MEROS®
MAXIMIZED EMISSION REDUCTION OF SINTERING
MEETING FUTURE ENVIRONMENTAL DEMANDS NOW!
WITH MEROS® - MAXIMIZED EMISSION REDUCTION OF SINTERING

YOUR CHALLENGE
Requirements placed on availability, process quality and productivity of sinter plants are continuously growing, and can only be met with designs suitable for the rugged iron and steelmaking environment. At the same time, a growing number of environmental regulations necessitate extensive investment. This especially affects sinter plants with their high quantity of emissions, which has become a focal point of authorities responsible for environmental protection. As plant designers, our job is to create concepts that offer the best possible solution serving environmental requirements and economical necessity simultaneously.

OUR SOLUTION
A fully satisfactory, environmentally compatible solution for the treatment of the offgas arising during the sintering process has not existed for a long time. In response to this challenge, Primetals Technologies developed the MEROS® process which stands for Maximized Emission Reduction Of Sintering. In a series of successive treatment steps the dust and harmful metallic and organic components present in the sinter offgas are removed to levels previously unattained with conventional gas-treatment techniques. Process operations and operating parameters were confirmed during two years of performance of the MEROS® demonstration plant. This was followed by the construction of the world’s first MEROS® industrial plant which started up at the sinter plant of voestalpine Stahl, Linz/Austria.

MEROS® – a dry-type offgas cleaning process to reduce harmful emissions from sinter plants
ADVANTAGES OF MEROS®:

- Highest removal efficiency for heavy metals, acid gases, dioxin and other VOCs due to countercurrent flow injection of additives
- Minimized quantity of recirculation dust, therefore fewer filter pulse-cleaning cycles and less compressed air required
- Minimized mechanical stress on filter bags by using low-pressure pulse cleaning
- Avoidance of system sticking due to dry dust recirculation
- Controlled and constant process temperature as the basis for efficient desulfurization with hydrated lime
- Flexible gas desulfurization with hydrated lime - Ca(OH)₂ or sodium bicarbonate - NaHCO₃ as alternative process solution
The injection of additives has two different objectives. Objective one is the desulfurization of the offgas (DeSOx) by injection of specific desulfurization powders. Objective two is the reduction of heavy metals, PCDD/F (dioxins/furanes) and other toxic organic compounds VOC (volatile organic compounds).

**MAIN BENEFITS**

- Perfect distribution of additives by several injection lances
- Highest removal efficiency due to countercurrent flow injection of additives at a high relative velocity

Beside a perfect distribution of the additives, a high relative velocity of the injected particles against the gas flow is needed. A combined injection of the two powders is realized in counter current direction to the gas flow at a relative velocity far above 30 m/s. To ensure excellent distribution, several injection lances are positioned inside the gas duct.

**PROCESS DESCRIPTION**

In the first step, adsorbents such as specially prepared lignite coke and hydrated lime for desulfurization are injected into the sinter offgas stream in the counter-current flow direction. In the second step, the gas stream passes to a conditioning reactor where the gas is moisturized and cooled to a temperature of about 90-100°C by means of an injected fine mist using dual flow nozzles (water and air).

This accelerates the chemical reactions required for binding and removing SO₂ and other acidic gas components. In the third step, the offgas stream passes through a pulse jet filter equipped with special high-performance fabrics where the dust and the trapped pollutants are removed. In order to enhance the gas cleaning efficiency and to reduce additive costs, the main portion of the dust is recycled to the offgas stream after the conditioning reactor. The dust removed from the system is conveyed to intermediate storage silos for subsequent disposal or further treatment.
**GAS CONDITIONING**
Special importance has to be addressed to the gas conditioning reactor. On the one hand temperature peaks are eliminated to protect the fabric filter bags and on the other hand the gas is conditioned at a desired process temperature (usually around 90-100°C) for improved desulfurization.

**MAIN BENEFITS**
- Special design of reactor inlet and outlet section to prevent clogging, settling and separation of particulates
- Special designed dual-flow nozzles to generate fine mist
- Set point temperature can be adjusted individually from the dust recirculation rate
- Permanently controlled and constant process temperature ensures reliable desulfurization of off-gas

**PULSE JET FILTER**
Main task of the fabric filter is the separation of the particulate matter transported with the offgas. This dust consists of primary dust, additives and reaction products. The dust particles remain on the outside surface of the filter cloth and the filter cake is built up at the surface of the membrane. When reaching a certain pressure drop over the filter, a compressed air pulse is activated and the filter cake falls off the cloth surface into the dust hopper.

