

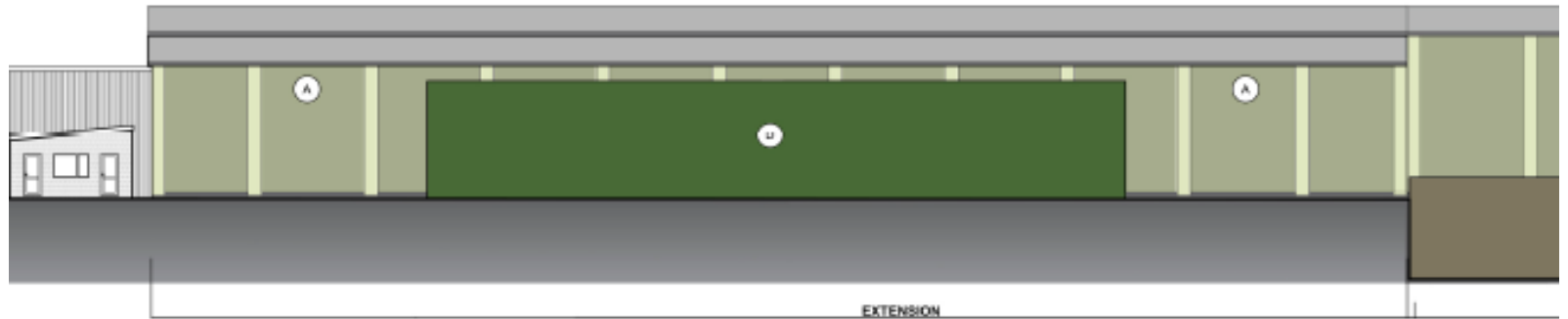
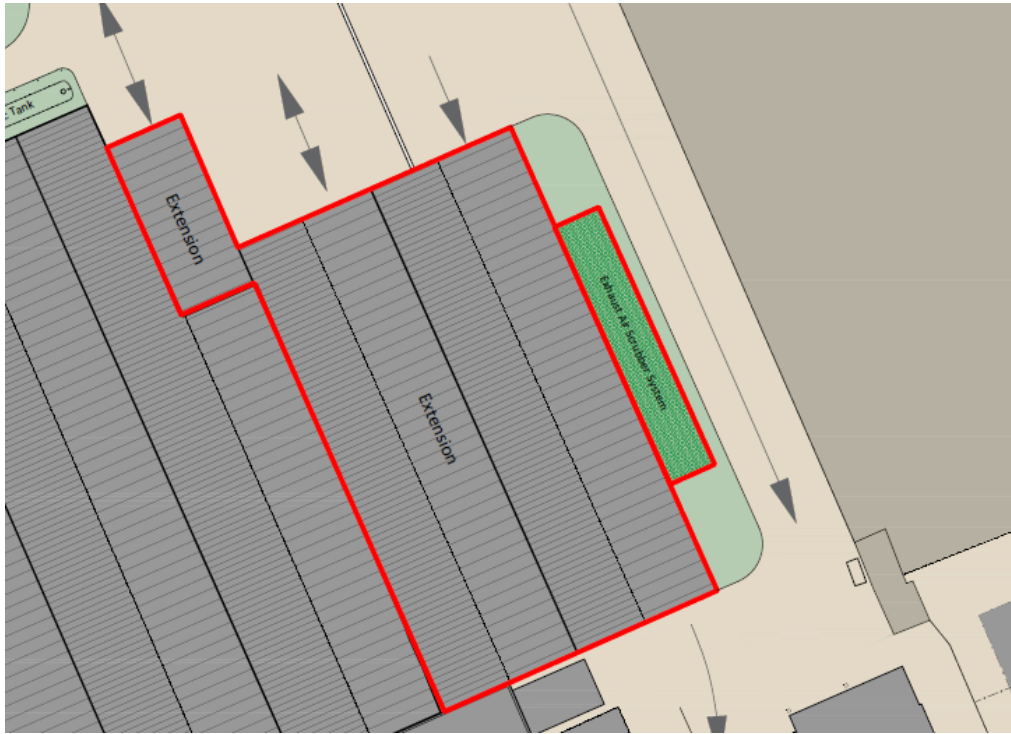


