

MANUAL FOR WATER TREATMENT PLANT

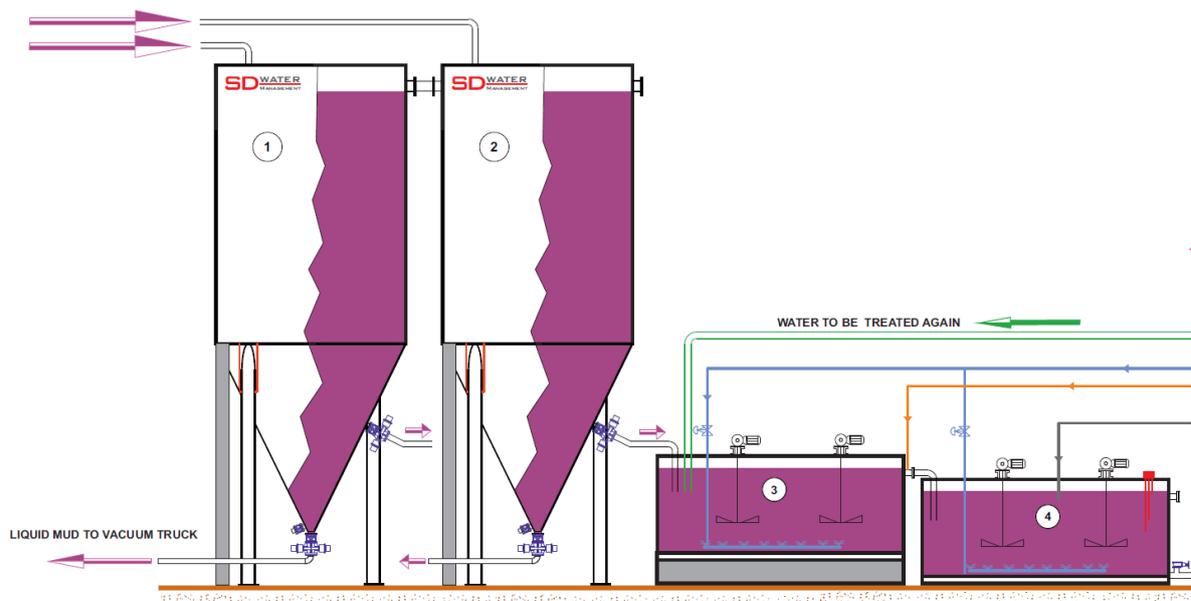
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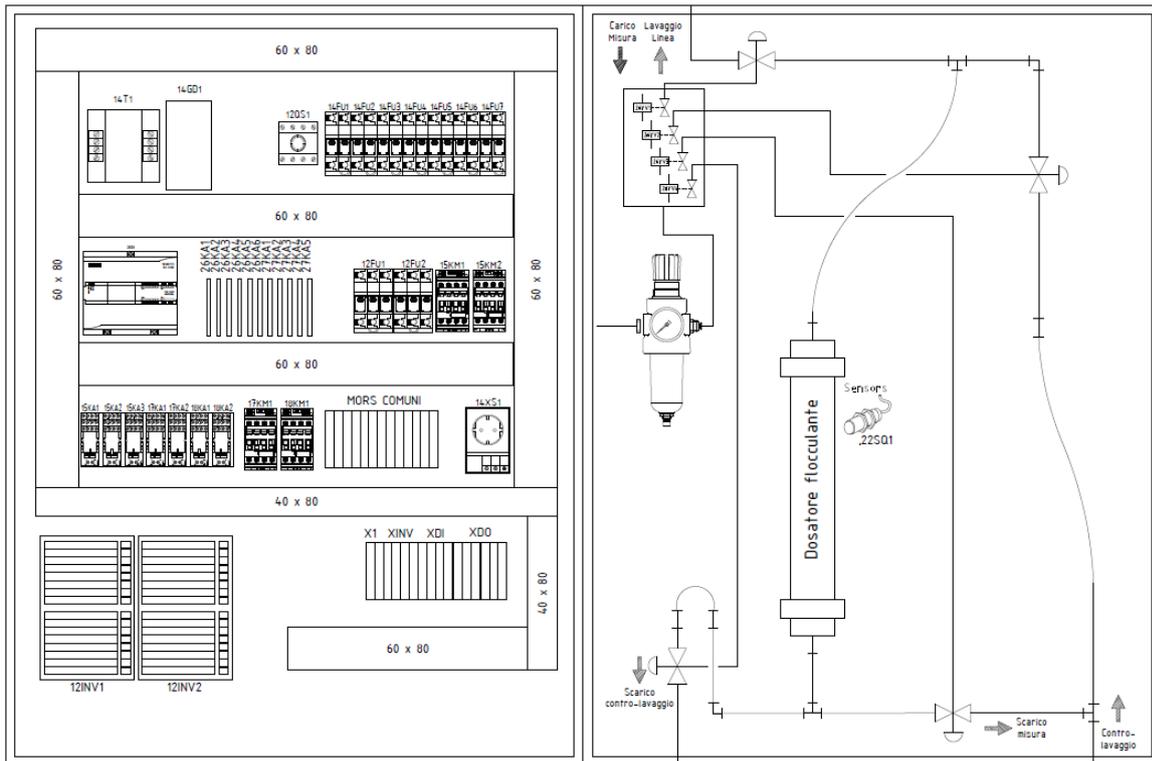
1. Scope of the plant and scheme

Information about the All the wastewater collected on the site from the tunnel and drainage areas are diverted in two manholes next to the water treatment plant facility. The manholes have a volume of approximately 10 m³. From here, the water is pumped to the two main silos that acts as buffer/collection area before the treatment starts. Their volume corresponds to 125m³ each, and it has been designed according to the maximum amount of water discharged to the plant in the worst condition (rainfall of 220l/s for ten minutes and 330 l/min from drilling activity ongoing on tunnel). The plant is also designed to treat up to 110 m³/h at the maximum capacity, that correspond to the maximum rate of water that can be discharged to the plant. When the wastewater level inside the silos increases and reach a set threshold, the plant is activated, and the wastewater is diverted by gravity to the first treatment tank (tank 3 in the picture 1). This tank works as homogenizer of water and it is also used as recirculating tank for the water that did not fulfil the required criteria in the last tank. CO₂ is added for a first control of pH and oil booms are installed to remove oil: the oil booms are a relatively simple and flexible system that allows to remove relevant quantity of oil(10kg/meter) and can be moved to different tanks depending by the needs. At the end of the first tank, coagulant material is added to the process with a automatic dosage system. The coagulant has the function of aggregate suspended solids and particles. The second tank (tank 4) works as fast mixing of the coagulant and metal removal is also added to enhance the precipitation of heavy metals in the wastewater. Then, the water is pumped to the sedimentation silos(clarifier) with two pumps (60 m³/h each).



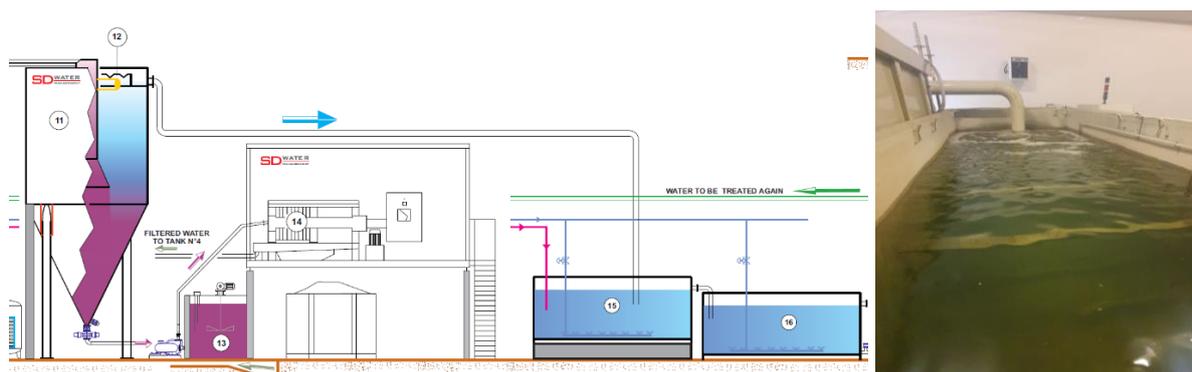
Figur 1: layout of the storage silos and two first treatment tanks

Here, flocculant is injected directly in the pipes to improve and speed up the settleability of the coagulated particles. Flocculant dosage is done automatically with an analyser (figure 2) that control the settleability every 30 seconds and adjust the dosage depending by the measured value. This advanced system allows to optimize the removal of suspended solid with considerable advantages in terms of efficiency and cost.



