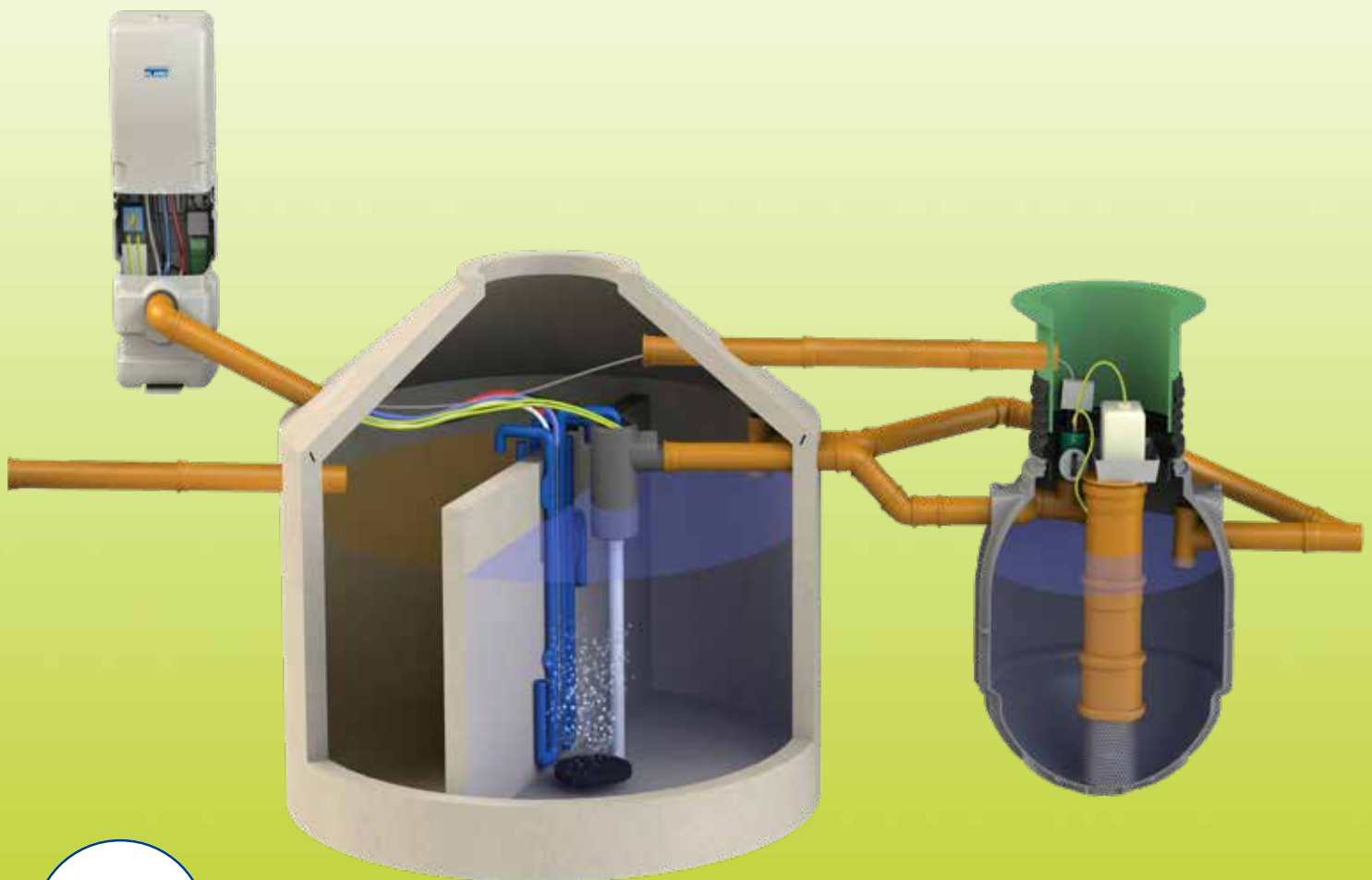


Assembly instructions & operating manual

for KLARO e-chlorination



GERMAN
DESIGN AND
ENGINEERING



No mechanical parts
in the wastewater



No pumps
in the wastewater



No electrical parts
in the wastewater

Assembly instructions & operating manual

for KLARO e-chlorination

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1. KL E-chlorination - Product description

The KL E-chlorination system is designed for a disinfection of biological treated domestic wastewater with liquid chlorine solution. It is installed downstream of a KLARO biological sewage treatment plant (STP). The system works with a robust flow sensor and a dosing unit. The sensor unit is integrated into the clear water discharge pipe. Once clear water flows through the pipe two electrodes activate the chlorine dosing pump which disinfects the water with liquid chlorine solution.



Figure 1: KL E-chlorination (dosing unit and sensor unit).

The clear water discharge from the SBR is executed with an airlifter. There are no electrical components inside of the SBR system needed. The KL E-chlorination is plugged into a power socket. It works independently of the control unit. Therefore the system can be operated in combination with all KLARO control units. With the dosing pump the chlorine consumption may be adjusted individually. This assures an ideal chlorine dosing rate.

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1.1. Working principle and Features

- When water is discharged from the SBR, two electrodes activate a waterswitch.

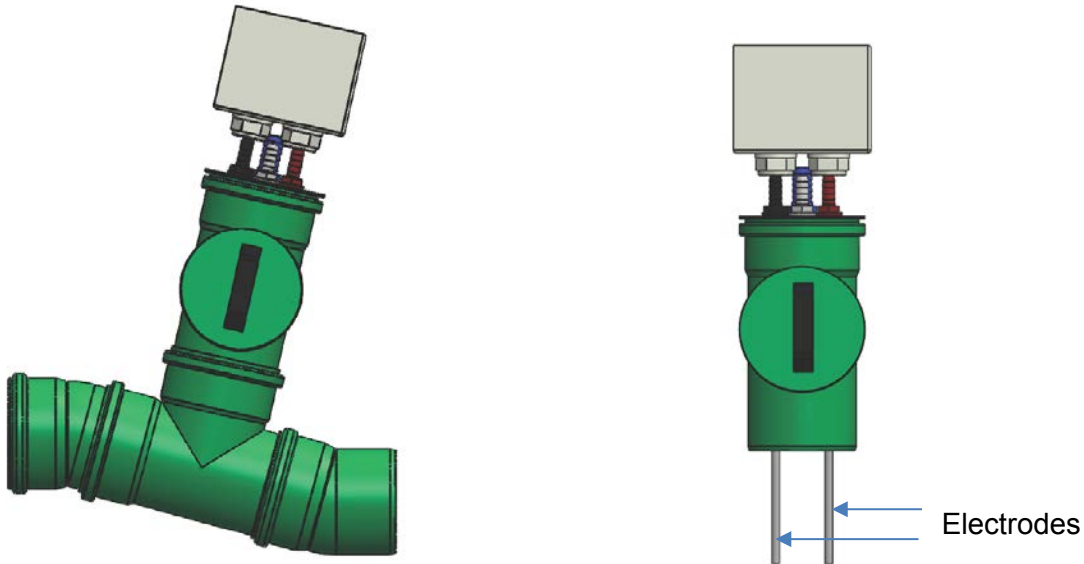


Figure 2: Sensor unit of the KL E-chlorination.

