PENTOL

Power plant optimisation made in Germany

Chlorine Conditioning

Treatment for Biomass Plants and Waste Incinerators

Fight Chlorine Corrosion

Increase lifetime of plant components

FIGHT **CHLORINE CORROSION**

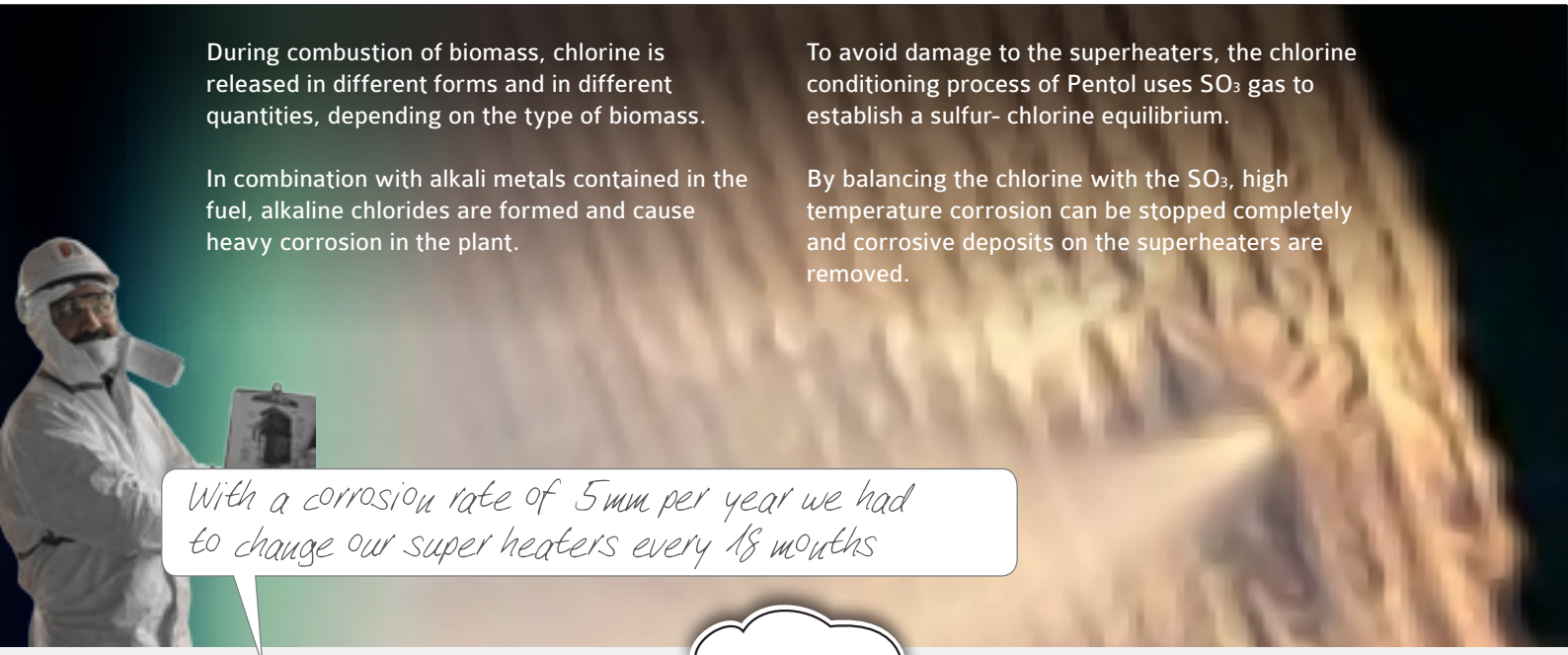
A new approach based on the sulfur - chlorine balance

During combustion of biomass, chlorine is released in different forms and in different quantities, depending on the type of biomass.

In combination with alkali metals contained in the fuel, alkaline chlorides are formed and cause heavy corrosion in the plant.

To avoid damage to the superheaters, the chlorine conditioning process of Pentol uses SO_3 gas to establish a sulfur- chlorine equilibrium.

By balancing the chlorine with the SO_3, high temperature corrosion can be stopped completely and corrosive deposits on the superheaters are removed.



During the combustion stage, fly ash is generated which, dragged by the warm gas current and given its rather plastic and semi-molten state, clings to the walls of the furnace covering the top of the post-combustion chamber and the steam generator pipes.