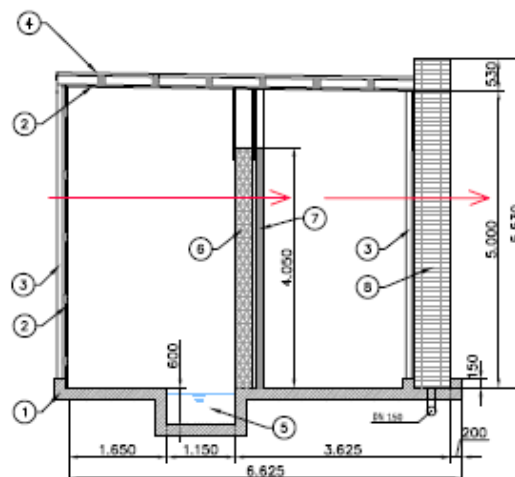
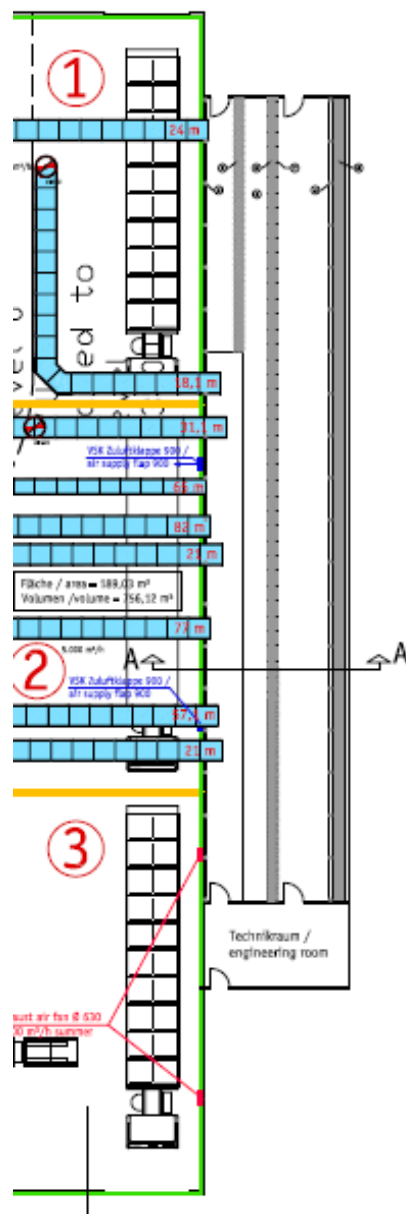
Industrial Automation

Automotive
Special Machines and Robotics
Drive Technology
Explosion-Proof Systems and Value Technology
Switchgear Construction
Building-Services Technology
New Energies
Agricultural Technology

EMMI ***Exhaust Air Scrubber System***

We build solutions.





- ① stundfester Beton (R25 R10) / acid-proof concrete
- ② 3mm PVC-Verkleidung / 3mm PVC-cladding
- ③ Stahlstütze / steel prop
- ④ Sandwich-Trapezblech / Sandwich trapezoidal profile
- ⑤ Wasserbecken / water basin
- ⑥ Filterwand 1 / filter wall 1
- ⑦ Tropfenabscheider / droplet separator
- ⑧ Filterwand 2 / filter wall 2
- ⑨ Leugenfilter / ly

Schnitt A-A M. 1:50 / section A-A scale 1:50



System construction and control technology

> Customised system construction

> Container design (waterproof, chemical-resistant, no intermediate consumption on-site)

When is it useful to build a multi-phase system?

The exhaust air from most emission sources contains not only odour but also other exhaust air substances, such as ammonia and hydrogen sulphide, which must be removed from exhaust air. Multi-phase systems ensure effective and cost-efficient exhaust air purification. In each individual phase, a selective purification process takes place, which always leads to a considerably improved reduction, thus ensuring that legal requirements are safely complied with.

Our exhaust air purification is equipped with a **Program-mable Logic Controller (PLC)** and the related hardware.

