwidzyn, Poland</td>
<td>International Paper Kwidzyn Sp. z o.o., Kwidzyn, Poland</td>
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<td>Retrofit of a tray for FGD scrubber upgrade, 86 MWeL, Lignite, Deuben PS, Germany</td>
<td>Mitteldeutsche Braunkohle-gesellschaft GmbH, Germany</td>
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<td>Retrofit of a tray for FGD scrubber upgrade, 600 t/h, Fenne PS, Bituminous Coal, Völklingen, Germany</td>
<td>Steag AG Saar-Völklingen, Germany</td>
</tr>
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<td>Engineering and key component supply for a Wet FGD, 150 MWeL, Lignite, Paroseni PS, Romania</td>
<td>LAB GmbH, Germany for Electro-centrale Paroseni S.A., Romania</td>
</tr>
<tr>
<td>FGD Tender evaluation, 6 × 800 MWeL, Bituminous Coal, Kusile PS, South Africa</td>
<td>Eskom Enterprises, Johannesberg, South Africa</td>
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### Legend
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**FLUE GAS CLEANING**

**WET FLUE GAS DESULPHURIZATION SYSTEMS**

**TRAY BASKETS**

- Flexible modular system for retrofit
- Increase of removal efficiency
- Reduction of power consumption
**APPLICATION**

- Thermal power plants
- Waste incineration plants

**Scope of application**

- Mercury balance assessments with own on-line mercury analyzers
- Integrated engineering solutions

**Benefits**

- Increase of operational flexibility
- Reduction of mercury emissions
- Proven and robust technologies

**AVAILABLE TECHNOLOGIES**

- Adsorption with activated carbon
- Duct injection
- Low pressure moving bed (patent pending)
- Separation in the flue gas desulphurization process
- Tray (reduction of mercury re-emission)
- Adding precipitating or complexing agent

**SCOPE OF SUPPLY**

- Mercury measurements and speciation
- Consultancy and optimization concepts
- Process engineering
- Engineering, supply and installation of components

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<td>Switch of neutralizing agent in the FGD and evaluation its repercussion on mercury removal, 35 t/h, Lignite, Plant Brottewitz, Germany</td>
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<td>Increase of the SO₂ capture in the second stage of a two-stage wet scrubber without negative effects on the overall mercury removal rate, 5.2 MWel, Vera Hamburg, Germany</td>
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<td>BREF impact study and concept development on mercury removal in the FGD, Lignite, 227 MWel, Maritza East 3, Maritza, Bulgaria</td>
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<td>Petcoke (co-)combustion study, quantification of the corresponding increase in heavy metals’ concentrations, 200 t/h, Heavy Fuel Oil and Low-Pressure-Gas, Shell Wesseling, Germany</td>
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<td>Consulting &amp; engineering support to assess sources and sinks of mercury in the power plant, Lignite, 188 MWth, Amsdorf PS, Germany</td>
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<td>Consulting and engineering support to assess sources and sinks of mercury in the power plant, 11x250 MWel, Lignite, Jänschwalde PS, Germany</td>
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**FLUE GAS CLEANING**

**MERCURY MONITORING AND MASS BALANCING**

- **PORTABLE CONTINUOUS MONITORING**
- **CLOSING OF MERCURY BALANCE**
- **MERCURY REMOVAL CONCEPTS**

**APPLICATION**

- Fields of Application
  - Speciation and quantification of elemental, oxidized and particulate mercury
  - Testing of permanent emission monitoring systems (single probes and long term)
  - Plausibility checks
  - Testing of influencing parameters (fast response time)

- Benefits
  - Portable modular design
  - Quick and easy transport
  - Integrated calibration

**TECHNICAL DATA**

- High sensitivity: 0.05 µg/m³
- Fast response: t(90) = 180 s
- Calibration certified (U.S. National Institute of Standards and Technology)