- As soon as the electrodes are activated, the chlorine dosing unit pumps hypochlorite solution into the chlorine contact tank.
- If no more treated wastewater is discharged from the SBR, the electrodes will no longer be in contact with water. The dosing pump will stop working.
- The inclination of 15° prevents an accumulation of water in the pipe so that an unintentional activation of the chlorine dosing will be prevented.
- **Emergency shutdown:** In case both electrodes are unintentionally electrically connected after the clear water discharging process (e.g. if a wet wipe is winded around both electrodes) the chlorine dosing pump will be switched off automatically after 30 minutes. Once the non-intended electrical connection is removed, the module will switch back to its normal operation automatically.

2. Components and setup



Figure 3: Delivered components for KL E-chlorination.

1. KL E-chlorination:
 - Sensor unit with electrodes and the green fittings.
 - Dosing unit with dosing pump and auxiliary control.
2. Accessoires:
 - 25 m dosing hose 6 mm
 - 10 l drip pan
 - 3 self-drilling screws
 - Foot valve 4x1 mm
 - Hose connector
 - Peristaltic hoses (PS 138-3,2x1,6 for higher dosing rates)



3. Components for chlorine contact tank baffling (optional)
4. Preinstalled chlorine contact tank (here: Saphir Tank 900) (optional).

Note: Canister with chlorine solution is not included.

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Figure 4 shows the general setup of the KL E-chlorination system. The KL E-chlorination module can be installed downstream of any KLARO SBR plant. The necessary chlorine contact tank can be made of plastic or concrete.

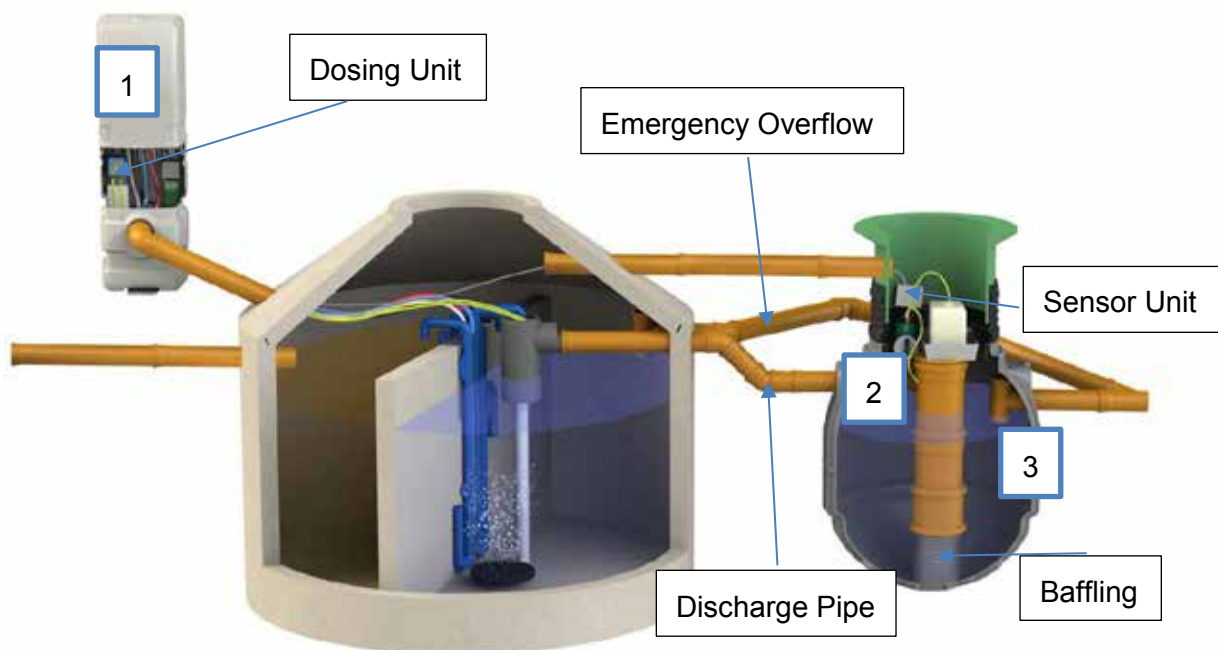


Figure 4: General Setup of KL E-chlorination in SBR concrete tank and Saphir 900 contact tank.

- The sensor unit (electrodes and green fittings) (2) is installed in the inlet pipe of the chlorine contact tank (3). **The sensor unit must be installed before the chlorine dosing point. The electrodes must not get in contact with the chlorine solution.** The sensor unit is connected with a 10 m cable to the dosing

unit (auxiliary control and chlorine dosing pump) (1) in an outside cabinet or a control chamber close to the STP.

- Once water flows into the contact tank the sensor unit is activated and the chlorine dosing pump (1) pumps liquid chlorine solution into the contact tank.
- The chlorine contact tank shall be baffled to ensure sufficient contact time for a safe disinfection (see 3.3).
- Chlorine solution (not included) can be stored inside the chlorine contact tanks manhole shaft (see 3.3).

3. Installation of the KL E-chlorination module

3.1. General information

A chlorine contact tank is necessary to provide enough retention time after the liquid chlorine addition for a reliable disinfection process prior to discharge or overflow.

Important:

- Retention time should be > 30 minutes
- The tank capacity for should be minimum one batch of the SBR system.
- Short circuiting should be avoided
- Disinfected water, as well as the the chlorine solution should be stored in a dark and cool place

3.2. Positioning and piping

Install the chlorine contact tank in a way that the treated wastewater can flow by gravity through the outlet pipe from the SBR into the chlorine contact tank. In order to ensure a stable operation of the KL E-chlorination an emergency overflow bypass is necessary. In case of an overflow of the bioreactor the emergency overflow protects the chlorine tank and the sensor unit inside the tank (see Figure 4).

The overflow pipe has to be on a lower level than the discharge pipe.

In a Carat tank the emergency overflow is realised by extending the Clearwater discharging airlifter. The airlifter pumps the treated wastewater on a higher level in the outlet pipe which is connected to the dome (Figure 5 and Figure 6). This discharging pipe leads to the chlorine contact tank. The emergency overflow is located on the former outflow of the discharging pipe. The minimum water level inside of the Carat tank remains the same.

