SAVA

A Company of the REMONDIS Group

Services for the Professional Treatment of Hazardous Waste.

> High temperature incineration of dangerous waste >

www.remondis.com

SAVA GmbH & Co. KG (High Temperature Incinerator), Brunsbüttel, is a company belonging to the REMONDIS Group, Lünen.

High Temperature Incineration of Hazardous Waste.

SAVA specializes in the professional treatment of hazardous waste in accordance with legal regulations. The incineration plant is one of the most modern in Europe and provides thermal treatment for solid, liquid and pasty hazardous waste.

Clear Objectives Consistently Achieved

SAVA fulfils its self-defined objectives for the treatment of dangerous waste by achieving high levels of responsibility and reliability:

- Destruction and elimination of environmentally hazardous organic materials
- Collection and concentration of heavy metals in filter dust
- Reduction of waste volume
- Recycling residual waste (slag, gypsum and filter dust)
- Recovering metals (steel scrap)
- Substituting fossil fuels with waste
- Generating energy (feeding electricity into the public mains)

Hazardous Waste Treatment for Industry and Local Communities

Since the plant was put into operation in summer 1998, SAVA has been ensuring that dangerous waste produced in the state of Schleswig-Holstein is disposed of safely. Since then, SAVA – with its state-of-the-art plants and environmentally sound hazardous waste disposal methods – has earned a reputation in Germany, Europe and beyond of being a reliable, flexible and professional partner for the disposal and recycling of hazardous waste. The waste treated includes residual material from the chemical industry and waste from commercial products such as paints, solvents, tar, medicines, chemicals or plastics. This also includes products found in every household such as wood preservatives and varnish paint, chemicals, pesticides and contaminated packaging.

SAVA is located on an area covering seven hectares in the industrial area of Brunsbüttel, near to the Elbe port and the Kiel Canal.

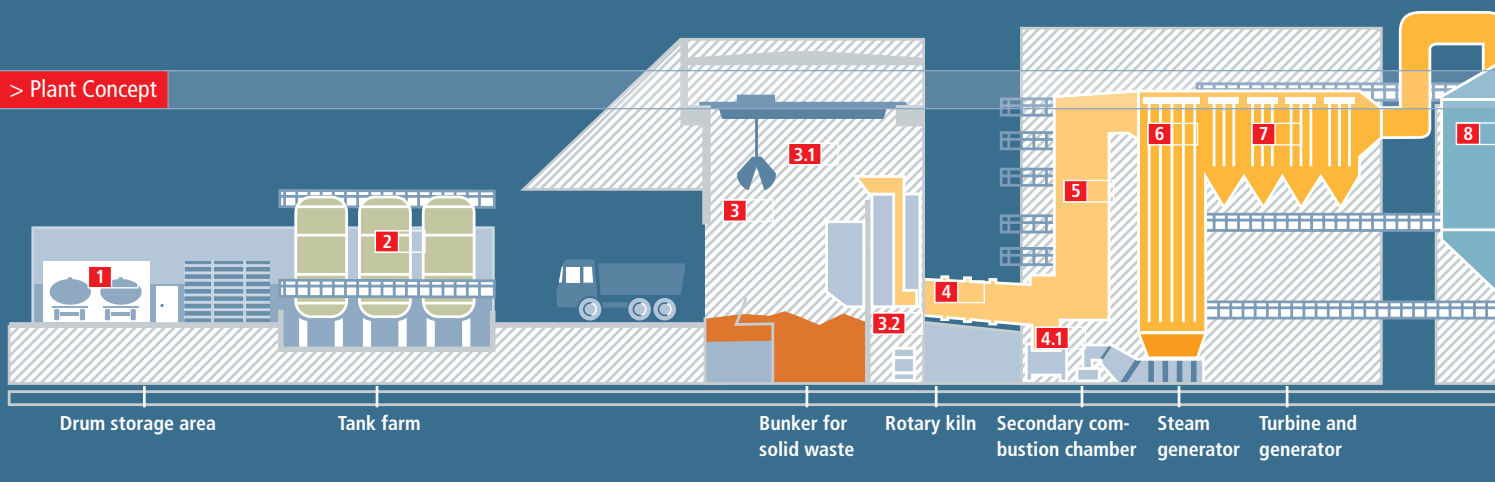
Complete Range of Services for the Disposal of Industrial Waste Worldwide

Since 2002, SAVA has been providing a specialist service disposing of obsolete pesticides and other chemicals throughout the world. Such projects have been successfully completed in Albania, Africa (Mauritania, Senegal, Cape Verde, Togo) and Romania. This full service is performed by our own specially trained and experienced field team.

