

Doosan Lentjes

Air Quality Control Systems



Wet flue gas desulphurisation

Our innovative technologies offer high reliability and availability

Dry & semi-dry flue gas desulphurisation

Requiring minimum investment costs. Achieving high flexibility for varying sulphur fuel contents and reduced water consumption

Dedusting

We have a wealth of expertise in dedusting solutions and one of the largest reference lists, with over 900 dedusting plants installed worldwide

Your partner for environmental technologies

Doosan Lentjes specialises in air quality control systems across the utility, municipality and industrial sectors. Our proven desulphurisation technologies help customers, all over the world, achieve cleaner power generation.

Doosan Lentjes started out life as Lentjes in 1928, when Ferdinand Lentjes established the business as a boiler manufacturing company. Since Bischoff (acquired by Lentjes in 1984) pioneered the wet lime/limestone FGD process with in-situ oxidation, Doosan Lentjes has further improved the process and today ranks amongst the most experienced providers of this technology. Doosan Lentjes has successfully installed its wet desulphurisation technologies in over 100 locations worldwide, with the equivalent of over 80 GW_e installed capacity. This includes approx. 11 GW_e of seawater FGD references.

Our Circoclean® semi-dry FGD / FGC technology has been applied in around 60 plants around the world, equivalent to approx. 47 Mio m³/h (STP, wet) total flue gas flow rate, with special experience gained for high-sulphur applications, such as, lignite.

We are committed to the continued development of industry-leading technologies and solutions for our customers and focus on being at the forefront of new trends and developments, enabling us to provide you with comprehensive, future-orientated concepts. We have the capacities and skills to solve your power generation and environmental challenges, from early planning through to finalisation.

Sustainable emission reduction

We implement environmentally friendly flue gas cleaning solutions, tailored to the needs of our clients and their local environments and designed for sustained emission reduction. Our vast proprietary product portfolio allows us to select the most advantageous process for each type of application to the benefit of our clients.

Innovative skills

With our extensive experience of project management and plant engineering, we can handle any of the challenges posed by your process. Reliability and innovative skills make us the ideal partner to help achieve your environmental and financial goals.

Bespoke solutions

Maintaining the energy efficiency of your processes, complying with the strictest licensing procedures and developing tailor-made solutions for your plant are the cornerstones of our approach.

Limestone flue gas desulphurisation (FGD): a highly efficient process for low emissions

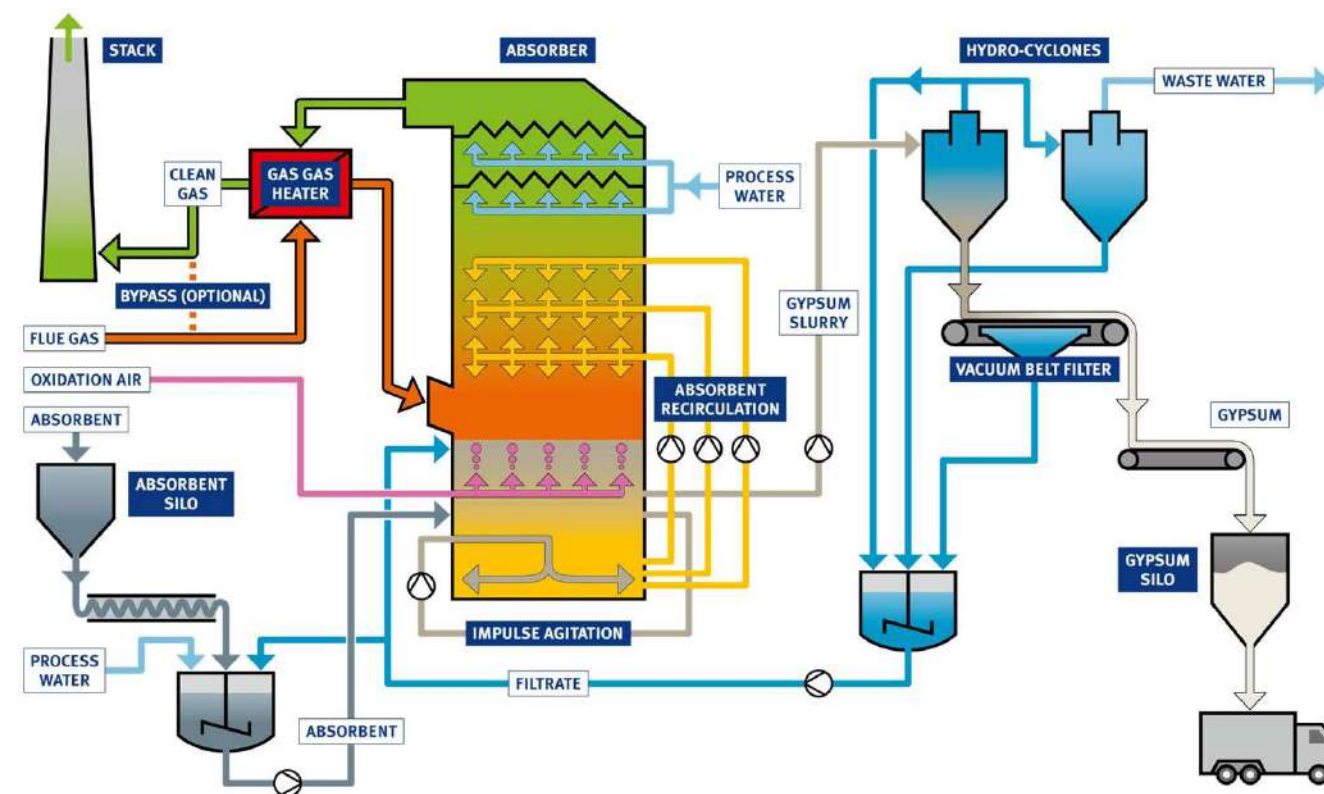
We have played a pivotal role in improving limestone FGD technologies and today we rank amongst the most experienced technology providers in this field.