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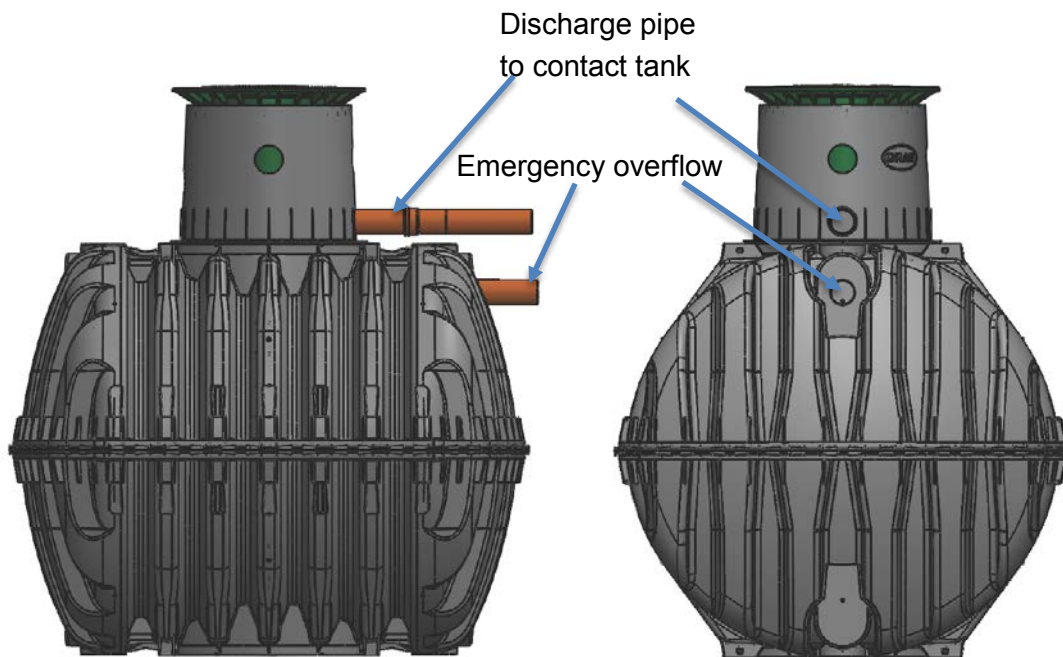


Figure 5: Pipe arrangement in the bioreactor before the KL E-chlorination.

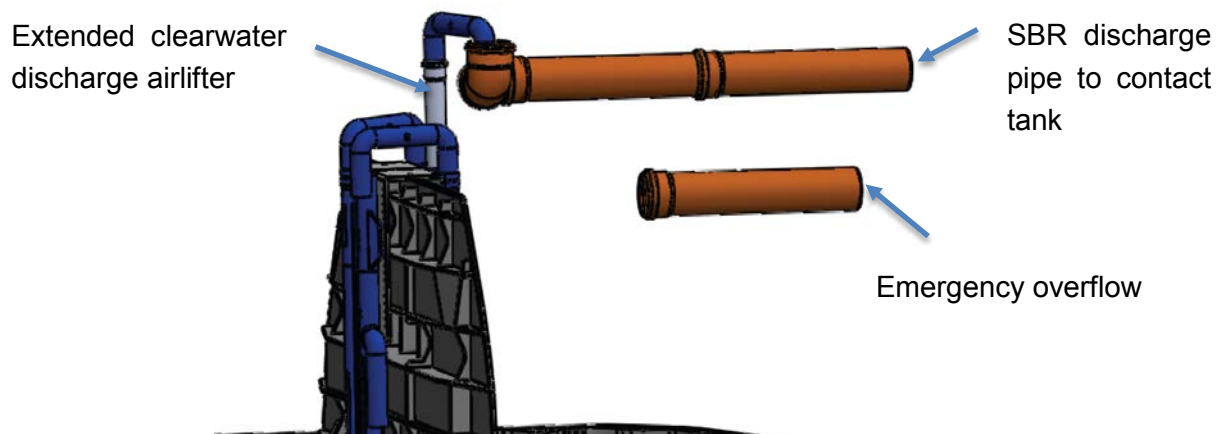


Figure 6: Arrangement of the extended airlifter and pipes inside of the Carat tank.

Install the outflow pipes and the Clearwater discharge lifter as shown in Figure 6.

In the following table the needed additional length of the airlifters are shown. The airlifter has to be extended by this length with the delivered extensions.

Tank	Mini Dome	Maxi Dome
	[mm]	[mm]
Carat 3750	230	230
Carat 4800	320	320
Carat 6500	340	340

Table 1: Needed extension of the Clearwater discharge lifter in a Carat tank.

3.3. Baffling and inner mounting parts in contact tank

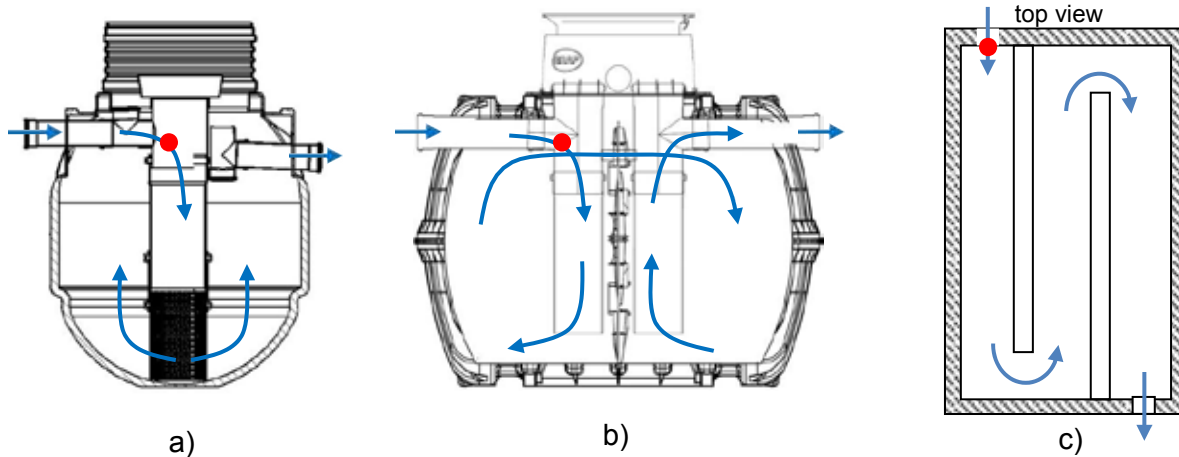


Figure 7: Examples of different baffling systems to avoid short circuiting in the chlorine contact.

• point of chlorine dosage;

→ water flow;

a), b): vertical baffled plastic tanks; c) horizontal baffled concrete tank .