**FOCUSSED FUEL TYPES**

- Bituminous Coal
- Lignite
- Waste
- Sludge
- Oil

**SCOPE OF SUPPLY**

- Analyzer rental
- Measurement planning & execution
- Remote monitoring possible
- Consulting
- Closing of mercury balance
- Plant specific mercury removal concepts (choice of removal technologies)
- Engineering assistance, e.g. feasibility studies

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# DRY FLUE GAS CLEANING SYSTEMS

## APPLICATION
- Coal fired boiler plants
- Heavy fuel oil fired boiler plants
- Refinery residue fired boiler plants
- Biomass boiler (incl. Biomass-waste) plants
- Waste, Refuse-Derived-Fuel (RDF) and sewage sludge incineration plants
- Process flue gases from Aluminium industry (e.g. electrolysis off gases)
- Steel industry (e.g. sinter plant off gases)
- Cement industry (e.g. process gases)

## BENEFITS
- Compact design with low plant area requirements
- 10,000 to 4,500,000 m³/h with a single reactor
- High availability > 98%
- High turn down ratio
- Flexibility in utilization of absorbents
- Low water consumption incl. wastewater
- Fuel flexibility e.g. SO₂ reduction from 8,000 mg/m³ [STP] down to below 200 mg/m³ [STP]
- Fuel flexibility e.g. HCl reduction from 2,000 mg/m³ [STP] down to below 10 mg/m³ [STP]
- No additional operator staff
- Low maintenance and spare parts

## SCOPE OF SUPPLY
- New-built FGCs and retrofit
- Consultancy
- Licensing
- Project management
- Process engineering
- Basic engineering
- Detail engineering
- Supply & installation
- Commissioning

## TECHNICAL DATA
- Simultaneous emission reduction for:
  - SO₂ < 200 / < 10 mg/m³ [STP]
  - SO₃ < 1 mg/m³ [STP]
  - HCl < 1 mg/m³ [STP]
  - HF < 1 mg/m³ [STP]
  - Hg < 1 µg/m³ [STP]
  - Dust < 2 mg/m³ [STP]

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<td>License for Dry CFB-FGD technology, 6 x 686 MWel, Bituminous Coal, Kendal PS, South Africa</td>
<td>STEINMÜLLER ENGINEERING GMBH for (Eskom Enterprises, Johannesburg, South Africa)</td>
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<tr>
<td>License for Dry CFB-FGD technology, coal and coal with secondary fuels fired plants, Poland</td>
<td>INSTAL-FILTER SA, Kościan, Poland</td>
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<tr>
<td>Basic and detail engineering, procurement and supply including installation and commissioning of 2x flue gas desulphurization and de-dusting plants, 185 MWth</td>
<td>INSTAL-FILTER SA, Kościan, Poland for (ENERGETYKA Group KGHM, Lubin, Poland)</td>
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<tr>
<td>Basic, detail engineering, procurement and supply including installation and commissioning of 2x flue gas desulphurization and de-dusting plants, 181 MWth</td>
<td>INSTAL-FILTER SA, Kościan, Poland for (ENERGETYKA Group KGHM, Polkowice, Poland)</td>
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<tr>
<td>Basic, detail engineering, procurement and supply including installation and commissioning of 2x flue gas desulphurization and de-dusting plants, 82 MWth</td>
<td>INSTAL-FILTER SA, Kościan, Poland for (Energetyka Ciepłna Sp. z o.o., Skiernicewice, Poland)</td>
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<tr>
<td>Consultancy, engineering, supply and advisory service for optimization of a water injection system upgrade for a flue gas cleaning and de-dusting plant.</td>
<td>Solvay Chemicals GmbH, Rheinberg, Germany</td>
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</table>

## BEYOND THAT
More than 70 GRAF-EnviroPro-team reference plants with previous Dry-CFB-FGC technology & Process Filter for almost any fuel from 10,000 to 3,500,000 m³/h with a single reactor.