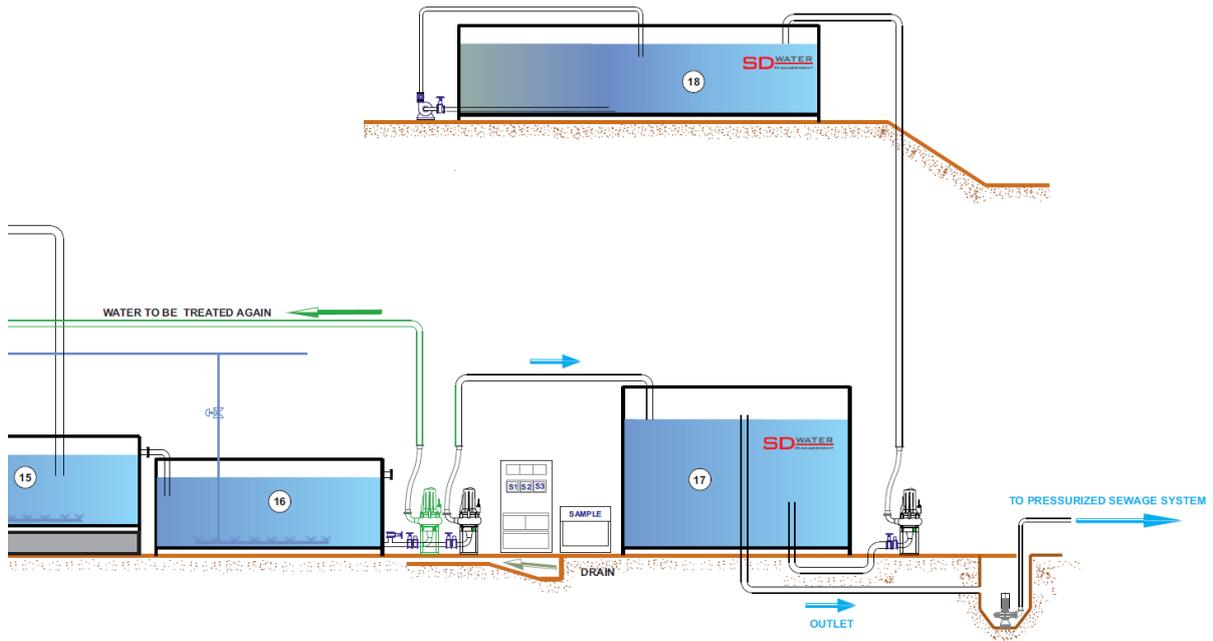
Figur 2: layout of the automatic flocculant dosage system

Once that the water mixed with coagulant, metal removal and flocculant enter the sedimentation silos, the particles that settle in the bottom are diverted to the filter press while clean water is moved from the top of the silos to the third tank by gravity. Here, ammonium removal (hydrogen peroxide, an oxidant agent) is added to oxidize NH_4 and transform it from soluble to volatile form (N present in atmosphere). Water is then diverted from the top of the silos (where oil booms are also installed) by overflow to the fourth (tank 15 in the scheme below) treatment tank: here, CO_2 is added to for a final control of the pH level and if the water quality is over the set limits, it is recirculated back to the first tank and the treatment process starts again until it is not reached the required quality.



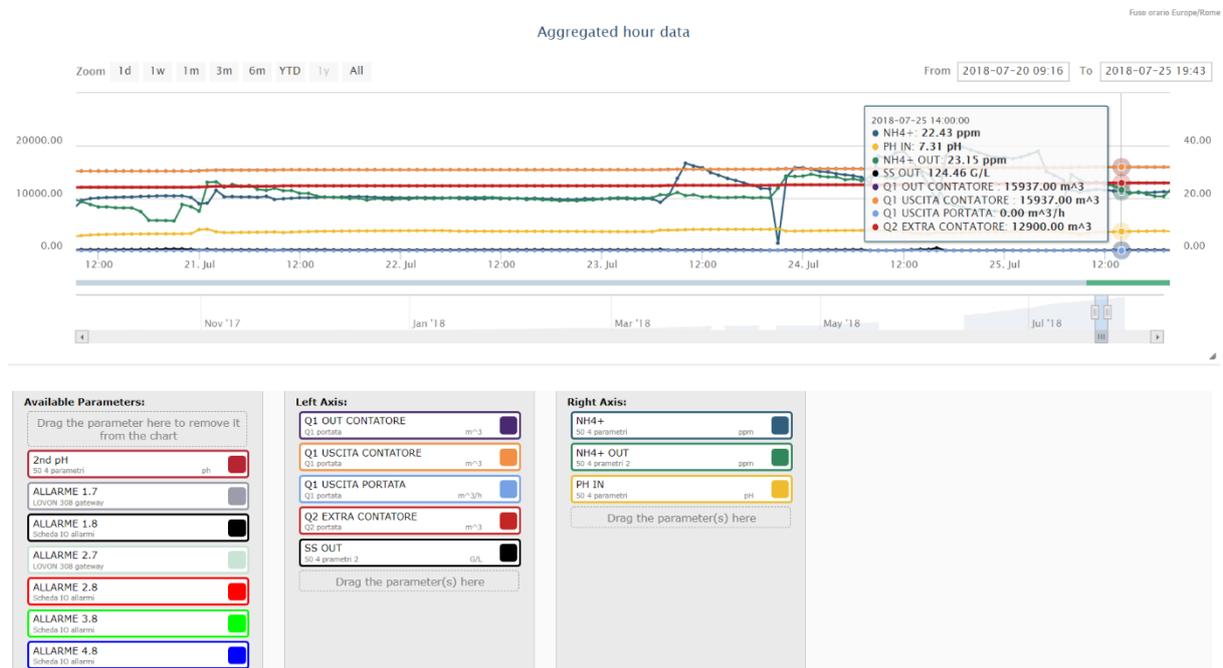
Figur 3: layout of the clarifier and last two treatment tanks

The clean water then flows from the tank 16 to a containment tank with a volume of 100 m3 located outside the water treatment plant (tank 17). Here, water is temporary stored before being diverted to the main storage area next to the tunnel where water is used for tunnel activities, as mentioned in chapter. Overflow is instead diverted to the sewage system, therefore no flow into the nature is ensured.



Figur 4 layout of last treatment area of the water treatment plant and storage of treated water

All the information regarding processed water, instantaneous values and problems/alarms are accessible through a dedicated software where the plant can be controlled and monitored on real time and action can be taken directly from remote. The set of Data can be visualized in a three-variable graph to facilitate the readability of the result.



