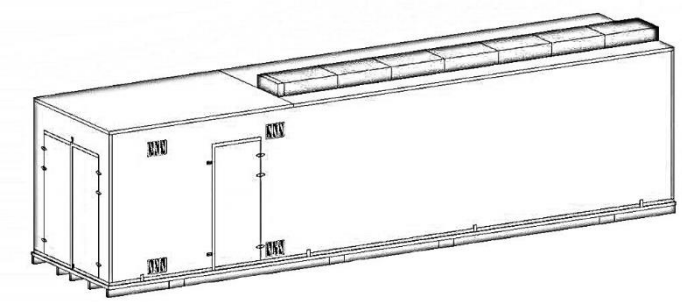
Big Manual

User manual

Air scrubber

CompoLiner

Code No. 99-94-0885 GB
Edition: 10/2021



Big Dutchman®

Inno+ B.V.
Maasbreeseweg 50
5981 NB Panningen
Netherlands
Phone : +31 (0)77-4657360
Fax : +31 (0)77-4657361
E-mail : info@inno-plus.nl
Internet : www.inno-plus.nl

EC Declaration of Conformity

In accordance with the Machinery Directive 2006/42/EC – Annex II-A
(Translation of the original text)

Description : Porcus / Pollo / CompoLiner / CompoTower air cleaning system

Inno+ B.V. confirms that the above product is in conformity with the provisions of the European directives listed below:

- Machinery Directive 2006/42/EC (incl. amendments)
- EMC Directive 2004/108/EC (incl. amendments)

The technical documentation can be compiled by the signee of this declaration in the name (and at the address) of the manufacturer.

This product conform with the harmonised standards below:

EN ISO 12100:2010	:	Safety of machinery – General principle for design – Risk assessment and risk reduction
EN IEC 60204-1:2006	:	Safety of machinery – Electrical equipment of machines – Part 1: General requirements

Panningen, Netherlands
Date: 04-01-2021 (dd-mm-yyyy)

Signature

Name : M. Ortmans
Title : Managing Director

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1. INTRODUCTION

The purpose of this manual is to explain the safety aspects, the operation, use and maintenance of the Inno+ air scrubber (hereinafter in this manual commonly referred to as **Air Scrubber** or **Air Cleaner**).
Please read this manual carefully, paying extra attention to chapter 2 (Safety). It is important that you know exactly how to operate the system and understand all instructions.
The following documents are included with the user manual:

- Electrical circuit diagram;
- Delivery certificate;
- Material Safety Data Sheets sulphuric acid and anti-foaming agent;
- Spare part list (available on request);

This manual is based on present-day technology. Inno+ retains the right to make changes to the documentation and is not obliged to modify any previous versions.
Please carefully store this manual for future use and reference.

ATTENTION

- The photos and diagrams used in this manual may slightly deviate from the actual situation on non-relevant points.
- This manual describes all available air scrubber options. Therefore, not all information in this manual may apply to your system.

In this manual, lists with various options are indicated as follows:

- Option-1
- Option-2
- ...

In this manual, actions to be carried out are indicated as follows:

- Step-1
- Step-2
- ...

The adjacent text boxes are used to emphasize certain parts of the text.

TIP

Suggestions and recommendations that make it easier or more convenient to carry out certain tasks.

ATTENTION

This remark makes the user aware of potential problems.

CAUTION

Procedures that are not carried out properly can cause damage to the installation or harm the environment.

2. SAFETY

2.1 Introduction

The Air Scrubber is a system with only a few mechanical processes. However, the system does require the use of chemical additives, which involves certain risks.
Therefore, persons working near or with the Air Scrubber must always strictly follow the recommendations and working procedures described in this manual.

ATTENTION

Always observe local regulations and statutory provisions regarding personal protection, hygiene and the environment.

2.2 Safety equipment installed

2.2.1 General

As the manufacturer, we have incorporated several safety devices to ensure the Air Scrubber meets statutory guidelines and to create a safe working environment.
The safety devices are:

- pH meter, see § 2.2.3;
- Safety water valve, see § 2.2.4;
- Check valve in the clean water supply, see § 2.2.5;
- Drip tray for the acid pump and protection around the sulphuric acid pipe, see § 2.2.6;
- Included safety cabinet with chemical-resistant personal protective equipment, see § 2.4.1.
- Emergency shower, see § 2.2.7.

WARNING

To prevent any personal injuries and minimise the environmental impact, it is essential that all safety functions remain operational and in place.

2.2.2 Technical/storage building

The Technical and acid room must only be opened to replace additives or for maintenance purposes as described in chapter 6. This room must be kept closed during normal operation to prevent any unauthorised access.

A separate cabinet is located behind the doors of the technical room. This cabinet houses all electrical control and circuit elements. It must only be opened in emergency situations, and by qualified electricians only.

WARNING

The technical room must only be opened by or under the supervision and responsibility of staff members who have familiarised themselves with the risks of the fluids used and know to handle these fluids with caution.

WARNING

Professional electricians only must carry out work on the electrical system

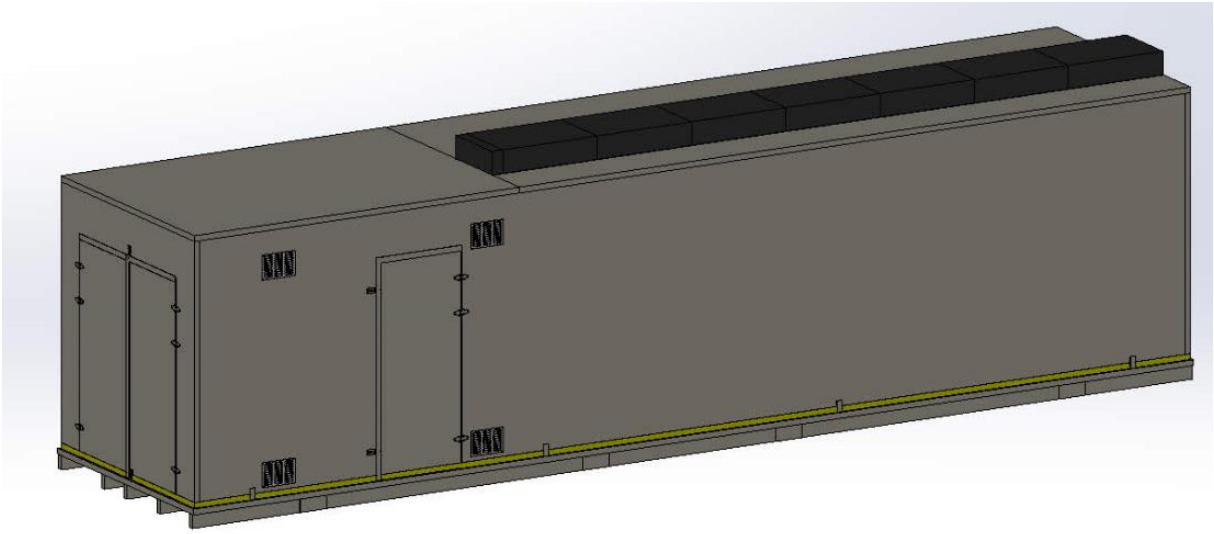


Figure 1: Storage room acid container (left doors) and Technical room (right door)

2.2.3 pH meter

In order to prevent problems that arise as a result of an erroneous pH reading the scrubber is equipped with a maximum run time timer. If the controller sees that the time has been exceeded and the pH set point is not reached. An alarm message is generated and the chemical pump will stop.
The sensors have a limited life span and must be replaced every year. The dealer can recalibrate the sensors every 6 months during servicing.

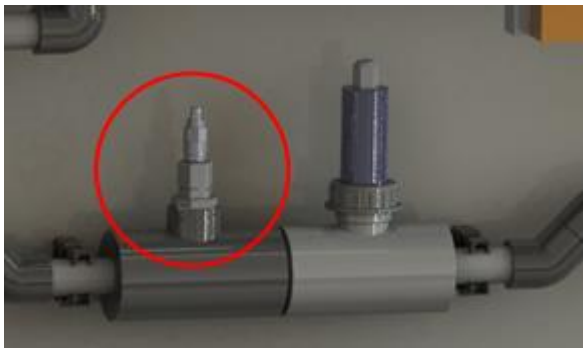


Figure 2: pH sensor

2.2.4 Safety water valve

The clean water supply circuit is equipped with a safety valve. The reservoir is equipped with an emergency float.
If the reservoir level control function does not function properly and the water reaches up to the emergency float, the safety valve closes to disable the water supply. This ensures the reservoir can never overflow.
The emergency float and safety valve are not controlled by the controller, but are directly connected.

Figure 3: Safety valve

2.2.5 Water supply check valve

The water supply is equipped with a check valve, located directly behind the clean water supply connection point. The check valve prevents any water from flowing back from the Scrubber to the water supply system.

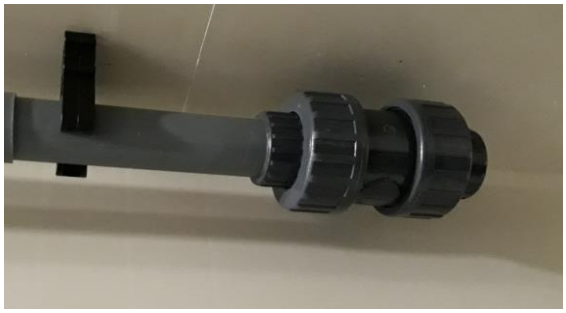


Figure 4: Safety valve

2.2.6 Protection around the sulphuric acid pump.

The line feeding the sulphuric acid from the storage location to the air scrubber must of course not be damaged.
As an additional safeguard the pipe has been placed in a sturdy PVC pipe, on which safety symbols have been affixed.
Sulphuric acid pump has been placed in a drip tray. In the drip tray is a switching contact; if a leakage is observed, the pump stops and an alarm is generated.
A metal cover has been mounted around the pump connections. This cover ensures that sulphuric acid can never be sprayed into the environment if there is a leak.

Figure 4: Sulphuric acid pump

2.2.7 Emergency shower and other personal protective equipment

An emergency shower is located in the acid storage room of the air scrubber, in order to be able to immediately rinse the injured person in the event of a sulphuric acid accident. Shower is connected to the water supply mains. It is the responsibility of user to ensure that the main valve is always open, and that the line cannot freeze.
In addition, a safety cabinet has been supplied with personal protective equipment that should be worn when working with sulphuric acid. See paragraph 2.4.
Next to the safety cabinet is an eye wash bottle to be used to rinse the eyes in case of emergencies.

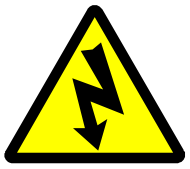
Figure 5: Emergency shower and safety cabinet

2.3 Pictograms

The air scrubber has the following pictograms:

WARNING

Replace any damaged or removed stickers as soon as possible.

