



THE SCIENCE OF A PURE ENVIRONMENT



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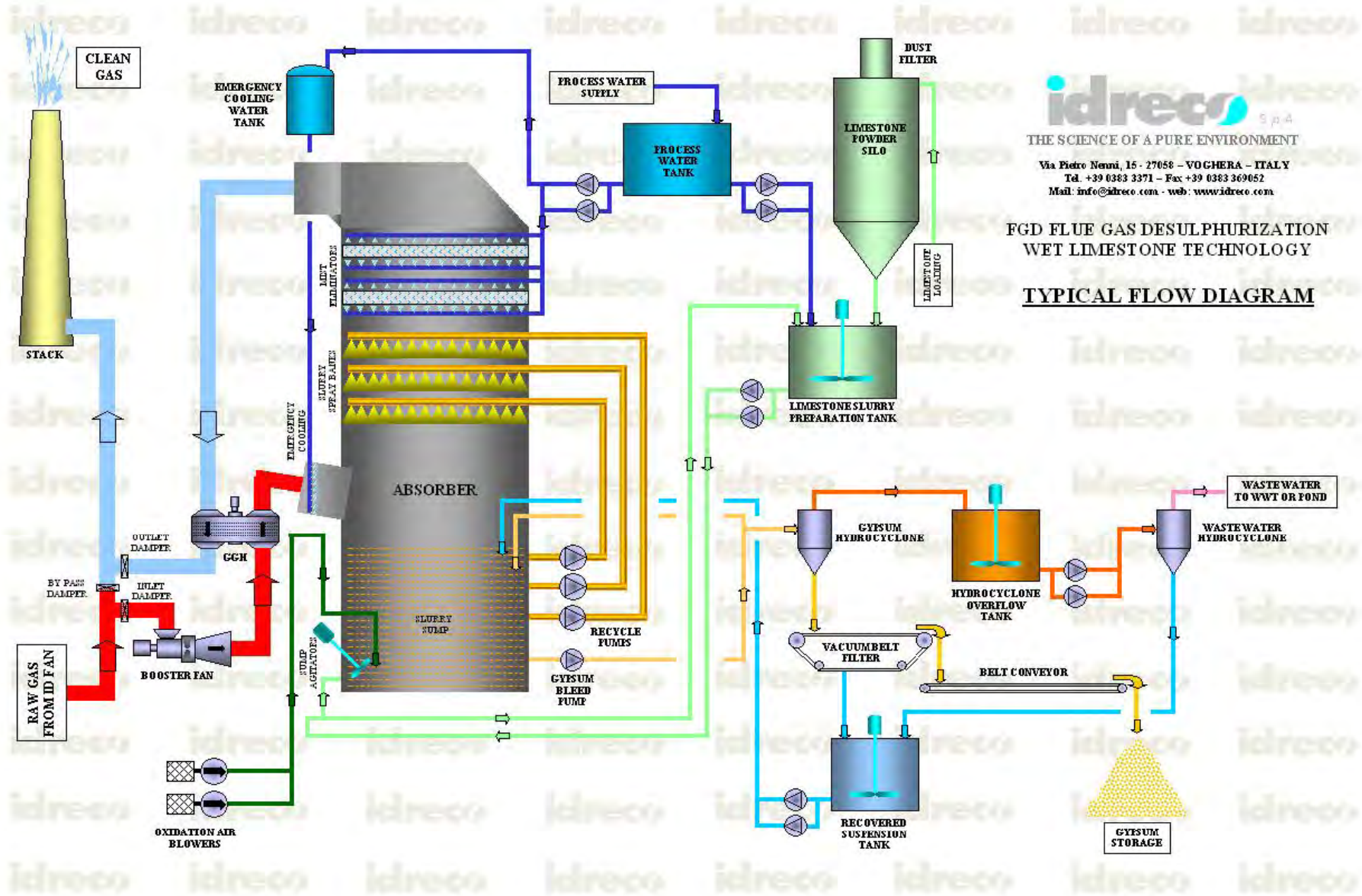
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Presentation of Wet Flue Gas Desulphurisation Technology

INTRODUCTION TO IDRECO WFGD TECHNOLOGY

Idreco WFGD (Wet Flue Gas Desulphurisation) technology is based on the wet limestone absorption method with production of gypsum.

A typical flow diagram of a baseline wet FGD system is shown in the next slide.



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FGD FLUE GAS DESULPHURIZATION
WET LIMESTONE TECHNOLOGY
TYPICAL FLOW DIAGRAM

INTRODUCTION TO IDRECO WFGD TECHNOLOGY

SO₂-containing flue gas contacts alkaline slurry in a counter-flow vertically oriented open spray tower absorber.

Limestone slurry is prepared mixing fine limestone powder with water in a slurry preparation tank. Sorbent slurry from this tank is then pumped into the absorber reaction tank.

The absorber is a counter-flow tower with flue gas flowing upwards, while limestone slurry is sprayed downwards by an array of spray nozzles. In the absorber, SO₂ is removed by both sorption and reaction with the slurry.

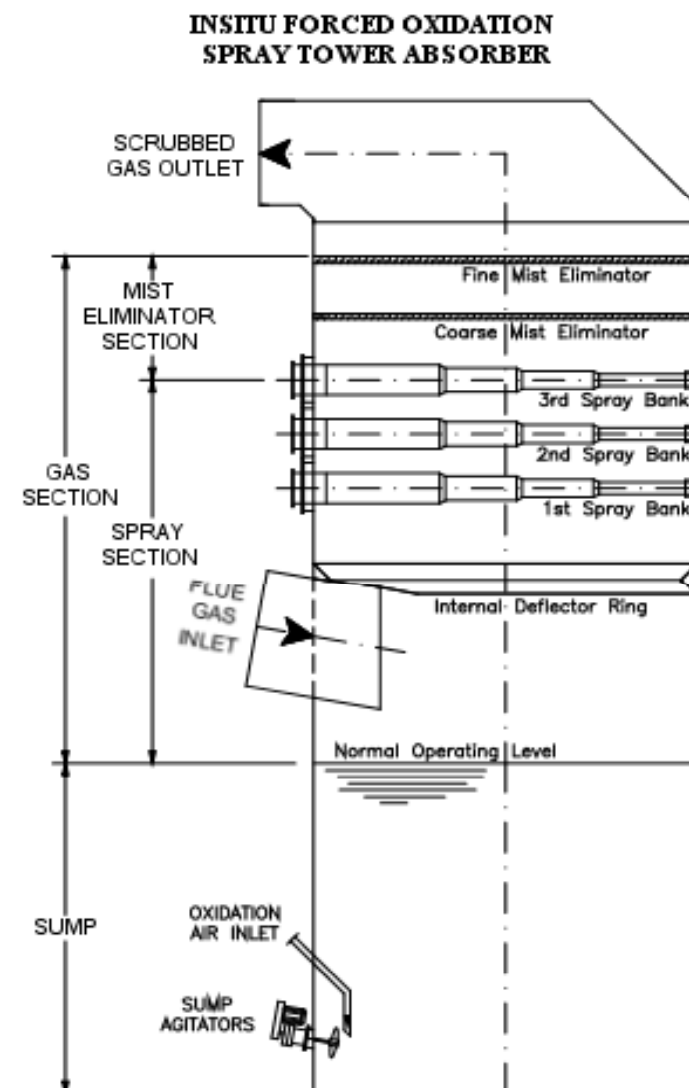
Reactions initiated in the absorber are completed in the “absorber sump” working as a reaction tank, which provides retention time for finely ground limestone particles to dissolve and to react with the dissolved SO₂ and to produce gypsum by means of air addition.

ABSORBER DESCRIPTION

The absorber consists of a vertical cylindrical vessel, with flue gas inlet and outlet openings.

The slurry in the sump consists of an aqueous solution of dissolved salts in which approximately 12 to 20 wt% solids are suspended. In order to keep these solids suspended in the slurry, the sump is provided with side entry agitators.

The part of the absorber between the gas inlet and gas outlet is called "the gas section" which may be subdivided in "the spray section" and in "the mist eliminator section". The part of the absorber below the gas inlet contains the absorber slurry and is called "the sump".



In the **SPRAY SECTION**, the flue gas to be treated is brought in intimate contact with a fine spray of slurry droplets, as produced by the slurry spray banks. The acid components, like SO₂, HCl and HF are absorbed to a large extent in the slurry droplets and react with the limestone present in the slurry.

Above the spray section, the **MIST ELIMINATOR SECTION** is installed. This section is equipped with a two-stage mist eliminator. The lower mist eliminator stage is a coarse separator, provided with a relatively large distance between the blades, for the separation of the major part of the entrained, relatively coarse slurry droplets from the ascending flue gas flow. The upper mist eliminator stage is a fine separator, provided with a smaller distance between the blades for the separation of the fine slurry droplets and mist eliminator wash water droplets from the ascending flue gas flow. The droplets, separated from the gas flow coagulate to large droplets, which drip from the lower edges of the mist eliminator blades and fall downwards to the absorber sump.

The **SUMP OF THE ABSORBER** has many functions:

- Completion of reaction of limestone with acid components.
- Conversion of initially formed sulphite to sulphate by forced oxidation.
- Provision of enough time for limestone dissolution.
- Crystallization of gypsum from the supersaturated solution.
- Provision of residence time in order to enable sufficient growth of gypsum crystals.
- Provision of buffer volume of liquids and solids in order to stabilize the operation of the absorber during fast changes in process parameters, such as: Flue gas flow / Flue gas temperature / SO₂ inlet concentration.

ABSORBER CHEMISTRY

The overall chemical reaction between gaseous SO_2 from the flue gases with an aqueous suspension of CaCO_3 and O_2 from oxidation air to solid gypsum crystals can be described as:



This overall reaction is the result of many intermediate reactions, such as:

a. **Formation of SO_3 ions** in the slurry water phase:



b. **Conversion of SO_3 ions to SO_4 ions** by oxidation:



c. **Dissolution of limestone** in the slurry water phase:



d. **Crystallization of gypsum** from the solution:

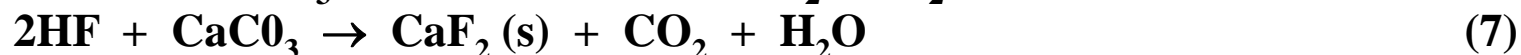


e. **Neutralization of hydrogen ions** by bicarbonate and hydroxyl ions:



ABSORBER CHEMISTRY

The other acid gas components HCl and HF react likewise with the limestone:



Most of the HCl, present in the flue gas, is absorbed in the absorber recycle slurry and forms the soluble salt CaCl_2 and is the cause of the chloride level in the absorber slurry. In order to prevent high chloride levels in the absorber, an absorber purge flow is required to remove the absorbed chlorides from the system.

Most of the HF, present in the flue gas is absorbed in the absorber recycle slurry and reacts with the limestone to CaF_2 , which is practically insoluble. This component leaves the absorber together with the gypsum and forms a minor constituent of the final gypsum product.

The absorber is not only an efficient scrubber for acid gases, also solid particles (fly ash) present in the flue gas, are removed to a large extent. The fly ash, removed from the flue gases, leaves the absorber with the gypsum and is also a constituent of the final gypsum product, lowering its purity.

From the intermediate reactions (1), (3) and (5) it can be concluded that the pH value of the absorber slurry is an important factor for the efficiency of acid gas removal.

According to reaction (1), H^+ ions are formed during the absorption of acid gases like SO_2 , HCl and HF. An increased H^+ ion concentration in the absorber slurry corresponds to lower pH values and will tend to shift the equilibrium of reaction (1) to the left, corresponding to a decreased ability of the slurry to absorb acid gases, resulting in a decrease of removal efficiency.

In order to maintain a high degree of removal efficiency, the H^+ ions must be quickly neutralized by an equivalent amount of alkalinity according to reaction (5).

ABSORBER CHEMISTRY

This alkalinity is produced by the dissolution of limestone according to reaction (3). The dissolution of limestone in water is a slow process, it depends on the following 3 factors:

- Particle size of the solid limestone particles.
A finely ground limestone dissolves faster than a coarse ground limestone.**
- Reactivity of the limestone. A reactive limestone dissolves faster than an un-reactive limestone.**
- pH value of the absorber slurry. A lower pH value leads to a faster limestone dissolution.**

From the above information, the following can be concluded:

- A high pH value is beneficial for the acid gas removal efficiency, but detrimental to the limestone dissolution rate**
- A low pH value is detrimental to the acid gas removal efficiency, but beneficial for the limestone dissolution rate**

Experience has shown, that an absorber slurry pH value of approximately 5.7 is the optimum pH value, resulting in a sufficiently high limestone dissolution rate and high acid gas removal efficiency.

