MINUTA VISITA TÉCNICA

"Calderas de calefacción Torres de San Borja"

Fecha	Viernes 11 de Octubre de 2013
Hora	10.00 - 12.00 horas
Lugar	Torres de San Borja, Santiago, Chile
Ubicación	Perímetro formado por la Av. Bernardo O´Higgins, Vicuña Mackenna, Diagonal Paraguay, Portugal, Santa Victoria y Lira
Asistentes	Priscilla Ulloa, Ministerio del Medio Ambiente Carolina Pacheco, Ministerio del Medio Ambiente Carlos Fernández, Ministerio del Medio Ambiente Jaime Escobar, SISTAM Ingeniería Natacha Valderrama, SISTAM Ingeniería Michael Schmidt, Energía del Sur

- El conjunto que comprende 18 torres habitacionales, conocido como Torres San Borja, posee una planta de agua potable, COSSBO, que pertenece a Torres San Borja[1]. Además tiene una red de agua caliente que provee agua sanitaria y calefacción. Estas 18 torres poseen aprox. 3.500 departamentos, con una población promedio de 12 mil habitantes.
- En la década de los 70´s tenían un sistema de calefacción compuesto por 5 calderas, cada una con una potencia de 7 [MWt], que utilizaban petróleo Nº6, después en los 80's se utilizó carbón, en los 90's se utilizó petróleo Nº5 y a partir del año 2000 se comienza a utilizar gas natural en dos de ellas. En el año 2010, producto del aumento del precio de combustible, se proyectó la instalación de una caldera a biomasa pirotubular con 3 [MWt] de potencia.
- Actualmente se encuentra en operación sólo la caldera a biomasa (chips y pellets), pero el funcionamiento es 100% chips y tiene una eficiencia del 90 [%]. El respaldo es una caldera a gas, cuando se realiza mantenimiento planificado una vez al mes (encendida) y dos veces al año (apagada).
- Tras un estudio de eficiencia energética, se disminuyó la temperatura del agua de distribución de 130 [°C] a 75 [°C], con el fin de minimizar las pérdidas de calor. El agua caliente se distribuye por una red de 3.6 kilómetros de zanjas caminables. Al día de hoy la caldera alimenta a 21 torres, con 2.600 departamentos, lo cual corresponde aproximadamente a 10.000 personas.
- Los chips provienen del puerto de San Antonio y corresponden al chip de rechazo de las plantas de celulosa. Son transportados en camiones de 100 [m^3] equivalente a 27 toneladas- con una humedad de hasta el 60 [%]. La descarga de los chips es por medio de un piso móvil y por correa a la bodega de almacenamiento de 300 [m^3] de capacidad.
- El consumo de combustible en invierno es de 100 [m^3/día] (1 camión), en verano es 1 camión/ 3 días. El almacenamiento de la biomasa se realiza en la ex-bodega del carbón.
- Respecto a las emisiones, indican que en el último reporte de diciembre del 2012 realizado por muestreo isocinético, **se midió un caudal de 8.000 m3/h, 52 ppm de NOx, 16 a 20 mg/m3 de MP y 19 ppm de CO**. El muestreo de la caldera a biomasa se realiza en el ducto que conduce los gases hacia la chimenea y el de la caldera a gas en la chimenea.

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[1] Fuente: http://www.elciudadano.cl/2009/08/17/10363/se-organiza-la-remodelacion-san-borja/

- La caldera cuenta con dos equipos de control, un multiciclón de dos ciclones y un precipitador electroestático de dos campos (fabricante SCHEUCH, http://www.scheuch.com/en/home/).
- El precipitador electroestático requiere una temperatura de entrada de gases superior a 70 [°C], con esto se evita la condensación y el posible daño que se pueda realizar al equipo. Durante los periodos de encendido de la caldera, no se enciende el precipitador electroestático hasta alcanzar esta temperatura, lo que puede suceder en un lapso de 2 a 3 horas. También existe un mecanismo de seguridad que apaga la caldera en caso de que el precipitador presente alguna falla.
- El monto de inversión 750.000 euros y el equipo de abatimiento de MP (ciclón y precipitador electroestático) 120.000 euros, un 20% del costo del proyecto.