The deposits grow in the most critical areas (the side walls, the top of the furnace towards the post-combustion chamber) and reduce heat exchange capacity, causing an abrasive action on the boiler pipe bundle.

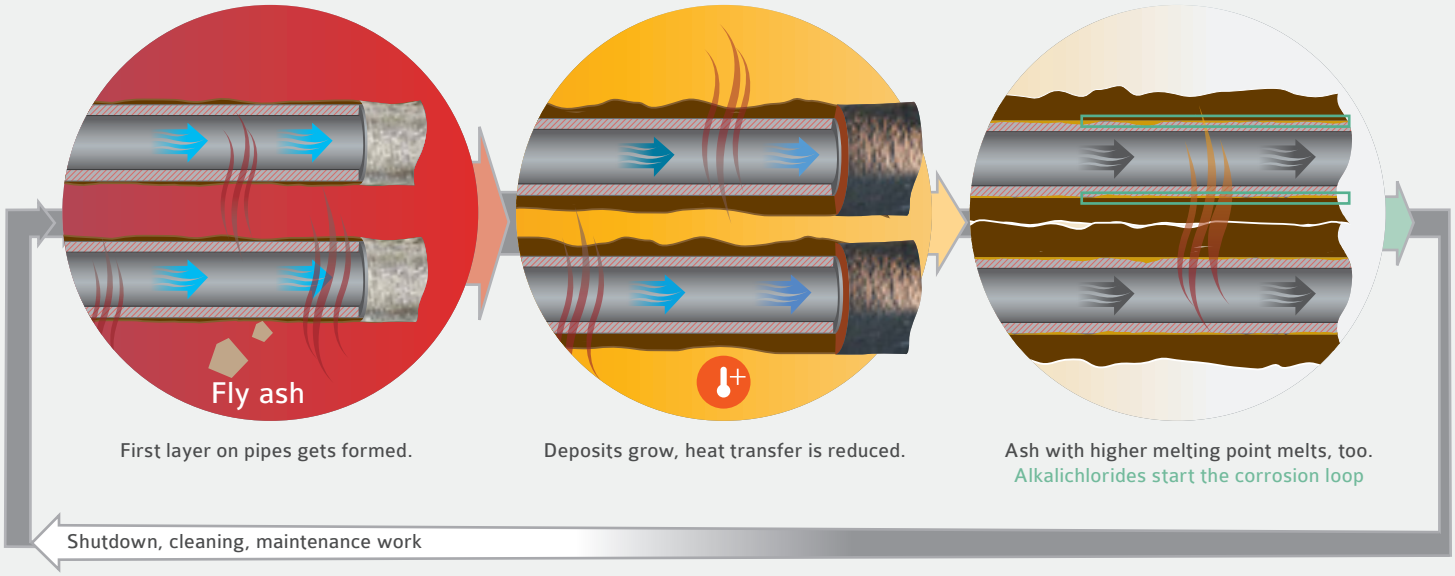
Along with the growing deposits on the pipes and walls inside the furnace, a higher temperature is required to obtain the proper steam temperatures leading to higher NOx emission values.

Contributing to these effects are
- Halogenated acids (HCl, HF)
- Sodium based compounds

Typically, the fouling inside the furnace reduces load of the plant and will dictate, when the plant needs to shut down for cleaning.

THE **CORROSION MECHANISM**

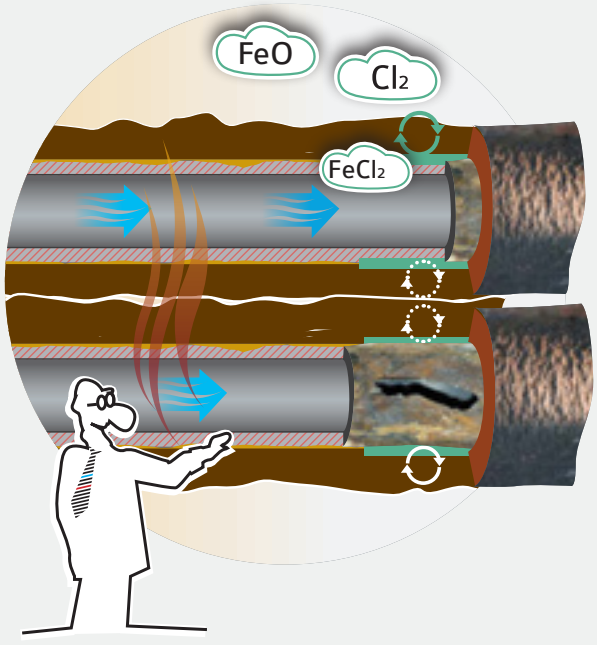
The circle of corrosion



Low melting temperatures allow molten salts to condensate on pipes with relatively low temperatures (eg. superheaters). The alkalichlorines diffuse through the deposits and attack the pipes. Iron is transported through the deposit to the surface, where it is released to the flue gas as ironoxide, while the chlorine diffuses back to the cooler pipe.