Limestone FGD is the most commonly used FGD process in the world. Sulphur dioxide (SO_2), hydrogen chloride (HCl) and hydrogen fluoride (HF) are removed by absorption with an alkaline scrubbing suspension, normally limestone.

We can also use lime or calcium hydroxide where necessary. Our advanced Doosan Lentjes scrubber design and system optimisation offers minimum investment and operating costs, as well as, the highest levels of availability.

Advanced scrubber design

The nucleus of our limestone FGD design is the scrubber, which takes the form of an open spraying tower that has been systematically developed using computerised simulation techniques. Our research in this field has allowed us to simulate process parameters in the scrubber. The result is an advanced scrubber design, characterised by minimum dimensions and liquid to gas ratio.



Wet lime / limestone FGD – Basic flow sheet

Customer benefits at a glance

- Outstanding references for all fuels (lignite, hard coal, oil, biomass, waste)
- SO_2 removal of over 99%
- Maximum HCl and HF removal levels
- Gypsum as a saleable end product
- Flue gas volume flows of up to approximately 5,000,000 m³/h (STP, wet) per scrubber
- Limestone as a favourably priced absorption agent
- Low operating costs and power consumption
- Open spray tower, low pressure loss

Use of the latest materials and construction techniques

As well as a sophisticated technical design, we place high priority on the use of the latest materials and construction methods. A variety of materials are used (high alloy, carbon steel with rubber lining, concrete with polypropylene lining, glass fibre reinforced plastics) adaptable scrubber entry and exit geometry, and the optimum layout of spray nozzles and spraying banks.



Wet flue gas desulphurisation

Especially suitable for high sulphur applications and large size power plants

SO_2 removal of over

99%

Low operating costs and power consumption

Seawater FGD: a cost-effective wet process for coastal regions

Our seawater FGD is an attractive alternative for cleaning flue gas from oil and coal-fired power plants located in coastal regions. We can use this technology to achieve the same levels of desulphurisation as those attained by using the limestone process, however, the seawater process is more cost-effective and does not create any by-product.

Natural process

We take seawater from your power plant cooling circuit and use it as an absorbent. The naturally dissolved bicarbonates in the seawater react with the acid components of the flue gas, such as sulphur dioxide. After absorption, the sulphur dioxide is bonded in the scrubber solution and oxidised into sulphates, which are a natural component of seawater.