Foto1: 4 calderas a gas

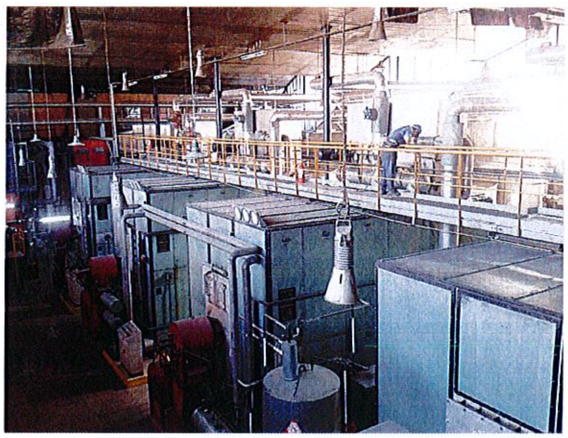

Foto2: Precipitador electroestático Scheuch de 2 campos de la caldera BINDER a biomasa

FICHA RESUMEN
TECNOLOGÍA DE CONTROL

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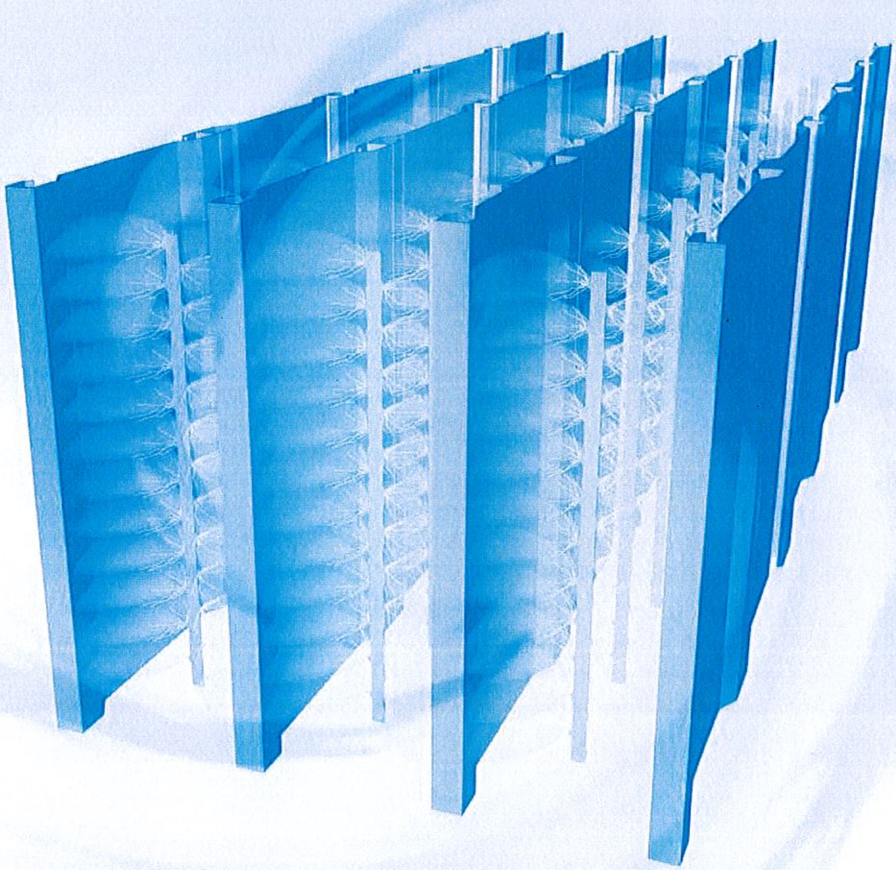
Nombre	Dry electroestatic precipitators for flue gas dedusting Precipitador electroestático seco (ESP) para reducción de polvo en gas de combustión
Marca	SCHEUCH (http://www.scheuch.com/en/home/)
País de origen	Austria
Tipo tecnología	Precipitador electroestático
Principio	Los electrones se emiten por un electrodo cargado negativamente y luego acelerados hacia un electrodo recolector cargado positivamente. Los electrones acelerados o en contacto con los iones de gas hacen que las partículas de polvo que fluyen a través del filtro cargado negativamente, se mueven hacia el electrodo recolector cargado positivamente.
Objetivo	Reducir las emisiones de polvos en gases de combustión generados por calderas de biomasa.
Características	• Resistencia a gases calientes (sobre 300°C) • Alta eficiencia de separación (>99%) • Insensible a fluctuaciones de carga, chispas y esporádicos sobrecalentamientos o cortocircuitos por punto de rocío • Bajas emisiones de ruido • Puede ser utilizado en calderas desde 250 kW hasta 100 MW, el cual corresponde a flujos de aire desde 1,000 a 500,000 [m^3/h] • Existen sistemas combinados: o Compact ESP desde 250 kW o 1, 2 o 3 campos de ESP o ESP con chimenea incluida o ESP con multiciclón integrado o ESP con multiciclón a contracorriente
Documento analizado	Folleto descriptivo
Ejemplo de lugar implementado	Calderas de calefacción Torres de San Borja. Caldera de 2,9 MW.
Distribuidor en Chile	Energía del Sur (http://www.energiadelsur.com/)