> Technical Data

Energy input	24.2 MW
Annual capacity	50,000 t
Incineration technology	Rotary kiln
Incineration temperature	950–1,200 °C
Temperature in the secondary combustion chamber	> 1,100 °C
Flue gas dwelling time	> 2 sec.
Steam generation	28 t/h
Power generation	max. 4.5 MW
Flue gas cleaning	7-stage wet-dry process

Thermal waste treatment and flue gas cleaning processes result in the creation of residues such as slag, filter dust and gypsum which can be used to construct access roads on landfills or for underground security measures in former mines. The heat generated is used to produce electricity, up to half of which is fed into the public network.



Professional Disposal.

SAVA's plant in Brunsbüttel was planned and constructed by experts with many years of professional experience. Right from the very beginning, priority was given to protecting the public and to environment and plant safety. The results from safety analyses have played a major role and all relevant rules and regulations concerning safety at work and fire and explosion protection systems have been followed closely.

The most important components are as follows:

1 Drum storage area
The warehouse is designed to hold 288 pallets with waste stored in small containers and drums.

2 Tank farm
Liquid waste is pumped into the tank farm which has a total capacity of 720 cubic metres.

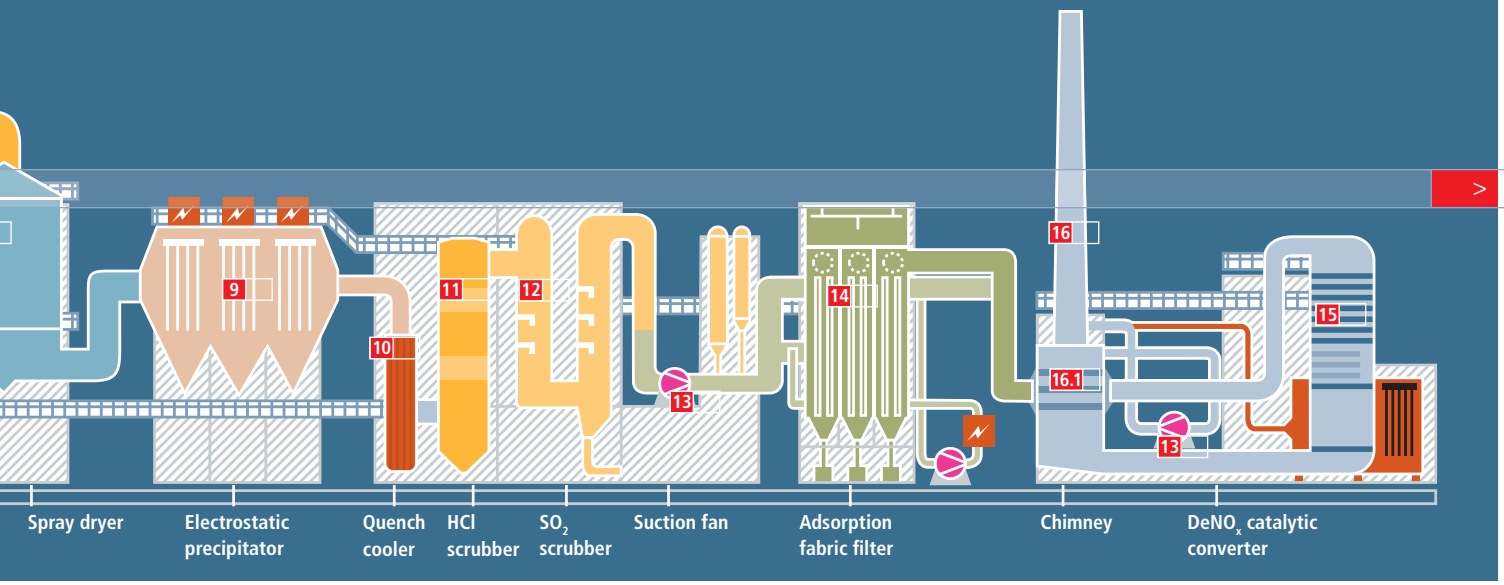
3 Bunker for solid waste
Solid waste delivered in containers is tipped directly into the 700 cubic metre bunker where it is mixed. Bulky waste is reduced in size by the shredder (3.1). Chemicals, pesticides, herbicides and other kinds of dangerous waste are fed directly into the rotary kiln via a drum elevator (3.2).

