

# FLUE GAS CONDITIONING

For coal fired power plants

# ESP EFFICIENCY

# SOLID EMISSION

# Whiteness gypsum

# Back corona effect

# THINK DIFFERENTLY

Pentol gained 50 years of experience  
in the field of international power generation

## History

Since 1969 Pentol has continually served the power generation market with solutions to optimize efficiency of combustion and to minimize emission. Initially serving heavy fuel oil fired power plants across Europe, Pentol's field of activity extended first to coal fired power stations and later to diesel engines and gas turbines all over the world. After 50 years we are proud to say that Pentol is well known across the globe as a reliable partner and supplier for the power industry.

## Evolution

Pentol quickly learned that power plant operators are in need of partners and not suppliers of commodities. For this reason, our extensive service network is available worldwide for technical assistance, combustion tuning and emission monitoring. Our vision is to reduce emission in combination with an increase of efficiency of the plant.



Eric Blauenstein (President/Founder), Olivier Blauenstein (CEO)



September 2019 Pentol celebrates its 50th birthday.

# WHAT IS FLUE GAS CONDITIONING?

## FGC unleashes the full potential of your ESP

Over the years the pressure of cost efficiency has been rising and rising, forcing the power industry to switch to coals that their boilers and ESP were not originally designed for. In addition, the emission limits have gotten more stringent, FGD units have been retrofitted to existing power stations making operation more and more difficult.

Pentol Flue Gas Conditioning will offer you these advantages:

- Reduced dust emission
- Better gypsum quality.

### HOW DOES IT WORK?

- To reduce particle emissions, the EFFICIENCY of the ESP needs to be increased.
- To increase the EFFICIENCY; the fly ash resistivity needs to be REDUCED.
- To reduce fly ash resistivity, SO<sub>3</sub> is added to the flue gas.

### Higher efficiency of the ESP has 2 advantages:

1. The particles are captured directly in the ESP and not carried over to the desulphurization unit.
2. The gypsum quality is increased and the intervals between cleaning cycles are extended.



### REDUCE FLY ASH RESISTIVITY

Reducing the fly ash resistivity, the ESP can work at or even above its design efficiency and collect more fly ash.

### INCREASE ESP PERFORMANCE

With the precipitator performing at its design efficiency, sparking and back corona is eliminated, extending the lifetime of the precipitator and allowing the operator to run the precipitator on rated current.

### GYPSUM QUALITY

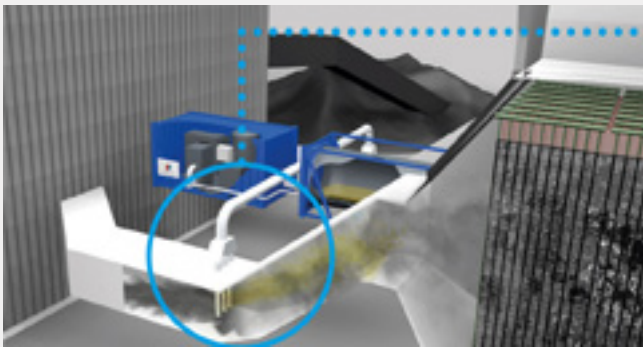
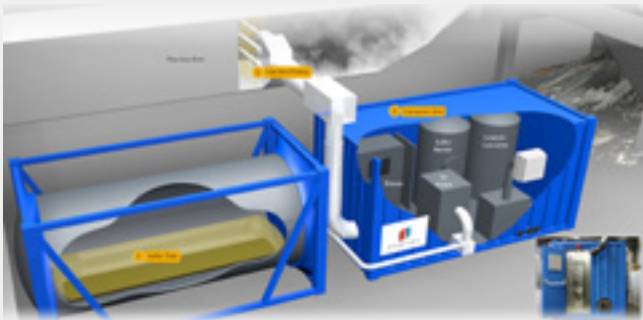
Gypsum quality is measured with 2 main parameters: Whiteness and Humidity. With FGC, the carryover of dust particles is reduced strongly. Consequently, the whiteness of the gypsum is increased. Humidity is reduced because the gypsum nuclei can grow bigger and are not limited in size by the dust particles.

### REDUCE EMISSION

Solid emission is widely reduced. With the automatic control system, the Flue Gas Conditioning System of Pentol follows the boiler load and ensures optimal treatment of the fly ash and guarantees best ESP performance.