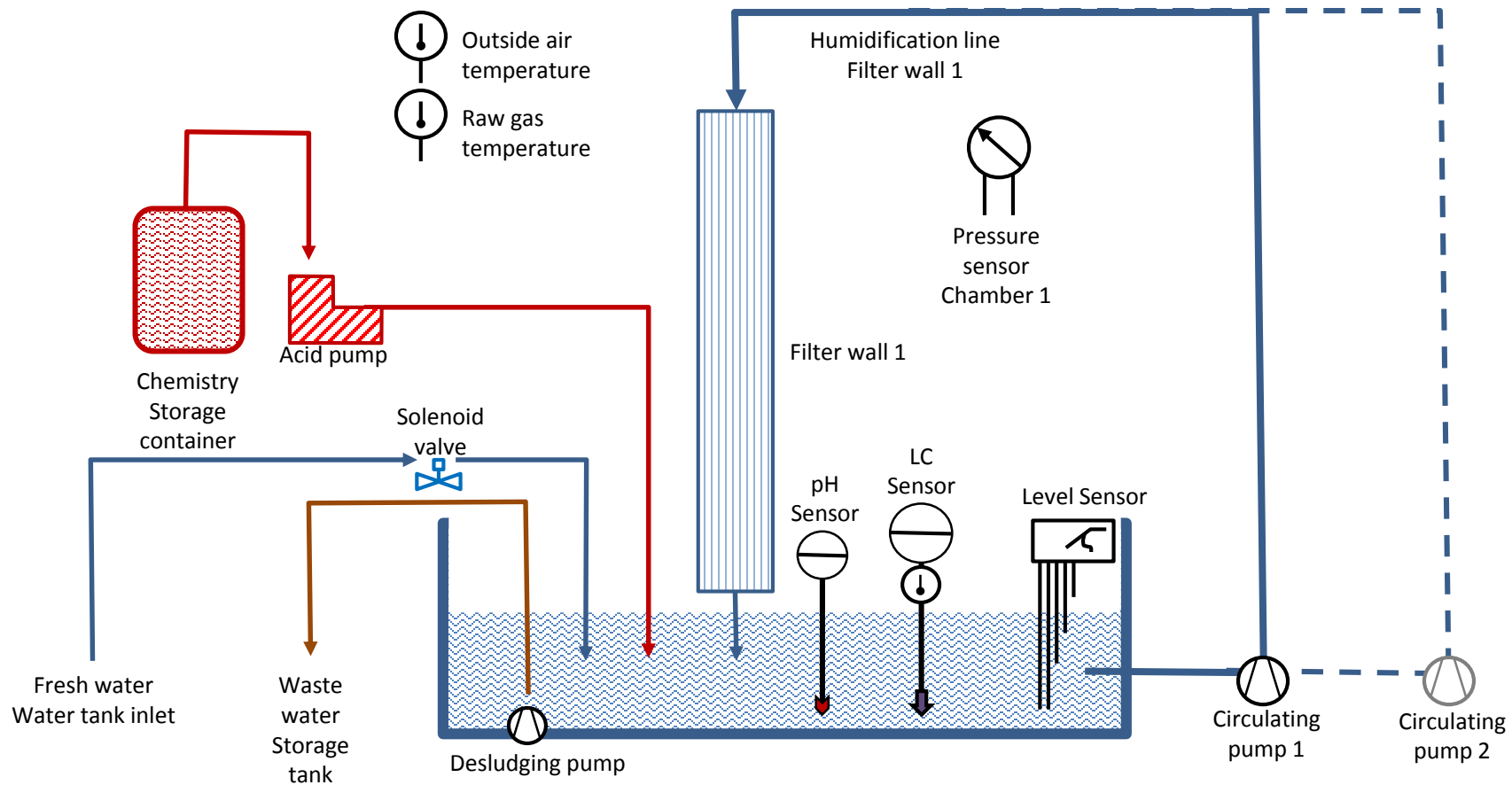
In addition to electrical controls, it also contains measurement technology evaluation systems and documentation modules. Hence, on the one hand, the system is operated automatically, whereas, on the other hand, operators can read all company-specific data and any malfunction messages on the integrated display at any time and, if necessary, react timely.

Advantages

- > No manual documentation is required, since an electronic operating manual and protocol is created automatically
- > Interfaces are available (BUS and LAN)
- > Remote inquiries and remote maintenance are available
- > Connection to the AgriFarmControl management system

