BOILER CLEANING SYSTEMS
for Improved Availability of Waste Incineration Boilers
Clyde Bergemann is a globally operating group of companies offering key components and solutions to customers focusing on energy related conversion and production processes.

The Group’s main activities lie in the following areas:

- **Boiler Efficiency** – improved boiler efficiency and effective on-load boiler cleaning
- **Materials Handling** – systems for fly and bottom ash
- **Energy Recovery** – Heat exchangers and heat recovery systems.

**Centre of excellence for boiler cleaning**

Clyde Bergemann GmbH in Wesel (Germany) is the competence centre for Boiler Efficiency within the Clyde Bergemann Power Group. The products are typically applied in thermal energy conversion processes based on coal, oil, waste and/or biomass. For over 60 years, the company has focused on developing and producing equipment to efficiently remove combustion residue from the heating and reaction surfaces of boilers during operation.

**Your Benefits**

- Improved boiler availability
- Controllable deposit build-up regardless of varying fuel quality
- Effective and efficient boiler cleaning
- Professional consultancy for all aspects of boiler cleaning
- Comprehensive service: from the planning and execution of the installation, through commissioning to services provided over the full service life of the boiler cleaning equipment
- Staff training by Clyde Bergemann experts

**Range of Services for On-load Boiler Cleaning**

Significant slagging can form in the furnace and severe fouling can build up on the convective heating surfaces of waste and biomass boilers. These deposits reduce heat transfer and also favour corrosion resulting in limited plant availability and reduced efficiency. Clyde Bergemann boiler cleaning systems cover all the significant zones in the boiler.

**Applications**

<table>
<thead>
<tr>
<th>Furnace</th>
<th>Superheater/Reheater</th>
<th>Economiser</th>
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<tr>
<td>SMART Cannon</td>
<td>Oscillating Sootblower</td>
<td>Part Retractable Sootblower</td>
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<tr>
<td>SMART Explosion</td>
<td>Retractable Sootblower</td>
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<tr>
<td>SMART HS</td>
<td>Part Retractable Sootblower</td>
<td>Rapping System</td>
</tr>
<tr>
<td>SMART Helix Water</td>
<td>SMART RS</td>
<td>SMART Explosion</td>
</tr>
<tr>
<td>Rapping System</td>
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</tr>
<tr>
<td>SMART Explosion</td>
<td>Steam/air as cleaning medium</td>
<td>Water as cleaning medium</td>
</tr>
<tr>
<td>SMART Explosion</td>
<td>Retractable Sootblower</td>
<td>No cleaning medium</td>
</tr>
<tr>
<td>SMART Helix Water</td>
<td>Rotating Element Sootblower</td>
<td></td>
</tr>
<tr>
<td>Rapping System</td>
<td>Steam/air as cleaning medium</td>
<td></td>
</tr>
<tr>
<td>SMART Explosion</td>
<td>SMART Explosion</td>
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</tbody>
</table>

**Instrumentation & Controls**

- SMART Cannon
- SMART Explosion
- SMART Helix Water
- Rapping System
- SMART Explosion

**Customer Service**

- SMART Cannon
- SMART Explosion
- SMART Helix Water
- Rapping System
- SMART Explosion
## Sootblowers for Boiler Cleaning with Steam or Air

<table>
<thead>
<tr>
<th>Description</th>
<th>Model</th>
<th>Travel</th>
<th>Cleaning zone</th>
<th>Operating principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retractable Sootblower</td>
<td>VX-H</td>
<td>0.5 - 2.4 m</td>
<td>360°</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SMART RS</td>
<td>4 - 12 m</td>
<td>0 - 360°</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SMART S-P</td>
<td>0.3 - 10 m</td>
<td>360°</td>
<td></td>
</tr>
<tr>
<td>Oscillating Sootblower</td>
<td>PS-P</td>
<td>0.3 - 6 m</td>
<td>60 - 360°</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RS-P</td>
<td>0.5 - 6 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PS-PB</td>
<td>up to 6 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part Retractable Sootblower</td>
<td>PS-HB</td>
<td>up to 6 m</td>
<td>360°</td>
<td></td>
</tr>
<tr>
<td>Rotating Element Sootblower</td>
<td>DB</td>
<td>-</td>
<td>30 - 360°</td>
<td></td>
</tr>
</tbody>
</table>

## The Complete Water Cleaning Portfolio

<table>
<thead>
<tr>
<th>Description</th>
<th>Model</th>
<th>Travel</th>
<th>Cleaning zone</th>
<th>Operating principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMART Cannon – Water Lance Blower</td>
<td>SMART Cannon</td>
<td>-</td>
<td>90° horizontal</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>90° vertical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SMART Helix Water</td>
<td>SMART Helix Water</td>
<td>4-12 m</td>
<td>0-360°</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Shower-Clean System</td>
<td>SMART Shower-Clean System (SCS)</td>
<td>-</td>
<td>360°</td>
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</tbody>
</table>
Fuels
The fuels used in waste incineration boilers have a significant influence on the formation and characteristics of slagging. Because of the broad range of waste constituents that may be exploited for their energy content, there are countless combinations of the ash composition. The ash tends to contain few self-cleaning elements such as silicon, aluminium or calcium. Elements which promote fouling such as potassium, sodium and chlorine predominate.