Dangerous voltage Location: ▪ On the exterior of the electrical box in the technical room.	
Corrosive Causes serious injuries to eyes, skin, airways and gastrointestinal tract Location: ▪ Near the storage location of the acid containers; ▪ Near the dosing pump for the sulphuric acid; ▪ Near the position where the acid is supplied to the reservoir.	
Text plates These indicate which chemicals are present: ▪ H_2SO_4 = Sulphuric acid 96% Location: ▪ Near the storage location of the acid containers; ▪ Near the dosing pump for the sulphuric acid; ▪ Near the position where the acid is supplied to the reservoir; ▪ On the supply pipe between the acid storage and the air scrubber (every meter).	**H_2SO_4 (96%)**

Safety signs mounted in the following places as shown in Figure 6:

- All accesses to the technical room.
- All accesses to the room where the sulphuric acid has been stored.

Figure 6: Safety sign for the sulphuric acid area

The sign indicates the following:

- Corrosive material.
- Naked flame prohibited.
- 80 = hazard identification number for sulphuric acid (corrosive substance) this code is particularly important for the transport of chemicals.
- 1830 = UN-number (substance identification number) for sulphuric acid.
- No entry for unauthorised persons: Keep the room closed and locked.

Symbols shown for required Personal Protective Equipment near the acid containers and the acid pump:
These symbols are also present on the covers of the acid container and filter.

Figure 7: Local regulations for working with sulphuric acid

Symbols present for required Personal Protective Equipment near the supply point of the anti-foaming agent:

Figure 8: Local regulations for working with anti-foaming agent

Existing symbols for compulsory Personal Protective Equipment near the air scrubber (near the filter package sprinklers and under the packages, depending on the local situation):
This also applies as a warning for risk of slipping.

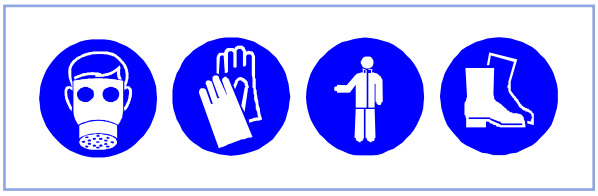
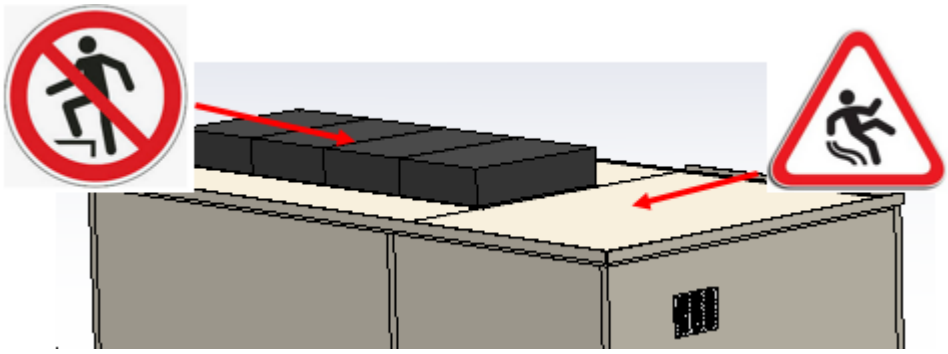


Figure 9: Local regulations at the scrubber



WARNING	ATTENTION
Do not stand on the drip catcher they cannot withstand load.	Observe all safety instructions when accessing the roof of the air scrubber.

2.4 Recommended Personal Protective Equipment (PPE)

2.4.1 Safety cabinet

The Air Scrubber is delivered with a safety cabinet (Figure 10). In this cabinet you will find the personal protective equipment required for any activities involving sulphuric acid.
The cabinet must be placed in a fixed location near the sulphuric acid storage.

WARNING

Periodically check the availability and condition of the PPE.
Anyone designated to work with the additives must know how to use the equipment and be familiar with the location of the cabinet.

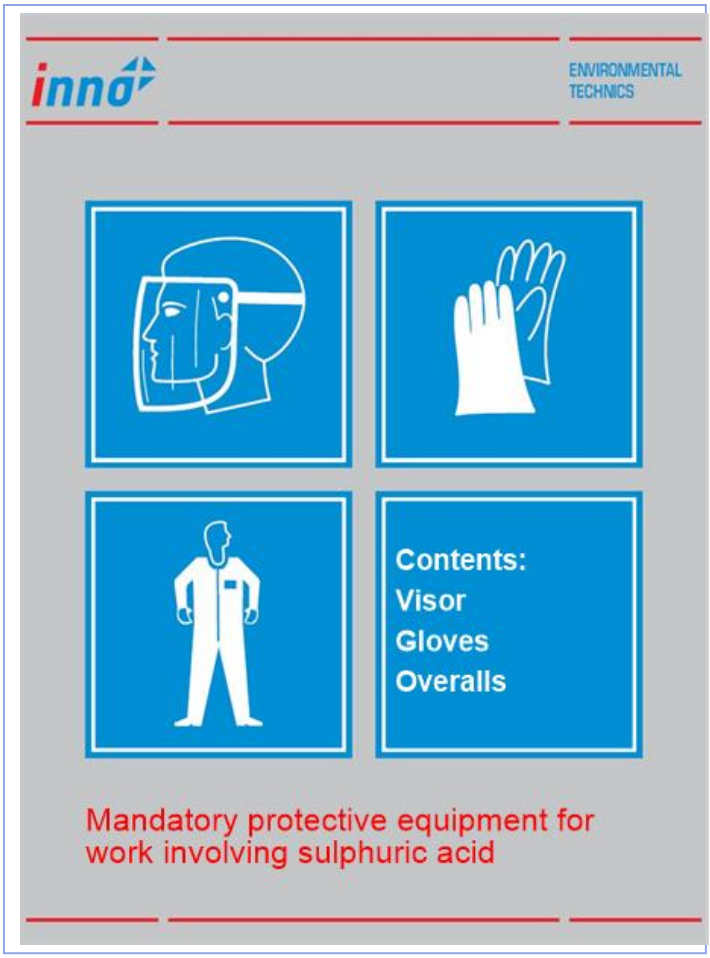


Figure 10: Safety cabinet with personal protective equipment

2.4.2 Personal Protective Equipment for activities involving sulphuric acid

Following Personal Protective Equipment is recommended for staff responsible for exchanging the acid tanks:

Eye and respiratory tract protection: ▪ Face shield or eye protection in combination with respiratory protection.	
Skin protection: ▪ Suitable gloves. Preferably use the gloves from the safety cabinet.	
Skin protection: ▪ Corrosion-resistant protective garments. Preferably use the apron from the safety cabinet.	

Materials that offer excellent protection against sulphuric acid are:
- Butyl rubber
- Polyethylene
- Tetrafluoroethylene

Less protection is offered by:
- Neoprene
- PVC
- Viton

Materials that offer poor protection are:
- Natural rubber
- Nitrile rubber
- PVA

WARNING

Do not eat, drink or smoke in the workplace.
After work, do not remove the gloves. Wash your gloved hands carefully first.
Then remove the gloves and wash your bare hands again.

2.4.3 Personal protective equipment for activities anti-foaming agent

Following personal protective equipment is recommended for staff responsible for exchanging the anti-foaming agent containers:

Eye protection: ▪ Safety glasses with side shields	
Skin protection: ▪ Suitable gloves against mechanical damage	
Skin protection: ▪ Fluid-resistant clothing	

ATTENTION

For working with Sulphuric acid and safety information see chapter 3.5

WARNING

Do not eat, drink or smoke in the workplace.
After work, do not remove the gloves. Wash your gloved hands carefully first.
Then remove the gloves and wash your bare hands again.

2.4.4 Personal Protective Equipment when working near the air scrubber

The following Personal Protective Equipment is recommended for staff responsible when checking and cleaning the air scrubber: This also applies to all locations where stable air and/or process water (or vapour) may be present, namely (depending on the local situation):

- In the pressure chamber
- Area near the package sprinklers
- Space under the packages, outflow of cleaning water
- Space above the packages where the purified air leaves the air scrubber.

WARNING

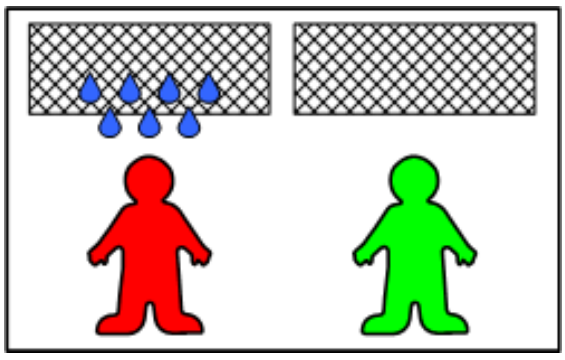
Do not eat, drink or smoke in the workplace.
After work, do not remove the gloves. Wash your gloved hands carefully first.
Then remove the gloves and wash your bare hands again.

TIP

Based on average use, weekly inspection and cleaning, ammonia mask filters normally have a lifespan of approximately 6 months.

Protection of the eyes and airways: ▪ Visor or eye protection, combined with respiratory protection or ammonia filter (for example FFABEK1P3D). Pay attention to the expiration date of the visor when removing the packaging!	
Skin protection: ▪ Suitable gloves. We recommend using the gloves in the safety cabinet.	
Skin protection: ▪ Non-corrosive protective clothing. We recommend using the clothes in the safety cabinet.	
▪ Acid resistant boots with non-slip soles.	

- The space under the filter packages must never be entered when the scrubber is in operation. The packages may be saturated with water, which would make it very heavy (especially in the case of excessive pollution). In exceptional situations, the structure might collapse.



2.5 Safety information Sulphuric acid

For working with sulphuric acid 51%-96% (EC-No. 231-639-5), the following warnings required by law apply:

R35 Causes severe burns.

S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

S30 Never add water to this product.

S45 In case of accident or if you feel unwell seek medical advice immediately (show the label where possible).

ATTENTION

Always read the information on the packaging and in the safety data sheets supplied by the manufacturer. They include first aid and safe storage

2.5.1 Action to be taken in the event of a sulphuric acid accident

In the event of inhalation:

- Never inhale sulphuric acid. At perception of smell, the exposure limit may already have been exceeded.
- Remove the casualty to fresh air, place in a half-seated position, and provide artificial respiration if necessary. Seek medical assistance immediately.

In case of eye contact:

- Immediately rinse with plenty of water for 15 minutes (remove contact lenses if necessary). Seek medical assistance immediately and continue rinsing during transport.

In case of contact with skin:

- First rinse with plenty of water, only then remove the clothing. In case of skin burns, do not pull off the clothing stuck to the skin.
- Flush again, seek medical advice and transport to hospital if necessary.
- Do not use (chemical) neutralisation agents, cover wounds in a sterile manner.

If ingested:

- Rinse out mouth, do not induce vomiting.
- Give two glasses water to drink and immediately transport to hospital.

TIP

In addition to this manual Inno$^+$ provides a set of safety data sheets for Sulphuric acid.

WARNING

Never dilute by adding water to the acid. Always add the acid to the water.

