TECHNICAL INFORMATION ABR 9901

Desulphurisation without residual water ABR

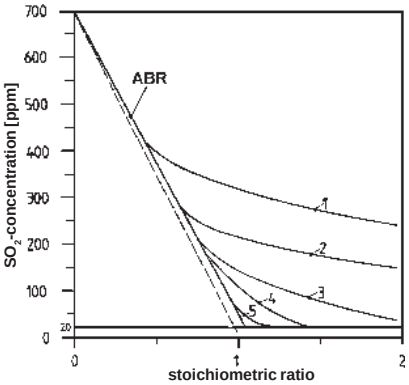
CALDYN Apparatebau GmbH

As a consequence of more stringent legislation concerning the purification of exhaust gases, processes with high separation efficiency are required. Due to increasing costs for energy and for dumping of waste modern gas cleaning systems must work with low energy and absorbent consumption.

In most of the gas cleaning systems employed today, acid pollutants such as SO_2, HF and HCl are removed from the gas stream with chalk. In the dry and semidry processes the consumption of calcium hydroxide is severalfold the minimal stoichiometric amount. Scrubbing systems work with a stoichiometric factor of about 1.1 (Fig.1). However an additional waste water treatment is required.

CALDYN has therefore proposed a system which permits flue gas treatment in a manner characterised by the following features:

- no waste water
- minimal chalk consumption (stoichiometric factor of 1.1)
- exceeding the requirements of the clean-air regulations



1 dry chalk injection at 120°C without recirculation
2 dry chalk injection at 120°C with recirculation
3 lime atomisation with 20-400 µm droplets
4 fluidized bed with recirculation
5 lime atomisation with 5-50 µm droplets

Fig.1 Comparison between different desulphurisation systems

Principle

The important steps of the ABR-process are (see Fig.5):

- pre-dedusting (optional)
- spray absorber
- dedusting
- quenching (gas saturation)
- high performance scrubbing system with aerosolenlargement

Pre-dedusting

Depending on dust concentration a cyclone is installed for dedusting of the flue gases. Thus particularly coarse dust particles which cause deposits and blockage of baffles and packings are removed.

Spray absorption

Lime slurry from the following scrubber is atomised in the spray absorber with CALDYN nozzle CSL /1/. Lime reacts with the acid flue gas pollutants SO_2, HF and HCl. Due to the operating conditions in the scrubber the pollutant concentration at the absorber outlet are relatively high. Therefore almost all of the lime is reacted within the spray absorber. The dry reaction products are removed together with the dust particles in the succeeding dedusting system.

Dedusting

ABR uses the MULTIWIR-system for dedusting and the removal of dry reaction products from the spray absorber.

A MULTIWIR-package consists of adjacent layers formed by straight strips. Alternate layers of the packing consist of strips of opposite inclination. Gas entering the packing is divided into several narrow streams.

The gas streams form subsequent layers of the package come into contact with each other at some angle. The momentum transfer at the crossing sections induce inverse rotational movement of the gas streams (Fig.2).

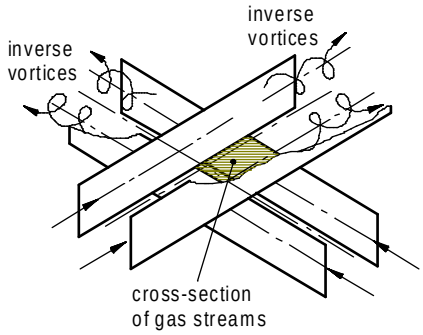


Fig.2 'Inverse vortex'-effect in the MULTIWIR-packing

The particles settle down on the surface of the strips in the packing due to centrifugal forces. A hammering system removes the dust deposits from the packing strips in a defined cycle time (Fig.3).

Compared to ordinary dedusters much higher gas velocities and therefore very compact designs can be realized. The costs of investment are considerably lower than for a bag filter or an electrostatic precipitator. In combination with the succeeding high performance scrubbing system the pollutant concentrations obtained in the clean gas lie clearly under the legal limit values. The MULTIWIR deduster can also be used at high temperatures. Therefore a filter bypass is not required.

Fig.3 MULTIWIR-deduster with hammering system

Quenching

After dedusting water is injected with CALDYN nozzle CSL inorder to saturate the flue gases before entering the scrubbing system /1/. The water droplets in the spray evaporate using heat out of the flue gas. CALDYN nozzles generate a defined and narrow droplet size distribution and therefore ensure a reliable gas cooling /5/.

Scrubbing system with aerosolenlargement

Lime from the bottom of the scrubber is circulated in the lower part of the scrubbing system with hydraulic nozzles CED. The regulation of chalk proportioning ensures complete reaction of the unreacted lime in the spray absorber. Therefore the scrubbing system is operating with substantial amount of unreacted lime and low pollutant concentrations. On the other hand the spray absorber is operating with high pollutant concentration and practically complete reaction of the injected lime. In addition a stoichiometric factor of 1.1 can be achieved with the ABR-system.

For the improvement of the mass transfer a MULTIWIR-packing is installed in the lower part of the scrubber. Dust particles, droplets with unreacted lime and the reaction products are removed in the succeeding demister.

After the demister pure water is atomised as minute droplets with CALDYN nozzles CSL inorder to generate supersaturated zones within the gas stream /4/. Steam condenses upon the small aerosol particles and increases their size to over 1 µm. These enlarged aerosols are furthermore increased in the succeeding MULTIWIR-coalescencer to 8 µm due to inertial and centrifugal forces in the inverse vortex streams of the package ('Inverse vortex'-effect see Fig.1). The consequent droplet eliminator separates the enlarged particles from the gas stream.