The behaviour of waste ash differs significantly from that of coal. The usual ash analysis methods are therefore only of limited use in the analysis of the tendency to slagging and fouling. Clyde Bergemann therefore works with specific ash/fuel analysis methods, taking account of the heavily corrosive properties of the ash from biomass and waste in developing its cleaning concept.

Boiler Geometry
Particular challenges in respect to the formation of coatings arise depending on the actual design of the boiler. Very tight gap pitches increase the risk of blockages, particular areas can be hotspots for fouling.

Our Solution
Clyde Bergemann has developed a series of boiler cleaning systems with cleaning parameters that can be adapted flexibly to changing deposit situations. Some cleaning systems such as SMART Helix Water and the Shower Clean System have been specially developed for waste incineration boilers. The control concepts deployed allow targeted cleaning. All these measures lead to an improvement in plant availability.

Intensive Cleaning Effect of Water Applied Gently
The severe deposit build-up in the convective area can also mean that conventional steam sootblowers will not work effectively. Consequently, the fouling will continue to increase, causing unplanned outages and reduced boiler availability. Water as the cleaning medium is capable of producing the required intensive cleaning effect.

To perform the cleaning as gently as possible on the heat exchanger pipes, specially designed hardware and software components and two gear motors with high-resolution resolvers ensure that the SMART Helix Water moves precisely to the cleaning position within the space between the heat exchanger tubes. Water is released for cleaning between the tubes only. This new cleaning method is also called “Go-Stop-Clean-Go”.

Only the deposit surfaces are hit by the water and this is solely done at the time of cleaning. Heat exchanger pipes are not thermally loaded and the amount of water poured into the boiler is reduced to a necessary minimum.

If no cleaning is required, the water flow is used to cool the retractable lance tube in a closed cooling circuit.

Your Benefits
- Removal of severe deposits on convective heating surfaces
- Cleaning with water without thermal loading of heat exchanger pipes ("Go-Stop-Clean-Go" mode)
- On demand release of the water jet for cleaning minimises the amount of water poured into the boiler
- Even narrow passes are cleaned reliably
- Flue gas temperature remains in the rated range
- Extension of boiler availability
- More flexibility as to the fuel mix since cleaning intensity can be adjusted to the fouling condition at any time
- No steam required for cleaning

Mastering Specific Challenges

SMART Helix Water – Ideal for Severe Fouling in the Superheater
SMART Shower Clean System (SMART SCS) – Cleaning Different Types of Deposits in Empty Passes

Suitable for the Widest Range of Deposits

The SMART SCS uses water as its cleaning medium. Located on the boiler roof, the system is suited for cleaning:

- the lower side of the boiler roof,
- the membrane walls
- the pendant heating surfaces.

Operation

Water is introduced into the boiler through a nozzle head mounted on a flexible, heat-resistant metal hose. Access for both the nozzle head and metal hose is affected by a guide tube. After cleaning, the metal hose with the nozzle head is completely retracted out of the boiler. An electro-pneumatic knife gate valve on the guide tube seals securely against flue gases.

The nozzle head forms a water jet with a defined spectrum of water droplets and momentum. To achieve optimal cleaning, it is important that the cleaning frequency as well as the water force, volume and velocity are specifically set to match the requirements of each individual boiler.

Three Alternatives

The Shower Clean System is available as a

- Stand-Alone System: recommended for empty passes with small, uniform cross-section;
- Single-Row System: recommended for boilers with rectangular cross-section; two or more flanges are arranged in a single row;
- Multiple-Row System: recommended for boilers with complex geometry - flanges are arranged in multiple rows across the boiler roof. By using a crane runway, different areas can be cleaned.

Your Benefits

- Increased plant availability due to reliable cleaning of the empty passes which are important for efficient plant operation
- Stable flue gas temperature
- Lower risk of high-temperature corrosion and reduced corrosion rate
- Shorter outage period as time-consuming manual primary cleaning is almost eliminated
- System design allows even narrow open passes to be cleaned during operation
- Corrosion protection of the knife gate valve by applying sealing air

SMART Shower Clean System (SMART SCS) – Cleaning Different Types of Deposits in Empty Passes

Rapping Devices – Gentle Removal of Deposits Without Use of a Cleaning Medium

Application

Especially horizontal boiler passes such as those found in waste incineration plants, can be cleaned with rapping devices. They can be applied to remove deposits from the heating and reaction surfaces of the convection area and economisers without any additional cleaning media like steam, air or water.

Function

Rapping systems may use mechanical hammers or pneumatically driven impact cylinders. Pneumatic single rappers have been proven in practice, as the impact energy can be adapted to the specific conditions of the plant.