**MAIN BENEFITS**
- Highest separation efficiency
- Persistent and temperature resistant filter bags suitable upto 250°C
- Low compressed air demand
- Minimized mechanical stress on filter bags using low pressure pulse cleaning
- Minimum filter area demand due to 8 or 10 meter length of filter bags
ADDITIVE AND RESIDUE STORAGE
The additives are delivered by tank trucks and pneumatically fed to the additive storage silos. From there the material is fed to the intermediate gravimetric dosage bins for further treatment and injection into the raw gas duct. Parts of the dust separated in the filter hoppers is not recirculated and conveyed to the residual storage silo. The residue is transported by a tank truck for external utilisation.

RECIRCULATION OF DUST
Most of the dust separated by the pulse jet filter is recirculated to the gas stream just behind the gas conditioning reactor. Doing so, the unreacted parts of additives are once again contacted with the offgas and the effective usage rate is increased which results in an optimized operation cost figure.
**PROCESS DESCRIPTION**

Depending on the local requirements and conditions, also sodium bicarbonate can be used as desulphurization agent. The use of sodium bicarbonate is preferred if highest DeSOx degrees are required, if a DeNOx plant is necessary (or expected in future) or where land-filling costs are high.

**ADVANTAGES OF USING SODIUM BICARBONATE**

- Desulphurization efficiency more than 95%
- Excellent stochiometry close to 1 and decreased amount of residue
- Possibility to elutriate the Na₂SO₄ out of the residuals and discharge the water into the see
- Higher reaction temperature, in case of a DeNOₓ plant less energy for reheating is required
- No water consumption – no cooling is required
- Simple process – low investment costs
- Less consumption of compressed air

**SUMMERIZING, SODIUM BICARBONATE IS FAVOURABLE IF**

- Highest DeSOₓ degrees are required
- DeNOₓ plant need to be installed either immediately or in the future
- Landfilling costs are high

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**COMPARISON OF SODIUM BICARBONATE AND HYDRATED LIME FOR USE AS DESULPHURIZATION AGENTS**

<table>
<thead>
<tr>
<th></th>
<th>Sodium bicarbonate (SBC)</th>
<th>Hydrated lime (HL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DeSOₓ degree</td>
<td>&gt; 95%</td>
<td>&lt; 85–90%*</td>
</tr>
<tr>
<td>Stochiometric factor</td>
<td>1.1</td>
<td>1.7–2.0*</td>
</tr>
<tr>
<td>Residual amount</td>
<td>- 70%</td>
<td>100%</td>
</tr>
<tr>
<td>Aditive costs</td>
<td>- 180–200%</td>
<td>100%</td>
</tr>
<tr>
<td>Temperature after DeSOₓ</td>
<td>sinter raw gas temperature (no cooling)</td>
<td>- 90–100°C</td>
</tr>
<tr>
<td>Coke gas consumption for DeNOₓ (if required)</td>
<td>60-70% saves considerably reheating gas!</td>
<td>100%</td>
</tr>
</tbody>
</table>

*depending on additive quality, sinter gas temperature, conditioning temperature
A fully satisfactory, environmentally compatible solution for the treatment of the offgas arising during the sintering process has not existed up until now. In response to this challenge, Primetals Technologies recently developed the MEROS® process. In a series of successive treatment steps the dust and harmful metallic and organic components present in the sinter offgas are removed to levels previously unattained with conventional gas treatment techniques. After two years of excellent performance of the MEROS® demonstration plant, the world’s first MEROS® industrial plant is now in operation since 2007 at the sinter plant of voestalpine Stahl, Linz/Austria.

**PLANT DATA**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas flow</td>
<td>650,000 Nm³/h</td>
</tr>
<tr>
<td>Raw-gas temperature</td>
<td>130°C (120–160°C)</td>
</tr>
<tr>
<td>Filter area</td>
<td>- 19,000 m²</td>
</tr>
<tr>
<td>Cooling-water flow</td>
<td>8-30 m³/h</td>
</tr>
<tr>
<td>Sinter gas cooling bys</td>
<td>2-50°C</td>
</tr>
<tr>
<td>Hydrated lime (original</td>
<td>- 330 kg/h</td>
</tr>
<tr>
<td>process design)</td>
<td></td>
</tr>
<tr>
<td>Sodium bicarbonate (current</td>
<td>- 500 kg/h</td>
</tr>
<tr>
<td>operation practica)</td>
<td></td>
</tr>
<tr>
<td>Lignite</td>
<td>- 60 kg/h</td>
</tr>
<tr>
<td>Dust recirculation</td>
<td>- 10 t/h</td>
</tr>
</tbody>
</table>