Innovative system

The core components of our seawater FGD plants are the scrubber and the neutralisation and oxidation basin. Our extensive experience of wet FGD systems has strongly influenced this technology and we equip the neutralisation basin with ultra-modern, highly efficient aeration membranes. We design each system to the specific operating conditions by using effective modern simulation software and mathematical reaction modelling.

- SO₂ capture above 99%
- No auxiliaries for limestone, gypsum and waste water necessary
- Low investment, operating and maintenance costs
- Minimum air and energy use
- Simple system configuration with reliable components, resulting in high availability
- Excellent environmental performance, verified by independent institutes
- Flexible part-load operation
- Dosing of sodium hydroxide in case of low alkalinity seawater

Seawater flue gas desulphurisation

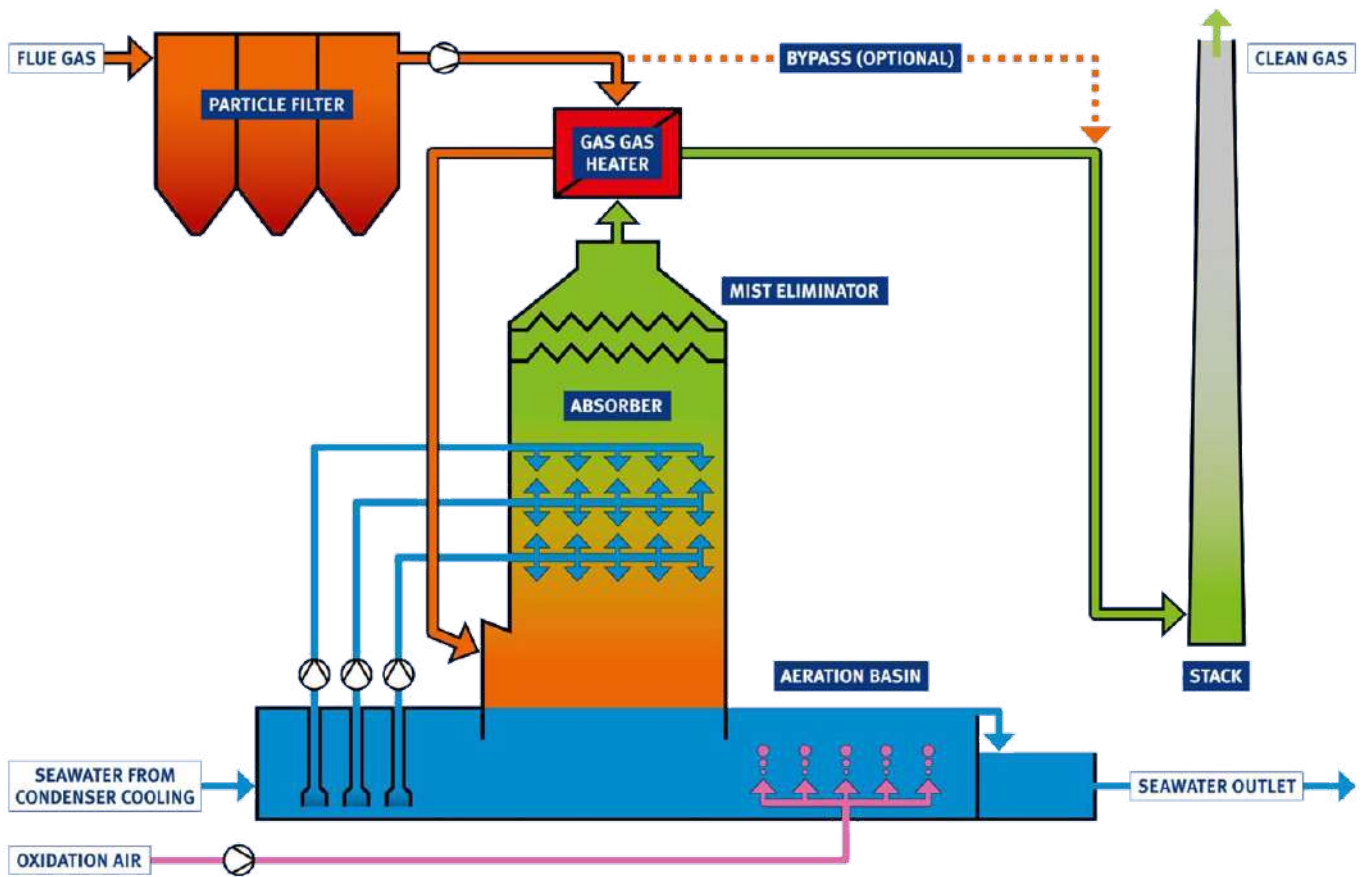
A cost-efficient alternative for power plants located in coastal regions