Place the canister with chlorine solution inside the contact tank's manhole shaft as shown in

Figure 8. Therefore use the two self-drilling screws and the drain tray to fix it onto the DN 250 socket plug inside the chlorine contact tank (see accessories section 2).



Figure 8: Mount the drip pan onto the plug connection in order to store the bleach solution inside the chlorine tank.

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3.3.1. Tank dimensions

In Table 2 some examples for different chlorine tanks are shown.

Table 2: Examples for some tank settings for the KL E-chlorination unit.

Tank	PE	Qd	Capacity total	4 cycles	3 cycles	2 cycles	1 cycle
	PE	m ³ /d	m ³	m ³	m ³	m ³	m ³
Saphir 600	5	0,75	0,54	0,23	0,30	0,45	
	10	1,50	0,54	0,45			
Saphir 900	5	0,75	0,79	0,23	0,30	0,45	
	10	1,50	0,79	0,45	0,60		
	15	2,25	0,79	0,68			
Saphir 1200	5	0,75	1,09	0,23	0,30	0,45	0,90
	10	1,50	1,09	0,45	0,60	0,90	
	15	2,25	1,09	0,68	0,90		
	20	3,00	1,09	0,90			
Carat 2.700L	10	1,50	2,65	0,45	0,60	0,90	1,80
	15	2,25	2,65	0,68	0,90	1,35	
	20	3,00	2,65	0,90	1,20	1,80	
	25	3,75	2,65	1,13	1,50	2,25	
	30	4,50	2,65	1,35	1,80		
	35	5,25	2,65	1,58	2,10		
	40	6,00	2,65	1,80	2,40		
	45	6,75	2,65	2,03			

3.4. Installation of the KL E-chlorination sensor unit

The sensor module (green elements) is prefabricated by KLARO and has to be installed in the inflow pipe of the chlorine contact tank (Figure 9).

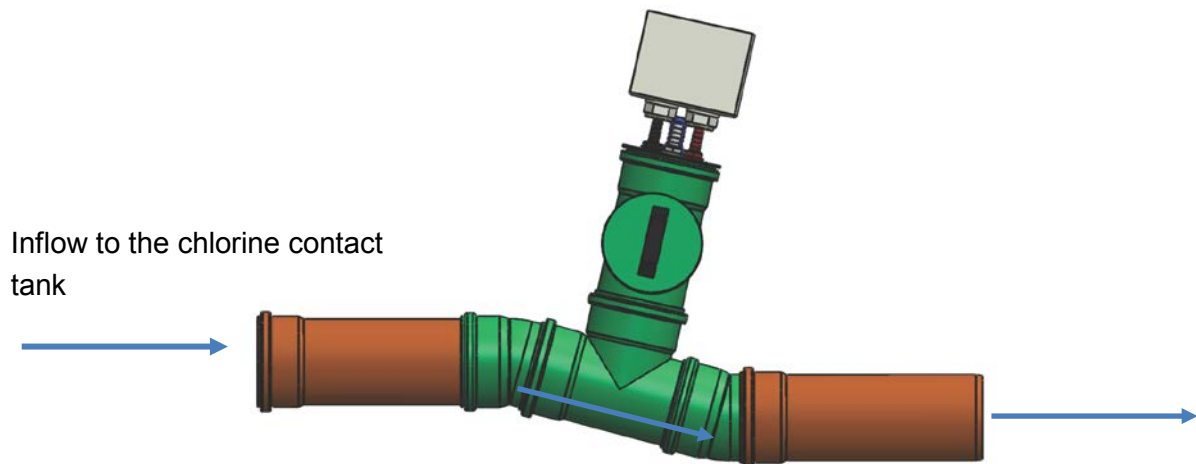


Figure 9: Installation principle of the KL E-chlorination sensor unit.

It is important, that the 15° inclination is assured, so that no water is accumulated in the module. The module has to be installed in an upright position and the electrodes have to be positioned in flow direction (Figure 10).

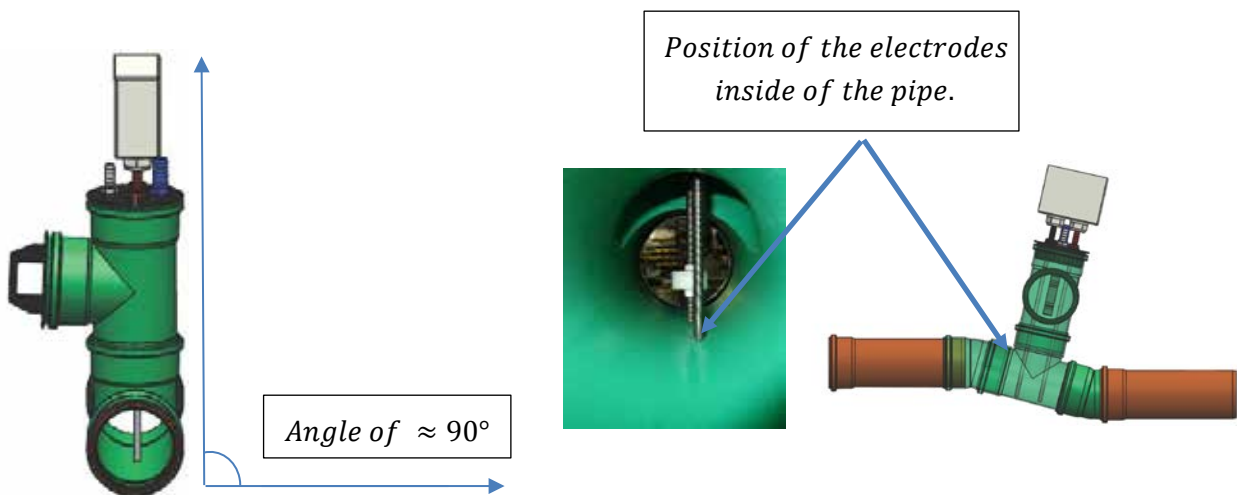


Figure 10: Upright position of the sensor unit inside the pipe and electrodes in flow direction position.

