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I N G E G N E R I A P E R L ' A M B I E N T E E I L T E R R I T O R I O

Tesi di Laurea Magistrale

Works on the rehabilitation of the wastewater treatment plant and the monitoring of the construction of an anaerobic digestion unit.

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Introduction

As part of my last year at the Politecnico di Torino in the Master course in Environmental and Land Engineering, I completed a six-month internship at Veolia Water. It takes place from March 3rd to August 30th in the Drôme Ardèche territory, more precisely in the city of VALENCE located in France, in the Drôme department (26).
The local authority (Communauté d'Agglomération Valence Romans Agglomeration) has entrusted Veolia Water with the operation of these structures, in particular the Valence wastewater treatment plant where VEOLIA is planning to build an anaerobic digestion unit on the water treatment plant of Mauboule.
The purpose of my internship participates in the development of the restoration projects and the work necessary to accommodate the anaerobic digestion unit whose operation is scheduled for 2022, my main activity concerns the restoration work and the deodorization service and ventilation. My internship took place 70% of the time in the offices of the VEOLIA agency at 163 rue de la Forêt and the rest of the time I was at the Valence wastewater treatment plant located in the Mauboule district. However, given the exceptional period, I had to work on other projects in parallel when we were in teleworking (for three months).
In this report, I will present the company globally and at the territory level. Then, I will explain the project for treating products from sanitation by an anaerobic digestion process on the site of the Valence water treatment plant. Then, I will develop my various missions carried out for the project mentioned above. Finally, in conclusion, I will end by discussing the possible future prospects of my project.

1 Presentation of VEOLIA company

1.1 Group history

At its origin, VEOLIA was called Compagnie Générale des Eaux (CGE), the company that was established in 1853 by imperial decree. Its founders have two goals: to irrigate the countryside and supply water to French towns and cities. CGE signs its first contract, to supply water to Lyon.
The first commercial success outside France was in 1880 in Venice (Italie). Constantinople (Istanbul) follows suit in 1882 and Porto in 1883. CGE extends its capabilities to wastewater treatment.
In 1980 CGE merges with several subsidiaries specialized in the design, engineering, and construction of water and wastewater treatment facilities to form "Omnium de Traitement et de Valorisation" (OTV). CGE acquires a controlling interest in CGEA (later known as Connex and Onyx), followed by "Compagnie Générale de Chauffe" (later known as Dalkia), bringing together the four business activities in which Veolia now specializes.
In 1998 CGE Group becomes Vivendi, except for the specialized water subsidiary in France, which retains the "Compagnie Générale des Eaux" name.
Vivendi Environment is established in 1999 to consolidate all environmental services activities: Vivendi Water (Water), Onyx (Waste Management), Dalkia (Energy), and Connex (Transportation). Vivendi Environment is listed on the Paris Stock Exchange on July 20, 2000. Vivendi Universal retains over 70% of the company's stock.
By December 2002, the French company becomes Veolia Environment in 2003, an independent company, with a variant name for each business activity

- Water: Veolia Water
- Environnemental services: Veolia Environnemental Services,
- Energy: Veolia Energy (Dalkia)
- Transportation: Veolia Transport

In 2009 Antoine FRÉROT takes over as CEO of Veolia Environment in November 2009 and sets out his goal for the company: "To become the industry standard for environmental solutions." By refocusing the business and implementing the strategic
In July 2013, Veolia simplifies its hierarchical structure, moving from a group divided along business lines to a truly integrated company. Its business activities are now organized by country, with the same organizational model throughout the world.
During COP21, held between 30 November and 11 December 2015 in Paris, Veolia reaffirms its commitment to combating climate change. A commitment based on 3 key actions aimed at curbing greenhouse gas emissions: the circular economy, the introduction of the polluter-pays principle, and the reduction of methane emissions. [1]

1.2 VEOLIA today

Veolia group is the global leader in optimized resource management. With nearly **178,780** employees worldwide, the Group designs and provides **water, waste, and energy management solutions** that contribute to the sustainable development of communities and industries.
Veolia Environment (*listed on Paris Euronext: VIE*) recorded consolidated revenue of **€27.189 billion** in 2019. [2]
Veolia is developed in three businesses activity:

- WATER that represents about 41% of its activity,
- ENERGY that represents about 22% of its activity,
- WASTE that represents about 37% of its activity,

Veolia's main clients are businesses and local authorities to which it offers its knowledge and skills in the three areas mentioned above.

Veolia's main competitors are:

- Suez: French water and waste management group. It is the second-largest group in the world behind Veolia. A sub-subsidiary of Suez Environment, Degrémont, built the Valence purification plant, a company specializing in drinking water production facilities and the treatment of wastewater and sludge.
- Saur: a group of companies that supports local communities and manufacturers in France and internationally in their development projects mainly related to water (engineering, works, operation) and leisure.

In the remainder of this report, we will only deal with Veolia Water, a Veolia subsidiary specializing in water and sanitation management. Veolia Water's different areas of expertise in water management are:

- Water production and water distribution,
- Wastewater treatment,
- Customer relations,
- Data management and smart services,
- Matter and energy valorization,
- Social and societal engineering,
- Control of impacts on the natural environment.

2 The organization of the company VEOLIA Water in France: Center-east region

Veolia Water in France is divided into several regions. In this report, only the Center East region will be presented. (figure 1)
The management of the regional center is based in Vaulx-en-Velin (69120), its director is Cyril CHASSAGNARD, he is supported by two deputy directors: Franck TEXIER (director of operations) and Stéphane LAURENT (director of development).
Each year, the deputy director Franck TEXIER comes to every agency of the territory to check every project, look at the works, at the management, and the finance. During my internship Mr. TEXIER was at the agency in August, therefore I had the opportunity to present to him the different missions that were assigned to me.
The regional centre coordinates its activities through 10 territories (division of territories in ***Figure 1***) responsible for contractual relations with local and industrial communities: Drôme-Ardèche, Loire-Auvergne, Isère-Savoie, Haute Savoie-Ain- Jura, Portes de Lyon, Saône-et-Loire, Bourgogne Centre, Nord Bourgogne, Val de Saône and Grand Lyon water. [3]

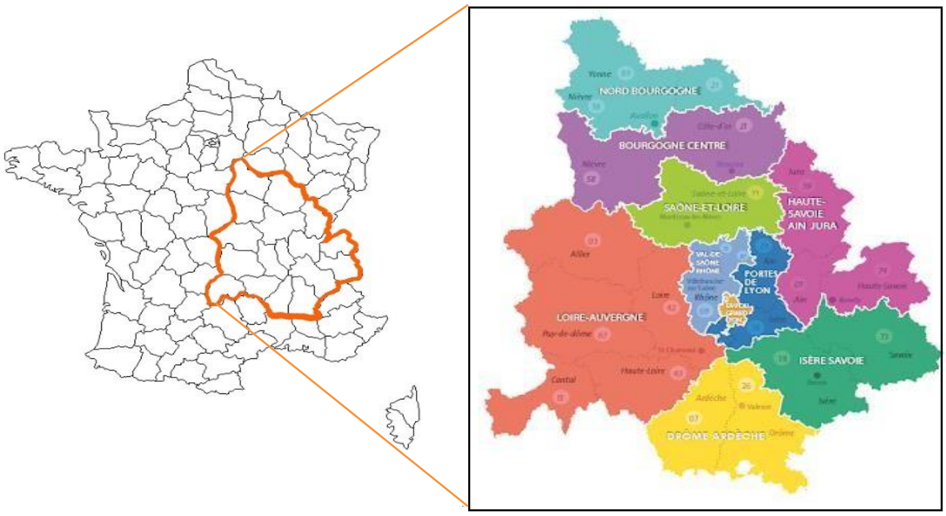


Figure 1: The centre-east region coloured function of the VEOLIA different territories

2.1 Drôme Ardèche Territory

My internship was in the Drôme Ardèche territory main office, located at 163 rue de la Forêt in Valence.

The territory is under the responsibility of Philippe FOREY, who is assisted by Olivier ROUCHIER, Director of Operations, and Maëlle LIMOUZIN, Head of Development.

The territory is divided into nine local services, each headed by a manager (organization chart in **APPENDIX I**). Some of them are not based in Valence, but in the cities around.

On the main office they were the following support services:

- An Administrative and Financial department: this entity ensures the financial management controls of the Territory and the monitoring of supplies (materials and products) necessary for operations,
- A Consumer Service, which manages all customer issues,
- A Development department: this entity is responsible, among other things, for studying markets, ensuring commercial monitoring, and monitoring calls for tenders in consultation with the contract directors.
- The Operation directive service.

2.2 Operations directive service

This internship was carried out more precisely in the Operations Department, under the responsibility of Olivier ROUCHIER, this entity is responsible for providing support to the operating departments, managing, and setting the objectives of the department managers. It also helps to provide the necessary assistance and to absorb the work peaks of daily operation.

The Department of Operations is composed of:

- An operating assistance service which provides logistical support and the production of technical dashboards to operators,
- A Safety and Quality Management department which provides support to operators to identify and remedy risky situations,
- A design office that carries out technical studies at the request of operators and communities and can also lead project management missions for carrying out development work on treatment structures.

In the department of operation Sarah HEMOUS, my internship supervisor is the studies and technical project engineer. She is in charge of the anaerobic digestion project. Her mission is to put in place the works and to follow the construction site. Moreover, she has also the responsibility for the rehabilitation and the new organization of the wastewater treatment plant. She is 60% of the week in the main office and the other time at the construction site ***Figure 2***.

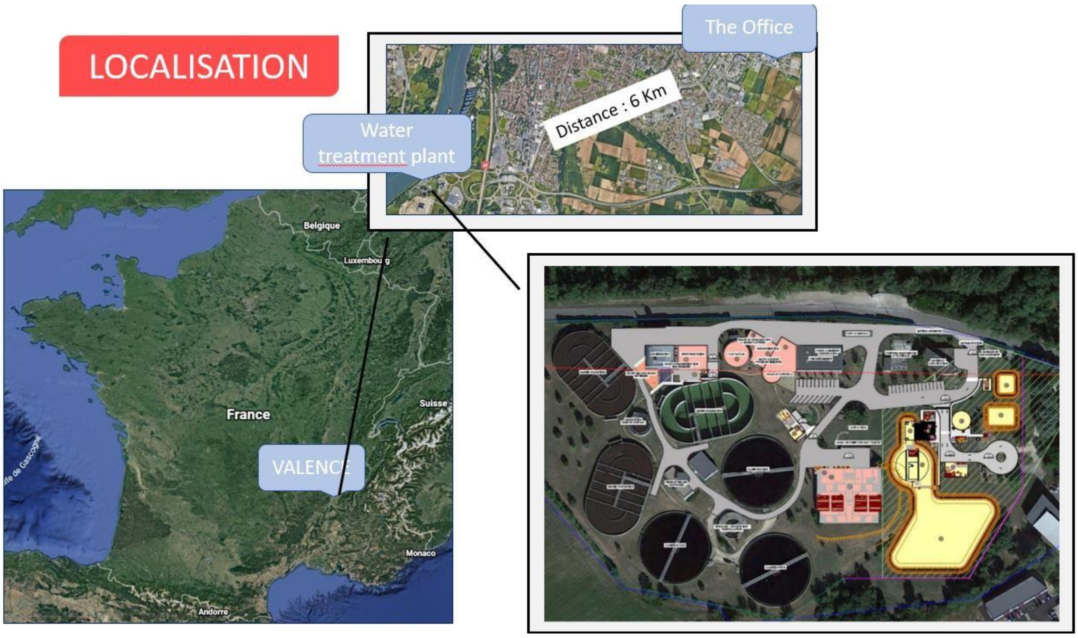


Figure 2: Localisation of the city of Valence, the main office, and the wastewater treatment plant

Valence is situated in the south of France; the main office and the wastewater treatment plant are at a distance of 6km. On the third photography, it is represented the future station, with the currently present.

3 The construction of an anaerobic digester project

3.1 Presentation of the project

The Urban Community of Valence is part of a sustainable development approach with the adoption of a Territorial Climate Air Energy Plan (PCAET) in 2010. The PCAET is a regional sustainable development project whose primary purpose is the fight against climate change by reducing the impact of human activities. Established by the National Climate Plan after the European directive of 2004 and taken up by the Grenelle 1 laws and the Grenelle 2 bill, it constitutes a commitment framework for the territory. [4]
One of the main objectives of the Agglomeration Community PCAET is the development of renewable energies in the community in order to free itself from fossil energy sources.
After several studies on the territory, the selected project consists of carrying out anaerobic digestion of sludge from the three cities which are Valence, Portes-Lès-Valence, and Romans-sur-Isère wastewater treatment plants on the site of Valence wastewater treatment plant., this process will be explained during the report.
The project is fully consistent with the current objectives of the energy transition because the anaerobic digestion makes it possible to produce biomethane, renewable energy, through its injection into the GRDF network as a substitute for fossil energies.

For this project, in 2017 Valence Romans Agglo has launched a call for tenders and then has selected the company Veolia Water, which holds:

- The construction of a treatment unit for products resulting from the three wastewater treatment plants by an anaerobic digestion process as well as modifications to the water and sludge systems resulting from the integration of this anaerobic digestion unit.
- The public service delegation for the operation of wastewater treatment plants in Valence and Portes- lès-Valence and their transit networks.
- The delegation of public services also involves the proper functioning of the wastewater treatment plant when the anaerobic digestion unit will be present, therefore improvement works are to be carried out by VEOLIA for the agglomeration.

In **APPENDIX II**, the plan of the Valence treatment plant, the works for all the new elements for the anaerobic digestion, and the existent treatment plant are shown.

3.2 Anaerobic digestion at the Valence water treatment plant

3.2.1 The geographical situation of the project

The anaerobic digestion project will be located at the Valence treatment plant. The substrates used will come exclusively from wastewater treatment plants. This will be sludge and grease from the Valence, Romans-sur-Isère, and Portes-Lès-Valence stations. ***Figure 3*** makes it possible to locate the three cities from each other.

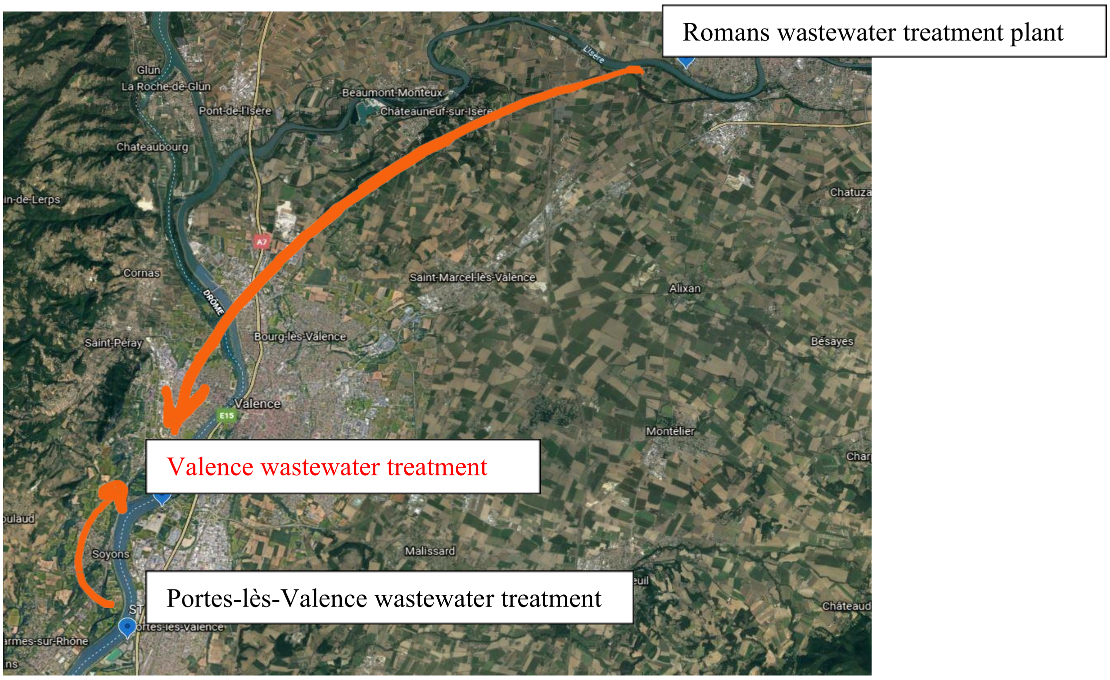


Figure 3: Representation of the three wastewater treatment plants involve in the methanisation project

Sludge from the Romans wastewater treatment plant will be transported by truck, while sludge from the Portes-Lès-Valence wastewater treatment plant will be pumped to the Valence wastewater treatment plant through a 4km pipe, which is also part of the public service delegation work in connection with the anaerobic digestion project, the implantation of the pipe is available in **APPENDIX III**.

3.2.2 Anaerobic digestion processes

Anaerobic digestion is a biological treatment of organic waste. More specifically, it is an anaerobic decomposition (in the absence of air) of organic waste by populations of microorganisms. The reaction occurring in this process is as follows:

Organic matter + microorganisms → Biogas + digestate

The anaerobic digestion process comprises four stages (illustrated in ***Figure 4***). Each step leads to the formation of intermediate compounds, which in turn serve as substrates in the next step.

The first step is hydrolysis. During this step, the microorganisms release enzymes capable of hydrolyzing macromolecules or polymers (proteins, lipids, and polysaccharides) into single molecules or monomers (amino acids, fatty acids).

The second step is acidogenesis. The monomers are metabolized by fermentation microorganisms to produce volatile fatty acids (acetate, propionate, butyrate, isobutyrate, valerate, and isovalerate), but also alcohols, hydrogen sulfide (H2S), carbon dioxide (CO2), and hydrogen (H2).
Then, the acetogenesis step allows the transformation of the various compounds from the previous phase into direct precursors of methane. A large percentage of volatile fatty acids and alcohols are taken up by autotrophic acetogenic bacteria to form acetate. The other part is converted into hydrogen and carbon dioxide.

In the last step called methanogenesis, the products of acetogenesis are converted into methane by strict anaerobic microorganisms. It is carried out by two possible routes: one from hydrogen and carbon dioxide by the so-called hydrogenotrophic species, and the other from acetate by the acetotrophic species.

Temperature, pH (between 6.5 and 8.5), and carbon/nitrogen ratio are important parameters that influence the stability of the biological process.

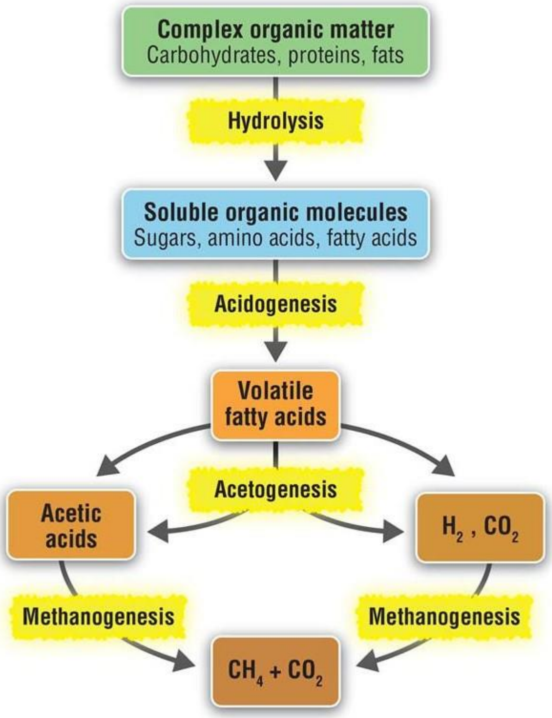


Figure 4: Biological process of anaerobic digestion

Before anaerobic digestion, the substrates are received and prepared. The objective is that as much material as possible is transformed into biogas, it should be noted that WWTP sludge and grease have a very high methanogenic power. The dryness of the sludge is a determining factor for anaerobic digestion the sludge must have dryness of around 6%. For this, improvements in the sludge sector will be carried out as part of the anaerobic digestion work.
Temperature is an important parameter, in fact, digestion is sensitive to temperature variations. A variation of 1 ° C for thermophilic digestion and from 2 ° C to 3 ° C for mesophilic digestion.
The pH in the digester should be between 7 and 7.5. This pH range is favorable to the steps of acetogenesis and methanogenesis.
The carbon/nitrogen ratio also influences the stability of the biological process. If this ratio is too high, the carbon does not degrade completely, the production of biogas decreases. For good stability, the ratio must be between 10 and 30.
VEOLIA is responsible for the exploitation of the biogas, the company has chosen to inject the gas into the GRDF network, a small part of the biogas can be consumed for self-consumption for heating the digester (backing up the fatal energy used).

3.3 Presentation of the three-wastewater treatment plant

3.3.1 Presentation of Portes-Lès-Valence wastewater treatment plant

Figure 5: Portes-Lès-Valence wastewater treatment plant, google earth view

The sewage system connected to the Portes-Lès-Valence treatment plant represented ***Figure 5***, has a nominal capacity of 76,000 equivalent population. However, the wastewater treatment plant receives 18% of its effluent treated is issued from industries (non-domestic water). Its capacity of treatment is only 40%- 50% (***Table 1***) but sometimes it happens that effluent charged arrived, due to the industries connected.

Table 1: Daily nominal capacity and charge rate from the 2017 data of Portes-Les-Valence WWTP [5]

Paramètre	Capacité nominale journalière	Charge moyenne journalière			Taux de charge 2017
		2015	2016	2017	
Volume (m^3/j)	8 942	7 701	6 457	6 173	69 %
DBO5 (kg O_2/j)	4 526	2 256	1 881	1 949	43 %
DCO (kg O_2/j)	10 829	5 116	4 309	4 409	41 %
MES (kg/j)	4 008	2 119	1 763	1 728	43 %
NTK (kg/j)	820	451	414	427	52 %

Biological performances at the biological rejection point (***Table 2***).

Table 2: Biological performances, efficiency of the Portes-Les-Valence WWTP [5]

Paramètre	Concentration au rejet réglementaire	Niveau de rejet moyen	Rendement minimal réglementaire	Rendement au rejet moyen	Nombre de bilans effectués
DBO5	25,00 mg/L	4,02	80 %	98,74 %	103
DCO	125,00 mg/L	25,11	75 %	96,55 %	104
MES	35,00 mg/L	5,12	90 %	98,18 %	103
NTK	15,00 mg/L	4,60	83 %	93,32 %	53

Nowadays the half of the sludge produced by the wastewater treatment is sent to the Valence furnace (***Table 3***). With the digester anaerobic all the sludge will be sent to the Valence treatment plan digester. And after the digestion, the furnace.

Table 3: By-products from the Portes-Les-Valences WWTP [5]

Nature	Quantité annuelle	Destination
Boues (siccité moyenne 23,4%)	2 514 t(MB) 588 tMS	Incinération à la STEU de Valence
Sables	1 731,72 t	Evacuation au CSDU classe 2, exploité par ONYX ARA à Chatuzange-le-Goubet (26)
Refus de dégrillage	2 695,90 t	Evacuation au CSDU classe 2, exploité par ONYX ARA à Chatuzange-le-Goubet (26)
Graisses	Non quantifiées	Mélangées aux boues avant déshydratation et incinération à l'UDEP de Valence

3.3.2 Presentation of Romans-sur-Isère wastewater treatment plant

Figure 6: Roman-sur-Isère wastewater treatment plant, google earth view

A sewage system connected to the Romans-sur-Isère treatment plant with a nominal capacity of 107,900 population equivalent (***Table 4***).