Inside the deposits, the chlorine concentration is increased and destruction of the pipes guaranteed.

The sticky deposits are not only highly corrosive, they also prevent a good heat transfer from the flue gas to the steam.



SULFUR / CHLORINE **BALANCE**

Reduce chlorine corrosion strongly with the optimum balance

Dosing point
To achieve the perfect S/Cl molar ratio, SO_3 is injected at the end of the first / beginning of the second draft or just above the super heater.

Pentol's approach to reduce chlorine corrosion is based on the assumption that the corrosion found on the surfaces of the super heaters is based on the mechanism of high temperature chlorine corrosion.

SO_3 is injected to sulfurize the chlorides in the flue gas in the 2nd pass of the boiler. The alkali chlorides are transformed to alkali sulfates. With a high or even full sulfurization of the alkali chlorides in the flue gas, alkali chlorides can no longer condense on the super heater and take part in the corrosion process. Without the base material the corrosion process is slowed down or even stopped completely.

SO_3 is chosen over SO_2 because of its high reactivity.

Theoretically, it is possible to burn a sulfurous fuel for co-combustion to sulfurize the alkali chlorides. However due to the slow reaction speed of SO_2 the sulfurization process is not sufficient for complete sulfurization. In tests it has been found that SO_3 reacts about 1000 times faster than SO_2.

Sulfurization of NaCl and KCl through SO_3 (and SO_2) are most efficient if the alkali chlorides are gaseous. The best temperature range for the sulfurization process starts at 600 °C. However the temperature range is limited to 800 °C, as the free SO_3 above this temperature will be reduced to SO_2 for thermodynamic reasons.

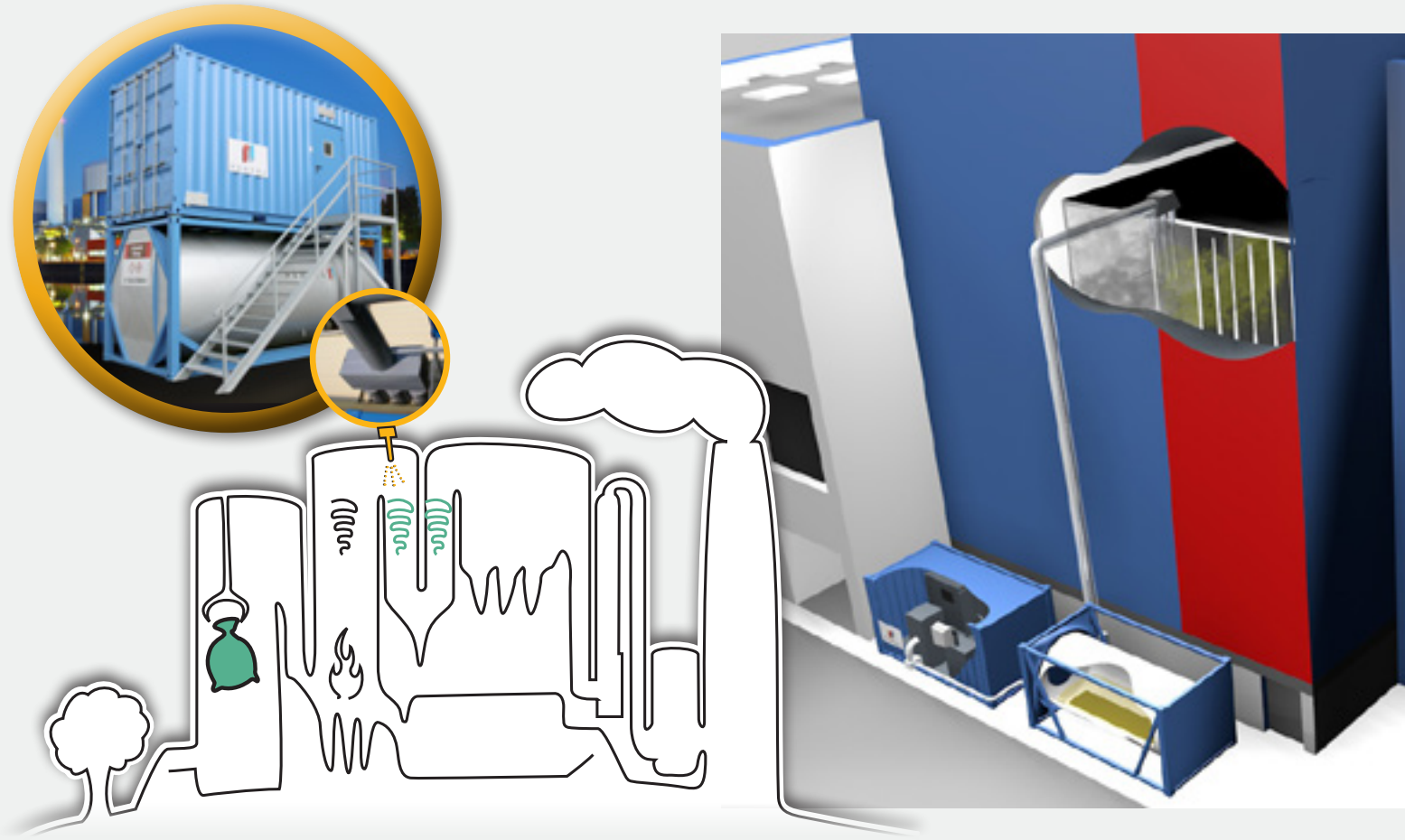
For an ideal sulfurization of the alkali chlorides in the flue gas according to the reactions described, a molar ratio of Cl/S = 2 is sufficient. Because of the nonlinearities of the technical process, a higher ratio will be required in real world applications.