The limestone slurry supply to each absorber is controlled in such a way, that the pH value of the recycled slurry remains approximately constant at normal operating conditions.

ABSORBER OXIDATION AIR INJECTION SYSTEM

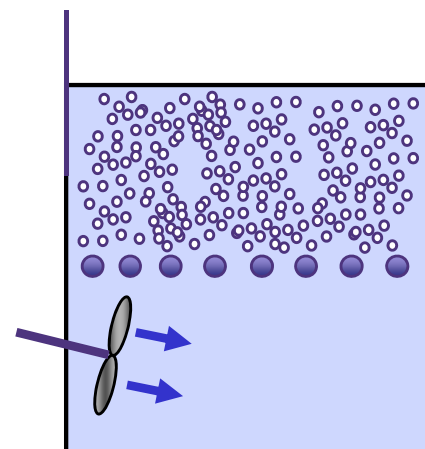
As can be concluded from intermediate reaction (2), oxygen is required for the oxidation of sulphite ions to sulphate ions.

Although a certain amount of natural oxidation can be attributed to the oxygen present in the flue gas, the sulphite oxidation occurs mainly in the absorber sump.

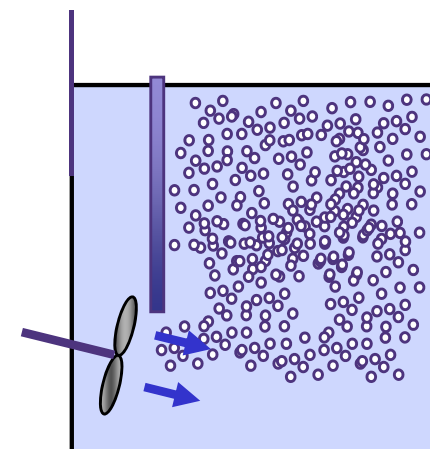
In order to obtain nearly 100% oxidation of sulphite to sulphate, each absorber is provided with an oxidation air injection system for the injection of a certain flow of oxidation air, supplied from a compressor system. The oxidation air is evenly distributed across the absorber cross-sectional area by an air injection system, consisting of: an air sparger bank of horizontally mounted pipes with drilled holes in the pipe side or a number of air lances installed in front of each agitator.

The fresh limestone slurry is added to the sump of the absorber.

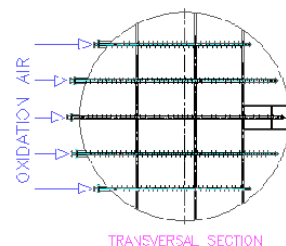
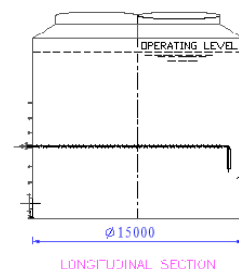
The pH value in the zone above the air sparger system is lower than the pH value of the absorber slurry in the lower part of the sump. A low pH value in the zone above the air injection system (the oxidation zone) promotes the oxidation of sulphite to sulphate.



BY AIR SPARGERS



BY AIR LANCES



Air spargers layout



Normal lances



Forced oxidation

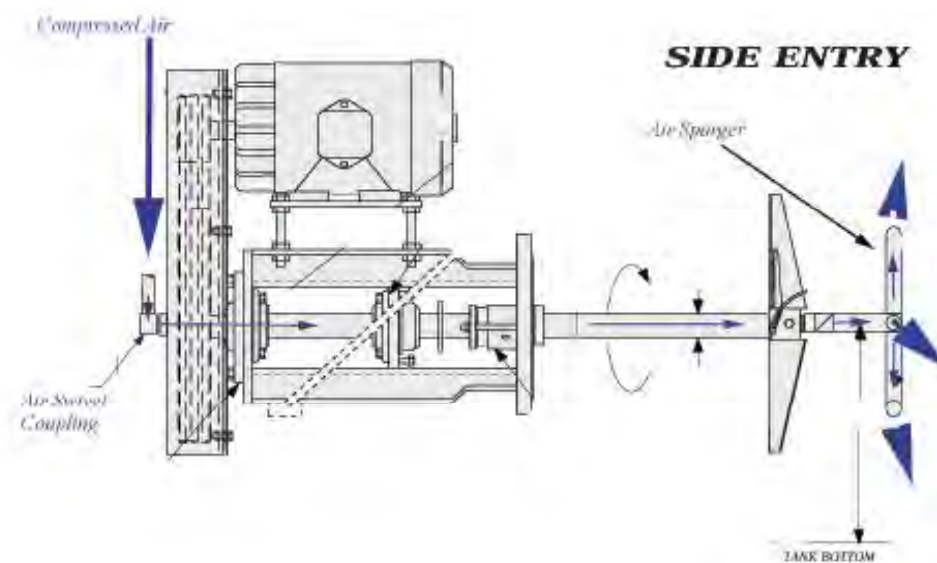
ABSORBER OXIDATION AIR INJECTION SYSTEM

The oxidation air is supplied by an oxidation air header located above the liquid level in the sump. From this header, separate air pipes run vertically downwards outside the absorber to the level of the air injection system. The air injection pipes are externally connected to the vertical air pipes. The hot compressed air is cooled down by means of a cooling water nozzles installed into the air header.

In case of use of air sparger system, each sparger pipe is provided with a shut-off valve and a flushing connection, so that each pipe can be flushed during normal operation.

In case of use of air lances system the flushing is not necessary because experience has shown that air pipe flushing is hardly required between absorber maintenance shut downs.

The liquid height above the air sparger system is derived from the required sump oxidation volume at the maximum mass flow of SO_2 to be removed from the flue gases.



ABSORBER RECYCLE SYSTEM

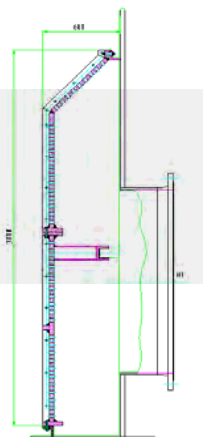
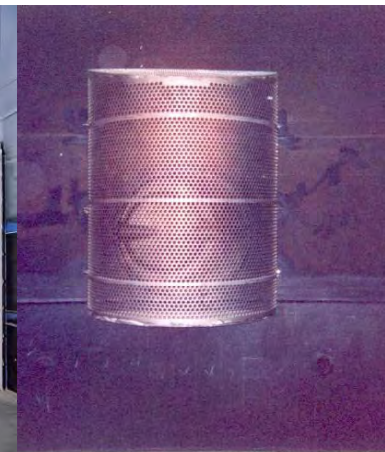
The absorber is provided with slurry recycle pumps, each connected to its own slurry spray bank. Each pump suction side is connected to the absorber sump via a suction pipe with a motor operated shut-off valve and a suction strainer. Each pump discharge side is connected to a spray bank via a pump discharge pipe.



The pump suction strainers prevent entrance of larger gypsum lumps in the spray bank system which might lead to clogged nozzles.

Each strainer is cleaned by the back flow of slurry when a recycle pump is taken out of operation.

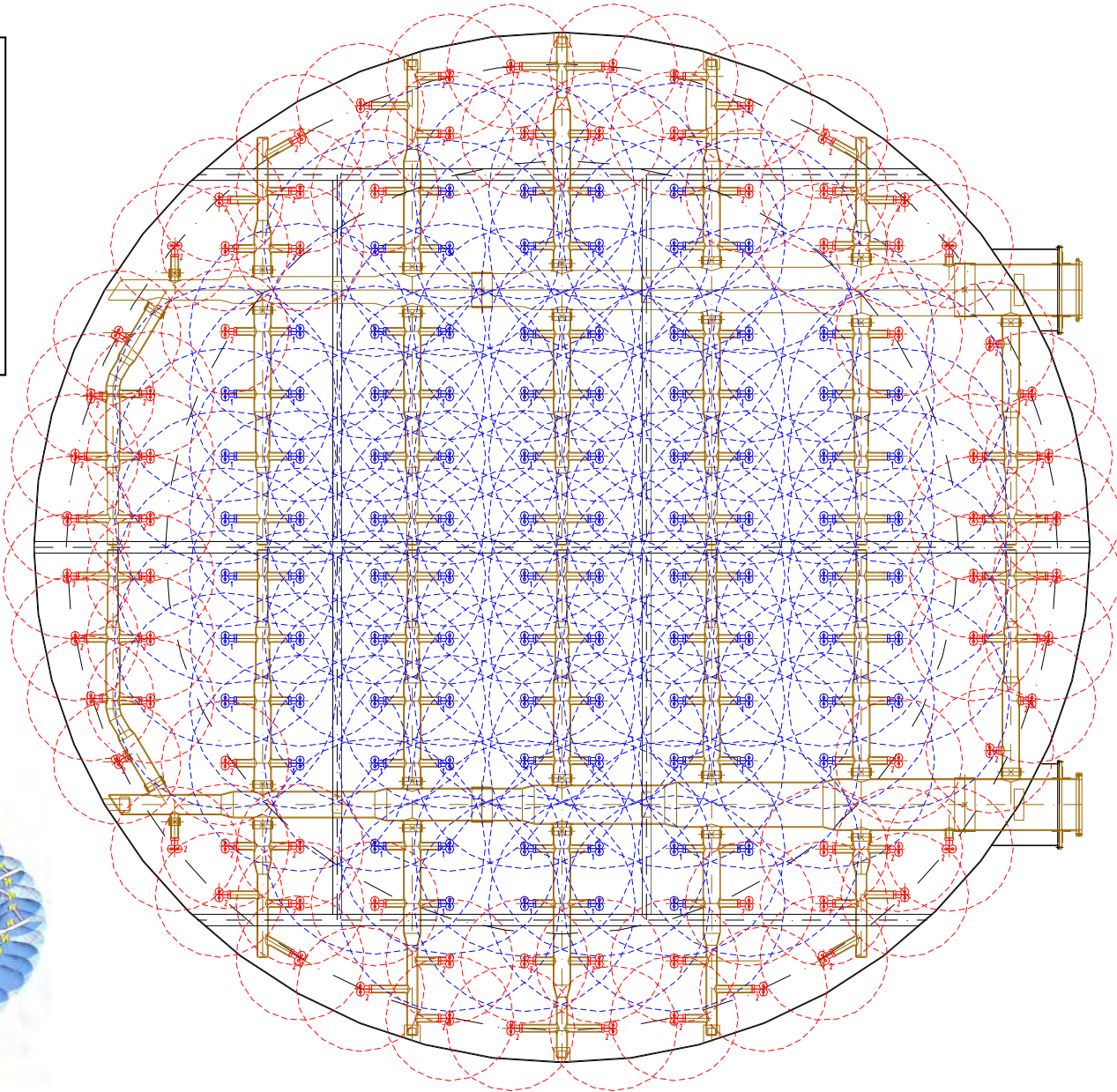
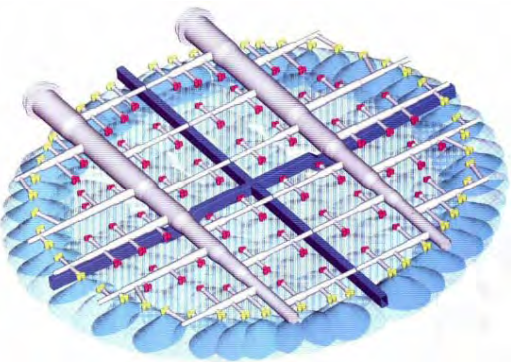
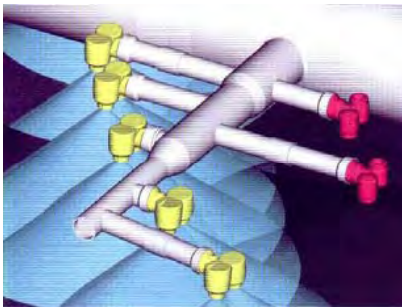
This should be done at regular intervals (e.g. once a week), also to check the proper operation of all pump safety devices. Each pump is provided with an automatically operating drain- and flushing system.