## LEGEND
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- CHP Combined Heat & Power Plant
- ESP Electrostatic Precipitator
- FGD Flue Gas Desulphurization
- SCR Selective Catalytic Reduction
- STP Standard Temperature and Pressure
- PS Power Station
**APPLICATION**

- Power Plants and Industrial Boilers
  - Dry electrostatic precipitator
  - Fabric filters also in combination with dry FGD (CFB-FGD)
  - Wet electrostatic precipitator

- Benefits
  - Reduction of dust emissions
  - Extension of fuel range
  - Upgrade of ESPs within existing footprint and structure
  - Energy savings through optimized high voltage supply
  - High availability
  - Increase of operational flexibility

**TECHNICAL DATA**

- Emissions:
  - Dust < 8 mg/m³ (STP)
  - In combination with Wet FGD upgrades: Dust < 3 mg/m³ (STP)

- Fuel Type:
  - Bituminous coal
  - Lignite
  - Biomass co-firing
  - Waste/Sludge
  - Oil

**SCOPE OF SUPPLY**

- Retrofit, Revamping and New-Built
  - Consultancy (e.g. for BREF compliance)
  - Process engineering
  - Mechanical design
  - CFD simulations of flue gas path and flow optimization
  - Supply & installation
  - Optimization concepts
  - Commissioning
  - Licensing

- Refurbishment, Revamping and New-Built
  - Consultancy (e.g. for BREF compliance)
  - Process engineering
  - Mechanical design
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**REFERENCES**

- Study of upgrade options for dust removal system (ESP versus FGD tray) in answer to BREF 2017
  - CLIENT: SLOVNAFT, a.s., Bratislava, Slovak Republic

- Study of upgrade options for air pollution control equipment in answer to BREF 2018 Lignite, 227 MWel, Maritsa East 3, Maritza, Bulgaria
  - CLIENT: ContourGlobal Maritsa East 3, Sofia, Bulgaria

- CFD calculations flow optimization, Milazzo Refinery, Italy
  - CLIENT: Raffineria di Milazzo S.C.p.A., Milazzo, Italy

- Retrofit of TR sets and control equipment for electrostatic precipitator, 166,000 m³/h (STP), Milazzo Refinery, Italy
  - CLIENT: Raffineria di Milazzo S.C.p.A., Milazzo, Italy

- Boiler and ESP design study and know-how transfer for 6 x 600 MWel, Bituminous Coal, Tutuka PS, South Africa
  - CLIENT: Eskom Enterprises, Johannesburg, South Africa

- Rehabilitation and optimization of ESP, 610,000 m³/h (STP), Lignite, Govora PS, Romania
  - CLIENT: CET Govora, Râmnicu Vâlcea, Romania

- Rehabilitation of electrostatic precipitator behind fluidized catalytic cracker plant (FCC), 166,000 m³/h (STP), Milazzo Refinery, Italy
  - CLIENT: Raffineria di Milazzo S.C.p.A., Milazzo, Italy

- Rehabilitation of electrostatic precipitator behind fluidized catalytic cracker plant (FCC), 90,000 m³/h (STP), BP Refinery Gelsenkirchen, Germany
  - CLIENT: Ruhr Del GmbH, Gelsenkirchen, Germany

- Concept engineering study for the optimization of ESPs, 6 x 600 MWel, Bituminous Coal, Tutuka PS, South Africa
  - CLIENT: Eskom Enterprises, Johannesburg, South Africa

- CFD flow simulation and optimization for ESP downstream pyrite roaster in sulphuric acid plant, 30,000 m³/h (STP), Haldor Topsoe Plant, Denmark
  - CLIENT: Ion Blast Ltd., Helsinki, Finland

- CFD flow simulation for ESP, shale oil plant, 119,000 m³/h (STP), Eesti Energia Narva, Estonia
  - CLIENT: Ion Blast Ltd., Helsinki, Finland

**LEGEND**

- BAT: Best Available Technology
- BREF: BAT Reference Documents
- CFB: Circulating Fluidized Bed
- CHP: Combined Heat & Power Plant
- ESP: Electrostatic Precipitator
- FGD: Flue Gas Desulphurization
- SCR: Selective Catalytic Reduction
- STP: Standard Temperature and Pressure
- PS: Power Station
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