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IMPORTANT: It has to be assured, that the electordes are only submerged in the water during the clearwater discharge from the SBR. Therefore the following measures must be kept:

- The height difference between the lower edge of the inlet pipe and the lower edge of the outlet pipe must be at least 10 cm (Figure 11):

$$dH \geq 10 \text{ cm}$$

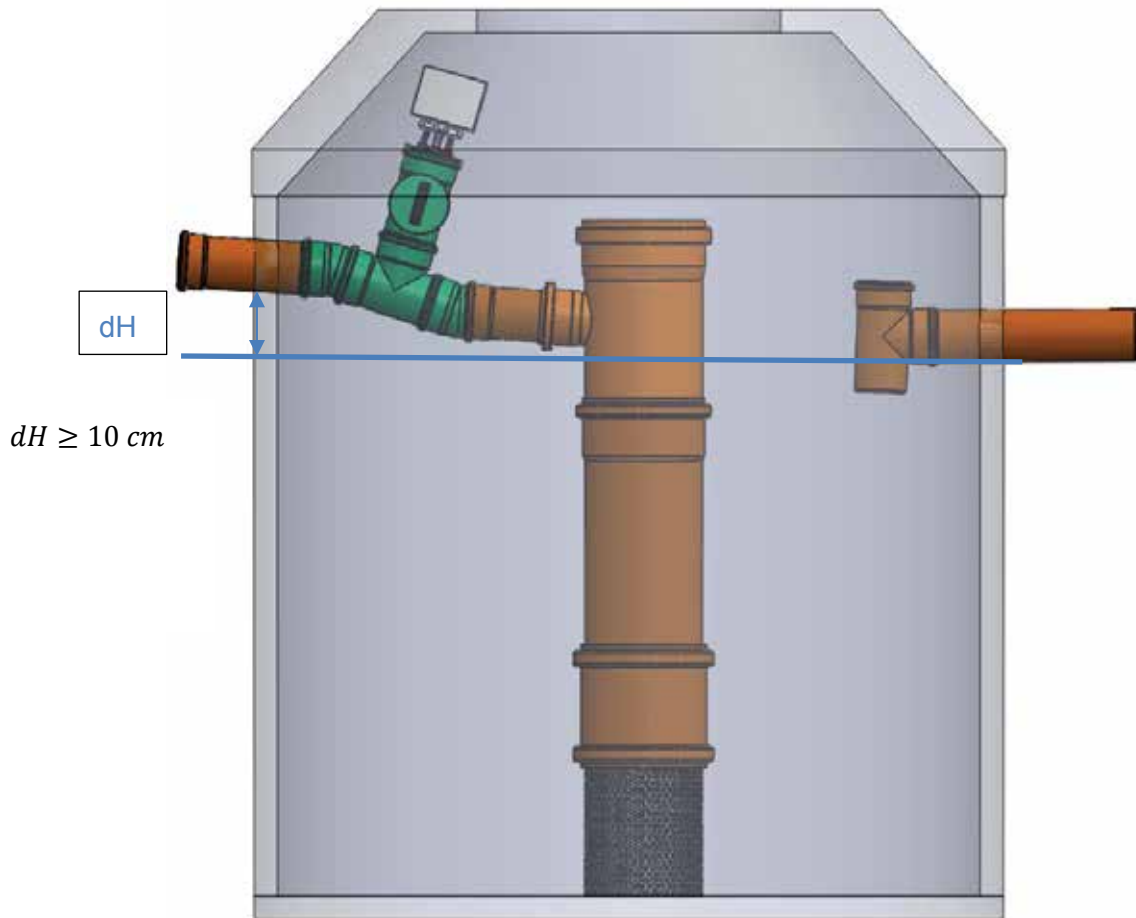
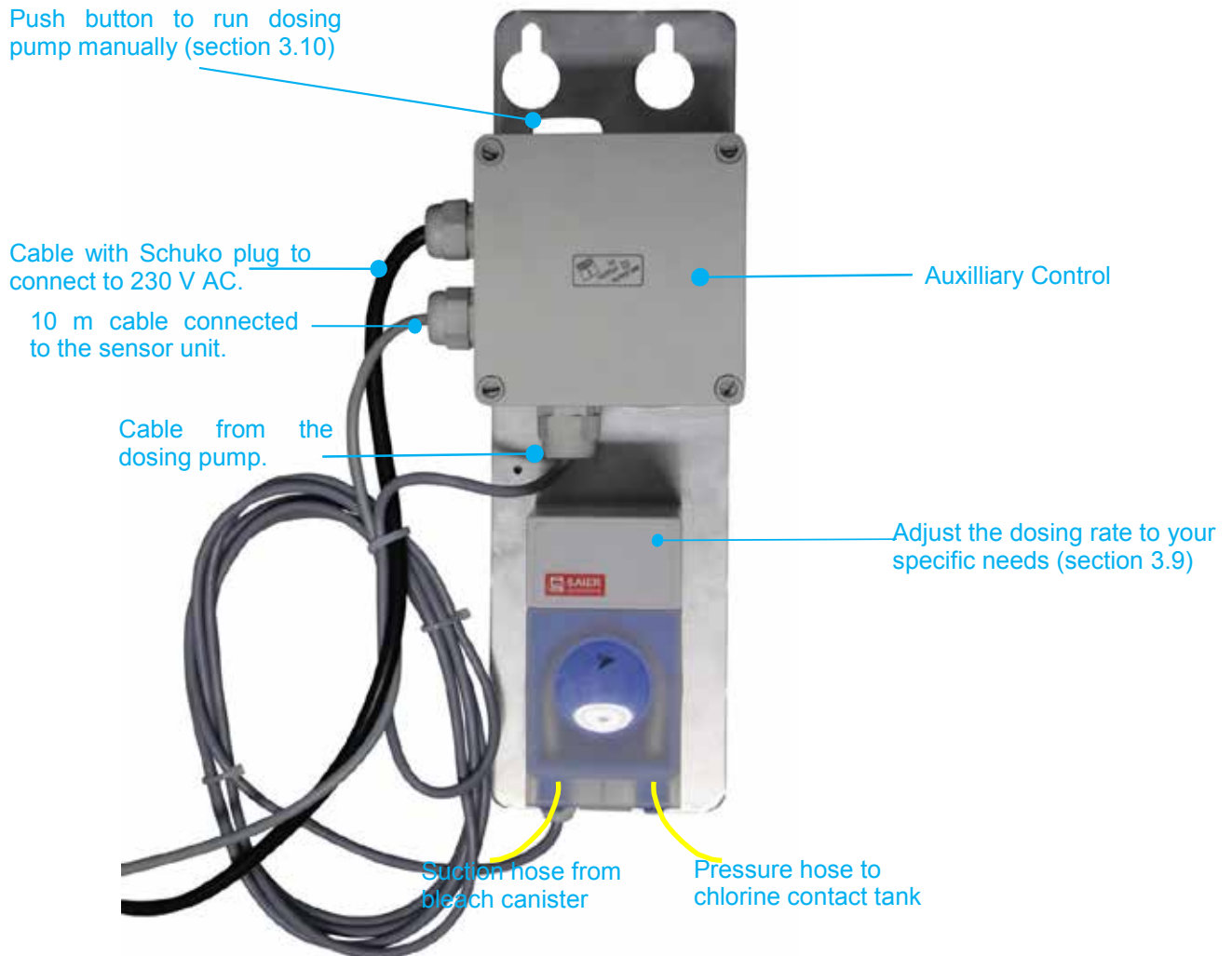


Figure 11: Example of the Installation of the sensor module in a concrete chlorine contact tank.