MEROS® at voestalpine, Linz/Austria
EMISSION REMOVAL

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Target Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO₂ removal</td>
<td>&gt; 50% (current operation practice)*</td>
</tr>
<tr>
<td>Clean-gas dust content</td>
<td>&lt; 5 mg/Nm³</td>
</tr>
<tr>
<td>NOₓ (as NO₂)</td>
<td>&lt; 150mg/Nm³</td>
</tr>
<tr>
<td>Hg</td>
<td>&gt; 97%</td>
</tr>
<tr>
<td>Pb</td>
<td>&gt; 99%</td>
</tr>
<tr>
<td>HCl</td>
<td>&gt; 92%</td>
</tr>
<tr>
<td>HF</td>
<td>&gt; 92%</td>
</tr>
<tr>
<td>Dioxin (PCDD/F) emissions</td>
<td>&lt; 0.1 ng TEQ/Nm³</td>
</tr>
<tr>
<td>VOC (condensable)</td>
<td>&gt; 99%</td>
</tr>
</tbody>
</table>

* Technically up to 98% SO₂ removal is possible

PROJECT SCHEDULE AND FURTHER IMPLEMENTATION STEPS

- Award of contract: March 2006
- Start of erection: October 2006
- Start-up: August 2007
- Conversion to sodium bicarbonate process: 2011
- Installation of SCR - DeNOₓ plant: 2012

SCOPE OF SUPPLY & SERVICES – PROCESS TURNKEY

- Project management
- Basic and detail engineering
- Procurement of all equipment
- Process control and automation level 1
- Erection execution of plant
- Supervision of erection and commissioning
In order to save CAPEX and OPEX for the MEROS® Plant Primetals Technologies recommends to combine the advanced gas cleaning investment with the Selective Waste Gas Cleaning system wherever technically possible.

**SELECTIVE WASTE-GAS RECIRCULATION SYSTEM**

Primetals Technologies has developed and implemented a new technology that enable environmental emissions from sinter production to be reduced. This has been achieved with the introduction of a selective waste-gas recirculation system in which the offgas from selected zones of the sinter machine is mixed with hot cooler off-air and is then recirculated to the sinter strand.

The selective waste gas recirculation system enables emission reductions in sinter production to previously unattained levels. Thanks to the advanced technology, the offgas from selected zones of the sinter machine is mixed with cooler off-air and/or ambient air and re-circulated to the sinter machine. The result is a significant reduction of the specific offgas volume by up to 50%.

Specific investment and operating costs for gas-cleaning facilities can therefore be kept at acceptable levels. The selective waste gas recirculation system from Primetals Technologies can be installed in existing or greenfield plants.

**MAIN BENEFITS**

- Waste gas volume by up to 50%
- Specific solid fuel consumption decreased by up to 10%
- Decreased investment and operational costs for waste-gas-cleaning plant
- Lower CO₂ emissions (reduction by up to 10%)
- Lower emissions freight of SO₂, NOₓ, PCDD/PCDF and heavy metals
- Extended battery service life
BAG FILTER CONTROL

SMART BAG FILTER CLEANING FOR ENVIRONMENTAL PLANTS IN THE METALS INDUSTRY

FIELD OF APPLICATION
All kind of dedusting systems with bag filter cleaning

OUR SOLUTION
An optimized bag filter control is the major precondition for cost reductions. Using a differential pressure measurement between bag filter inlet and outlet, and the actual volume gas flow, an optimal cleaning cycle mode is automatically selected by the bag filter control unit. A fast and reliability electronic module with MOS-FET technology, which additionally features self-monitoring functions, controls the cleaning valves. The duration of the open time for each cleaning valve can be adjusted, thereby reducing the compressed air consumption to a minimum.

FUNCTION
Cost-efficient production in accordance with environmental requirements forms the basis for competitive steelmaking. Thanks to intelligent, fast and robust electronic modules, the bag filter control unit optimizes bag filter operation, featuring a significantly reduced cleaning air consumption as well as the detection of defective cleaning valves. This stand-alone self-monitoring package can be easily implemented in existing plants, thereby ensuring completely automatic operation. A standard bag filter operates without any energy optimization, based on fixed cleaning cycles where the cleaning valves purge compressed air into the filter bags. A malfunction of a cleaning valve can only be detected manually through acoustic checks, which are both time consuming and cost intensive. Most of the cost-intensive compressed air is wasted, because the cycle time is not adjustable in the system.