2.5.2 Cleaning up of spilled sulphuric acid

- Wear prescribed Personal Protective Equipment (see paragraph 2.4.2).
- The spilled product must be dammed up.
- Absorb it in an inert absorbent material (e.g. sand, but not sawdust) or neutralise it with bicarbonate (for example, soda, beware of reactions).
- Remove the reaction product with water.
- Drain away cleaning water to the sewer.
- Label any containers and dispose of them in accordance with local rules.

TIP

Inert = a fluid that does not react with any other material.

ATTENTION

See paragraph 3.4 for details on sulphuric acid storage.

2.5.3 Double-walled acid tanks

Only double-walled acid tanks may be applied (ask Inno⁺ for specifications). These tanks are safety inspected by the manufacturer annually. Tanks are equipped with a built-in suction tube, and have chemical quick couplers for connecting the suction pipe.

2.6 Anti-foaming agent safety information

Under normal conditions of use anti-foaming agent is not dangerous for humans and the environment. Nevertheless, the following advice applies:

- Avoid contact with the skin.
- Avoid contact with the eyes.
- Do not consume the substance.
- Ensure good ventilation in confined spaces.

First aid measures:

- Skin contact: wash off with soap and water.
- Eye contact: Rinse eyes thoroughly with plenty of water.
- Ingestion: Do not induce vomiting. Drink one or two glasses of water. If necessary, consult a physician.

Environmental precautions:

- Do not drain into surface water or sanitary sewer system.
- In case of fire: remove contaminated extinguishing water separately, do not drain to the sewer.

Cleaning spilled liquid:

- Absorb in inert absorbent material (e.g. sand, acid binder, universal binder, sawdust).
- Shovel into a suitable container for disposal.

Storage details:

- Store in closed packaging in a dry and well-ventilated place.
- Temperature must not be lower than 0°C.

TIP

Inert = a fluid that does not react with any other material.

2.7 Noise level

The noise level of the Air Scrubber is well below 70 dB (A). Measured on all sides of the cabin at a distance of approx. 1 meter from the exterior.

2.8 Certification

Air scrubber complies with Machinery Directive; supplied separately is the relevant CE declaration.

2.9 Specific use

- The Air Scrubber is designed to remove ammonia from the air out of stables, as described in this manual.
- The Air Scrubber may only be used if all safety devices are in place and in working order. They are described in § 2.2.
- Before carrying out any work, users must familiarise themselves with the available safety equipment (see § 2.2). The Air Scrubber must always be used professionally and responsibly.
- Make sure to remove unnecessary parts, materials or tools from the Air Scrubber during use.
- Unless otherwise specified, always fully switch off the Scrubber control system when carrying out maintenance, and lock the main switch with a pad lock.
- Keep the working area and technical room clean and make sure there is sufficient lighting.
- Always close the technical room and electrical box and keep them locked during normal use.
- Store the sulphuric acid in an approved, closed space with adequate ventilation.
- When cleaning the Air Scrubber always at least two persons must be present.
- The Air Scrubber requires regular maintenance. See the instructions in chapter 6 for more information. If the filter packages become excessively polluted, the water does not drain from the packages sufficiently. The resulting large weight gain may pose a risk to the stability of the structure.
- Keep access routes and stairs clear and dry to prevent freezing and/or slipping.
- Always respond promptly to alerts on the computer. A low pH value may be hazardous to the health.
- Always use original Inno^{+} components for maintenance and repair work.
- Observe any local regulations regarding disposal of drainage water polluted during the air scrubbing process.
- Always make sure there is plenty of absorption agent available to clean up any spilt sulphuric acid.
- If you detect any leakage, consult your Inno+ dealer immediately to discuss what actions must be taken. Clean up any chemical leakages in conformity with the instructions in § 2.5.2

2.10 Incorrect use

- No other chemicals or different chemical concentrations must be used, as prescribed in chapter 9.
- Maintenance of the process water circuits and components in the technical room must be carried out as described in this manual. Never experiment, but always consult your dealer for more information.
- Never climb onto the Air Scrubber during operation.
- Competent persons over the age of 16 must operate the Air Scrubber.
- During operation, limit time spent in the vicinity of the air scrubber. Do not enter the process area of the Air Scrubber while in operation.
- The technical room and computer settings ensure proper operation and the safety of the Scrubber. Never adjust any of the cleaning or process settings not described in this manual!
- Never add any chemicals to the process water by unless prescribed by Inno+ or your dealer.
- Never carry out any repairs on or modify the instrumentation or pipelines of the Air Scrubber. This can disrupt the process and cause dangerous situations. Always refer to the dealer.
- The machine must be earthed properly. Never remove any of the earth connections!
- Mechanical modifications of the Scrubber or pipeline, such as drilling holes, can cause damage to the Scrubber or hazardous chemicals to escape under pressure.
- Never bypass any safety devices such as fuses and never replace them with types that have other specifications.
- Make sure that the emergency shower and safety cabinet are freely accessible & functional.
- Do not use acid tanks that differ from the regulation in paragraph 2.5.3.

2.11 Other responsibilities of the user

- The following aspects are not covered by the delivery of Inno+. However, as these issues affect the safe use of the air scrubber, these areas are the responsibility of the user.
- All ingress and egress to the technical room must be lockable.
- User must provide a facility for the collection and/or disposal of process water should the reservoir overflow.
- Drain line of the drain silo must be provided with a valve that can be locked by e.g. a padlock. The large quantity of contaminated water can pose a risk to health and the environment should the silo empty unexpectedly and uncontrolled.
- The supply line to the drain silo should be built in such a way that it cannot be damaged easily.
- Always make sure that there is enough available storage capacity in the drain silo.
- To prevent hazards arising from external calamity, crash protection must be installed around the air scrubber construction and the drain silo (where applicable).
- Make sure there is sufficient lighting in all places where maintenance to the air scrubber must be carried out, as well as in the technical room.
- Ensure there is sufficient grounding for protection against lightning strikes.

3. SYSTEM DESCRIPTION

3.1 Air Scrubber: general set-up

The Air Scrubber cleans air from the CompoLiner manure treatment system and removes contaminants such as ammonia, bad odours and particulate matter.
The polluted air is blown through the filter pack of the Air Scrubber. A large amount of process water is continuously flowing through the filter package, which binds the ammonia. The process water returns to the reservoir and is pumped back to the filter pack.
The air that leaves the Air Scrubber again has been cleaned of the components for a large part; gradation depends on the system's configuration (for example, 70 or 95%).
As soon as the process water has reached a conductivity of 250mS (which indicates the process water can no longer absorb Ammonia), the system automatically drains a set amount of polluted process water.

The Air Scrubber is designed to automatically refill with clean water and chemicals. The Air Scrubber is also equipped with a Programmable Logic Controller, PLC in the Control Panel, installed in the technical room.

The scrubber is easy to operate, but it needs occasional maintenance.
Described in this manual are all necessary actions to take.

3.2 Operation

Figure 14 shows the Air Scrubber is built in a number of separate chambers:

- **Process area:** This is where the actual cleaning process takes place. It houses the water reservoir and filter packages.
  The contaminated air inlet is located on the side of the process area. The cleaned air leaves the process area through the top.

Figure 121: Filter pack with sprinkler pipes

The drip catcher collects any condensed liquid and it drips back to the process water. The air exhausted to the outside atmosphere can have an increased level of humidity.

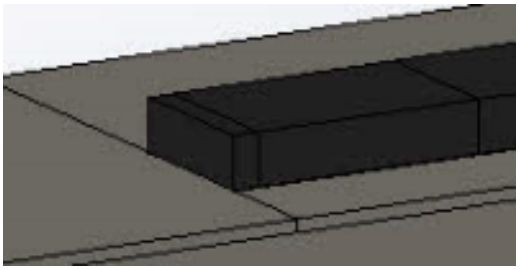


Figure 132: last stage (drip catcher)

- **Technical room:** This is where the process is monitored. Anti-foaming agent is added to the water here. In this area, the circulation pump, the pH sensor, conductivity sensor and the water valves are located. The control cabinet is installed here, housing the Programmable Logic Controller and other electrical components.

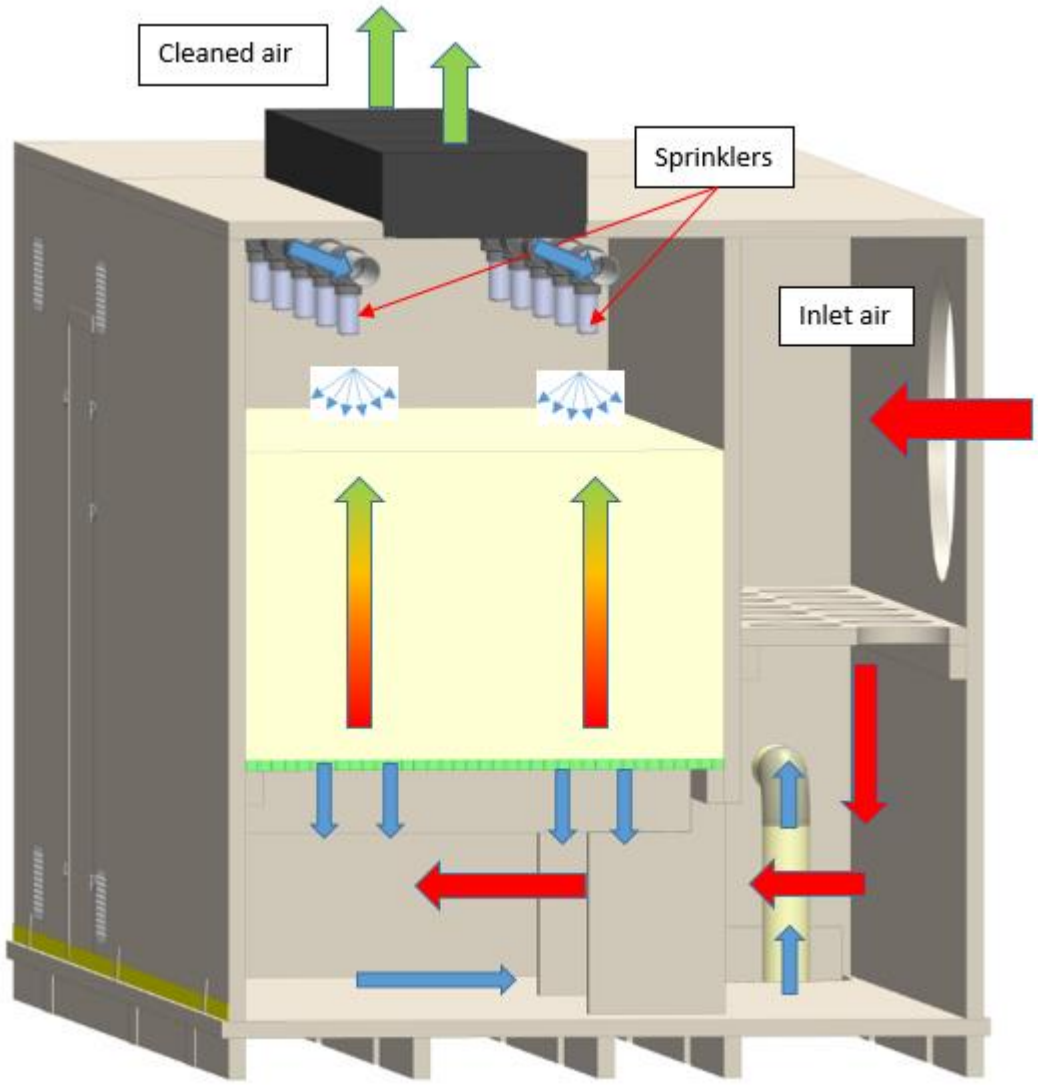


Figure 14: General Air Scrubber structure

3.3 The Air Scrubbing process

Figure 15 shows a schematic overview of the Air Scrubbing process.

