Bachelor's Thesis

Project for the installation of a ring of demineralized water in a chemical plant

REPORT

Degree: Bachelor's degree in engineering of Aerospace Vehicles

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Acknowledgments

El projecte que es presenta en aquest document és una tesi de Grau que no hauria estat possible realitzar sense la col·laboració d'un seguit de protagonistes als que tot seguit intentaré agrair.

Donat que el projecte es realitza íntegrament a l'empresa Henkel, no hauria estat possible implementar-lo sense la col·laboració de totes les persones que hi treballen i concretament dels responsables a la fàbrica i en especial del cap d'enginyeria, Ivan Ortiz, que, a més, ha estat el responsable de la inversió que ha permès fer realitat aquesta instal·lació i gràcies Jaume i Jordi per permetre'm responsabilitzar-me malgrat la meva falta d'experiència.

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Preface

The chemical industry represents an industry benchmark in our immediate environment. Companies increasingly are favoring the quality of their products and goods offered to consumers and, to offer them, the facilities must be of the highest quality and meeting the requirements for able to finish providing the highest possible standards.

The purpose of this project is, in part, to achieve this assertion projecting a facility of the highest quality possible.

Similarly, and given the strong growth of this industry, and specially companies who are on the forefront of the sector, are increasingly committed to sustainability: reducing the ecological impact of their productivity involving for example, the use as less as possible of the resources as necessary as water. This is one of the concerns that the project aims to solve.

Abstract

The project presented in this document deals with the installation of a ring of demineralized water in a chemical plant, including all phases of the project from its definition to the implementation based on the existing installation plant for water transport and modifying it to achieve all the requirements.

For the realization of the project there are been followed the procedures of the company Henkel Iberica Operations, S.L.U. which is the owner of the facilities where the project has been implemented.

Is part of the definition of the installation, as well as the design, the installation, the assembly, the startup and the monitoring of the operations and the transferring to maintenance and production departments.

Confidential names and values

To keep the confidentiality of the facilities and operations of the company, the significant names and values used in this report must be interpreted as approximate values or references that does not represent the reality of the company or the project.

Names identifying elements have been modified for the same reason.

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Acronyms

MPT: Metal Pre-Treatment, Henkel business

A&S: Adhesives & Surfaces, Henkel business

SS2: Standard Specifications number 2 for Henkel piping design

FAT: Factory Acceptance Test

SAT: Site Acceptancy Test

QC: Quality Control

FDA: Food and Drug Administration

UV: Ultraviolet

SP: Sample Point

PO: Plant of Osmosis treatment

LAHH: Level Alarm High-High (meaning very high level)

LAH: Level Alarm High

LAL: Level Alarm Low

LALL: Level Alarm Low-Low (meaning very low level)

LI: Level indicator

LT: Level Transmitter

LSHH: Level Switch High-High (security indication for the very maximum capacity before overfilled

HV: Valve controlled by electro pneumatical components

HS: Hand valve

P: Pump

V: Vessel

M: Mixer

PRFV: Glass-Fiber Reinforced Plastic (GFRP in english – PRFV in spanish)

P&ID: Piping and Instrument Diagram

1. Aim

The aim of the project is to design, plan, install and implement a new installation of pipelines for the transport and movement of demineralized water on the plant of Henkel Ibérica Operations, S.L.U, located in Montornès del Vallès following the specifications of hygienic installations defined on the requirements.

2. Scope

Is included in the scope of the project:

· Study of the needs and characteristics of the facility based on the requirements.

· Design of the facility and its operation

· Planning the implementation

· Supervision of assembly

· Startup and operational testing (SAT & FAT)

· Transfer to production and maintenance departments

The following fields are carried out by subcontractors specialized in the field and according to the planning and detailed study carried out in the project:

· Assembly and connections of the installation

· Automation program implementation.

3. Requirements

The theoretical water storage capacity of the factory was 330 m3 before the project implementation and is a requirement to increase this capacity to 390 m3 using two new interconnected vessels of 30 m3 each one.

The new facility should allow carry demineralized water treated by osmosis plant in the same plant to all consumption points located in the production building and to the factory boiler.

It is considered that the consumption points are the inlets to all the mixers in the section, the inlets to all cleaning systems of the mixers, the Quality Control laboratory of the section, the filling collector of the section and the inlets to the cleaning system of two different installations in other sections.

It is a requirement of the project to follow the standard FDA and specifications for hygienic pipe design [Attachment 1]. These are quality specifications for the design of the installations. Both specifications indicate:

- Materials in contact with the water must be AISI 316-L stainless steel.
- Inside roughness must be 0.8 micrometers or less.
- Water must be in a minimum movement of 1 m/s to prevent stagnate.
- UV Dose Radiation must be 750J/m2.
- The connections between the line of circulation and consumption points should be a maximum length of three time the diameter of the pipe.
- Hygienic sampling point are required.
- Pumps and other apparels, machines or equipment must have certificates and hygienic characteristics.

The production department has redacted the specific requirements for the operation of the installation. The project consists of the following specific requirements:

- All consumption points must be filled with a minimum flow rate of 30 m3/h.
- The consumption points consisting of filling the mixers must be filled with a minimum flow rate of 50 m3/h.
- Mixers that do not have direct and exclusive inlet for the cleaning process should incorporate.
- The installation must not carry chlorine for water treatment.

4. Justification

In order to produce products with consideration of Hygienic is essential to follow the guidelines of FDA for facilities that categorizes the installations based on quality requirements. For certain products produced in the plant is necessary to ensure the compliance of the same and to achieve them the new installation is implemented.

At the factory where the project is implemented there is an older installation to transport water to the consumption points but does not meet the necessary requirements established by the company and is a must to update it.

The implementation of this new facility allows to increase the storage capacity of demineralized water from 330 m3 to 390 m2 and allows to split the installation of water circulation into two different installations: Ring of production or consumption and storage ring. This makes possible to meet the requirement of having the water in constant movement.

Using demineralized water for cleaning is a considerable reducing consumption since in some production processes the water used can be reused by different recovery techniques if it is demineralized but this is not possible for usual water. Thus, when a cleaning of a batch production is done, the water used to clean the filling lines can be packaged in containers labeled according to the product that has been cleaned and restore using it in the next load. This produces a savings in water consumption as well as the economic effects and sustainability effects that has been decisive for the justification of the investment in the group.

The justification for the project is to reduce the impact of waste water: if demineralized water is used for cleaning, it can be recovered and reused and therefore decreases the amount of water used reducing the ecological impact and manufacturing costs. In addition, stop using sodium hypochlorite, which until now was a manual application, reduces costs and manpower.

The saving per year estimated by the company with this new implementation are shown on the Table 4.1

Concept	**€/year**
Sodium hypochlorite	150
Manpower for sodium hypochlorite application	4.000
Non-conformities (QC analysis) because of water used	40.000
Treatment of waste water not able to be reused	44.500
Increasing of capacity by increasing the flow rates	15.000
Maintenance costs for old installation (only difference with now)	8.000
Total savings	**111.650**

Table 4.1: Savings estimated for new water installation

In the table 4.2 are shown the Key Financial Figures which justifies the investment with the budget shown in the document BUDGET.

Internal Rate of Return	38,45%
Payback Period	2,4 years
Savings per year	111.650€
Total Budget	268.870€

Table 4.2: Key Financial Figures

5. State of the art

In previous installation off demineralized water transport in the plant there is not a recirculation, but there were two vessels that acted as a buffer accumulating water to fill a third vessel that sent water to consumption points acting as a raw material pipe line. With this kind of transport may appear tightness contamination of water that can be solved with small concentrations of sodium hypochlorite. This solution limits the use of certain products in the receipts specially for those with colorants and is no longer available because of this limits.

In the previous installation, the valves were ball valves which are not certified as hygienic and the pumps were not certified for the hygienic standards.

With all these facts is known that all the installation must be new but the storage vessels can still be in use in the new installation.

6. Installation description

The project is divided into two interrelated installations including: the ring of water consumption and the water storage ring. This separation allows a facility only for the consumption of water independent of the water storage facility. With this separation is much easier to detect areas of pollution and as the same time, easier to solve them.

The ring of water consumption consists of two vessels (number 15 and 16) connected by deep acting as a single constant recirculation vessel (15-16) carrying water to all points of consumption.

There are considered as consumption points on the production ring:

- An inlet for each mixer (mixers are named M1, M2, M3, M4, M5, M6, M7, M8 and M9).
- An inlet for the cleaning installation of each mixer. The cleaning installation consists into a ball with some open points which pulls out the water at medium pressure.
- Four points for the manual consumption.
- The quality control laboratory of the section.
- The inlet to the filling collector.

The storage ring consists of three vessels, two of them (74 and 75) are interconnected by deep acting as a single vessel (74-75) and send water to the third vessel. The third vessel (number 19) returns the water to the previous two vessels or sends water to the boiler of the factory.

There are considered consumption points of the storage ring:

- Centrifugal pumps that send water to the boiler.
- The consumption ring.