The sulfurization process is described in the following reactions:
$2\ KCl + SO_3 + H_2O \rightarrow K_2SO_4 + 2\ HCl$
$2\ KCl + SO_3 + 1/2\ O_2 \rightarrow K_2SO_4 + Cl_2$
Similar reactions take place with sodium or calcium.

CHLORINE CONDITIONING

Process description

Dosing point
To achieve the perfect S/Cl molar ratio, SO_3 is injected at the end of the first / beginning of the second draft or just above the super heater.



Liquid, elementary sulphur is stored in a steam heated tank. By means of a dosing pump, the sulfur is transported into the sulphur burner. Together with pre-heated air, the sulphur is converted to SO_2. After the sulphur burner, the SO_2/air gas mixture is passing the 2-stage converter unit, oxidizing the SO_2 to SO_3.

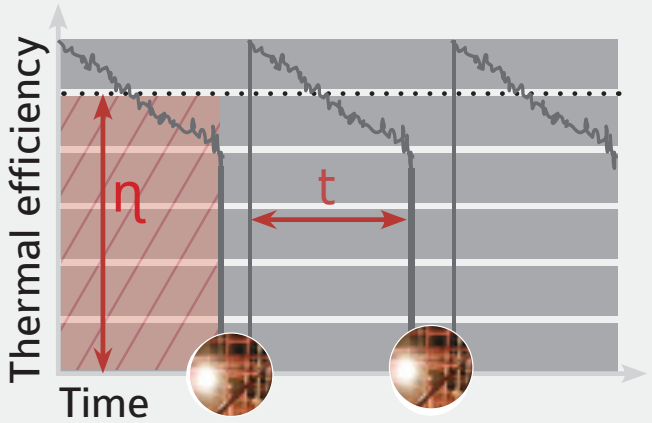
Now the SO_3 is available for reaction. No SO_3 is stored in any place and the correct quantity is produced automatically by the system. SO_3 reacts in a much more active way than SO_2 or ammoniumsulfate and the dosing rate is considerably lower.
With Pentol SO_3 injection, the conversion rate of sulfur to SO_3 is 97 %.
Compared to traditional sulfur injection, the consumption of sulfur is therefore nearly 100 times lower with the same effect.