ABSORBER RECYCLE SYSTEM – THE SPRAY BANKS

Each spray bank consists of one or more main headers pipes, which feed a system of branch pipes.

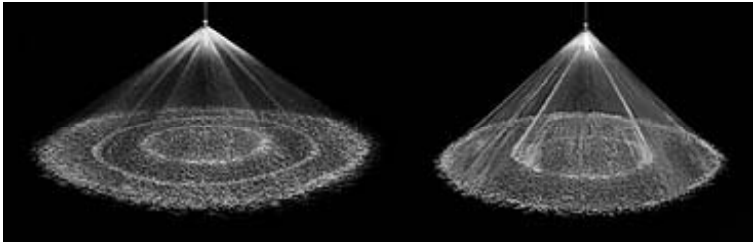
The slurry spray nozzles are mounted on the branch pipes.



ABSORBER RECYCLE SYSTEM – THE SPRAY NOZZLES

The spray bank of absorber comprises spray nozzles in sufficient quantity to ensure complete coverage of the absorber cross-sectional area. Due to the multiple spray bank arrangement and due to the rotated position of each subsequent spray bank, "dry" spots in the descending slurry spray are prevented. This results in efficient gas scrubbing.

HELIX
TYPE



120 deg.

90 deg

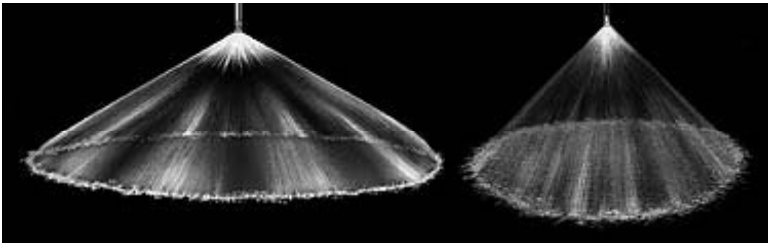
Full Cone Spray Pattern



Hollow Cone Spray Pattern



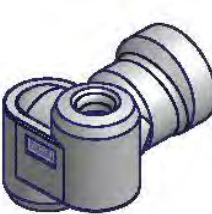
TANGENTIAL
TYPE



120 deg.

90 deg

THE LATEST GENERATION OF NOZZLES FOR FGD : THE LECHLER TWIN-ABSORB®



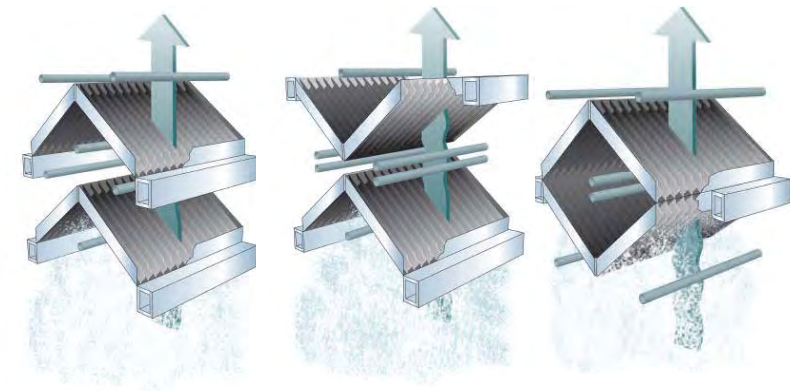
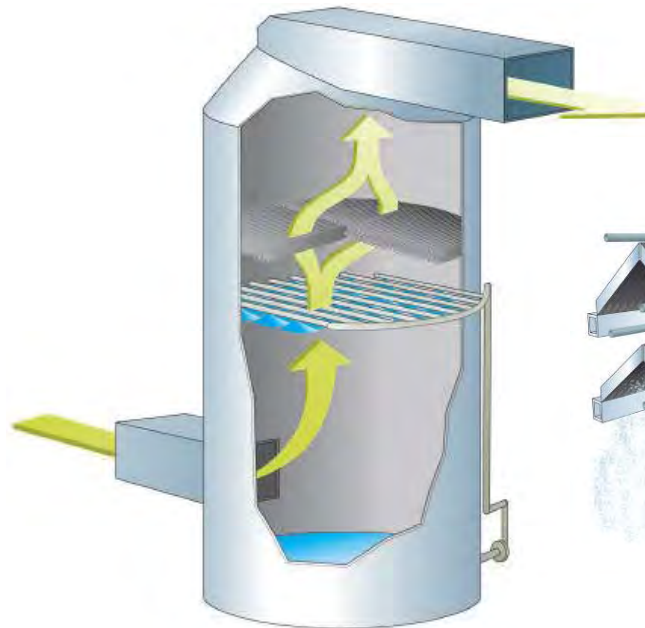
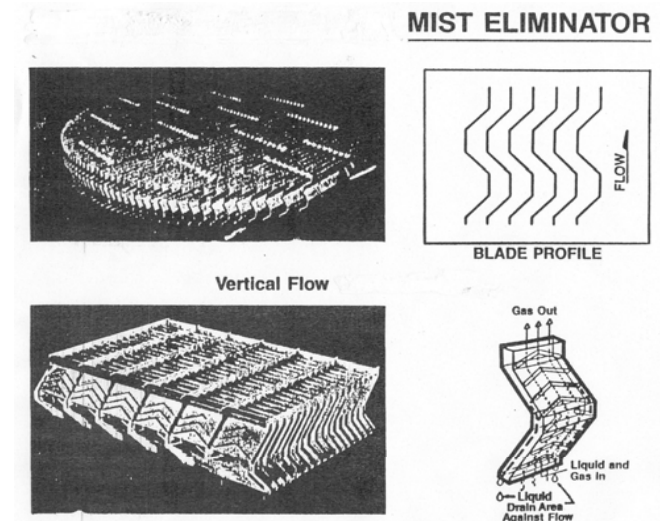
ABSORBER MIST ELIMINATOR SYSTEM

The absorber is provided with two-stage mist eliminator, in order to retain liquid droplets in the absorber. These mist eliminator stages must be cleaned regularly in order to prevent clogging due to deposition of solid material as gypsum and fly-ash.

Cleaning is effected by water wash via a spray bank system: the lower mist eliminator is provided with 2 (two) spray banks, 1 (one) below and 1 (one) above this mist eliminator, while the upper mist eliminator is usually provided with only 1 spray bank below this mist eliminator.

Each spray bank consists of a number of parallel pipes, provided with spray nozzles on equal distances. The nozzle pattern ensures complete coverage of the mist eliminator surfaces. Each spray pipe of a spray bank is provided with a pneumatic cylinder operated on/off valve, and only 1 (one) spray pipe is activated at the same time. All on/off valves are connected to a programmable timer mechanism, enabling adjustment of spray pipe activation sequence, and the duration of the spray time.

Each spray pipe is activated for approximately 2 minutes, then its on/off valve is closed again. After a certain pause time, the next on/off valve, according to the sequence, is opened for 2 minutes. This system cleans the mist eliminator surfaces in sections with a high intensity of wash water.



ABSORBER MIST ELIMINATOR SYSTEM

The mist eliminator wash water is also the absorber make-up water which is lost by the following causes:

- Evaporation of water from the absorber slurry due to the cooling and saturation with water vapour of the flue gases during the passage of the absorber.
- Absorber purge flow for the removal of chlorides.
- Crystal water and the residual moisture in the dewatered gypsum product
- Entrainment of liquid water by the clean gases leaving the absorber, although this loss is very small.

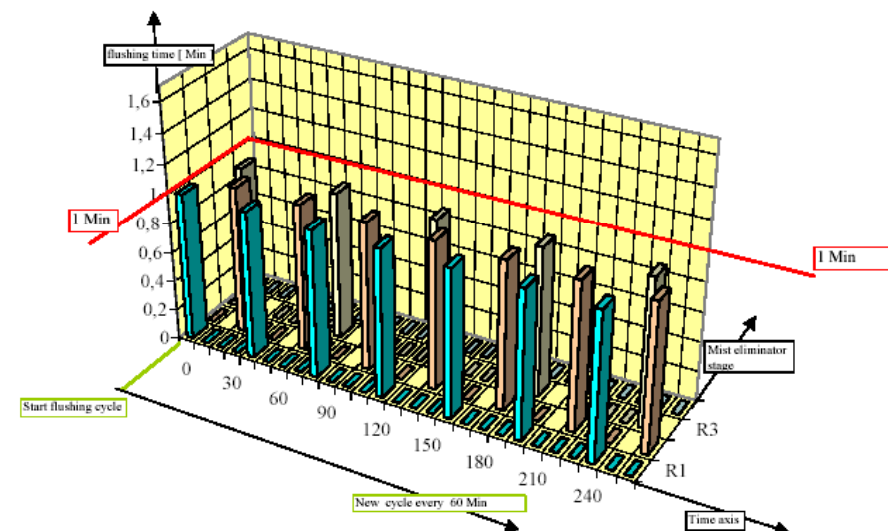
The absorber is also supplied with water from the following sources:

- Water in the limestone slurry fed to the absorber
- Vacuum belt filter cake wash water and basket rinse water which is fed to the absorbers producing product gypsum via the circuit water system.

The losses are much more than the supplies; therefore make-up water is to be supplied to the absorber in order to maintain the water balance. This make-up water is supplied as mist eliminator wash water.

The absorber make-up water flow (mist eliminator wash water flow) is controlled by the absorber level control system. This level control system adjusts the pause time between the subsequent activations of the mist eliminator spray bank pipes.

At high boiler loads and high flue gas temperatures more make-up water is required, resulting in reduced pause times in the mist eliminator wash cycle; low boiler loads and low flue gas temperatures will result in increased pause times.



ABSORBER BLEED & GYPSUM CYCLONES

The absorber removes SO_2 from the flue gases and produces gypsum. Obviously, the produced gypsum must be removed from the absorber, otherwise the gypsum would accumulate in the absorber, leading to an absorber slurry with a high concentration of suspended solids. The normal average suspended solids concentration in the absorber slurry is about 15.0 wt%, but slightly lower or higher concentrations do not interfere with the proper absorber operation.

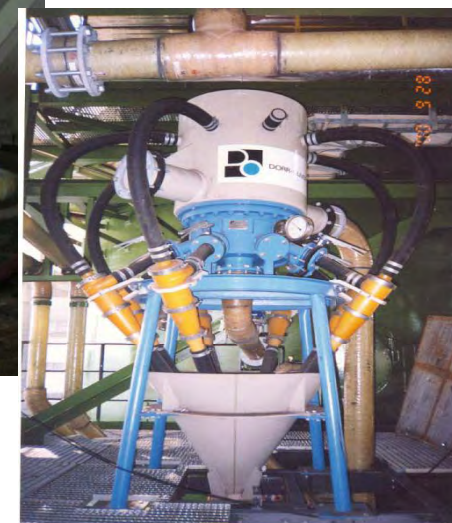
It is the task of the absorber bleed system to remove the actual gypsum production in each absorber.

The bleed system consists essentially of an absorber bleed pump and a gypsum cyclone battery, supplied with absorber slurry by the absorber bleed pump.

This system is operated at a fixed capacity, which is larger than the maximum gypsum production of the absorber. The gypsum suspension flows through a main ring. In case the hydrocyclones are not ready, the gypsum suspension is discharged back into the absorber.



The system operates as described below:



The gypsum cyclone battery comprises a multiple cyclone arrangement, complete with feed distributor and overflow collector.

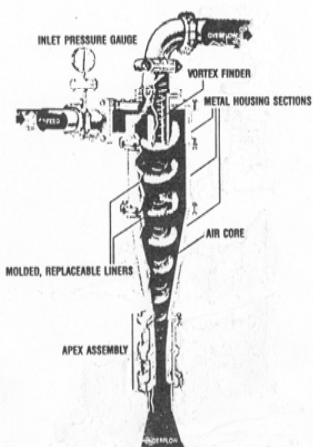
The cyclones are fed with absorber bleed at a constant pressure and hence at a more or less constant feed flow with a suspended solids concentration of approximately 15 wt%.

ABSORBER BLEED & GYPSUM CYCLONES

The cyclones split the feed flow in a cyclone underflow with a suspended solids concentration of approximately 50 wt% and a cyclone overflow with a suspended solids concentration of approximately 3,5 wt%. The underflow of the cyclones is collected in the gypsum slurry distribution tank and then flows to the vacuum belt filters.