Excellent
environmental
performance,
verified by
independent
institutes

over
90
selective catalytic reduction
units installed worldwide

over
210
wet FGD units
installed worldwide



Seawater FGD – Basic flow sheet

Dry & semi-dry FGD / flue gas cleaning (FGC) processes: effective multi-pollutant removal

In addition to the wet FGD processes, we have continued to further develop our dry and semi-dry flue gas cleaning processes, namely Circoclean® and FER-DI® (Flexible Economic Reagent Direct Injection). Both are ideally suited for removing multi pollutants. Applications are possible downstream of coal, oil, biomass and municipal solid waste fired boilers, as well as, sewage sludge incineration plants.

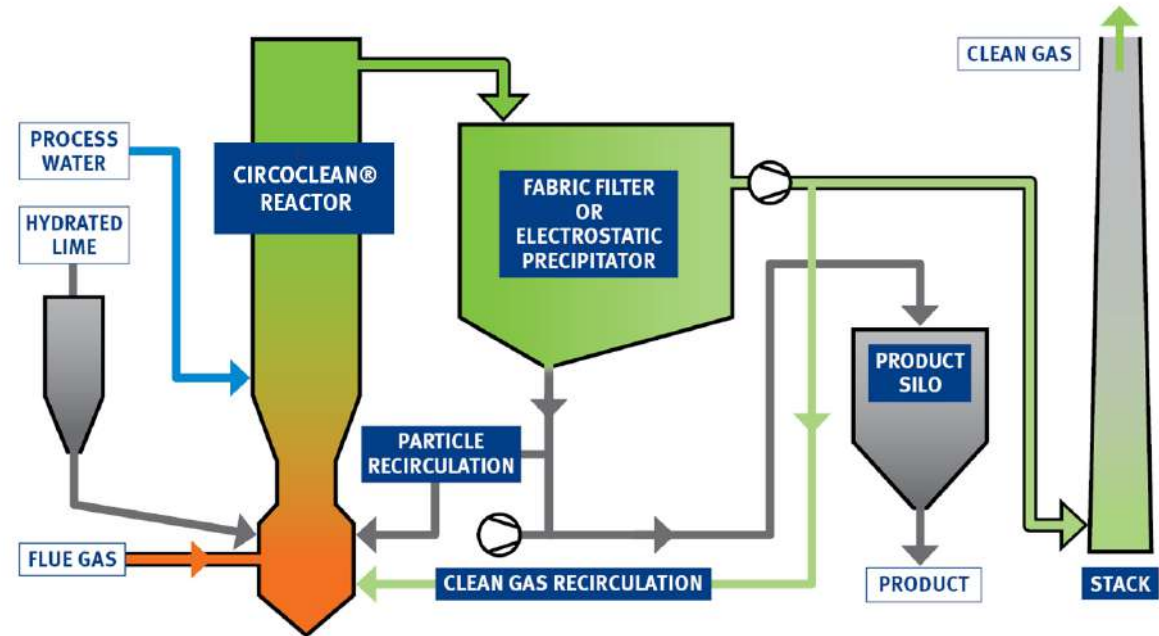
Circoclean® FGD / FGC

Our Circoclean® FGD / FGC process for utility boilers operates at a temperature of approximately 70°C and uses hydrated lime for the absorption of SO₂, SO₃, HF and HCl. We can achieve SO₂ reduction efficiencies of up to 99 % due to the intensive mass transfer and the high velocity in the circulating fluidised bed (CFB) reactor, called Circoclean® reactor, yet still only require a small footprint.

Process

Our semi-dry flue gas cleaning process is based on the well proven circulating fluidised bed (CFB) technology. The flue gas flows through a fluidised bed reactor and then enters a downstream particulate control device, which can either be a fabric filter or an electrostatic precipitator.