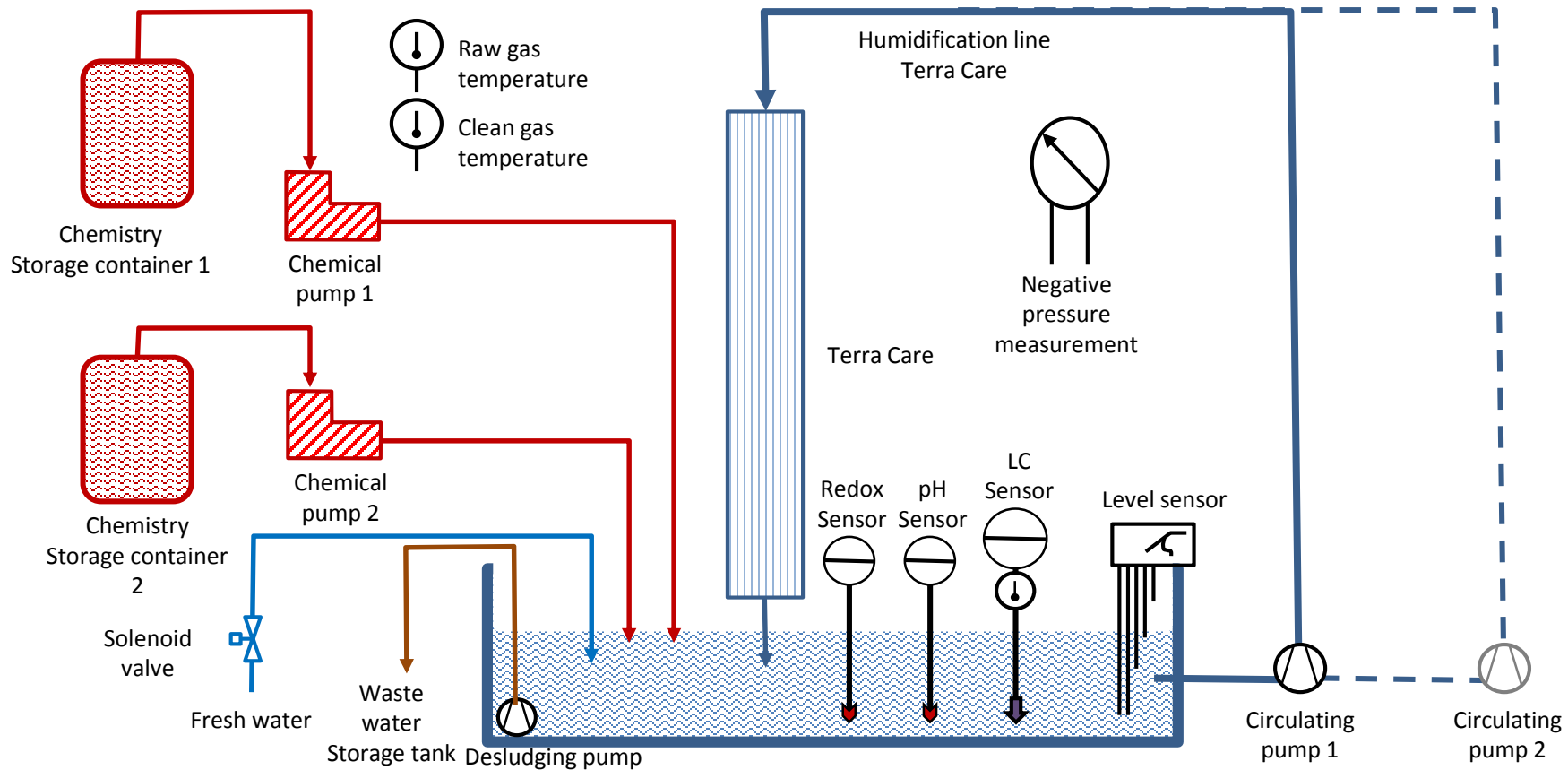
General

Acid stage



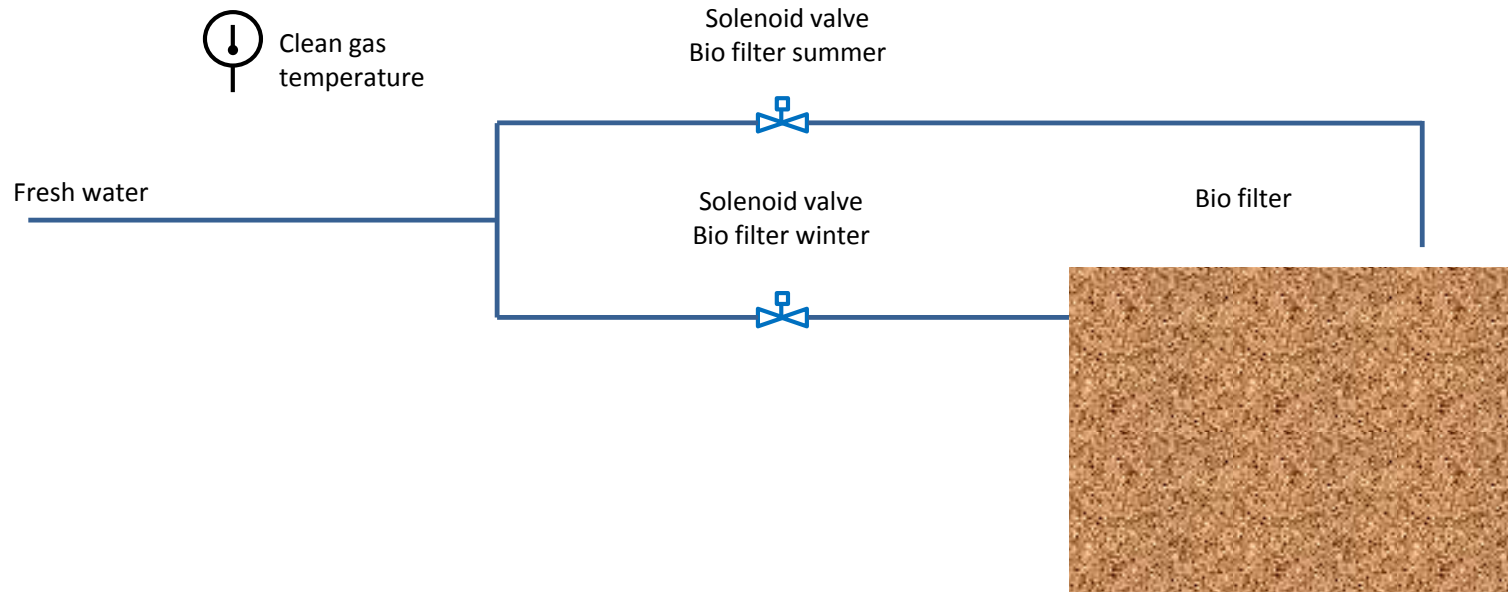
General

Alkali stage



General

Bio filter





Functional Description of PlanET LethBridge Air Purification Biogas Plant

Basic information

Here, it must be distinguished that two different exhaust air ducts are to be dealt with, which need cleaning via two exhaust air cleaning systems.

Exhaust air line for room air conveyance

Here, a larger quantity of air with lower concentrations of exhaust air components (odour, NH_3 , H_2S) is expected. Here, the air in the receiving hall is extracted in the event of local discharge, as well as the air in the bunker rooms with the units installed in them.

Maximum air quantity in receiving hall: 33,500 m³/h

Maximum air quantity in bunker rooms: 11,700 m³/h

Installed system: 3-stage

- 2-stage chemical with an acidic and an alkaline stage to condition the exhaust air before entering the
- biological stage with root wood filler

Ventilation of the room in which the steriliser is installed need not be conveyed on the exhaust purification system, as there is no contact here between the input, intermediate or finished products and the atmosphere. Therefore, only the heat loads need to be dissipated for this room. These can be freely emitted. The calculation of the ventilation to remove the heat loads is not included in this functional description.

Exhaust air line process exhaust

The exhaust air should be fed directly from the process to the exhaust air purification system. Here, the exhaust air comes from the expansion process of sterilisation, as well as from vapours exiting the hot end products of sterilisation. The exhaust air temperature may reach values up to 150 °C.