L'anell d'emmagatzematge està format per tres tancs, dos dels quals estan interconnectats entre ells per el fons actuen com a un de sol i envien aigua al tercer o a l'anell de producció. Aquest tercer tanc retorna l'aigua als dos anteriors o envia aigua a les bombes d'enviament a la caldera de la fàbrica.

The vessels used in all installation are in the Table 6.1.

Vessel	State before project	Materials	V (m3)
015	Out of use	316L Stainless steel	30
016	Out of use	316L Stainless steel	30
019	In use	316L Stainless steel	30
074	In use	PRFV	150
075	In use	PRFV	150

Table 6.1: Characteristics of the vessels used in the project

The installation is shown at figure 6.1

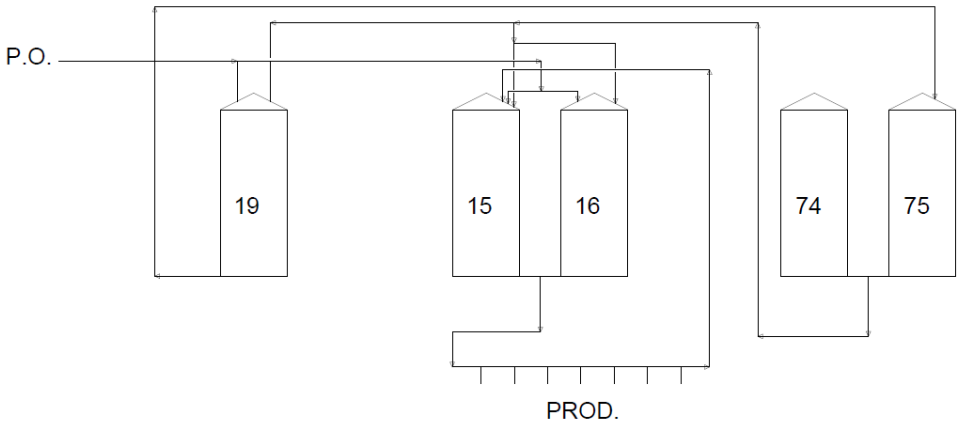

Fig. 6.1: General diagram of the installation

In the following sections the system of work of each part of the installation is being detailed and their characteristics but is important to mention at this point that the flow of water will produce a minimum flow rate of 25 m3/h and a maximum flow rate of 55 m3/h. Knowing these flow rates, pipelines are being dimensioned according to the requirements and this flow rates with a result of a pipe diameter of 80 mm.

Diameter (mm)	**V (m/s) if Q=25m3/h**	**V (m/s) if Q=55m3/h**
50	3,54	7,78
65	2,09	4,60
80	**1,38**	**3,04**
100	0,88	1,95

Table 6.2: Comparison between diameter of piper to guarantee a minimum flow speed of 1m/s.

6.1 Storage ring

The storage ring consists of the vessels 74-75 and the vessel 19. The only inlet for the water is from the osmosis plant to the vessel 19.

As it is going to be shown in the following sections, the water enters the tank 19 and then goes to the 74-75. Once there, from the 74-75 returns to the vessel 19 and so on if the installation is storing water.

6.1.1 Osmosis plant

Osmosis plant is itself another independent installation of the factory but has a special involvement with the installation projected in this report because it is the only way to supply water in normal conditions.

It is a facility in operation and its planning and operation are not in the scope of this project.

Osmosis plant has different configurations of work than can achieve an output of 15, 25, 40 and 50 m3/h at a pressure of 1 bar. For the calculations and the dimensioning have been considered all the possibilities but for programming it is considered a flow of 25 m3/h because is the most common flow rate.

Under normal conditions, the plant fills the vessel 19, thus filling the storage ring. With the installation, the osmosis plant can fill the vessels 15-16 filling directly the consumption ring but this is only for special situations not considering the normal use of the installation.

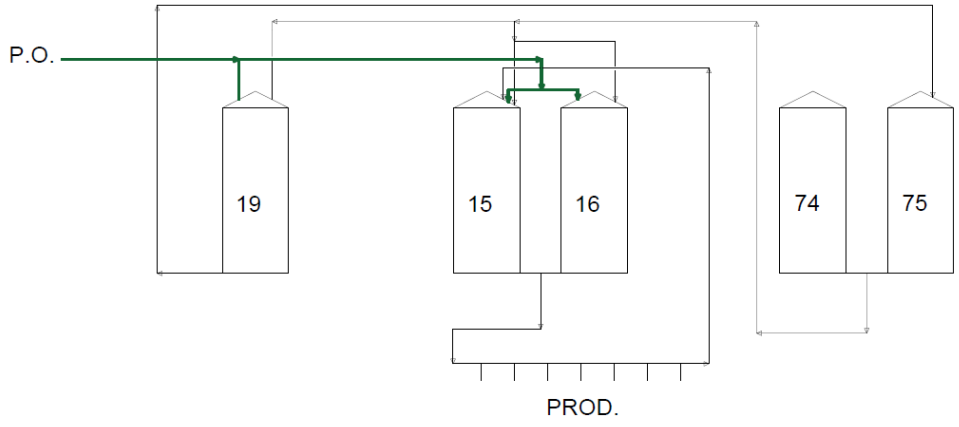

Fig. 6.2: Osmosis Plant filling vessels 19, 15 and 16

6.1.2 Vessel 19

Vessel

The vessel number 19 is a cylindric stainless steel vessel with flat bottom which has a theoretical capacity of 30 m3. The vessel is equipped with a radar that transmits continuous level and a security level to prevent overload.

The vessel is in operation in the previous installation of water but does not meet hygienic requirements:

- System of air filtering is missing. It uses an atmospheric vent without filter.
- The valves of discharge are ball valves.

To use it according to the requirements a filter must be incorporated and ball valves must be replaced for butterfly valves with clamp connections.

Installation

Water is sent from the vessel 19 to the vessels 74-75 and there the water is stored. It can build up to 300 m3 of demineralized water in this point.

Vessel 19 also fills the boiler of the factory.

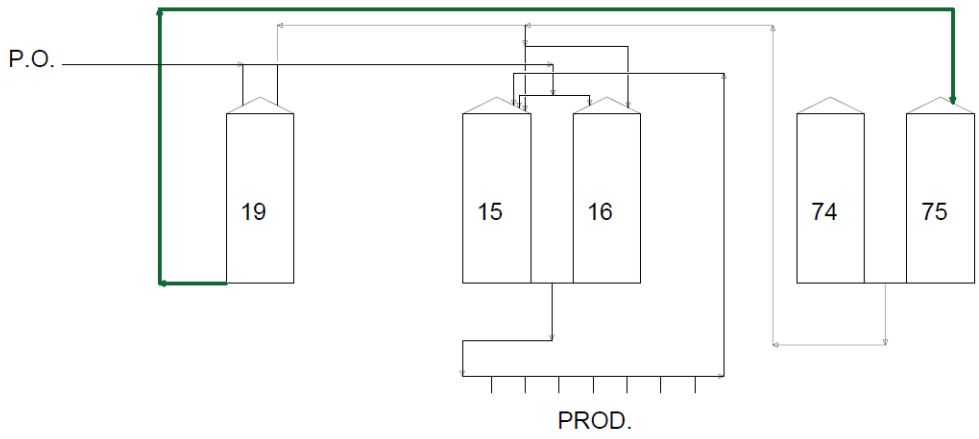

Fig. 6.3: Water from Vessel 19 to 74-75

6.1.3 Vessels 74-75

Vessels

Vessels 74 and 75 are two vertical PRFV vessels with a theoretical capacity of 150 m3 each one. Both vessels were in service before the project

Installation

From the vessels 74-75 are two possible shipments: Return the water to the vessel 19 to close the storage ring or send water to fill the vessels 15-16.