The cyclone overflow is collected in the gypsum hydrocyclones overflow tank and most of it flows back to the absorber. A part of this collected overflow is pumped to the 2nd hydrocyclone. The overflow of this hydrocyclone, containing a small quantity of solids, is sent to a waste water treatment plant for the purpose of discharging fly ash, inerts of the limestone and chlorides; the underflow, containing larger particles of limestone and gypsum, is recovered to the absorbers.

HYDROCYCLONE SOLIDS SEPARATOR

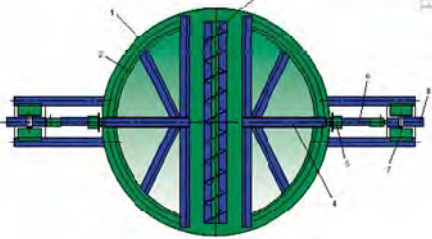
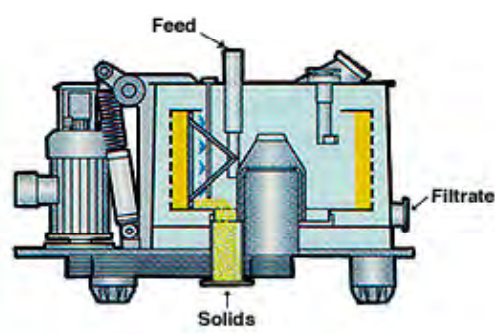
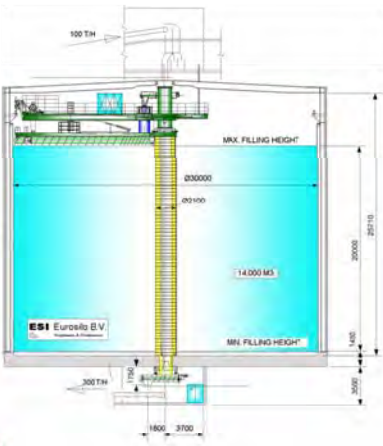
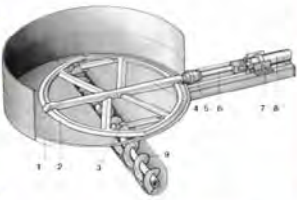
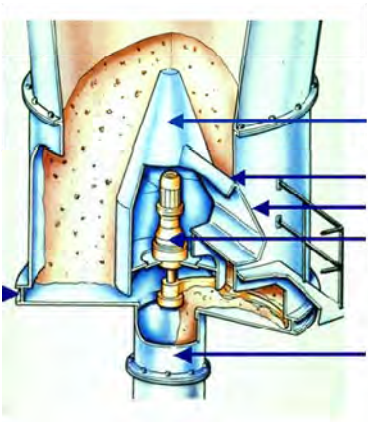
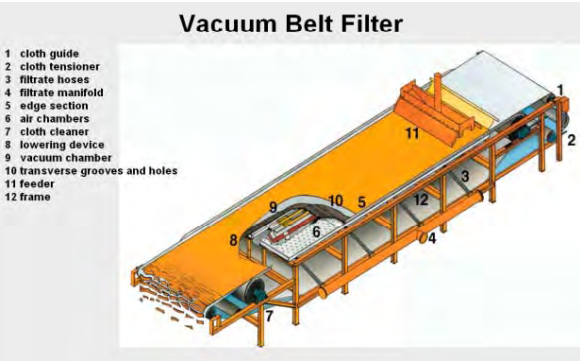


The function of the gypsum cyclone battery is 3-fold:

- Increase of suspended solids concentration in the absorber slurry to the proper vacuum belt filter feed concentration.
- Classification of the suspended solids in the absorber feed slurry. The coarser, heavier particles leave the cyclones with the underflow, while the smaller, lighter particles leave the cyclones with the overflow, which is returned to the absorber for further growth of the small particles.
- Separation of the small limestone particles still present in the absorber bleed slurry. These fines are returned with the overflow to the absorber for further utilization in the desulphurisation process; the limestone concentration in the concentrated slurry to be transferred to the gypsum dewatering is therefore lower than in the absorber slurry.

This improves both the purity of the final gypsum product and limestone utilization.

GYPSUM DEWATERING



Patent Sliding Frame with two moveable elements
Pat.-No. 4403986

The underflow coming from the first hydrocyclone is collected by gravity to the gypsum slurry distribution tank and then to two vacuum belt filters where gypsum is dewatered to a moisture content less than 10 % mass.

Gypsum washing is done in the vacuum belt filters with addition of process water.

The filtrate of the vacuum belt flows to the recovered suspension tank which supplies the absorber with additional water.

Also use of vertical centrifuges is possible in specific cases to have gypsum with less moisture content than the one produced by the vacuum belt filters.

The dried gypsum is then stored in gypsum silos equipped with special extraction systems or in a storehouse.

From the above storages the dried gypsum is finally loaded to trucks for sales.



LIMESTONE PREPARATION



Limestone powder is normally stored inside a silo, which includes dust removal device, fan, duct.

The limestone powder is extracted from the silo by means of a dosing rotary valve into the limestone suspension preparation tank, where industrial water is added.

The tank is completed by side entry or vertical agitator which assures the complete mixing of powder with water.

After mixing, the limestone slurry, with a concentration of approx 30% is delivered to the absorber by means of slurry pump and distribution ring.

Limestone Slurry can be also prepared starting from big stones, unloaded at site from trains or trucks which are firstly grinding using dry mills and then by wet ball mills for the direct preparation of the slurry.

Slurry pipelines are designed in such way that under any condition no sedimentation can take place.



THE SCIENCE OF A PURE ENVIRONMENT



LIMESTONE SLURRY TRANSPORTATION
Distance = 1200 m. Shajiao C 3x660MW Units



HEAT EXCHANGER CONSIDERATIONS

ADVANTAGES AND DISADVANTAGES OF USING HEAT EXCHANGER

Flue gas heat exchanger is needed to increase the temperature of the treated flue gas leaving the absorber before the gases are discharged to the atmosphere.

The main reasons to use flue gas reheat are the following:

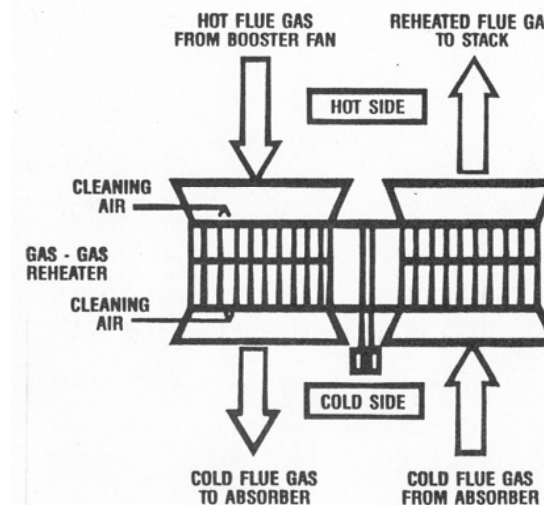
- to improve the dispersion of pollutants into the atmosphere (higher)
- clean gas temperature increases the plume's buoyancy, as a result of a higher plume rise and better dispersion of flue gas.
- to reduce the visible plume (reduction in the plume visibility depends also on ambient temperature and wind conditions).
- to avoid liquid droplet rainout from the stack (increasing clean gas temperature promotes evaporation of small droplets at the demister outlet and minimizes condensation on the duct walls).
- to avoid corrosion problems on downstream materials.

The most used system to reheat the clean gases is the regenerative reheat system (Ljungstrom), which removes part of the heat from the raw flue gas upstream of absorber and transfer that energy to the treated flue gas. Heat exchangers reduce the temperature of the flue gas entering the absorber and reduce both the adiabatic saturation temperature of the flue gas and the rate of evaporation in the absorber; therefore the water consumption is reduced.

The main disadvantage in using heat exchanger is a pressure drop increasing and consequently a higher booster fan power consumption.



REGENERATIVE REHEATER
LJUNGSTROM TYPE



HEAT EXCHANGER CONSIDERATIONS

COMPARISONS BETWEEN ROTARY TYPE GGH AND TUBE TYPE

The regenerative gas-gas heater is a heat exchanger through which untreated gas and treated gas pass in counter-current flow.

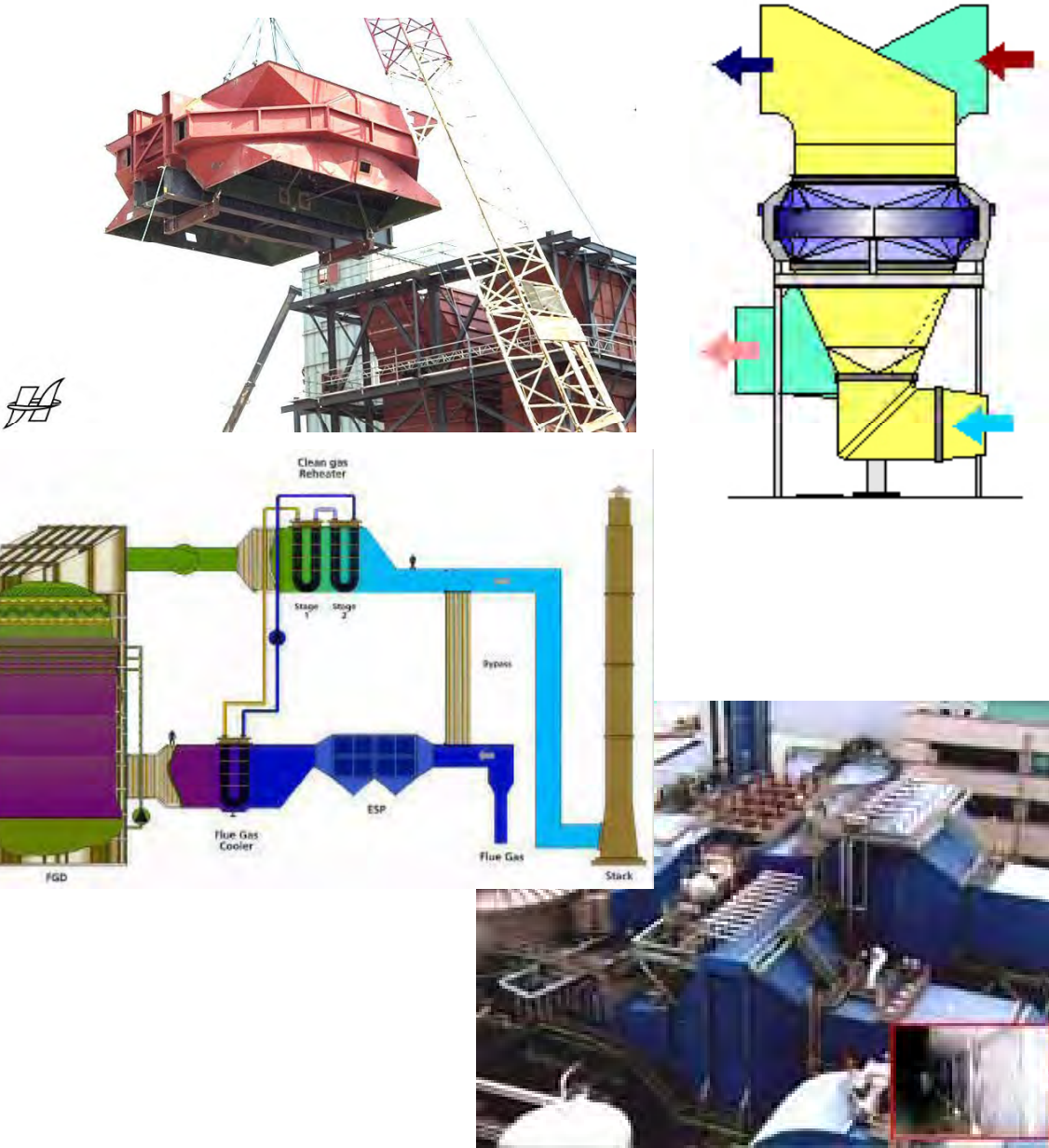
The regenerative heat exchanger does not require any additional energy as the heat content of the untreated gas is utilized to reheat the treated gas

Studies have shown that, for FGD plants operating times in excess of 3000 hours per year and more than 20 °C reheat, the regenerative GGH is the most economic system available for the gas reheat.