By rapping the fouled convection heating surfaces the bank tubes are caused to vibrate so that the deposited layer falls off. Cleaning of each heating surface can be controlled variably and as a function of the process.

Your Benefits

- Optimum cleaning – extends the boiler availability
- Neither air nor steam is required as a cleaning medium, hence maintenance costs are lower
- Simple operation and messages from and to the control room
- Controlling deposits in flexible boiler operation and with varying fuel mixtures or variable fuel quality

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<thead>
<tr>
<th>Description</th>
<th>Model</th>
<th>Operating principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapping system</td>
<td>PKL</td>
<td>Cleaning of heating surfaces and economisers in facilities with varying fuels and loose deposits</td>
</tr>
</tbody>
</table>
SMART Explosion is an efficient solution for the cleaning of heating surfaces of steam generators. The system is used to keep both superheater and economiser bundles, and also empty passes, clean. It can be installed in tight spaces where access is difficult, a particular advantage thanks to its small size.

The explosion pressure wave induces short vibrations in the walls and tube bundles of the boiler. Slagging and fouling are thus removed. The accumulation of ash deposits is completely prevented by running the generator at appropriately short intervals (e.g. once an hour).

The explosion generator is typically mounted with its discharge tube extending in a horizontal direction. However, vertical installation on the boiler is likewise an option. The unit is fitted movably on a rail and is held in place via a spring mount or by direct attachment to the flange provided by the customer.

At present there are three models, SMART Explosion EG10, EG10L and EG10XL available. The generators are mounted almost identically, with the larger versions achieving progressively better cleaning results.

A Laval nozzle can optionally be used instead of the straight outlet tube to improve the cleaning performance in the boiler.

### Your Benefits

- Small volume, small footprint
- Higher boiler efficiency
- Reduction of downtimes
- Low operating costs
- Broad range of application for various fuels and boiler types

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SMART IsoTemp is deployed to measure the temperature of the flue-gas in the different areas of the incinerator. This is required to indicate to the plant operator how to regulate the temperature distribution in the required areas.

### Your Benefits

- Controlled temperature thresholds
- Uniform thermal distribution
- Homogenous combustion process
- Reduced slagging and hence, reduced possibilities of corrosion at the furnace
- An efficient SCNR process through targeted activation of the spray nozzles at respective levels

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<tr>
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<tbody>
<tr>
<td>SMART Explosion</td>
<td></td>
<td>Selective cleaning of heating surfaces using explosion generators</td>
</tr>
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## Selection of Our References

<table>
<thead>
<tr>
<th>Plant</th>
<th>Fuel</th>
<th>In Operation Since</th>
<th>Cleaning Systems Used</th>
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<tbody>
<tr>
<td>Khok Charoen, Thailand</td>
<td>Waste</td>
<td>2017</td>
<td>2 x PS-H retractable sootblowers  2 x PS-HB Part retractable sootblowers  16 x Rotating element sootblower DB</td>
</tr>
<tr>
<td>Dinan, France</td>
<td>Waste</td>
<td>2013</td>
<td>1 x Shower Clean System SCS</td>
</tr>
<tr>
<td>Tallinn, Estonia</td>
<td>Waste</td>
<td>2013</td>
<td>1 x Shower Clean System SCS</td>
</tr>
<tr>
<td>Herten, Germany</td>
<td>Waste</td>
<td>2012</td>
<td>2 x Shower Clean System SCS  4 x pneumatic rapping systems in superheater  4 x pneumatic rapping systems in economiser</td>
</tr>
<tr>
<td>AEB Amsterdam, Netherlands</td>
<td>Waste</td>
<td>2012</td>
<td>4 x Shower Clean System SCS  4x SMART Cannon</td>
</tr>
<tr>
<td>Baku, Azerbaijan</td>
<td>Waste</td>
<td>2011</td>
<td>2 x Shower Clean System SCS</td>
</tr>
<tr>
<td>Twence, Netherlands</td>
<td>Waste</td>
<td>2010</td>
<td>1 x SMART Helix Water  2 x Shower Clean System SCS</td>
</tr>
<tr>
<td>Brescia, Italy</td>
<td>Waste</td>
<td>2009/1995</td>
<td>28 x PS-SL retractable steam sootblowers  1 x PS-AT traverse soot blower</td>
</tr>
<tr>
<td>Rostock, Germany</td>
<td>Waste</td>
<td>2008</td>
<td>1 x Shower Clean System SCS  2 x pneumatic rapping systems in superheater  2 x pneumatic rapping systems in economiser</td>
</tr>
<tr>
<td>Thonon incinerator, France</td>
<td>Waste</td>
<td>2008</td>
<td>2 x SMART Cannon  5 x SMART Helix</td>
</tr>
<tr>
<td>Kassel incinerator, Germany</td>
<td>Waste</td>
<td>2003/2006</td>
<td>6 x SMART Cannon</td>
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