FEATURES AND **BENEFITS**

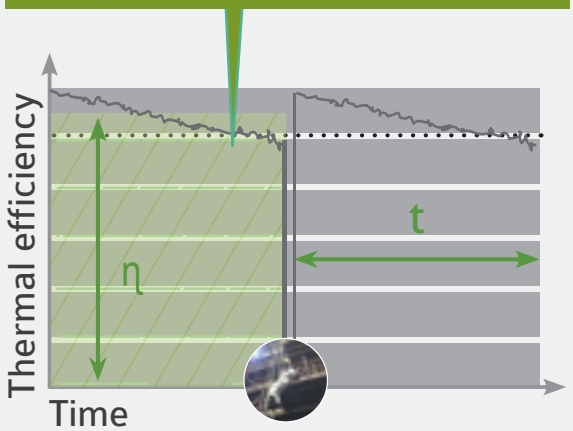
Increase the availability of the plant

Fully automatic operation with low operating cost (1 kg Sulfur costs approx 0.20 EUR) and low steam and energy consumption (exothermal reaction of sulfur combustion is used to heat the system)

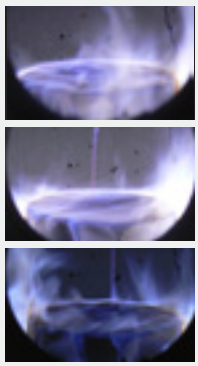
Maintenance before SO_3 treatment



Longer time between shutdowns



ASK FOR YOUR TEST DEVICE.
Please contact us for a test run in your incineration plant.
We will stand on your side from start to finish.



50 YEARS OF EXPERIENCE

Your professional service partner who understands your tasks and needs

Eric Blauenstein
Founder & President

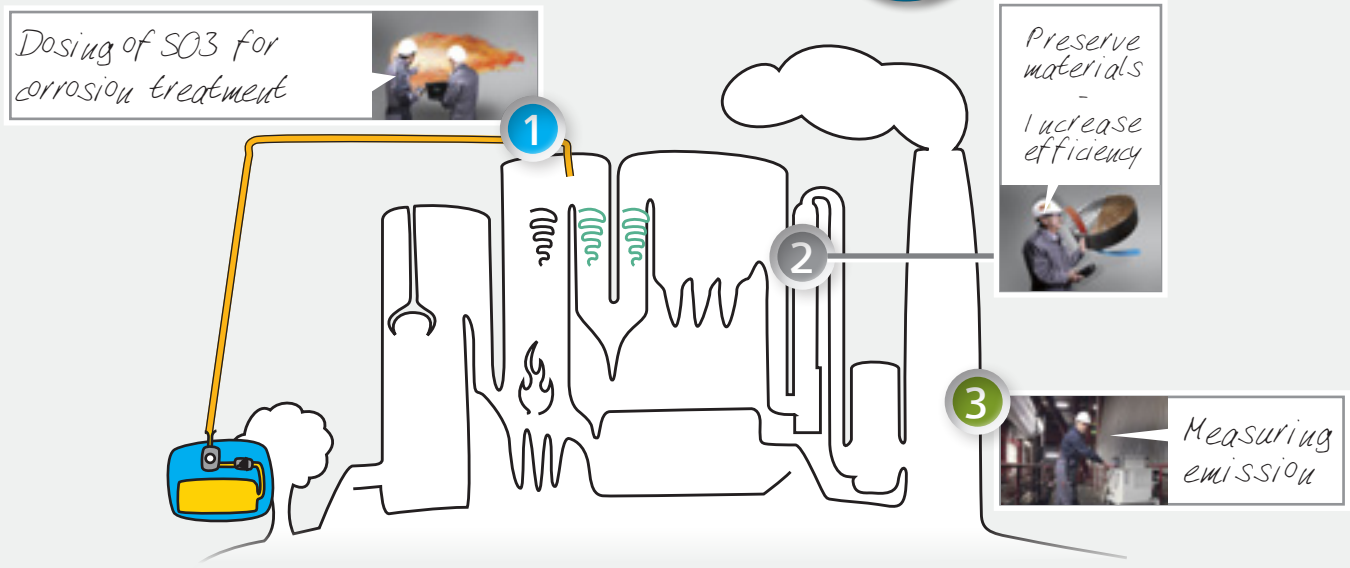
Olivier Blauenstein
CEO

50 Years PENTOL

Pentol brings nearly 50 years of experience in treatment of deposits inside boilers using various fuels.
Our intention for waste incinerator plants is

- to extend the time of maximum load of the plant
- increase efficiency of the plant
- reduce the shut-downs for cleaning
- optimize the efficiency of the plants treated

We always see the big picture



We examine the whole process to identify parts or equipment where we see optimization potential, and where we can contribute to better fuel combustion.

www.pentol.net/
power-plant-optimization

Typically, our products and technologies consist of three parts. First is the protection of your boiler or gas turbine (or diesel engine). Next is environmental protection. Finally, we seek an efficiency increase that will reduce emissions and easily pay for the treatment through cost savings.