MAIN BENEFITS
• Automatic control of the entire bag filter features high efficiency of the bag filter cleaning process
• Pre-tested technological package including HMI, software and hardware
• Powerful electronics replace conventional relays
• Short implementation and commissioning time in new or existing bag filters
• Short amortization time and high return of investment
• Energy savings due to reduced cleaning air consumption
• Reduction of maintenance costs
THE ENVIRONMENTAL PLANTS INSTALLED BY PRIMETALS TECHNOLOGIES COMPRESE

• Pulse jet bag filter units and reverse air bag houses
• EAF dedusting comprised of watercooled ducts, drop-out boxes, quenching towers, forced draught coolers, cyclones, canopy hoods, mixing chambers, filters, fans and stacks
• AOD dedusting comprised of watercooled stacks, forced draught coolers, canopy hoods, filters, fans and stacks
• Noise reduction, dog and elephant houses
• DeS dedusting comprised of moveable hoods, cyclones, filters, fans and stacks
• Dedusting systems for the glass and ceramic industry

As a state-of-the-art system integrator for EAF dedusting equipment, Primetals Technologies offers comprehensive in-house solutions for primary and secondary off-gas treatment in the field of EAF steelmaking.

THESE PROVEN PRIMETALS TECHNOLOGIES DEDUSTING SOLUTIONS ARE CHARACTERIZED BY

• Advanced simulation tools
• Modular design pulse jet filters
• Proven water-cooled duct design
• Proven quenching tower design
• Proven forced draught cooler design
• Custom-made solutions
• “Fit-for-use” applications
• Highest flexibility
OUR PULSE JET FILTERS ARE CHARACTERIZED BY

• Standard filters designed for low and easy maintenance in a steel shop environment
• Modular filter design, which permits future extensions with add-on components
• Dramatic reductions in installation times due to the modular design of prefabricated panels, hoppers and filter heads
• Accurate blowpipe positioning with centering on the venturis, which ensures long bag life
• CFD-modelled filter casing for heavy particle separation and optimized flow distribution through bags
• Low energy consumption due to the cast-aluminum classic venturi situated on top of the bags, which provide an efficient secondary air in-draught
• Low energy consumption using straight blowpipes, which eliminates elbow losses
• Low energy consumption and pressure loss through the filter casing, due to an optimized gas flow, large venturi diameters and maximized damper dimensions
• Fully automatic filter cleaning with no moving parts on the inside of the filter
• Filter cleaning operation in either online or offline mode
• Filter cages, which are designed to protect the bags and allow them to be walked on after installation
• Fully standardized service interchangeable parts, which are commercially available worldwide for the entire filter range
REFERENCE PLANT
MAANSHAN IRON AND STEEL COMPANY, P.R. CHINA

After two years of operation of the MEROS® demonstration plant and one year of excellent performance of MEROS® commercial plant at voestalpine Stahl, Linz/Austria, the world’s second MEROS® industrial plant was awarded by Maanshan Iron and Steel Company, P.R. China in the year 2008.

PLANT DATA

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<th>Value</th>
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<tbody>
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<td>Gas flow</td>
<td>520,000 Nm³/h</td>
</tr>
<tr>
<td>Raw-gas temperature</td>
<td>~140°C (120–160°C)</td>
</tr>
<tr>
<td>Filter area</td>
<td>~16,400 m²</td>
</tr>
<tr>
<td>Cooling-water flow</td>
<td>~8-30 m³/h</td>
</tr>
<tr>
<td>Sinter gas cooling</td>
<td>20-50°C</td>
</tr>
</tbody>
</table>

Additives:

<table>
<thead>
<tr>
<th>Additive</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrated lime</td>
<td>~1,000 kg/h</td>
</tr>
<tr>
<td>Lignite</td>
<td>~60 kg/h</td>
</tr>
<tr>
<td>Dust recirculation</td>
<td>~8 t/h</td>
</tr>
</tbody>
</table>

EMISSION LIMITS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO₂ removal</td>
<td>&gt;80% / &lt;200 mg/Nm³</td>
</tr>
<tr>
<td>Clean-gas dust content</td>
<td>&lt;5 mg/Nm³</td>
</tr>
</tbody>
</table>

PROJECT SCHEDULE

- Award of contract: March 2008
- Start of erection: Spring 2009
- Start-up: Summer 2009

SCOPE OF SUPPLY & SERVICES

- Project management
- Basic engineering of entire plant
- Supply of mechanical and electrical key-equipment
- Process control and automation level 1
- Supervision of erection and commissioning
LIFE CYCLE SERVICES FOR YOUR PLANT

OPERATIONAL SUPPORT

BENEFIT FROM OVER 50 YEARS OF EXPERIENCE
Comprehensive services for metallurgical plants, from supply of original manufacturer components, spare and wear parts to consulting, technical assistance and training.