In the regenerative heat exchanger the heat transfer surface comprises thin profiled elements, made of enameled carbon steel, which are contained in a rotor and arranged parallel to the flow. Since the rotor rotates at a constant speed, some leakage of raw gas to the clean gas occurs and decreases the overall SO2 removal efficiency of the FGD system; to reduce leakage to less than 0,5 % improved radial seals are installed and sealing air is injected.

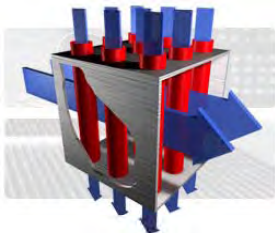
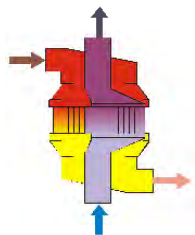
Shell and tube heat exchangers have two sets of exchangers, with water as a heat transfer fluid pumped through them; because there is no direct connection between the inlet and outlet ducts there is no flue gas leakage.

Pipe material is usually special plastic as well as Teflon.



HEAT EXCHANGER CONSIDERATIONS

Comparison between
The two types of exchanger

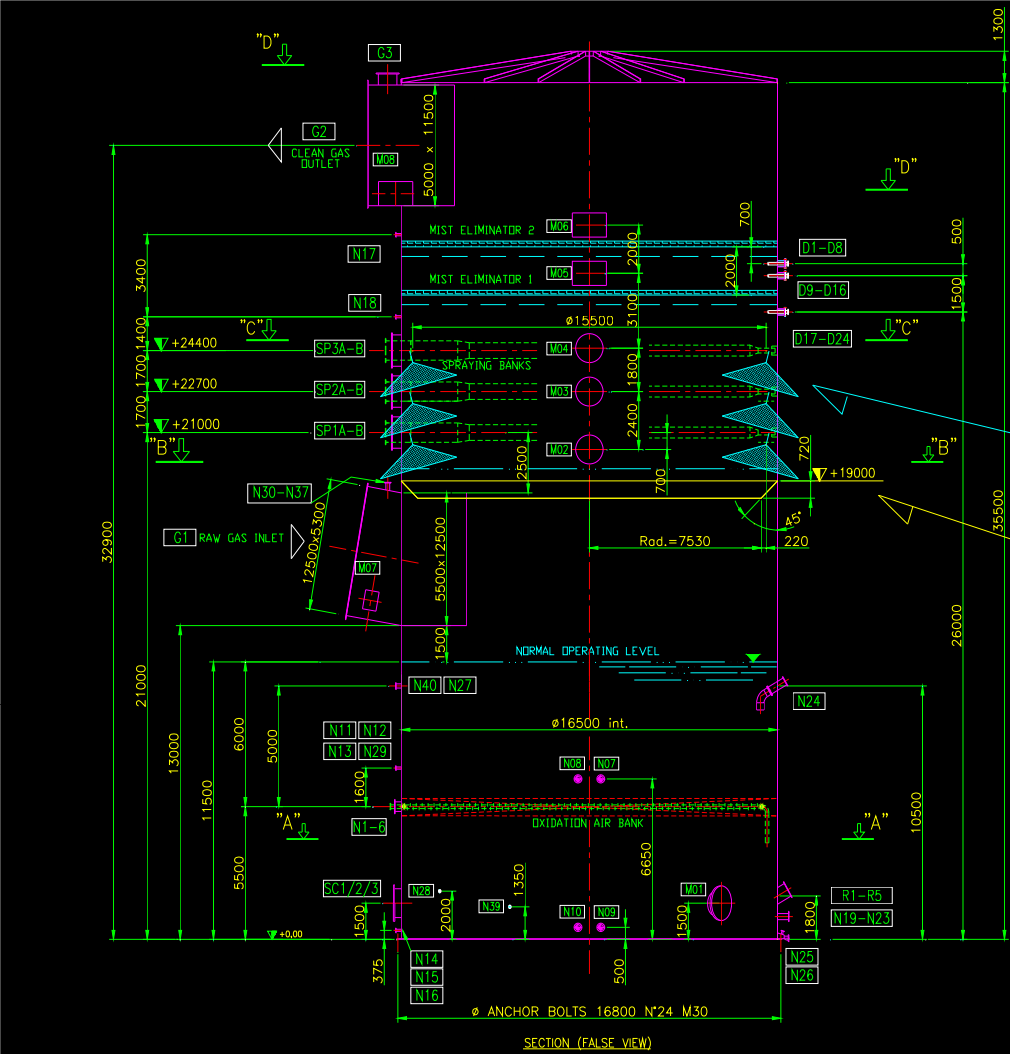


	REGENERATIVE GGH	SHELL AND TUBE EXCHANGER
OVERALL DIMENSIONS	More compact	Less compact
LEAKAGE	Low	None
PRICE	Lower	Higher
FLUID COMPOSITION	None	Water
RAW GAS PRESSURE DROP (mbar)	4 - 5	4 - 5
CLEAN GAS PRESSURE DROP (mbar)	4 - 5	4 - 5
EQUIPMENT REQUIREMENTS	GGH only	Pipes to connect 2 heat exchangers plus circulating water pumps and chillers

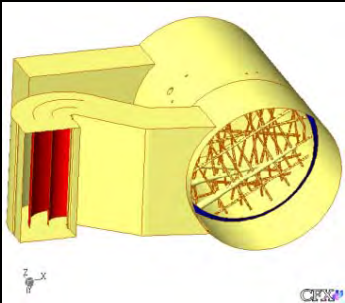
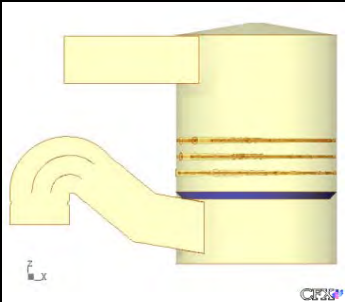
HARMONIC UNIFORMITY BETWEEN THE HIGHER DESULPHURIZATION EFFICIENCY AND LOWER ENERGY CONSUMPTION

Fluid dynamics computation allows to optimize the absorber and gas duct size and shape, so that gas pressure drops along the FGD plant are minimized. Therefore, booster fan power consumption is also optimized.

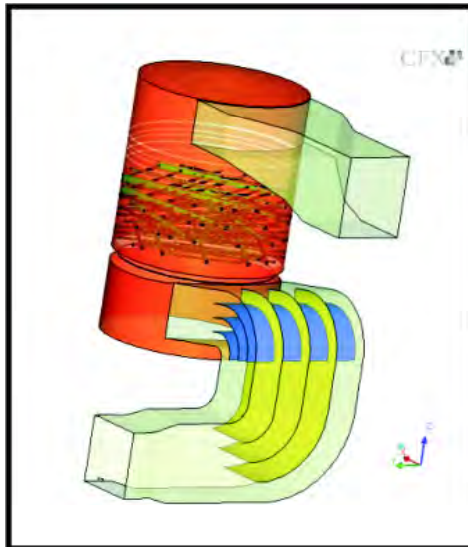
The number of recycle pumps is selected to minimize the power consumption to operate in function of the effective SO₂ amount in the absorber inlet raw gases.



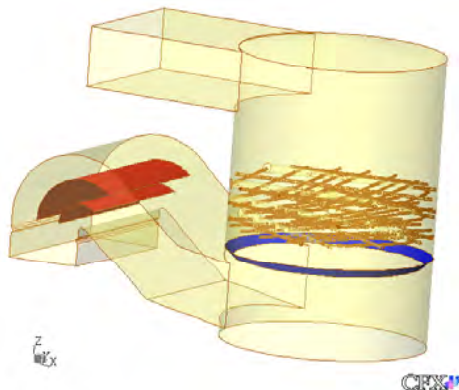
EXTERNAL CIRCLE
FULL CONE
SPRAYING NOZZLES
DEFLECTOR RING



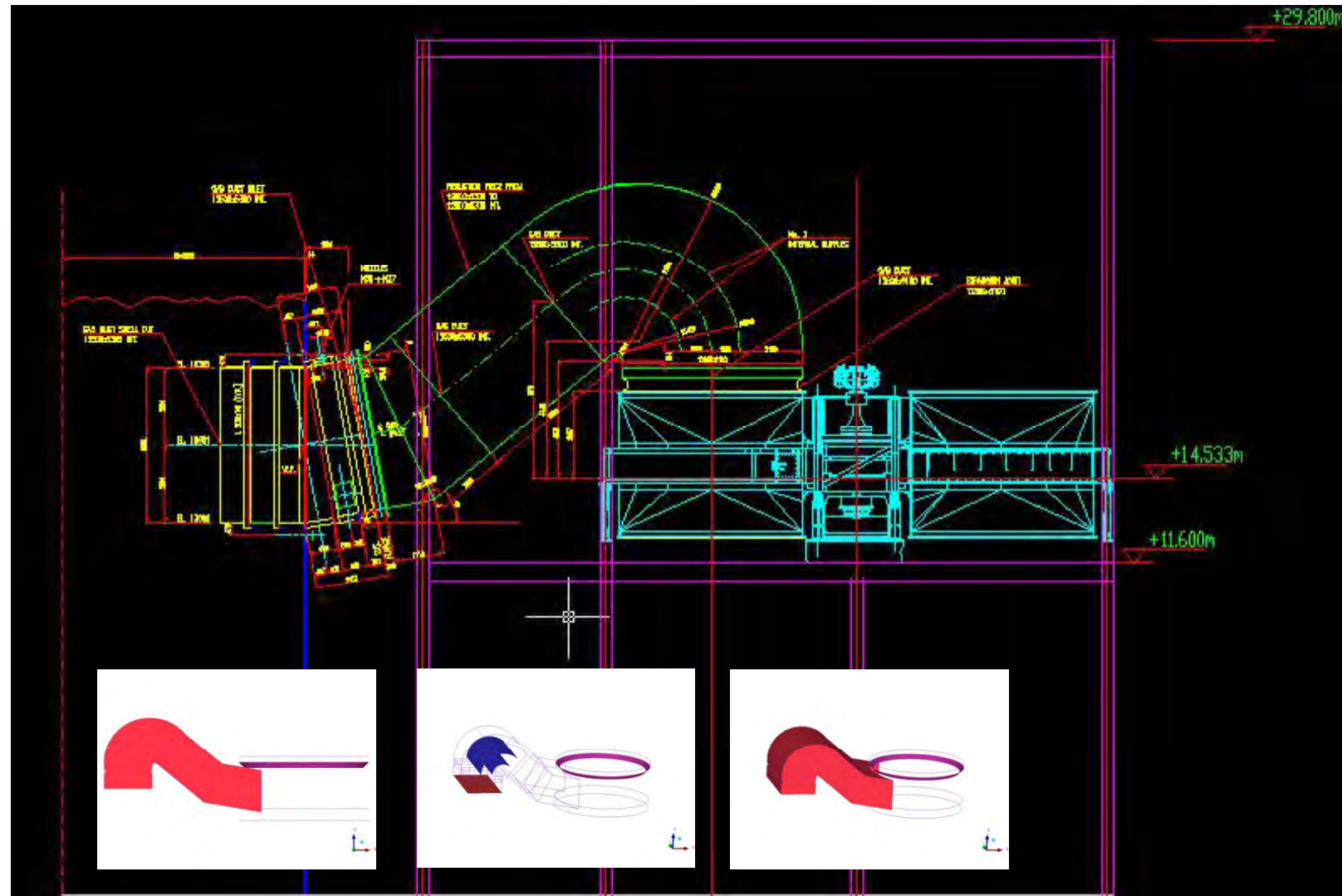
HARMONIC UNIFORMITY BETWEEN THE HIGHER DESULPHURIZATION EFFICIENCY AND LOWER ENERGY CONSUMPTION