The exhaust air from the sterilisation of slaughtering byproducts contains high concentrations of NH_3 , H_2S and mercaptans. Odour concentration values of 10⁶ GE/m³ can be assumed in this case.¹

Therefore, the following interpretation is taken for the treatment of the process exhaust air stream:

A chemical scrubber made of fibreglass-reinforced plastic, which must be operated on an alkaline basis. At this stage, the continued use of hydrogen peroxide is necessary.

Here, only the conductive components, hydrogen sulphide and mercaptans, are purified, as this is technically more difficult. Ammonia separation is then performed in the following process in the large scrubber; residence time in the local stage is sufficient for the separation of alkaline exhaust substances.

After passing through the GfK scrubber, the exhaust air from this line is added to the room exhaust air purification system in order to eliminate the remaining exhaust air components therein and to subsequently reduce ammonia and the remaining concentrations of acidic exhaust air components.

Maximum air quantity sterilisation: 2,200 m³/h

The structural dimensions of this chemical scrubber are given in the drawings.

A filler package is installed on the inside, which is irrigated from above by nozzles. A droplet separator is installed above the nozzles, which minimizes the discharge of aerosols to the subsequent stages of exhaust air purification.

Here, despite the low volume flow, these scrubbers are to be operated with a very high irrigation density in order to achieve safe separation and a reduction in the exhaust air temperature. This prevents the water from drying on the fillers due to high exhaust air temperature.

The water reserve for this scrubber is located below the large exhaust air scrubber. The GfK scrubber is fed via a pressure pump; the water return flow into the reserve tank is promoted via an additional pump.