# OPERATING PRINCIPLE

Produce the right quantity of SO<sub>3</sub> online



Pentol Flue Gas Conditioning units consists of a converter unit, a liquid sulfur storage tank, injector probes and an optional electric steam boiler. The whole system is installed in a container in our workshop and comes completely tested to your site.

The converter unit includes all electrical and the mechanical instrumentation and equipment that is needed to convert liquid sulfur into an SO<sub>3</sub> / air mixture.

Filtered ambient air is heated up well above the self-ignition temperature of sulfur by means of electrical heaters. In the sulfur burner, the sulfur ignites, oxidizes to SO<sub>2</sub> and is converted to SO<sub>3</sub> with the Pentol TwinCat catalyser.

The SO<sub>3</sub>/air mixture is then injected into the flue gas stream by means of injection probes with typical dosage rates of 10 to 15 ppm. Depending on the availability of liquid or granulated sulfur, an appropriate tank has to be chosen.

The complete installation is optimized to save energy. The energy required to keep the catalytic converter at its operating temperature is taken from the combustion process of the sulfur. This allows to reduce the electrical load to a minimum. In addition, the air flow is reduced at low loads to enhance the net efficiency of the unit.

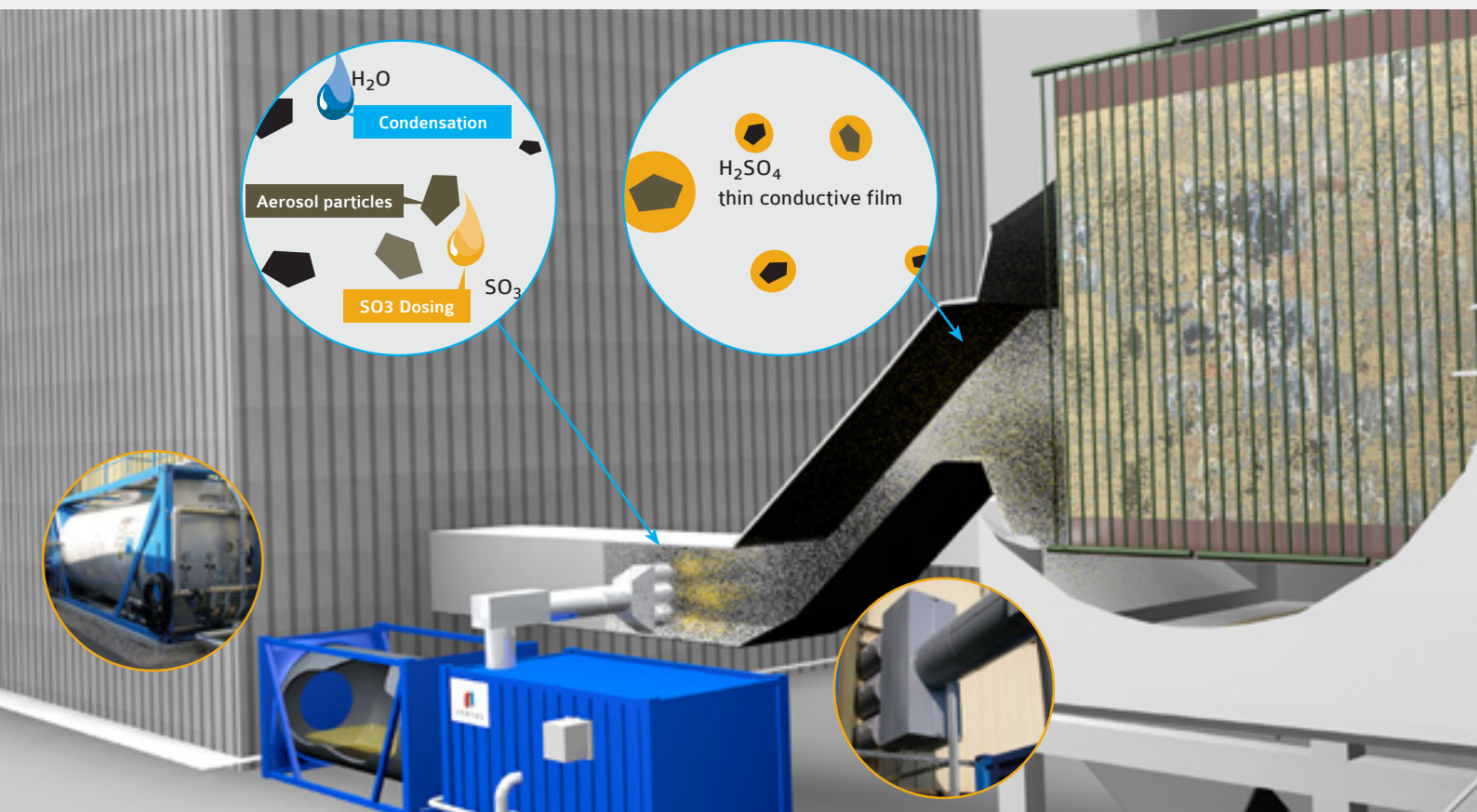