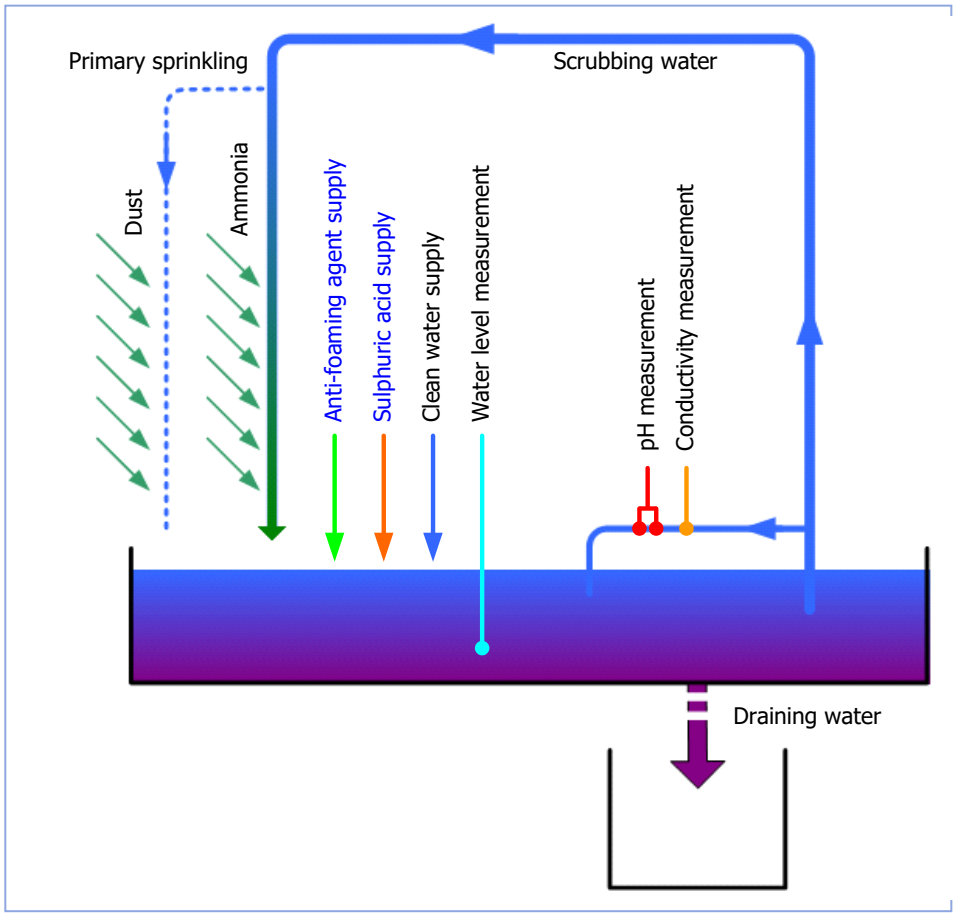


Figure 15: Air Scrubber fluid flows

A supply of fresh water fills the Air Scrubber reservoir.

- The following substances are added to the water:
  - Sulphuric acid, to increase the acidity and lower the pH value
  - Anti-foaming agent, to ensure that the washing water will not foam.

The process water containing the additives is sprayed continuously onto the filter packs.
The contaminated air flows into the process area then up through the wet filter pack. The air containing the ammonia is exposed to the process water. The ammonia is absorbed by the process water, and flows back into the reservoir.

Figure 16: Filter pall rings

The longer the system is operational, the more solid substance will arise in the process water.
As soon as the process water is contaminated beyond 250mS, reduction levels start to decrease. A portion of the water then drains automatically. The reservoir automatically fills with fresh water.
During the drain cycle, the process water still present is pumped around and over the packages.

The lower the pH-value of the process water, the better the ammonia is absorbed from the air.
Due to the ammonia-absorption, concentration of sulphuric acid in the water decreases. It will be increasingly difficult for the process water to clean the air. That is why new sulphuric acid is automatically added to the main sprinkler supply line. This is automated, by means of an acid pump.

Some water evaporates during the regular Air scrubbing process and some of the water is exhausted with the outgoing air.
The level control system provides an automatic supply of fresh water and keeps the water at the right level.

TIP

Key figures for chemical scrubbers:

- pH value during the cleaning process: pH2;
- Conductivity when saturated (start drainage): 250 mS/cm.

Conductivity of clean water is 0 mS/cm;

Instrumentation diagram

Figure 17 shows the control and monitoring equipment for the cleaning water.

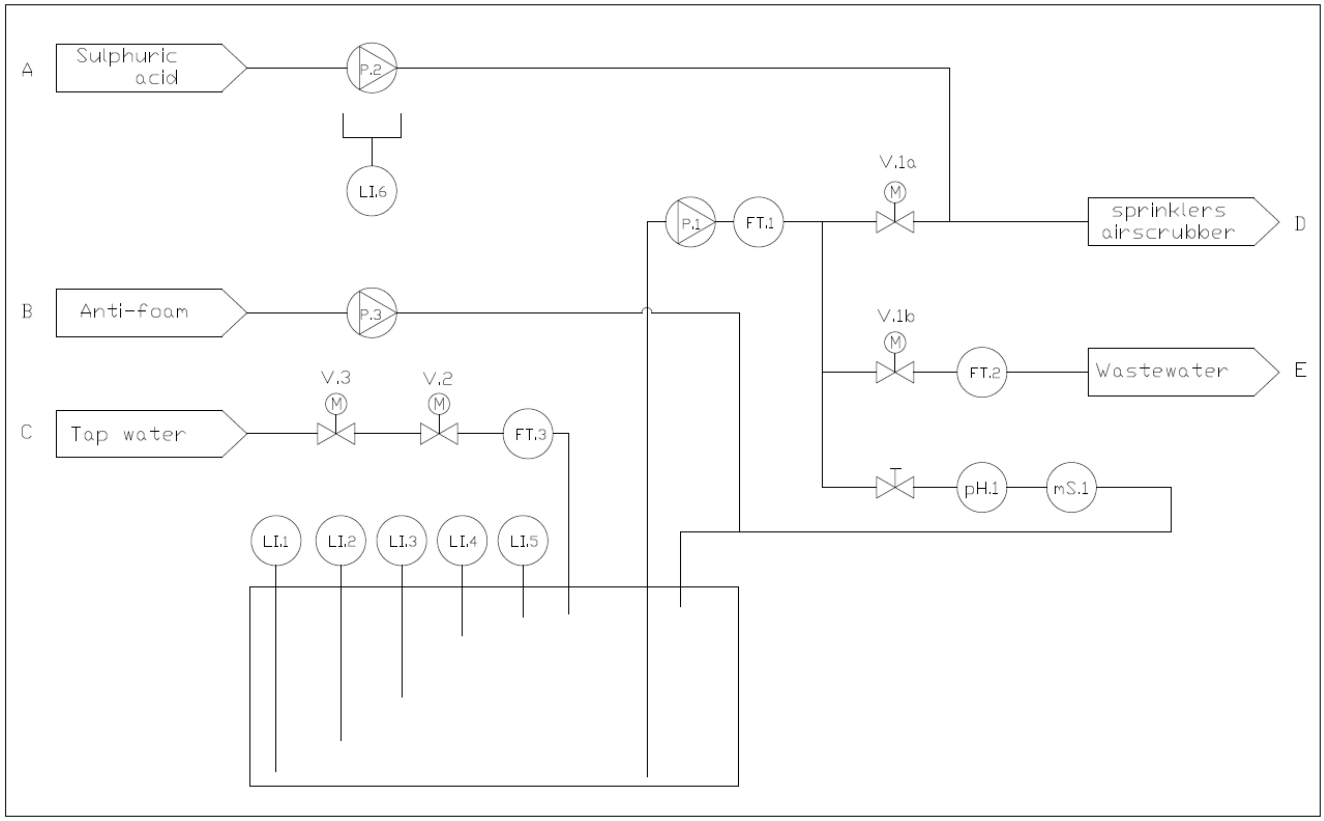


Figure 17: Process water process diagram

P.1 = Circulation pump process water
P.2 = Acid pump
P.3 = Antifoam pump
LI.1 = Minimum level float. Level is too low, pump stops, alarm.
LI.2 = Washer level float. The working level of the air scrubber, refilled with fresh water.
LI.3 = Pump Start level float. Pump cannot start below this level.
LI.4 = Drain level float. Water level too high, drain cycle starts.
LI.5 = Emergency float. Water level dangerously high. Supply closes. Alarm.
LI.6 = Drip tray acid pump leakage sensor. Acid pump stops, alarm.
V.1a = Wash water supply valve. During Drain cycle, this valve closes partly.
V.1b = Drain water valve. Opened when 250mS conductivity is reached.
V.2 = Water supply valve. Refills the reservoir with fresh water. The controller keeps the water level as constant as possible.
V.3 = Emergency valve. Closes water supply on Error, loss of power, LI.5 lifted.
FT.1 = Flow sensor. Monitors circulation. If below a set level, pump stopped. Caused by dirty or clogged sprinklers or filter.
FT.2 = Drain water meter. Measures the flow volume on counter.
FT.3 = Clear tap water meter. Measures the flow volume on counter.
pH.1 = pH sensor; constantly measures process water pH, sends mV signal to pH Controller in Control Panel. Sensor life span of 1 year. Replace after 1 year
mS.1 = Conductivity sensor. Sensor is connected with the PLC to show conductivity and control drainage cycles.