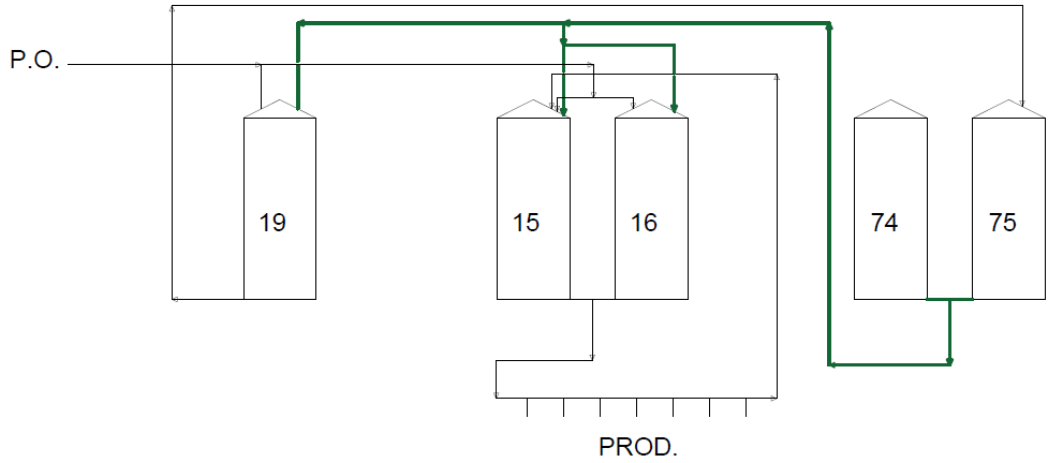

Fig. 6.4: Possible movements of water from vessels 74-75

6.1.4 Summary

When the consumption ring is not being filled, the storage ring is completed with the configuration shown in Fig. 6.5

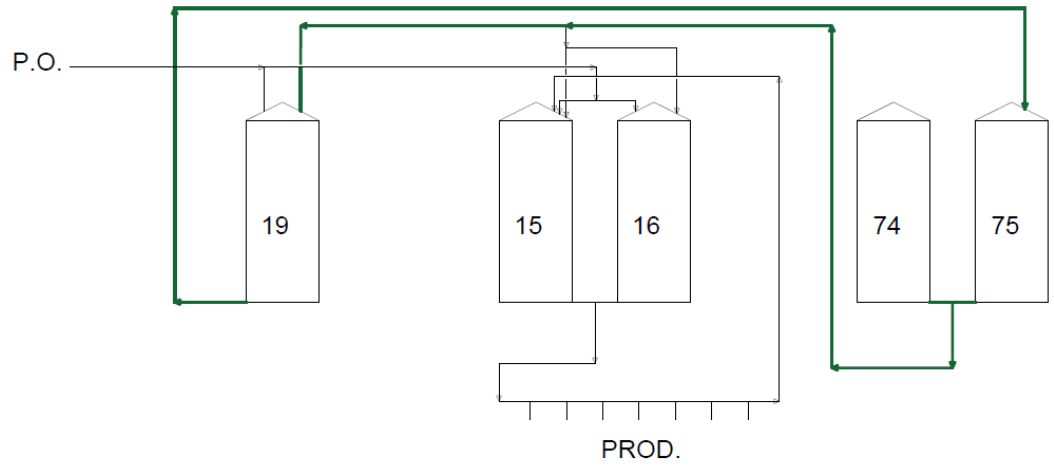

Fig. 6.5: Storage ring drawing

6.2 Consumption ring

The consumption ring consists of the vessels 15 and 16 and the installation of pipes that brings water to the consumption points.

6.2.1 Vessels 15-16

Vessels

As in the vessel 19, this are two vertical cylindrical vessels of stainless steel AISI 316-L but which were not in use.

In order to put them into operation was carried out a cleaning, an inspection and a disinfection with an acid solution.

To put them into operation the same filter that has been mentioned for the vessel 19 is installed in both vessels. The vessels are equipped with a radar transmission level and a level of security to prevent overload.

Installation

To send water to the consumption points the only way is from the vessels 15-16 and the return to the same vessels completes the main ring also known as the consumption ring. Every consumption point of demineralized water in the production building is on the consumption ring.

As it is being seen before, the vessels 74-75 are going to be filled from vessels 74-75 but can be also filled from the osmotic plant.

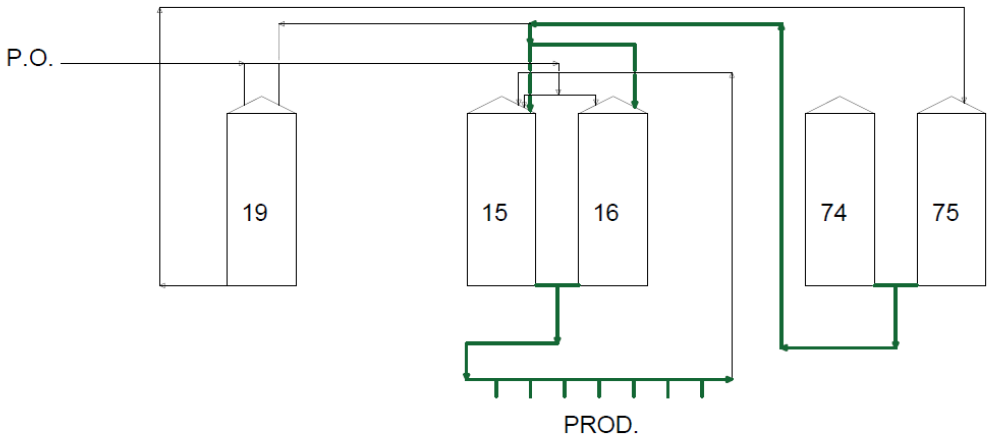

Fig. 6.6: Vessels 74-75 filling vessels 15-16

6.2.2 Return of the consumption ring

At the entrance of the production building, it has been installed three valves: one in each direction and one as a by-pass as it is shown in the Fig. 6.7.

The valve in the return way is an automatic valve.

This has been made for two reasons:

1. In the event of maintenance operations in the production area the installation allows to make a bypass and only emptying the part of the ring inside the building without stopping the flow of water in this ring.

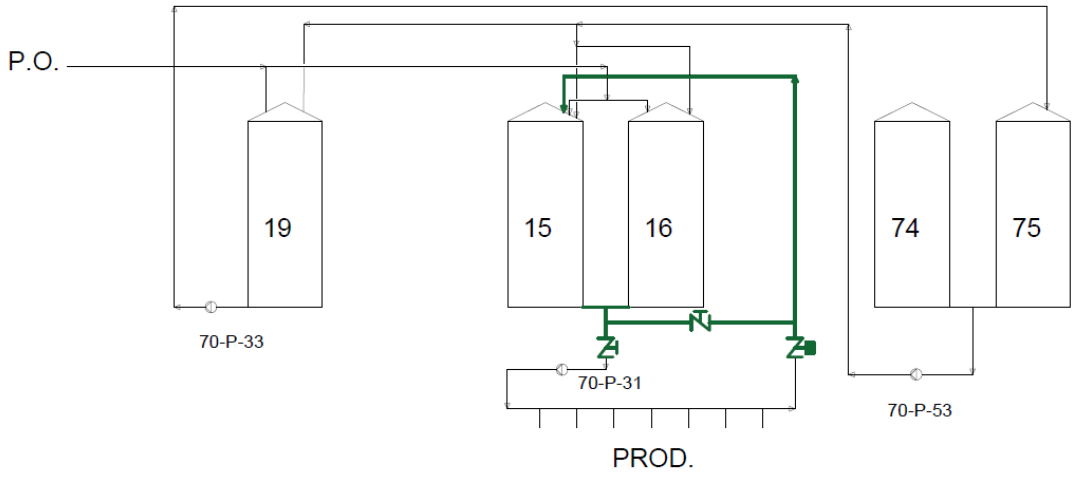

Fig. 6.7: Return from the consumption ring without incoming on production building

2. Use the automatic valve located in the return way as the end of the water line when necessary for operation. When a consumption point needs a bigger pressure, this valve closes slowly and the pressure increases. When the consumption point is filled, this valve opens and becomes a water ring again. The valve has regulated the velocity of closing to avoid hammering.

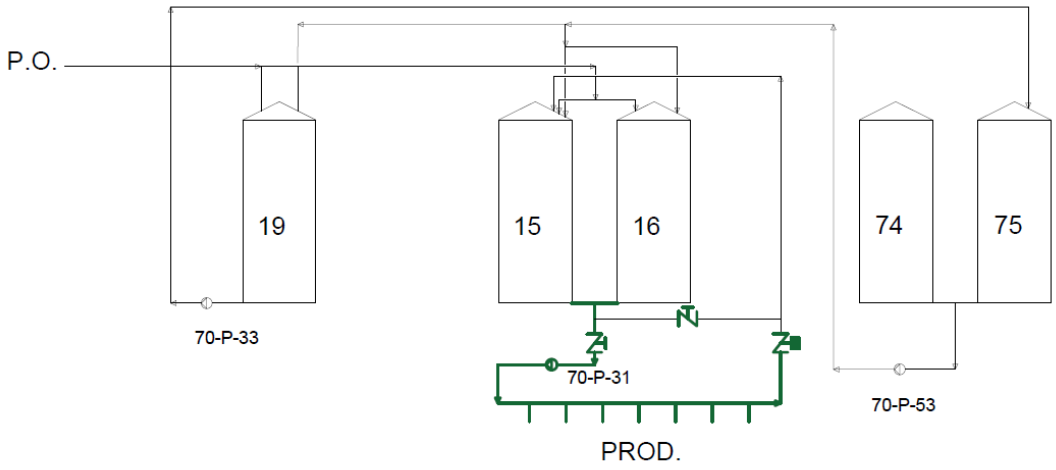

Fig. 6.8: Consumption points filling without return

6.3 UV lamps

The facility has two UV lamps to treat water from the two facilities. One lamp is located on the impulsion of vessels 74-75 and previously to reaching vessels 19 and 15-16.