Table 4: Daily nominal capacity and charge rate from the 2017 data of Romans-sur-Isère WWTP [5]

Paramètre	Capacité nominale journalière	Charge moyenne journalière			Taux de charge 2017
		2015	2016	2017	
Volume (m^3/j)	14 490	13 305	12 357	11 181	77 %
DBO5 (kg O_2/j)	6 474	4 942	4 594	4 539	70 %
DCO (kg O_2/j)	13 730	11 841	10 382	10 057	73 %
MES (kg/j)	4 760	5 302	4 362	4 102	86 %
NTK (kg/j)	1 123	892	743	820	73 %

Table 5: Biological performances, the efficiency of the Romans-sur-Isère WWTP [5]

Paramètre	Concentration au rejet réglementaire	Niveau de rejet moyen	Rendement minimal réglementaire	Rendement au rejet moyen	Nombre de bilans effectués
DBO5	25,00 mg/L	9,95 mg/L	80 %	97,71 %	156
DCO	125,00 mg/L	48,66 mg/L	75 %	94,94 %	156
MES	35,00 mg/L	16,66 mg/L	90 %	95,63 %	156
NTK	-	7,42 mg/L	-	90,67 %	52

Nowadays the half of the sludge produced by the wastewater treatment is sent to the Valence furnace (***Table 6***). The other part is sent to the composting. With the digester anaerobic all the sludge will be sent at the Valence treatment plan.

Table 6: By-products from the Romans-sur-Isère WWTP [5]

Nature	Quantité annuelle	Destination
Boues	5 391 t(MB)	Incinération STEU de Romans : 2 396 tMB Compostage : 2 995 tMB
Sables	28,27 t	Evacuation au CSDU classe 2, exploité par ONYX ARA à Chatuzange-le-Goubet (26)
Refus de dégrillage	43,10 t	Evacuation au CSDU classe 2, exploité par ONYX ARA à Chatuzange-le-Goubet (26)
Graisses	1 669,48 m^3	Traitées avec les graisses extérieures dans un ouvrage dédié (CARBOFIL) sur la STEU de Romans

3.3.3 Presentation of Valence wastewater treatment plant

Figure 7: Valence wastewater treatment plant, google earth view

The anaerobic digestion project will be carried out at the Valence treatment plant (***Figure** 7*). This station has a nominal capacity of 171,600 Population equivalent and the treatment plant is sized to treat up to 2,800 m3 / h of effluent in dry weather and up to 11,800 m3 / h in wet weather.
As it is possible to observe the charge rate (***Table** 7*) in 2017 attempts 50%. In 2020, charge rates have not increased significantly.

Table 7: Daily nominal capacity and charge rate from the 2017 data of Valence WWTP [5]

Paramètre	Capacité nominale journalière	Charge moyenne journalière			Taux de charge 2017
		2015	2016	2017	
Volume (m^3/j)	46 750	37 616	28 949	25 470	54 %
DBO5 (kg O_2/j)	10 300	4 993	5 094	5 579	50 %
DCO (kg O_2/j)	25 700	11 790	11 795	12 767	54 %
MES (kg/j)	15 900	6 451	5 909	6 361	40 %
NTK (kg/j)	2 620	1 160	1 126	1 126	43 %

Biological treatment (***Table 8***) in Valence treatment plant presents an efficiency really performant. The process used to treat the wastewater is well designed.

Table 8: Biological performances, the efficiency of Valence WWTP [5]

Paramètre	Concentration au rejet réglementaire	Niveau de rejet moyen	Rendement minimal réglementaire	Rendement au rejet moyen	Nombre de bilans effectués
DBO5	25,00 mg/L	2,75	80 %	98,72 %	156
DCO	125,00 mg/L	20,11	75 %	95,93 %	156
MES	35,00 mg/L	4,83	90 %	98,04 %	156
NTK	10,00 mg/L	2,54	83 %	94,20 %	104

The DENSADEG treatment (***Table 9***) is a specific building used only during the rainy days when the water flow rate exceeds 2 800m3/h, the rainwater is sent to this building that treats the rainy water with a physical-chemical treatment.

Table 9: Rainy weather operation [5]

Paramètre	Rendement minimal réglementaire	Rendement au rejet moyen	Niveau de rejet moyen	Nombre de bilans effectués	Nombre de bilans non-conformes
DBO5	55 %	65 %	45,76 mg/L	20	1
DCO	70 %	70 %	113,34 mg/L	20	3
MES	80 %	77 %	51,30 mg/L	20	3
NTK	15 %	31 %	19,33 mg/L	13	2

Figure 8 illustrates the current treatment of wastewater as a function of the inflow. This treatment is modified with the arrival of the anaerobic digester, we will see the modifications later.
The wastewater effluent arrives via the lifting station, in dry weather, which corresponds to an incoming flow rate of less than 2800 m^3 / h, the water goes to the pre-treatment zone which consists of a screen, sand separator, oil separator, then joined one of the three aeration basins to end up in one of the three clarifiers (clarifier in ***Figure*** *7*).

If the inflow is greater than 2,800 m3 / h, with the rainwater, the water in the lifting station passes through an overflow and reaches the storm treatment building (Lamellar Settling in ***Figure 8****),* a

technology for treating stormwater consisting of four flocculation basin, four sand traps, and two settling tanks.
Rainwater and water from biological treatment are discharged into the Rhône after treatment. Sludge and fats are collected, then dehydrated using centrifuges, and are burned by the incinerator on site.

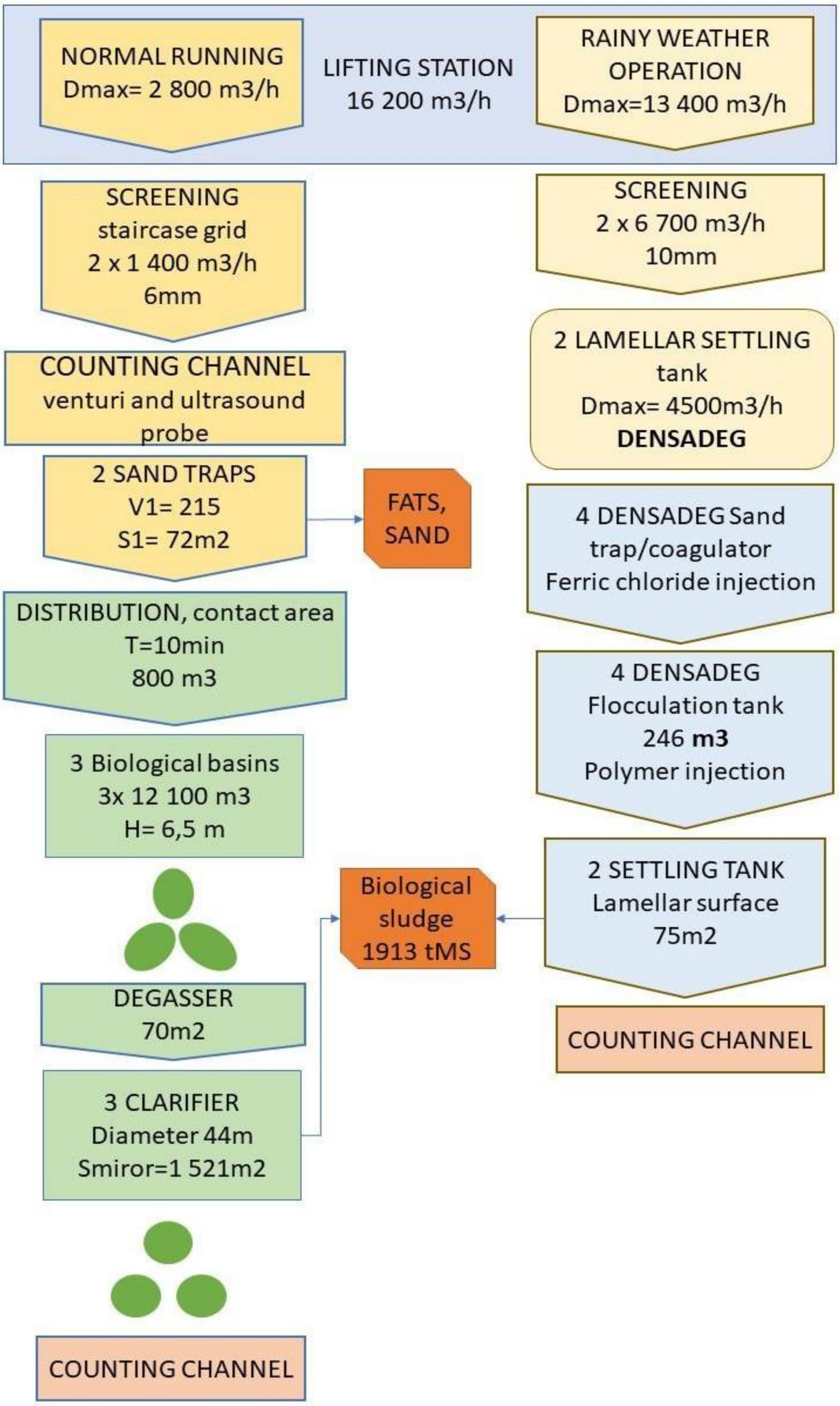


Figure 8: Steps of the wastewater treatment plant

3.4 Project characteristics

3.4.1 Presentation of the future organization of the treatment plant.

3.4.1.1 Digestion network

The digester will have a capacity of 5,000 m^3 and will be built in reinforced concrete on a concrete slab. The digester will be a digester without a gaseous sky: Gastop. In this type of digester, the sludge/biogas interface is limited to the biogas outlet, so this limits the risks of the digester exploding.
The type of digestion that will be implemented is mesophilic, i.e. the temperature of the process is between 35 and 40 ° C. The chosen biogas recovery is to inject the gas into the GrDF network, and a small portion is consumed for heating the digester (to save the fatal energy used).
All inlets and outlets of the digester will be made from the top of the structure to avoid accidental drainage from the bottom. The fresh sludge will be introduced by tapping in the piping of the sludge recirculation loop. This recirculation will heat the sludge. On leaving the digester, part of the sludge will pass through a water/sludge exchanger. The sludge will come out of the exchanger at 39 ° C.
To homogenize the mixture, the digester is constantly stirred by an axial agitator which will be composed of two stages of blades. [6]

In ***Figure 9***, the digester structure is illustrated.

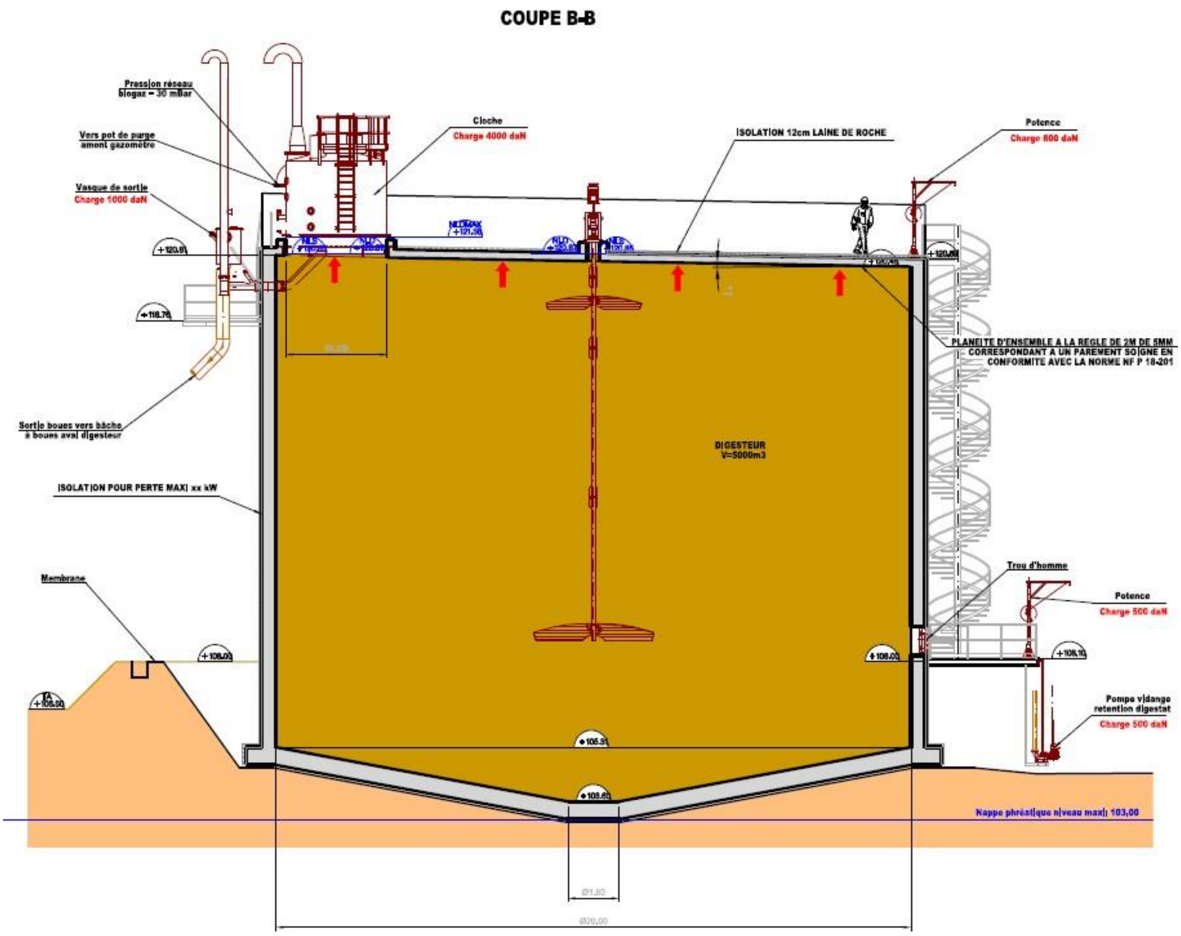


Figure 9: GASTOP anaerobic digester

Table 10: Characteristic of inlet sludge send to the digester

Parameters	*Units*	*Annual average at the beginning*	*Maximum future average (2035)*
Volume	m^3/j	214	271
Total amount of dry matter	kg_{MS}/j	12 848	16 304
Volatile matter content (MV)	% MV	74,9	76,5
Sludge dryness limit	% MS	6	6

In 2035, one of the goals is to treat an amount of dry matter of 16 304 kg_{MS}/j. The other parameters are presented in the ***Table 10***.

The sludge will be heated at 35°C, it has a solid content of 6%, and their residence time in the digester will be 23days at the beginning. The goal is to attempt a residence time of 18days in 2035, in the case the daily sludge volume could be augmented. [6]

$$Volume_{digester} = \frac{Production}{solid\ content} x\ retention\ time$$

$$Volume_{digester} = \frac{12848\ x\ 10^{-3}}{0{,}06} x\ 23 = 4925\ m^3 < 5000\ m^3$$

It is inferior at the digester capacity.

The digestion process takes place at a temperature of 35 ° C. The temperature of the digester will be maintained by a water/sludge type heat exchanger, placed on the digester recirculation circuit. Two lobe pumps (one in operation; one in emergency) will allow the circulation of the sludge which will be withdrawn from the upper part of the digester and reinjected into the fresh sludge feed pipe which goes back to the bottom of the digester. The hot water passing through the exchangers comes from a mixing bottle. The sources of calories to heat the water that will be used to maintain the sludge at the desired temperature (35 ° C) are:

- High-temperature smoke from the incinerator, or heat pump on the treated water (see next chapter)
- Boiler powered by biogas or natural gas (back-up). The sludge circulation circuits of the digesters will be insulated in order to limit heat loss. The digester will also be isolated in order to limit heat losses...

3.4.1.1.1 Heat losses due to the walls

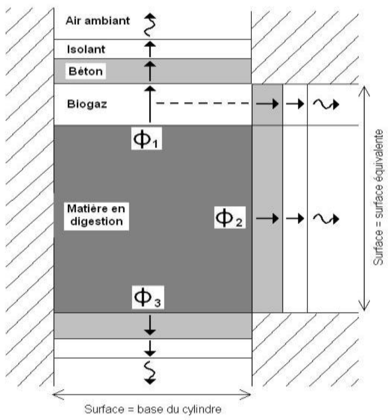


Figure 10: Representation of the heat losses according to the different axes of the digester

It can be observed three flow on the ***Figure 10***, $\phi1, \phi2, \phi3$, as $\phi2$ *and* $\phi3$ cross the 3 same layers, they are considered as the same. As result, there are 2 flows.
A radial heat flow through a hollow cylinder in steady state is given by the following relationship:

$$\phi = \frac{2\pi.\lambda.H}{\ln\left(\frac{r_1}{r_2}\right)}.(T_1 - T_2)$$

But: $\phi = \frac{(\lambda.S_W)}{e}.(T_1 - T_2)$

So, the total wall surface of the cylinder is: $S_w = \frac{2\pi.H.e}{\ln\left(\frac{r+e}{r}\right)}$

Sw= 809,2 m^2

In black is the surface S_2, at the top in blue it is the surface S1

- $\lambda_{concrete}$ **= 1,75 W·m^{-1}·K^{-1}**
- $\lambda_{isolant}$ **= 0,036 W·m^{-1}·K^{-1}**
- λ_{biogaz} **= 0,0304 W·m^{-1}·K^{-1} at 35°C (60% CH_4 + 40% CO_2) ;**
- R_{SE} **= 0,04 m^2·K·W^{-1}**
- ***E$_{concrete}$=1m***
- ***E$_{isolant}$=0,5m***
- ***E$_{biogas}$=0,2m***

$$S_1 = S_d + 0{,}1.S_w$$

$$\boldsymbol{R_{th}}1 = \boldsymbol{R_e} + \boldsymbol{R_{isolation}} + \boldsymbol{R_{concrete}} + \boldsymbol{R_{biogaz}}$$

$$R_{th}1 = \frac{1}{S_1}.\left(R_{SE} + \frac{e_{isolant}}{\lambda_{isolant}} + \frac{e_{concrete}}{\lambda_{concrete}}\right) + \frac{e_{biogas}}{\lambda_{biogas}.Sd}$$

$$S_1 = \pi.10 + 0{,}1.809{,}2$$
$$S_1 = 112{,}34\ \mathrm{m}^2$$

$$\boldsymbol{R_{th}}1 = 0.34\ \boldsymbol{K.W^{-1}}$$

Rth1 is the equivalent resistance of all the thermal transfer of the digestion matter through the biogas, the high walls of the digester, and the roof.

$$S_2 = S_d + 0{,}9.S_w$$

$$\boldsymbol{R_{th}}2 = \boldsymbol{R_e} + \boldsymbol{R_{isolation}} + \boldsymbol{R_{concrete}}$$

$$R_{th}2 = \frac{1}{S_2}.\left(R_{SE} + \frac{e_{isolant}}{\lambda_{isolant}} + \frac{e_{concrete}}{\lambda_{concrete}}\right)$$

$$S_2 = \pi.10 + 0{,}9\ .809{,}2$$
$$S_2 = 759{,}7\mathrm{m}^3$$

$$\boldsymbol{R_{th}}2 = 0.13\ \boldsymbol{K.W^{-1}}$$

Rth2 is the equivalent resistance of all the thermal transfer of the digestion matter through the walls of the digester and bottom.

The thermal losses are situated at the bottom and the walls, the biogas appears as a real good isolant.

$$R_{tot} = \frac{R_b . R_h}{R_b + R_h}$$

$$\mathbf{R_{tot} = 0,09\ K.W^{-1}}$$

The average annual temperature in Valence is 12,4, this temperature is considered as Text. ΔQ represents heat loss:

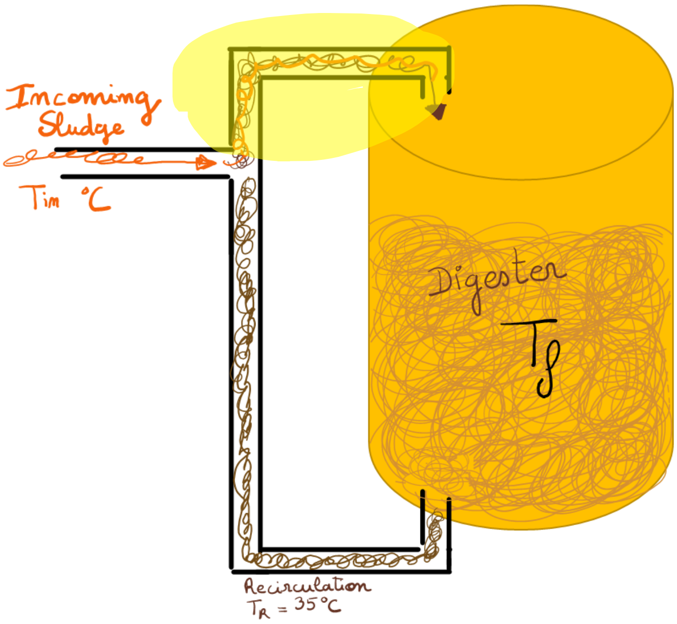
$$\Delta Q = \frac{T_0 - T_{ext}}{R_{tot}} . t$$
$$\Delta Q = 251. t$$

For t= 24h : **ΔQ= 6 026 Wh**

These energy losses need to be compensated.

3.4.1.1.2 Heat losses due to incoming sludge

Then the sludges are introduced on the digester already heat by the recirculation sludge. In fact, the pipe for the introduction of the sludge is connected with the recirculation pipes.



In order to calculate the heat loss due to the incoming sludge, the hypothesis that in this pipe colored in yellow there is 60% of recirculation sludge at 35°C and 40% of new sludge injected at 21°C heated by the upstream process is made.
Q1 is the heat flux gained by the incoming sludge because the incoming sludge is at a temperature of T_{in}=21°C, colder than the recirculating sludge.
Q2 is the heat flux lost by the recirculating sludge because the recirculating sludge is at a temperature of T_r=35°C, hotter than the incoming sludge.

$$Q_1 = -Q_2$$
$$M_1 x\ C_{heat\ capacity}\ x\ (T_f - 21) = -M_2\ x\ C_{heat\ sludge} x\ (T_f - 35)$$

The calculus is focused on the yellow part, after the mixing of the incoming sludge and the recirculating sludge. The total mass is M_{tot}

$$M_1 = 0{,}6\ x\ M_{tot}$$
$$M_2 = 0{,}4\ x\ M_{tot}$$

$$0{,}4xM_{tot}xC_{heat\ capacity}\ x\left(T_{mixed\ sludges} - 21\right) = -0{,}6x\ M_{tot}xC_{heat\ sludge}x(T_{mixed\ sludges} - 35)$$
$$0{,}4\ x\ \left(T_f - 21\right) = -0{,}6\ x\ (T_f - 35)$$
$$T_{mixed\ sludges} = 0{,}4\ x\ 21 + 0{,}6\ x\ 35 = 29{,}4\ °C$$

The incoming sludge on the digester has a temperature of 29,4°C .

Then the incoming sludge flow rate represents 214m^3/j and the total volume of the digester is 5000m^3, but it is the maximum accepted, the hypothesis is to say that the digester is filled with 3000 m^3.

214 m^3 represents 6,7% of the total content.

The temperature of the total sludge:
$$M_1x\ C_{heat\ capacity}\ x\ \left(T_f - 29{,}4\right) = -M_2\ x\ C_{heat\ sludge}x\ (T_f - 35)$$

$$T_f = 34{,}55°C$$

With the incoming sludge every day we lose 0,45°C in that example.
It is important to take this into account.

3.4.1.2 Sludge network

The characteristics of sludge from Romans, Portes-Les-Valence, and Valence have different dryness's:

- Sludge from the Valence treatment plant:
  - Primary sludge (dryness 1.5%)
  - Biological sludge (dryness 0.4 - 0.5%)

- Romans wastewater treatment plant:
  - Biological sludge (dryness 0.4 - 0.5%)
  - Primary pasty sludge (dryness 18 to 22%),

- Portes-Les-Valence purification plant:
  - Biological sludge (dryness 0.4 - 0.5%)
  - Primary sludge (dryness mixture 1%).

However, all this sludge will feed the digester continuously and will return with dryness of 6% (by the liquid route), some sludge must therefore undergo a physical change (thickening, dilution). Then all of this sludge must be mixed and homogenized before feeding the digester.
At the end of digestion, the sludge will be destructured using a new process and then dehydrated using two centrifuges.
The dehydrated digested sludge will then be incinerated in the furnace at the station. The furnace can handle all digested sludge due to the reduction in the volume of sludge in the digestion facility. (***figure 11)*** [6]
On the sludge network, lots of modifications will be done ***(Figure 11***).