Figur 5 graphical layout of the monitoring software for the water treatment plant

1.1 Reference document

- WTP layout
- 3C070005 Beskrivning Installation under byggtid Handling 11.2.2
- 3W070220 Technical report dimensioning WTP

2. Chemical unit and dosage

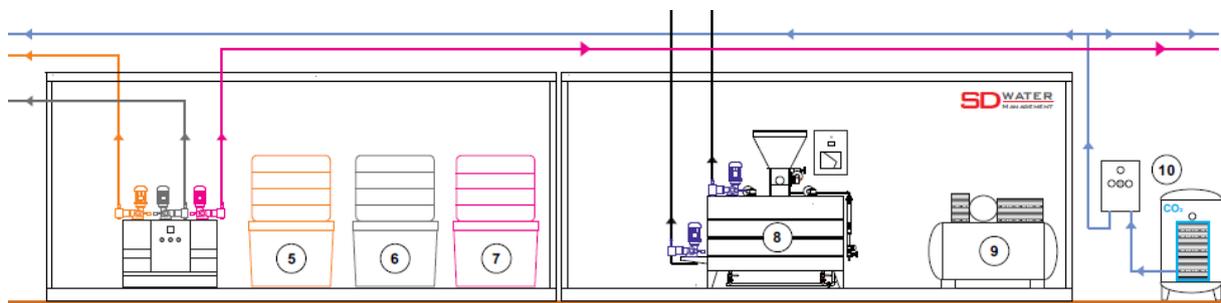
Five different chemical are added to the water to reduce turbidity, presence of metal, adjust pH and reduce concentration of Ammonia. The injection of chemical is done in different points of the plant. Indeed, the chemicals should be never added in the same point, since this can lead to ineffective reaction with the water. They are listed below in order of injection sequence:

1. Coagulant (PAX): it leads to the neutralization of the charge of the particles, making them bond to each other
2. Metal removal (Na3t): it leads to the neutralization of the charges of the heavy metal, making them bond to each other
3. Flocculant (Cationic Polyacrylamides): it makes the colloides and other suspended particles in liquid to aggregate through a physical process.
4. Reduction of ammonium NH₄ necessary if the content is > 45 mg / L. Berg blast expected through emulsion consisting of ammonium giving rise to the automatic addition of hydrogen peroxide H₂O₂ for reducing the value in accordance with the chemical reaction:



It means that the ammonium content is reduced by conversion to ammonia NH₃ evaporates.

5. Carbon dioxide (CO₂): the injection of bubbles of CO₂ form carbonic acid or H₂CO₃, which is in equilibrium with bicarbonate (HCO₃⁻) and hydrogen ions (H⁺). For example, an increase in CO₂ will result in increased carbonic acid formation (H₂CO₃) which leads to an increase in both HCO₃⁻ and H⁺. The hydrogen ions then reduce the pH.



Figur 6 layout of chemicals area of the water treatment plant

Coagulant, metal removal and hydrogen peroxide are dosed through normal chemical pumps that are adjusted manually. ½ Inches hose are used to inject the chemicals into the water, in different stages. CO₂ is added in several stages through ½ inches hoses, its flow is regulated through a manual flow meter.

Average chemical pump set up is:

	Coagulant	Metal removal	Hydrogen peroxide
Pump set up (%)	8 -16	3 - 8	15-20
Concentration(µl/l)-(ml/m ³)	200-600	50 - 200	800 - 1200
Key factor	Turbidity, water ph	Metal concentration	Amount of nitrogen in the water

As showed above, the concentration of hydrogen appears high due to the high amount of Nitrogen in the incoming water (values between 150 and 200 mg/l). Indeed, according to the stoichiometric reaction, 1 mol of H₂O₂ is needed for each mol of NH₄. Assuming a concentration of 200 mg/l of NH₄, it will be needed 590 mg of H₂O₂ solution (35% solution) to reduce it to 50 mg/l. It corresponds to 590g/m³ of H₂O₂ solution. Estimating an average monthly amount of 8000 m³ of water treated, it will be needed aprox 3-4000 kg of H₂O₂ to reduce the whole Nitrogen from 200 to 50 mg/l. Estimating the average cost of hydrogen peroxide is 10sek/kg, it corresponds to 3-40000 sek/month. Compared to the cost of exceeded concentration from SVOA (approx. 2-30000 sek per month) and considering the “management” cost of the chemical (hazardous product if stored more than 50 l, see SÄIFS 1999:2), it was recently decided to not use it anymore.

More information about the chemical processes are explained in the report *3W070220 (002) technical report dimensioning WTP*. The correct chemical dosage is achieved through regular test that are done on the incoming water at the plant, explained in a dedicated document (*Technical report- optimal Dosage test and dosage curve for chemical WTP*). The flocculant instead is dosed automatically through a dedicated unit that is described in the chapter 4.

The pumps are automatically started by the PLC according to the input signal that they receive. For example, the coagulant and metal removal start when the pneumatic valve DN200 opens and water starts to flow from the silos to the tank 3. On the other hand, Hydrogen peroxide activates when the water analyser unit detects a value of Ammonia over the threshold.

The flow of CO₂ start as well when the water analyser unit detect a value of pH over the limit. The flocculant is instead injected directly into the pipe that goes from the tank 4 to the silos.

The chemical pumps required little maintenance, that consist in the control of the oil level and if there is any presence of leakage.

It is important to handle the chemicals according to health, environment and safety regulations. Specific information are provided in chapter 12. The consumption of chemicals depends by the amount and quality of incoming water. It is important to always ensure a sufficient stock to not run out of chemicals.

2.1 Reference document

- *D5. Technical report- optimal Dosage test and dosage curve for chemical WTP*
- *D2. 3W070220 (002) technical report dimensioning WTP*
- *Brochure-Product-Information-Manual-hydrogen-peroxide-December-2015*
- *p-10419-carbon-dioxide-to-reduce-ph*
- *A3. Manual pump dosing chemicals(FSE 302 + FSE 308)*

2.2 Troubleshooting

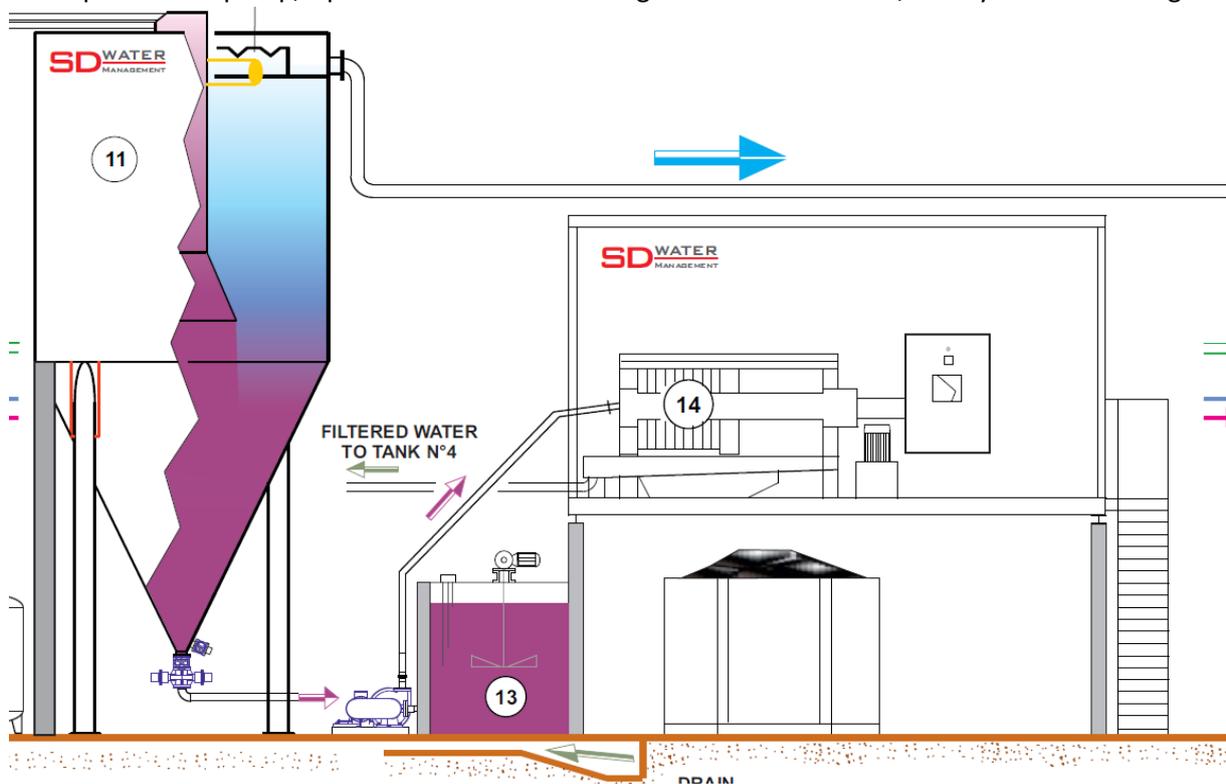
- If the hose is not proper connected to the IBC chemical tank, air can come in, affecting the dosage rate. It is important to check the hoses daily.
- The pumps do not work correctly at a low rate, it can happen that due to the hydraulic head, the chemical is not pumped to the tank. Check daily the injection point to visually inspect the effectiveness of the injection.

