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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Flue Gas Cleaning
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+49(0) 2261 / 78950-507
REFERENCE CLIENT

Feasibility study for retrofit of an SCR plant, Heide Refinery, Germany
Raffinerie Heide GmbH, Hemmingsedt, Germany

Study for upgrade options of air pollution control equipment in answer to BREF 2017, Lignite, 227 MWel, Maritza East 3, Maritza, Bulgaria
ContourGlobal Maritsa East 3, Sofia, Bulgaria

Feasibility study for co-firing of petcoke, 200 t/h, Heavy Fuel Oil and Low-Pressure Gas, Shell Wesseling, Germany
Shell Deutschland Oil GmbH, Wesseling, Germany

Engineering and supply of an SNCR test plant to optimize the existing SNCR, Cement Plant Rudersdorf, Germany
CEMEX Zement GmbH, Rudersdorf, Germany

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
Eskom Enterprises, Johannesburg, South Africa

Supply and implementation of a new oil and gas firing system at a steam generator plus retrofit of a catalytic DeNOx system, 200 t/h, Heavy Fuel Oil and Low-Pressure Gas, Shell Wesseling, Germany
Shell Deutschland Oil GmbH, Wesseling, Germany

License and know-how transfer agreement for catalytic DeNOx system, China
Guizhou XingYun Environment Protection Co. Ltd., Guiyang, P.R. of China

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
MIRO Karlsruhe, Germany

Engineering and retrofit of an SCR-DeNOx plant, 200 t/h, Heavy Fuel Oil and Low-Pressure Gas, Shell Rheinland Refinery, Germany
Shell Deutschland Oil GmbH, Wesseling, Germany

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**REFERENCE LIST EXCERPT**

**NOx REDUCTION SYSTEMS**

**APPLICATION**
- Power Plants and Industrial Boilers
  - Low NOx Burners (LNB)
  - Selective catalytic reduction (SCR) with honeycomb catalyst with plate catalyst
  - Selective non-catalytic reduction (SNCR) e.g. in the cement industry
- Benefits
  - Reduction of NOx and NH3 emissions
  - Extension of fuel range
  - High availability
  - Increase of operational flexibility
  - Reduced NH3 consumption

**TECHNICAL DATA**
- Emissions:
  - NOx < 50 mg/m³ (STP)
  - NH3 slip < 1 mg/m³
- FUEL TYPE
  - Bituminous coal
  - Heavy fuel oil & residues
  - Waste/Sludge
  - Lignite
  - Biomass co-firing

**SCOPE OF SUPPLY**
- Consultancy
- Process engineering
- Mechanical design
- CFD simulations
- Supply & Installation
- Optimization between LNB and SCR / SNCR
- Adaptation of boiler and water-steam cycle
- Adaptation of heating surfaces
- Optimization of flue gas distribution and NH3 injection
- Commissioning
- Licensing

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**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
WET FLUE GAS DESULPHURIZATION SYSTEMS

TRAY BASKETS

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

APPLICATION

Fields of Application
- Power plants
- Industrial plants
Benefits
- Reduction of pollutant emissions (SOx, SO2, mercury, dust)
- Increase of operational flexibility
- Optimized consumption of limestone
- Optimized distribution of oxidation air
- Reduction of auxiliary energy consumption

TECHNICAL DATA

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

FUEL TYPE

- Bituminous Coal
- Lignite
- Biomass co-firing
- Waste/Sludge
- Oil

SCOPE OF SUPPLY

- Retrofit, 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

REFERENCE LIST EXCERPT

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<tr>
<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>
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<tr>
<td>Engineering and supply of a tray level for wet FGD, 22 MWth, Herten Waste-to-energy plant Unit IM 1, Germany</td>
<td>AGR Betriebsführung GmbH, Herten, Germany</td>
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<tr>
<td>Study of upgrade options for 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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<tr>
<td>Engineering for the conversion of absorber from lime to limestone, 351/h, Lignite, Plant Brottewitz, Germany</td>
<td>Südzucker Plant Brottewitz, Germany</td>
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<tr>
<td>Licence for dry CFB-FGD technology, 6 x 686 MWel, Bituminous Coal, Kendal PS, South Africa</td>
<td>Eskom Enterprises, Johannesburg, South Africa</td>
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<tr>
<td>Retrofit of a tray for FGD scrubber upgrade, 2 x 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 x 50 MWel, Bituminous Coal, International Paper Kwidzyn, Poland</td>
<td>International Paper Kwidzyn Sp. z o.o., Kwidzyn, Poland</td>
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<tr>
<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, 600t/h, Fenne PS, Bituminous Coal, Völklingen, Germany</td>
<td>Steag AG Saar-Völklingen, Germany</td>
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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 Electrocentrale Paroseni S.A., Romania</td>
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<td>FGD Tender evaluation, 6 x 800 MWel, Bituminous Coal, Kusile PS, South Africa</td>
<td>Eskom Enterprises, Johannesburg, South Africa</td>
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LEGEND