LOW INVESTMENTS FOR STATE-OF-THE-ART TECHNOLOGY
Decades of experience worldwide in design, manufacturing, and commissioning as well as consulting of metallurgical plants ensure each client with innovative modernizations and mechatronic solutions for its processing chain.

ON-AND OFFLINE MAINTENANCE AND REPAIR SERVICES
With wide-ranging international network of customer support experts and worldwide repair and maintenance workshops, Primetals Technologies is your ideal single source partner for maintenance services.

With a portfolio consisting of operational support, plant upgrades, and maintenance services you can focus on your core business while Primetals Technologies assures your plant’s optimum performance.

Fast, reliable, and experienced service and support for the metallurgical industry Primetals Technologies strives to be a long-term lifecycle partner dedicated to your success. We offer a full range of services across the entire lifecycle of your plant, including consulting and technical assistance, directly from a single provider. Our service portfolio ranges from a spare parts service available at just the right time to advanced staff training and technical support, upgrades of components and plants to be technical up to date; also from repair service of key components for a longer lifecycle, to online and offline maintenance. Our services reduce cost, increase productivity, improve product quality, and ensure safety.
The information (including, e.g., figures and numbers) provided in this document contains merely general descriptions or characteristics of performance based on estimates and assumptions which have not been verified. It is no representation, does not constitute and/or evidence a contract or an offer to enter into a contract to any extent and is not binding upon the parties. Any obligation to provide and/or demonstrate respective characteristics shall only exist if expressly agreed in the terms of the contract. These estimates and assumptions have to be analyzed on a case-to-case basis and might change as a result of further product development. Primetals Technologies excludes any liability whatsoever under or in connection with any provided information, estimates and assumptions. The provided information, estimates and assumptions shall be without prejudice to any possible future offer and/or contract. Any use of information provided by Primetals Technologies to the recipient shall be subject to applicable confidentiality obligations and for the own convenience of and of the sole risk of the recipient.
REFERENCE PLANTS CURRENTLY UNDER EXECUTION

**MEROS® PLANT FOR NEW 450M² SINTER PLANT**

**Customer**
PJSC “Enakievo Metallurgical Works”, Ukraine

**Type of plant**
MEROS® plant in combination with SWGR

**OUR SOLUTION**
METINVEST / Enakievo Works is going to invest into a brownfield plant expansion to replace existing, outdated sintering facilities. In order to meet the most stringent environmental emission limits Primetals Technologies has offered the MEROS® technology based on soda additive in combination with selective waste gas recycling.

**TECHNICAL DATA**
Gas flow: 570,000 Nm³/h
Clean gas dust content < 20 mg/Nm³
SO₂ clean gas content < 500 mg/Nm³
Dioxin clean gas content < 0.1 ng/Nm³

**MEROS® PLANT FOR NEW SINTER PLANT #3**

**Customer**
Kardemir A.S., Turkey

**Type of plant**
MEROS® plant (brownfield expansion)

**OUR SOLUTION**
Kardemir A.S. is expanding their ironmaking production by installation of additional sinter plant #3. In order to meet with the local environmental standards – specially with regard to SO₂ emission – the MEROS® technology based on hydrated lime is applied. Furthermore, as first cleaning stage to remove the major portion of iron ore dust, cyclones are supplied.

**TECHNICAL DATA**
Gas flow: 400,000 Nm³/h
Clean gas dust content < 10 mg/Nm³
SO₂ clean gas content < 500 mg/Nm³

**4 MEROS® PLANTS FOR EXISTING SINTER PLANT #D & #E**

**Customer**
ILVA SpA, Italy

**Type of plant**
MEROS® plants to replace outdated ESPs

**OUR SOLUTION**
ILVA SpA is driven by stricter environmental regulations to further reduce the dust and dioxin emissions at their existing sinter plants operated in Taranto. Due to the excellent performance of the MEROS® reference plants, customer finally selected the MEROS® technology based on soda process in combination with Active coal injection. Furthermore, all required provisions for future DeNOₓ plant are incorporated in the plant design.

**TECHNICAL DATA**
Gas flow: 4 x 850,000 Nm³/h
Clean gas dust content < 10 mg/Nm³
SO₂ removal efficiency min. 90%
Dioxin clean gas content < 0.1 ng/Nm³