- Before to start the plant, remember to open the valves of all the chemical IBC, since there is no signal that the pumps are not pumping chemical.
- The CO2 hose are distributed in the bottom of the four tanks, and they have small holes for the injection of the gas in the tank. Due to sedimentation, especially in the tank 3 and 4, it is possible that the holes in the hoses get clogged. For that reason, it is important to clean the tanks every 3 to 4 months.
- The flocculant hoses can get clogged, especially after a period of inactivity. For that reason, it is needed to clean them periodically.
- Important to check the status of the valves and tanks before to start the plant and when the plant is turned off
- Some of the chemicals used in the plant are acid and inflammable. It is important to handle the chemicals according to the health and safety regulations to reduce the risk of accident.

3. Filterpress unit

Once that the chemical are mixed with the water and it is pumped up to the clarifier silos (number 11 in the scheme), the flocs will settle in the bottom of the clarified. Once that the sediment material start to rise, the pneumatic valve in the bottom of the silos will open (on time bases or manually) to discharge the sedimented material from the clarifier silos to the tank 13 (mud tank). From here, when the level in the tank increase, the electrodes give the signal to the filterpress PLC that the tank is full. Consequently, the mud with high percentage of water is then pumped up to the filterpress machine (number 14) to remove the water and produce hard compressed mud “brick”.

The filterpress is composed by 20 “clothes” that acts as filter for the water: the mixture of water and mud is pumped up to the nets that filter the water. The mud is kept in between the clothes while the water flows out into two lateral channels and then back to the treatment plant. At the end of the right lateral channel are installed two electrodes that reveal a current flow (in A) when both are submerged by water. When the clothes start to get full of mud, the pressure increases and the amount of water that filters out decrease. Once that the level of water in the channel go below a set threshold, the electrodes will be over the water and no current will pass in between. This will give a signal to the PLC to stop the mud pump, open the nets and discharge the “bricks”. Then, the cycle will start again.

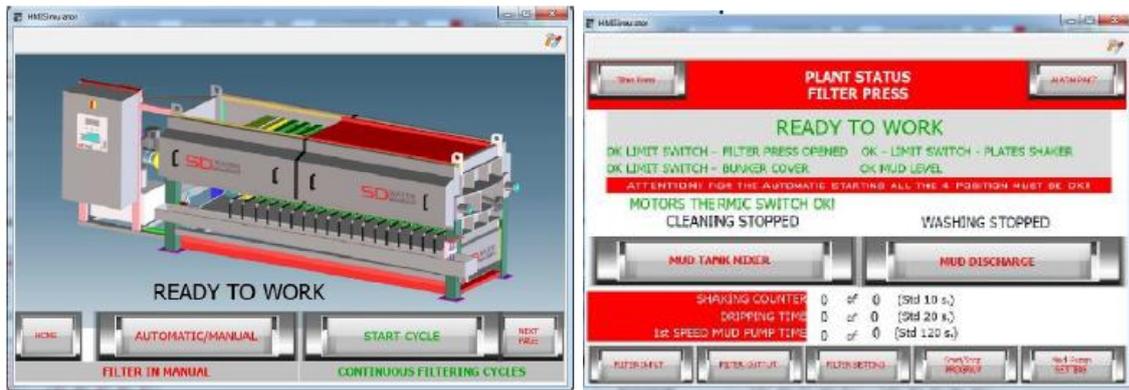


Figur 7 layout of clarifier(sedimentation) silos, mud tank and filterpress of the water treatment plant

From the filterpress panel is also controlled the functionality of the flocculant pumps, the stirrers, the discharge of the clarifier and the pit pumps. For example, from here the two flocculant pumps and pit pumps can be set to work simultaneously or in alternate. Moreover, an inverter controls the power of the two pit pumps accordingly to requirements.

The filterpress can be set up to automatic mode: a specific number of cycle per day for each day of the week, in a specific time can be scheduled in the panel.

In order to start, the filterpress must show the text:”ready to work” as below:



Figur 8 filterpress display

That means that all four settings are ok (filterpress is opened, limit switch, bunker cover and mud level). In order to stop the operation of the filterpress, the button "last cycle" must be selected. In this way, the filterpress will carry out the last cycle and then stop. In case of emergency, the emergency button can be pushed and the filterpress, bunker cover and clothes can be opened manually through the panel.

The clothes and underclothes need to be cleaned daily, inspected regularly and changed when required/once a year. The mud pump need to be checked daily as described in the wtp checklist.



Figur 9 filterpress clothes and pump

It is important to check daily the mud tank (point 13) to see the quality and quantity of mud discharged by the clarifier. If the mud is too thick, it is required to run the filterpress for longer time, while if it is too liquid the discharge should be less often. If you can see some small "streams" in the mud, it is a indicator that the coagulant is probably too high in concentration.

3.1 reference document

- A4. Manual Filter press (FSE 302 + FSE 308)
- 019-electrical cabinet-1-Filter press-2017-08-30

- A5. Manual mud pump
- C2. WTP checklist

3.2 Troubleshooting

The main problem with the filterpress are:

- Never-ending time for pressing: this can be due to several factor. The first is the status of the mud pump: indeed, the inner part of the impeller is made of two rubber shells that rotate and push the mud up from the mud tank to the filterpress. If these parts get deteriorated, it might take long time to push the mud to the press. Otherwise, it can be due to the electrodes functionality for the discharge.
- Mud discharge too liquid: it can be due to a too high concentration of flocculant/other chemicals or it is a signal that the mud pump need to go under service for control.
- If the clothes are not cleaned regularly, it can lead to problems in the pressing and in deterioration of the clothes itself. They need to be cleaned daily with a jet washer machine. The pressure should not bee to high because it can damage the clothes.
- If the mud pump start to make a strange sound, it is recommended to open and check the shells. Shells need to be substituted every 6/8 months. The motor should instead be checked every 2 years.
- If the temperature is too cold, it can lead to problems in the opening and closing of the filterpress. Important to keep the filterpress area warm.
- It is important that, in case of a reset of the filterpress, all the settings are set up as described in the manual.
- If there is an overtension in any of the electrical parts of the filterpress, the fuses will break and the plant will stop. It is important to monitor the plant while in operation to avoid any further problems.

4. Flocculant unit

4.1 Flocculant mixing unit

The flocculant is a polymer that is generally delivered as 25kg powder bags. To add the polymer to the water, it is first necessary to produce a solution, mixing it with water. This process is done by the flocculant mixing unit: the powder is added from the cone and it is dosed with a spiral system. The dosage of this system should be of 1 kg/h. Specific information are described in the manual of the automatic flocculant unit.