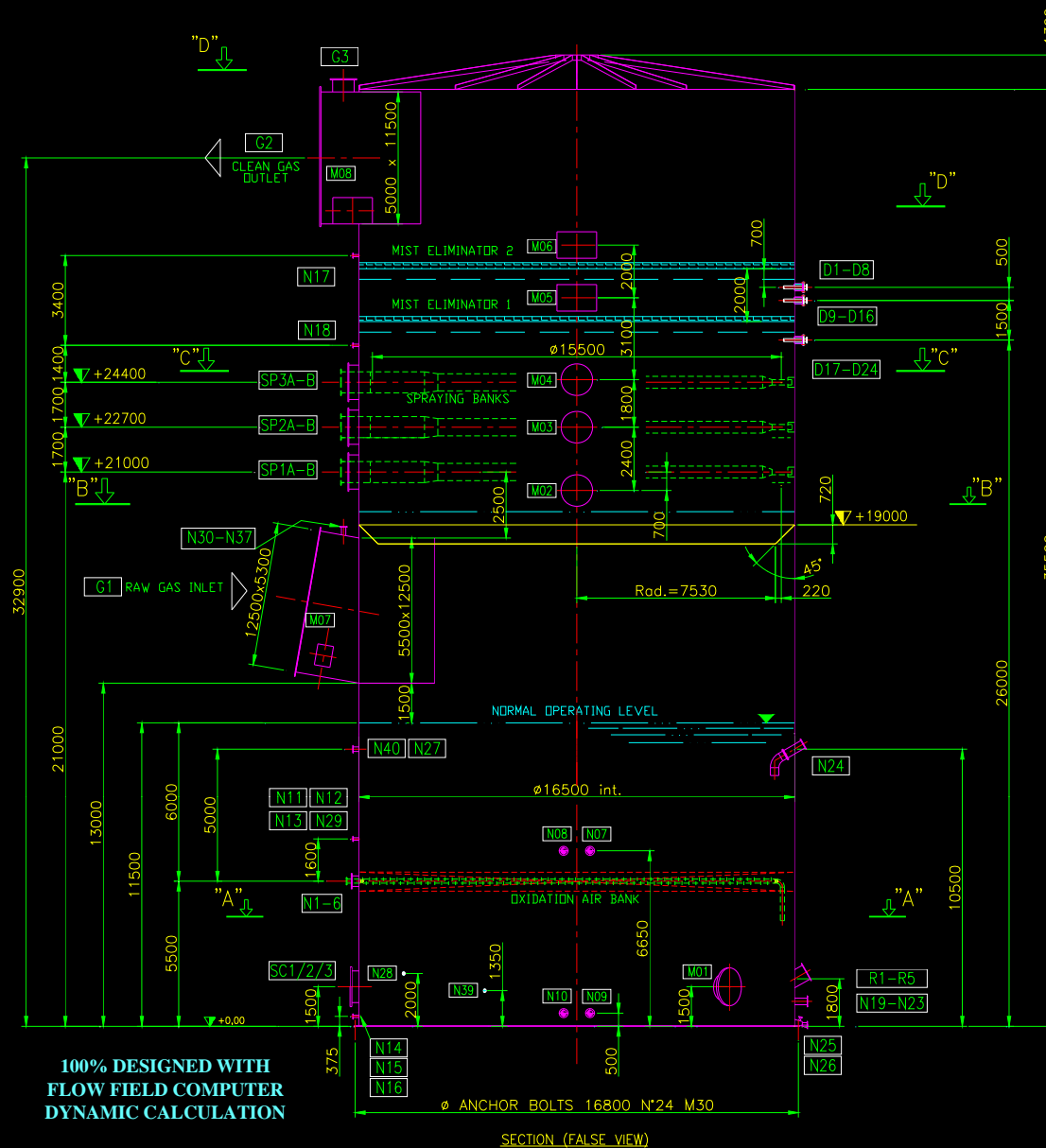
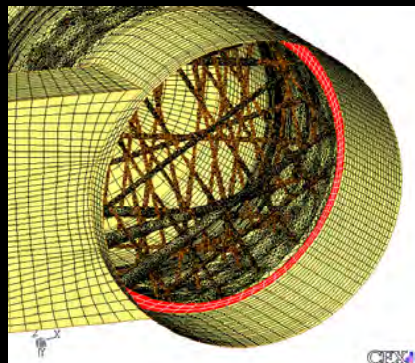
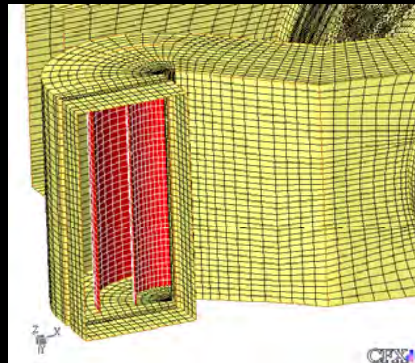


GAS DUCT INLET WITH OUT GGH



GAS DUCT INLET WITH GGH

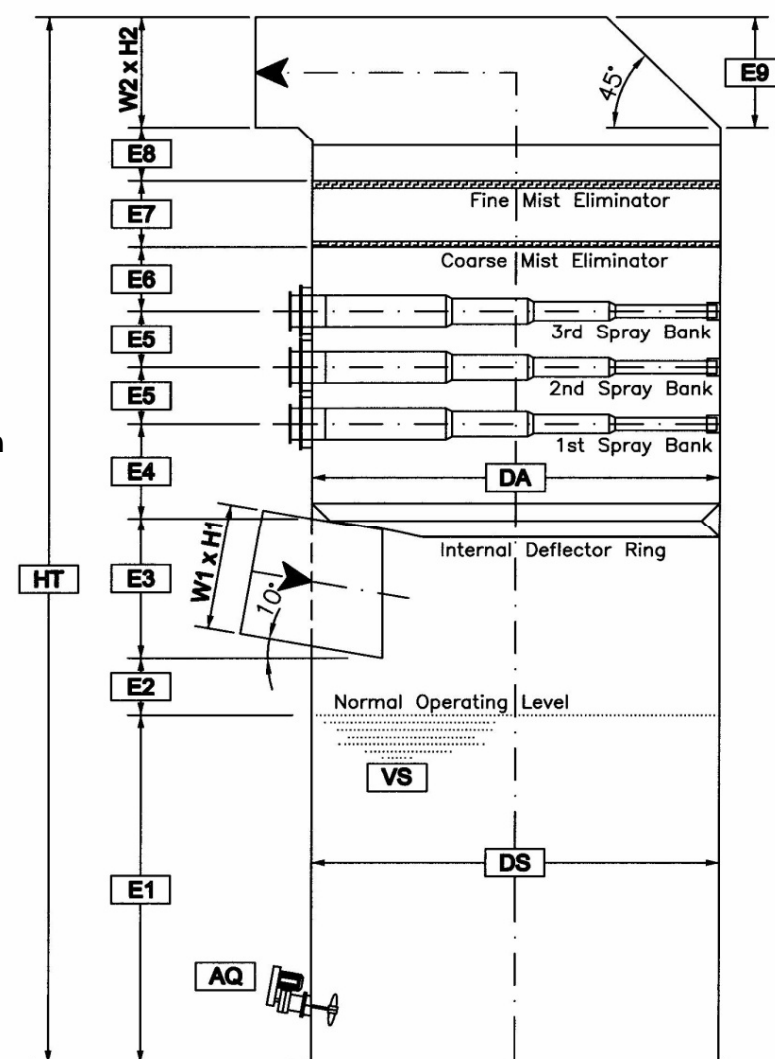




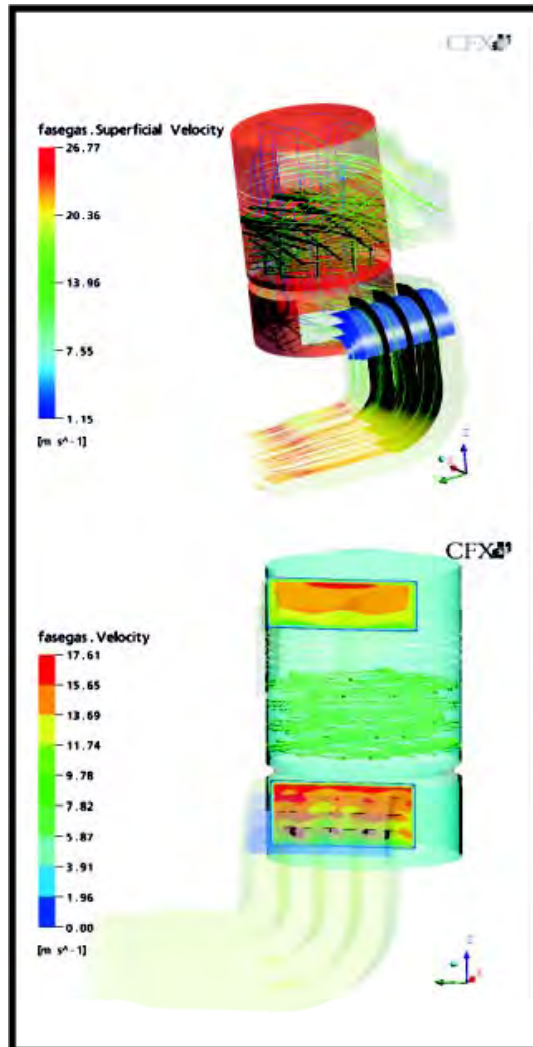
DESIGN CHARACTERISTICS OF THE ABSORBERS

HEIGHT OF ABSORBER

- E1.** Height of the sump: in function of the retention time of the recirculated slurry in the sump, usually around 4 minutes.
- E2.** Free space between the liquid level in the sump (H1) and the bottom of the inlet gas duct, usually 1800 mm.
- H1.** Height of inlet gas duct. It is selected in function of the dimensions of the gas duct at GGH outlet and is sized to have a flue gas velocity at the absorber inlet of approx. 12-16 m/s.
- E4.** Height of absorbing area: Distance between the top of the inlet duct and the centerline of the upper spray bank. Usually it is considered a space between the top of the inlet duct and the centerline of the first spray bank of approx 3000 mm.
One internal ring, internally installed, will increase the uniform flow distribution along the section of the absorber, before the first spray bank.
- E5.** The distance between two spray banks depends on the diameter of the single bank, which depends on the recirculation pump flowrate and on the geometry of the cone made by the nozzles; usually it is 1800 mm.
- E6.** Free space between the last spray bank and demister is approx. 2000 mm.
This space allows to have a uniform flow distribution before the demister zone.
- E7.** Demister zone: it is selected by the demister manufacturer, included the space for the demister washing pipes.
- E8.** Free space between demister and bottom of the outlet duct: usually approx. 1700 mm.
This space allows to have a uniform flow distribution after the demister.
- H2.** Height of outlet gas duct: Selected in function of the dimensions of gas duct at GGH inlet and is sized to have a flue gas velocity at the absorber outlet of approx 12-16 m/s.



DESIGN CHARACTERISTICS OF THE ABSORBERS



**100% DESIGNED WITH
FLOW FIELD COMPUTER
DYNAMIC CALCULATION**

SPRAY NOZZLES

Idreco technology uses tangential nozzles which produce a full or hollow cone spray patterns. The fluid full cone shape allows to cover a high specific surface and to produce a large number of very fine droplets in order to reach an elevated liquid surface area for improving the gas/liquid mass transfer. Droplet mean diameters for the slurry spray nozzle are typically between 2000 and 2500 μm ; this value allows the perfect contact between raw gases and slurry and optimizes liquid to gas ratio. The nozzle working pressure is around 0,5 – 0,7 barg of liquid column, so that the recycle pump head and power absorption can be optimized. Idreco has specifically designed the distribution of nozzle inside the absorber so that a complete spray coverage is achieved.

pH VALUE

Typical operating pH value is around 5 – 6. Optimum value is 5.7

LIQUID GAS RATIO

Liquid gas ratio amount expresses the surface area of droplets which come in contact with flue gas. The selection of L/G ratio depends mainly on the following parameters:

- SO₂ concentration in the flue gases at the absorber inlet
- SO₂ requested removal efficiency.

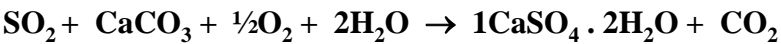
Ca/S RATIO

Limestone utilization is very high. Limestone consumption can be assumed to be 2 – 3 % higher than the stoichiometric value.