The Pentol flue gas conditioning system is installed in containers, making installation and start up quick and simple.

The units are pre-tested and can be installed while the power station is running, reducing the down time of the plant to install the injector probes to one day only!

Rental units are available for testing of the technology. This is interesting as in many cases, the existing ESP is in a bad state and the client has a broad range of available retrofits. A test unit can quickly show the potential of the existing ESP controller and mechanics.

**THE TEST IS THEREFORE AN IMPORTANT TOOL TO MINIMIZE INVESTMENT COST FOR A RETROFIT.**



Pentol Flue Gas Conditioning is a simple and reliable way to optimize ESP efficiency. With a market share of 100% in Europe, we offer the best available technology to comply with particle emission legislation and reduce carry-over of dust into the FGD unit, increasing the gypsum quality and reducing waste water treatment cost.

Pentol Flue Gas Conditioning has more or less the same effect as building an additional ESP field. Without the need for space, of course. And without changing the ductwork of your plant. And at a fraction of the cost.

Pentol Flue Gas Conditioning reduces solid emission ...

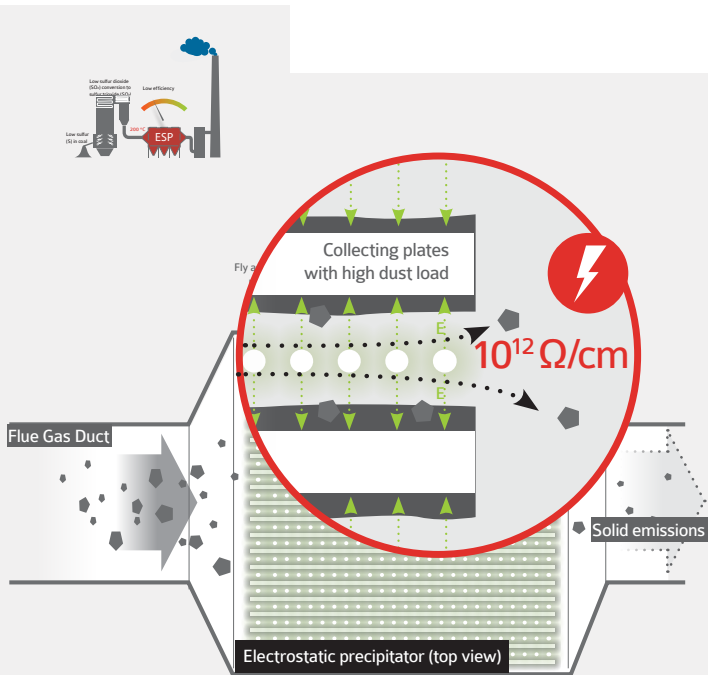
by injecting  $\text{SO}_3$  into the flue gas stream