- The existent flotation tank will be converted into a sludge mixing tank before the thickening step. Now the all the primary sludge and biological sludge are collected and mixed. After they are sent to the dynamic draining drum. Because we need a dryness limit of 6% and the flotation tank was not able to reach this dryness.
- The existing building uses to tidy the dumpster is converted into the sludge thickening building. That will replace the flotation step thanks to the new method: Dynamic draining drum.
- The existent Physico-chemical sludge tank is converted into a mixing sludge tank (the last step before the sludge is sent to the anaerobic digestor). On the mixing tank an injection of milk of lime will be provided to correct the pH and allow to be in the range necessary for the good progress of the digestion (pH 6.9 - 7.8).)

- Float sludge degassing tank converted into a ferric chloride injection tank: ferric chloride will be added to complex the phosphorus and limit the presence of hydrogen sulfide,
- Dehydration building reorganized: upstream of the dehydration a destruction step will be put in place.

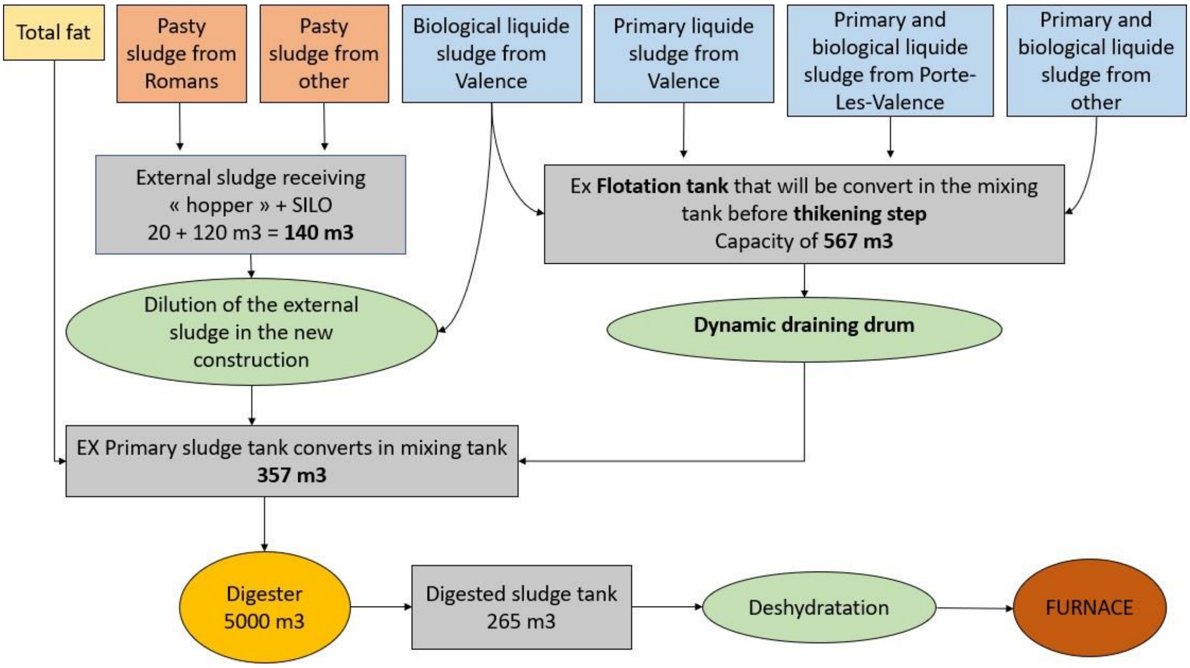


Figure 11: STEP of the sludge network

3.4.1.3 Biogas network

The biogas will exit the digester to be stored in an 810 m^3 gasometer. This structure will also allow buffering of variations in biogas production before treatment. If the storage volume is not large enough, a flare will be present on the site. The characteristics of the biogas are presented in ***Table 11***. [6]

Table 11: Biogas characteristics

Parameters	*Units*	*Annual average at the beginning*	*Future annual average (2035)*
Quantity of biogas product	Nm^3/j	4 128	4 463
CH_4 content	%	63	63
Maximum flow of injected biomethane	Nm^3/h	145	145

It is possible to calculate the quantity of biogas product, with the data from table 11:

The daily amount of sludge is 214 m^3/d, and represents a total amount of dry matter of 12 848 kgMS/d. The percentage of volatile matter in the sludge represents 74,9% and dryness of 6%.
The sludge residence time of the sludge in the anaerobic digester is 23days at a temperature of 35°C. As considered a density of

If the digester is considered as a perfect batch reactor, such as perfectly homogeneous and well mixed.

As the sludge are composed of 74,9% of MV:

$$12\,840\ x\ 0{,}749 = 9\,617{,}2\ kgMV/d$$

The estimation of a slaughter rate of 56% of the volatile matter is made, which gives 5 385 kg of eliminated volatile matter. [7]
The production of biogas is estimated at 800-1000L by kilogram of eliminated volatile matter (**Table 12**).

$$5385\ X \frac{800}{1000} = 4308{,}5\ m^3\ of\ biogas\ per\ day$$

$$4308{,}5\ x\ 0{,}63 = 2714\ m^3 of\ CH_4$$

Of course, this calculated value is approximative, this calculus gives a production of biogas superior to the biogas production calculated by VEOLIA in the **Table 11.** The difference can be explained by the approximation the density of sludge.

As in theory, there are different ways to calculate the biogas production, the following calculus, will use a second method with the COD eliminated (***Table 12***).

Thanks to the table, the production of methane can be estimated thanks to the COD eliminated, it represents 0,35 Nm^3 CH_4 / kg COD eliminated.

Considering 63% of methane in the biogas product (**Table 11**)

$$\frac{0{,}35}{0{,}63} = 0{,}56\ \frac{m^3 biogas}{kgCOD_{eliminated}} = 555{,}56\ \frac{L\ biogas}{kgCOD_{eliminated}}$$

$$\frac{800}{580} \frac{L/kg_{MV}}{L/kg_{COD}} = 1{,}37 \frac{kg_{COD}}{kg_{MV}}$$

And as calculated before the volatile matter represents 9 617,2 kgMV

$$1{,}37\ x\ 9\,617\ =\ 13175{,}29\ kg_{COD}$$

With a yield of 65%, it gives: [7]

$$8\,563\ kgCOD$$

And then this represents a production of methane around:

$$8\,563\ x\ 0{,}34 = 2\,911\ m^3 CH_4$$

Table 12: Data on the production of biogas in the mesophilic anaerobic digester, given by prof. DAGOT [8]

Paramètres	Valeurs
Acides Gras Volatiles	100<AGV<500 mgCH_3COOH /L
Titre Alcalimétrique Complet	1500 < TAC < 6000 mg $CaCO_3$/L
AV/TAC	< 0,2
pH	6,6 à 7,5
Température	30 - 37 °C
Charge massique	<0,13 kgMV/kgMV.j
Temps de séjour hydraulique	> 20 jours
Concentration en MS et MV	30 - 80 g/L à 60 - 80% MV
Biogaz produit	65 à 70 % CH_4 à 30 à 35% CO_2 800 à 1000 L/kg MV éliminée 0,35 Nm^3 CH_4/kg DCO éliminée 10,2 kWh électrique O,5 kWh thermique /kWh
Ratio C/N/P	400/7/1 (risque de dépassement alcalin)
Pouvoir Calorifique Inférieur	PCI= 9,42 kWh/m^3 à 15°C
Production boue	40-50 gMES/kgDCO éliminée
Coût	

The biogas in this project will end up being injected into the GrDF network. The biogas will therefore have to comply with the technical specifications of the gas networks. This means that it must have the same characteristics as natural gas.
The physico-chimical caracteristics are : higher heating value (*Pouvoir calorifique supérieur*), Wobbe index (*Indice de Wobbe*) , density (densité), CO_2 content (teneur en CO_2), H_2O content (teneur en H_2O)…In France the natural gaz distribution is separate in two categories : B type gas and H type gas. It will depend on the provenience of the gas. Valence is situated in a H zone that mean the gas products in this zone needs to satisfy H exigences (***Table 13***). [9]

Table 13: GRDF characteristics asked for Gas type H

Caractéristique	**Spécification**
Pouvoir Calorifique Supérieur (conditions de combustion 0 °C et 1,01325 bar)	**Pour une injection en zone de Gaz H : 10,7 à 12,8 kWh/m^3(n) (combustion 25°C : 10,67 à 12,77)** Pour une injection en zone de Gaz B : 9,5 à 10,5 kWh/m^3(n) (combustion 25°C : 9,48 à 10,47)
Indice de Wobbe (conditions de combustion 0 °C et 1,01325 bar)	**Gaz H : 13,64 à 15,70 kWh/m^3(n) (combustion 25°C : 13,6 à 15,66)** Gaz B : 12,01 à 13,06 kWh/m^3(n) (combustion 25°C : 11,97 à 12,97)
Densité	Comprise entre 0,555 et 0,70
Point de rosée eau	Inférieur à -5°C à la Pression Maximale de Service du réseau en aval du Raccordement 9
Point de rosée hydrocarbures 10	Inférieur à -2°C de 1 à 70 bar
Teneur en soufre total	Inférieure à 30 mgS/m^3(n)
Teneur en soufre mercaptique	Inférieure à 6 mgS/m^3(n)
Teneur en soufre de H_2S + COS	Inférieure à 5 mgS/m^3(n)
Teneur en CO_2	**Inférieure à 3,5% (molaire) pour une injection en zone de Gaz H** Inférieure à 11,7% (molaire) pour une injection en zone de Gaz B
Teneur en Tétrahydrothiophène (produit odorisant THT)	Comprise entre 15 et 40 mg/m^3(n)
Teneur en O2	**Inférieure à 0,75% (molaire) pour une injection en zone de Gaz H** Inférieure à 3% (molaire) pour une injection en zone de Gaz B
Impuretés	Gaz pouvant être transporté, stocké et commercialisé sans subir de traitement supplémentaire
Hg	Inférieur à 1 µg/m^3(n)
Cl	Inférieur à 1 mg/m^3(n)
F	Inférieur à 10 mg/m^3(n)
H2	Inférieur à 6 %
NH3	Inférieur à 3 mg/m^3(n)
CO	Inférieur à 2 %
Température du bio méthane	Inférieure ou égale à 35°C et supérieure à 5 °C

To have the same characteristics as natural gas, biogas must be purified. It must be treated to remove CO_2, H_2S, VOCs, siloxanes produced during digestion. In ***Figure 12***, the different steps of the future biogas treatment are represented.
First, the water vapor is removed by lowering the temperature to 5 ° C to condense the water. Part of H_2S and NH_3 are removed at the same time. A first non-impregnated activated carbon filter (microporous) will retain VOCs, while the second filter will retain the remaining H_2S and NH_3 (impregnated activated carbon). The gas will be sent to the filters under a pressure of 50 -100 mbarG. The CO_2 will then be removed by separation on selective membranes by pressurizing the gas to 13.5 barG. The CH_4 will thus be concentrated in the retentate (fluid retained by the membrane), while the CO2 will pass through the membrane, as will the water vapor. They will form the "off-gas" or permeate (the fluid which passes through the membrane).

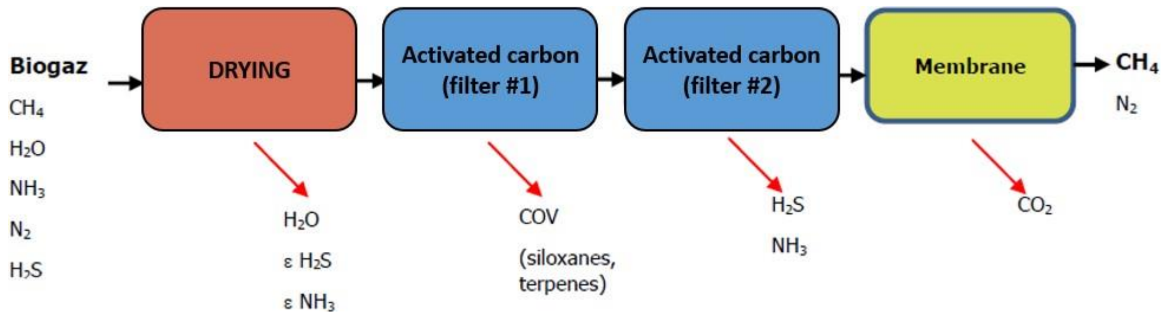


Figure 12 Steps of biogas treatment.

In the end, the biogas is composed of 97% of methane and it is called biomethane.

3.4.1.4 Water network

On the water line in rainy weather two lamellar decanters are used, this is a technology of Degremont, Densadeg 4D TGV. These decanters will be adapted to become primary decanters during dry weather. This modification will allow the production of primary sludge. This type of sludge has a higher methanogenic potential than biological sludge. Therefore, it will increase the biogas production in the digester.
The decanters will still be used in their original configuration during rainy weather. The operation in rainy weather mode concerns 3 to 4% of the annual volume at the entrance of the plant.
One of the differences between the two operating modes is the presence of flocculants and coagulants. In rainy weather ferric chloride and polymers are added, which is not the case in dry weather. The reason is that in wet weather, the speed of the effluent is too high to have good decantation.
The switchover of primary settling tanks to stormwater treatment is presented in **APPENDIX IV**. The part of the work on Densadeg will be developed in more detail later in the report.

3.4.1.5 RESUME

To resume, to assume the implantation of the digester anaerobic VEOLIA needs to improve the existent wastewater treatment plant. In this rapport, it was explained what parts of the station are going to improve and modify. New parts are the digestion network and the biogas network. Rehabilitation concerned the water network, sludge network. In the rest of the rapport, it will be mentioned the rehabilitation of the deodorization, which is why the air network has not been presented in this first part.

3.5 The different characters

The Client for this project is Valence Romans Agglomeration. For information Valence Romans Agglo urban community brings together 54 municipalities and has 221,737 inhabitants and was established on January 7, 2017, following the application of the NOTRe[1] law and the inter-municipal cooperation plan. Valence Romans Agglomeration with VEOLIA has a public service delegation contract for the operation of the Valence, Romans-Sur-Isère, and Portes-Lès-Valence wastewater treatment plants. This contract was renewed in 2018 for 15 years. In the specifications, the delegate (VEOLIA) was asked to carry out and finance work relating to anaerobic digestion.
In 2018, Veolia responded to this call by joining a consortium with five other companies:
Veolia (agent): coordinates the entire construction and operation contract.

- **Aagroup** (architect): architectural design of the new treatment plant and works for the realization of the building permit, this architect's office is in Valence.

The other enterprises are partners. In **APPENDIX V** is represented the construction sign gathered all the principal's actors of the project:

- **OTV** (representative of the sub-contracting group of construction companies, subsidiary of the VEOLIA group):

Designs and coordinates the studies and works of the anaerobic digestion unit.
In charge of the supply, installation, and commissioning of equipment and the electricity/automation component relating to anaerobic digestion.

- **EIFFAGE** (civil engineering company): in charge of carrying out foundation work by rigid inclusions, as well as the study and construction component of all buildings.
- **CHEVAL TP** (earthworks company): responsible for carrying out earthworks and soil replacement.
- **RAMPA TP** (public works company): ensures the installation of underground networks as part of anaerobic digestion.

[1] Nouvelle Organisation Territoriale (August 7th 2015) : French law concerning the new territorial organization.

A project manager was subsequently appointed, he is separate from the companies responsible for construction. The non-design contractor chosen is **Cabinet Merlin** (it was not involved in the design phase; it only intervenes in the construction phase). Its various missions are to carry out the environmental authorization file and to control the project in the preparation and execution phase (organization of meetings, verification of technical documents, etc.).
As regards the technical controller (CT) and the safety and health protection coordinator (CSPS), for the digester unit construction site, they were chosen in March 2019. **SOCOTEC** company won this assignment.
As part of delegation work, consulting and choosing a CT and a CSPS was one of my missions and will be developed later in the report.

3.6 Financial aspect

The project implemented is financed by Veolia under its operating contract. Thus, the operator is responsible for the investment and is remunerated through: the sanitation fee collected from subscribers (without a significant increase of the latter on average over the whole territory compared to previous years, but with the homogenization of prices at the scale of the agglomeration), of the revenue generated by the resale of biomethane, up to 80% of the revenue, the 20% of the remaining amount will be paid to Valence Romans Agglo.
At the end of the 15-year delegation contract, the operator will return the installations of the methanation plants built in Valencia Romans Agglo, which will then become the owner of the methanation and will receive 100% of the revenues generated by the resale of biomethane.

3.7 Project timetable

The lead time for the project is 36 months. The realization is broken down into three phases.

3.7.1 END of phase I

Phase 1: study phase, started on October 1, 2018, it lasted 21 months (12 months initially + 9 months late).
The tasks that were carried out during this phase are:

- Study and design of installations,
- Realization of Civil Engineering, Equipment and Roads and Miscellaneous Networks guide plans,
- Finalization of guide plans and deposit of building permits,
- Concrete studies and special foundations,
- Establishment of the ICPE authorization file, in April 2020 the prefectural authorization order was issued, however, third-party expertise was requested and resulted in a delay of 205 (two hundred and five) days, or nine months.
- Building permit deposit,
- Writing of the new operating instructions,
- Creation of electrical diagrams and wiring specifications

3.7.2 The environmental authorization files.

The definition of an installation classified for the protection of the environment (ICPE) is any installation operated or owned by a natural or legal person, public or private, which may present dangers or disadvantages for:

- the convenience of the neighborhood,

- public health, safety, and sanitation,
- agriculture, protection of nature, the environment, and landscapes,
- rational use of energy,
- the conservation of sites, monuments, or archaeological heritage.

Each installation is classified in a nomenclature which determines the obligations to which it is subject, in decreasing order of the level of risk: authorization, registration, or declaration regimes.
In France, when an anaerobic digester will treat sludge from a wastewater treatment plant, presents in the same place, the site is submitted at the authorization procedure to comply with the regulation of the ICPE[2].
Two authorizations were asked, the first one is article **2781 2.a** of the ICPE [10]

Figure 13: "Methanization facilities for non-hazardous waste or raw plant material, excluding methanization facilities for wastewater or urban sewage sludge when they are digested on their production site: with a number of materials treated being greater than or equal to 100 t / d "

2781	Installations de méthanisation de déchets non dangereux ou de matière végétale brute, à l'exclusion des installations de méthanisation d'eaux usées ou de boues d'épuration urbaines lorsqu'elles sont méthanisées sur leur site de production :			
	1. Méthanisation de matière végétale brute, effluents d'élevage, matières stercoraires, lactosérum et déchets végétaux d'industries agroalimentaires :			
	a) la quantité de matières traitées étant supérieure ou égale à 100 t/j	A	2	10.11.09
	b) la quantité de matières traitées étant supérieure ou égale à 30 t/j et inférieure à 100 t/j	E	-	12.08.10
	c) la quantité de matières traitées étant inférieure à 30 t/j	DC	-	10.11.09
	2. Méthanisation d'autres déchets non dangereux			
	a) la quantité de matières traitées étant supérieure ou égale à 100 t/j	A	2	10.11.09
	b) la quantité de matières traitées étant inférieure à 100 t/j	E	-	12.08.10

Figure 13:Article 2781 of the ICPE french regulation

The second is article **3532** [11]

Figure 14: "Recovery, or a mixture of recovery and disposal, of non-hazardous non-inert waste with a capacity exceeding 75 tonnes per day and leading to one or more of the following activities, with the exclusion of activities falling under Directive 91/271 / EEC:

- biological treatment
- pre-treatment of waste intended for incineration or co-incineration
- treatment of slag and ash
- treatment in a grinder metal waste, in particular waste electrical and electronic equipment and end-of-life vehicles and their components"

3532	Valorisation ou un mélange de valorisation et d'élimination, de déchets non dangereux non inertes avec une capacité supérieure à 75 tonnes par jour et entraînant une ou plusieurs des activités suivantes, à l'exclusion des activités relevant de la directive 91/271/CEE : .... - traitement biologique - prétraitement des déchets destinés à l'incinération ou à la coïncinération - traitement du laitier et des cendres - traitement en broyeur de déchets métalliques, notamment déchets d'équipements électriques et électroniques et véhicules hors d'usage ainsi que leurs composants *Nota.* - lorsque la seule activité de traitement des déchets exercée est la digestion anaérobie, le seuil de capacité pour cette activité est fixé à 100 tonnes par jour.	A	3	ied 17.12.19

Figure 14: Article 3532 of the ICPE french regulation.

However, the digester anaerobic will not treat 100 tonnes a day, if it was the case, it will be classified as SEVESO. In our case, it was needed to submit at the Authorisation (A) and to respect the Best Available Techniques (IED).
The administrative examination of the environmental authorization request comprises four phases for an overall examination period of 10 to 11 months, under the supervision of the DREAL:

- In an upstream phase,
- An examination phase,

[2] Installation Classées Protection de l'Environnement

- A phase of a public inquiry,
- A decision phase.

Before the examination phase, discussions take place between the different actors to specify the information, consultation is carried out to know the opinions of residents and users.

The examination phase begins when the file is submitted. For this project, the file was submitted on January 29, 2019, to the prefecture to be sent to the inspector of the DREAL[3].
This examination phase, which should normally last 4 months, has been suspended. The file was received inadmissible by the inspector in March 2020. The latter requested third-party expertise for the study of dangers given the sensitive environment (presence of a nursery next door) and the potential consequences of the hazardous phenomena presented by the planned installations. The hazard study was carried out by the company Bureau Veritas (in this subcontractor project of Cabinet Merlin)
This third-party expertise started in April 2020 and is carried out by INERIS[4]. They had to check the following points:

- If the release of potential hazards has been correctly assessed,
- the completeness of the hazardous phenomena has been ensured,
- the classification in terms of probability is satisfactory,
- the classification in terms of the seriousness of the dangerous phenomena is satisfactory,
- no major accidental scenario has been omitted, in particular concerning the past listing of the accidents of the establishment or this type of industry,
- the assumptions used and the orders of magnitude of the consequences of the accidents analyzed appear relevant,
- the methodologies and models used appear to be adapted to the presumed level of risk and have been concretely used,
- The nature of the parameters and equipment important for safety that you have identified appear relevant.

After this third-party expertise, the authorization is delivered, it had to lead to 205days late, but the construction site can begin. However, with the sanitary crisis, companies are not able to work.

3.7.3 Phase II

Phase 2: works phase, began on June 30, 2020, with a delay of nine months. Normally the phase II will take 18 months.
During my internship, I had the opportunity to attend several site meetings. These site meetings brought together all the interlocutors from each company participating in the work. Several topics were discussed during these meetings, such as:

- Shifting of the conduct of Leroy Merlin: Carried out by the company RAMPA.
- Demolition of the existing fence and installation of the new fence. Produced by the company CHEVAL.
- Site installations. This involves the construction of temporary paths to access the site, the establishment of the living area, offices, and electrical connections necessary for the site. Made by the EIFFAGE company.
- Earthworks. Produced by the CHEVAL company.
- Cast and installed lifting station Produced by the EIFFAGE company.
- Poured and installed drain pot. Made by the EIFFAGE company.
- Earthworks of the digester. Produced by the CHEVAL company.

During these site meetings, the companies take stock of the progress of the week to the project manager and the delegated project manager, emphasizing the problems encountered, the solutions found, or envisaged.
The goal is to be as constructive as possible, it starts with a tour of the site, with personal protective

[3] Direction Régionale de l'Environnement, de l'Aménagement et du Logement
[4] Institut National de l'Environnement Industriel et des RISques

equipment, then towards the base camp for the rest of the meeting.
Each company is important because each decision taken during the meeting can have a significant impact on the rest of the site, moreover, it is necessary to keep a good relationship with the group of companies and to manage potential conflicts. The delegated client needs to attend these site meetings to see the progress of the site and to report to the Client, Valence Romans Agglomeration.

The end of the work and the project was scheduled for October 1, 2021, however certain elements such as the delay in the ICPE authorization and the health crisis of COVID 19 have delayed the theoretical date to December 18, 2021.

3.7.3.1 Following the construction: phase II

Figure 15: In red the property of Valence Romans agglomeration, next to the WWTP.