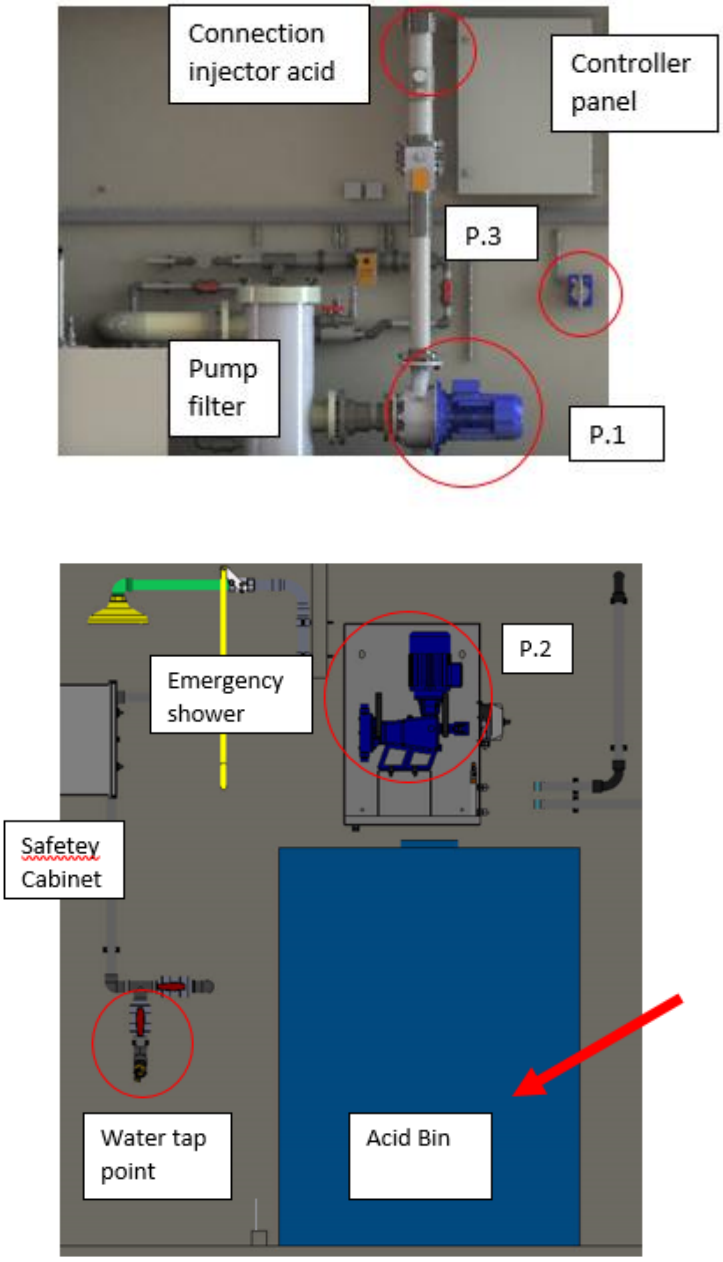
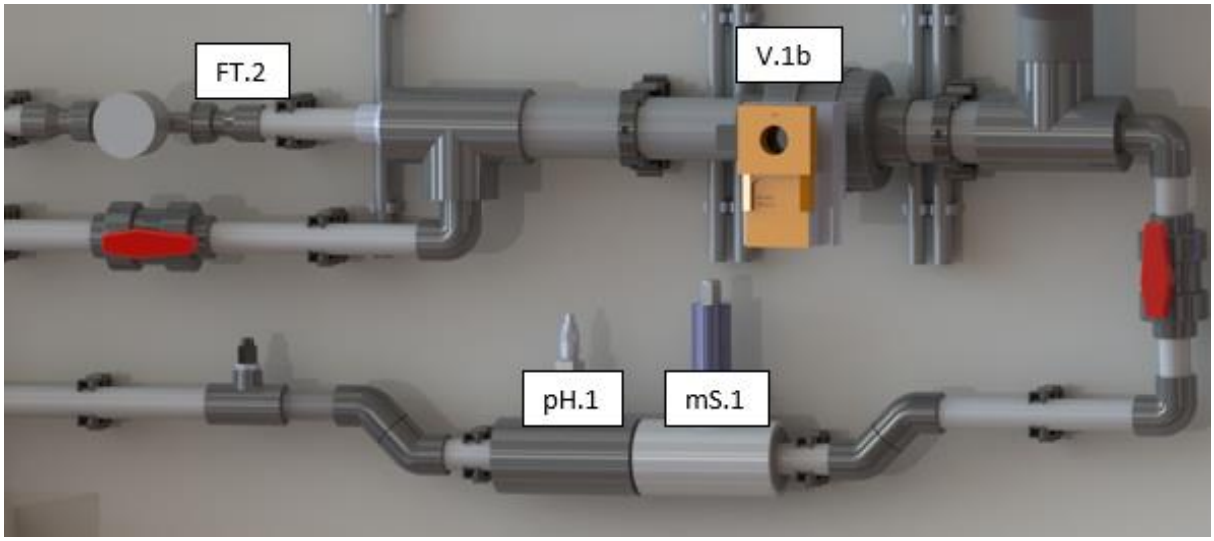
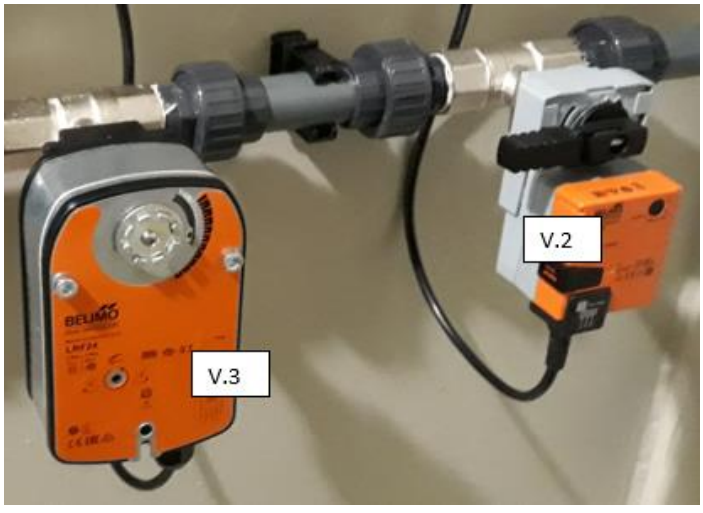


Figure 18: Technical room (top) Lockable storage room acid container (bottom)


LI.5
LI.4
LI.3
LI.2
LI.1


FT.1
V.1a


FT.2
V.1b
pH.1
mS.1


V.2
V.3


LI.6

3.4 Winterisation

For installations in cold climates, two 2kW heaters are installed. One in the Technical room and one in the Acid Room. These are to prevent freezing and damage.
Set these heaters to their lowest setting.

3.5 Sulphuric acid supply

Figure 19 shows how the sulphuric acid is supplied to the air scrubber, if a system with replacement containers is applied.

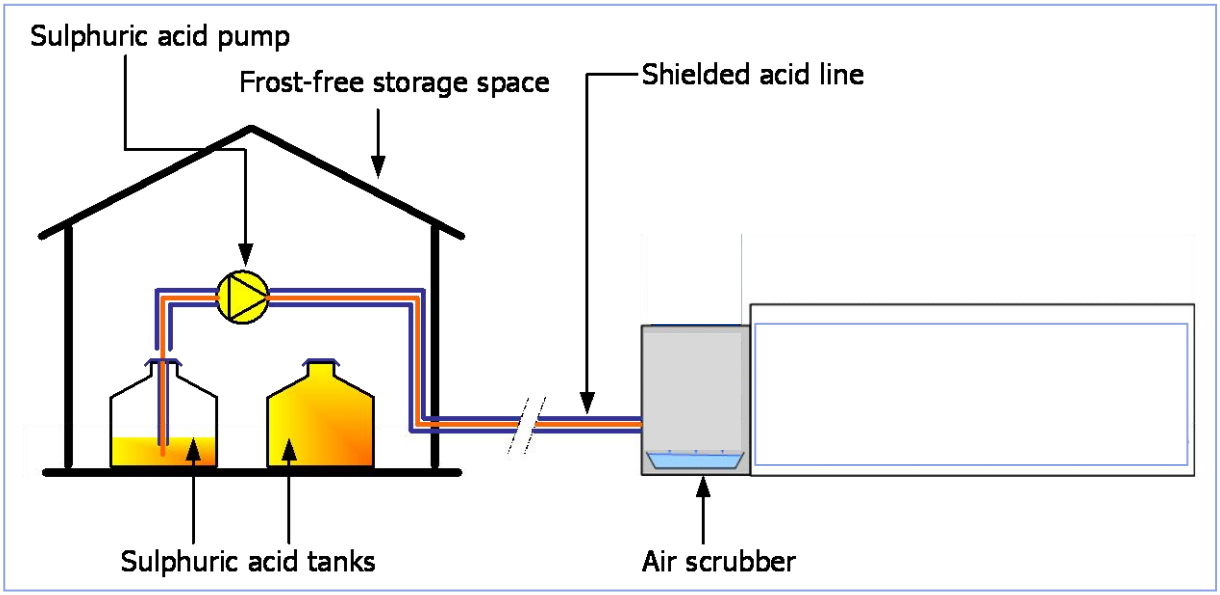


Figure 19: Supply of sulphuric acid

For this the main features are:

- Containers should be lined up in a well ventilated, covered and closed space with acid-resistant and impermeable floor.
- The temperature of the storage space must be at least 5°C. Heater is provided.
- Too cold storage can lead to problems when pumping the acid to the scrubber.
- Acid pump is located close to the tanks. Under the pump is a drip tray, in which a sensor that in the event of a leakage sends a signal to the PLC triggering an alarm.
- Acid pump is connected with a plug and socket that is part of the air scrubber control. As soon as the main switch of the control panel is switched off, the acid pump will always immediately switch off too.

WARNING

Sulphuric acid is highly corrosive.
It can cause serious personal injuries and serious damage to the environment.

WARNING

Prevent water contacting concentrated acid. As a result, vigorous reactions arise releasing harmful fumes.
These problems do not occur when adding acid in small amounts to a large amount of water.

- A check valve in the acid tank ensures that the acid cannot flow back from the pipe into the tank.
- Sulphuric acid line is connected to the Acid Injector installed in the main sprinkler line. This ensures that no water can flow back into the acid line.
- The acid line to the air scrubber can be quite long, and is placed in a solid PVC pipe to prevent mechanical hazards. Symbols have been affixed on the pipe that indicate that this is a sulphuric acid line.

ATTENTION

Refer to the instructions of paragraph 2.5.2 for instructions regarding the disposal of spills of sulphuric acid.

Figure 20: Sulphuric acid pump (left) and sulphuric acid tank (right)

Figure 21: Discharge injector

3.6 Control panel

Figure 22: Control cabinet

On the cabinet are the following components:

- Display: for process values and settings. For more information, see chapter 4.
- Main switch for the electrical supply of the entire system. Switch is lockable with a padlock to prevent energisation.
- Various alarm signal lamps (red).
- Switches for acid and antifoam pump. Automatic and manual.
- Push button with lamp, to start and stop system.
- Push button for reset alarms
- Inside, the PLC, motor protection group, pH Controller and other electrical components.

4. THE CONTROL PANEL

4.1 Display and buttons

Figure 23 shows the set-up of the display of the controller.

Current pH value

Set pH value

Current conductivity value

Set conductivity value

Buttons for controller settings or touch to switch backlight.