Before vehicles are unloaded, the waste is inspected and samples taken and analysed in the company's laboratory in accordance with waste legislation.

4 Rotary kiln
In the rotary kiln, the heart of the plant, environmentally hazardous organic substances undergo thermal treatment and are reduced to non-toxic materials. The rotary kiln is fed specific mixtures of solid, liquid and pasty waste to ensure the combustion properties vary only very slightly. During the thermal treatment, the waste is slowly rotated towards the end of the rotary kiln. The resulting slag drops into a water pool (4.1) where it is cooled down and any metal contents removed magnetically. The recovered scrap is recycled for use in steel production.

5 Secondary combustion chamber
The secondary combustion chamber ensures the complete destruction of any remaining organic substances. For this process, the dwell time of the flue gas has to be at least two seconds at a minimum temperature of 1,100°C pursuant to the 17th Ordinance of the Federal Emissions Control Act.

6 Steam generator
Steam with a temperature of 320°C and a pressure of 40 bar is generated in the steam boiler. The generated steam is fed into the turbine.



7 Turbine and generator

In the turbine plant, electric power is produced by the steam from the boiler. The maximum performance of the turbine and generator is 4.5 MW. 2 MW are reserved for internal requirements, the rest is fed into the public mains.

8 Spray dryer

Following the steam generation in the boiler, the flue gas is cooled down in a spray dryer by evaporating the neutralized waste water from the quench and the HCl scrubber. Heavy metals are absorbed prior to this by a mix of lime and activated carbon.

9 Electrostatic precipitator

The dusty flue gases, which have a temperature of 210°C, slowly flow through the electrostatic precipitator. The fine dust is collected as a result of the ionisation process of the dust particles.

10 Quench cooler

The quench cools the flue gases down to saturation temperature to protect the subsequent wet scrubbing modules. The flue gases are cooled down at a very rapid rate to prevent the formation of dioxins and furans. In the quench, mercury is also extracted from the flue gas.

11 HCl scrubber

In the HCl scrubber, hydrochloric acid and other halogens as well as any remaining dust and heavy metals are extracted during a two-phase procedure. The resulting waste water is treated in a neutralisation process and then evaporated in the spray dryer (8).

12 SO_2 scrubber

The alkaline scrubber (lime-milk) also operates in two stages and eliminates SO_x (sulphur oxides). As a result of oxidation with atmospheric oxygen, a gypsum suspension is formed. The mixture is then drained and converted into dry gypsum which is recycled.

The storage capacity of SAVA is sufficient to ensure five days of operation.

13 Suction fan

The fans transport the flue gas to the chimney and generate a negative pressure in the flue gas cleaning system, which guarantees that no flue gases can leak out unmonitored – along the entire system from the rotary kiln to the chimney.

14 Adsorption fabric filter

The flue gases are heated up again so that they can be purified with activated carbon in the adsorption fabric filter. After this, a mixture of fine lime and activated carbon is injected to remove organic trace elements and residual heavy metals from the flue gas.

15 $DeNO_x$ catalytic converter

The $DeNO_x$ catalyst transforms the nitrogen oxides into nitrogen and water by adding an ammonia solution.