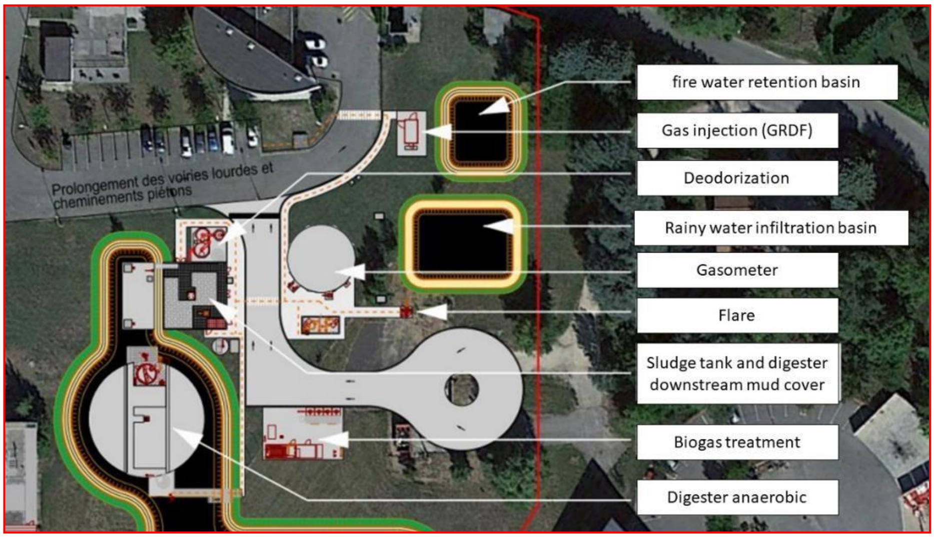


Figure 16: Construction site, future view of the works

All the following pictures are taken by me or people that gave me the right to use it.

3.7.3.1.1 STEP 1: June 29th: displacement of a pipe

The construction of the anaerobic digester (***Figure 16***) and the other works such as the retention basin the pump building, the burner are situated in the property parcel of valence agglomeration ***(Figure 15)***. This parcel is now extended to the wastewater treatment plant.

In this parcel there is an existed misplaced water pipe from the commercial center to the wastewater treatment plant, but it needed to be displaced due to the others works in the future, in fact, the pipe was under a future building, the purge pot, but the purge pot needs to be burry.
When the pipe has been moved by the enterprise RAMPA, the pipe needed to be tested to verify if there is no leak. For that, the enterprise that put in place the pipe needs to make a pressure test.

July 1st: It was at VEOLIA to follow the pressure test, to verify if the test was realized in a good way. That permits to assure the enterprise RAMPA, in case of future problems to be not involved. That also permits to verify if the test is realized in a good way and check the result of the test.
STEP of the pressure test:

- Before the pressure test, the pipe needs to be backfilled and the two extremities of the pipes need to be closed.
- Then a bit of water is introduced to evacuate the air present in the high part of the pipe.
- The rate of flow is a twentieth of the service flow, to avoid the water hammers.
- The test has taken two hours because the pressure needs to be augmented to one bar every five minutes. In the end, the pressure test is one point five more elevated than the service pressure.

The test was good, all the results were correct, no leak has been discovered.

3.7.3.1.2 STEP 2: 06/07/20 Earthworks

Soil stripping was carried out by the company CHEVAL in charge of doing the earthwork. Since it generally involves working on large volumes of materials, earthmoving operations are frequently carried out using construction equipment such as excavators and shovels (***Figure 17 & 18***).

Figure 17: Stripping of the site by the enterprise CHEVAL

These works are fundamentals for the rest of the construction. They permit to build a solid and plane surface. Moreover, on a part of that parcel was the old wastewater treatment plant (in 2000) which was demolished, thus the soil composed of big material and some plastic materials need to be removed and replaced by better soil (taken in a nonpolluted part of the parcel).

Figure 18: Overview of the site 06.07.2020

3.7.3.1.3 STEP 3: construction of the purge pot, relief post, and the discovery of an unplanned water pipe 20.07.2020

Figure 19: Unplanned offset of a water pipe

The stripping at the lifting station permits the discovery of an unplanned offset of a water pipe (***Figure 19***), on the figure you can observe the white pipe and next to it a red line, the red line represents the real position of the pipe on the station construction plans. This offset represents one meter and a half. This position would result in an offset of the intermediate lifting station to maintain an acceptable distance from the sheet pile wall for placing the formwork. Second support should also be provided to allow the earthwork of the electrical premises; sloping is no longer possible due to the reduced distance from the intermediate lifting station. A modification request form must therefore be opened to manage this hazard. It will have to justify the chosen solution concerning the various constraints (technical, planning, etc.).

The evolution of the construction of the Purge pot represented ***Figures 20 & 21,*** the purge pot is a tank where the different purges will be collected.

Figure 20: purge pot 28/07

Figure 21: purge pot 20/07

The site meetings gathered all the enterprises from the group. Usually, they were every Monday morning in the life base. we were as close as possible to the construction site. Before the life base installation, all the meetings were organized in the WWTP office. After the installation, all the meetings were in this building (*Figure 22*)

Figure 22: Installation of the life base by EIFFAGE company

3.7.3.1.4 STEP 3: Panel construction sign installed, pumping wells put in place and decanter drawdown in function 28.07.2020

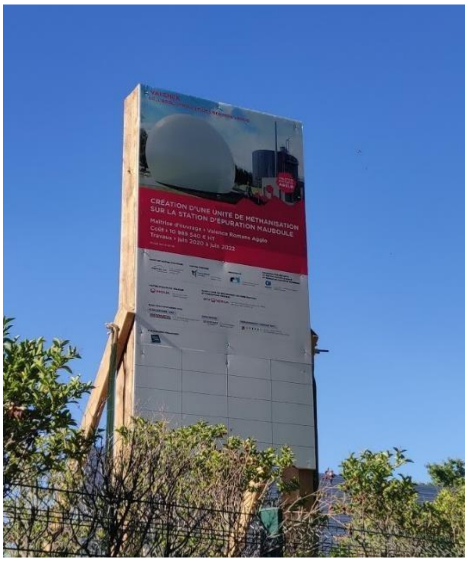


Figure 23: Panel construction sign

3.7.3.1.5 Groundwater drawdown well

The groundwater level is higher than the bottom of the digester, pumping wells were put in place to decrease the level and to permit the construction. Five pumping wells were installed and pump day and night, four in the future digester position, and one at the relief post. (***Figure 24***)

Figure 24: Two pumping wells at the future anaerobic digester position

Figure 25: decanter drawdown

However, the organism that gave us the construction authorization was very clear concerning the groundwater. It needs to be treated before being rejected on the river. That is why a decanter was chosen. Thanks to this decanter the pumping water can be rejected at the end of the wastewater treatment, without increasing the flow of the wastewater to treat for the WWTP.
However, to protect VEOLIA employees that are working on the wastewater treatment plant, every day a sample of the pumping water is taken out. That permits if there is a contamination/pollution not to engage the responsibility of the operators of the wastewater treatment plant, by analyzing the sample.

3.7.4 Phase III: the last phase

Phase 3 begins with the notification of the construction completion report.

This phase can be separated into two parts. The first part concerns the period of development and set-up. The tune-up period aims to carry out all necessary checks and adjustments and to ensure that there are no construction defects.
Regarding the setting up of the anaerobic digestion unit, the principle consists of gradually increasing the quantity of sludge sent to digestion. The increase in the load of the digesters will be accelerated by a supply of digested sludge from another station which will be used to seed the digesters. Inoculation is carried out up to 5% of the volume of the digesters in total. The ramp-up is estimated at 90 days.
The second part concerns the observation period and warranty tests.
The end of the work and the project were scheduled for October 1, 2021, however certain elements such as the delay in the ICPE authorization and the health crisis of COVID 19 have delayed the theoretical date to December 12th,2021.
The end of the start-up period is scheduled for April 14th, 2022 and the injection of biogas for GrDF is scheduled for June 20th,2022.

3.8 Safety on site

3.8.1 Individual protection equipment's

4 gas detector:

Every employee is obligate to have his personal 4gas detector on him. The detector needs to be on and charged regularly.
Detects explosive gases as well as O_2, CO, NO_2, SO_2 and H_2S

Every employee has his own individual protection equipment and needs to take care of it. All the equipment or obligatory on the treatment plant.

After the sanitary crisis, it was forbidden on-site to be without his/her mask obviously ***(Figure 26)***.

Figure 26: Veolia zone, the mask must be worn

3.8.2 Collective protection

3.8.2.1 Security documents

The PPSPS (Special health and safety protection plan) and IC (the joint inspection visit) are obligated to begin the works for every company on the group or a subcontractor, it is asked by VEOLIA. They are obligated because several companies will be working on the site at the same time.
The PPSPS is needed because it permits to give the following information:

- The organization of the site,
- The sanitary facilities available,
- The nature of the work to be performed,
- The possible risks for workers in carrying out their work,
- The possible risks that the work of the company can cause for workers in other companies,
- The possible risks that the work of other companies can generate on the workers of his company,
- The precautions that can be taken to avoid these risks.

Some companies do not need PPSPS because they are just here to make some analysis and to verify the ground composition, they are not making works on the site.
One of my other mission for VEOLIA was to prepare a consultation file for the search for a Safety and Health Protection Coordinator and then to answer and select between three answers, it will be explained in the next part.

3.8.2.2 Sanitary crisis COVID-19, collective security

My internship took place during the sanitary crisis and a new organization needs to be put in place to continue the work. To ensure that the companies working on the site comply with all the health rules in place, we called on a COVID referent from the SOCOTEC company.
The objective of this mission is to discuss and advise companies in the face of this problem. To this end, two weekly visits are planned. They will be formalized posterior by the dissemination of a report which will assess the COVID risk, in particular, using a graduated scale (***Figure27***).
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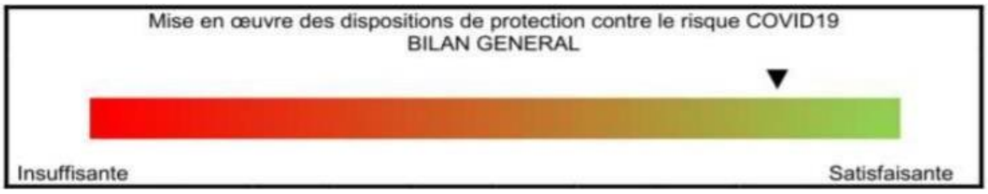


Figure 27: General assessment of the implementation of the protection provisions against the COVID-19

3.9 Resume

My participation at every meeting was very instructive for my future. Indeed, I could observe the different situations that can happen on a construction site as a project owner. The different relations that we need to maintain, to manage. The difficulties that you can encounter.
But thanks to the meeting I also could interact with the other actors such as the project manager, the construction site manager, the study manager, the architect… That permits me to have a global view of the construction site and to maybe think about other perspectives of work.
During the meetings, I had learned a lot concerning the progress of a building site and the importance of great and good preparation beforehand.

The construction site took 20% of my mission, the rest of the time I was working on the rehabilitation work part. In fact, Valence Romans agglomeration wanted some improvement on the station, VEOLIA answered at the offer and needed to realize this part of the market. On this part, VEOLIA was free to choose their subcontractor but one of the big difficulties was to respect the price of the market.

4 Delegation public service works

In the Public Service Concession contract, the management of wastewater and sludge treatment works in Valence is combined with the performance of various works, to be carried out by VEOLIA.
The other works to improve the existing facilities are the subject of the consultation that I had to draft. They concern five major works on the reasonably sized wastewater treatment plant (from € 100k to over € 1 million). These works are:

- TF = The replacement of the flue gas cooling units of the UDEP sludge incineration furnace in Valence. They must be carried out on the one hand for renewal reasons and on the other hand to meet a need for a change in technology with a view to the construction and future operation of a digester for sludge from wastewater treatment plants. on the Valence UDEP website. The objective is to recover the calories from the fumes produced by the furnace to allow the digester sludge to be heated using successive exchangers.
- **TC1 = The development of rainwater and/or pre-treated water treatment structure.**
- **TC2 = The replacement of new and stale air networks and the installation of new ventilation equipment.**
- TC3 = Extension of the reception area for dewatered external sludge from the existing room.
- TC4 = The creation of a liquid sludge transfer network of approximately 4 km between the Portes-Lès-Valence and Valence treatment plants (**APPENDIX III).**

In the following part the TC1 and the TC2 works will be explained, they were the principal thematic of my internship.

To carry out this type of work and because of the number of companies intervening at the same time, it is necessary to call on a technical controller and a safety and health protection coordinator.

4.1 Redaction of a consultation file for a safety and health protection coordinator CSPS

The role of the CSPS (Safety and Health Protection Coordinator) is to manage the interactions between the different companies in order to prevent a risk brought by one company from affecting another. Constructions are classified into three categories; the missions of the CSPS depend on these categories: [12]

- CSPS level 3: In the case of sites bringing together at least 10 building companies or 5 in civil engineering and the volume of which exceeds 10,000 man-days,
    - He needs to keep an RJC (site logbook), to trace the different actions or information relating to the progress of the SPS coordination.
    - Make a joint inspection visit with the contractors.
    - Upon receipt of the work, provide a « Subsequent Interventions on the Structure » called DIUO (*Dossier d'Interventions ultérieures sur l'Ouvrage*).
- CSPS level 2 (in addition to the above operations): in the case of sites exceeding 30 working days where the workforce exceeds 20 workers at a given time and where the expected volume of work is greater than 500 man-days,
    - Draw up a PGC (General Coordination Plan).
    - Have the Enterprises draw up a PPSPS (Specific Safety and Health Protection Plan).
- CSPS level 1 (in addition to the above operations): in the case of a site with or without particular risks bringing together at least 2 companies.
    - Establish the draft internal regulations of the CCISST (Inter-company College for Safety, Health, and Working Conditions).

4.1.1 Consultation file for the CSPS

A consultation file contains all the information relating to the nature of the work in which the CSPS will have to intervene, the conditions of intervention defined by the Client.

In this case, each tender had to contain the following documents:

- A financial proposal, with at least the detail of the remuneration package by tranche and by mission element. The prices are expressed in euros excluding VAT (value-added taxes).
- A document justifying the measures that the candidate proposes to adopt for the performance of his mission and explaining his quality approach. This document will contain all of the candidate's justifications and observations to assess the quality of his offer and in particular:
- The presentation of the person (s) who will be in charge of the file with, in particular, the CV of each of them.
- CSPS skills certificate
- Insurance
- The presentation of the time spent by section and by mission element.
- A list of references in terms of CSPS missions for achievements comparable to the subject of the contract both in terms of size of structures and constraints.
- The date from which the mission can be started.

One of the first missions of this internship was the drafting of a consultation file for a coordinator of safety and health protection (CSPS). We consulted for an offer cut into 5 slices ***(Table 14),*** a firm slice, and 4 conditional slices. The TF "*Tranche Ferme*" is a work that must be done, the TC "*Tranches Conditional*" constitute a market share that can be optional, to have an idea of the price of the service it is better to put all the conditional work in a quote than making a quote for each job to be done.

Table 14: Presentation of the different works present on the consultation, with the number of companies working at the same time on the construction site and the WWTP

	Estimated number of enterprises present in the construction site	Construction work category
TF = The replacement of the flue gas cooling units of the UDEP sludge incineration furnace in Valence. They must be carried out on the one hand for renewal reasons and on the other hand to meet a need for a change in technology with a view to the construction and future operation of a digester for sludge from wastewater treatment plants. on the Valence UDEP website. The objective is to recover the calories from the fumes produced by the furnace to allow the digester sludge to be heated using successive exchangers.	6	2
TC1 = The development of rainwater and/or pre-treated water treatment structure.	Less than 10	2 or 3
TC2 = The replacement of new and stale air networks and the installation of new ventilation equipment	3 to 4	2 or 3
TC3 = Extension of the reception area for dewatered external sludge from the existing room.	2 to 4	3
TC4 = The creation of a liquid sludge transfer network of approximately 4 km between the Portes-Lès-Valence and Valence treatment plants	2	2 or 3

In the redaction of the consultation file, it is important to give a lot of details about the works that must be done. That permits the consulting enterprise to proposed to us a safety controller adapted at our work. Is for the site safety and the safety of all the wastewater treatment plant. That is why it is very important to have all the essential information.

4.1.2 Choice of the company, after the launch of the call for tenders

We had to contact 3 companies in order to respect corporate equity, the three companies were SOCOTEC, APAVE and Bureau Veritas.
The choice of company is based on several criteria which are set out in the consultation file, each company consulted is therefore kept informed of the procedures for selectivity.
The criteria fall into three categories, this is a purely arbitrary rating, and it is a way of separating them:
The technical merit, we evaluated it on 30 points, here is an extract of what we expected, the best company has a total of 30 points, which breaks down according to:

- Guarantees and professional capacities, ie what references do they have, what are the CSPS qualifications that the company puts on our project, has the company already worked on a similar project.
- Guarantees and technical and financial capacities, here are the technical and human resources placed at our disposal that will count, for example, some companies offer software to facilitate the management of operations and their follow-up or to facilitate the transfer of documents. and easily see what has been processed. Usually, for human resources, there is a CSPS dedicated to the mission and a deputy who assists him in his absence.
- A presentation of the team with a Curriculum Vitae of the CSPS (s) and other people directly or indirectly involved in the mission of our project is appreciated.

The price, evaluated on 50 points, the company offering the best price obtains 40 points and the others are noted with the following equation:

$$evaluation = \frac{enterprise}{beter\ enterprise\ price} x\ 40$$

To this score is added a score out of 10 which concerns the distribution of the cost according to the hours spent.
Response times are rated out of 20 points; this rating takes into account the start date of the assignment depending on the work.

Table 15: Study results of the CCSP consultation

N° Offer	1	2	3
Enterprise	SOCOTEC	APAVE	VERITAS
Technical value /40	40	38	21
Price /40	23,3	30	19,1
Intervention delay /20	20	20	20
TOTAL /100	**83,3**	**88**	**60,1**

After scoring out of 100 points and comparing the three offers (***Table 15***), the most interesting was APAVE with a score of 88 but SOCOTEC has been chosen. The designated CSPS was level 3 for our project and it was the same person as the one already designated for the anaerobic digestion project. In addition to the attractive price, he already attends site meetings, he knows the various interlocutors, the speakers, this makes it possible to facilitate the mission and the dialogue between each one.

5 The deodorization

Respect for the neighborhood, health, safety, and public health measures leads to systematically considering the control of odorous gas emissions from urban or industrial wastewater treatment facilities.

Table 16: ICPE regulation concerning the authorized limit of gas rejected on the atmosphere

Paramètre	Unité	Valeur max	Valeur moyenne	Limite de rejet
NH_3	mgN/m^3	20	10	0,7
N org	mgN/m^3	4	2	1
H_2S	mgH_2S/m^3	14	7	0,1
RSH	mgS/m^3	6	3	0,05
Amines	mgN/m^3	---	---	0,1
Aldéhydes et cétones	mg/m^3	---	---	0,5
Unité d'odeur	UO	---	---	600

Indeed, we can read in the ICPE decree that the station must capture these odorous gases emission and cover the emitting areas, but also ventilate them to offer operators a satisfactory workspace and conduct these gases. towards a deodorization, to respect the limits of ***Table 16***. [9]
It is important for personal safety, the degradation of the building with the corrosion phenomena urge by the corrosive gas such as H_2S.
During all the different steps of the treatment, odorous pollution is emitted. With the ***Figure 28***, it is represented the principal's step that emits odorous pollution.

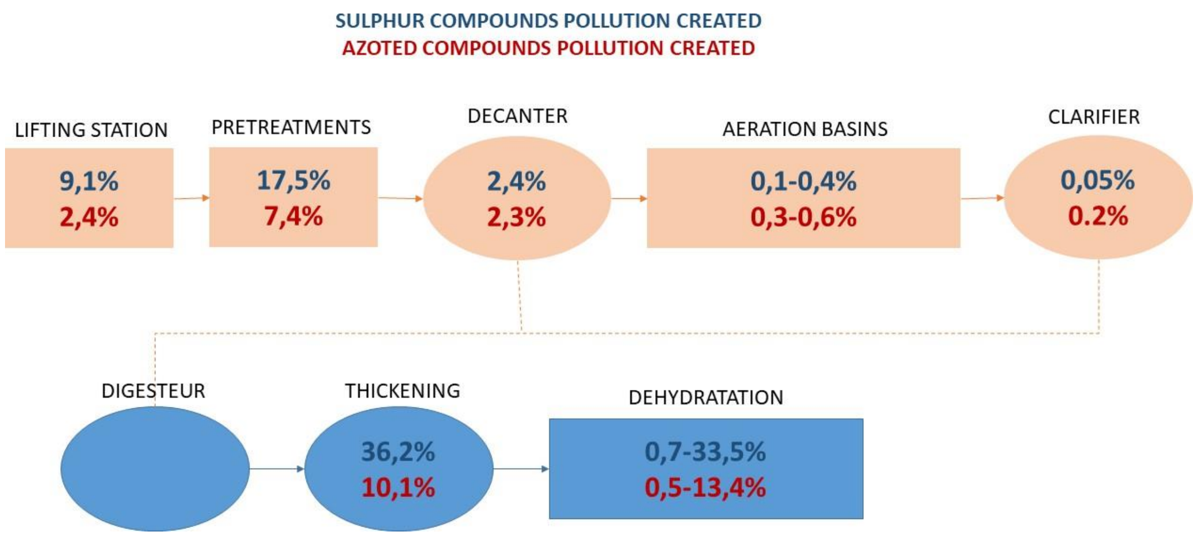


Figure 28: Odorous pollution emitted function of the treatment process

At the Valence treatment plant, there is deodorization existent. A new one will be built next to the digester anaerobic, this new one will collect the new buildings constructed. That permits to deal with the airflow between the two deodorizations. On the ***Table 17*** it represented the different structures either connected to the new deodorization or connected to the existent deodorization.

Table 17: Resume of the structures connected to the new or the existent deodorization

New structures	Connected to the new deodorization	Connected to the existent deodorization
Pre-treated water lifting station		X
External sludge dilution tank		X
Digester mud outlet	X	
All water pit (digester)	X	
Sludge tank downstream digester	X	
Sludge building pumping room	X	
Existents structures		
Mixing tank (ex-flotation tank)		X
Thickener building		X
Mixing tank all sludge (ex-Physico-chemical treatment tank)		X
Ferric chloride injection tank		X
Silo (120 m3)		X
The external sludge reception building		X
Centrifuges building		X

The existent deodorization consists of three stages of Physico-chemical washing in series (acid,bleach, caustic soda) and is designed to treat stale air throughout the current station. Its treatment capacity is 25,000 m3 / h.
This unit was put into operation in 2005 but was quickly shut down. This is linked to a malfunction of the inadequate design of the air intake systems. Since then, the shutdown has not been identified as a problem with odors, so it has not been put back into service. However, the ICPE decree stipulates that the air drawn in must be treated through deodorizing units of suitable dimensions and it is asking that the existent deodorization needs to be in service before 2022.
The work of putting ventilation back into service falls within the scope of the DSP work (delegation of public services) relating to the operation of the Valence and Portes-Lès-Valence stations. This work is not carried out as part of the anaerobic digestion work, because a new deodorization will be created of the autotrophic activated carbon and biological filter type to deodorize the sludge dewatering room which represents a flow rate of 5,000m^3/ h and our current deodorization will not be able to accept them.