The following settings are planned:

GfK scrubber: alkaline scrubber

pH value: 12.5

Max. conductivity 100 mS/cm

Hydrogen dosing: 150 ppm

Pumps used here:

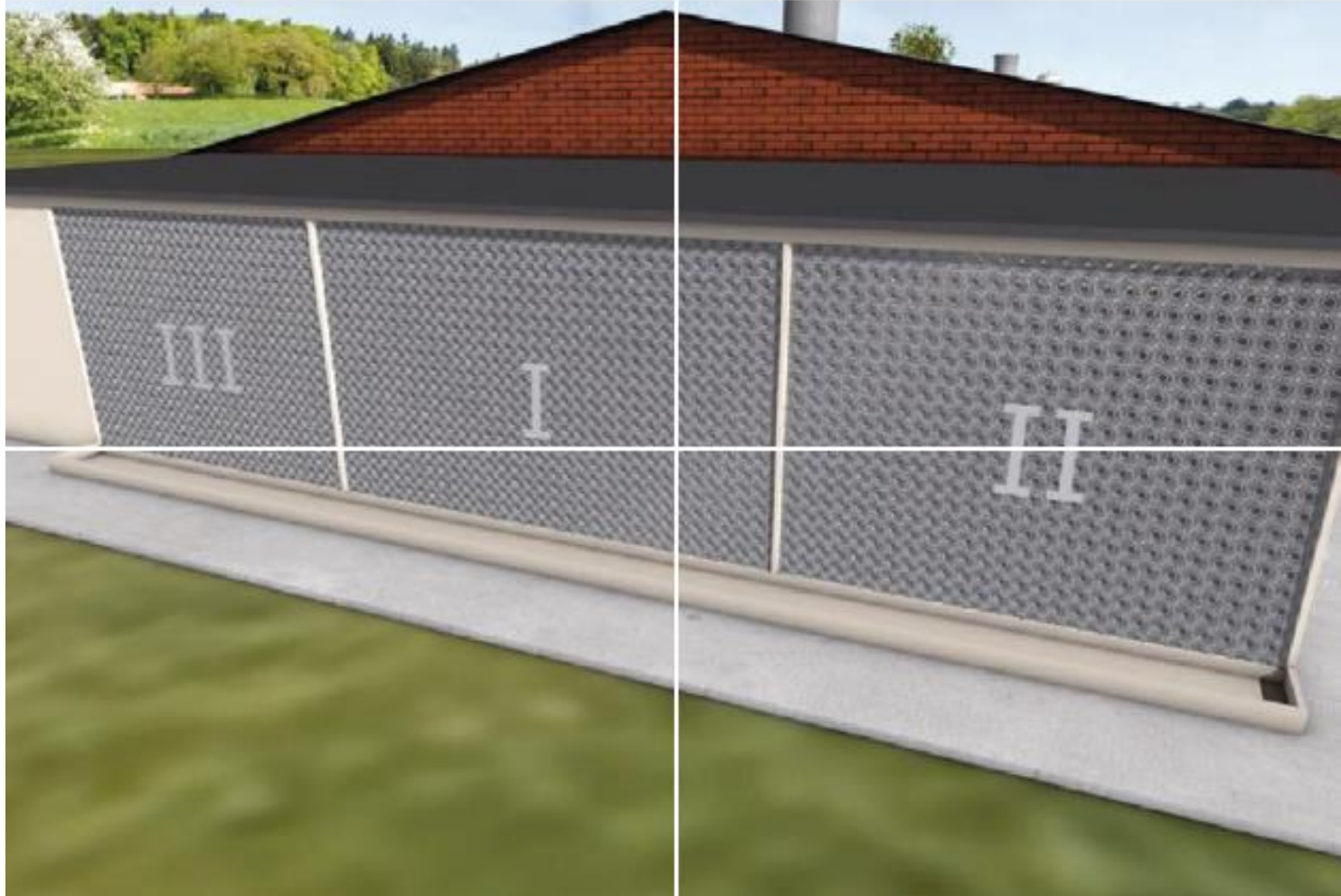
Pressure pump for irrigation: SP – 5A – 12

Dosing pumps: 2 x Prominent Beta/4

Measurement technology:

pH: JUMO Aquis Touch pH with single-rod electrode
and LF with Sensor EcoLine Ci

¹ All the above data come from our own measurements as well as the available measurement reports from other systems.



System configuration:**Exhaust air purification of extracted room air:**

Filter walls I and II (chemical cleaning, cleaning stages I and II)

Since the extracted room air is contaminated by the harmful gases ammonia and hydrogen sulphide as well as dust, the exhaust air must be conditioned so that it is cleaned from these substances before the bio filter.

Inlet of hydrogen sulphide would cause the biological filter wall to decompose due to the acid formation, and inlet of ammonia leads to a further reduction of the pH value while further adding to the nitrogen salts, which are inhibitory and toxic to the odour-inhibiting and degrading biology. The VDI guideline 3477 Exhaust Air Purification Bio Filter therefore provides for the chemical elimination of these exhaust air ingredients. Therefore, strict observance of the parameters listed here is essential for proper functioning of the entire exhaust air purification system.