The CALDYN system is a reliable method for the separation of fine dust particles as well as SO_3-aerosols with low energy consumption.

Main advantages

- The residual pollutant concentrations achieved with the ABR-system are substantially lower than the legal limits
- Low absorbent consumption (stoichiometric factor approximately 1.1)
- No residual water
- Safe removal of aerosols with low energy consumption (e.g. compared to high performance venturi scrubber)
- The MULTIWIR-deduster has a compact design and can be operated over a wide temperature range
- The MULTIWIR-system for mass transfer, droplet elimination and coalescencer ensures a reliable operation without chocking also at substantial dust and chalk concentrations.
- Due to the working principle CALDYN-nozzles CSL have a comparatively large outlet diameter and operate with low flow velocities. Therefore plugging of the nozzle can be successfully avoided and the erosion inside the nozzle is negligible. This ensures a reliable operation of the spray absorber with lime.

Operating results

The CALDYN pilot plant ABR with a capacity of 500 m³/h flue gas was successfully installed at Rüdersdorfer Futterphosphat and at Vereinigte Aluminiumwerke (Fig.4). The residual concentrations of SO_x, HCl, HF and dust achieved with the ABR-pilot plant were substantially lower than the legal limits.

Fig.4 CALDYN pilot plant ABR

Additional information

/1/ Technical Information CSL 9801 (pneumatic nozzles)
/2/ Technical Information MW 9901 (MULTIWIR-system)
/3/ Technical Information CALWIR 9901 (scrubbing-system)
/4/ Technical Information „The Role of Minute Droplets in the Separation of Aerosols from Gases"
/5/ Technical Information QN 9702 (quenching)

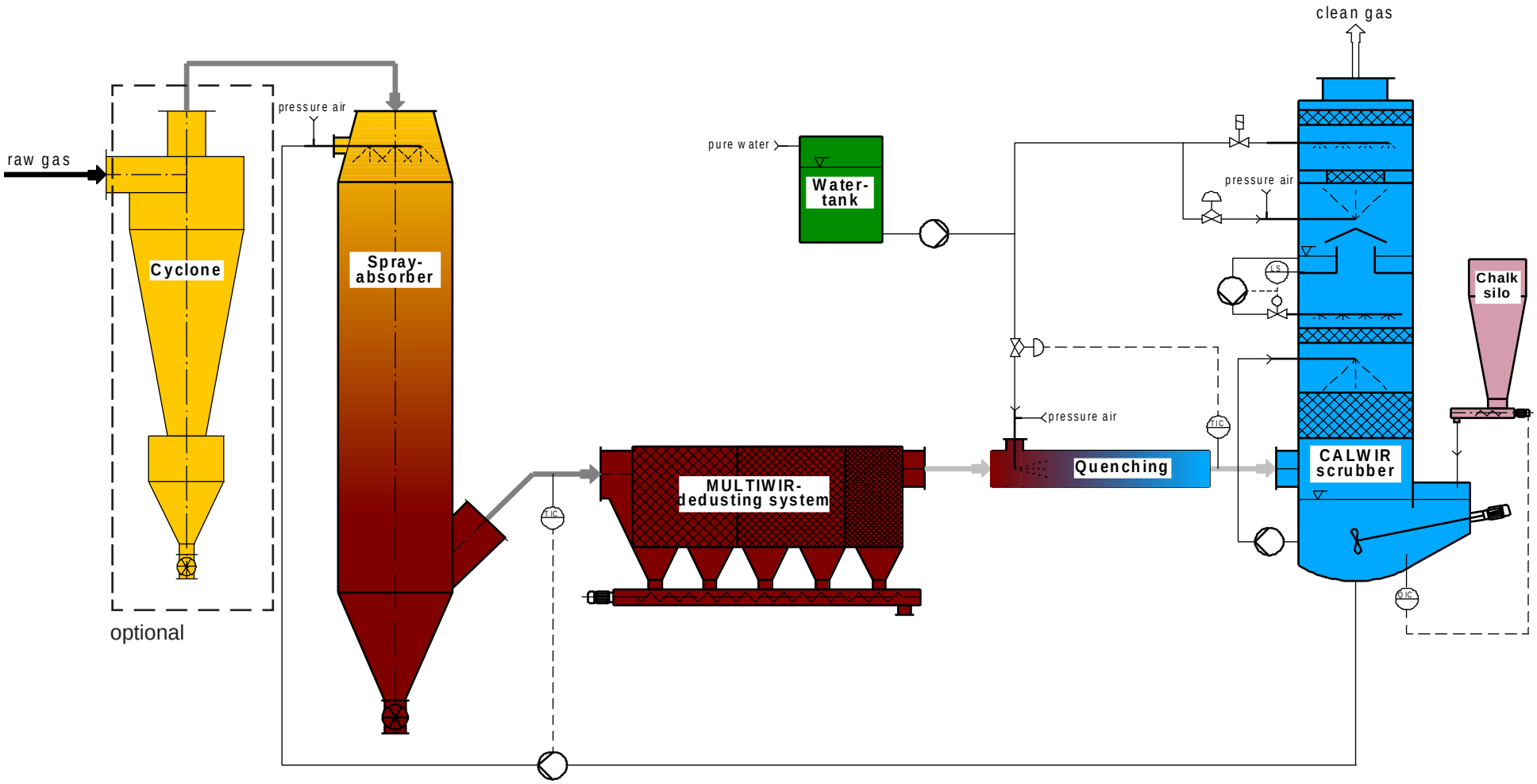


Fig. 5 Layout of the ABR-system

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