Figur 10 Flocculant mixing unit

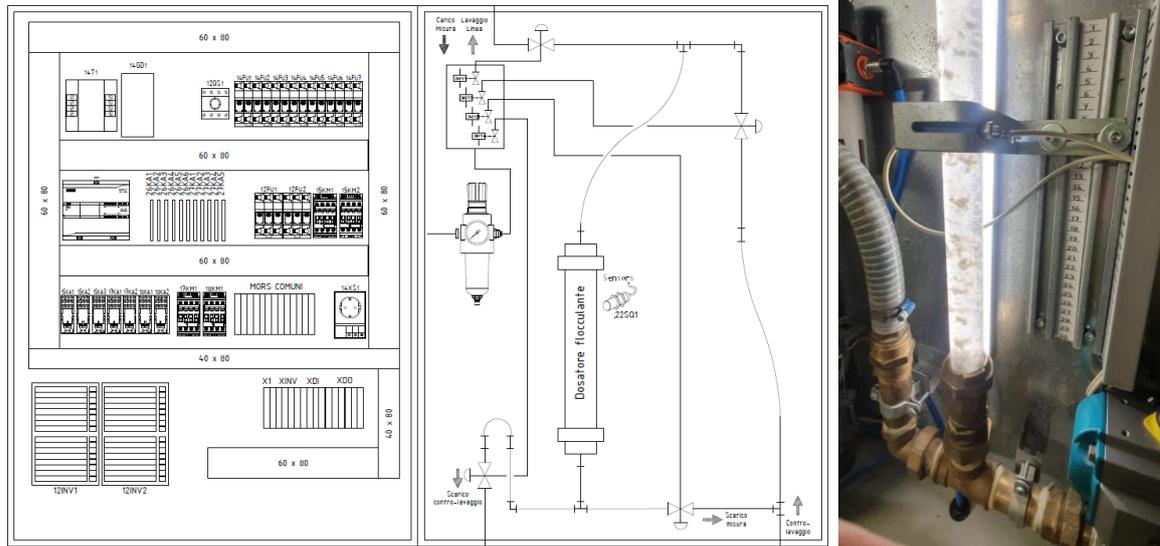
4.2 Flocculant analyser unit

The flocculant analyser unit is a dedicated system to adjust automatically the amount of flocculant injected tot the water according to the sedimentation speed. From the panel it is possible to set the parameter for the intaking, measuring and cleaning time of the system. The control is regulated through a PLC. The following parameters should be set to have an optimal analysing time:

- Intaking water: 20 – 30 sec
- Cleaning: 10 -15 sec
- Analysing : 40 – 60 sec

In the sensor it is possible to set the threshold for increasing or decreasing the pump speed (indicated in Hz). The analyser will count the time when the water cleanliness is over the threshold limit or below and increase or decrease the speed accordingly. Clean water will give back a value of 4000 while dirty water equal to 0. These values are calculated from the light passing by the two-optic sensor (if there is particles in the middle the light will not pass through, giving back a value of 0). The water is pumped from the third silos (clarifier) into the analyser.

The glass flocculant analyser represents basically what is happening in the third silos. If quite consistent flocs are created in the glass tube, (0.5/2)cm diameter, it means that the process is working fine (see below). Otherwise, there might be something wrong in the chemical process.



Figur 11 flocculant analyser

Two cavity pumps are used for the injection of the flocculant in the system. The automatic flocculant unit communicates to the pumps the frequency of the pumping rate.

4.3 Reference document

- 019-QE-Flocculant unit-2018-09-08
- A2. Manual automatic flocculant unit (FSE 302 + FSE 308)
- A6. Manual progressive cavity pump flocculant (FSE 302 + FSE 308)
- 019-electrical cabinet-2-Analyzer-2018-01-25

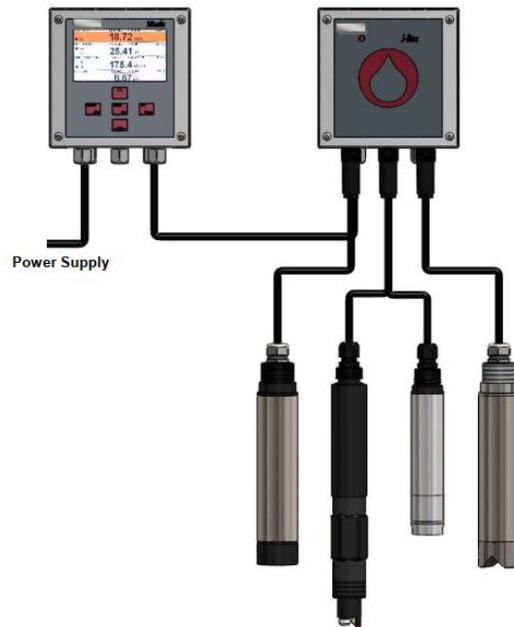
4.4 Troubleshooting

- The flocculant cavity pumps get easily clogged if they stay still for some time. Recommended to flush water at the end of the WTP usage and test it in manual mode at the start of the new cycle. In order to unclog the pumps, it is required to move up and down the spiral part of the pump with pliers.
- Flocculant mixer inlet get clogged by the flocculant if the dosage of water is too low or if the direction of the pipe is not correct: check water flow in the box and ensure that no powder gets stuck on the sides.
- Check the water pressure, if too low the system will not start. It is also important to have a constant pressure of water in the plant, otherwise the dosage system can have problems.
- Once a year or when needed, it could be required to adjust the dosage of the flocculant powder. To do that, it is required a chronometer and a weighting scale to check how much powder is added in a interval of time. It should be set by 1 kg/h
- In the winter, the mixing of flocculant with wastewater could be harder due to lower temperature of the water. The efficiency of the chemical reaction is lower and to enhance the reaction could be suggested to increase the amount of water (up to 2m³/h) and increase the flow of flocculant into the water through the two pump (this should be done automatically by the analyser, in case it can also be adjusted manually in the flowmeter of the pump)

- It is required to clean the glass cylinder once a month or when needed to have a proper functioning of the system
- The optic sensor must be properly installed and it should show the value “4000” with clean water
- It is important to turn off the flocculant analyser unit if the plant is not running
- The open and close action of the valves can lead to damage to the hoses and leaking of water and the mispositioning of the optic sensor. It is important to check the water pressure and the sealing.
- The pump can vibrate a lot during operation due to clogging of the hose, that can lead to breakage of mechanical part and the flow regulator. It is suggested to check the hose and the non return valve periodically to ensure that are clean and free.
- It is important to use clean water in the flocculant mixing unit, otherwise the chemical can start reacting in the container.

5. Water analyser unit

The analyser unit consist of a “copy”, in small scale, of the tank 3,4,15 and 16 shown in the picture 1 and 2. Indeed, the water is taken from each tank with a hose system (small hose of ½ inch) that send water continuously to the analyser unit by gravity, while the plant is running. In this way, it is possible to analyser real time all the relevant parameter in each tank. According to the parameter value (visualized in *the 50 series 4 multiparameter instrument*), the PLC give an input to different pumps or valves.



Figur 12 The analyser unit

The following parameters are checked in the tank 4 (incoming water):

- Conductivity
- pH
- NH4

The conductivity probe provides information about the amount of metal and suspended solid present in the inlet water. According to that, a different dosage of coagulant and metal removal should be set. The pH probe provides information regarding the alkalinity of the incoming water. According to that value, a threshold parameter could be set to start the CO₂ flow to reduce the pH in the tank 3 and 4. The NH₄ probe provide information about the content of Ammonia in the water. According to that, a different dosage of Hydrogen peroxide should be set.

The following parameters are checked in the tank 15:

- pH

The pH probe provides information regarding the alkalinity of the water in the tank 15. If the CO₂ injected in the tank 3 and 4 will not be enough and the pH is still high, this sensor will tell to the plant to start the CO₂ injection also in the tank 15 and 16.

The following parameters are checked in the tank 16:

- Turbidity
- pH
- NH₄
- PAH (Polycyclic aromatic hydrocarbons)

In the last tank, if any of the above parameters are above the set threshold, the instrument will tell to the plant to activate the recirculation pump and send back the water to the first stage, in order to go through again all the steps.

In the instrument it is possible to modify and set threshold, in this case they have been set according to the SVOA requirements listed in chapter 6. Detailed information regarding the usage of the *50 series 4 multiparameter instrument* are described in the dedicated manual *Manual 50 Series 4 parameters EN (FSE 302+FSE 308)*

It is important to keep all the probes submerged in the water, if they get dry the probe can get damaged and not work anymore. Moreover, it is important to keep the tanks clean to get the correct value.

All the sensors have a specific manual for calibration and they need to be recalibrated periodically.