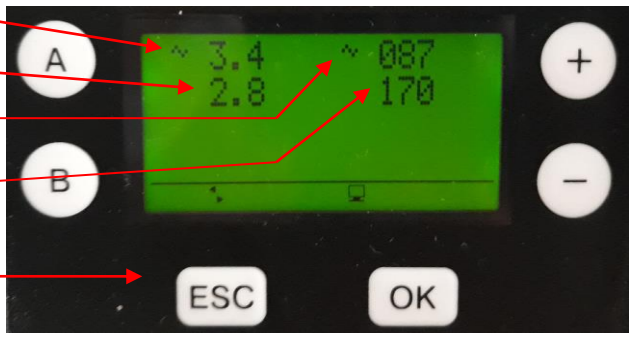


Figure 23: Display

Alarm lamps:

- Thermal fault pump
- Dry running protection pump
- Minimum level pump stops
- Emergency float lifted
- Runtime exceeded acid pump
- Acid leakage detection acid pump cabinet

Switches:

- Antifoam pump manual left, auto right.
- Acid pump manual left, auto right.

Pushbuttons:

- System on/off
- Reset alarm(s)

4.2 Switch system on.

When no red light is on or flashing then you start the system.

1. Fill filter pot with water to prime the system. Seal the filter pot is sealed.
2. Ensure the intake and process area are clear of all persons, animals and materials.
3. You can start the system by pressing the system on / off button. When one or more red lights are on then solve the problem before you start the system.
4. Monitor system flow and pressure closely when first starting.

5. ALARMS

5.1 How to recognise an alarm situation

The Air Scrubber Control System constantly monitors the entire installation to ensure proper operation. If one of the installation's components or controls malfunctions, the corresponding red alarm lights illuminates or flashes.
In such a situation, depending on the severity of the malfunction/error, the air scrubber will either switch off or remain operational.

To reset the alarm first resolve the malfunction. Push the reset button.

In the list below, you can see the different alarms.

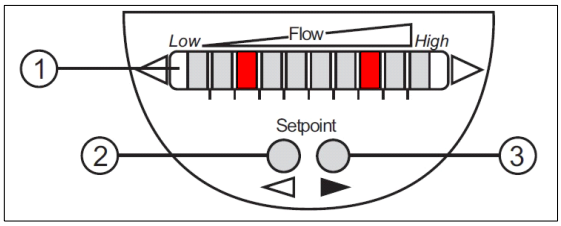
ATTENTION

It is important that the malfunction is first found and corrected before pressing the reset button. This is to prevent damage to the system. For more information, please read § 6.2.

5.2 List of alarms

Message code and meaning	H	Consequence and required action
Runtime exceeded acid pump Acid pump has been on for too long without interruption, without the pH reaching the pH setting. Possible causes: ▪ Sulphuric acid container is empty. ▪ There is air in the acid line. ▪ Valve of the by-pass is closed, because of which the process water cannot get to the pH-sensor. ▪ Acid pump is broken. ▪ This is a problem with the pH sensors.	■	➢ Check the acid container; replace if necessary. ➢ The manual valve in the bypass, make sure that it is at least 10% open the transparent tube must be filled with water. ➢ If the problem is still not solved, please contact Dealer

Message code and meaning	H	Consequence and required action
Acid leakage detection acid pump Liquid found in the drip tray under the acid pump. Possible causes: ▪ Tube connection not correct ▪ acid hose released ▪ Pump is defective ▪ pump head is leaking ▪ Sensor detection defective		➢ Deactivate pump and wear PPE before removing cover ➢ Clean the drip tray (read paragraph 2.5.2). ➢ Have the tube connections repaired by Dealer. ➢ At pump defective/leakage: consult Dealer.
Emergency high water level The reservoir level became so high that the emergency float was lifted causing the safety valve to close. Possible causes: ▪ A large supply of external water, rain water, cleaning water. ▪ The water supply valve is defective; it stays open. ▪ The water level float is defective ▪ The emergency float is dirty.	■	The system does not take any more water. The circulation pumps function normally. ➢ Check the main valve and water supply system. ➢ Clean the emergency float. ➢ If external water has entered the reservoir, partially drain the reservoir. ➢ If the problem cannot be solved or if the problem keeps recurring, contact Dealer.
Minimum Level pump stops There is not enough water in the reservoir. Possible causes: ▪ The water supply filter is blocked, insufficient water supply flow during filling. ▪ One or both valves are closed. ▪ Insufficient capacity water supply system. ▪ Water supply valve defective. ▪ Too much water evaporation loss. ▪ A large leak in the system.	■	➢ Check the main valve and water supply system. ➢ If the problem cannot be solved or if the problem keeps recurring, please contact Dealer. ➢ Check drip catchers ➢ Check for reservoir leaks
Pumps thermal The circulation pump has overloaded and was switched off thermally. The motor protection switch in the control cabinet has switched off. Possible causes: ▪ Pump damaged or seized up. ▪ Motor switch defective or configured incorrectly.		➢ Check pump motor is not wet. ➢ Consult Dealer.

Message code and meaning	H	Consequence and required action
Dry running protection pump Circulation pump delivers too little flow and is therefore deactivated. On the flow sensor, two red LEDs have turned red. The left led exactly indicates the dry running.  Possible causes: ▪ Reservoir is empty; ▪ Filter for the circulation pump is polluted; ▪ Sprinklers are clogged/contaminated	■	➢ Check water level and inlet valve (manual valve); ➢ Clean pump filter, see section 6.5.4; ➢ Clean Sprinklers

6. MAINTENANCE AND PREVENTIVE MONITORING

6.1 Safety

Unless otherwise indicated: take into account the following when performing maintenance:

- Take any unused additives/residue to a depot for chemical waste, in conformity with local regulations.
- Any spilt additives must be removed immediately with special materials, as specified in § 2.5. Remove the used granules in accordance with local regulations.
- Keep in mind that fans are located in the direct vicinity of the Air Scrubber.

WARNING

Always wear the Personal Protective Equipment specified in each section of this manual.

WARNING

Never flush sulphuric acid with water! If relatively little water is added to sulphuric acid this causes violent reactions.

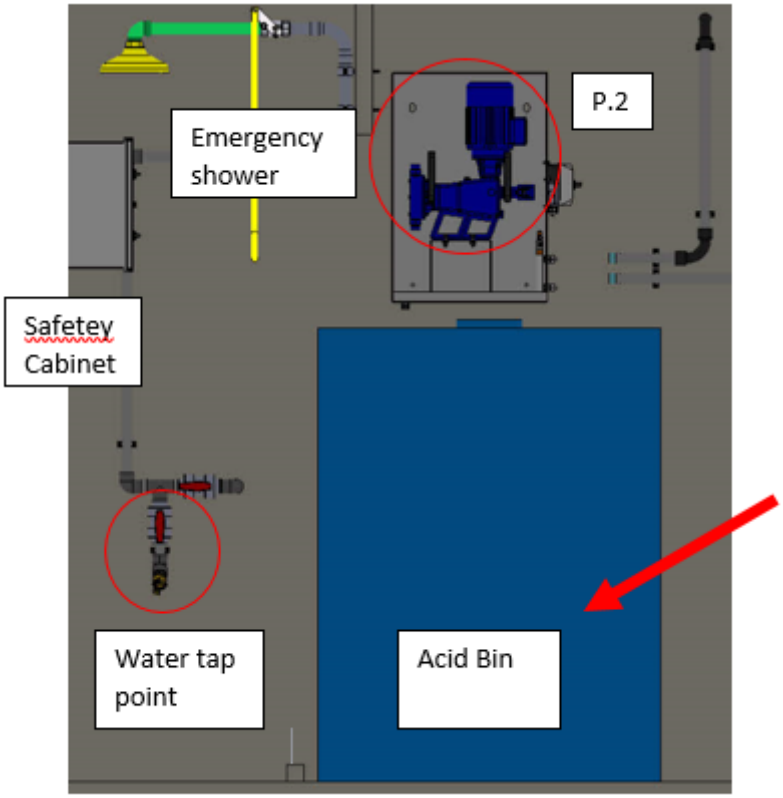
6.2 Maintenance overview

Maintenance aspect	See	Daily	Weekly	Monthly	Annually
Check sulphuric acid vat	§ 7.3.1	■			
Check flow over the circulation pump	§ 7.4.1		■		
Check anti-foaming agent	§ 7.4.2		■		
Inspection safety equipment	§ 7.5.1			■	
Cleaning: technical room	§ 6.5.2			■	
Cleaning sensors	§ 6.5.3			■	
Cleaning: circulation pump filters	§ 6.5.4			■	
Other checks	§ 6.5.5			■	
Major maintenance by Dealer as per maintenance contract, if any.	§ 7.6				■

6.3 Maintenance Daily

6.3.1 Check sulphuric acid bin.

Check the 7.5.1 contents of the sulphuric acid container.
If it is empty, refill as soon as possible.



WARNING

No water droplets from the shower may get to the acid.
On the floor there must be markings to position the acid vat.

WARNING

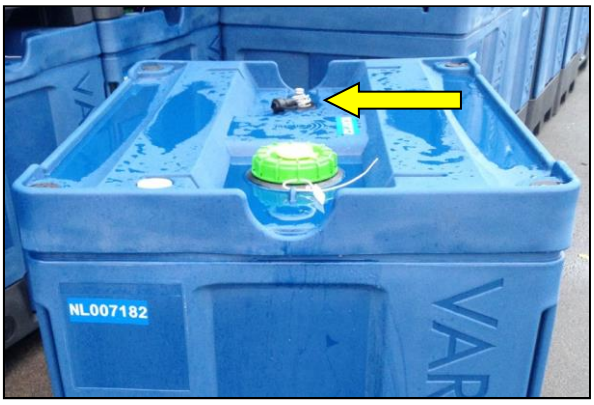
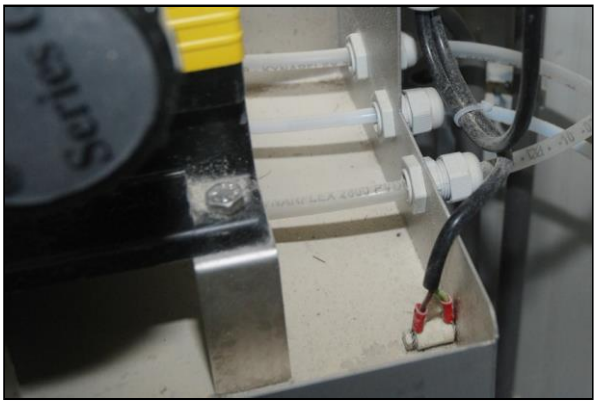
Wear prescribed personal protective equipment (see paragraph 2.4.2):

- Face shield combination with respiratory protection;
- Suitable gloves;
- Corrosion-resistant clothing.

WARNING

If no more sulfuric acid is present, there will be no ammonia reduction.
The concentration exhausted will be potentially high and toxic.

Replace an empty sulphuric acid tanks in accordance with the following procedure.