We dose fresh additives into the flue gas upstream of the fluidised bed reactor while a large part of the solid material from the reactor is fed back to the fluidised bed as a recirculate. Water is also injected to lower the flue gas temperature and to achieve higher separation performance. Our advanced process management minimises material consumption and residues.



Circoclean® FGD / FGC – Basic flow sheet

Customer benefits at a glance

- Proven technology with excellent references
- Removal of air pollutants in one step (dust, SO₂, SO₃, HCl, HF, dioxins, furans, polychlorinated biphenyls (PCBs), heavy metals)
- Relatively low investment cost
- Compact design, easy to retrofit
- Simple aggregates, operation above dew point
- No corrosion, low maintenance
- High availability
- Low sorbent consumption due to product recirculation
- High desulphurisation efficiency and low emissions
- Wastewater-free
- Handling of highest loads of pollutants and sudden changes in their concentration

Low investment and maintenance costs

One of the key advantages of our Circoclean® FGD / FGC system is its compact design. Our semi-dry Circoclean® technology benefits from not using rotating or wearing parts, which not only reduces investment costs, but also maintenance expenditure. More importantly, the simplicity of our system design provides high levels of availability.

Dry & semi-dry flue gas cleaning

Ideally suited for the removal of multi pollutants
Wide range of application potential

Circoclean® FGD / FGC

High reagent consumption efficiency allows coping with highest loads of pollutants and sudden changes in their concentration

FER-DI® FGC / FGD

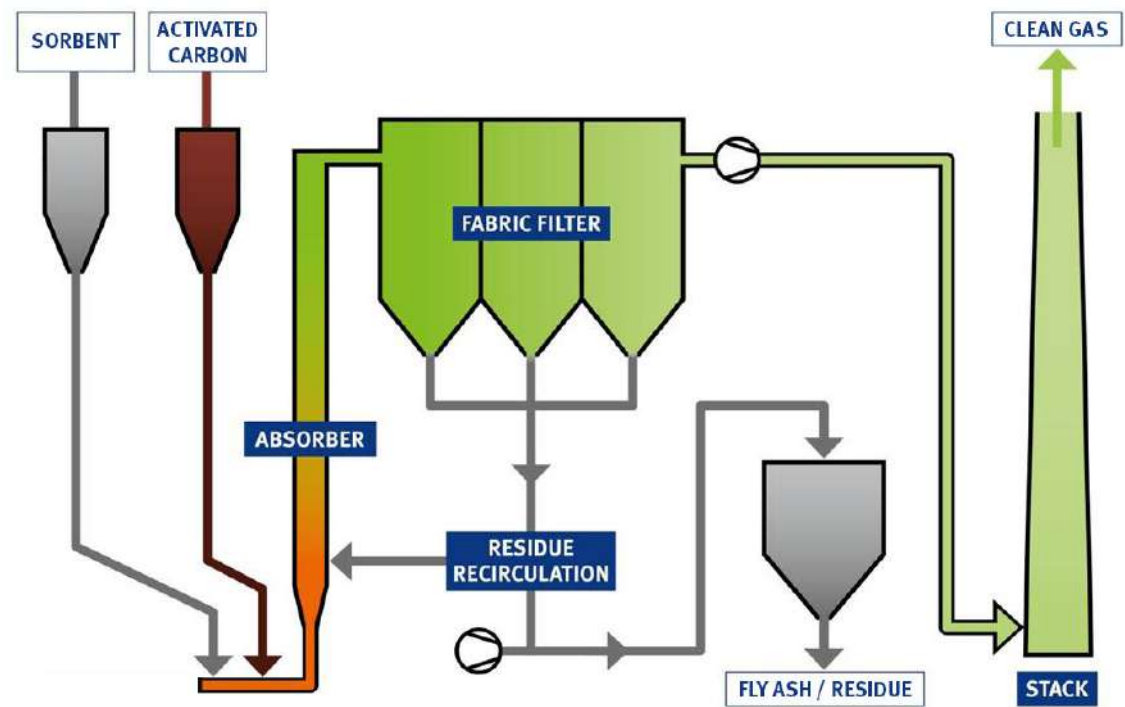
Our FER-DI® FGD / FGC process is a straightforward method developed to handle typical concentrations of harmful substances like SO_x, HCl, HF, as well as, hydrocarbons and heavy metals. We either use sodium bicarbonate or hydrated lime as removal agent.