by reducing the fly ash resistivity

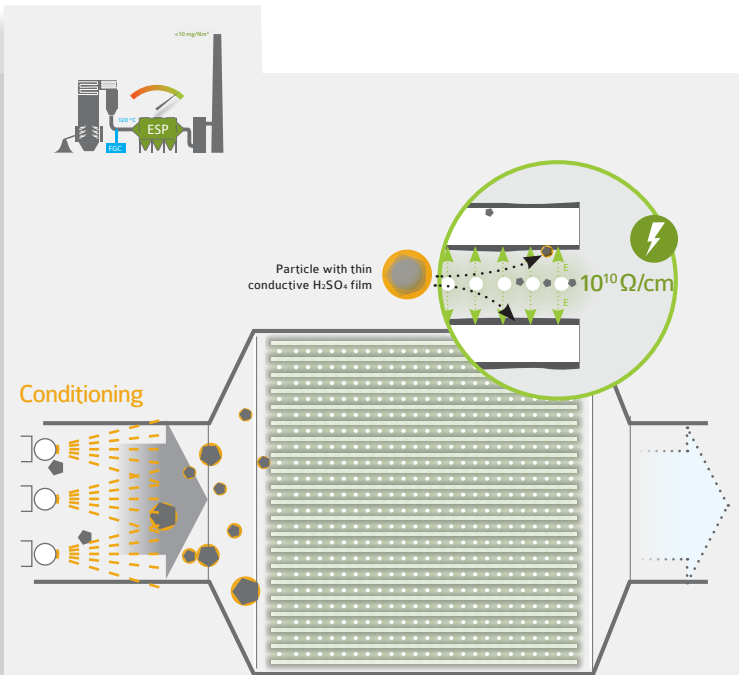
by increasing the efficiency of your ESP

# MODIFY FLY ASH RESISTIVITY

to run ESP on its design point

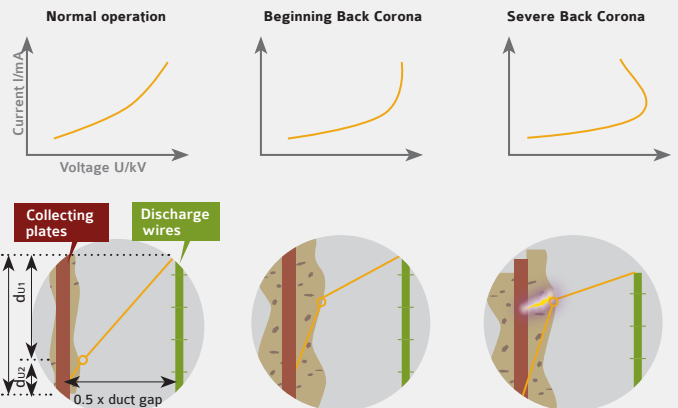


Fly ash has an electrical resistivity that is been made use of by the electrostatic precipitator (ESP). The ESP produces a huge electrical field where the dust is collected on large steel plates. The collection speed depends on the fly ash resistivity. Typically, coal with low sulfur level tends to produce fly ash with high resistivity. The ESP cannot build up an electric field that is strong enough to collect high resistivity particles, leading to higher than usual emissions or a break through of the ESP at high load.



## Pentol Flue Gas Conditioning adds a small amount of SO<sub>3</sub> to the flue gas.

Just enough to reduce the fly ash resistivity, the ESP can now collect the dust properly and is running at its design capacity. Changing coal is getting easier, as the operator can simply increase or decrease the injection of SO<sub>3</sub>, preventing the need to mix different coals.



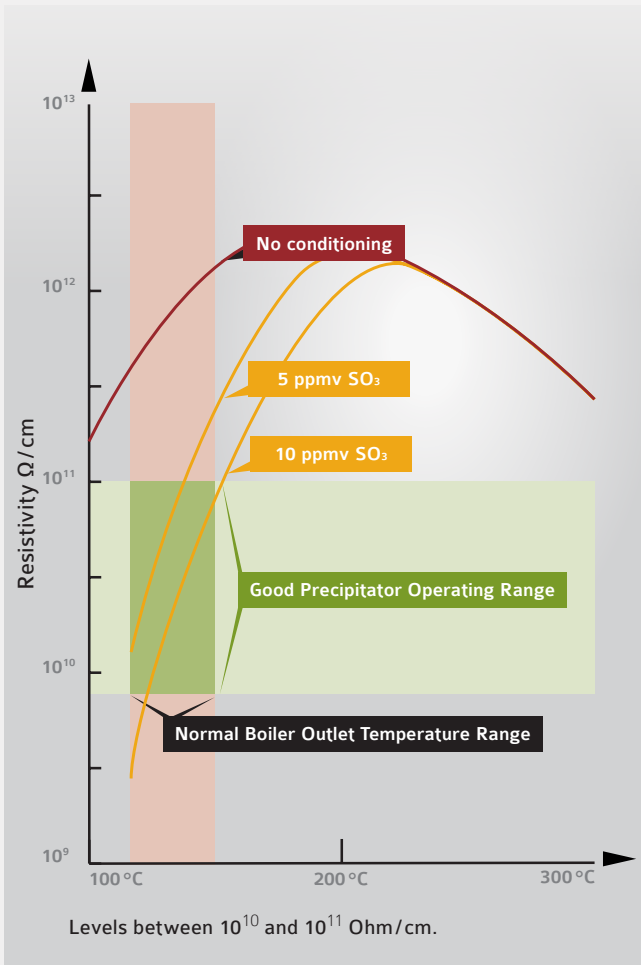
## AVOID THE BACK CORONA EFFECT AT DUST COLLECTION