16 Chimney

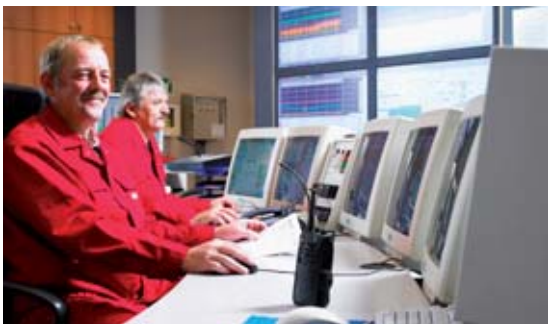
The chimney releases the hot flue gas (approx. 140°C) into the atmosphere at a height of 60 m. The flue gas, which first travels through a gas-gas heat exchanger (16.1), is monitored and measured continuously.

A section of the SAVA flue gas cleaning units.

Cleaning Flue Gas with State-of-the-Art Technology.

The 17th Ordinance of the Federal Emissions Control Act and the 'Technical Instructions on Air Quality Control' ensure that Germany has very strict emission limit values – especially compared to international standards. The emission ceilings approved for the SAVA plant are lower than the normal values – generally half the legally prescribed limit. By using modern technology and prudent processing methods, the figures recorded by SAVA remain far below these limits.

All emission data is not only monitored and documented on site, it is also forwarded online to the respective monitoring authorities.



Safety and Responsibility for Our Environment

SAVA ensures that hazardous substances in waste are destroyed safely by supplying the plant with a homogenous blend of different wastes. The waste mixtures are created during extensive pre-treatment processes such as, for example, the crushing of solids or the mixing of liquids by convection.

Additional measures are carried out during the flue gas cleaning processes to ensure that the residual waste is of a high quality so that it can be sent straight on for recycling.

The combustion temperature in the rotary kiln and the afterburning chamber is kept at such a level that the hazardous waste is converted into an environmentally harmless material. The temperature has to be at least 1,100°C. SAVA's emission values are clearly below the prescribed maximum emission values – see also page 6.

Safety of the groundwater is ensured by an underground sealing coat which stretches along all the areas of the plant where materials which could pollute water are handled. The plant itself operates without waste water. Odour emissions from the bunker area are prevented by an extensive exhaust air system. All emptying stations for tank trucks and containers have suction units. This air is fed into the incineration process separately via a central collection line.

Continuous Control

Up-to-date emission data is sent online to the monitoring authorities to enable them to check that the regulations are being observed at all times. The emission measuring station registers and monitors dust, CO, NO_x, SO_x, HCl, Hg and C_{total} continuously. In addition to this, SAVA publishes its current monthly average values on its internet page (www.sava-online.com).

> SAVA Emission Data

Parameter	Emission limits 17. BlmschV	Emission limits SAVA	Mean annual value of a year's measurement
Carbon monoxide	50 mg/m³	50 mg/m³	3.65 mg/m³
Particulates	10 mg/m³	5 mg/m³	0.33 mg/m³
Carbon total	10 mg/m³	5 mg/m³	0.49 mg/m³
Hydrogen chloride	10 mg/m³	5 mg/m³	0.10 mg/m³
Sulphur oxides	50 mg/m³	25 mg/m³	2.85 mg/m³
Nitrogen oxide	200 mg/m³	100 mg/m³	83.80 mg/m³
Mercury	0.03 mg/m³	0.03 mg/m³	0.0014 mg/m³

SAVA's annual values are far below the emission limit values laid down in the 17th Ordinance of the Federal Emissions Control Act (17. BlmschV).

> SAVA Annual Measurement

Parameter	Limit value	Results of a year's measurement
Hydrogen fluoride	1.0 mg/m³	< 0.3 mg/m³
Total of cadmium and thallium	0.05 mg/m³	0.0005 mg/m³
Total of antimony, arsenic, lead, chromium, cobalt, copper, manganese, nickel, vanadium, tin	0.50 mg/m³	0.018 mg/m³
Total of arsenic, benzpyrene, cadmium, cobalt and chromium	0.05 mg/m³	< 0.002 mg/m³
Dioxins and furans as TE*	0.10 ng/m³	< 0.0001 ng/m³

* The toxicity equivalent (TE) is a total value for the assessment of the total toxicity of all dioxins and furans.

The content level of heavy metals, hydrogen fluoride as well as dioxins and furans in the waste gas is recorded at different intervals once a year. The figures recorded also fall far below the legally prescribed limit values for this area.

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