000104

Dry Electrostatic Precipitators



for Flue Gas Dedusting

scheuch
TECHNOLOGY FOR CLEAN AIR

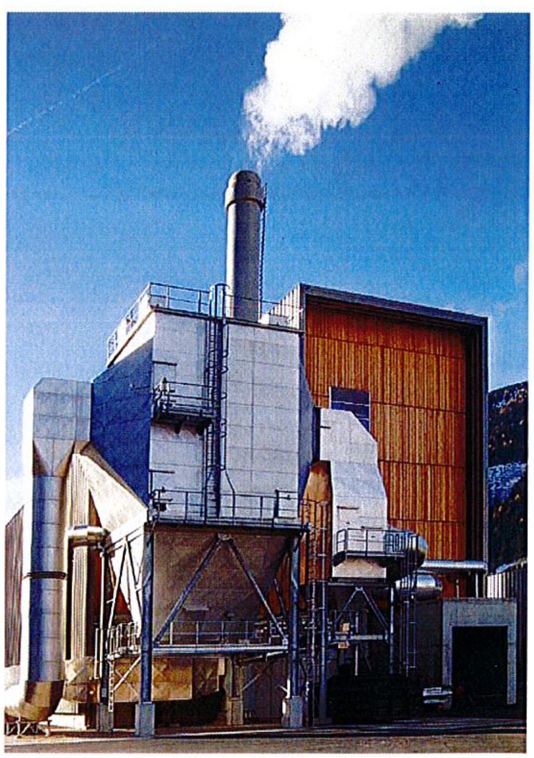
Overall Know-How Makes the Difference

Scheuch has extensive know-how in filtration technology, including practical experience with thousands of filtration plants in operation around the world in different industrial sectors.

Depending on the application, we offer a variety of processes and system combinations for dust removal:

- Centrifugal separators for pre-separation
- Electrostatic precipitators
- Fabric filters supplemented with sorption-based processes for additional removal of pollutants
- Flue gas condensation plants for heat recovery (ERCS)

All filtration technologies are based on Scheuch's own development work and are protected by patents with respect to their most important functional aspects.



We have for many years placed special emphasis on the optimization of individual machines and components with respect to their efficiency. An integrated view of the overall plant (including, for example, incoming flow, flow distribution in the equipment, pipe layout) is an essential prerequisite for improved process adaptation and the lowest possible life cycle costs.

Range of Application: Flue Gas Dedusting

We primarily use dry electrostatic precipitators to dedust the flue gases generated by biomass-fired boiler installations. In contrast to fabric filter systems, the electrostatic precipitator (ESP) is especially reliable in this role because it is relatively insensitive to the entry of sparks and because it tolerates boiler load fluctuations extremely well.

Advantages of the Dry Electrostatic Precipitator

- Hot gas resistant (up to 300° C in standard versions with special temperature-dependent designs for higher temperatures)
- High separation efficiency (Separation rates of more than 99%)
- Insensitive to load fluctuations, flying sparks, overheating and sporadic undershooting of the dew point)
- Low operating costs because of a low level of pressure loss (resulting in a reduction in fan power consumption) and low maintenance costs (no replacement filter bags)
- Long service life and high operational availability
- Low retrofit costs at any time because the low level of pressure loss makes it unnecessary to adapt equipment
- Low noise emissions

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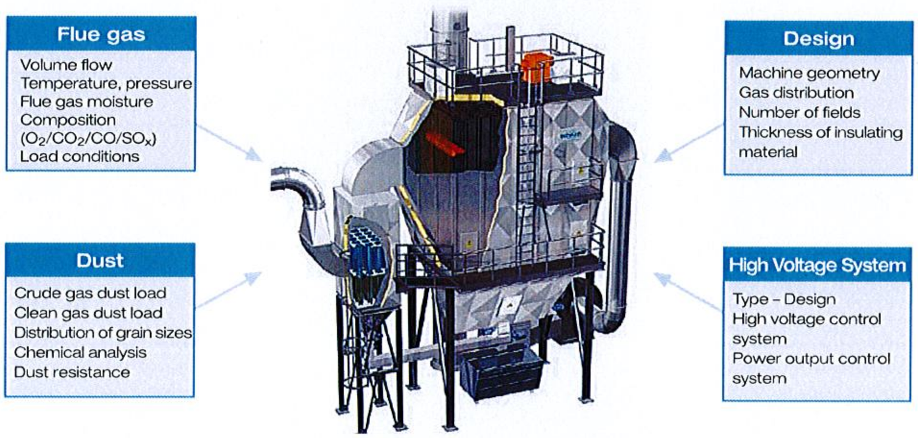
Proper Design and Dimensioning Determine Efficiency

The design of electrostatic precipitators used to clean flue gases generated by biomass-fired combustion processes requires substantial process know-how because many parameters must be considered. On the one hand, consideration must be given to flue gas parameters that have a direct influence on the separation efficiency and also to ash composition. On the other hand, the basic process conditions must also be considered. The proper assessment of the advantages and disadvantages of different technologies or combinations of technologies, e.g., downstream heat recovery systems, makes it possible to achieve the optimal customer-specific solution.