5.1 Presentation of the deodorizing system presents on the station

Figure 29: The three towers

The wastewater treatment plant is fitted with a deodorization system with three towers in ***Figure 29***. The stale air extracted from a building is sent by a fan to the bottom of the towers in series, it crosses the tower vertically, passes through the support for the lining where the solutions of acid or bleach or caustic soda trickle, which are injected in the form of droplets which come into contact with air. Before reaching the next tower, the air meets a demister which limits the entrainment of droplets. The washing solution is collected, and a part is recirculated. [13]

5.1.1 Composition of a tower

Each tower is constituted from the bottom to the top of the following elements (***Figure 30***): [14]

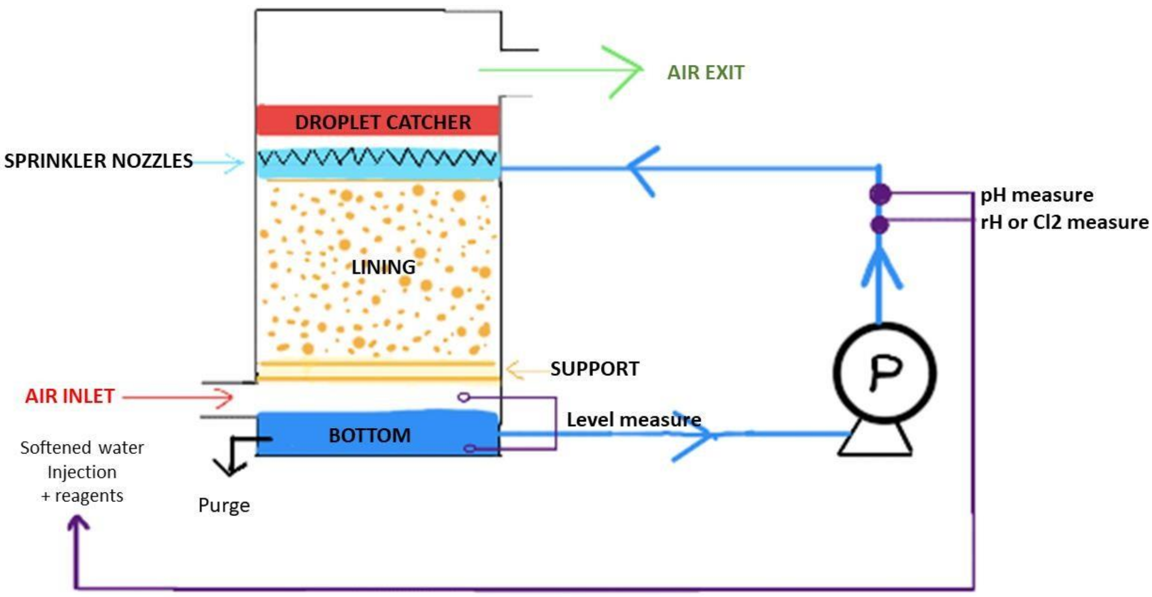


Figure 30: Deodorization tower, presentation of the composition

The tower base, bottom: it is a bath made up of softened water and chemical reagents. These reagents depend on the type of gas that is to be eliminated in the tower in question.

Recirculation pumps: each tower is equipped with a recirculation pump. They allow the bath located at the bottom of the tower to be raised to the spray ramps (composed by sprinkler nozzles) located at the top of the tower between the packing and the demister.

The lining: it is a layer 2.50 meters thick made up of polypropylene rings. It increases the exchange surface as well as the contact time between the air and the recirculated product to improve the washing efficiency.

The droplet catcher: The air passing through the packing can be lightly charged with water droplets, In order to avoid the entrainment of this water (and especially of the chemicals present) in another tower or outside, the demister at the tower exit above the spray ramps. The demister takes the form of an accumulation of porous layers where the gas phase can flow easily, but not the liquid phase, which falls to the base of the tower.

5.2 To a polluted air at a treated air

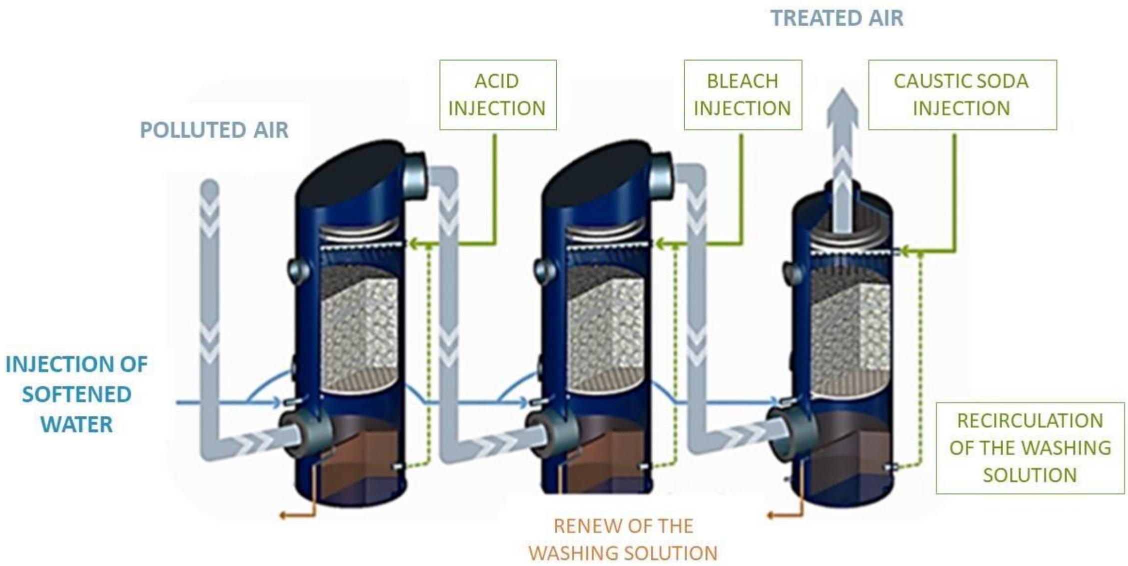


Figure 31: Deodorization process

1. In the first tower (***Figure 31***), the azoted components are eliminated thanks to sulfuric acid injection (H_2SO_4).

The main representative of nitrogen gases is ammonia (NH_3). The other gases of this family are amino compounds of the R-NH_2 type such as methanamine, of the crude formula: CH_3NH_2; or R — NH, such as N-methylethanamine. Nitrogenous gases have the particularity of exhibiting a basic character. Thus, putting them in the presence of a strong acid will cause a complete acid-base reaction which will eliminate almost all these gases by transforming them into different salts which will be concentrated in the tower base. The strong acid used is concentrated sulfuric acid. The chemical reaction takes place when the polluted air comes into contact with the recirculated reagent. The main chemical reaction that takes place is as follows, ammonium is transformed into ammonium sulfate by sulfuric acid. [14]

$$2\ NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4 \qquad (Ammonia) \qquad \text{Equation } 1$$

$$2\ CH_3 - NH_2 + H_2SO_4 \rightarrow (CH_3 - NH_3)_2SO_4 \qquad (Methylamine) \qquad \text{Equation } 2$$

For the reaction to take place, the pH must be kept around 2.5. From a pH greater than 3.5 sulfuric acid no longer removes ammonium. The stale air passes through an acidic solution (sulfuric acid: H_2SO_4), allowing the elimination of nitrogen compounds, including ammonia. The water potential (pH) is maintained at 2.5 on this tower.

2. The second tower (***Figure 31***) allows washing of the air with a basic oxidizing solution, bleach (NaClO). This particularly allows the removal of sulfur gases such as hydrogen sulfide (H_2S).

Sulfur gases are better known under the name of mercaptans (R-SH), it is a colorless gas from the thiol family whose smell is reminiscent of rotten cabbage. It is a naturally occurring substance that can be found in the blood, brain, and other tissues, animals, and humans. Sulfur gases have a reducing character. Thus, putting them in the presence of an oxidant such as chlorine, initiates an oxidation-reduction reaction which will have the consequence of transforming the gases to be eliminated into sulfate salts which will concentrate in the base of the tower. [14]

$$H_2S + 4\ NaOCl \rightarrow H_2SO_4 + 4\ NaCl \qquad (Sulfur\ gases\ oxydated) \qquad \text{Equation } 3$$

Transformation of residual nitrogen compounds by the formation of chloramine:

$$NH_3 + NaOCl \rightarrow NH_2Cl + NaOH \qquad \text{Equation } 4$$

This chemical reaction only proceeds correctly at basic pH. For this, the solution at the bottom of the tower, which is recirculated, is maintained at pH = 9, and the Redox potential (rH) is maintained at 795 mV by injecting the reagents, there is a rH ah pH controller.

3. The last tower (***Figure 31***) more particularly removes the mercaptans with a basic oxidizing solution, sodium hydroxide (NaOH), it binds volatile fatty acids (VFAs), reduced sulfur, and residual chlorine.

It removes in particular carboxylic acids, hydrogen sulfide, mercaptans. [14]

$$H2S + 2\ NaOH \rightarrow Na2S + H2O \quad (reduced\ sulfur\ removal) \qquad \text{Equation 5}$$

$$Cl2 + 2\ NaOH \rightarrow NaOCl + NaCL\ (chlorine\ removal) \qquad \text{Equation 6}$$

$$CO2 + \ 2\ NaOH \rightarrow Na2CO3 + H2O \ (Carbon\ dioxide\ removal\ ) \qquad \text{Equation 7}$$

$$R - COOH + NaOH \rightarrow R - COONa + H2O\ (Carboxylic\ acid\ removal) \qquad \text{Equation 8}$$

The pH must be kept at a minimum of 9, and the Redox potential at 690 mV.

5.3 Ventilation restart Project

First, as the ventilation did not work for a while, the volume of the ventilation has been reviewed in order to include the new buildings that will be attached at the existent deodorization and the unchanged buildings.
The air renewal happened when you pressurized the building. Pressurization of the building is made thanks to the **air handling unit,** in fact, it takes outdoor air and warm or refresh it, then the treated air is sent in the building throughout the ventilation network. The warmed treated air creates a flow in the building and the air present in the building is displaced till the polluted air network (and finish in the deodorization treatment). However, to have optimal results some precautions need to be taken into account for example avoid dead zones in rooms (stagnant air), doors need to be closed, presence of high and low aspirations in rooms [13]:

- m_air = 29 g / mole
- m_H_2S = 34 g / mole (stagnates on the ground)
- m_NH_3 = 17 g / mole (always in height)

In fact, all the gases have not the same molecular weight and to respect the legislation and the limit of exposition (ICPE). All the elements are important.
Data given by VEOLIA presents an air extraction rate for specific building/activities [13].

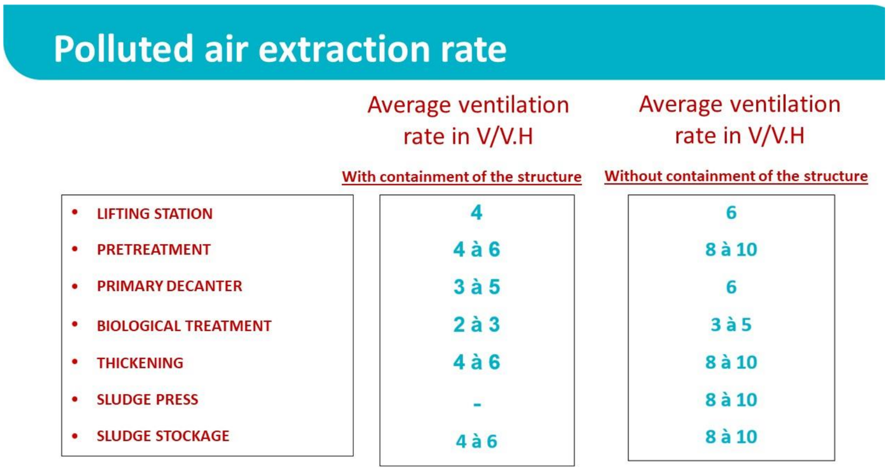
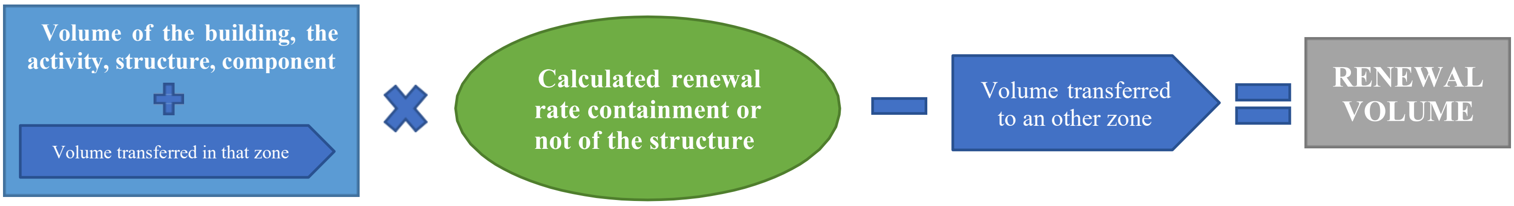


Figure 32: Polluted air exctraction rate, data given by VEOLIA

With the total volume of the different parts you apply this coefficient, multiply your volume and you have the volume that you must renew, and the volume sent to the deodorization.



Thanks to these calculations we were able to evaluate the total future volume that will be sent to the deodorization. (***Table 18***)
In fact, it needs to take into account every odorous sourcing, calculate their volume, then the renewable rate is applied.
The renewable rate will depend if the odorous source is contained or if there is a direct plug on it.

Table 18: Calculations of the volume sent to the deodorization

		Extract air							
Local	volume	Direct	Transfert from an other zone	Total	Renewal rate calculated	Transfert to another zone	Volume sent to the deodorization	Containment of the nuisance	Flow rate process
	m3	**m3/h**	**m3/h**	**m3/h**	**v/v.h**	**m3/h**	**m3/h**		
Pretreatment peripherical structures									
Counting channel	936	4 500		4 500	**4,8**	0	4 500	yes	no
Pre pit night soil	521	3 300		3 300	**6,3**	3 300	0	yes	no
External grease pit	648	500	3 875	4 375	**6,8**		4 375	no	no
Pit night soil	272	1 300	400	1 700	**6,2**	900	800	no	no
All water post	80	400		400	**5,0**	400	0	no	no
				Subtotal	**9 675**				

Retreatment									
Grease trap grit removal	19		50	50	**2,6**		50	confined atmosphere	no
Grit removal gaseous sky	17		50	50	**2,9**		50	confined atmosphere	no
Distributor to biological	63		150	150	**2,4**		150	confined atmosphere	no
Local grit removal	24		75	75	**3,2**		75	confined atmosphere	no
Sand trap	23		75	75	**3,2**		75	confined atmosphere	no
				Subtotal	**400**				

In the next table, the ventilation is divided into two different circuits. The two circuits lead to the deodorization. The only difference is that they will have their own blower.

Table 19: Air polluted flow send to the existent deodorization in [m3/h]

Distribution of stale air extraction flows in m^3 / h to the existing deodorization		
	Circuit 1	**Circuit 2**
Raw water lifting station	2 000	
Pretreatment building and peripheral structures	9 500	
Mixing tank before thickening operation (ex flotation tank)		1 250
Upstream digestion mixing tank (ex physico-chemical sludge tank)		720
Ferric chloride injection tank (ex-degassing tank of floated sludge)		180
Silo of 120m3	200	
Primary decanter (Densadeg rainy treatment building)		5 300
New created pre-treated water lifting station		270
Sludge thickening building (ex workshop)		3 037
Sludge dilution building		2 610
Centrifuges building	5 350	
The external sludge reception building	2 020	
Total	**19 070**	**13 367**

We have a total of 32,437 m^3 / h (***Table 19***) which will pose a problem because the existing deodorization was undersized and can only accommodate 25,000 m3 / h, this remains to be confirmed during the first tests in 2022 because like the deodorization has been stopped in 2005 and has never really worked, it is difficult to know what volume it can treat. One solution is being considered, it would be the construction of a second deodorization with the activated carbon technology or biological autotrophic filter type near the dehydration building and which would be connected with the external sludge reception silo and the external sludge reception building. To have this possibility, it has been thinking of a means of isolating the two organs which could be affected by the second new deodorization.

Nowadays, new installations are planned to limit undersizing and increase the productivity of the existent deodorization. These works will be presented in the call for tender redacted for a budget of 100 000 €.

To understand better all the organs that composed the ventilation systems I was in charge of the creation of a flow diagram, **APPENDIX VI**. That diagram permits to read the architectural view easily and to see where all the connections are.

5.4 The realization of the invitation to tenders

A call for tenders is a procedure that allows a sponsor (the Client) to choose the company (the tenderer who will be the supplier) most able to carry out a service of works, supplies, or services. The goal is to put several companies in competition to provide a product or a service.
To find the company that will carry out the work of putting the ventilation back into service and renovating it, it is necessary to submit a call for tenders to at least three different companies. These companies must give us the documents requested in the company's consultation file, before a defined date. Upon delivery of these documents, their offer is studied and discussed, site visits are also possible. The Client chose the company that will carry out the work according to different criteria, in my invitation to tender the criteria were as follows:

- Financial aspect
- Aspect technical aspect and the organization
- Timetable

For the financial aspect, VEOLIA has its purchasing department, each offer is reviewed by the department. The person in charge of the project must submit an order to the purchasing department, the purchasing department compares, analyzes, and negotiates certain prices with the company. It follows the validation or not of the order.

5.5 Documents for the creation of a call for tenders

The consultation for the commissioning of the ventilation is accompanied by a CCTP (book of special technical clauses), CCAP (book of special administrative clauses), and the DPGF (Breakdown of the overall fixed price).

5.5.1 Consultation regulation RC

This document sets out the consultation rules that the parties must respect.
The contracting authority, here VEOLIA Water, is presented, the various interlocutors, the object of the consultation in a synthetic way, the duration of the contract, the date of submission of the response to the call for tenders, the execution times benefits. The offer can be divided into a lot, which is to say several jobs independent of each other.
The consultation regulations also make it possible to define the terms and conditions for the submission of tenders and the documents to be submitted in the tender, it should be noted that any file with a document missing when the tender is submitted will be refused. [15]
In this document, the contracting authority can specify the developments expected in the Supporting Technical Report, which constitutes a response document to the tender. For example, in the consultation regulations, we asked that the company structure its thesis in the form of files or sub-files on specific points such as the planning, organization, and specific means to meet intervention deadlines, draw up an engine balance sheet, guarantee the safety of workers on the structures
If the companies contacted need more information or need to go to the site for more technical information, it is possible to make an appointment with the contracting authority if the consultation regulations so stipulate.
The criteria for choosing offers are also presented in the Consultation Regulation, in this way each company knows in advance which aspects will have the most impact on their response, and in this way they can adapt their response to the offer trying to be the most competitive possible. For example, in our case companies are rated out of 10 with the following weighting (***Table 20***):

Table 20: The criteria on which VEOLIA will choose the subcontractor

	weighting
Financial aspects	4
Technical and organizational aspects	4
Planning	2

The planning was not important because the work was not in the same part as the other and only VEOLIA needed to intervene in the deodorization components. However, the financial aspects were very important because we had a maximum price to respect and the company has to be at this price.

5.5.2 Book of special technical clauses (*CCTP Cahier des Clause techniques particulière*)

It is part of the specifications and more generally of the consultation documents, it is a contractual document, once signed, it has legal value since it then becomes the law of the parties. [16]
In order not to be open to challenge, and to limit the legal risk, the content must be written clearly and impartially, so as not to end up arbitrarily excluding certain candidates, nor favoring others. It sets the technical clauses for a specific contract; it is an essential part of the business consultation file. These are the stipulations that give a precise description of the services to be performed and allow the person responsible to monitor the progress of the contract and the proper performance of these services. It details the subject of the contract, the organization of the site with the safety hygiene rules and the future documents to be submitted if the company consulted is chosen as the safety prevention plan and the joint inspection visit to which it is submitted in our case given the presence of the CSPS.
It gives details of the services to be performed within the framework of putting the network back into service. If the company requires certain methods, certain materials, it must specify this in the book of special technical clauses.
That document gives a global view to the companies we consult of all the work we will need to do. That permits us to estimate their future price.

5.5.2.1 Listing of the elements composing the ventilation network that need to be changed present in the CCTP

All the works to do are presented on the following paragraph because the work descriptions are composing the CCTP.

Installation of two centrifugal axial ventilations

The deodorization was never functional because the exhaust air system was badly designed; Indeed the air circuit was in totality connected to a single centrifugal axial ventilation fan for a flow rate of 32,000 m3/h, its power is 75 kW, and its rotation speed is 1560 rpm, a second identical fan serves as the backup. The new modification will be the presence of two fans with the same characteristics as the old ones, but which will operate permanently and will have an individual exhaust circuit and plenum (circuit 1 and circuit 2 in Table 7).
A reflection on the distribution of the flows has been made, according to the location of the buildings it would be judicious to connect the dewatering building and the external sludge reception building on circuit 1, which increases significantly the volume to be treated for the fan of circuit 1. However, this would allow us to consider an isolation device to create a third deodorization in case of non-compliance of the emissions.

Air Treatment Unit modification

It is a technical organ of air treatment, an Air Treatment Unit (shown in ***Figure 33***) takes the outside air and makes it undergo a heat treatment, it can heat or cool the air. This treated air is then put back into the fresh air network to renew the air in the buildings. The fresh air is blown then when the air circulates in the different buildings, thus create an outgoing airflow through the ventilators that supply the deodorization, this air is called stale air.

The old Air Treatment Units are with gas-fired functioning, if the electrical capacity of the station allows it, the new ones will be electric. They will be equipped with a filtration system to filter the fresh air and a variable speed drive to regulate the supply of fresh air to the room.
The main change is that the new Air Treatment Unit will have a flow rate of 10,560 m3/h, while the old ones had a flow rate of 8,800 m3/h, this will allow a faster and more efficient air renewal. This 20% extra flow rate will also allow for more balanced airflow.

Figure 33: Air treatment unit

Changing the grids of the fresh air and stale air networks with incorporated registers

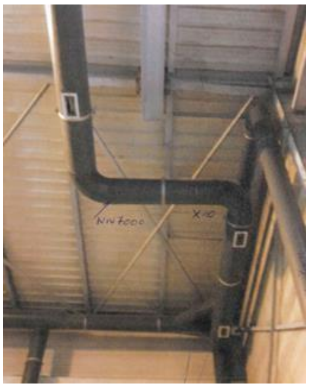


Figure 34: Grids to replace

The grids (***Figure 34***), the fresh air network, and the stale air extraction system and must be changed and replaced by grids with a built-in air register. In this way, it is possible to adjust the airflow and have better control over the ventilation system.

Change of missing or damaged pipes

The ventilation has not worked for a long time and some elements have been damaged or taking off, it needs to replace just the missing part of the network. All the pipes are in Polyvinyl chloride as know as PVC.
During the internship, for the redaction of the CCTP it was necessary to make a list of all the missing pipes, damaged pipe, their diameters.

Figure 35: Missing pipe

Figure 36: Damaged pipe

5.5.3 Book of special administrative clauses (*CCAP Cahier des Clauses Administratives Particulières)*

The special administrative clauses set out the administrative provisions specific to each market. [17] The subject of the contract and the designation of the contractors, the type of work, the constituent parts of the contract, the various protagonists, the method of execution of the contract,

5.5.4 Breakdown of the overall fixed price (*DPGF Décomposition du Prix Global Forfaitaire)*

It is intended to provide the detail of the fixed price established by the economic operator. The version I proposed for the business consultation file is available in **APPENDIX VII.**
Each candidate must fill in the lines requested in the breakdown of the overall fixed price, the price is expressed in euros excluding tax, and in our case cannot be updated and cannot be revised for the duration of the work. The price will be scored by comparing the completed breakdown of the overall fixed price documents.

5.6 Conclusion about my deodorization project

This call for tenders was drafted but was not launched, it should have been given to three different (unnamed for the respect of the market) companies in April 2020 but given the exceptional events and the delay caused, the restarting of ventilation was not a priority in June because other works such as the rehabilitation of the stormwater building were more urgent. Indeed, another company has to work on this building in December, and piping work had to be carried out before this "deadline", to avoid financial penalties, so the deodorization works will be executed in January 2021. Besides, my supervisor also had to manage the start of work on the digester. As a result, there has not been a business consultation phase for the moment.
As explained above, the rain-fed building will be converted into primary treatment, so many works must

be put in place. Sophie ROCH, Sarah HEMOUS's second intern was in charge of this project, so I was able to participate in several company consultations for various works such as pumping and cleaning of this building, but also for coring, the installation of manholes, the resining of the canals. This work has not yet started and is scheduled for the end of the year (October 2020).
In the next part, it will be explained the modification of this future primary treatment, more precisely the operations concerning emptying the building and resinating its walls
This building will continue to be used in rainy weather and as explained above but also as a primary treatment in dry weather, reagents must be introduced to promote coagulation and flocculation in rainy weather only. In fact, in rainy weather, flow rates can reach 9,000 m3 / h against 2,800 m3 / h in dry weather. To be effective the treatment in rainy weather requires the addition of a reagent because the residence time for a physical treatment is not long enough to treat all this volume of water. As a result, I had to size the metering pumps for the polymer injection.