As the exhaust air purification system is still subjected to the partial flow from the process exhaust air purification system, the filter surface loads and the flow rates for all filter layers must be dimensioned accordingly here.

Both filter walls are installed perpendicularly and made of individual welded plastic blocks (L x W x H = 910 x 460 x 450 mm). Two wall connection brackets prevent vertical gaps between the fillers, which would allow contaminated raw gas to escape. The walls are 2.7 m high. The height of the surface in contact with the exhaust air to be purified is 10 cm lower, since each upper filter wall area is enclosed in a stainless steel groove in order to fix the filter wall in place.

The special design of the filter walls and a special humidification system ensure the complete water dampening of the filter wall surfaces. This first filter wall is to ensure the highest possible efficiency in terms of ammonia separation. The second filter wall serves to separate hydrogen sulphide.

The filler is constructed in such a way that a PP flat film is (with structure) is alternately bonded. The specific surface of this filler is 80 m²/m³ filter material. The flow rate and the filter surface loads are designed to be low in accordance with the chemical demand.

Ammonia separation is ensured via the deflection of the air stream over the draining water surface on this filter wall I. The nitrogen-containing exhaust air components and dusts are separated here. The prerequisite for this decomposition is a pH-regulated control system regulated (pH = 3.00 to max. 3.50) including acid dosing technology and conductive conductivity measurement. Only the front filter wall area is wetted (up to about half) so that the rear area supports the function of the droplet separator. The descending water is carried further into the filler by the air flow, so that it will be almost completely wetted.

Hydrogen sulphide will be separated in the second filter wall; to do so, the pH value must be adjusted to a pH min. of 12.0 and a pH max. of 12.5. This high pH value ensures that mercaptans are also extracted from the exhaust air. For this wall, the same measurement technology is necessary as described for the separation of ammonia.

Humidification system for the filter walls/water reservoir

The humidification system is identical for both filter walls, so it will only be described once.

The humidification system consists of two PVC pipes. The pipes are installed in such a way that one line is in front and one line on the filter wall wet the latter. This ensures that no large water aerosols are carried out of the filter wall and can enter the subsequent stage.

The pipelines have a double row of bored holes (offset by 90°) with a diameter of 7.5 mm. The humidification pipes I and II have two opening closures so that they can clean the pipes from the inside. The main pipeline is connected to one or more suction pumps. The suction pumps continuously feed the circulatory water from the water reservoir to the humidification line of filter wall I. The draining water gets to the whole long side of the installed filter wall I and flows into the water reservoir. The lengths and widths of this water reservoir vary and depend on the exhaust air volume to be purified as well as the structural conditions on site. The water quantity evaporated from the water reservoir is automatically fed to the reservoir via a solenoid valve. This quantity is detected via a water meter (including pulse transmitter) and recorded in the electronic operating log

Filter wall II (droplet separator)

A droplet separator (Type TEP 130) is installed downstream of every filter wall. The reason for this installation is that both stages are chemically operated, thus requiring the system to avoid any transmission from the water stages. This further ensures that only the necessary amount of chemicals needs to be dosed into the system.

This droplet separator operates in accordance with the deflecting plate principle. The exhaust air flowing out of the respective filter wall is abruptly forced to change its flow direction. Due to the higher inertia, the droplets/aerosols cannot follow this deflection and collide with the "installations". The droplets run off on the flat films and are fed back into the respective water reservoir.

Filter stage III (biological purification)

A biological surface filter must be installed downstream for high odour reduction. The bio filter is intended to remove the residual emissions, in particular to reduce the odours and remove them via microbiological metabolism. Since ammonia/hydrogen sulphide is barely present when entering the biological fill, a chemical degradation of the biology can be excluded.

Filter wall III is separately installed on two redundant filter surfaces behind filter wall II, and consists of torn root wood with various sievings (up to 150 mm). The bio filter intended for this area has a layer thickness of 2.05 m. The surface of each individual filter measures 14.80 m x 7.81 m.

Since the previous filter walls are, as described above, subject to a continuously draining film of water, this area has increased water evaporation. This ensures a relative humidity of > 95 % for the air flowing into the bio filter bed. In order to counteract drying up, the bio filter filler is additionally moistened with fresh water. The individual humidification times are set on the computer and taken over by the PLC. The humidification is switched on via solenoid valve. The humidification times are set by the system operator, since each operation involves a different evaporation rate due to different temperature and relative humidity values. The necessary switching-on times must be empirically determined by the operator. This can be done by checking the available drainage water or by determining the run time of the pump in the sump of the bio filter. At this point, carrying out irrigation in short pulses several times throughout the day is recommended.