The advantages of Scheuch's dry electrostatic precipitators include

Low investment costs

- High separation efficiency
- Compact design
- Optimal incoming flow and gas distribution
- Customer-specific design (system combinations with pre-separator)
- Modular design principle with high degree of pre-assembly

Low operating costs

- Low level of pressure loss
- Real-time digital control system
- Boiler-dependent adjustment of high-voltage power (partial load operation)
- High-voltage power control via dust measurement

High operational availability

- All components developed in-house
- High quality through in-house manufacturing
- Comprehensive maintenance concept

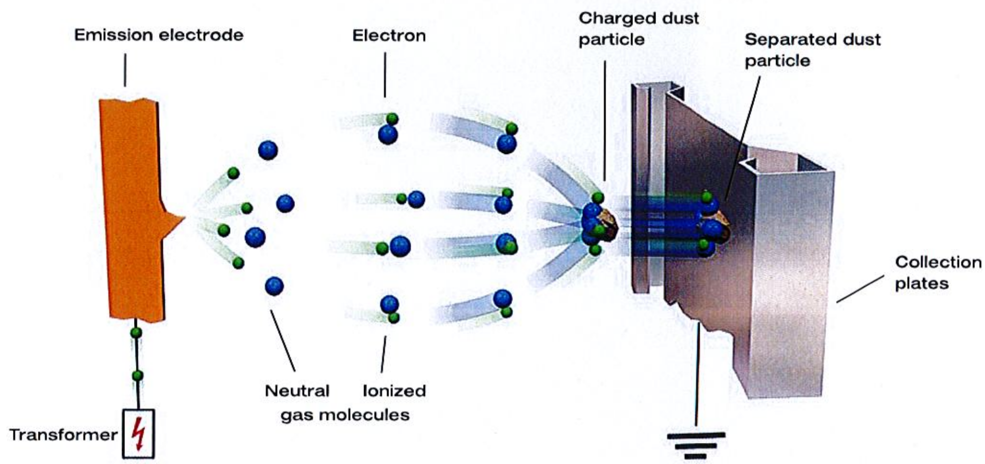
Single Source Solution

Especially noteworthy is the fact that, in addition to the individual components of the ESP, the complete materials handling technology (discharge devices) as well as other components, including cyclones and fans, are also developed and manufactured in-house and adapted to specific plant configurations. The overall implementation — which occurs without interface problems — as well as additional system combinations, including our heat recovery system, makes an important contribution to a high level of plant efficiency for the operator.

The Principle of Electrostatic Precipitation

Particle Charging

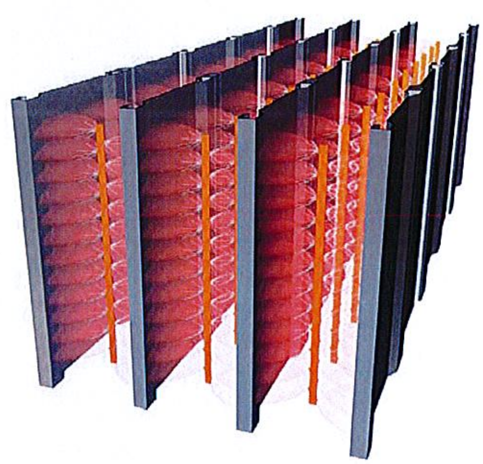
Particle separation in the electrostatic precipitator is based on the principle of electrostatic precipitation. Electrons are emitted by a negatively charged emission electrode and then accelerated towards a positively charged collection electrode. The accelerated electrons or contact with the gas ions causes dust particles flowing through the filter to become negatively charged and subsequently move towards the positively charged collection electrode.