6 Future primary decanter works on the modifications and rehabilitation of the rainy weather building.

On the water line in rainy weather two lamellar settling tanks are used, a technology from Degremont, Densadeg 4D TGV which only works in rainy weather. These settling tanks will be adapted to become primary settling tanks that will operate continuously during dry weather (station inlet flow rate less than 2800m3 / h). This modification will make it possible to produce primary sludge. This type of sludge has a greater methanogenic potential than biological sludge and will increase the production of biogas in the digester.
It is important to notice that this future primary settling is composed of two decanters (pink color). These two decanters are alimented by two flocculation tanks each (green), and the flocculation tank is the next step after the sand trap tank (orange). (***Figure 37***)
Network B has put in function only one time, for the first time but there was an automatic problem. The entire ferric chloride tank was released on network B. All the pipes were metallic, and it has led to irreversible damage on it. The network was not functional. One of the missions is to fix it and put the B network in function.

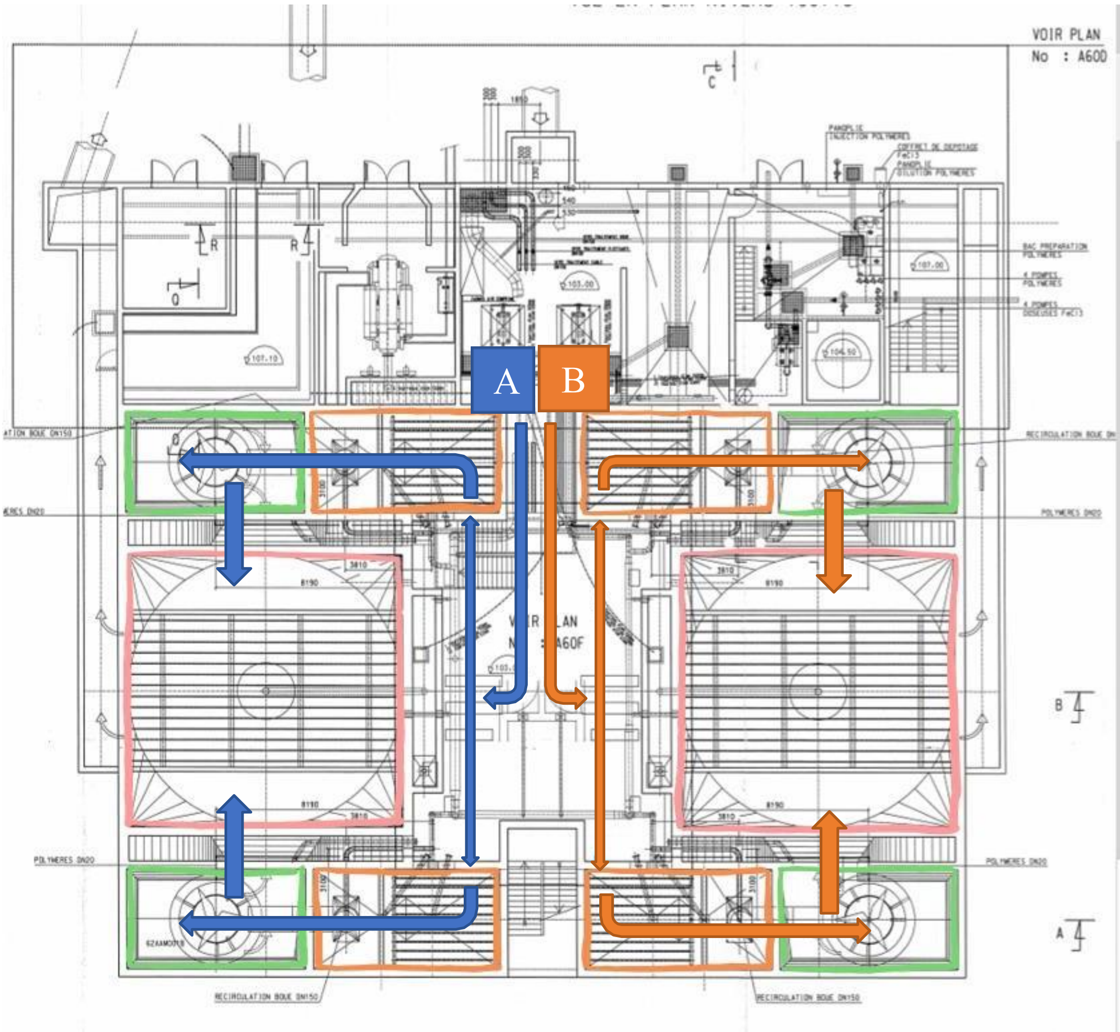


Figure 37: future primary treatment building, now existant rainy treatment building

During a rainy episode, the specific pumps on the relief post are running, the incoming water by overflow is sent to the Densadeg. At first, the water pass through a screening 10mm (**APPENDIX IV)** to recall the water network). Then the water is separated into two parts, one goes on channel A and the other part on channel B (normally an equivalent flow is sent on the two canals). Then the mail channel is divided into two secondary channels. The secondary channel leads to the sand trap tank (***Figure 38 _ 1***), then the water arrives at the flocculation tank (***Figure 38 _ 2***), and by overflow goes on the decanter (***Figure 38 _ 3***). The decanter is a lamellar backflow decanter (***Figure 38 _ 4***), constituted of hexagonal modules (***Figure 38 _ 5***). That permits to optimize water treatment. [18]

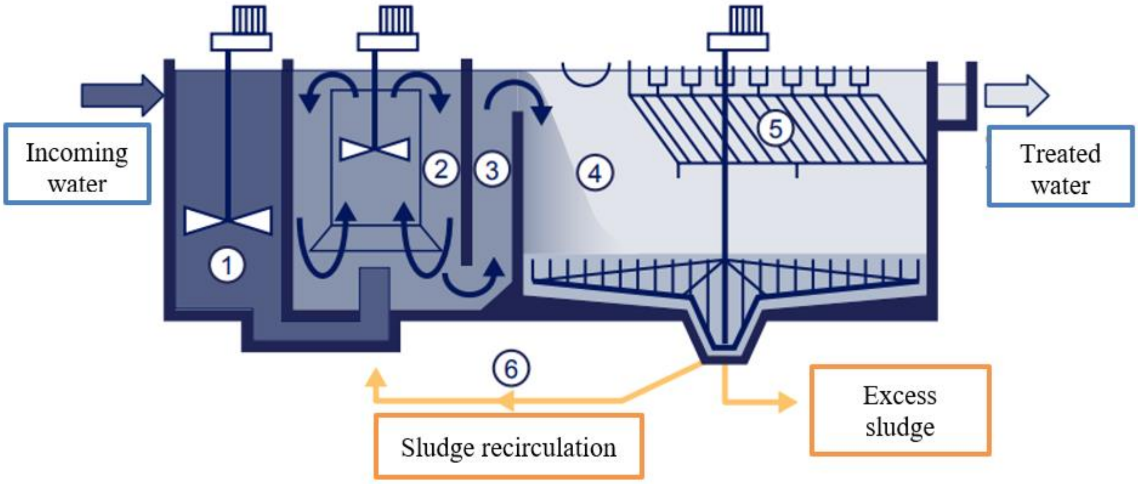


Figure 38: Densadeg explication of the operation, DEGREMONT TECHNOLOGY

6.1 Rehabilitation of the future primary treatment

6.1.1 Change of piping

The B network needs a huge modification in comparison to the A network. As the ferric chloric damaged all the pipes, it is necessary to inspect all the pipes. Most of them will be changed for a security reason, but some pipes are completely under the building and they will be inspected by a televised inspection technology for example.
As the pipe will be changed in the same way as before, it is necessary to have the same components as the valves, clapper, to add it to the new pipes.
That mission was to identify all the components of the B network on the plan at first (***Figure 39***), due to the COVID situation, and then to verify.
The ***Figure 39*** is a real example of the work effectuated. It seems simple, but only thanks to plan and architectural view it can be difficult.

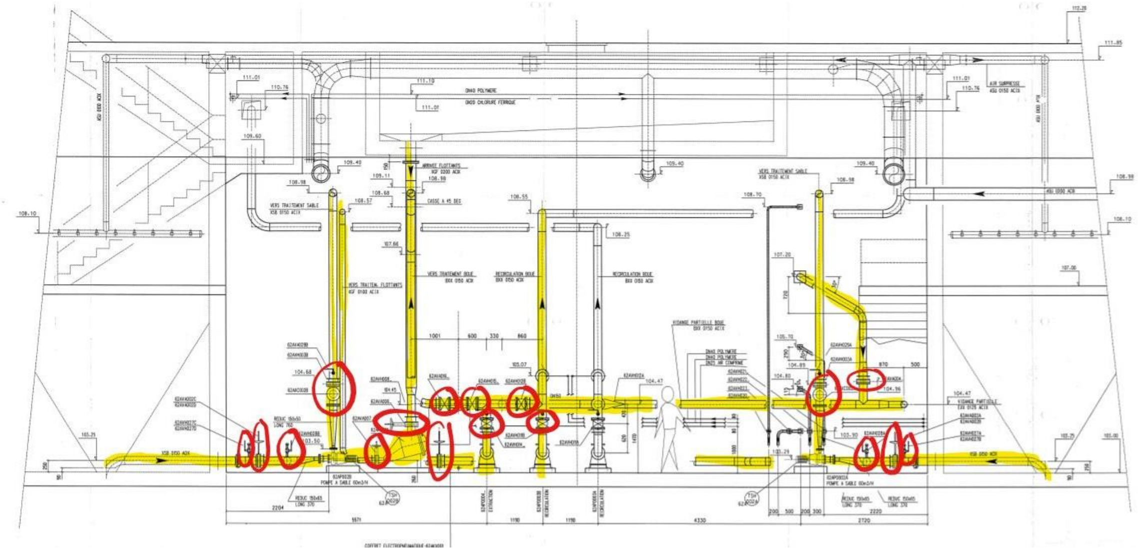


Figure 39: Example of the primary identification of the components

Generally, all the components were represented and named by a unique tag write in the plan and in the existent components. The tag is composed of two first numbers corresponding at the building, then a letter corresponding at the network (B or A for the rainy treatment building), then the component type (valve, clapper), the three last numbers corresponding at their classification for the same type.

A rotative manual valve: 62 B VH 029
An automatique valve : 62 B VA 001
A clapper: 62 B XC 002

That permits us to identify the type of the component and to have its characteristic as if it is an automatic valve, manual valve, its diameter…

Figure 40: Reality, control of the components

By comparison to reality, we can have the validation of the characteristics founded and then request an estimate from a specialized company.

The mission was to ask for a quote at an enterprise. It is important to notice that VEOLIA has its own finance department and every spent needs to be asked at the department. Like that it permits to have better financial governance of the group for every VEOLIA water in France. It limits the fraud and the disadvantage between different agencies. Moreover, this service has its own list of referenced companies. That means that the quote needed to ask only at a referenced company. As the situation was delicate due to the COVID-19 crisis, Tecofi was chosen because it was the first enterprise to answer for a reasonable price. The quote is available **APPENDIX VIII.**

6.1.2 Pumping

In order to verify the quality of the different basins and to make some works on it. The building needs to have some access. For the WWTP operators, it would be necessary to have manholes because all the basins have deep around heigh meters and there is only a few access by the top, but it is not enough when the treatment will become a primary treatment. As the building is half-buried, in that case, the manholes will be created at four meters from the bottom.
The enterprise that VEOLIA has consulted can create the manholes, after the manholes are created, lots of interventions are planned. Such as physical improvements that will create a better water distribution or a checking of all the organs present in the different basins, for example, the four aeration nozzles or the two-digester scraper.
The water under the B basins (in red) is just rainwater, but the basins need to be empty for future operations and the creation of the manholes. That is why it was needed the total volume of water present in the different basins, like that the pumping can be put in place with an adaptive pump.

The determination of the volume was important because that will determine the planning and the pump to choose. Moreover, if the volume is too important, you had to hire a subcontractor.
With the different plans of the building available in the offices, the total volume of the different basins was known. The measurement of the level of water on the different basins has been effectuated thanks to a piezometric probe. (***Table 21)***

The total volume for the B side was **1569,7 m³**. In the beginning, the WWTP workers have said no to pump this volume because it was the beginning of august and lots of team members were on vacation. VEOLIA has asked at SARP for an estimate for this activity. The price was not on the VEOLIA rehabilitation budget, in this situation, the pumping has been planned for the half of august and the WWTP workers have done the pumping.

Table 21: Rainwater to pump on the B side in the five basins

Calcul volume vidange File B									
File		dessableur		flocculateur + goulotte		décanteur		evacuation floc en surface	
longueur (m)	15	hauteur prit en compte(m)	7,1	hauteur prit en compte(m)	8,15	hauteur prit en compte(m)	6,5	hauteur	1,59
épaisseur (m)	1,5	longueur (m)	7,8	longueur (cm)	750	diametre (m)	12	NL	111,69
NL (m)	0,4	largeur (m)	4,425	longueur (m)	7,5	NL (m)	109,5	largeur	0,9
volume eau à pomper m3	9	NL (m)	110,1	largeur (cm)	562,5	volume eau à pomper	735,1	longueur	8,325
Sous-file		volume	245,0565	largeur (m)	5,66			volume eau à pomper	11,91
longueur (m)	22			NL (m)	111,15				
épaisseur (m)	1,5	volume interne béton m3 M	54						
surface quart de cercle	4,5	petites pentes	86,13	volume "structure "					
NL (m)	0,2	grandes pentes	62,64	longueur (m)	4,425				
volume eau à pomper m3	7,6	volume eau Mo 2	191,0565	largeur (m)	2,25				
		volume eau à pomper m3 (M	96,2865	hauteur (m)	4,05				
		2 dessableurs	287,3	volume à enlever	80,645625				
				volume eau à pomper m3	265,321875				
				2 floc (m3)	530,6				
					345,9675				
total (m3)	1569,7								
tot + partie floc	1581,6								
Volume pompé par UDEP	313,465125								
Volume à pomper par ext	1268,1								

6.1.3 Resin

As the building will be used as primary treatment and the concrete risks to be damage more quickly with the presence of gas and charged water.
To avoid corrosive phenomena and premature damage, a solution has been proposed. It is the application of a protective resin on the concrete. The resin will be applied only on the surface in contact with the gas, which means the submerged surfaces are excluded.
That is why when the pumping is done, the enterprise SARP needs to come and clean the tanks using water in high pressure in all the different basins (just B side).
As the B side of the building has never been functional the concrete has been preserved and not presents physical damages. It is important to have an estimation of the concrete quality because the Resin application needs to be performed on a cleaned and homogeneous surface.
In the ferric chloride injection part of the building, the concrete presents faults. Those will be rebuilt using cement which will act as a resin. It costs more but allows optimal protection.

For example, ***Figure 41***, the photography is taken above the flocculation tank of the B side, before the pumping. It can be observed that even if the B side has never been used, it is not protective of the gas. The part that we can observe will be protected thanks to the resin application. It is a difficult work because the flocculation tank is eight meters deep.

Figure 41: Example of wall part to resin, situated on the flocculation tank

6.1.4 Injection of polymers substances

The decanters will always be used in their original configuration during rainy weather. Operation in rainwater mode concerns 3 to 4% of the annual volume entering the factory.
One of the differences between the two modes of operation is the presence of flocculant and coagulant. In rainy weather, ferric chloride and polymers are added, which is not the case in dry weather. The reason is that during rainy weather, the speed of the effluent is too high to have a good settling, the addition of reagent makes it possible, to meet the regulatory requirements for effluent discharges.

The switching of primary settling tanks to rainwater treatment is presented in **APPENDIX IV**
A section on the study of the injection of reagents is developed below because there is a problem with the sizing of the polymer injection pumps which are undersized, which results in an abatement efficiency that is sometimes below standards

6.1.4.1 Polymer injection

The polymers used for the flocculation are acrylamide copolymer type polymers. They are therefore polymers of very high molar mass that are found in the form of powder or emulsion. They can be anionic or cationic.
The dissolving of powdered flocculants requires certain precautions:
- Solutions, even diluted, can be very viscous.
- Flocculants are subject to mechanical degradation if agitated too quickly.
- Flocculants tend to form lumps if they are not dispersed under the right conditions.

For the treatment of rainy weather, the station is equipped with an automatic preparation tank of the Polypack AP type with a capacity of 4165 liters. (***Figure 42***)
A station consists of the main tank partitioned into three successive tanks with overflow transfer, it allows continuous and automatic production of liquid solutions from powdered polymer. [19]

- A first tank A, called the preparation tank, receives the water regulated in pressure and flow, as well as the powder dosed using a screw feeder ensuring a regular drop of the product on the disperser; the polymer dispersed by a stirrer begins to swell and dissolve, then flows into the next tank;
- A second tank b said to be maturation, provided with an agitation, ensures a residence time necessary for the "swelling" of the molecular chains of the flocculant and the dissolution of the product.
- A third tank C, called supply or storage, is equipped with a regulation allowing the automatic dosing:

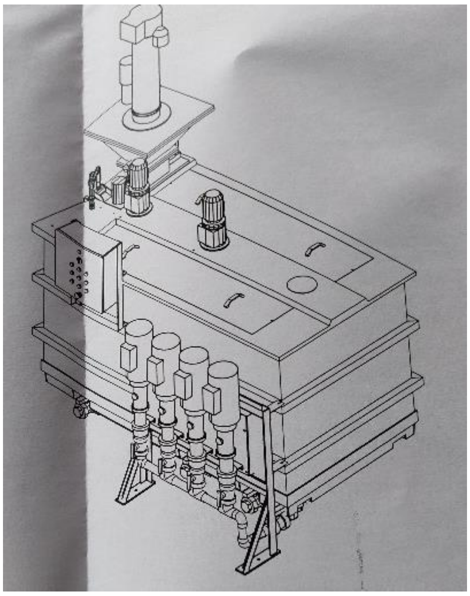


Figure 42: Polypack station, it is the station to prepare the polymer solution

For better security of the system, it is composed by:
- A level controller for the high level which results in the delayed water shutdown and the powder injection shutdown)
- A very high-level controller that triggers a security alarm)
- A level detector for the low level, which triggers the water inlet is delayed as well as the powder inlet
- A level detector for the very low level which triggers the dosing pump stop for safety

6.1.4.2 Data used for the pump estimation

Table 22: Data concerning the Polymer preparation tank called Polypack

	AP 4165
Tank weight (approx) kg	**520**
Tank length, mm	**2440**
Width of the tanks, mm	**1340**
Height of the tank, mm	**1460**
The diameter of the water inlet pipe, in inches	**1'G**
Minimum flow of the water inlet, en l/h	**1500**
Maximum flow of the water inlet, en l/h (seuil réglé en usine)	**10000**
Tank Volume l	**3100**

6.1.4.3 Calculation of the effective theoretical concentration of the polymer solution in the POLYPACK tank

In rainy weather four flocculation tanks will operate, the recommended dosage of anionic polymer is 0.5g / m^3, this dosage slaves to the flow rate treated. The data come from the explanatory memorandum of Valence dated December 20, 2000.
A flocculation tank has a treatment capacity of 246 m^3, the Densadeg has four flocculation tanks. Subsequently, the calculations are directed to the treatment of the total volume of the four flocculation tanks.
The polymer is prepared in a POLYPACK tank with a useful capacity of 3100 L.

$$C' x\, V' = C\, x\, V$$

The problem is that we do not know the concentration of the preparation in the tank:

$$C' x\; 3{,}1 = 0{,}5\; x\; 246$$

$$C' = 39{,}7\; g/m^3$$

The polymer preparation tank must be functional and usable for the four flocculation tanks

$$4x\; 39{,}7 = 158{,}7 \frac{g}{m^3} = 0{,}159 \frac{g}{L}$$

To be sure of the effectiveness of the solution and after discussion with the staff of VEOLIA water, the concentration will be set at 0.2 g / L.
Depending on the polymer powders chosen the viscosity will be different. Some vendors offer powdered polymers that are uniform in size, resulting in a more reliable solution.

6.1.5 Calculus of the optimal water flow rate

With the information in ***Table 22***, we have different drinking water inlet rates. This water feeds the tank for the preparation of the polymer solution. In this study, the goal is to know the optimal flow of drinking water to be injected to create a 2 g/L polymer solution according to the powdered polymer injection flow rate.
DOSAPRO DP32P.2.1P.1 Powder dispenser the data indicated on the data plate is missing. Not having all the information on the DP32P powder dispenser, the choice is between two flow ranges. 0.14 to 0.6 kg / h or 0.6 to 4.2 kg / h. Initially, the calculus were performed for both ranges, however, quickly only the range from 0.6 to 4.2 kg / h has been considered.

Calculation of the polymer concentration in the tank, results are given on the ***Table 23***:

$$polymer\ concentration_{solution}\ \left(\frac{kg}{L}\right) = \frac{polymer\ pouder\ rate\ injection\ \left(\frac{kg}{h}\right)}{injection\ water\ injection\ rate\ \left(\frac{l}{h}\right)}$$

Table 23: Determination of the polymer solution concentration in g/l in the preparation tank

Concentration in g/l	Minimum flow rate of injected water de in l/h	Flow rate l/h				Maximum flow rate of injected water de in l/h
Polymer rate in g/h	**1500**	**2000**	**3000**	**5000**	**7500**	**10000**
140	0,093	0,070	0,05	0,028	0,019	0,014
600	0,4	0,300	0,20	0,12	0,080	0,06
4200	2,8	2,100	1,40	0,84	0,560	0,42

This graph (***Figure 43***) allows us to estimate the flow rate of powdered polymer to be injected and the flow rate of drinking water to be injected to reach the desired concentrations, it will be useful for the rest of the report. These two parameters will be the two easily variable parameters once the installation is overhauled. Also, in the Polypack AP instruction manual it is noted that the powder metering device must be adjusted according to the water inlet and not the withdrawal rate.
Once the filling pump is calculated, they will be adapted to a flow rate.