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FGD  Flue Gas Desulphurization
HCP  Combined Heat & Power Plant
ESP  Electrostatic Precipitator
SCR  Selective Catalytic Reduction
STP  Standard Temperature and Pressure
PS  Power Station
APPLICATION AVAILABLE TECHNOLOGIES SCOPE OF SUPPLY

Fields of 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

- 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

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

REFERENCE LIST EXCERPT

REFERENCE CLIENT

Recording of mercury removal in correlation to SO₂ removal. Assessment of sources and sinks of mercury, 530 t/h, Bituminous Coal, CHP Fenne, Völklingen, Germany
STEAG AG, Saar-Völklingen, Germany

Switch of neutralizing agent in the FGD and evaluation its repercussion on mercury removal, 35 t/h, Lignite, Plant Brottewitz, Germany
Südzucker Werk, Brottewitz, Germany

Assessment of chemical heavy metal precipitation and corresponding adjustment of the absorber water cycle, 750 MWe, Bituminous Coal, Mehrum PS, Germany
KW Mehrum GmbH, Hohenhameln, Germany

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 MWe, Vera Hamburg, Germany
Hamburg Stadtentwässerung AöR, Hamburg, Germany

Increase of SO₂ capture in a two-stage wet FGD scrubber without reducing mercury removal rate, 22 MWe, Herten Waste-to-energy plant, Germany
AGR Betriebsführung GmbH, Herten, Germany

BREF impact study and concept development on mercury removal in the FGD, Lignite, 227 MWel, Maritza East 3, Maritza, Bulgaria
ContourGlobal Maritsa East 3, Sofia, Bulgaria

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
Shell Deutschland Oil GmbH, Wesseling, Germany

Consulting & engineering support to assess sources and sinks of mercury in the power plant, Lignite, 188 MWe, Amsdorf PS, Germany
Romonta GmbH, Seegebiet Mansfelder Land, Germany

Consulting and engineering support to assess sources and sinks of mercury in the power plant, 11x250 MWe, Lignite, Jänschwalde PS, Germany
Lausitz Energie Kraftwerk AG, Cottbus, Germany

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MERCURY MONITORING AND MASS BALANCING

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

FLUE GAS CLEANING

- PORTABLE CONTINUOUS MONITORING
- CLOSING OF MERCURY BALANCE
- MERCURY REMOVAL CONCEPTS
FLUE GAS CLEANING

DRY FLUE GAS CLEANING SYSTEMS

APPLICATION

Fields of use
- 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)

TECHNICAL DATA

Simultaneous emission reduction for
- SO\(_2\) < 200 / < 10 mg/m\(^3\) (STP)
- SO\(_3\) < 1 mg/m\(^3\) (STP)
- HCl < 1 mg/m\(^3\) (STP)
- HF < 1 mg/m\(^3\) (STP)
- Hg < 1 µg/m\(^3\) (STP)
- Dust < 2 mg/m\(^3\) (STP)

SCOPE OF SUPPLY

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

BENEFITS

- Compact design with low plant area requirements
- 10,000 to 4,500,000 m\(^3\)/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. SO\(_2\) reduction from 8,000 mg/m\(^3\) (STP) down to below 200 mg/m\(^3\) (STP)
- Fuel flexibility e.g. HCl reduction from 2,000 mg/m\(^3\) (STP) down to below 10 mg/m\(^3\) (STP)
- No additional operator staff
- Low maintenance and spare parts