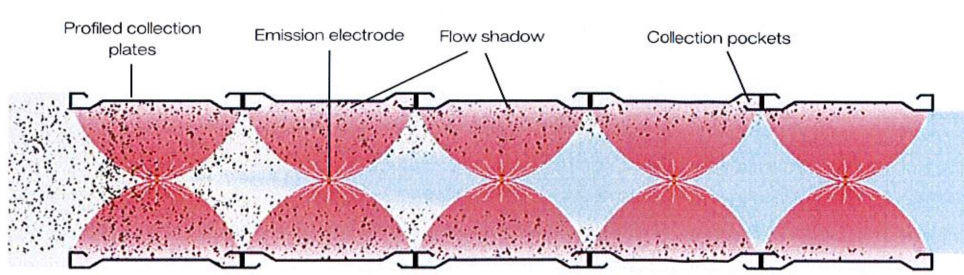


Particle Separation

The dust that collects on the profiled collection electrodes is periodically cleaned by a tap-off mechanism and is thus removed from the gas stream. The formation of so-called collection pockets on the collection electrodes prevents the re-entrainment of particles that have already been separated from the gas stream.

Electrostatic precipitators are therefore extremely well suited for separating fine dust from gas flows.





Keeping Technology on the Move

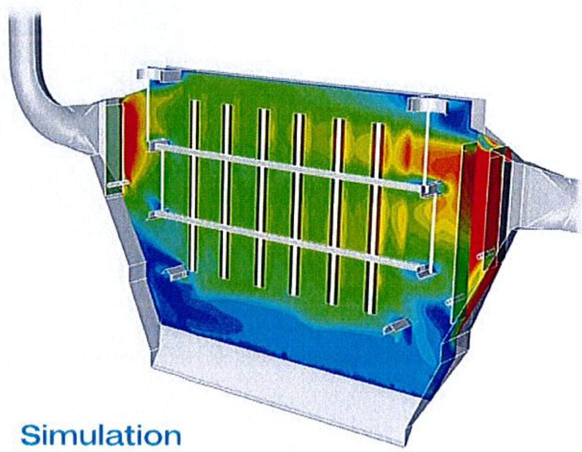
In order to further improve the state of this technology, we have a strong focus on research and development projects. For example, testing conducted at our in-house Technikum, or Tech Center, helps us to better understand the processes that take place in the separation zone of dry ESPs. Our development work is constantly focused on such themes as flow distribution, electrode geometry, different particle types and dust characteristics, high voltage supply, cleaning systems and re-entrainment, as well as mechanical construction and dust discharge.

Operational Data for Research and Development

Operational data logging and plant measurements ensure verified scale-up to industrial standards. Through follow-on testing in our in-house laboratory, we are able to support customers in the event of problems and optimize plants and equipment onsite. If, for example, clean gas dust levels are continuously measured, an energy optimization program can be installed to reduce power input during periods of partial load operation. This reduces operating costs and saves electrical energy.

Flow Optimization to Improve Efficiency

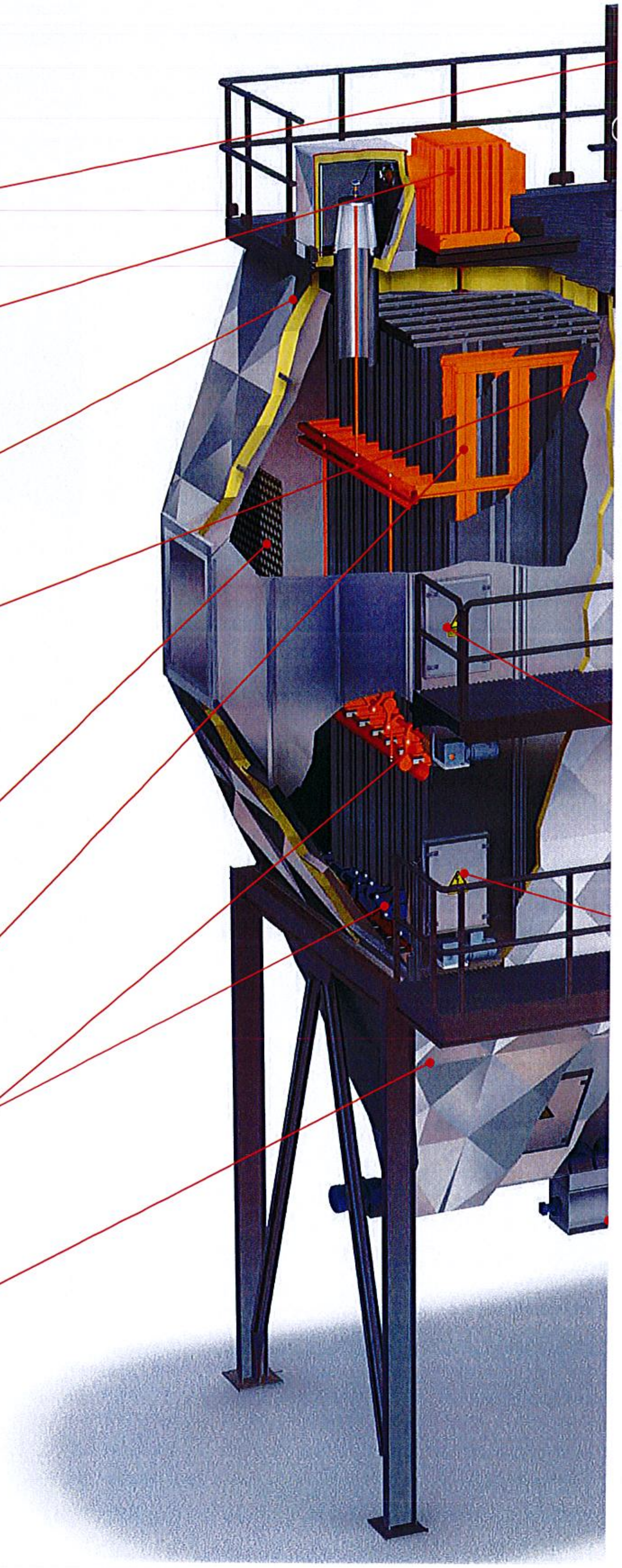
Uniform flow distribution in the separation zone of an electrostatic precipitator is a decisive criterion for best possible operation. In addition, bypass flows must be avoided and dust re-entrainment must be minimized during the tap-off process. For this reason, Scheuch has already worked for a number of years with CFD software - CFD is an acronym for Computational Fluid Dynamics - that offers opportunities for flow optimization based on this computational method. Further, this method makes it possible to more and more precisely predict particle paths inside the ESP and the flow distribution in the electrical field.