The other lamp is located at the exit of the vessels 15-16 and above any point of consumption.

The situation of the lamps is schematically shown in the figure Fig. 6.9.

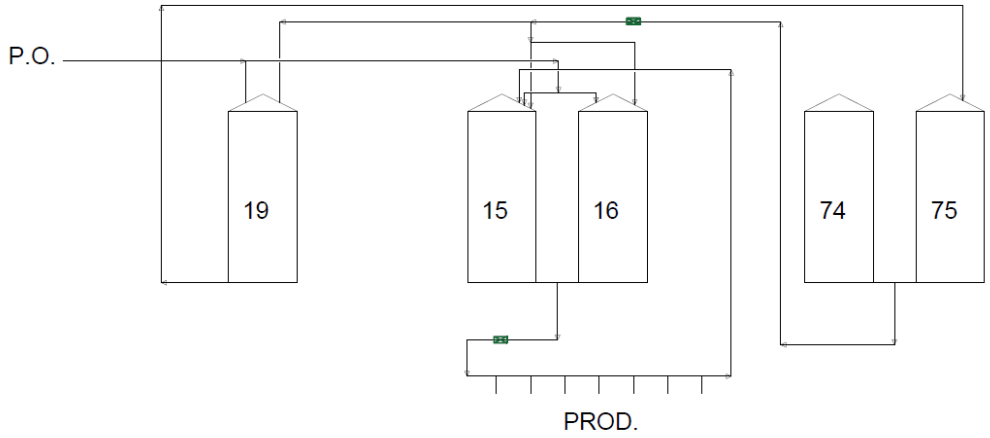

Fig. 6.9. General outline of the location of the lamps

The goal of each lamp is:

- Storage ring lamp: Water treatment consists in reducing the colonies of bacteria and prevent their growth so that the incoming water to vessels 15-16 and, therefore, the consumption ring already has an acceptable quality. This lamp applies a dose of 120 mJ/cm2 or equivalent 1200 J/m2.

- Consumption ring lamp: Stabilize water features. It is a less powerful model that applies a dose lower than the previous model as it only aims to maintain water quality. This lamp applies a dose of 80 mJ/cm2 or equivalent 800 J/m2.

With this configuration, the maximum time that can be the water without treatment is 11 hours if the vessels are filled to the maximum and during this time the water circulation is at 30 m3/h.

These are medium pressure UV lamps with the highest intensity per square centimeter in the UV industry and with higher power which allows to not only avoiding the growth of bacteria but destroying them. Using the sensors and monitoring capabilities of the system, lamps can be adjusted for maximum dose output.

6.4 Sample points

The installation has three sample points as it is shown in the figure Fig. 6.10

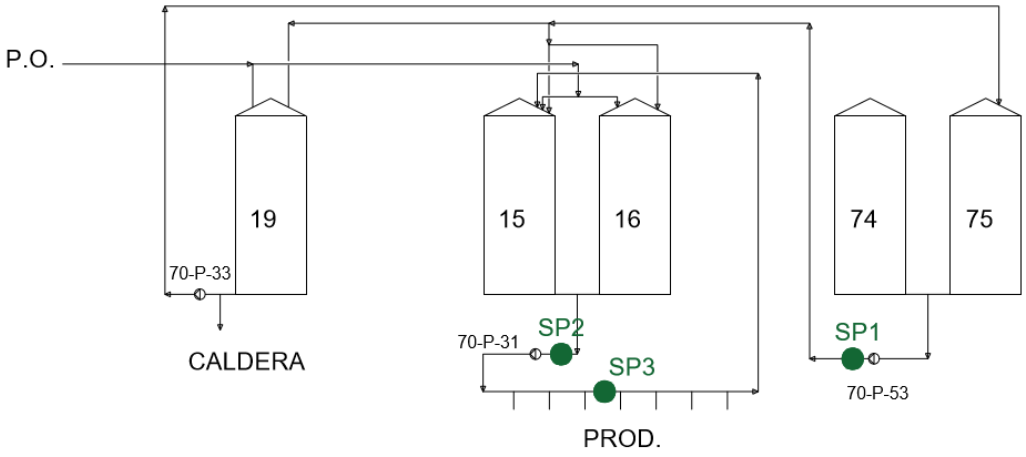

Fig. 6.10. Sample points location

- SP1: At the pump 70-P-053 output located between the vessel 74 and vessel 75.
- At the admission of the pump 70-P-31 before the second UV lamp.
- Located beside the mixer M3, on the rise of the pipe between the consumption points.

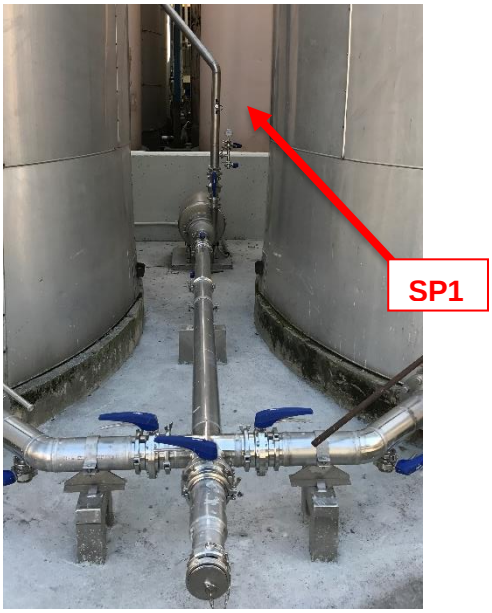

Fig 6.11. Sample point 1

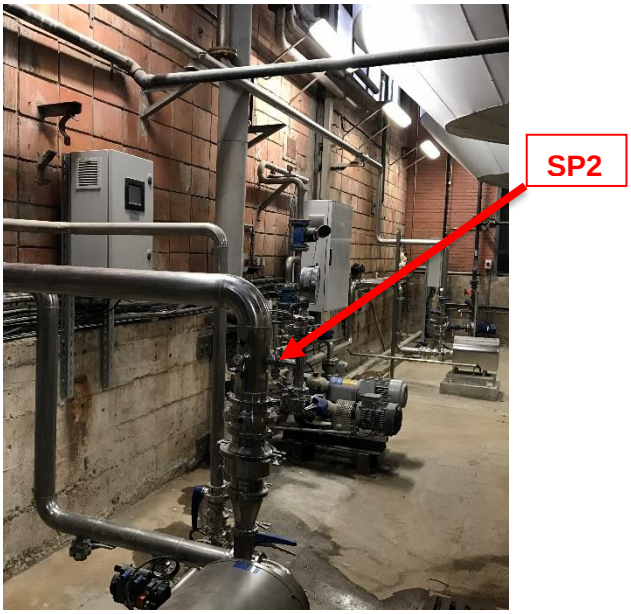

Fig. 6.12. Sample point 2

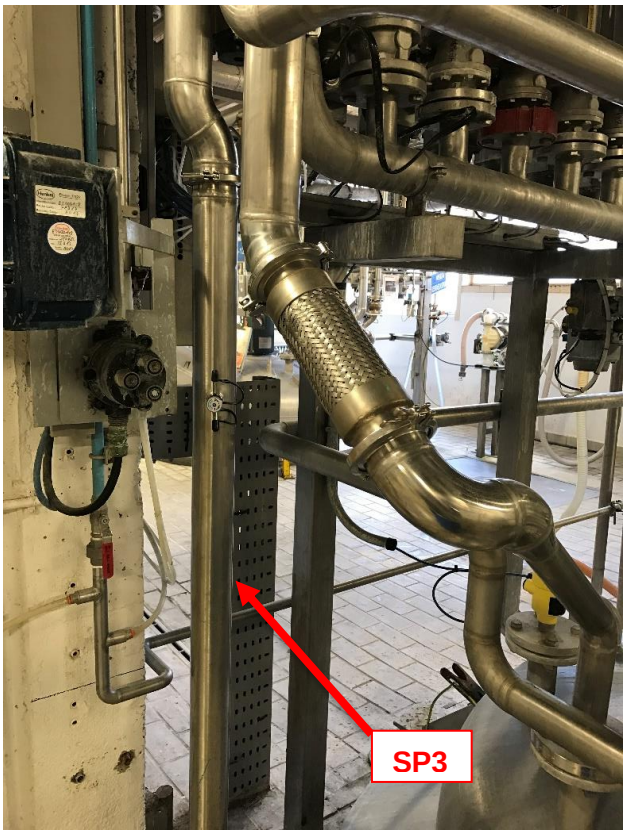

Fig. 6. 13. Sample point 3

7. Functional description

7.1. Level of vessels

Vessel 19

Radar of vessel 19

CODE	VALUE (L)	ACTION
LAHH	23.000	Stop demand from vessels 74-75 by stopping pump 70-P-53
LAH	19.000	Stop demand from osmotic plant.
LAL	6.000	When the vessel goes to minimum level the discharge pump stops to allow the filling of this vessel. Once recovers the minimum level, it starts a count of 10 minutes to pump up.
LALL	3.000	Stops every output of the vessel which means stops the transport of water to the boiler.