Process

The absorbent is directly injected into the hot flue gas passing through the ducting area downstream of the boiler. Subsequently, the flue gas enters a particulate control device which can either be a fabric filter or an electrostatic precipitator. If required, solid particles are separated and partially fed back into the ducting area to improve the utilisation of the reagent used.

Cost-effective design

Our FER-DI® process benefits from its compact plant design and the associated low space requirements which is why investment costs are significantly reduced. Furthermore, the simple design allows both the operation and maintenance expenditures to be minimal.



FER-DI® FGD / FGC – Basic flow sheet



Fabric filters and electrostatic precipitators: the right technology for your type of ash

A modern dedusting system is a crucial component of every flue gas cleaning plant and we can apply one to your plant, whether industrial or utility. Our dedusting systems can assist your plant to achieve high reliability, strict compliance with prescribed threshold values and reasonable operational costs.

Fabric filters

Our fabric filters are not just used for dust collection, but also for the absorption or partial absorption of gaseous pollutants, such as, SO_2 , HCl and HF, as well as, heavy metals and polychlorinated hydrocarbons. Our fabric filters are virtually unaffected by most critical ESP influence factors and maintain low ash emissions even under changing coal and ash qualities. To date, we have installed more than 300 fabric filters worldwide.

High-pressure pulse jet fabric (HPPJF) filters – typically applied for smaller gas volumes

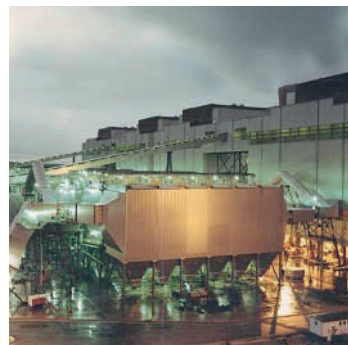
Dust laden gases pass from outside the filter bags through to the inside and the dust deposited is removed by using pulses of compressed air. The dust cake falls into the filter hopper and can be discharged. The fabric filters are designed with multiple compartments, so that the plant sections can be easily separated from the gas stream for inspection and maintenance purposes.

Low-pressure pulse jet fabric (LPPJF) filters – designed to handle large volume flows from 200,000 m^3/h to several millions m^3/h .

The main advantage of this type of filter is that the low scavenging air reservoir pressure is below 1 bar, as opposed to between 2 to 7 bar in conventional systems, requiring far less energy for the cleaning process. Clean gas dust content below 5 mg/Nm^3 can be achieved.

Electrostatic precipitators (ESP)

We have one of the largest precipitator databases in the world and have equipped over 600 plants worldwide with ESPs, ranging from one to 16 units per plant. Dust particles or droplets floating in the gas are negatively charged by discharge electrodes connected to a high voltage transformer rectifier unit. The particles migrate towards the collecting electrodes under the influence of a strong electrical field where they adhere. Electrodes are purged periodically and deposits are collected in hoppers located under the precipitator. Clean gas dust content below 10 mg/m^3 can be achieved.



With over
900

dedusting plants installed worldwide, we have a wealth of expertise in dedusting solutions and one of the largest reference lists

We have
equipped over
600

plants worldwide with ESPs, ranging from one to 16 units per plant



Oroszlány, Hungary

Wet limestone flue gas desulphurisation

Fuel:

Lignite

Technical data:

Gross power generation: 1 x 240 MW_e
Flue gas flow rate (per line, wet): 1,140,000 m³/h (STP)
SO_x removal efficiency: >97%

In 2002, **Doosan Lentjes** was awarded the contract by Vértés Power Plant Ltd. to provide a wet limestone FGD plant for the lignite-fired power station located in Oroszlány, Hungary. The delivery included the absorber system, booster fan, gypsum hydrocyclons, limestone system and wet stack on top of the absorber.

The cutting-edge wet limestone FGD solution especially developed for high sulphur applications helped to reliably reduce the high amount of SO₂ in the flue gas to a minimum whilst complying with all applicable European emission requirements.