Simulation and Specification

As the result of intensive development work in this area, Scheuch is now able to simulate complete electrostatic precipitators during the planning phase. Cost-intensive and time-consuming model building and measurements in our own Tech Center are not necessary for most applications.
This tool makes it possible to take into account unfavorable incoming flow situations for electrostatic precipitators and to compensate for them by selecting appropriate guide and distribution devices. This benefits the customer by making it possible to include the ESP unit in the overall plant in a way that is more precise and that usually saves space.

HIGHLY COST-EFFECTIVE THR



Grounding accessories including tools attached to safety rail

Hermetically sealed transformers

Thermal insulation prevents dew point undershooting and protects against accidental contact

Profiled collection electrodes ensure excellent and reliable dust separation

Several rows of perforated plate ensure optimal gas distribution with minimal pressure losses, as these perforated plates exhibit a very low resistance value

Specially designed emission electrodes ensure high separation efficiency

Tap-off mechanism: Cleaning of the collection and emission electrodes occurs periodically using tap-off hammers

Dust collection basins with an adequate angle of inclination reduce the risk of caking; discharge screws ensure problem-free discharge of dust

ROUGH MATURE TECHNOLOGY

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Function

The dust-laden gas enters the filter horizontally, passing over gas distribution plates before being evenly distributed through a number of street-like "channels" formed by the walls of the grounded collection electrodes.

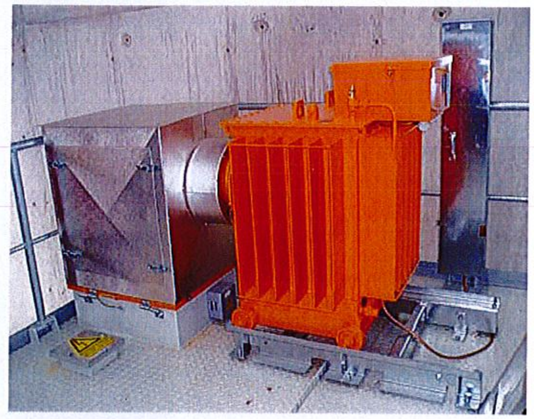
Located in the middle of each channel are emission electrodes, which have a high negative charge and which ionize the gas through a corona discharge. As the gas flows through the filter, the dust particles are negatively charged when they make contact with the gas ions and subsequently collect on the positively charged collection electrodes. The layer of dust that collects on these electrodes is periodically dislodged by a tap-off mechanism. The dust falls into a collection basin and is then removed by a screw conveyor. In order to avoid potential deposits on the emission electrodes, these are also cleaned by a tap-off mechanism.

Good Accessibility For Low Maintenance Costs

Simple and quickly completed maintenance tasks make a significant contribution to plant availability and have a positive impact on operating costs. This not only saves time and money, but also offers a high safety level for the operator's personnel.

Good Accessibility

Scheuch's dry electrostatic precipitators are designed to provide the best possible access to all relevant maintenance points. They have worker-accessible platforms near the tap-off mechanisms, offer generously dimensioned control doors for side access, and offer adequate clearance for inspection and cleaning of the filter channels, including the ability to remove and remount the gas distribution plates.