Table 7.1: Actions of radar of vessel 19

The security level of vessel 19 stops the pump that fills the vessel, 70-P-53. This is not a program maneuver but an interlock condition.

Vessel 15-16

Radar of vessel 15-16

CODE	VALUE (L)	ACTION
LAHH	26.000 x2	Stop demand for filling vessels.
LAH	20.000 x2	When the maximum level is lost, the demand of filling from the vessels 74-75 starts.
LAL	16.000 x2	Makes an advice of urgent need of water and fills the vessels at 50 m3/h by putting the discharge pump of 74-75 at 50 Hz.
LALL	3.000 x2	Stop the pump 70-P-031 and appears a POP-UP of no water for consumption.

Table 7.2: Actions of radar of vessel 15-16

The security levels of vessels 15 and 16 closes all the inlets of them to avoid an overload.

Vessel 74-75

Radar of vessel 74-75

CODE	VALUE (L)	ACTION
LAHH	140.000 x2	Stop pump 70-P-33.
LAH	132.000 x2	Start demand when maximum level is lost.
LAL	30.000 x2	POP UP of very low level of water appears as an alarm.
LALL	500 x2	Stop pump 70-P-53.

Table 7.3: Actions of radar of vessel 74-75

7.2. Case 1

No production consumption

While there is not a consumption in the consumption ring, the two rings works as independent installations.

7.2.1 Storage ring

Vessel 19 fills vessels 74-75 using pump 70-P-33. This pump has not a frequency shifter so it works at a constant frequency giving an output flow rate of 31 m3/h.

Vessels 74-75 fill vessel 19 using pump 70-P-53 that has a frequency shifter that allows the pump to work at two different frequencies: in this situation works at 30 Hz giving an output flow rate of 28 m3/h and showing on the control screen LOW VELOCITY.

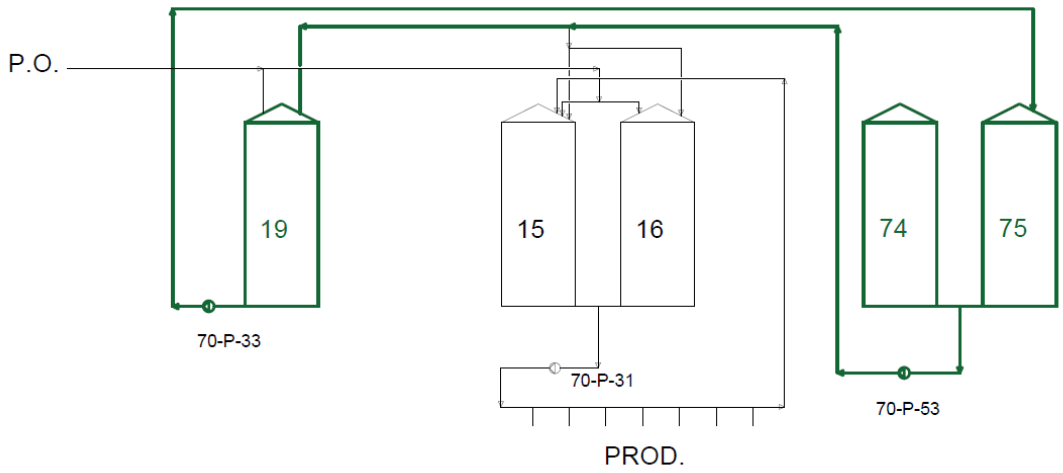

Fig. 7.1. Storage ring drawing

In this situation, it is desired that the transport of water is similar in both ways but the flow rate from vessel 19 to 74-75 is slightly higher than in the other way to allow possible osmotic water filling of tank 19.

Currently the vessel 19 takes about 50 min to reach the minimum (LAL) as shown in the following graphic.

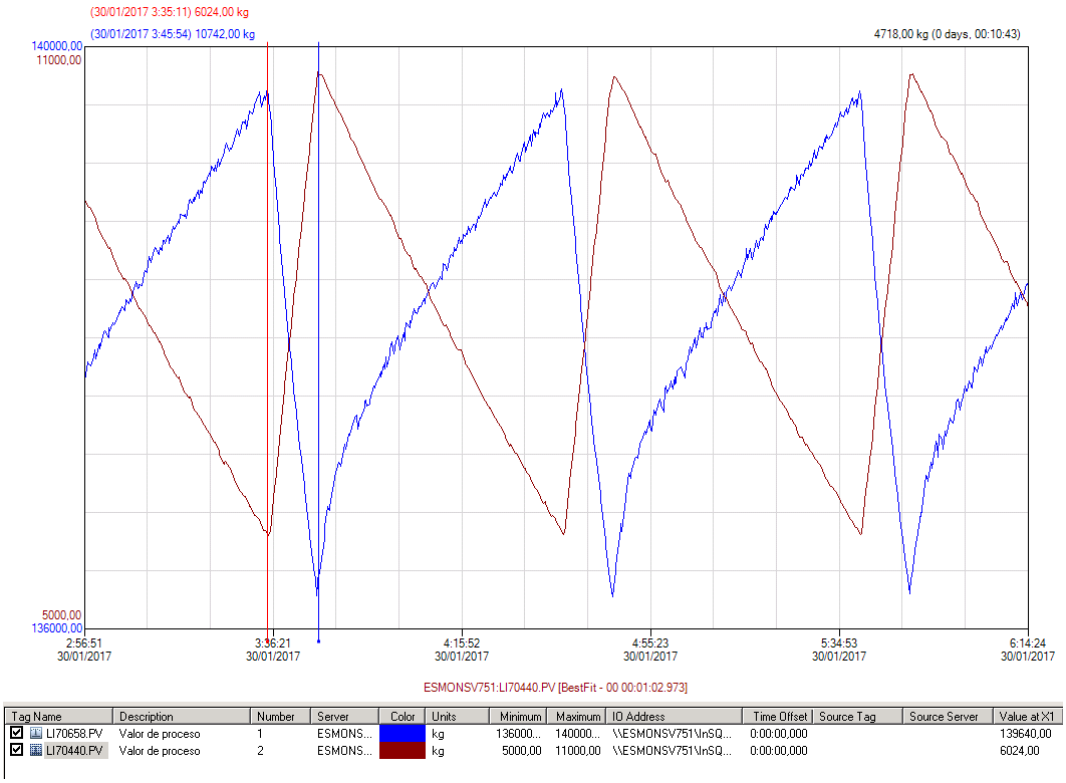

Fig. 7.2. Vessels 74-75 in blue line filling the vessel 19 in red line. 10 minutes is the time of charging the vessel 19.

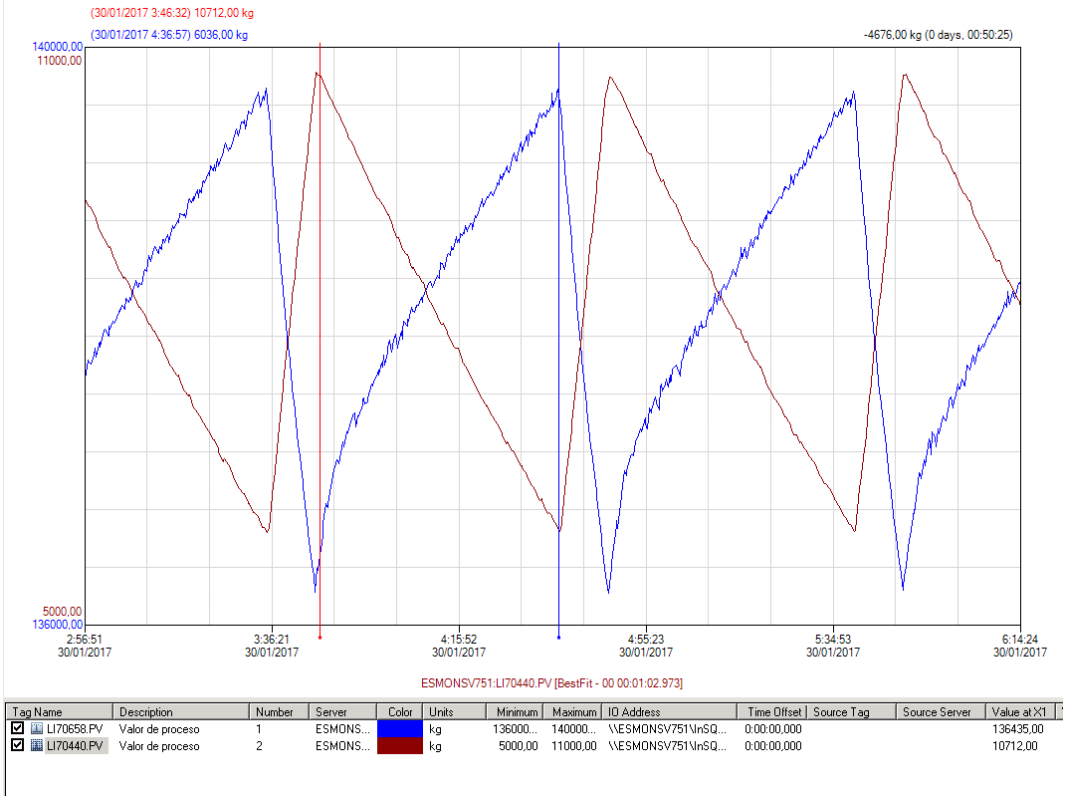

Fig. 7.3. Vessels 74-75 in blue line filling the vessel 19 in red line. 50 minutes is the time of discharging the vessel 19.