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<td>License for Dry CFB-FGD technology, 6 x 666 MWel, Bituminous Coal, Kendal PS, South Africa</td>
<td>STEINMÜLLER ENGINEERING GMBH for (Eskom Enterprises, Johannesburg, South Africa)</td>
</tr>
<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>
</tr>
<tr>
<td>Basic and detail engineering, procurement and supply including installation and commissioning of 2x flue gas desulfurization and de-dusting plants, 185 MWth</td>
<td>INSTAL-FILTER SA, Kościan, Poland for (ENERGETYKA Group KGHM, Lubin, Poland)</td>
</tr>
<tr>
<td>Basic, detail engineering, procurement and supply including installation and commissioning of 2x flue gas desulfurization 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 desulfurization and de-dusting plants, 82 MWth</td>
<td>INSTAL-FILTER SA, Kościan, Poland for (Energetyka Cieplna Sp. z o.o., Skierneńskie, Poland)</td>
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<tr>
<td>Basic, detail engineering, procurement and supply including installation and commissioning of 2x flue gas desulfurization and de-dusting plants, 81 MWth</td>
<td>INSTAL-FILTER SA, Kościan, Poland for (Miejskie Przedsiębiorstwo Energetyki Cieplnej Sp. z o.o., Włocławek, Poland)</td>
</tr>
<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 m\(^3\)/h with a single reactor.

LEGEND

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FLUE GAS CLEANING

DUST REMOVAL SYSTEMS

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

DISCHARGE ELECTRODE

LOW DUST EMISSIONS
- HIGH EFFICIENCY
- REDUCTION OF POWER CONSUMPTION

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<td>Study of upgrade options for dust removal system (ESP versus FGD tray) in answer to BREF 2017</td>
<td>SLOVNAFT, a.s., Bratislava, Slovak Republic</td>
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<tr>
<td>Study of upgrade options for air pollution control equipment in answer to BREF 2018 Lignite, 227 MWel, Maritsa East 3, Maritza, Bulgaria</td>
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<td>CFD calculations flow optimization, Milazzo Refinery, Italy</td>
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<td>Retrofit of TR sets and control equipment for electrostatic precipitator, 166,000 m³/h (STP), Milazzo Refinery, Italy</td>
<td>Raffineria di Milazzo S.C.p.A., Milazzo, Italy</td>
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<td>Boiler and ESP design study and know-how transfer for 6 x 600 MWel, Bituminous Coal, Tutuka PS, South Africa</td>
<td>Eskom Enterprises, Johannesburg, South Africa</td>
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<td>Rehabilitation and optimization of ESP, 610,000 m³/h (STP), Lignite, Govora PS, Romania</td>
<td>CET Govora, Râmnicu Vâlcea, Romania</td>
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<td>Rehabilitation of electrostatic precipitator behind fluidized catalytic cracker plant (FCC), 166,000 m³/h (STP), Milazzo Refinery, Italy</td>
<td>Raffineria di Milazzo S.C.p.A., Milazzo, Italy</td>
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<td>Rehabilitation of electrostatic precipitator behind fluidized catalytic cracker plant (FCC), 90,000 m³/h (STP), BP Refinery Gelsenkirchen, Germany</td>
<td>Ruhr Del GmbH, Gelsenkirchen, Germany</td>
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<tr>
<td>Concept engineering study for the optimization of ESPs, 6 x 600 MWel, Bituminous Coal, Tutuka PS, South Africa</td>
<td>Eskom Enterprises, Johannesburg, South Africa</td>
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<td>CFD flow simulation and optimization for ESP downstream pyrite roaster in sulphuric acid plant, 30,000 m³/h (STP), Haldor Topsoe Plant, Denmark</td>
<td>Ion Blast Ltd., Helsinki, Finland</td>
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<td>CFD flow simulation for ESP, shale oil plant, 119,000 m³/h (STP), Eesti Energia Narva, Estonia</td>
<td>Ion Blast Ltd., Helsinki, Finland</td>
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RELY ON GOOD EXPERIENCES

YOU CAN COUNT ON US AS EXPERTS IN THE AREAS OF

- COMBUSTION SYSTEMS
- FLUE GAS CLEANING
- STEAM GENERATION

ALLOW US TO ASSIST YOU IN YOUR EFFORT TO MEET UP-TO-DATE ENVIRONMENTAL DEMANDS WHILE REMAINING ECONOMICALLY EFFICIENT!

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