5.1 reference document

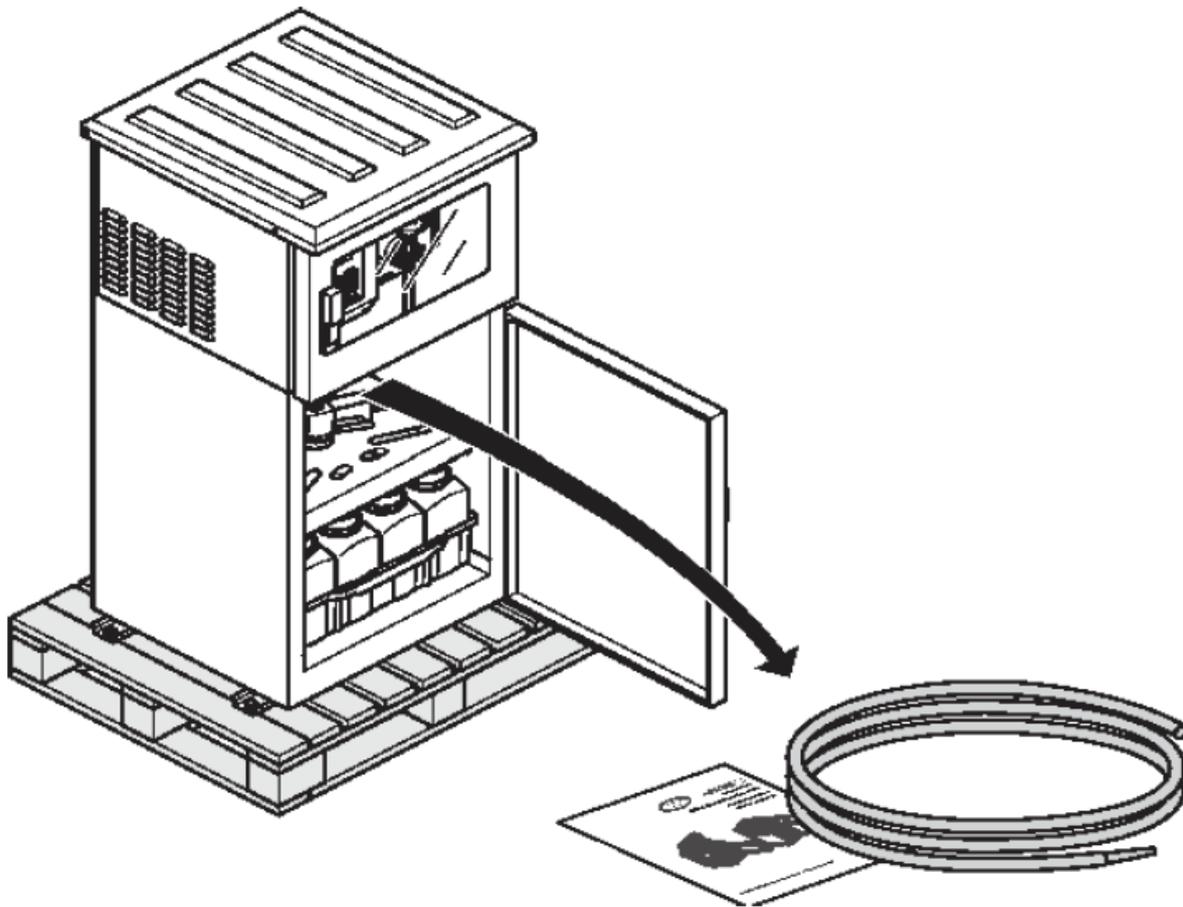
- A1. Manual 50 Series 4 parameters EN (FSE 302+FSE 308)
- A10. Manual digital conductivity probe EN (FSE302+FSE308)
- A11. Manual digital infrared turbidity probe S461 EN (FSE 302+FSE308)
- A12. Manual digital probe multiparameter ISE S470 Ammonia EN - (FSE302+FSE308)
- A13. Manual digital probe PAH S480 EN (FSE302+FSE308)
- A14 Manual digital probe S401 pH
- Riktlinjer för avloppsvatten från industrier och andra verksamheter (SVOA)

5.2 Troubleshooting

- If the pH sensor cannot be recalibrated, it usually means that the probe cannot recognise acid and basic pH. In this case, it is possible to try to clean the sensor with a solution Sodium hypochlorite and then submerge the probe into a solution with Sodium Chloride. If it does not work, it is required to change the probe.
- It is recommended to recalibrate the sensors once a month or when required.
- It is important to clean the tanks daily for a correct functioning of the system
- It is important to check that the hose that bring water from the tanks to the analyser are not clogged. They need to be cleaned regularly, especially from the tank 1.
- It is important to read the instruction manual before to work with the instrument.

6. Sampling unit

In the plant is installed an automatic sampler for the sampling of the outgoing water. It automatically takes sample of the water that is pumped out of the plant. The instrument can sample water according to time, and flow, in digital or analogic. The connection with the flowmeter allows the machine to take sampler according to the flow. The samples are kept in a refrigerated box underneath the machine. Since 2 liters are required per week, the automatic sampler should be set up accordingly. For example, if an estimated flow of 400 m³ per week is treated by the plant, the instrument should be set to take 10 cl every 20m³. That means that 200 cl (2 liters) will be collected weekly. Generally, it is good to sample a bit more water then required to ensure that at least 2 liters are sampled. In the case above, the instrument could be set to take 10cl every 15 m³.



Figur 13 Automatic water sampling unit

In order to access to the settings, it is required to enter the password that is shown in the manual. It is important to read the manual carefully before to complete any changes in the settings.

In order to carry out the sampling correctly and avoid to contaminate the samples, it is important to have a specific competence in sampling.

6.1 reference document

- A8. Manual water sampling EN (FSE 302 - FSE 308)
- A9. Manual flowmeter EN - (FSE 302+FSE 308)

6.2 Troubleshooting

- Since the machine works with a vacuum system (sucking the water from the outflowing pipe) it is important that the metal cylinder is properly sealed.
- The amount of water to be sampled depends by the amount of water treated. For this reason, it is important to have an idea of the water treatment average water incoming per week and set the instrument accordingly. It is also preferable to have more water then required then less.
- It is important that the bottles are properly located in the containers inside the machine, otherwise the sampled water may end out of the bottles.
- It is important to clean the bottles once a week, after the sample is taken
- If the flowmeter has a technical problem, the sampling machine will not work. For this reason, it is important to check the functionality of the flowmeter regularly. In case of problem with the automatic sampler, it can be due to a technical problem of the flowmeter.
- In case of any problem, the sampling can be performed manually through the machine.

7. Starting the plant and control panel

The main control panel and switcher located near the tank 16 enable to control the starting and stopping of the plant. With the switcher on the bottom right, it is possible to start the plant. If activated and the level is at least 8 meters inside the silos (that means 2 meters from the top of the cone section), the main pneumatic valve will open and water will start to flow to the tank n1. The flow of the water can be manually in the valve in the silos room, after the pneumatic valve. Simultaneously, the chemical pumps of coagulant and metal removal will start to add chemicals in tank 1 and 2. At the moment, the plant is set with a flow of 60 m³/h and the chemical pumps and pit pumps inverter are set accordingly.

If the switcher is left on, the plant will treat all the water and empty the silos and stop at 6 meter. Then, the plant will automatically start again when the level reach 8 meters. This setting allows the plant to not start and stop every few minutes that would negatively affect the chemical dosage (it is generally better to make the plant run continuously for several hours instead of start and stop frequently the system). The settings can be changed going into the digital control panel in the picture below. More information are described in the *A19 manual for sonar level*.

From this panel, is also possible to control other pumps of the plant. The pumps located in the pits in the silos room are automatically controlled by the panel and operate from 0 to 12 meters. Basically, they pump the water up in the silos when coming from tunnel and surface area. If the plant is full and the level goes above 12 meter (at the top of the silos), the pump will stop automatically and water will overflow in the sewage.

From this panel is also possible to control the return pump and the pump from the 100 m³ tank storage to the tunnel reserve storage (300m³). The reserve storage pump should be set always on, except for when the water quality is not good enough to reuse in the machine in the tunnel (i.e. foam problems or low ph).

Before to start the plant, it is important that the operator go through the plant checklist to ensure that all the parts are inspected (*C2. Wtp daily checklist*).

The values are communicated every 5 minutes to the software, where it is possible to check the silos level.