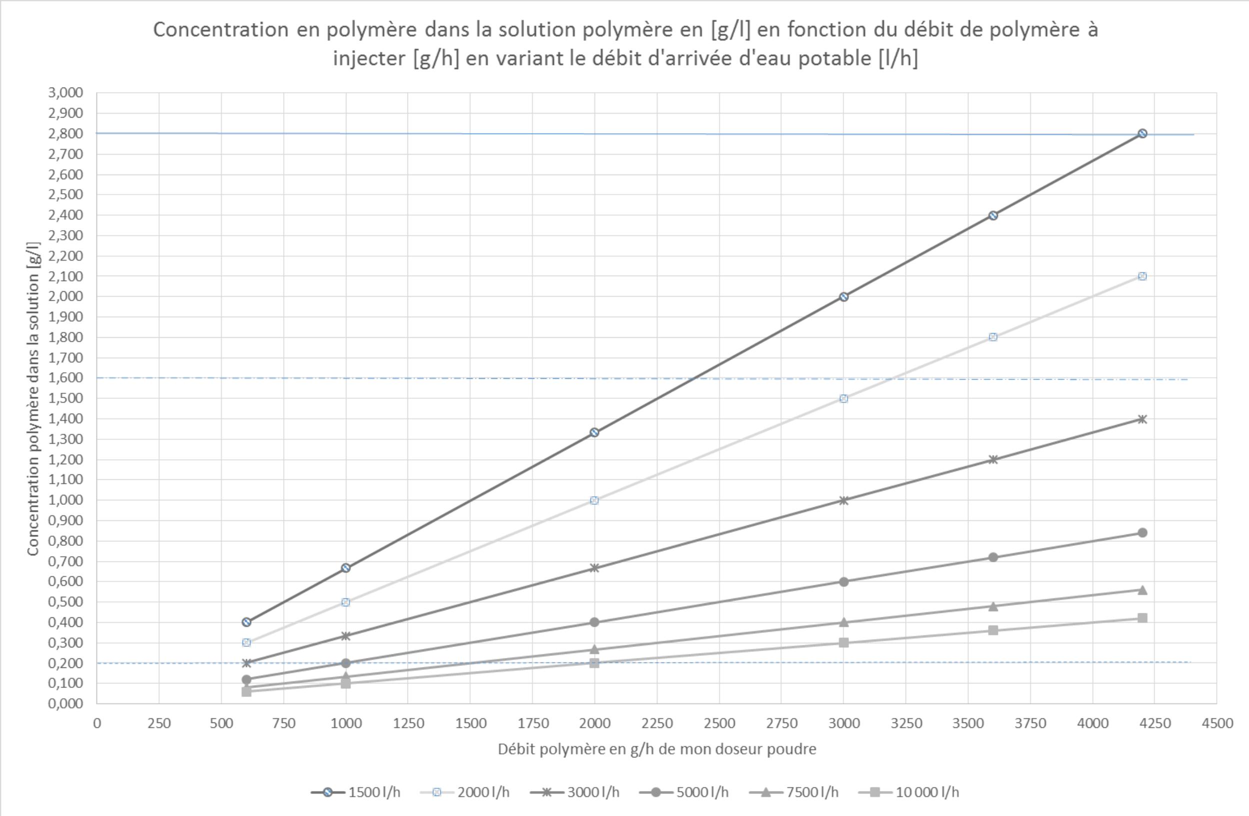


Figure 43: Polymer concentration on the preparated solution function of the polymer injection flow rate and the water inlet flow rate

This chart gives the different configurations that permit to obtain a concentration of 0,2 g/l, by lecture it is possible to obtain 0,2 g/l with the configuration reported on the ***Table 24.***

Table 24: Configuration to obtain 0,2g/l in the preparation tank

Polymer flow rate g/h	Inlet water flow rate l/h
600	3000
1000	5000
1500	7 500
2000	10 000

6.1.6 Draw-off pumps rate calculus

The draw-off pumps are the pumps that draw the prepared polymer solution from the tank to inject it into the four flocculation basins.

One rule is obligated, with a safety factor of 1.2 minimum, results are on the ***Table 25***:

$$water\ inlet\ flow = 1{,}2\ x\ draw\ of\ flow$$

Table 25: Draw-off rate calculated function of the polymer rate and the water inlet rate

polymer rate g/h	Water inlet rate l/h	Draw-off rate l/h
600	3000	2 500
1000	5000	4 167
1500	7 500	6 250
2000	10 000	8 333

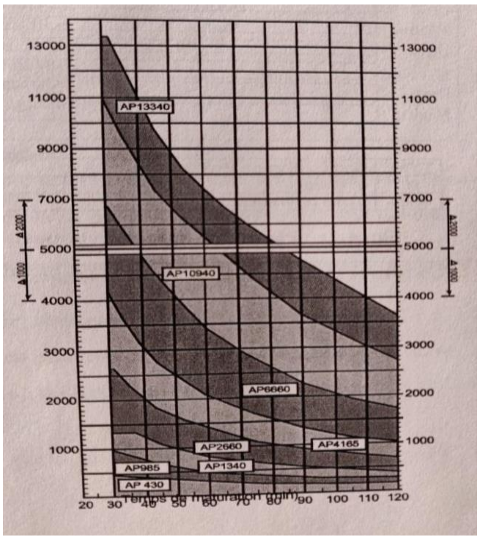


Figure 44: Effect of the draw-off rate on the maturation time, data extract from the Polypack DENSADEG AP 4165 L notice book

On the ***Table 26*** is reported all the data given by the lecture of the ***Figure 44***.

Table 26: Maturation time function of the draw-off rate of the pump

Maturation time (min)	Draw-off rate l/h	
	Draw-off rate minimum	Draw-off rate maximum
30	2600	4100
40	2000	3000
50	1700	2500
60	1400	X
70	x	X

The draw-off rate of the pumps will directly affect the maturation time. To remain close to the withdrawal flow rates in line with the values in *Table 26*, it is observed that this corresponds to maturation times of 40 to 50 min.
These configurations may be the most optimal from a pump and ripening time point of view. It remains theoretical. The withdrawal flow rate that is retained is 2500 l/h, for a drinking water flow rate of 3000 l/h, and a polymer powder flow rate at 600 g/h to "treat" the four flocculation basins.
In the previous approach, it was only considered the volume of the four flocculation basins, in the next step, it will determine the draw-off pumps to treat the flow of rainwater entering the rainwater treatment building.
To go further: given the change from dry weather to rain, during a thunderstorm, the primary treatment building will automatically switch to a rainwater treatment building. Depending on the storms the inflow can increase very quickly. The preparation time of the tank plus the polymer injection time is not in our favor in the sense that it is important to anticipate whether phenomena as much as possible. A solution could be as follows, from a certain threshold flow rate measured in the lifting station, we could have an injection of the polymer to treat the total capacity of the flocculation basin and the establishment of the preparation of the new solution. of polymer. As a result, the water present in the flocculation basin is already loaded with the polymer.
The flow of powdered polymer and drinking water for the treatment of the incoming effluent will be controlled by its inlet flow. This would allow preparation upstream of the arrival of rainwater in the

Densadeg and a more optimal physicochemical treatment. In the following we will start with the opposite reasoning, that is to say, that we will take the maximum water flow to be able to treat to calculate the withdrawal flow rate of the tank pumps.

6.1.7 Finding the right draw-off pump

The maximum flow that the rainwater treatment building can treat is 9,000 m^3/h. So, if the concentration must be 0.5 g/m^3 in the flocculation basin, the polymer distributed in the four flocculation basins needs to be 4500 g/h.
According to ***Table 24***, the tank can prepare a concentration of up to 2.8 g/l of a polymer. It would be necessary to have a withdrawal rate of:

$$2{,}8\ x\ Draw\ off = 4500\frac{g}{h}$$
$$Draw\ off = 1607\frac{l}{h}$$

The draw-off rate for exceptional storms must be 1607 l/h for the preparation of 2.8 g/l of a polymer. In theory, the tank is capable of preparing a solution at this concentration (***Figure 43***). The problem could arise in transporting the solution. Indeed, a polymer solution is a very viscous solution, and our pumps must be able to transport them, this part will not be treated in this report.
For the theory to come as close as possible to practice, it is necessary to take into account the "normal" values that the rain treatment receives during the year. On average, it receives 4000 m^3/h during rainy periods. Following the previous reasoning, a quantity of 2000 g/h of polymer would be required.

Table 27: Draw-off flow calculated with different rate and depending on polymer solution's concentration

Rainy water rate to treat	9 000 m3/h	4 000 m3/h
Polymer quantity to inject [g/h]	4 500 g/h	2 000 g/h
Polymer solution's Concentration	Draw-off flow	Draw-off flow
0,01	321429	142857
0,29	15379	6835
0,57	7878	3501
0,85	5295	2353
1,13	3988	1772
1,41	3198	1421
1,69	2670	1187
1,96	2291	1018
2,24	2006	892
2,52	1785	793
2,80	1607	714

On the ***Table 27***, the values highlighted in green (concentrations: 1.13 and 1.41) are the values for the most frequent cases on the station, I chose to highlight them because they are close to those in orange (concentrations:
2.24 and 2.52), the extreme case on the station and the value of pumps found in the first part. Now the reflection turns to the question of the choice of pumps and their number.
At the time 4 draw-off pumps were installed, one pump was used to supply a pipe which was divided into two, one to supply the interior of the flocculation basin and another in the pump room for the recirculation of sludge. Now that the settling tank takes on the function of the primary settling tank, the

sludge recirculation function has been removed, it is no longer necessary to inject polymer at this level. The choice between a configuration with 4 pumps of 500 l/h each feeding a flocculation basin or a configuration with 2 pumps of 1000 l/h feeding the two flocculation basins of the same row A or B arises. The best arrangement will be chosen later with further calculations on the pressure drops and the viscosity of the polymers.

6.2 Resume

Polymers are an interesting subject because they are part of the essential reagents for the proper functioning of treatment in rainy weather. There is still calculus and works to be done on this subject, but I really enjoyed participating at these calculi. When the building will be put into operation, modifications to the dosage will probably appear. I regret not having been able to deepen this subject with professionals.

7 An internship during the sanitary crisis COVID-19

My internship started on March 1st, I arrived during my internship supervisor's leave, the first week I started reading documents on the anaerobic digestion project, I read the documents, VEOLIA works a lot with GOOGLE Drive, which gave me some adaptation time during the first week. During my second week of internship, I had the chance to go to the Valence wastewater treatment plant for a site meeting before the start of the work which was scheduled for April, this first visit allowed me to understand my readings of the first week and also to visualize the extent of the work to be done on the restarting of the ventilation.

However, I found myself confined after two weeks of internship in a company. This complicated period has turned our planning and our objectives upside down. I had a hard time accepting it at first because the conditions I found myself in were not suitable for working from home, in the parental home, in the countryside. I had to be adaptable and patient, I was also able to count on my internship tutor Sarah who followed me as best she could during this period even with slower activity. I thank her for her listening and her frankness during this period.

During this period I worked on the drafting of the call for tenders for ventilation work, the response to a call for tenders for the search for leaks, on the drafting of a PPSPS and prevention posters for another project, which I have not addressed in this report.

During the health crisis, the site did not move forward and the date of the first shovel was postponed, nevertheless, it was necessary to prepare the deconfinement and all the resulting hygiene measures. So I had the opportunity to participate in a meeting on the field of hygiene on construction sites and the implementation of a new adaptation of the site, particularly in the living areas. This allowed me to understand just how versatile a site engineer is, in all possible situations. A site is constantly subject to hazards, whether meteorological, health, economic, technical, etc.

8 Prospects for the future

I chose to do my internship at VEOLIA in VALENCE when I was offered the subject of the rehabilitation of the premises of the Valence purification plant as part of the construction of an anaerobic digester unit. Because I knew that my mission was going to take place in the field and that I would have to follow the site closely.
Indeed, my first experience in internship took place within the biomass cogeneration plant in Pierrelatte, which enabled me to become aware of renewable energies and the recycling of our waste. In addition, during my double degree, I chose courses related to anaerobic digestion (in Italian and English), it was a subject that interested me and in which I was therefore already very interested. My knowledge of anaerobic digestion and recovery of sewage sludge was useful to me to understand the scope of the construction project and the need for the project in the context of the recovery of sludge, which is currently incinerated or sent to the composting while the oven is off. Another reason why I chose to do my internship in Valence is the restitution of my lessons in Italy on construction sites and projects with the procedures that this generates. Indeed in Italy, I had courses on the different stages of preparation of a site, the authorizations to be done, the regulations, however, it was complicated for me to restore this knowledge with the Italian-French translation.
Given my double degree course in Turin, my six-month internship ended without continuation as I returned to Limoges for my 5th year in engineering school. However, having done my final year internship before my final year made me realize that I still lack experience, self-confidence, and autonomy. My studies in Italy brought me a lot but only from a theoretical point of view, in this internship I was confronted with many differences between the fields of theory and practice, the most concrete example that I Remember for my future is that on a map a pipe can be located in one place, but when we dig, it is offset by one meter fifty.
Through this experience, I would like to stay in the working world, so I applied for a co-up program, but in another area, at the CEA (Commissariat des énergies atomiques) in Bagnol-sur-Cèze, on the nuclear waste treatment and chemical investigation. The choice of another field is well thought out because, despite a very rewarding last year internship in the construction industry, I want to allow myself to discover the field of nuclear power and waste management.

9 Conclusion

My final year of engineering school internship took place at Veolia Compagnie Générale des Eaux in the Valence branch. Its subject was the installation of an anaerobic digester at the Valence purification plant.

This project consists of carrying out a mesophilic type digester for the sludge from the Valence, Portes-Lès-Valence, and Romans-sur-Isère purification stations on the site of the Valence purification station. The objective is to reduce the quantities of sludge and to produce biomethane which will be injected into the GRDF network. My principal subject was the ventilation and the deodorization restart project. Indeed, I was in charge of the redaction of a call for tenders, unfortunately, due to the lack of time urged by the sanitary crisis and the work conditions. I could not send it and begin the launch of my offer. Moreover, I had worked on other interesting subjects such as the rehabilitation of the rainy treatment on a primary treatment.

I found this internship very interesting. Indeed, it was an engineering internship with autonomy and responsibilities, therefore ideal for entering the world of work. With a project of this scope, I was able to meet many stakeholders, carried out quite diverse missions. This internship also allowed me to put into practice the anaerobic digestion and project management courses, seen during my double degree in Italy

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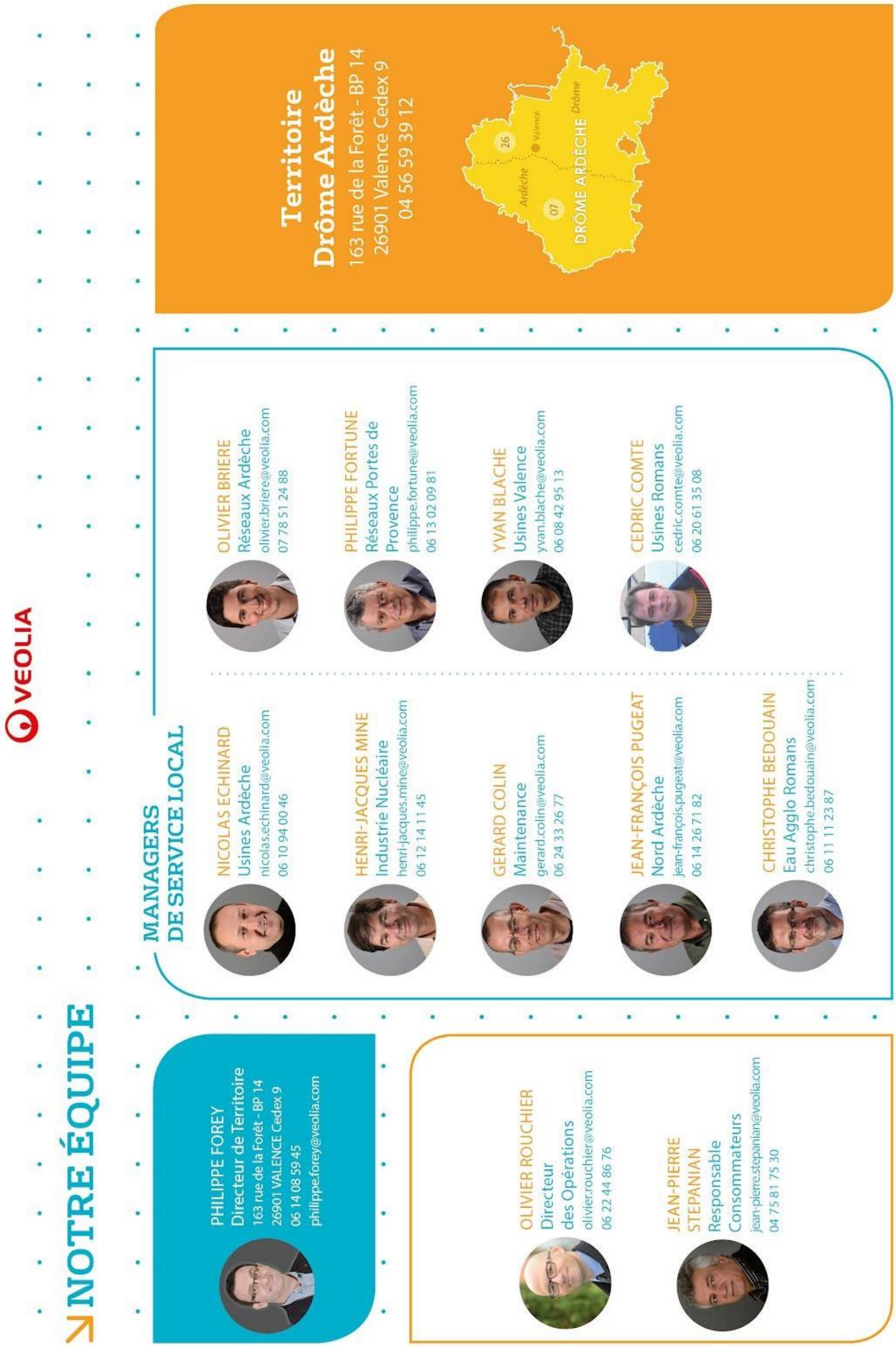
11 APPENDIX

APPENDIX I
-
Drôme-Ardèche Organization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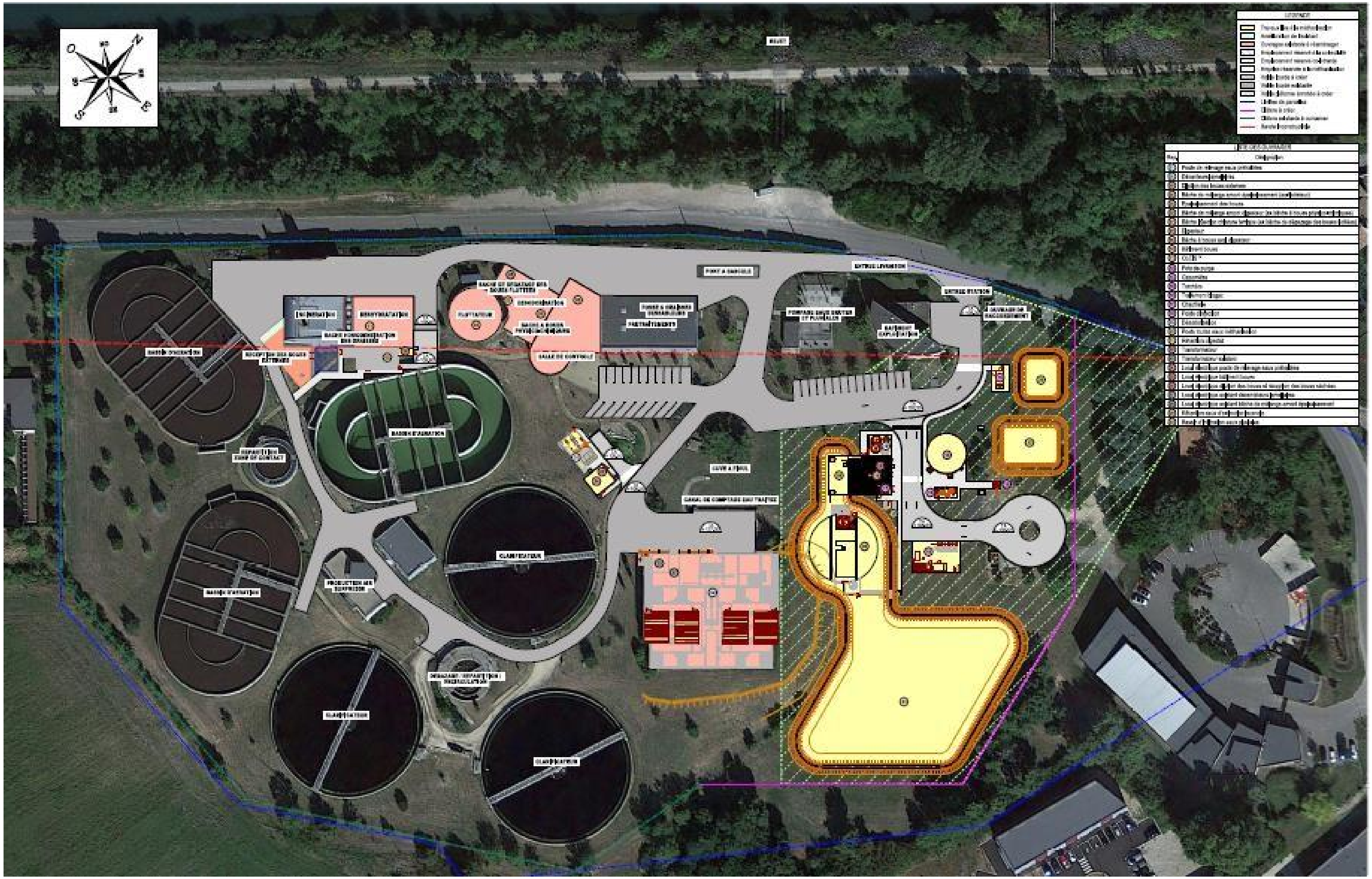
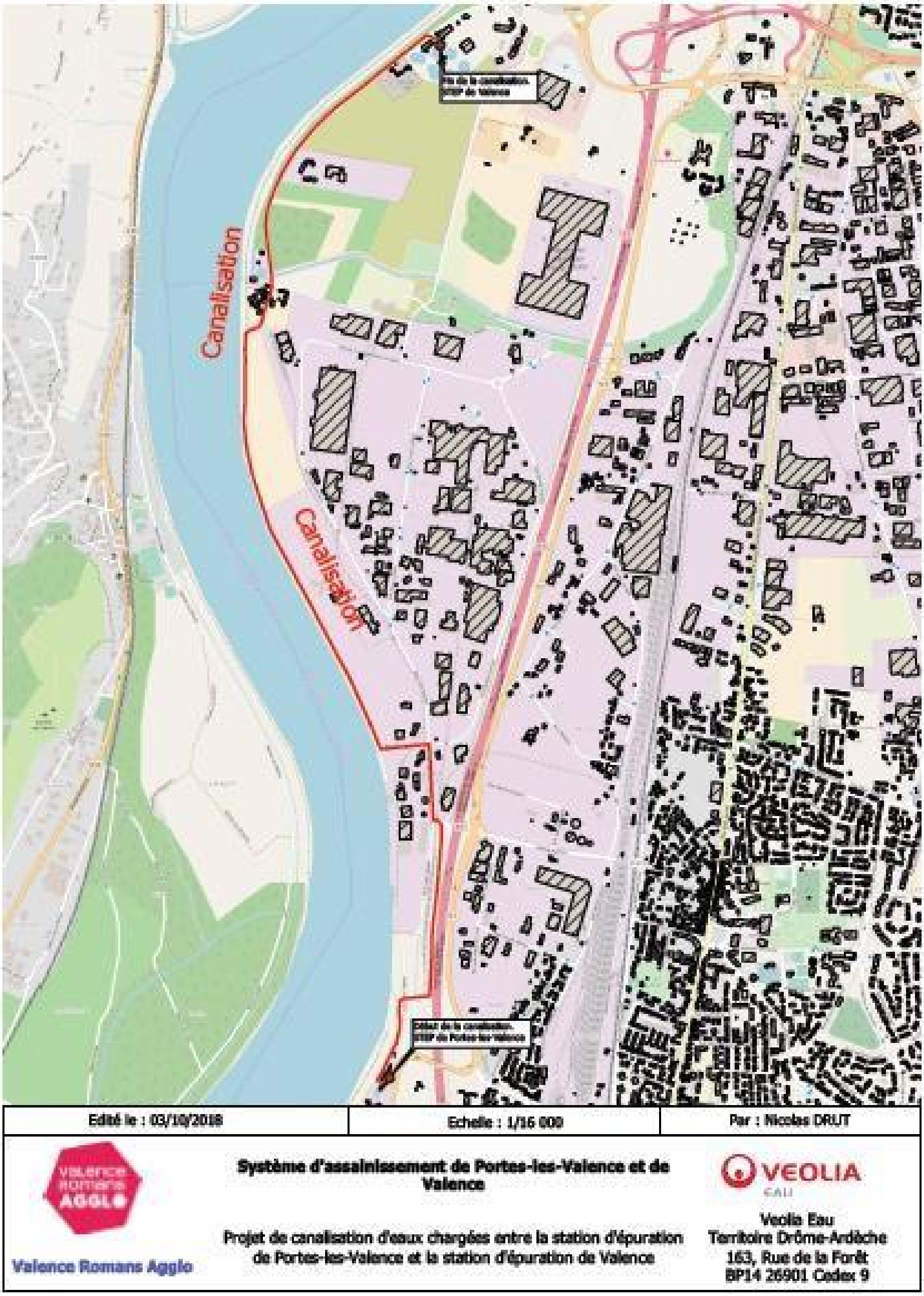
26901 Valence Cedex 9
04 56 59 39 12
26
Ardèche
Valence
07
DRÔME ARDÈCHE
Drôme