The sensor unit in the chlorine contact tank should be installed in a way, so that it can be reached from the manhole for maintenance (see chapter 4).

3.5. Installation of KL E-chlorination dosing unit

Install the auxiliary control with the dosing pump inside your control cabinet (or, if an indoor cabinet is used, next to your STP's control unit). The auxiliary control is equipped with a 2 m cable which has to be plugged to a power socket and a 10 m cable which is connected to the electrodes of the sensor unit.



- Never dose sodium hypochlorite into water which was disinfected with chlorine tablets. Empty and clean the tank before!

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3.5.1. Installation of the 6 mm chlorine dosing hoses

It is recommended to start the installation of the 6 mm hoses in the chlorine contact tank.

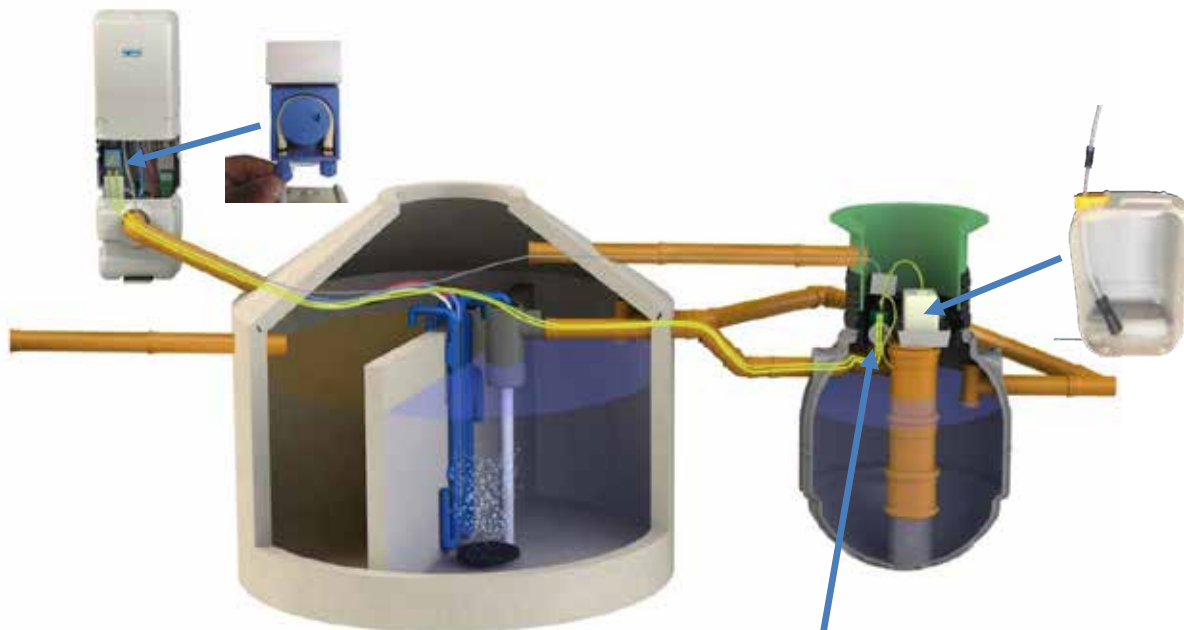


Figure 12: Connection of the dosing hose (yellow).



Figure 13: Installation of the 6 mm chlorine dosing hoses in a chlorine tank (e.g.: Saphir tank).

There are two free nozzles installed in the sensor module where the hose have to pass through. Pull the suction side through the white nozzle and the dosing side through the blue nozzle (Figure 13).

Then connect the suction side and the dosing side to the dosing pump of the dosing unit. The suction side, which sucks the chlorine solution out of the canister has to be installed on the left connector of the dosing pump (Figure 14).



Figure 14: Connection of the suction hose to the dosing pump.

The dosing hose, which doses the chlorine solution into the chlorine tank has to be connected to the right connector.



Figure 15: Installation of the foot valve to the suction hose inside of the chlorine canister.

In order to ensure a stable dosing connect the foot valve to the suction side of the hose and put it inside the canister as shown in Figure 15.

Pull the dosing hose approx. 10 cm through the 6 mm hole in the KLARO baffling.

NOTE: The dosing point must be always downstream of the sensor unit of the KL chlorination module. The electrodes must not get in contact with the chlorine solution.

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3.5.2. Electrical connection of the Sensor Module to the Dosing Unit

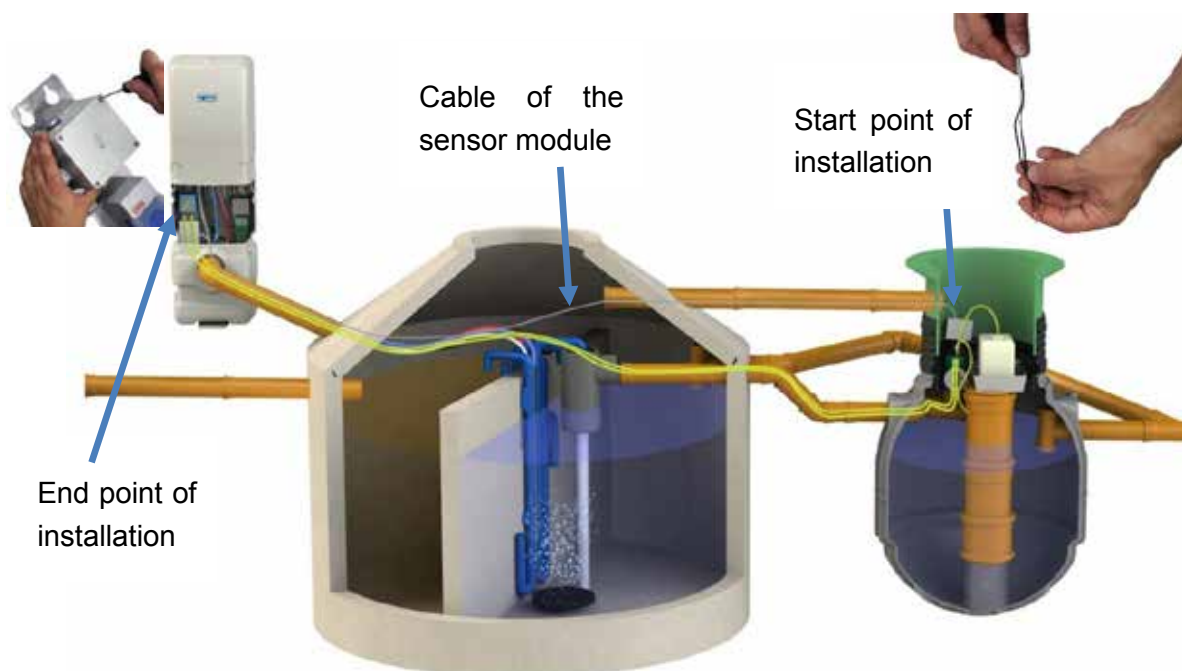


Figure 16: Electrical connection of the sensor module to the dosing unit.