Transformer on castors

Simple Maintenance

In addition to providing good accessibility, Scheuch has taken specific steps to facilitate maintenance work by the operator's personnel. Insulators, for example, can be checked from outside and entry into the filter for the purpose of cleaning the insulator interior is not necessary. If necessary, the post insulators can be exchanged with minimum disassembly. The required grounding of the transformer unit takes place via the easily accessed control opening of the high-voltage insulator on the filter roof.

Grounding kit

Safety

With an optional Safety-Key-System, entry into the filter unit and grounding of the transformer can only be undertaken after progressing through a pre-specified safety plan. Each step in the plan can only be completed as a function of the previous step.

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SERVICE PAYS OFF IN HIGH PLANT AVAILABILITY

High operational availability of a filtration plant is the fundamental requirement of plant operators. With the know-how of its experts, Scheuch offers modern upgrade and maintenance concepts. Comprehensive measurement processes are used to perform gas and dust analyses, function checks and acoustical analyses as part of an optimal support concept whose goal is the highest possible level of plant availability.

Measurement of the dust concentration

Service Contract

Plant shutdowns are expensive. It is therefore advisable to have inspection and maintenance work performed once each year in order to promptly identify and correct problems. These measures allow us to guarantee the long-term and problem-free function of your filtration plant. We therefore advise customers to sign an inspection and service contract.

Hinged cover for easy access to insulator

Point-by-Point Checklist

We guarantee that your plant will be regularly inspected in accordance with our maintenance instructions. This includes, amongst other things, a functional inspection of the high-voltage supply system, a technical inspection of the plant for functional deficiencies, and functional inspections of the filter cleaning units and discharge system, the monitoring, protection and safety devices, the electrode cleaning system, dust discharge devices and the electrical control system, as well as a detailed inspection of the auxiliary heating equipment and insulators.

Lowest Service Costs

Service appointments are arranged ahead of time so that the customer can also prepare for the appointment (e.g., should it be necessary to cool down the boiler installation or perform cleaning before the service appointment). As a rule, this prevents expensive repairs, unplanned equipment failures and plant downtime.

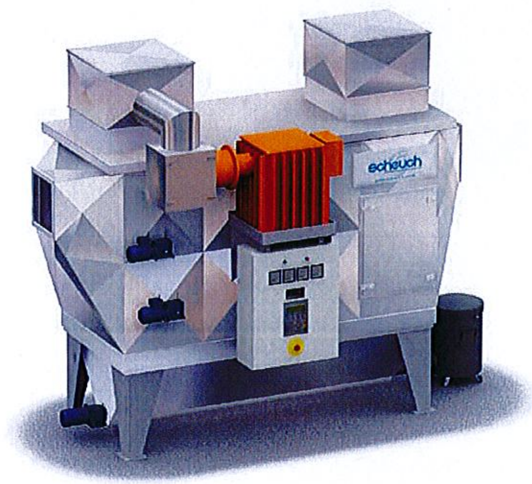
Upon completion of inspection and maintenance work, the customer receives a report detailing the extent of the work performed and repairs that may be required.

Grounding of insulator

A Complete Program

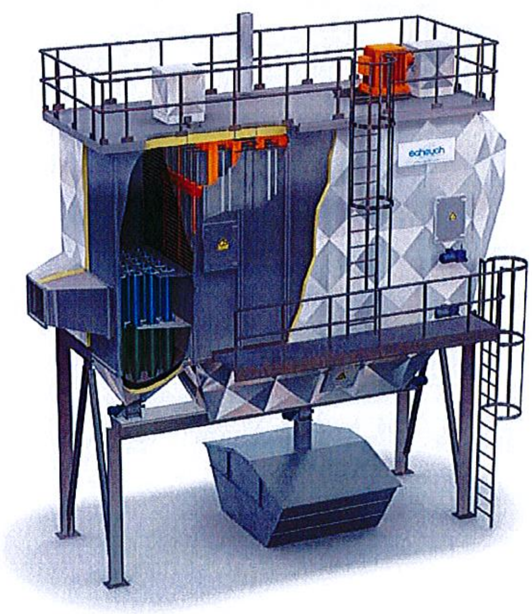
The program includes compact filter units that are used for boilers rated at roughly 250 kW and above, system combinations with an integrated pre-separator stage, and combinations consisting of a separate multi-cyclone and dry ESP. Depending on the existing flue gas parameters and basic conditions, these systems use 1-, 2- or 3-field dry electrostatic precipitators.

Scheuch has a carefully tiered modular program with firing thermal capacities ranging from 250 kW to roughly 100 MW, which corresponds to airflows of 1,000 to approximately 500,000 Bm³/h.