No.	Description	Photo
1.	➢ Place a new container in place of the empty container. ➢ Container must be flat on the floor, not on a pallet, temporary support or any other platform	
2.	➢ If present, remove the protective caps from the couplings. ➢ Disconnect the quick couplers from the empty container. ➢ Connect hoses to the new container.	
3.	➢ Remove the cover from the acid pump. ➢ Visually check for sulphuric acid in the drip tray underneath the pump. ➢ Replace the cover. If there is a leakage: ➢ Read paragraph 2.5.2 for cleaning up of the sulphuric acid. ➢ Contact your dealer to have the leakage repaired.	

ATTENTION

Refer to paragraph 2.6 for instructions regarding the disposal of Sulphuric acid spills.

WARNING

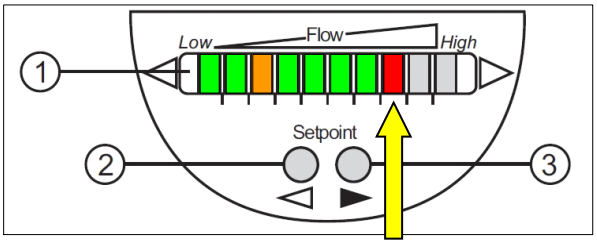
It is important to replace the cover. If there is a leak or a fault in the pump, this cover protects from splashes.

6.4 Maintenance Weekly

6.4.1 Check flow over the circulation pump

Check the flow meter to see if there is enough water over the sprinklers.
There must not be a red light on.
For a maximum flow over the pump, only green and orange lights must be on.

When the right (position) led is red then clean the filter of the pump chapter 7.5.4

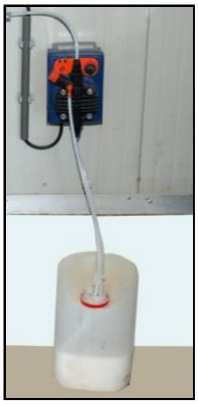
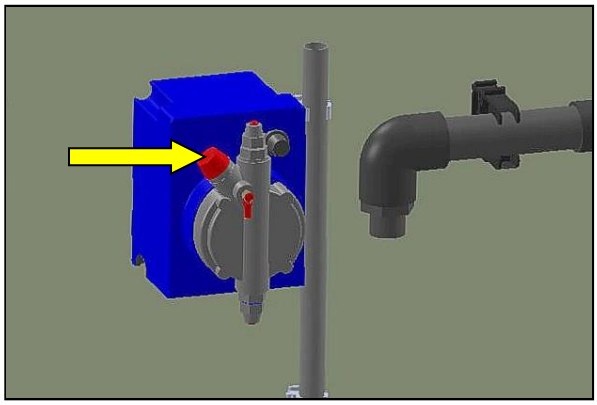


ATTENTION!

Monitor the overall status of the Air Scrubber approximately 2x a day, at first. After a while, you may want to decide to monitor only 1x a week, based on your own experiences and insights.

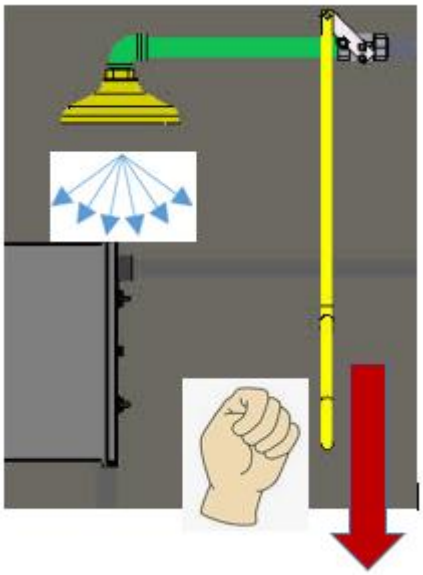
6.4.2 Check anti foaming agent

Replace an empty tank of anti-foaming agent in accordance with the following procedure

No.	Description	Photo
1.	➢ Place a new container as close as possible to the empty container. ➢ Unscrew the cap of the new container. ➢ Replace the suction hose from the empty container into the full container.	
2.	If the hose drained completely, it may be that the pump cannot suck from the container anymore. Then do the following: ➢ Turn open the knob. ➢ Via control switch on the anti-foaming pump. ➢ Wait till the pump head is filled with liquid. The liquid passes through the other hose back into the container. ➢ Close the knob again. ➢ Switch the pump back to **Auto**.	

6.5 Monthly maintenance

6.5.1 Safety equipment inspection

No.	Description	Photo
1.	➢ Check the proper operation of the emergency shower. ➢ Make sure that the supply valve is open.	
2.	➢ Check the contents of the safety cabinet.	

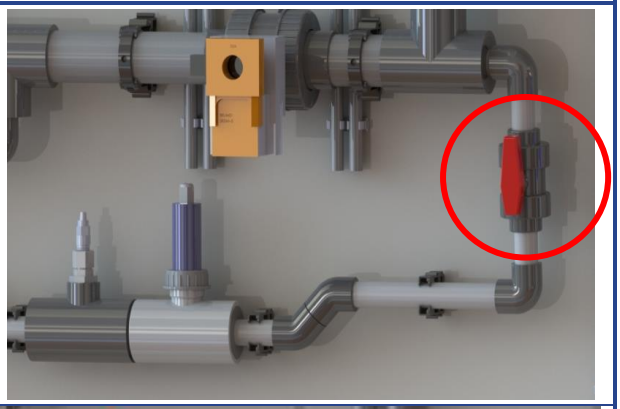
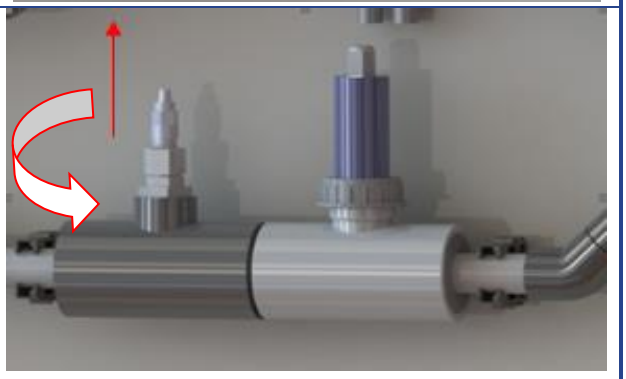
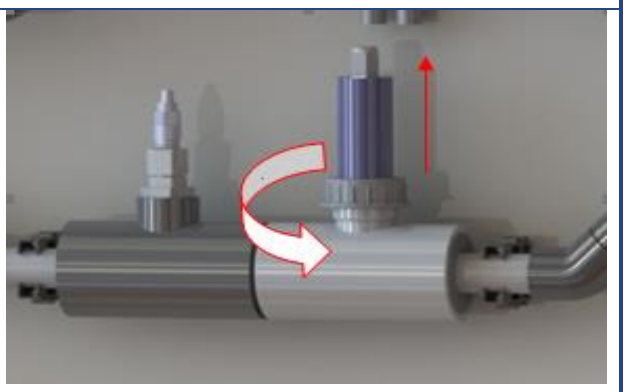
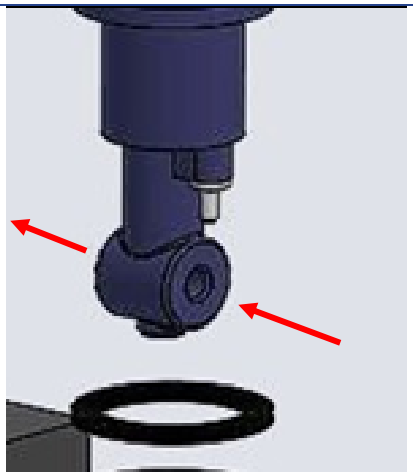
6.5.2 Cleaning the technical room

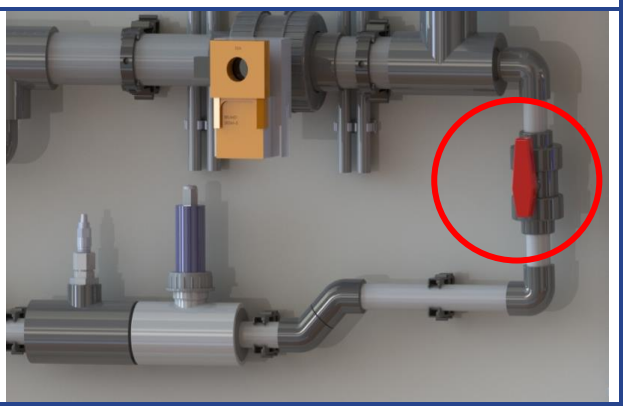
WARNING
Keep both feet firmly on the ground. Remember, the frames and pipes cannot support load.

CAUTION
▪ Do not use a high pressure cleaner, steam cleaner or water hose. ▪ Keep the control cabinet locked at all times. ▪ Keep al electrical components and motors dry. ▪ Do not step on the pipes.

No.	Description	Photo
1.	➢ Clean the technical room using a damp cloth and a soft brush. ➢ Dry any wet components immediately. ➢ Clean up any spilt chemicals in accordance with the safety precautions stated in chapter 2. ➢ Check the pipe system for any leakage. Qualified staff only must repair leaks.	
2.	➢ Check the ribs and intake grill of the pump motors for any excessive dust. Wipe them clean with a brush. ➢ Ensure intake grill is clear to pass air.	

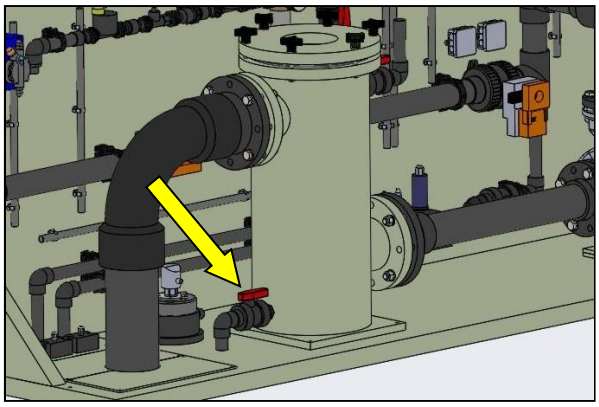
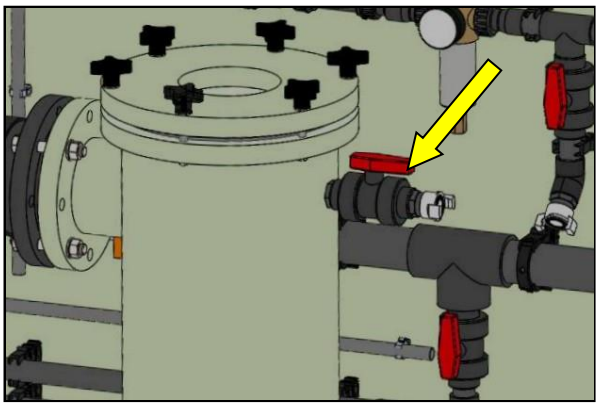
6.5.3 Cleaning the sensors