It is necessary to connect the cable of the sensor module inside of the chlorine tank to the auxiliary control of the dosing unit. To electrically connect the sensor unit to the dosing unit it is recommended to disconnect the cable of the electrode from the waterswitch inside of the auxiliary control. Then the cable can be led from the installation point of the sensor unit to the place where the dosing unit is installed. Follow the steps as shown in the pictures below.

- **Note: During the installation the KL E-chlorination module must NOT be connected to electricity.**

- Open the auxiliary control of the dosing unit with a screw driver.



Figure 17: Opening the auxiliary control of the dosing unit.

- Disconnect the two electrical wires which are connected to the water sensor connection of the waterswitch.



Figure 18: Disconnection of the electrical wires which are connected to the watersensor.

- After disconnecting the wires the cable which leads to the sensor unit can be removed from the auxiliary control.



Figure 19: Disconnect the electrical wires from the water sensor connection and remove the cable.

- Lead the sensor cable from the conduit pipe of the chlorine contact tank to the auxiliary control of the dosing unit.



Figure 20: Sensor cable, which is connected to the electrodes.

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- Once the cable of the sensor unit was led from the chlorine tank to the dosing unit, reconnect the cable to the water switch. Close the auxiliary control of the dosing unit with a screw driver.

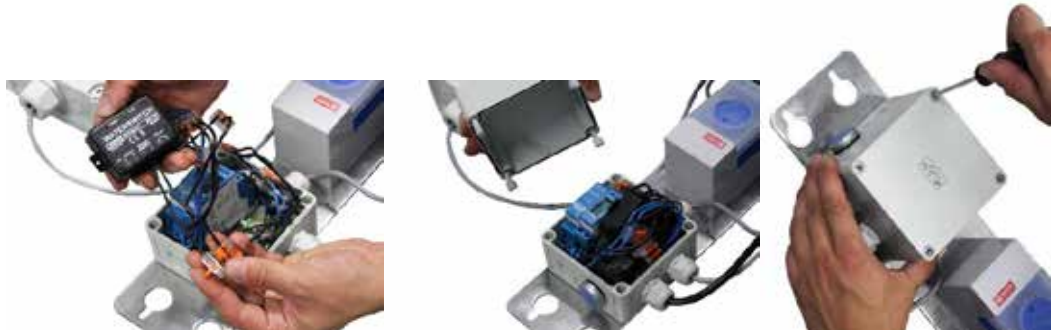


Figure 21: Reconnection of the sensor cable to the auxiliary control.

3.6. Control Settings for KL E-chlorination

The KL E-chlorination system works independently of the control unit so there are no specific adjustments necessary.

Only if the Clearwater airlifter is extended which is e.g. needed for the installation in a Carat tank (see 3.2). In this case the discharging time should be extended

Table 3: Needed extension for S, M and L Clearwater discharge lifter in dependency of different compressors.

Airlifter	Compressor			
	LA 60	LA 80	LA 120	LA 200
S	+ 30 %	+ 30 %	+ 30 %	+ 30 %
M	+ 30 %	+ 30 %	+ 30 %	+ 30 %
L	+ 30 %	+ 30 %	+ 30 %	+ 30 %

3.7. Chlorine disinfectant

KL E-chlorination is designed for the use of liquid sodium hypochlorite solution (also chlorine bleach, Na(OCl)) with a concentration of 12,5% available chlorine. Lower concentrations are suitable as well.

This chemical is not included in our shipment. It is usually available in shops for swimming pool equipment or where chemical products are sold.

Safety instructions:



- Sodium hypochlorite is a highly corrosive chemical! It may cause severe injuries in contact with skin or eyes!
- Always use protective gloves and safety glasses when handling the chlorine solution.
- Store at a cool, dry and dark place, where unauthorized people and children have no access.
- Read the safety data sheet of the purchased product carefully!
- Never bring sodium hypochlorite in contact with any other chemicals like chlorine tablets or acidic substances, because toxic gas can be released or even fire.
- Never dose sodium hypochlorite into water which was disinfected with chlorine tablets. Empty the tank before!

Chlorine demand:

- Chlorine demand depends on various factors like bacterial contamination, ammonia nitrogen, pH and temperature and cannot be predicted exactly.
- The disinfection of nitrified secondary effluent usually requires about 5-10 g of available chlorine per m³.
E.g.: 5 litres of bleach with 12,5 % available chlorine will last for > 3 months for 5 PE. A 6 % chlorine solution will double the required volume of bleach.
- The chlorine dosing adjustment should be done accordingly to chapter 3.8.

Notes on purchasing and storage of chlorine solution

- Chlorine concentration in the solution decreases with time. Always buy fresh chlorine, do not store additional chlorine for replacement over a long time. If stored, keep it cool and dark. Take into account that corrosive gases may be released even from closed canisters.
- Buy amounts which will be consumed within 3 – 4 month.
- If storage temperatures exceed 20°C frequently; chlorine solution with lower concentrations are reasonable. Lower concentrations degrade much slower than high concentrations of chlorine.
- If the chlorine solution cannot be placed in the manhole shaft of the chlorine contact tank, find a cool, dark place which is well ventilated and not accessible for unauthorized people and children. The chlorine canister should be placed below the level of the chlorine dosing pump. The drain tray, on the top of which the canister can be placed inside the tank, can collect the chlorine solution in

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3.8. Chlorine dosage adjustment

Due to local regulations and varying effluent parameters as pH, temperature or ammonia concentration, dosing rates may need to be adjusted in order to meet the site-specific requirements.

There are two possibilities to adjust the chlorine dosing:

- The peristaltic hose can be changed in order to get a different flow range (compare Table 4).
- The potentiometer position can be adjusted to change the dosing rate of the chlorine solution (Figure 22).



Figure 22: Adjustable potentiometer position.

The smaller pump hose (PS 138-1,6x1,6 PH) covers flow rates from 0.3 to 8.3 ml/min. Each step increases the flow rate by approximately 0.9 ml/min. The bigger pump hose (PS 138-3,2x1,6 PH) covers flow rates from 1.1 to 33.3 ml/min.

Table 4: Flow rate in dependence of hose diameter and control knob position.