Moneypoint, Ireland

Circoclean® flue gas desulphurisation

Fuel:

Coal

Technical data:

Gross power generation: 3 x 305 MW_e
Flue gas flow rate: 3 x 1,200,000 m³/h (STP, wet)
SO₂ removal efficiency: >91%

In 2004, **Doosan Lentjes** was contracted by Ireland's Electricity Supply Board (ESB) to deliver a turnkey project for the Moneypoint coal-fired power station located near Limerick, Ireland, which involved a turnkey retrofit of the FGC equipment consisting of selective catalytic reduction (SCR) for denitrification and dry Circoclean® systems for desulphurisation.

The system's compact design ensured a small footprint and helped reduce capital investment costs. Thanks to highest removal efficiencies, the plant is fulfilling European emission requirements.

With Doosan Lentjes as the sole EPC provider of the project, ESB had the certainty of receiving a complete solution from a trusted source. A key measure of the successful project execution was meeting the challenge of ongoing operation while retrofitting the FGC system within a limited space.



Kjøpsvik, Norway

Seawater flue gas desulphurisation

Fuel:

Waste fuels

Technical data:

Flue gas flow rate: 280,000 m³/h (STP, wet)

SO₂ removal efficiency: up to 95%

In 2017, **Doosan Lentjes** was awarded the contract to provide a turnkey seawater flue gas desulphurisation (FGD) system at the Kjøpsvik cement plant, located in close proximity to the sea in northern Norway.

Acting as the sole EPC provider has allowed Doosan Lentjes to deliver an integrated solution securing an ongoing operation of the cement plant with only minimal shut-off periods for tie-in during the retrofit.

Apart from fulfilling emission requirements, the new FGD plant is flexible to be adapted to various load conditions in terms of flue gas flow and sulphur content which is vital for minimising both operation and maintenance costs.



Customer-focus

Engineering excellence and innovation

Global-reach

Your benefits with us at a glance

- Outstanding engineering competence combined with a wealth of expertise in international project management
- World-class FGD / FGC technologies for a wide range of fuel types
- Decades of experience in wet and dry processes applied around the globe
- Provision of cost-effective and tailor-made solutions from one trusted single source
- Reliable removal of multi-pollutants, such as, sulphur dioxide (SO₂), sulphur trioxide (SO₃), hydrogen chloride (HCl), hydrogen fluoride (HF), dust, furans and heavy metals like mercury
- Achievement of all environmental goals through full compliance with the most stringent emission reduction requirements
- Flexible adaption of FGD / FGC system to various load conditions with respect to flue gas flow and sulphur content
- High plant availability
- Cost-efficient constructability through a maximum level of modularisation ensuring an achievement of all economic objectives
- Innovative and tailor-made solutions through continuous investments in in-house research and development activities
- Tailor-made after sales services encompassing maintenance and modernisation

At your side after completion

Even after your plant has been commissioned, our expertise remains at your disposal. Our service portfolio includes a comprehensive programme of maintenance and modernisation support for power plants and industrial facilities. If required, we can even train your personnel.

Our service teams know their trade inside out. Our expertise covers every aspect of plant engineering, maintenance and modernisation. We aim to minimise downtime, ensuring a cost-effective operation and optimised cost-benefit ratio.

- We can take care of your entire maintenance requirements, from planning to implementing maintenance programmes
- In the event of a malfunction, our rapid, efficient, on-site deployment handles the problem reliably and competently
- We analyse specimens in the laboratory and provide accurate conclusions without delay
- We develop and implement optimisation concepts for your plant
- We promptly deliver spare parts
- We can provide thorough, individual training for your personnel



AQCS in 360° at Doosan Lentjes

Visit our homepage and take a virtual journey through our AQCS facilities around the globe – a great opportunity for you to experience our reference plants in an impressive 360° environment and convince yourself of our capabilities! To start the tours, please type the address below in your internet browser and open the Virtual Doosan World.

www.doosanlentjes.com

Doosan Lentjes

Doosan Lentjes is a global supplier of processes and technologies that harness the energy contained in sustainable and conventional fuels. Our specific areas of expertise include key technologies for the recovery of energy from waste and sewage sludge, as well as, circulating fluidised bed boilers and flue gas cleaning systems. For more than 90 years we have been pioneering innovative energy solutions and convert millions of tonnes of waste into energy every year.

Doosan Lentjes is part of a powerful combination of companies united under the Doosan Group to deliver complementary technologies, skills and value to customers the world over.



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