Figur 14 plant control panel

7.1 reference document

- A19. Manual for sonar level
- 019-electrical cabinet-3-Pumps 2017-09-08
- C2. Wtp daily checklist

7.2 Troubleshooting

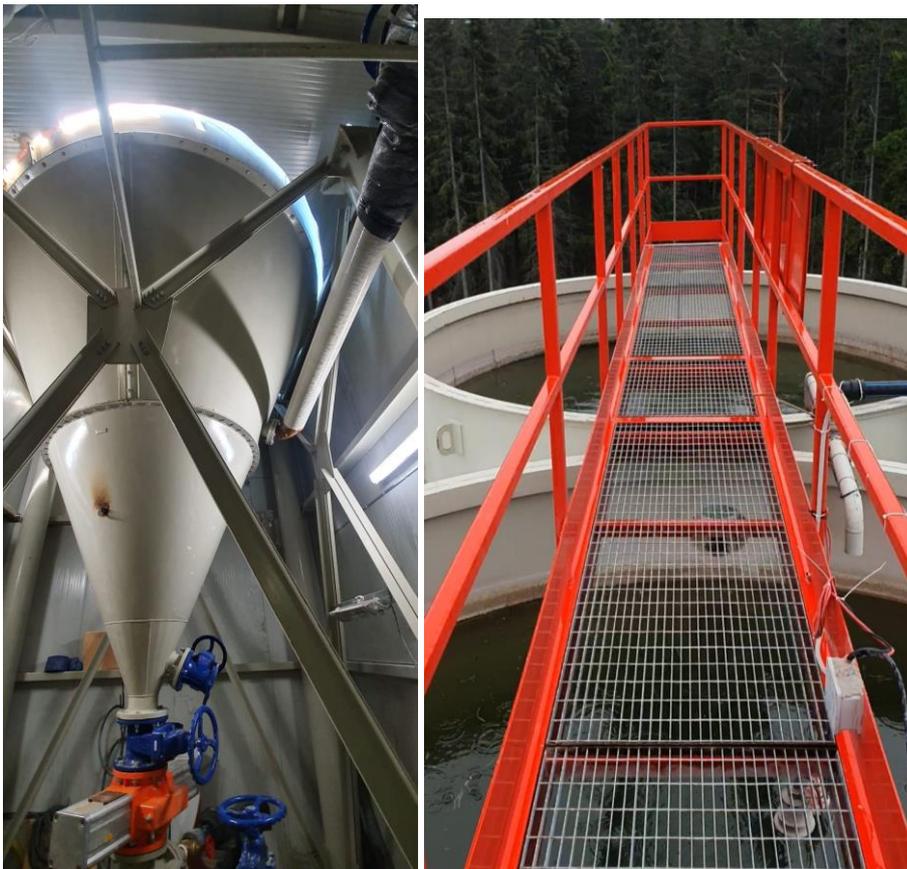
- If the flow of the plant is changed, it is important to check the chemical pumps rate and the power of the two pit pumps.
- If the plant is not starting, it might be due to high level of water in the treatment tanks. In this case, the sonar/electrodes in the tanks must be checked.
- Presence of foam in the plant tanks can lead to a wrong signal to the sonar and not starting the plant.
- If the level is at least 8 meters, the plant will not start.
- If the level is showing error value or above 12 meter, the pumps in the pump pit will not start
- If the valve that control the opening/closing of the pneumatic valve are not working correctly, the valves might also not function correctly, leading to problems to start the plant. It is important to check the compressor and functionality of the solenoid valves if any problem occurs.
- If a problem with the sonar up on the silos occurs, it is recommended to calibrate the value at a "fictitious" value above 8 meters to keep the plant running while waiting/substituting the spare part.

8. Silos for wastewater storage

As described in the chapter 1, two silos of 125 m³ each are used as storage of incoming water before to go through the chemical process. The two silos are connected in the pipes before to send the water to the first tank, therefore the water is always mixed and at the same level.

It is important that the water is keep recirculating inside the silos, otherwise it might get clogged due to the fine material mixed with cement that is coming from the tunnel or it might freeze during the winter time. As well as this, the pump that send the water up in the silos from the pit should be checked daily.

Heaters are installed in the room to increase the temperature of the silos. On Top of the silos, it is installed a sonar for the water levels that communicate to the control panel mentioned in chapter 7.



Figur 15 Silos for incoming wastewater storage

The level of the silos should be monitored to ensure that no overflow happens.

The recirculation system is regulated by a valve at the bottom of the silos. The solenoid valve opens and close the pneumatic valve alternatively, approximately one minute each. This allow the water to flow back in the pit on alternate mode.

8.1 [reference document](#)

9. C2. Wtp daily checklist

8.2 Troubleshooting

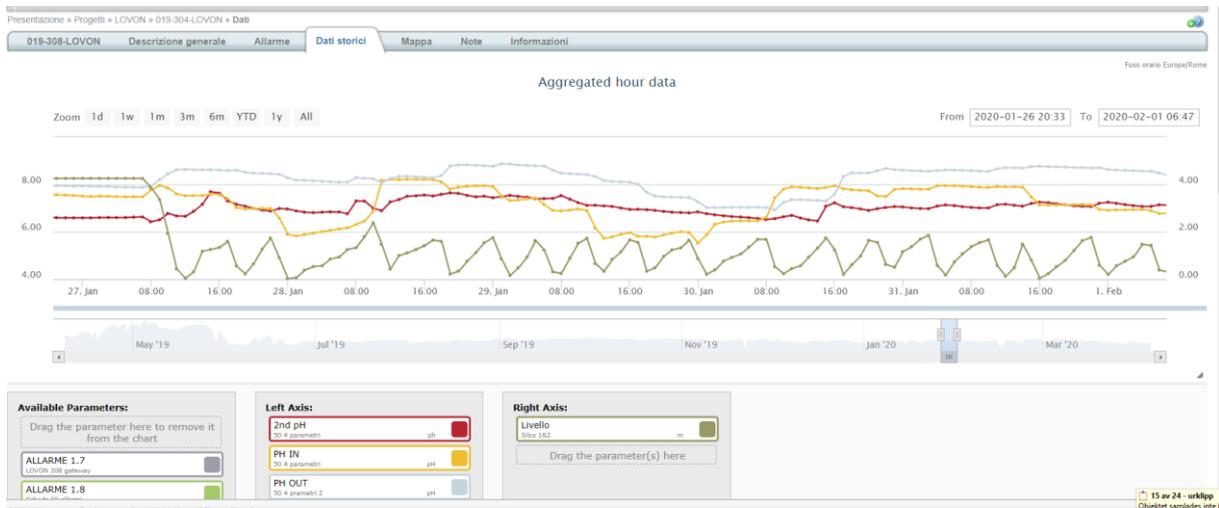
- If the valve get clogged, it is suggested to try to backflush water to unclog it before to disassembly it completely. If it still does not work, the side valve can be carefully opened to flush out some of the mud.
- It is important to follow carefully the instruction to disassembly the pneumatic valve
- If the pumps do not start, it might be that the pump floater sensor get clogged in the pit. It need to be checked on daily basis
- During the maintenance, it is important to empty the silos before close the valve manually to reduce the time and pressure of the water into the valve, reducing the risk of clogging.
- In case of formation of low temperature and formation of ice, it is recommended to check the surface of the silos to ensure that ice is not forming. If the case, the sonar could read the wrong value and cause problems to the plant.



Figur 16 example of pneumatic valve issue

9 Software usage, alarm and monitoring

A dedicated guide for the software usage for monitoring of the plant and alarms is available, called “Manual for software usage”.



Figur 17 screenshot of the software used for monitoring the plant

9.2 reference document

- Manual for software usage

9.3 Troubleshooting

- If the signal of the software is not working, it is recommended to turn off and on again the router/datalogger at the wtp
- The software can be set to send alarm to phone number or email if needed. Request to SDwater for this tool.
- If the signal for the software for the WTP at FSE 304 is not working, check in the control room in the office if the cable is connected correctly and plug it off and on again.
- If the signal for the software for the WTP at FSE 303 is not working, check that the sim card is correctly installed and with data available.
- If some sensors are not communicating, check the communication protocol in the control panel and in the software.

10 Spare part and suppliers

All the required spare parts of the plant can be found in a dedicated list (spare parts WTP) that is kept updated continuously and there is also information about the minimum required in stock and supplier. In the list is specified also where the spare part is located (which pallet) and information about last changes and problems occurred.