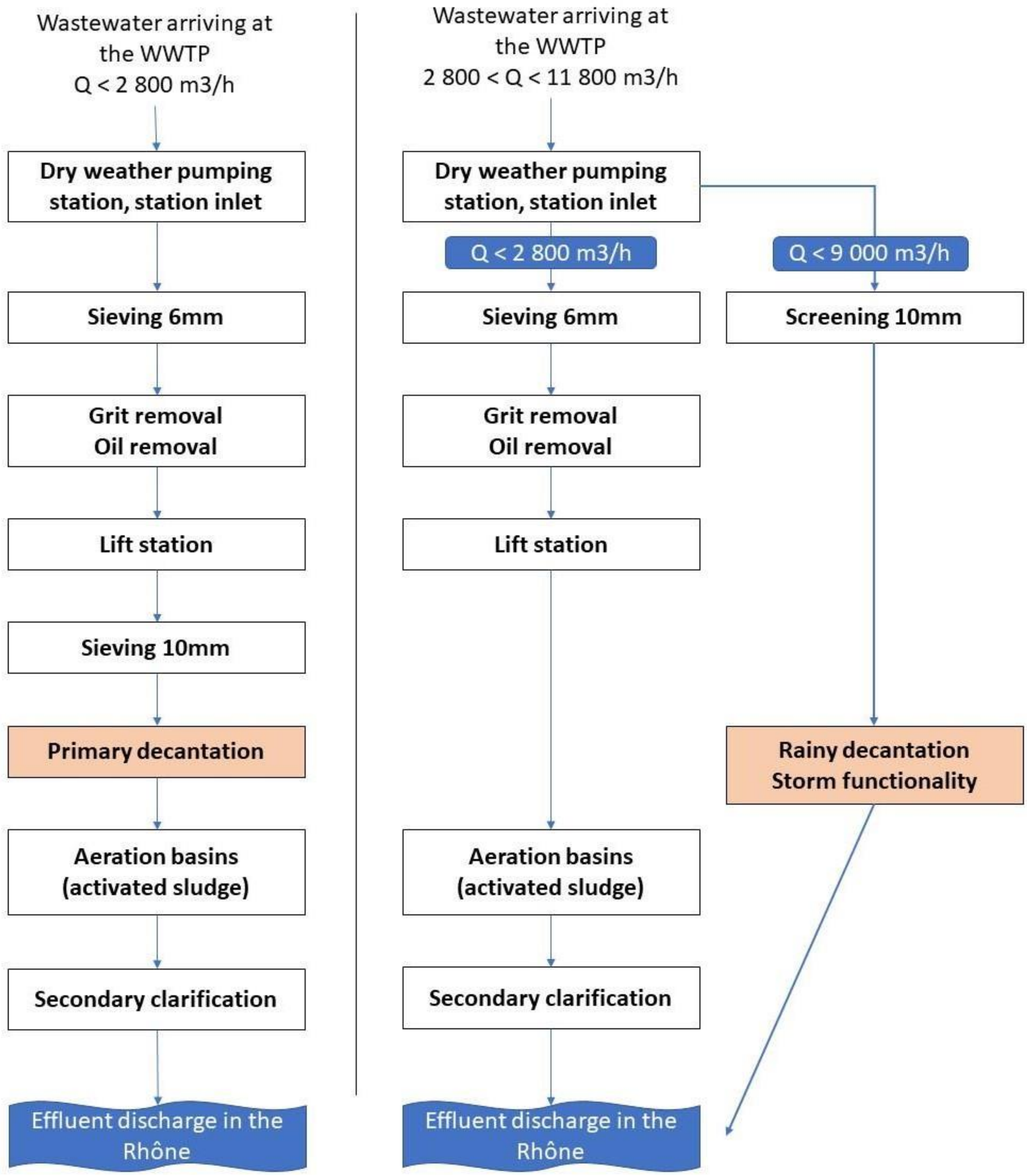
APPENDIX II
-
Project mapping



APPENDIX III
-
Pipe trajectory for the transportation of the sludge to Portes-Les-Valence to the Valence wastewater treatment plant


Canalisation
Canalisation
Edité le : 03/10/2018
Echelle : 1/16 000
Par : Nicolas DRUT
Valence Romans AGGLO
Valence Romans Agglo
Système d'assainissement de Portes-les-Valence et de Valence
Projet de canalisation d'eaux chargées entre la station d'épuration de Portes-les-Valence et la station d'épuration de Valence
VEOLIA EAU
Veolia Eau
Territoire Drôme-Ardèche
163, Rue de la Forêt
BP14 26901 Cadex 9

APPENDIX IV
-
WATER NETWORK

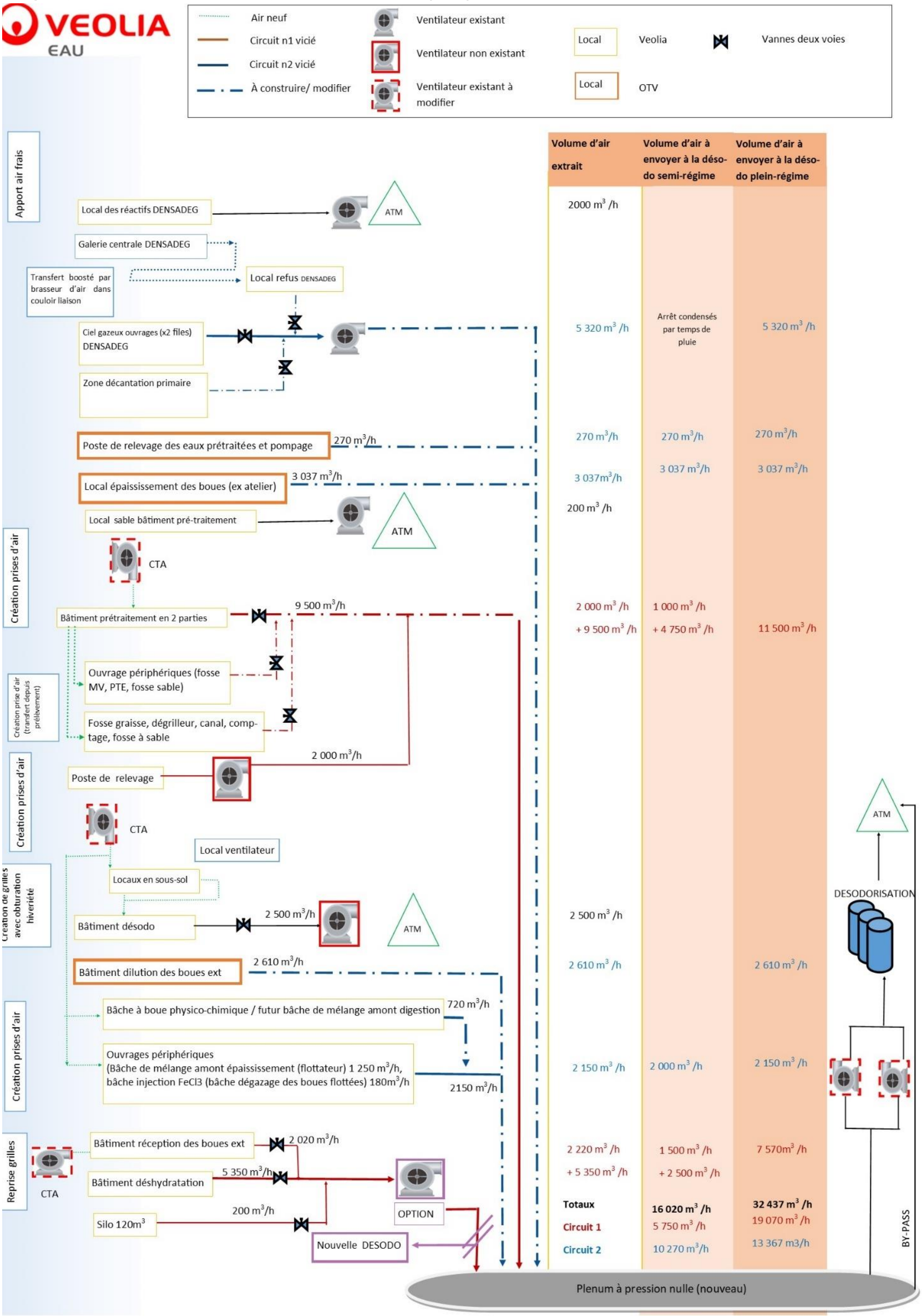

Wastewater arriving at the WWTP Q < 2 800 m3/h
Dry weather pumping station, station inlet
Sieving 6mm
Grit removal
Oil removal
Lift station
Sieving 10mm
Primary decantation
Aeration basins (activated sludge)
Secondary clarification
Effluent discharge in the Rhône
Wastewater arriving at the WWTP 2 800 < Q < 11 800 m3/h
Dry weather pumping station, station inlet
Q < 2 800 m3/h
Q < 9 000 m3/h
Sieving 6mm
Screening 10mm
Grit removal
Oil removal
Lift station
Rainy decantation
Storm functionality
Aeration basins (activated sludge)
Secondary clarification
Effluent discharge in the Rhône

APPENDIX V
-
Construction site panel, presentation of the different enterprises

GARCIA Manon
INGENERIA PER L'AMBIENTE E IL TERRITORIO

APPENDIX VI
-
Diagram of the ventilation different organs and flow

GARCIA Manon
INGENERIA PER L'AMBIENTE E IL TERRITORIO



APPENDIX VII

Breakdown of the overall fixed price (DPGF)

REMISE EN ETAT DU RESEAU D'AIR VICIE ET DE LA VENTILATION
DE LA STEP DE VALENCE

Poste	Désignation		Génie civil	Equipement	Total
I	**Prestations intellectuelles et préparation de chantier**				
cf 1.2	Base vie, raccordement électrique, cabane de chantier..				
cf 1.2	Matériel de manutention, nacelle...				
cf 3.1	Plan d'exécution				
cf 3.2	Plan de prévention, VIC				
cf 3.3	réunion de chantier				
II	**Travaux**				
II.1	**relevage des eaux brutes**				
cf. 7.	ventilateur extracteur dans gaine 2000m^3				
		raccordement électrique			
II.2	**local de prétraitement air neuf**				
cf 8.1	remplacement de la CTA existante (prendre en compte arrive				
cf 8.1	racoordement électrique de la CTA				
cf 8.1	adaptation en PVC des gaines d'entrée d'air et de pulsion d'a				
cf 8.1	plaques de PVC (obturer les trous anciens tuyaux)				
cf 8.2	remplacement des grilles du réseau air neuf				
cf 8.3	modification gaine de pulsion air neuf				
II.2	**local de prétraitement air neuf**				
cf 9.1	remplacement des grilles du réseau air vicié				
cf 9.2	remplacement gaine air vicié par Ø200				
		clapet de réglage			
cf 9.3	création d'un réseau au dessus des bassins				
cf 9.3	fosse arrivée eaux brutes				
		refaire jonction entre deux gaines			
		realiser un piquage sur la gaine			
		Prévoir 4 extractions d'air par bassin			
cf 9.4	fosse a graisses				
		ajout clapet et T			
II.2	**zone prétraitement, pré fosse des matière de vidange, foss**				
cf 9.5	vérification du bon état des prises directes				
II.3	**local desodorisation**				
cf 11.2	remplacement des deux ventilateurs (centrifuge)				
		montage/démontage des équipements			
cf 10.1	remplacement de la CTA Existante				
cf 10.2	piquage vers fosse Ø250 sortie air neuf				
cf 10.3	remplacement des grilles du réeau air neuf				
cf 10.4	ajout gaine air frais local épaississement (piquage)				

APPENDIX VIII
-
TECOFI PRICE OFFER

Tecofi

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Tél: 33 (0) 4 72 79 05 79 - Fax: 33 (0) 4 72 79 05 70 - +33 (0) 4 72 79 05 70
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Vos Réf.: SUITE DV132728
Nos Réf.:
Date de création de dossier :
Date Création de la commande: 02/07/20
CODE : CT0062697
Représentant : Yann BONNARD
Affaire suivie par : Gnilane FAYE
Mail : g.faye@tecofi.fr
Tél : 33 (0)4 72 79 44 46 Fax : 33 (0)4 78 90 19 19

GRS VALTECH VEOLIA
SERVICE COMPTABILITE
2/4 AVENUE DES CANUTS
CS 60 320
69517 VAULX EN VELIN CEDEX
France

A l'attention de : MR Sophie ROCH
Mail : sophie.roch@veolia.com Mob :
Tél : +33 04 26 20 63 46 Fax : +33 04 84 88 17 47

REFERENCE	DESIGNATION	DIM.	QTE	DELAI	PU NET	TOTAL HT NET
ZZGFA	AFFAIRE SUIVIE PAR GNILANE FAYE					
	VEUILLEZ TROUVER CI-DESSOUS NOTRE MEILLEURE OFFRE:	DN25				
BS1143-0025	RBS PASSAGE INTEGRAL ACS - LAITON/PTFE FF LEV PN25	1"	11	3S	3,95	43,45
REPERES : 62BVH027A/62BVH027B/62BVH027C/62BVH027D/62BVH028A/62BVH028B/62BVH029A/62BVH029B/62BVH020 62BVH021/62BVH026		= 2,54 cm				
	CORPS : LAITON CW617N / SPHERE : LAITON CHROME					
	SIEGE ET PRESSE-ETOUPE : PTFE / AXE : LAITON					
	RACCORDEMENT : FEMELLE BSP					
	PRESSION DE SERVICE MAXI : 25 BAR					
	POIGNEE PLATE ACIER					
	PASSAGE INTEGRAL / ACS 19 ACC NY 387					
BS6245-0040	ROBINET BOISSEAU SPHER.PI INOX PN16 BR.A LEVIER	40	1	0J	114,40	114,40
REPERES : 62BVH018						
	PASSAGE INTEGRAL					
	CORPS ET SPHERE : INOX 1.4408					
	SIEGES : PTFE + 15% VERRE					
	ETANCHEITE AXE : PTFE					
	ECARTEMENT: STANDARD FABRICANT					
	MANOEUVRE PAR LEVIER					
	RACCORDEMENT A BRIDES PN16					
	PRESSION MAXI DE SERVICE 16 BAR					
	TEMPERATURE MAXI DE SERVICE -20/+200° C					
VG3400-00N10150	VANNE GUILLOTINE FONTE PELLE INOX NITRILE PN10 VOL	150	2	0J	119,17	238,34
REPERES : 62BVH003A/62BVH003B						
	CORPS FONTE MONOBLOC PEINTURE EPOXY CUITE AU FOUR					

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Siège social :
83 RUE MARCEL MERIEUX - CS 92013 - 69969 CORBAS CEDEX - France
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OFFRE DE PRIX/FACTURE PROFORMA N° DV133144 du 02/07/20

SUITE - Page 2

Vos Réf.: SUITE DV132728
Nos Réf.:

GRS VALTECH VEOLIA
SERVICE COMPTABILITE
69517/VAULX EN VELIN CEDEX
France

REFERENCE	DESIGNATION	DIM.	QTE	DELAI	PU NET	TOTAL HT NET
	MINI 150µM-PELLE USINEE ET POLIE INOX 304 - JOINT DE SIEGE NITRILE - GARNITURE DE PRESSE-ETOUPE PTFE + 1 JOINT NBR - TIGE INOX MONTANTE - PLAQUES SUPPORT PREFORMEES PERMETTANT L'ADAPTATION D'ACCESSOIRES - MONTAGE ENTRE BRIDES PN10 - COMMANDE PAR VOLANT					
VG3400-03NI0150Z153 *REPERES : 62BVA017/62BVA016*	VANNE GUILLOTINE FONTE PELLE INOX NI.PN10 VERIN DE	150	2	1S	389,70	779,40
	CORPS FONTE MONOBLOC PEINTURE EPOXY CUITE AU FOUR MINI 150µM-PELLE USINEE ET POLIE INOX 304 - JOINT DE SIEGE NITRILE - GARNITURE DE PRESSE-ETOUPE 2 TRESSES FIBRE ACRYLIQUE + 1 JOINT NBR - TIGE INOX MONTANTE-PLAQUES SUPPORT PERFORMEES PERMETTANT L'ADAPTATION D'ACCESSOIRES MONTAGE ENTRE BRIDES PN10-CAPOT DE PROTECTION INOX-COMMANDE PAR VERIN PNEUMATIQUE DOUBLE EFFET 6 BAR + 1 KIT CFC XCKM OUVERTURE ET FEMETURE DN65 AU DN300					
VG3400-031NI0150Z07 *REPERES : 62BVA002A/62BVA002B/62BVA002C/62BVA002D/62BVA005A/62BVA005 B*	VANNE GUILLOTINE FONTE INOX NI.PN10 VERIN DE+CMS	150	6	1S	726,90	4 361,40
	CORPS FONTE MONOBLOC PEINTURE EPOXY CUITE AU FOUR MINI 150µM-PELLE USINEE ET POLIE INOX 304 - JOINT DE SIEGE NITRILE - GARNITURE DE PRESSE-ETOUPE PAR TRESSE P.T.F.E. - TIGE INOX MONTANTE-PLAQUES SUPPORT PREFORMEES PERMETTANT L'ADAPTATION D'ACCESSOIRES-MONTAGE ENTRE BRIDES PN10-CAPOT DE PROTECTION INOX-COMMANDE PAR VERIN PNEUMATIQUE DOUBLE EFFET 6 BAR EQUIPE DE COMMANDE MANUELLE DE SECOURS + KIT CFC XCKM OUVERTURE ET FEMETURE DN65 AU DN300					
VG3400-031NI0125 *REPERES : 62BVA004*	VANNE GUILLOTINE FONTE INOX NI.PN10 VERIN DE+CMS	125	1	1S	661,50	661,50

Tecofi

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333487080RCSLYON - APE 2814Z - TVA intra FR : FR51333487080

OFFRE DE PRIX/FACTURE PROFORMA N° DV133144 du 02/07/20

GRS VALTECH VEOLIA
SERVICE COMPTABILITE
69517/VAULX EN VELIN CEDEX
France

Vos Réf.: SUITE DV132728
Nos Réf.:

REFERENCE	DESIGNATION	DIM.	QTE	DELAI	PU NET	TOTAL HT NET
	CORPS FONTE MONOBLOC PEINTURE EPOXY CUITE AU FOUR MINI 150µM-PELLE USINEE ET POLIE INOX 304 - JOINT DE SIEGE NITRILE - GARNITURE DE PRESSE-ETOUPE PAR TRESSE P.T.F.E. - TIGE INOX MONTANTE-PLAQUES SUPPORT PREFORMEES PERMETTANT L'ADAPTATION D'ACCESSOIRES-MONTAGE ENTRE BRIDES PN10-CAPOT DE PROTECTION INOX-COMMANDE PAR VERIN PNEUMATIQUE DOUBLE EFFET 6 BAR EQUIPE DE COMMANDE MANUELLE DE SECOURS					
V0C4241C-00EP0150	VANNE OPERCULE CAOUT. FONTE GS COURT. BR. PN10/16 VOL	150	4	0J	168,00	672,00
REPERES : 62BVH010A/62BVH010B/62BVH013/62BVH014						
V0C4241C-00EP0250	VANNE OPERCULE CAOUT. FONTE GS COURT. BR. PN10/16 VOL	250	1	0J	356,00	356,00
REPERES : 62BVH009						
	CORPS ET CHAPEAU GGG50 REVETUS EPOXY AXE INOX-OPERCULE FONTE GS REVETU EPDM CONCEPTION SELON NF EN 1171- ENCOMBREMENT SUIVANT EN 558-1 SERIE COURTE-TIGE NON MONTANTE- FERMETURE SENS HORAIRE-SANS ZONE DE RETENTION RACCORDEMENT A BRIDES PN10/16 -VOLANT FONTE GS EPAISSEUR DE LA PEINTURE: 250 µM MINI RAL5015 PRESSION 16 BAR CERTIFICAT ACS ACS 16 ACC LY 039					
CB3241PN16-0150	CLAPET DE RETENUE BATTANT FONTE CAOUT. BR. PN10/16	150	2	0J	231,20	462,40
REPERES : 62BXC002A/62BXC002B						
	CORPS, OBTURATEUR ET COUVERCLE FONTE FT25 - JOINT DE COUVERCLE FIBRE - ETANCHEITE CAOUTCHOUC/LAITON MONTAGE HORIZONTAL ET VERTICAL ASCENDANT SUR BRIDES PN10/16					
CBL4240-0150	CLAPET A BOULE FONTE GS / NITRILE BRIDES PN10 CORPS ET CHAPEAU FONTE DUCTILE GGG50 REVETU PEINTURE EPOXY CUITE AU FOUR 150µM BOULE FONTE REVETU NITRILE; JOINT DE CHAPEAU NITRILE; RACCORDEMENT A BRIDE PN10	150	1	0J	148,87	148,87

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OFFRE DE PRIX/FACTURE PROFORMA N° DV133144 du 02/07/20

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Vos Réf.: SUITE DV132728
Nos Réf.:

GRS VALTECH VEOLIA
SERVICE COMPTABILITE
69517/VAULX EN VELIN CEDEX
France

REFERENCE	DESIGNATION	DIM.	QTE	DELAI	PU NET	TOTAL HT NET
	ENCOMBREMENT SUIVANT EN 558-1 SERIE48, DIN 3202/1 SERIE F6 ANNEAU DE LEVAGE PERMETTANT UNE MANUTENTION AISEE-MONTAGE HORIZONTAL OU VERTICAL ASCENDANT					
ZZFRANC	FRANCO DE PORT					
ZZCOM	LA RESPONSABILITE DE TECOFI NE PEUT ETRE ENGAGEE SANS VERIFICATION DE VOTRE PART SUR L'ADEQUATION ENTRE LE CHOIX DU MATERIEL ET LES CONDITIONS REELLES D'UTILISATION LES CERTIFICATS DOIVENT ETRE RECLAMES AVANT LA COMMANDE -CERTIFICAT DE CONFORMITE EN 10204-2.2 : 5€ (standard) -CERTIFICAT MATIERE ET TEST HYDRAULIQUES EN 12266-1 : 15€ (STANDARD) -CERTIFICAT MATIERE 3.1 EN 10204 (par DN) :15 € (standard) -CERTIFICAT DE TARAGE : 15€ (STANDARD) -CERTIFICAT ATEX : 50€ (STANDARD) -CERTIFICAT D'ORIGINE PAR LA CHAMBRE DE COMMERCE :50 € FACTURE TAMPONNÉE PAR LA CHAMBRE DE COMMERCE:15€ -EUR1 : 50€ TOUTEFOIS, LES PRIX SONT VARIABLES POUR LES PRODUITS SPECIFIQUES. MINIMUM DE COMMANDE : DES FRAIS DE 30 € SERONT AJOUTES POUR TOUTE COMMANDE INFERIEURE A 150 € VEUILLEZ NOUS CONTACTER POUR TOUTES INFORMATIONS COMPLEMENTAIRES					
FINGFA	NOUS RESTONS A VOTRE DISPOSITION POUR TOUT COMPLEMENT D'INFORMATION. CORDIALEMENT. G. FAYE					

VALIDITE DE L'OFFRE : 02/08/20
REGLEMENT Virement - à 45 jours fin de mois
DOMICILIATION
BANQUE CIC RHONE EST ENTREPRISES - 38 AV DES FRERES MONTGOLFIER - 69680 CHASSIEU - France
N°: 10096 18512 00061600401 91 - IBAN: FR7610096185120006160040191 - BIC: CMCIFRPP

TOTAL EUR HT	7 837,76
TOTAL EUR NET HT	7 837,76
TVA 20%	1 567,55
MONTANT EUR TTC	9 405,31

GARCIA Manon
INGENERIA PER L'AMBIENTE E IL TERRITORIO