COMPACT ESP from 250 kW

ESP with directly attached exhaust stack



ESP with integrated multi-cyclone

ESP with upstream multi-cyclone

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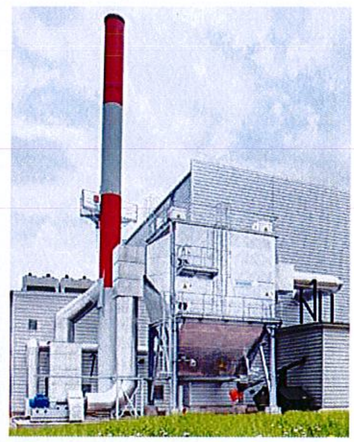
FIRING THERMAL CAPACITIES FROM 250 kW TO 100 MW

ESP with attached exhaust stack

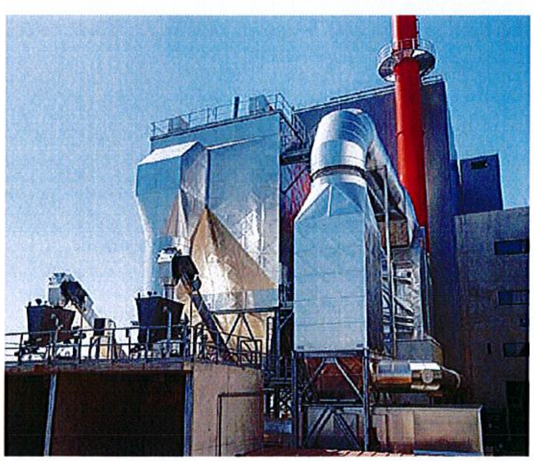
ESP with integrated multi-cyclone



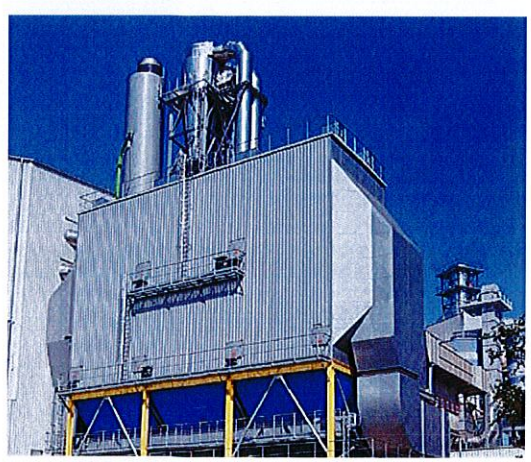
Single-field ESP

Single-field ESP with multi-cyclone

2-Field ESP with multi-cyclone



2-Field ESP with ERCS plant



3-Field ESP

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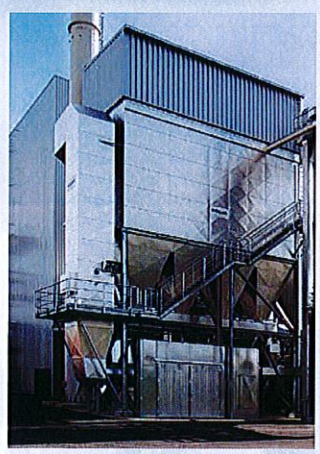
Tailor-Made Solutions For Flue Gas Cleaning

With a complete program for dedusting, heat recovery and pollutant reduction, we offer customers tailor-made specialized solutions that perform at the highest technological level with respect to both ecology and energy efficiency.

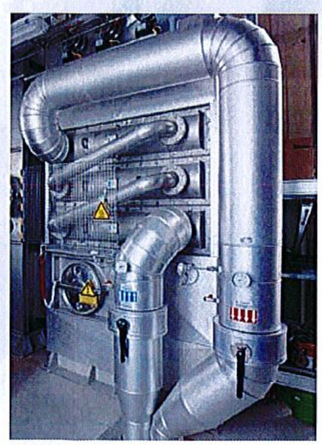
Bag Filtration Systems

Because of their exceptional filtration performance, fabric filter plants are extremely well suited for filtering fine dust to guaranteed levels of < 3 mg/Nm³ and for use in combination with sorption-based processes to reduce pollutants.



Sorption Processes

For the energetic utilization of treated and contaminated fuels, as well as waste and residual materials, Scheuch has developed its own adsorption and absorption methods for the cleaning of exhaust gases.



Heat Recovery with ERCS

If untreated and wet biomass is used to generate heat and electricity, the use of exhaust gas condensation plants is generally recommended. Our ERCS process (Energy Recovery & Cleaning Systems) offers highly efficient heat recovery and energy-optimized plume removal.

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TECHNOLOGY FOR CLEAN AIR

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