7.2.2 Consumption ring

The vessels 15 and 16 send demineralized water by using the pump 70-P-31 to the production building and all the water returns to the vessels. This pump has a frequency shifter which allows to make the transport of water at two different flow rates. In this situation of non-consumption, the pump works at 35 Hz giving an output flow rate of 30 m3/h and showing on the control screen LOW VELOCITY.

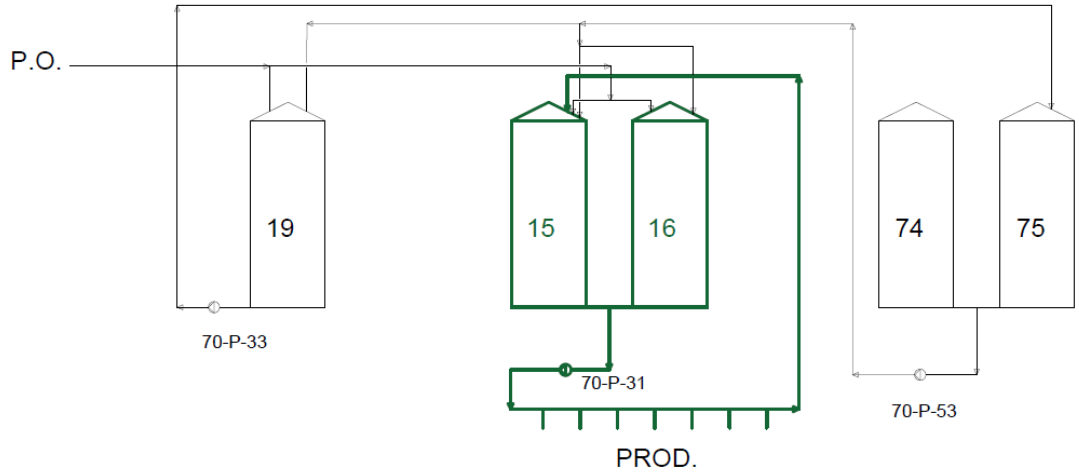

Fig. 7.4. Consumption ring drawing

7.3. Case 2

Consumption situation.

It is considered that water is being used when one of the automatic valves is open, including direct inlet to mixers, inlet to cleaning system of mixers, manual consumption points or the quality control laboratory. In the case of the manual consumption points, the manual valves have a position detector that when detects the open position of the manual valve gives the order to open to the automatic valve.

If there is any demand of consumption, the frequency changes to 50 Hz giving an output range of 55 m3/h showing on the control screen HIGH VELOCITY. It does not turn into high speed if the consumption is for the inlet of the filling collector.

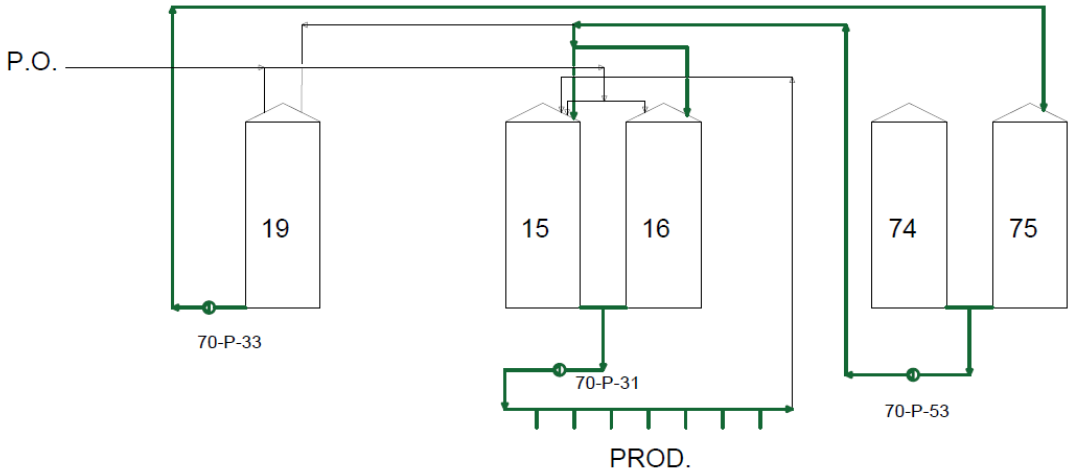

Fig. 7.5, Vessels 74-75 filling at the same time vessels 15-16 and 19

When there is direct filling to a mixer or to the cleaning system of a mixer and with the objective of increasing the pressure and the flow rate, there is an automatic valve on the return pipe to the vessels that is normally opened and closes when the consumption point is opened. In this configuration, the flow rate is 55 m3/h. This setting only applies for the demand of the mixers. In the other cases, the manual consumption and the quality control laboratory is not needed this increase of pressure and flow rate.

This valve has the closing movement regulated to make it slowly in order to avoid water hammer by giving less air to make the movement of closing to the valve that should be necessary.

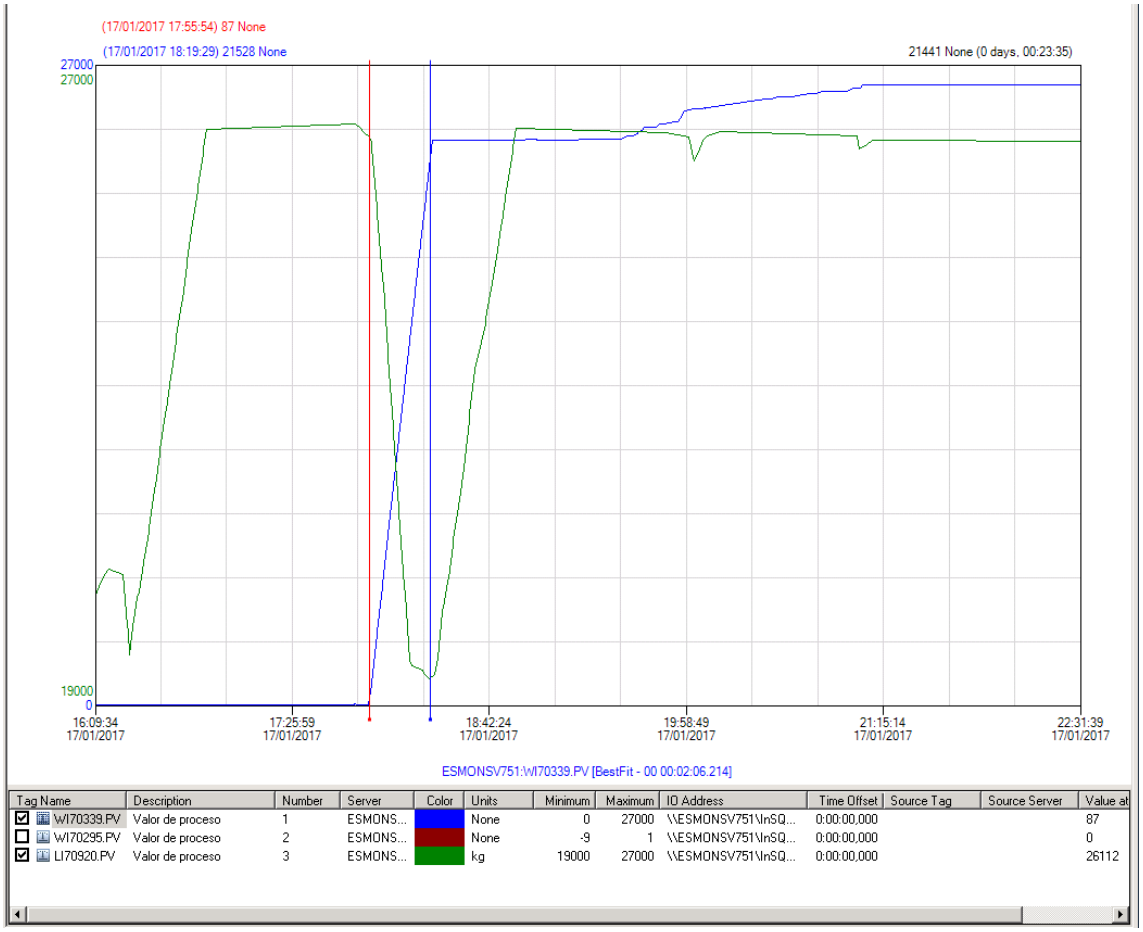

Fig. 7.6. In blue, a mixer is filled, in green, vessels 15-16 are discharging. Both flow rates are 55 m3/h.