Some of the spare parts can take long time for ordering and delivering. For this reason, it is important to have in stock minimum quantity needed to be sure that the plant can run in case of any problem.

SPARE PART LIST - UPDATE 18.03.2020											
Item in english	Item in Italian	code	in stoc	minimum stock	location	Pallet	part	comment	To be ordered	URGEN	SUPPLIER
Ammonium probe	Sonda ammonio	5470	1,00	1,00	FSE308 Warehouse		5 analyser			NO	Paab
Turbidity probe	Sonda torbidità	5461	0,00	1,00	FSE308 Warehouse		5 analyser	2020.03.18 to be sent back for revision		NO	Paab
Conductivity probe	Sonda conduttività		0,00	1,00				2020.03.18 one to be sent back for revision		NO	Paab
pH Probe	Sonda Ph	5401	0,00	1,00	FSE308 Warehouse		5 analyser	2020.03.18 three to be sent back for revision		NO	Paab
PAH probe	Sonda Olii		0,00	0,00			analyser			NO	Paab
mud recirculation pump	pompa di ricircolo fanghi	SWPFA075	1,00	1,00	FSE308 Warehouse (out)		recirculation pump			NO	to be che
Sensor for filter press	Sensore per filtropressa	PROXS618	2,00	2,00	FSE308 Warehouse		1 filterpress			NO	sdwater
underclothes set (20 undersol)	Set sottotela (20)	FP90020/JN	2,00	3,00	FSE308 Warehouse		4 filterpress			NO	to be che
Filtering clothes set (20 clothes)	set tela filtranti (20)	FP90020/L	2,00	3,00	FSE308 Warehouse		4 filterpress			NO	to be che
Relay for filter press 24AC	Rele per filtropressa 24AC	FIN4052	10,00	3,00	FSE308 Warehouse		1 filterpress			NO	ahsell
Non return valve for flocculant system 1"	Valvola di non ritorno per sistema flocculante 1"	VNR1	0,00	2,00	FSE308 Warehouse		6 flocculant pump	changed 2 2020.03.15, ordered 10 2020.03.18		NO	ahsell
Flocculant dosing pump	Pompa dosatrice flocculante	ZDÜCKS	1,00	1,00	FSE308 Warehouse		6 flocculant pump			NO	prominen
kit maintenance flocculant pump	kit maintenance flocculant pump (albero)		1,00	2,00	FSE308 Warehouse		6 flocculant pump	1 used 2019.12.10		NO	sdwater
Flocculant analyser glass pipe	Tubo vetro analizzatore flocculante	FLANALYMK (TT)?	1,00	1,00	FSE308 Warehouse		6 flocculant system	1 used, 1 taken 05/08 for 303		NO	sdwater
Flex metallic pipe for analyser	tubo metallico flessibile per analizzatore	FLANALYFT	5,00	3,00	FSE308 Warehouse		6 flocculant system	4 used at 303 1 taken 05/08		NO	ahsell
Analysier photocell flocculant	Analizzatore fotocellula flocculante	FLANALYFC	0,00	1,00	FSE308 Warehouse		6 flocculant system	1 substituted at 303 check if it works		NO	sdwater
Rubber rear shell for mud pump	guscio di gomma posteriore pompa fanghi	SWPFA075GP	2,00	2,00	FSE308 Warehouse		3 mud pump	1 used nov2018 1 used 08/07/2019		NO	sdwater
Impeller for mud pump	grante pompa fanghi	SWPFA075GI	2,00	2,00	FSE308 Warehouse		3 mud pump	1 used nov2018 1 used 08/07/2019		NO	sdwater
Rubber front shell for mud pump	guscio di gomma anteriore pompa fanghi	SWPFA075GA	2,00	2,00	FSE308 Warehouse		3 mud pump	1 used nov2018 1 used 08/07/2019		NO	sdwater
mud pump filter press feeding	pompa fanghi per filtropressa	450CX	1,00	1,00	FSE308 Warehouse		mud pump	1 full pump, next offices warehouse		NO	
								1 full kit (1 albero, 4 cuscinetti, 1 molla, tenute meccaniche, guarnizioni, paraoli)			
kit maintenance shaft mud pump	kit manutenzione per albero pompa fanghi	450CX-MK	2,00	2,00	FSE308 Warehouse		6 mud pump	1 kit missing 2 paraoli (WAS 50 05)		NO	
Set of bearings mud pump	Set cuscinetti pompa fanghi	SWPFA075 CU	2,00	1,00	FSE308 Warehouse		6 mud pump	4 bearing for each set		NO	
Fail for Solenoid valve metal work silos	Rubina Flettivalvola apertura silos	13VA1111NN	3,00	2,00	FSE308 Warehouse		1 control panel			NO	ahsell

Figur 18 dedicated list for the required spare parts of the plant

10.2 reference document

- Spare part list WTP

11 Maintenance activity and checklist

All the required maintenance to be done on daily, weekly, monthly and yearly bases are reported in the dedicated lists.

Dedicated checklists are in place to track all the maintenance done, and it is available at the plant.

The digital daily checklist is filled in online by the operator in a sharepoint form below:

Water treatment plant

1. Construction site *
 - FSE 303
 - FSE 304
2. Operator *
 - Paolo Valeri
 - Karol
 - Konrad
3. Start *
Please input date in format of dd/MM/yyyy
4. End time *
Please input date in format of dd/MM/yyyy
5. Coagulant concentration (%) *
Enter your answer
6. Metal removal concentration (%) *
Enter your answer
7. Filterpress use *
 - Yes
 - No
8. Water flow mud pump
 - Yes
 - No
9. Start Filterpress time
Please input date in format of dd/MM/yyyy
13. Check status oil booms *
 - Yes
 - No
14. Chemical status
(select only if needed)
 - Coagulant to be ordered
 - Metal removal to be ordered
 - Flocculant to be ordered
15. Filterpress cleaning
 - Yes
 - No
16. Cleaning analyser tanks *
 - Yes
 - No
17. General cleaning of WTP *
 - Yes
 - No
18. Grease mud pump and stirrers check *
 - Yes
 - No
19. Mud to be disposed *
 - Yes
 - No
20. Spare part used *
 - Yes
 - No
21. Spare part name *
Enter your answer
22. Comments and notes *
Enter your answer

Figur 19 digital daily checklist of the wtp via sharepoint

11.2 reference document

- C1. Maintenance tracking checklist
- C2. Wtp daily checklist V2
- C3. Calibration checklist
- A18. Manual maintenance WTP-2018-01-29-a

12 HSEQ aspects

12.2 Chemical and compressed gasses

A dedicated training called *F4.1 Chemical training* and *F4.2 H&S TRAINING WTP* is available in the Folder "F" of the documentation.

12.3 Oil removal

A dedicated information about oil removal is explained in the technical report *D.8 Oil removal system - water treatment plant*

12.4 Risk assessment

Risk assessment of the water treatment plant is described in the document *F5.1 A.R. - 019-17 LOVON Rev.00.it.en* and the environmental risk are described in *F5.2 Environment risk assessment WTP*.

12.5 Signs and kits

List of signs is available under *F3.1 safety labelling WTP chemicals* and *F3.2 sign for wtp*.

12.6 Compressor

All the documentation related to the compressor che be found under the folder F1. A daily checklist is filled in by the operator directly at the plant to check the status of the compressor. A 3months checklist is also available at the plant, filled in by the operator to check the status of the compressor.

12.6.1 Reference document

- F1.1 daily checklist
- F2.2 3month checklist eng
- F2.3 FLTprogram
- F2.4 Avvikelse2

12.7 Waste

All the waste should be handled accordingly to construction site regulation. Bins for different material(plastic, paper, wood, steel) should be available at the water treatment plant. Absorbent used material should be disposed as hazardous waste, as well as leftover chemicals and spillage.

13 Supplier contact

In case of any technical problem, SDwater management can be contacted at the following numbers:

<https://www.sdwm.it/en>

Tel: +39 02 9988891 Fax: +39 02 99815392

E-mail: info@sdwm.it