DESIGN CHARACTERISTICS OF THE ABSORBERS

OXIDATION AIR FLOW

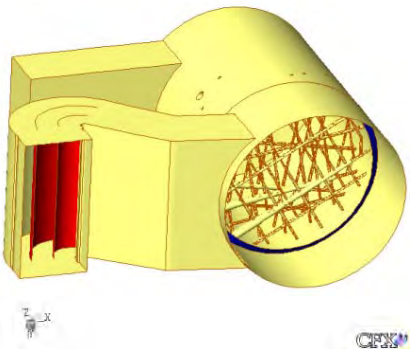
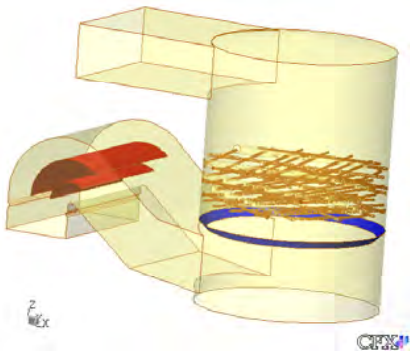
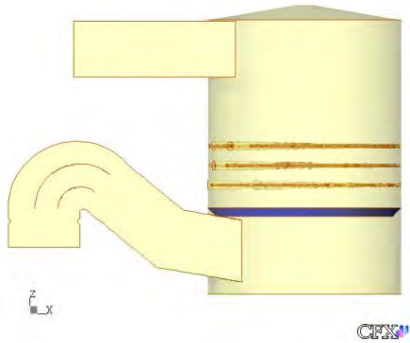
Oxidation air flow is calculated in function of the overall chemical reaction:



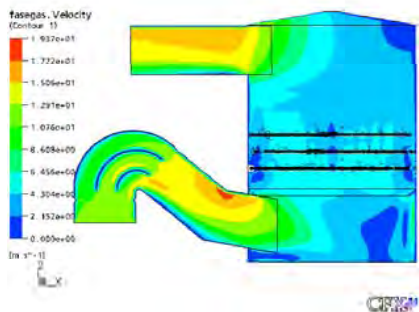
The air consumption can vary from 2,3 to 3 times the stoichiometric value. This value can also depend on the requested final gypsum quality.

SLURRY CONCENTRATION

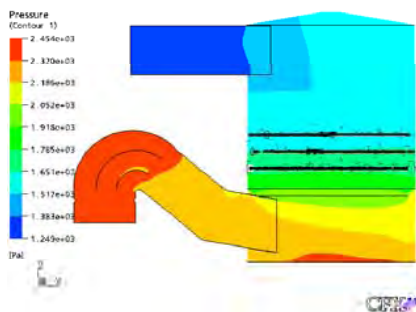
Solids concentration in the slurry is typically maintained at 12 to 20 percent solids by weight. It is controlled by removing a part of the slurry from the reaction tank for subsequent dewatering. Proper solids concentration in the slurry is necessary to ensure scale-free operation of the absorber. Correct solids retention time in the reaction tank is essential to achieving high utilization of limestone and maintaining correct handling and dewatering properties of solids.



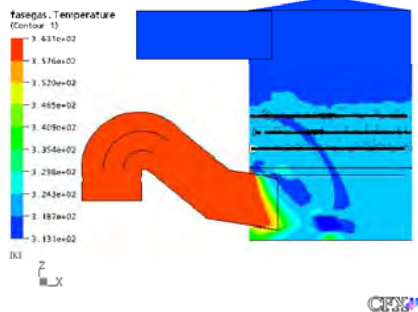
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DYNAMIC CALCULATION



VELOCITY



PRESSURE



TEMPERATURE

Technical measures taken to assure the safe operation of the absorber

Emergency Cooling System

Emergency cooling system is foreseen to cool the absorber inlet flue gas in case any emergency situation can occur, such as a failure of the electrical supply (slurry recycle to spray banks is prevented) or a failure in the GGH rotation. Emergency cooling system is needed to avoid any damage to temperature sensitive absorber internals such as linings and mist eliminators blades.

Emergency cooling system is designed according to the maximum possible inlet temperature for a timing of approx 5 minutes, time sufficient to open the by pass damper and close the raw gas and clean gas dampers.

Emergency cooling system consists of emergency cooling tank, positioned in the upper part of the absorber, of relevant pipes and automatic valve, and a series of spray nozzles installed inside the absorber inlet duct. Spray nozzle displacement is opportunely studied to achieve an uniform distribution of water along the duct section.

Selection of absorber materials

Absorber materials are selected to take into account the severe working conditions to which they are submitted.

- Inlet gas duct is made of Hastelloy C 276.
- Absorber can be either all internally rubber lined, or all glass flake lined, or full metal.
- Alternatively, rubber can be used in the lower part of the absorber (sump zone) whereas the absorbing zone can be either rubber lines, metal lined by Hastelloy cladding or full metal.

Prevention against scaling

Scaling is avoided checking the correct solids concentration in the slurry in a range of 12 – 20% and then in the reaction tank which is located in the lower part of the sump. A series of agitators are located inside the sump and assure the perfect agitation of the slurry into the sump avoiding any solids sedimentation.

Blowing air is injected inside the sump to promote controlled oxidation of calcium sulfites to calcium sulfate and to obtain rapid calcium sulfate crystal growth on seed crystals. Forced oxidation minimizes scaling in the absorber and also results in slurry that can be more easily dewatered.

Prevention against clogging

Nozzle clogging cannot occur since liquid flow is counter current to gas flow. Usually, nozzle are tangential cone type which has free passage equal to 40 mm. Alternatively spiral nozzles, with free passage equal or higher than 25 mm can be also used.

Furthermore, into the absorber the suction zone of the recycle slurry pumps is provided of one screen with 20 mm diameter holes; this avoid to re-circulate solids with big dimensions to the spray nozzles.

Technical measures taken to assure the safe operation of the absorber

Prevention against flue gas short cut

Absorber geometry is optimized to avoid any flue gas short cut; fluid dynamics computation is used to verify the perfect and uniform distribution of velocity along all the height of the absorber; absorber inlet and outlet gas ducts working is also investigated.

If necessary, after the preliminary fluid dynamics study, some special deflectors inside the absorber or/and in gas ducts can be installed to improve the flow conditions.

Wide variation of the sulphur content in the coal

Sizing of the absorber recycle pumps is made taking into account the worst possible working conditions, i.e. check coal conditions; in that way the guarantee parameters of SO₂ removal efficiency can be achieved under any conditions.

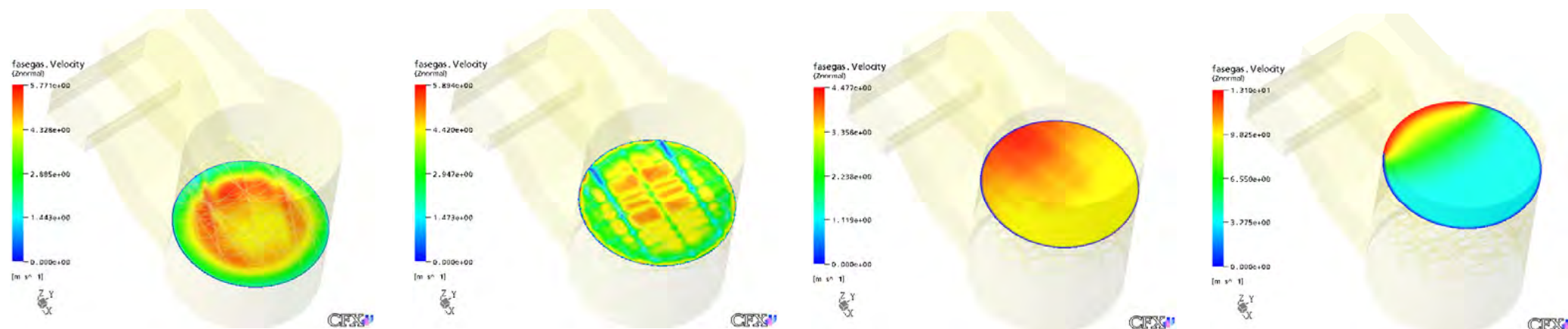
If the sulphur content in the check coal is greatly different from the normal exercise conditions (ie design coal conditions) it is better to foresee one or more spare spray banks (and then one or more relevant recycle pumps) which can be started when an high SO₂ content occurs at the absorber inlet.

In that way in normal conditions, in order to reduce the power consumption, only the requested recycle pumps will be in operation.

Eventually a suitable software can be supplied to optimize the recycle pumps utilization.

FGD adapting to changing working conditions

Idreco FGD system can follow automatically any different working conditions, changing the limestone consumption (to maintain a certain set value of pH inside the absorber) and the mist eliminator washing timing.



THE ADVANTAGES OF IDRECO WET FGD TECHNOLOGY

- **High separation efficiency**
- **Limestone consumption close to stoichiometric ratio**
- **Reduced Space requirement resulting from compact construction**
- **Scrubbing tower complete with integral absorption, oxidation, crystallizing and mist separator stage.**
- **Plug-proof scrubber construction. No packing grids, nor tray or other similar devices to increase the contact surface between liquid and gas are foreseen in Idreco FGD technology.**
This solution avoids any encrusting during operation, therefore frequent and heavy maintenance is not required.
- **Trouble free equipment start-ups and shut-downs**
- **Complete gas desulphurisation within 10-15 minutes from equipment start-up**
- **The system is very flexible and accepts quick increasing of gas flowrate and of SO₂ inlet content.**
- **Production of valuable gypsum ready for sales.**

HIGH RELIABILITY BY INSTALLING A THOROUGHLY PROVEN FGD DESIGN

*I-DeSOx[®] the proprietary software for the process calculation
of Flue Gas Desulphurisation plants with IDRECO WFGD wet limestone/gypsum technology*



Multilanguage Internet Web interface



*I-DeSOx[®] the proprietary software for the process calculation
of Flue Gas Desulphurisation plants with IDRECO WFGD wet limestone/gypsum technology*

I-DeSOX - Data Input - Microsoft Internet Explorer

Indirizzo: <http://idesox.idreco.com/input.asp?BID=bid3>

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Tel +39 0383 3371 - Fax +39 0383 369052 - e-mail: info@idreco.com - web: www.idreco.com

I-DeSOx[®]

Project	bid3	
项目		
New Revision	7	
新修订		
Plant Name	Prova	
工厂名		

GENERAL DATA / 通用数据

Altitude	10	m
海拔		
Atmospheric pressure	1013	mbara
大气压力		
Ambient air temperature	25	° C
外部空气温度		
Ambient air relative humidity	50	%
外部空气相对湿度		

GAS DATA / 烟气数据

Dry flue gas flowrate		Nm ³ /h
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Operazione completata

Start | Eudora - [In] | FGD for USA market | Microsoft PowerPoint - [...] | Jasc Paint Shop Pro | I-DeSOX - Data Input ... | 17.08

User-friendly Process Data Input form




*I-DeSOx[®] the proprietary software for the process calculation
of Flue Gas Desulphurisation plants with IDRECO WFGD wet limestone/gypsum technology*

I-DeSOx - Project Home Menu - Microsoft Internet Explorer

File Modifica Visualizza Preferiti Strumenti ?