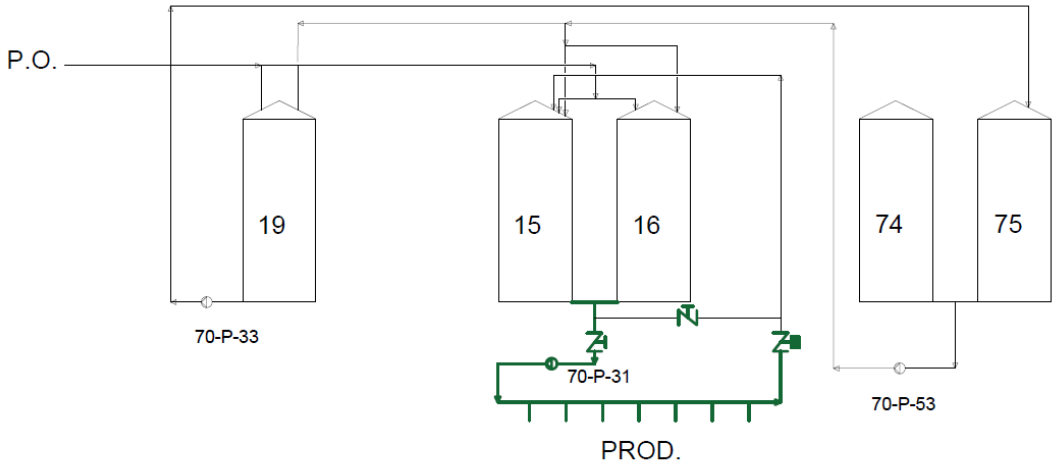

Fig. 7.7. Location of return valves.

7.3.1 Quality control laboratory

The water inlet comes from an automatic valve on the ring but the consumption point is a tap. To manage an automatic valve with a manual tap is used the pressure inside the pipe from the automatic valve to the manual tap.

When the tap is opened and the automatic valve is still closed, the pressure is close to 0 bar because is almost empty. When the pressure sensor detects the drop-in pressure, the program opens the automatic valve filling the pipe reaching a work pressure until the manual tap is closed. When the manual tap is closed, the automatic valve is still opened the pressure increases inside the pipe to a new higher pressure. When the pressure sensor reads this second and high pressure, the program closes the automatic valve.

Fig. 7.8. Pressure detector

7.4. Filling consumption ring from storage ring

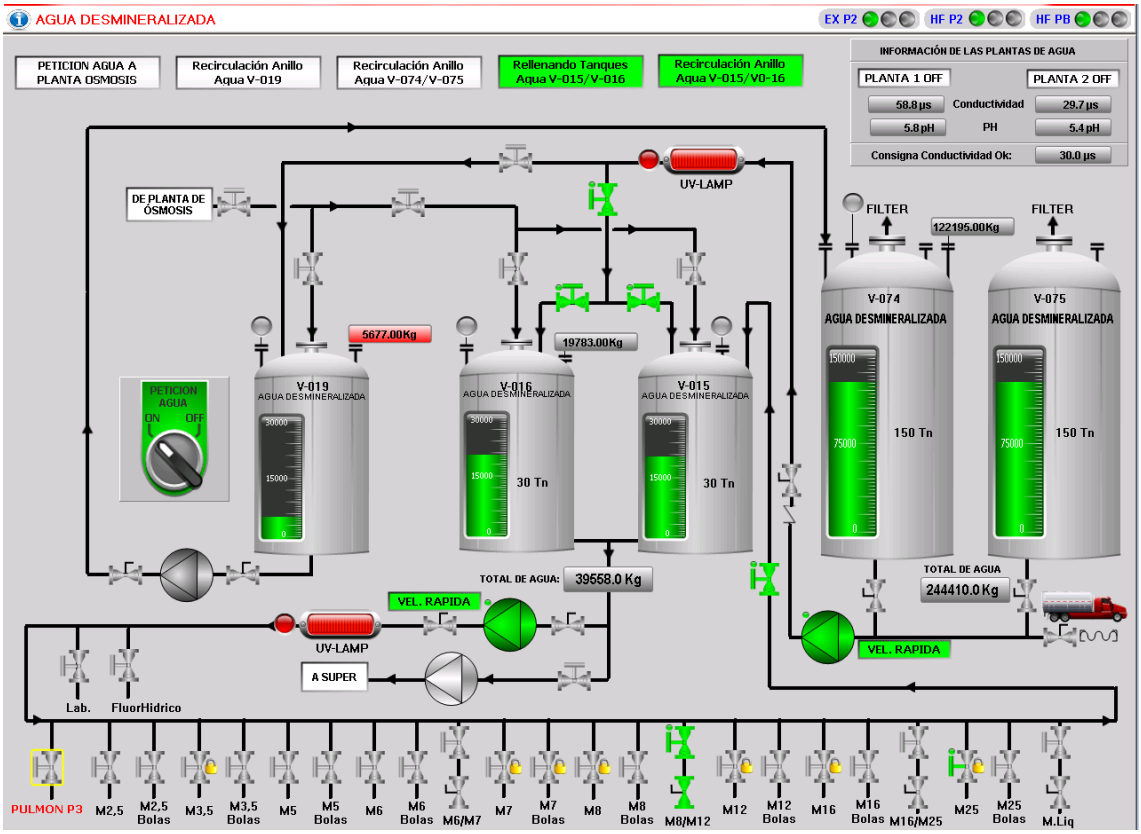

Fig. 7.9. Loading consumption ring from storage ring

In this configuration, the vessels 15-16 lose the maximum level (LAH=20.000) and activate demand to the vessels 74-75. These vessels start to fill the vessels 15-16 while still filling the vessel 19 until vessels 15-16 reach the very high level (LAHH=26.000).

If the vessels 15-16 lose the minimum level (LAL=16.000) the fast demand would activate putting the pump 70-P-53 at 50 Hz making an output flow rate of 50 m3/h and only filling the vessels 15-16 until they reach the very high level (LAHH=26.000).

In the Fig.7.10, is shown how the level of the vessels 15-16 (blue line) lose the maximum (LAH =20.000) and then the vessel 19 (green line) stops to be filled from the vessels 74-75 (red line) because are filling only vessels 15-16.

Is possible to see how the vessels 15-16 take about 40 minutes to recover the very high level (LAHH=26.000) at which point the vessels 74-75 start to fill vessel 19 again.