SO<sub>3</sub> is amazingly important because it naturally combines with the moisture in the flue gas to create sulfuric acid. Sulfuric acid immediately reacts with the fly ash particles to form a thin conductive film, which eventually lowers the fly ash resistivity.

With the precipitator performing at its design efficiency, sparking and back corona is eliminated, extending the lifetime of the precipitator and allowing the operator to run the precipitator on rated current.

# REDUCE FLY ASH RESISTIVITY

Why is this so important?



The fly ash resistivity is an important parameter to design electrostatic precipitators and determine their size.

For economic reasons, expensive filters should be designed as small as possible, which limits the coal types that can be used.

Every coal or blend of coals has its own fly ash resistivity value that predicts how this coal or coal blend will affect the ESP.

Flue gas conditioning of Pentol keeps the fly ash resistivity in a good precipitator operating range, allowing constantly low emissions with a broad range of coal types or coal blends.

The size of the flue gas conditioning unit is selected based on coal quality, exit gas temperature and ESP design.



# EXAMPLE

of a retrofit in a German power plant.

## This example shows the deployment of a FGC unit in a German power plant.

This specific boiler had some issues with combustion, leading to very high emissions after the 2 parallel ESPs. To solve that problem, a third filter was built in series to the existing ESPs.

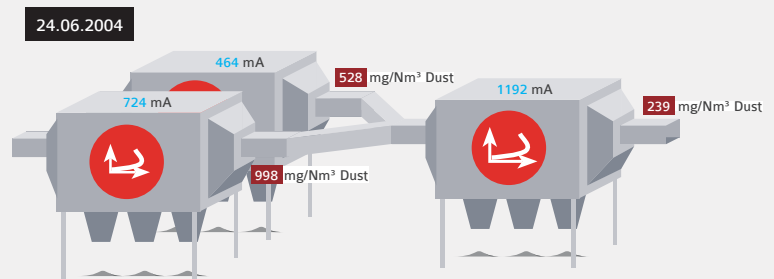
Unfortunately, due to the nature of the coal and the high resistivity of the ash, the 3rd filter wasn't very effective in cleaning of the flue gas and dust was entering the FGD at a concentration of approx. 240 mg/Nm<sup>3</sup>.

This very high dust concentration lead caused several problems:

1. The FGD plant was fouled quickly and had to be cleaned every 5 weeks, resulting in regular shutdowns and loss of power production.
2. The growth of the gypsum particles was limited, increasing the humidity of the gypsum and the fly ash particles captured in the FGD reduced the whiteness of the gypsum. As a result, the gypsum could not be sold but had to be disposed of.
3. The solid emission after FGD was exceeding the emission limit.

Pentol conducted a test on this boiler with one of our mobile FGC units. After a few days of operation only, the dust concentration after the 3rd ESP did not exceed 39 mg/Nm<sup>3</sup> anymore, eventually stabilizing at <20 mg/Nm<sup>3</sup>. Within a few days and with a minor investment, the 3 points mentioned above were solved and the test unit was never returned and our customer decided to equip five more boilers with FGC.

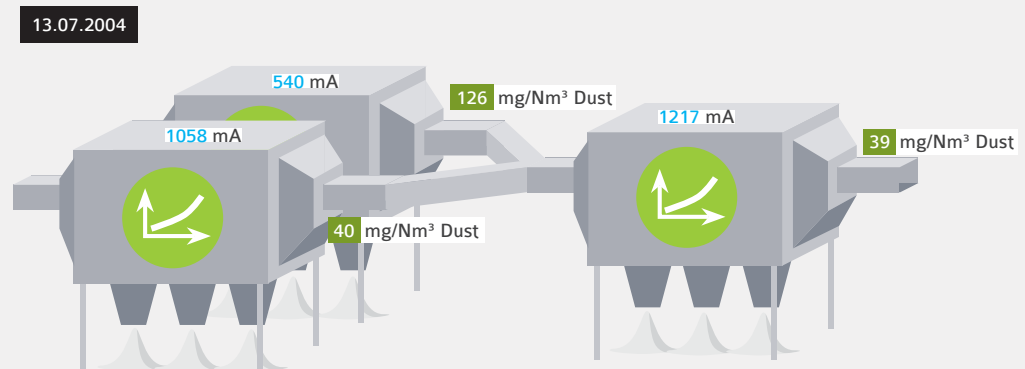
Before installing FGC technology, a third ESP has been built in-between the existing ESPs and the FGD unit.