Indietro Cerca Preferiti

Indirizzo: http://idesox.idreco.com/home_bid.asp?BID=bid3 Vai Collegamenti >>



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Selected Project / 所选项目

Partner	Project	Plant Name	New Revision	
伙伴	项目	工厂名	新修订	
andrea	bid3	Prova	4	Insert Input Data 插入输入数据

[Run Calculation / 进行计算](#)

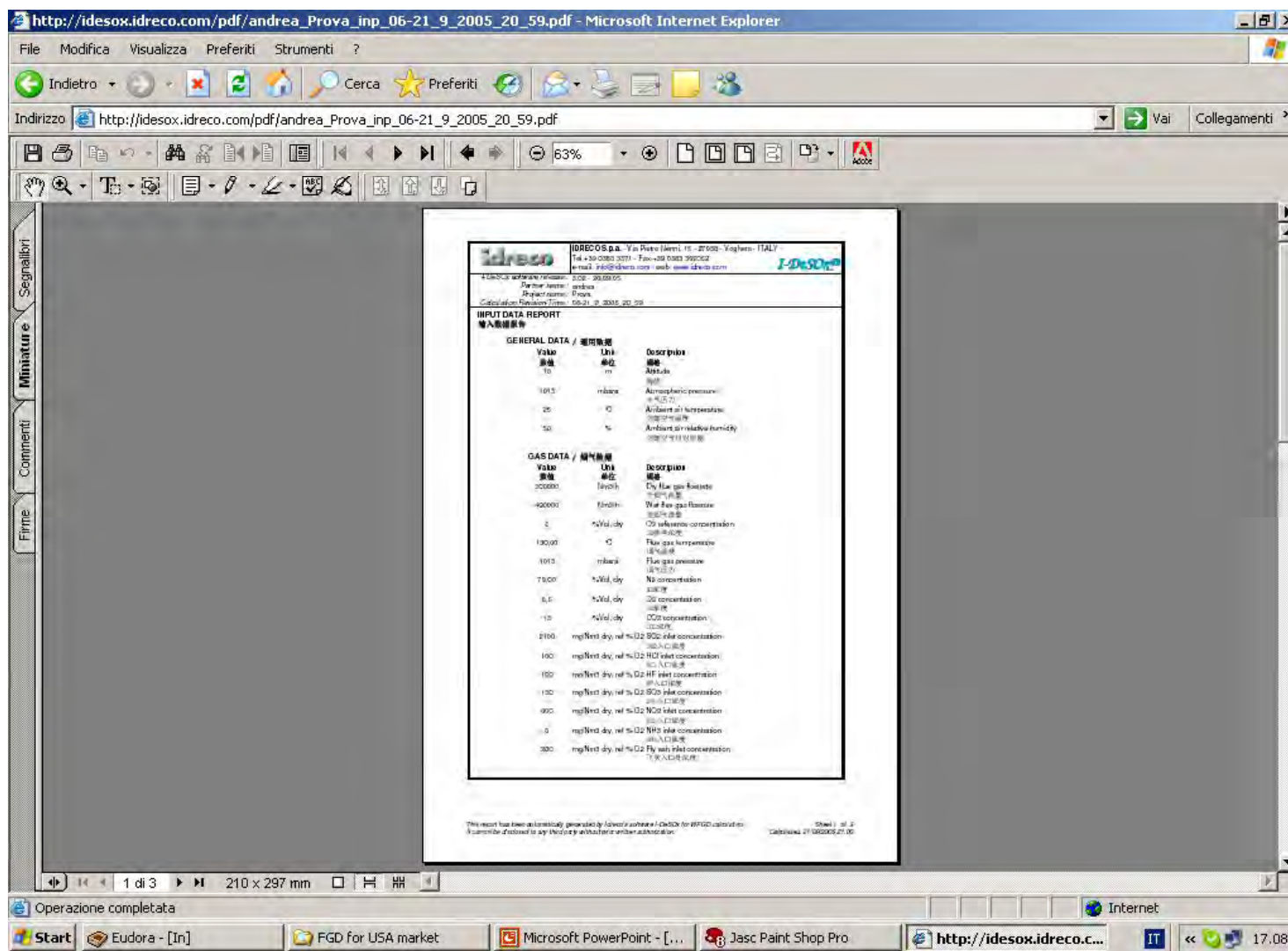
Previous Calculations List / 前计算清单

I-DeSOx Release	Partner	Plant Name	Rev. - Date - Time	Absorber and Equipment Report	Mass Balance Report	Input Data Report
释放I-DeSOx	伙伴	工厂名	审阅-日期-时间	吸收塔和主要设备报告	物料平衡报告	输入数据报告
3.02 - 20/09/05	andrea	Prova	06-21_9_2005_20_59	Download .pdf	Download .pdf	Download .pdf
3.02 - 20/09/05	andrea	Prova	05-21_9_2005_19_54	Download .pdf	Download .pdf	Download .pdf
3.00 - 15/09/05	andrea	Prova	04-20_9_2005_06_33	Download .pdf	Download .pdf	Download .pdf
3.00 - 15/09/05	andrea	Prova	03-18_9_2005_06_48	Download .pdf	Download .pdf	Download .pdf
3.00 - 15/09/05	andrea	Prova	02-17_9_2005_05_01	Download .pdf	Download .pdf	Download .pdf

Start Eudora - [In] FGD for USA market Microsoft PowerPoint - [...] Jasc Paint Shop Pro I-DeSOx - Project Ho... 17.06

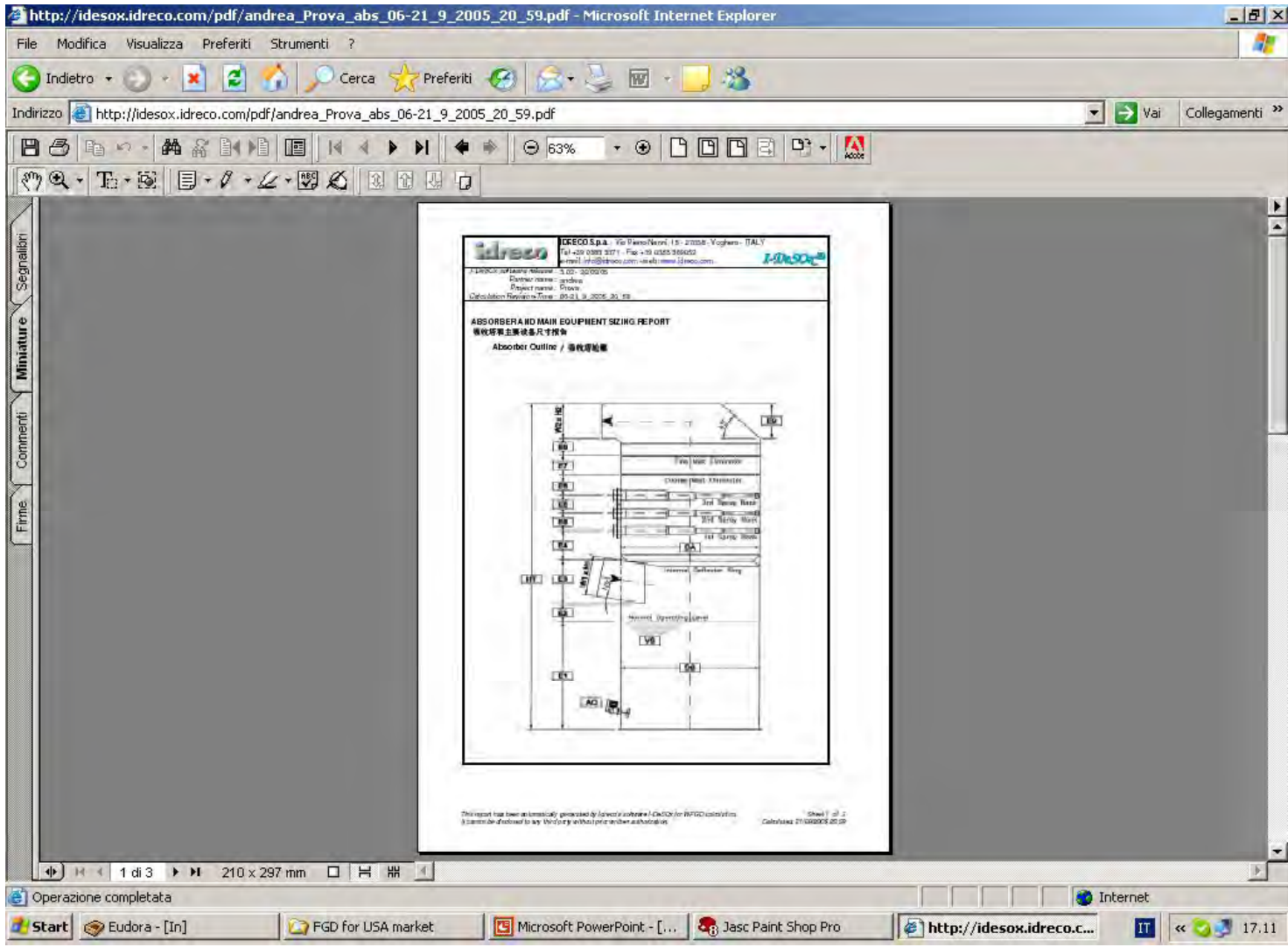
Database of all performed calculations

*I-DeSOx[©] the proprietary software for the process calculation
of Flue Gas Desulphurisation plants with IDRECO WFGD wet limestone/gypsum technology*



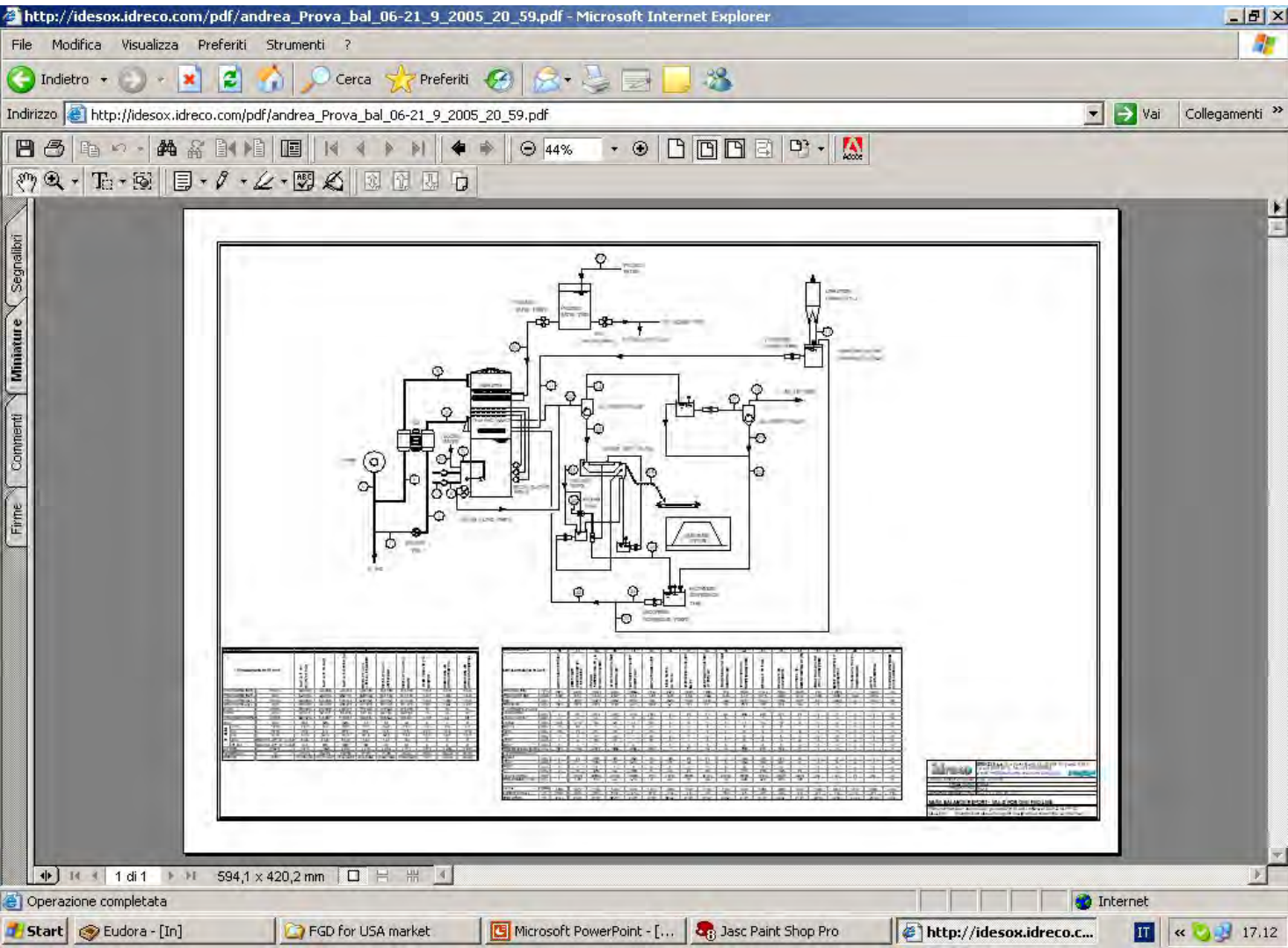
Automatic Report of Input Data

*I-DeSOx[®] the proprietary software for the process calculation
of Flue Gas Desulphurisation plants with IDRECO WFGD wet limestone/gypsum technology*



Automatic Report of Main Equipment Sizing

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of Flue Gas Desulphurisation plants with IDRECO WFGD wet limestone/gypsum technology*



Automatic Report of Mass Balance Sheet



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E-mail: info@idreco.com

Thank you !



**STATE OF THE ART TECHNOLOGIES FOR
AIR POLLUTION CONTROL**