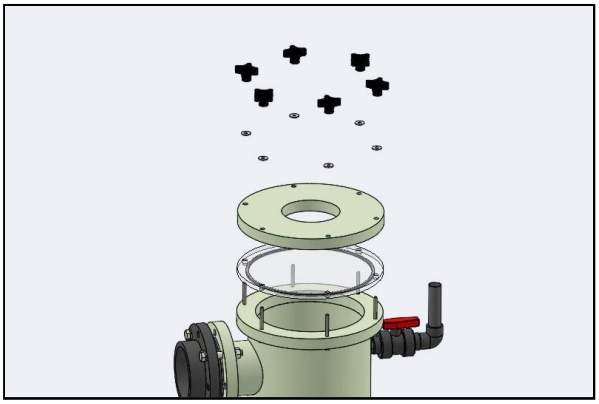
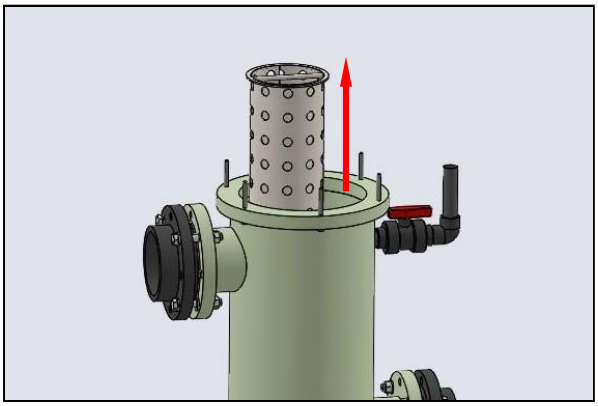
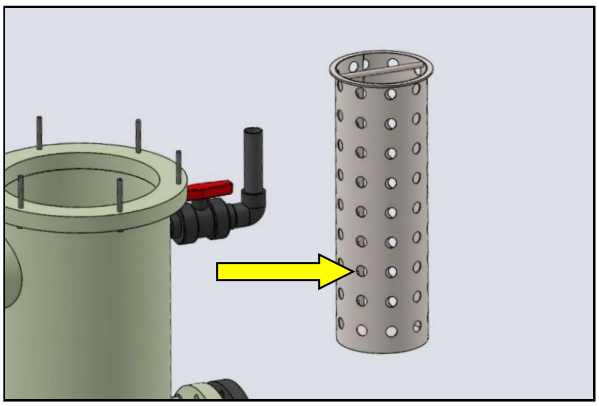
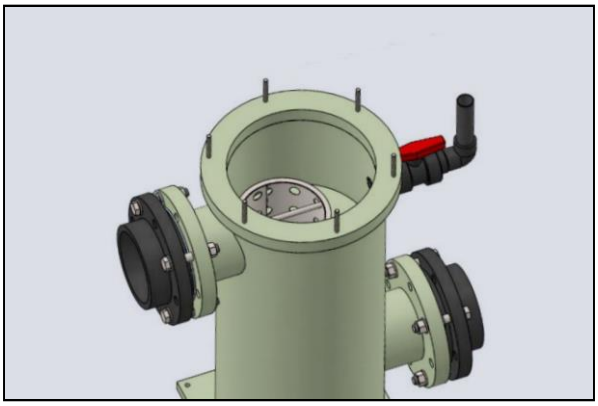
No.	Description	Photo
1.	➢ Turn the manual valve closed	
2	pH sensors: ➢ Loosen the swivel. ➢ Take care the sensor is made of glass, and must be carefully taken out in vertical direction. ➢ Remove the sensor and clean it with a damp cloth. ➢ Place the sensor back, carefully ➢ Tighten the swivel, hand tight only	
3.a	Conductivity sensor: ➢ Loosen the large swivel nut. ➢ Remove the sensor. ➢ There is a rubber gasket between the positioning block and sensor, do not lose it. ➢ Carefully clean the sensor using a damp cloth.	
3.b	➢ Place the sensor back in the block, keeping in mind the right order: ▪ Remember the flow direction; in this photo, indicated with a red arrow. ▪ Position the sensor in such a way that the channel in the sensor tip matches the flow direction. ▪ Align the metal part of the sensor with the inflow side. ▪ Tighten the swivel hand tight.	

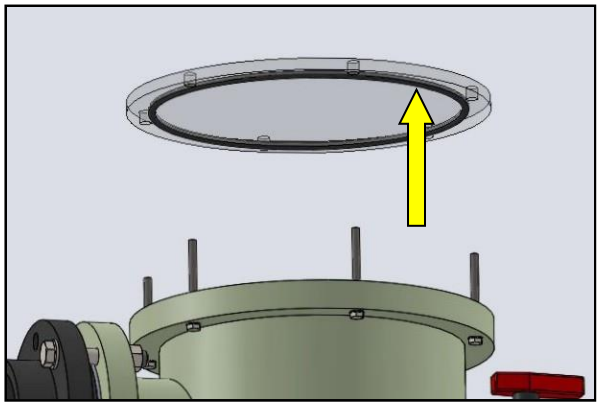
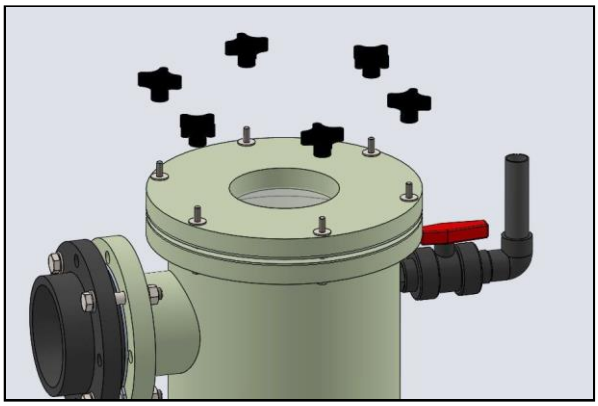
No.	Description	Photo
4.	➢ Turn the manual valve for a minimum of 10% open, keep opening until the transparent tube is completely filled with water.	

6.5.4 Cleaning the circulation pump filter

WARNING	WARNING
Wear prescribed Personal Protective Equipment: ▪ Face shield ▪ Suitable gloves ▪ Corrosion-resistant clothing	When the air scrubber is switched off, no air scrubbing is taking place. Air outside may be toxic.

No.	Description	Photo
1.	➢ Switch off the system by pressing the start / stop push button.	
2.	➢ Open the lower drain valve of the water filter. Water in the filter casing can flow back into the reservoir now.	
3.	➢ Gradually open the upper venting valve to allow the filter to fully drain. ➢ Close both valves once the water has fallen to the top of the filter basket.	

No.	Description	Photo
4.	➢ Unscrew the screw buttons. ➢ Remove the flange and the cover.	
5.	➢ Pull the filter basket from the filter casing.	
6.	➢ Carefully clean the filter basket.	
7.	➢ Place the filter basket back into the filter casing. ➢ Carefully clean the top of the filter casing. ➢ Fill the filter casing with water, up to intake pipe.	

No.	Description	Photo
8.	➢ Make sure that the O-ring is clean and fits tightly into the slot of the lid. ➢ Put the lid back onto the filter casing, with the O-ring facing the filter casing edge.	
9.	➢ Place the flange on the cover. ➢ Put the washers on the studs. ➢ Mount the screw buttons. Evenly and crosswise. ➢ Tighten fasteners hand tight only.	
10.	➢ Switch on the system by pressing the push button. ➢ It may take some time before the pump is switched on if start-up water level has not been reached.	

6.5.5 Other checks

- Check all the piping for leaks
  - Clean water lines
  - Drain line
  - Sulphuric acid line
  - Anti-foaming line
- Check if all warning symbols and stickers are still present. Replace it if required.

6.6 Annually

CAUTION

- Never use a high-pressure cleaner or a steam cleaner. This can cause damage. Always use a maximum water pressure of approx. 10 bar.
- Do not step on the pipes.

WARNING

- Always wear the Personal Protective Equipment described in § 2.4.4.
- A second person must be present, to come to the rescue if the first person should become unwell. The second person must not enter the air scrubber during cleaning / maintenance operations, and must be able to call for assistance.

7. DISPOSAL AND RECYCLING

If the Air Scrubber is to be decommissioned, it must be disassembled. Take into account the following pointers:

- Clean the Air Scrubber.
- Dispose of the tanks with additives in accordance with local regulations.
- Disconnect the mains supply and make sure it cannot be activated accidentally.
- Disassemble the pumps, measuring equipment, and any other accessories.
- Dismount acid lines and hoses. Empty and clean them thoroughly to ensure no acid remains. First, read paragraph 2.5 for more information.
- Work from top to bottom when disassembling the Air Scrubber. Use proper aids and tools to do this and work safely.
- All components must be disposed of in accordance with local regulations, and preferably, taken to a recycling company.

WARNING

Prior to disassembly:
Designate a person that is responsible for the operation and safety.
This person must ensure that measures are taken to prevent the risk of falling.
The person must also ensure that no one gets under the cleaning packages without reason.

8. WARRANTY AND LIABILITY

In accordance with the order, Inno+ provides a warranty for the equipment and components only. The warranty is only valid if the Air Scrubber maintained in top condition in accordance with the guidelines in this manual. Skilled and qualified personnel are required to carry out operational activities.
Wearing and non-durable parts are not covered by the warranty.
Inno+ cannot be held liable for any unsafe situations, accidents or damage as a result of:

- Any damage or loss, of any nature, suffered by the user or any third parties, resulting from or in connection with the use or inability to use the Air Scrubber and/or documentation.
- Ignoring warnings or regulations stated on the Air Scrubber or in this documentation.
- The use of the Air Scrubber for purposes or situations other than those indicated in this documentation.
- Any modifications made to the Air Scrubber that have not been agreed upon in writing by Inno+.
- The use of unoriginal and/or deviating additives / chemicals.
- Required periodical maintenance not carried out in time. For example: the filter packages gather considerable weight if they are not cleaned properly. The extra weight can damage the system structure.
- Water and/or chemical damage to the technical room, buildings or animals because of leakage or spilt fluids that were not rectified and or cleaned immediately.
- Damage to the environment, buildings and crops because of a malfunctioning Air Scrubber.
- Maintenance, settings, and/or repairs carried out by unskilled, unqualified people.
- Disassembled, by-passed or deactivated safety equipment/precautions.
- Lightning strikes.

9. TECHNICAL SPECIFICATIONS

The Air Scrubber has the following specifications:

Main dimensions	L x W x H 9540mm x 2250mm x 2500mm
Framework material	PP Polypropylene
Supply voltage mains	3x 200V 60Hz Neutral and Earth or 3x 230/400V 50/60Hz Neutral and Earth
Max. energy consumption	4 kW
Supply voltage heating/lights	2 connections 200/230V 50/60Hz 2 kW
Water consumption	See delivery certificate
pH value inside the Air Scrubber	2
Sulphuric acid to be used (H_2SO_4)	Concentration 96 - 98%
Consumption of sulphuric acid (H_2SO_4)	See delivery certificate
Anti-foaming agent to be used	Anti-foam
Storage anti-foaming agent	T > 0°C
Storage sulphuric acid	T > 5°C
Cleaning Capacity	300 ppm Ammonia NH_3 @ 30.000m^3/h