Nevertheless, emission was too high for the FGD, (> 200 mg/Nm<sup>3</sup>), necessitating to shut down the boiler every 5 weeks to clean the FGD unit.

## After installing the Flue-Gas-Conditioning system

Only hours after starting the FGC system, the emission dropped from 240 mg/Nm<sup>3</sup> to <40 mg/Nm<sup>3</sup> before FGD. The filter has been cleaned within hours and up to the end of operation of this boiler (around 10 years later), the FGC unit has been running permanently without any interruption.

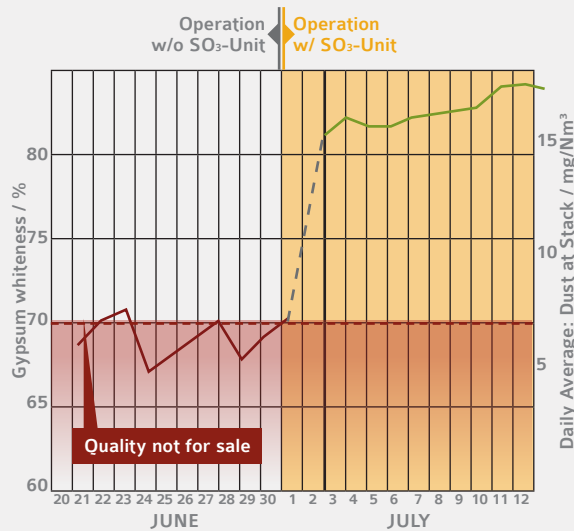


# MAKE GYPSUM VALUABLE

instead of disposing it of with costs at a cost.



Impure fragile structure



Clean stable structure

In most countries, exceeding the emission limit forces the reduction of power production of the unit. The loss of production pays the cost of a complete Pentol FGC unit in a few days. This is why Pentol keeps mobile rental units available for testing, wherever an urgent need arises.

For plants equipped with FGD who sell their gypsum, a similar situation exists with FGD availability. If FGD is polluted by dust, the washers need to be cleaned regularly and the dust particles hinder the particle growth of the gypsum, resulting in a grey, watery gypsum of low quality. With Pentol Flue Gas Conditioning, whiteness and humidity of the gypsum are easily increased to comply with your buyer's specification.



Desulfurization

FGD

# WE NEED TO GET IN TOUCH PERSONALLY.

1 Contact Pentol to arrange the first visit in your plant

2 Pentol analyzes coal characteristics and boiler to select the best treatment

3 On site, the dosing point is defined and the skid prepared

4 Pentol produces the startup documentation to record long term and short-term savings

5 Continuously, Pentol measures results from treatment and assists the client during operation

6 The treatment is supervised continuously



Victor Gomez,  
Sales Manager

«Please contact me – we keep in touch and assist our clients continuously for best results.»

Questions regarding function, support, and sales are answered via our online chat support or via e-mail to [sales@pentol.net](mailto:sales@pentol.net), as fast as possible.

Every power plant is unique. We have learned that no two boilers are similar and every client has to be treated on an individual base.

We are thrilled by the challenge of your individual situation and we look forward to meet you!



# IS THIS ALL PENTOL CAN DO?

## Also recommended



**PentoMag®2500** anti slagging additive with dosing unit for coal trayers.

PentoMag 2550 is an additive to fight slagging in the boiler. If you suffer from sintered ash deposits or eye brows around the burners, this will help you to increase availability and efficiency.



**SO<sub>3</sub>monitor** is a mobile SO<sub>3</sub> emission control unit, delivering reliable data.

Providing SO<sub>3</sub> emission-data allows the operator to burn fuel in the most efficient way, to minimize corrosion of the plant and limit acid discharges to the environment.