The consumed amount of fresh water is in turn recorded in the electronic operating log via a water meter with a pulse transmitter.

The humidification times are set in such a way as to compensate the daily quantities of evaporated water.

The following can be listed here as operating parameters:

Temp. exhaust air bio filter entrance	min. 16 °C
	max. 38 °C
Rel. humidity bio filter entrance	min. 16 °C

Initial concentration H ₂ S	> 3 ppm
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Initial concentration NH ₃	> 5 ppm
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Sensor and Measurement Technology (pH value and conductivity measurement)

A pH control system and acid dosing system in the first filler wall as well as an alkaline dosing system in filler wall 2 are ensured via a pH measuring system. This is supported in both stages by an inductive conductivity measurement in the circulating water.

In order to efficiently carry out the pH and conductivity measurements, sensors are installed so that the dosing of the acid/base does not interfere. A pH value range is entered on the computer which ensures the optimal ammonia uptake of the scrubbing water. This range is between pH = 3.0 – 3.5. A pH value between 12.0 and 12.5 must be set for the separation of hydrogen sulphide and mercaptans.

The dosing of acids/bases is performed in such a way that the employed dosing pumps continuously feed acids/bases into the corresponding water basin when the lower pH threshold is reached. The chemical tanks are installed directly on the exhaust air purification system. Acids/bases must be added until the circulating water reaches the second pH threshold value again. The quantity of chemicals used is calculated using the runtime of the dosing pump and the corresponding flow rate (l/h), and stored in the electronic operating log.

In the second alkaline-operated filler wall, the dosing of hydrogen peroxide is still necessary. This serves two purposes: firstly, it stabilises the separated sulphur salts; and secondly, it breaks down long-chain hydrocarbon compounds. This allows them to be more easily metabolised in biology. The dosage regulation is carried out here by measuring the hydrogen peroxide content in the circulating water. The value to be set here is 100 ppm. The hydrogen peroxide is fed into the water reserve tank via an additional dosing pump.

To properly calibrate the pH values and conductivity in the washing water (pH calibration at maximum intervals of 2 months), the water temperature in the water reservoir is detected using a PT-100 and is stored in the electronic operating log. The PT-100 is coupled to the conductance detection measuring equipment.

To counteract water salination with the bound salts, the conductivity value must be measured. Via the computer (setting values), the maximum possible conductance of 100 mS/cm is entered and taken over by the PLC.

Desludging of the circulating water is automated via a drain pump or a solenoid valve. Upon achieving the maximum allowable conductance of 100 mS/cm, a portion of the washing water reserve from the water reservoir is desludged. The desludged water is stored in the double-walled reservoirs under the exhaust air purification system until further use or until its disposal.

The desludged water quantity is controlled by filling fresh water (water meter with pulse transmitter). The running time of the desludging pump is saved in the SPS log (Emptying activated - Emptying executed).

If the desludging pump is not switched on due to a malfunction, the conductivity in the scrubbing water will further increase. The system operator receives a warning when the conductance

approaches 105 mS/cm. The system is switched off automatically when the conductance of 120 mS/cm is reached.

Technology used:

Dosing pumps Prominent Beta/4

Measurement technology:

pH: JUMO Aquis touch and

Conductivity: LF with Sensor EcoLine Ci

Circulation pumps: SP-60-1

Fresh water supply:

The evaporated and desludged water quantity is automatically refilled in the respective water reservoir via a solenoid valve. A water meter documents the fresh water consumption. The evaporation of water from the water reservoir and the resulting quantity of waste water, which is caused by the operation of the exhaust air purification systems, depends on the outside air temperature, the exhaust air temperature, the rel. humidity, the air flow rate and the actual noxious gas concentrations.

Clarification tanks

These are located underneath the two-stage scrubber and are divided into two basins. In one basin, ammonium sulphate solution is desludged from the acid scrubber; in the other, the solution with sodium bicarbonate sulphate is stored until further use or until its disposal.

Chemical storage tanks

These are made entirely of plastic and designed with a double wall. As this exhaust air cleaning system requires three chemicals, three tanks are accordingly available.

Sulphuric acid is stored in the first tank, sodium hydroxide solution in the second tank and hydrogen peroxide in the third tank.

The tanks are equipped with a visual and metrological fill level control via a float. A warning lamp is installed in the receiving hall