Step	Peristaltic pump hoses	
	PS 138-1,6x1,6 PH 4.8 mm	PS 138-3,2x1,6 PH 6.4 mm
	ml/min	ml/min
1	0,3	1,1
2	1,2	4,7
3	2,1	8,3
4	3,0	11,8
5	3,9	15,4
6	4,7	19,0
7	5,6	22,6
8	6,5	26,1

If no local regulations are specified, it is recommended to aim a total residual chlorine concentration (TRC) as follows:

TRC in mg/l	Action
< 0,5	Increase dosage
0,5 - 2,5	OK
> 2,5	Decrease dosage

To achieve a TRC between 0.5 – 2.5 mg/L the dosing rate with a 12.5 % hypochlorite solution requires different adjustments in dependency of the airlifter. In the following table the recommended initial dosing adjustments are shown.

Table 5: Recommended initial dosing adjustments in dependency of the diameter of the airlifter.

Diameter Airlifter	Recommended hose	Potentiometer position
DN		
50	PS 138-1,6x1,6 PH 4.8 mm	2. Position
70	PS 138-1,6x1,6 PH 4.8 mm	5. Position
100	PS 138-3,2x1,6 PH 6.4 mm	3. Position
125	PS 138-3,2x1,6 PH 6.4 mm	4. Position

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4. Startup

The KL E-chlorination has to be plugged into a power socket. The hose of the dosing pump have to be filled with liquid chlorine solution. To fill the hose with chlorine solution push the integrated push button (see Figure 23).



Figure 23: Integrated push button to fill the dosing hose with chlorine solution.

Additionally the flow rate of the pump should be checked and compared with the expected flow rate.

- Conduct a function test and determine the volume output of the dosing pump:
 1. Fix the dosing hose on a beaker. Use a suitable beaker size in dependency of the expected flow rate. You should be able to read the pumped volume as accurate as possible.
E.g.: PS 138 – 1.6x1.6, 4.8 mm: 50 mL beaker volume;
PS 138 – 3.2x1.6, 6.4 mm: 200 mL beaker volume.



Figure 24: A possibility to fix the hose on a beaker on site.

2. Push the button for a defined time (recommended time: 3 min). The pump will work as long as you keep the button pushed. Once you release the button the dosing pump stops working immediately.



3. The output volume in the beaker has to be read off. The volume flow can be calculated with Equation 1. Compare the calculated volume flow with the expected volume output (Table 4).

$$\text{Volume flow} = \frac{\text{Volume in beaker}}{\text{Time the pump was working}}$$

Equation 1: Calculation of the volume flow.

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5. Maintenance

The following parts of the KL E-chlorination system need regular maintenance:

- Chlorine contact tank
- Sensor unit
- Dosing unit

5.1. Chlorine contact tank

Check the chlorine residual within the regular maintenance service at the outlet of the chlorine contact tank with a chlorine test strip for free and combined chlorine or any other appropriate method. The sum of free and combined chlorine is called total chlorine and should exceed 0.5 mg/l for safe disinfection performance.

The measurement must be undertaken onsite, not in a laboratory.



Figure 25 Examples of chlorine residual measurement methods: test strips (left) or DPD test method (right).

- Check the total residual chlorine concentration at the contact tanks outlet within every maintenance and adjust the dosing rate if necessary (see 3.8)
- Check the chlorine contact tank for debris. Any organic content inside of the contact tank will increase the chlorine demand for disinfection.
- Empty and clean the tank if excessive amounts of debris have accumulated.

5.2. KL E-chlorination sensor unit

Remark: Only a low voltage of 12 V is applied to the electrodes. The electrodes can be touched without any danger.

- Dismount the KL E-chlorination sensor unit out of the inflow pipe. Use the installed handle. Don't pull it out on the cable or elsewhere.



- Check the electrodes. If there are any deposits on the electrodes remove them.
- Perform a function test by connecting both electrodes with an electrically conductive material like metal. You can use for example a metallic screwdriver to connect both electrodes. As soon as both electrodes are connected check if the dosing pump is working.



Figure 27: Performing a function test of the electrodes.

- Remove the electrical connection. Once the connection is removed the dosing pump will stop working immediately.
- Install the sensor unit back into the inflow pipe. Make sure that it has an upright position and the electrodes are oriented as shown in Figure 28.

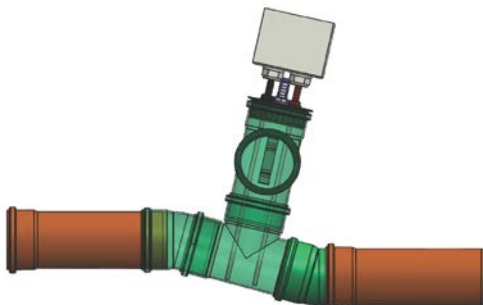


Figure 28: Position of the electrodes after installing the sensor unit back into the inflow pipe.

- Reverse the polarity of the electrodes during each maintenance. Unplug the module from electricity by unplugging the power connector. Open the auxiliary control and reverse the connection to the watersensor (see Figure 29).

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Figure 29: Changing the polarity of the electrodes.

5.3. KL E-chlorination dosing unit

- It is recommended to replace the peristaltic pump hose once a year.



Figure 30: Change the peristaltic hose once a year.

6. Glossary Chlorination

- **Available chlorine:**
Chlorine compounds which are available for disinfection purposes.
- **Bleach dosage:**
Volume of bleach per minute pumped by the peristaltic pump in ml/min. Adjustable between 0.3 to 8.3 ml/min. A volume flow of 4 ml/min is pre-set.
- **Bleach dosage ratio:**
Volume of bleach dosed to a certain volume of effluent water in ml/m³.
- **Chlorine concentration:**
Mass of chlorine per liter water (mg/l).
- **Chlorine dosage:**
Dosage of available chlorine per liter of water in mg/l. 3 – 10 mg/l are common.
- **Combined chlorine concentration:**
Chloramines (NH₂Cl, NHCl₂, NCl₃) in water in mg/l; product of the reaction of chlorine with ammonia.
- **Contact time:**
Time after the initial chlorine addition where chlorine reacts with the contaminants in water; essential for effective disinfection prior to effluent release. Measurable concentrations of available chlorine decrease within in this time while pathogens are killed. 30 minutes is the recommended minimal contact time for effective disinfection.
- **Free chlorine concentration:**
Summarized mass of chlorine in the form of Cl₂ (molecular chlorine), OCl⁻ (hypochlorite) and HOCl (hypochlorous acid) in water in mg/l.
- **Residual chlorine concentration:**
Measureable chlorine concentration as free, combined or total chlorine after the contact time. Local regulations and recommendations on minimal values may vary. Total residual chlorine concentrations of 0.5 – 2.5 mg/l are common and sufficient for effective secondary effluent disinfection when a contact time of 30 minutes is maintained.
- **Sodium Hypochlorite solution:**
Aqueous, alkaline solution of Na (OCl) with a certain ratio of available chlorine in weight-%, also called bleach. Ratios between 5% and 13% are common and suitable for wastewater disinfection.
- **Total chlorine:**
Sum of free and combined chlorine in mg/l.

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