For optimizing coal fired Power plants

### **Pentol develops products and services for the power industry.**

Our goal is to help our customers reduce emission and increase the performance of coal and oil-fired power stations. Pentol looks back on more than 30 years of successful treatment of boilers and looks forward to a cleaner world.

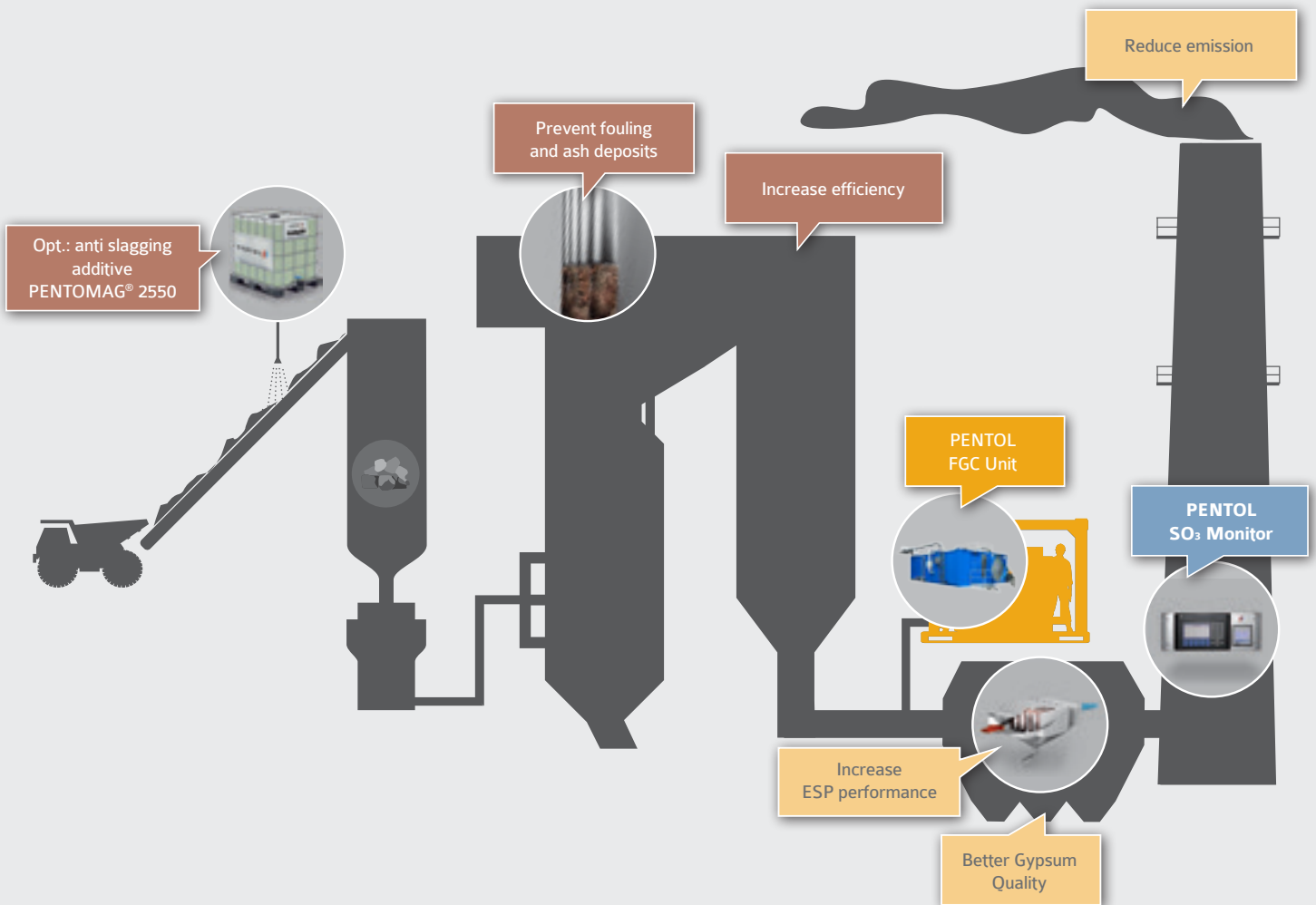
Ask our staff for a presentation or training.

Did we get your attention?

We would love to hear from you and discuss any questions you might have personally. Pentol has more than 100 units operating in Europe and successful references in Asia, Middle East and Central America and we are proud to share them with you!

# FLUE GAS CONDITIONING

For Coal Fired Plants



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