PENTOL

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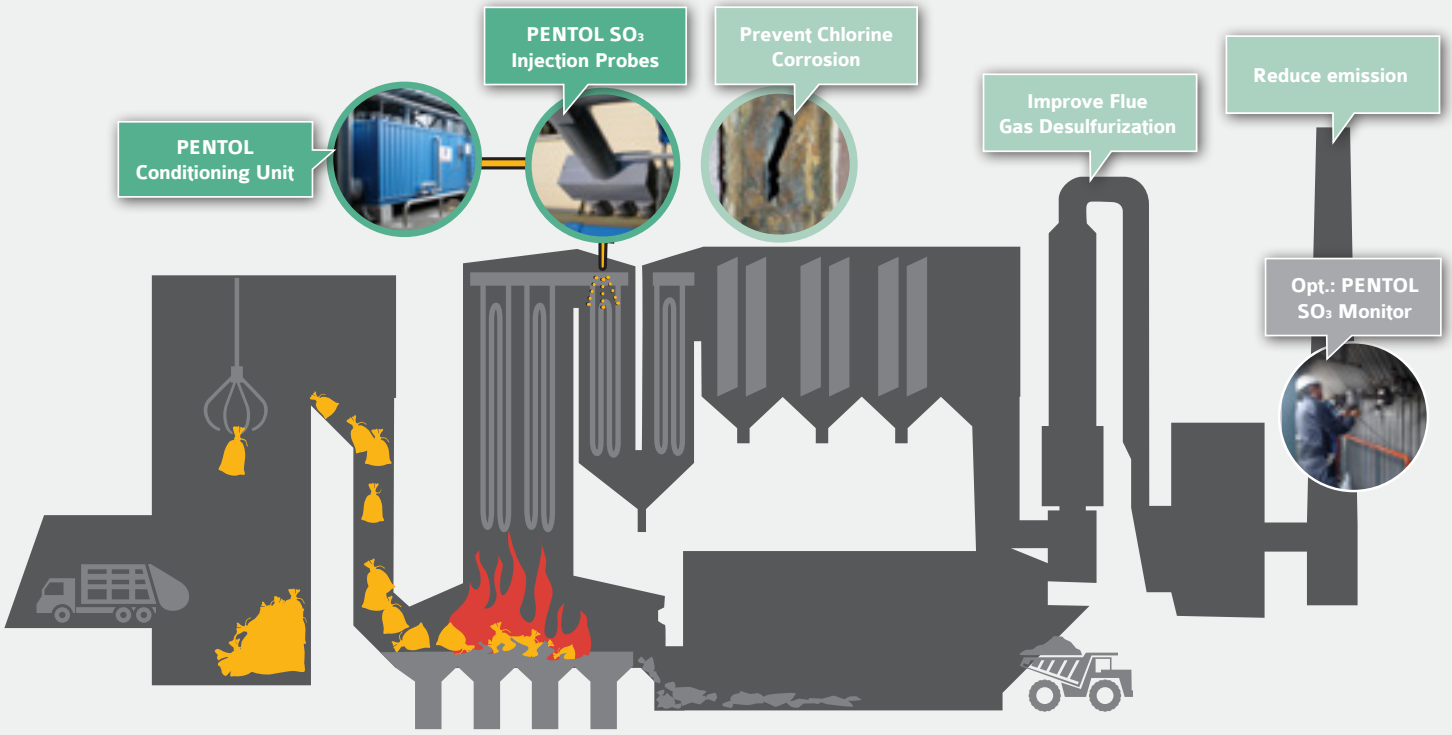
Chlorine Conditioning

For Biomass Plants and Waste Incinerators



PENTOL GmbH

Degussaweg 1 / P.O. Box 206
D-79634 Grenzach-Wyhlen

Tel. +49(0)7624300-0
Fax: +49(0)7624300-190

sales@pentol.net
www.pentol.net