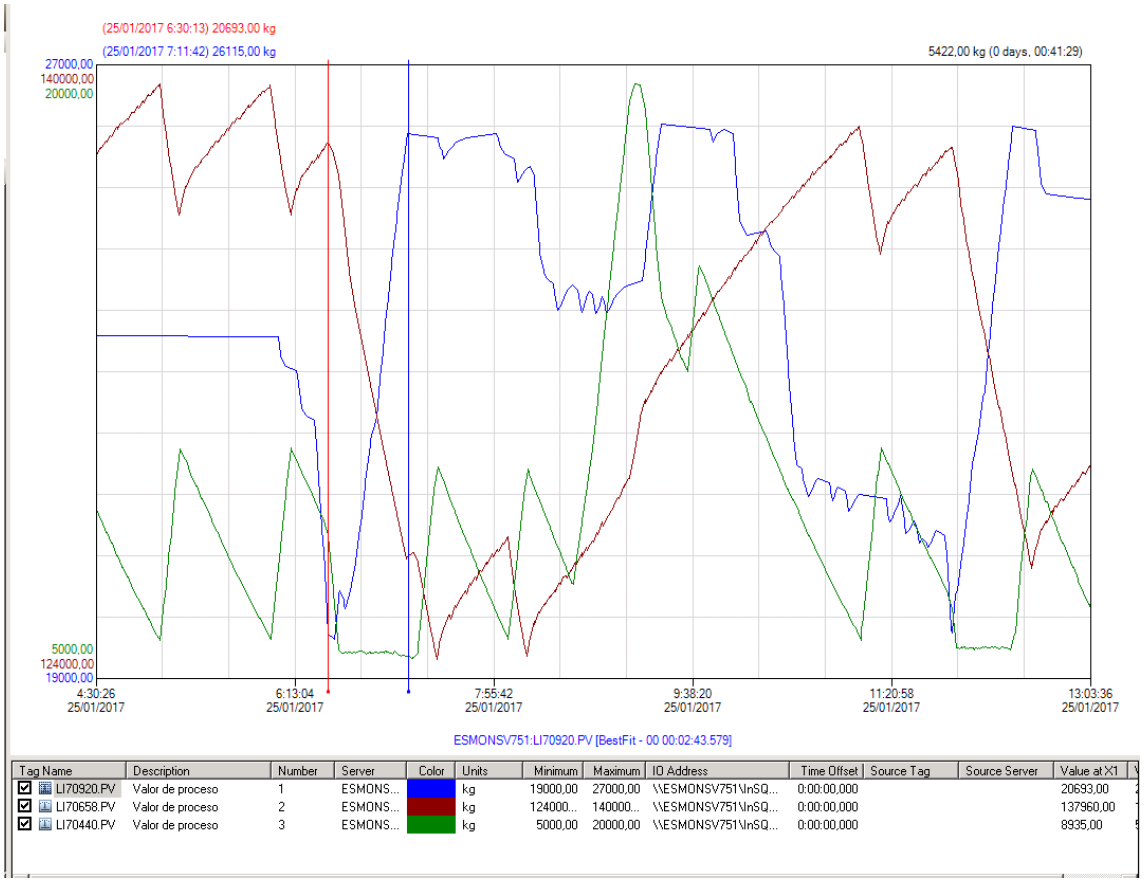

Fig. 7.10. Evolution of levels while filling consumption ring from storage ring

7.5. Filling storage ring from osmosis plant.

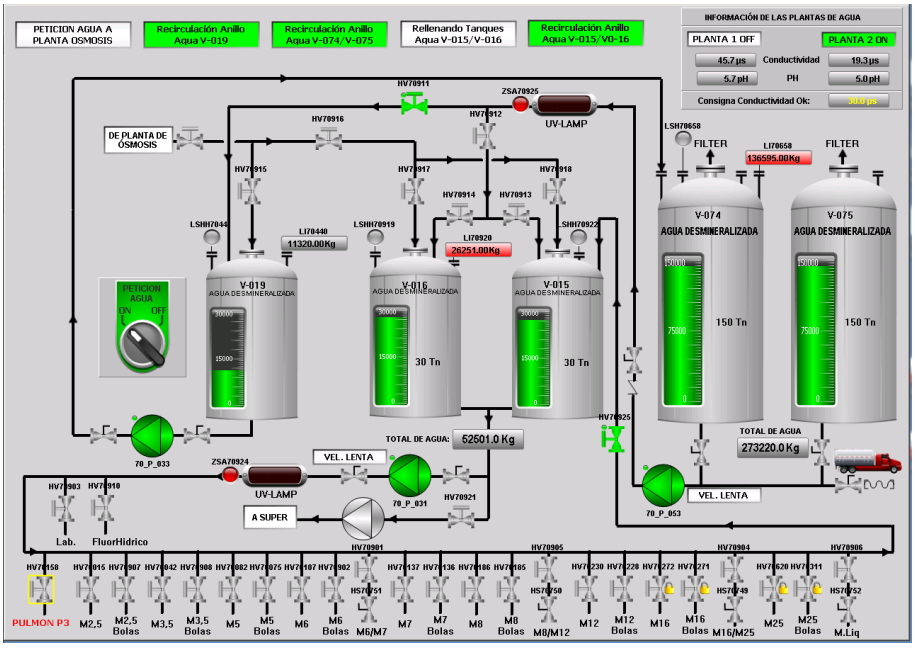

Fig. 7.11. Case of non-consumption with full vessels 74-75

The request selector to osmosis plant is in ON position but there is no reception of water because the vessels 74-75 are above the maximum (LAH). If the vessels 74-75 are below the maximum level, the osmosis plant starts to fill the ring.

This selector can be manipulated only by the plant engineers, the maintenance managers and production managers

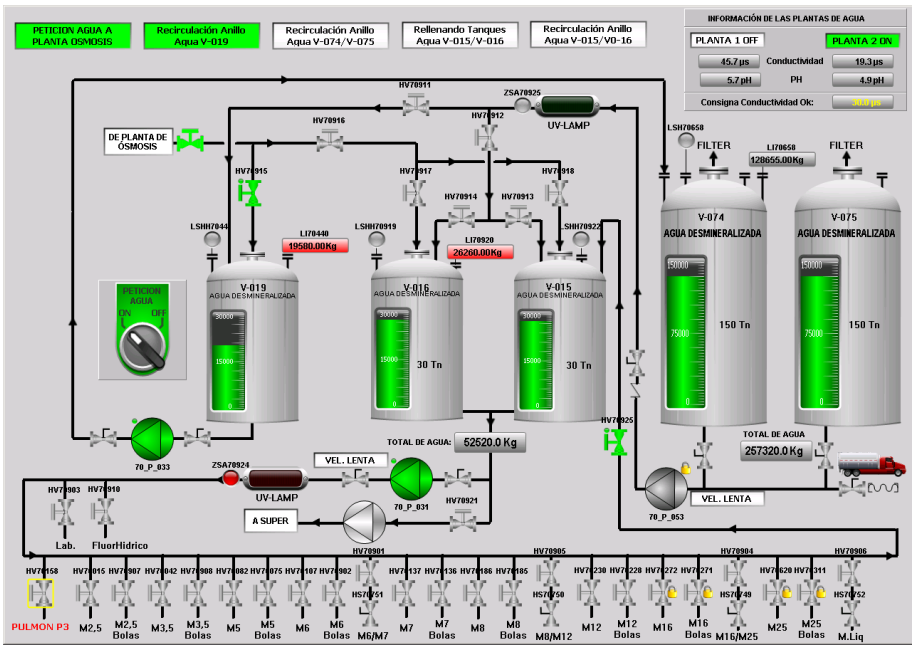

Fig. 7.12. Case of non-consumption without full vessels 74-75

7.6. Boiler

The boiler has an irregular consumption which depends on the season of the year. The boiler feed is made through pumps belonging to the installation of the boiler and not to the water supply installation. This pumps can be feed from the water vessels of another section of the factory or from the vessel 19.

If the pumps do not demand, all feeds are closed using automatic valves. When the demand is activated, the valve HV70926 from the vessel 19 opens whenever the tank has a volume of more than LALL=3.000 liters.

If the demand is activated but the vessel 19 has less than the very minimum level, the valve HV70926 keeps closed and opens the valves from the other section whenever the vessels from the other section have enough level of water.

If all the vessels have not enough level of water to feed the boiler, all the valves keeps closed and the boiler turns off.

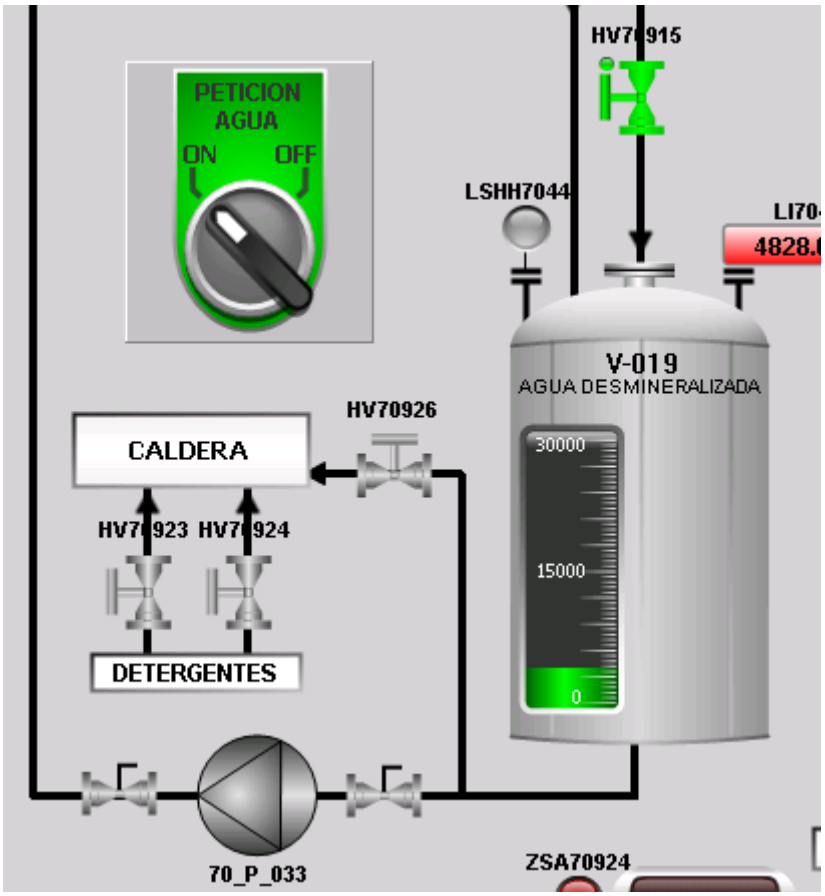

Fig. 7.13. Connections to the boiler

7.7. Filling collector

The connection to filling collector is made through an steam exchanger. From the consumption ring arrives water to the exchanger using the valve HV70825 when a cleaning operation is activated on the collector. This kind of consumption do not activate the high velocity for the pump of the ring.

The output from the exchanger to the collector has a temperature transmitter that allows to know the temperature at which water enters the filling collector.

When a cleaning operation is activated in the filling collector, the valve of the line selected for the cleaning opens and then opens the valve from the water ring and the valve from the steam pipe.

If the temperature reaches 60ºC steam valve closes for not keeping heating the pipe.

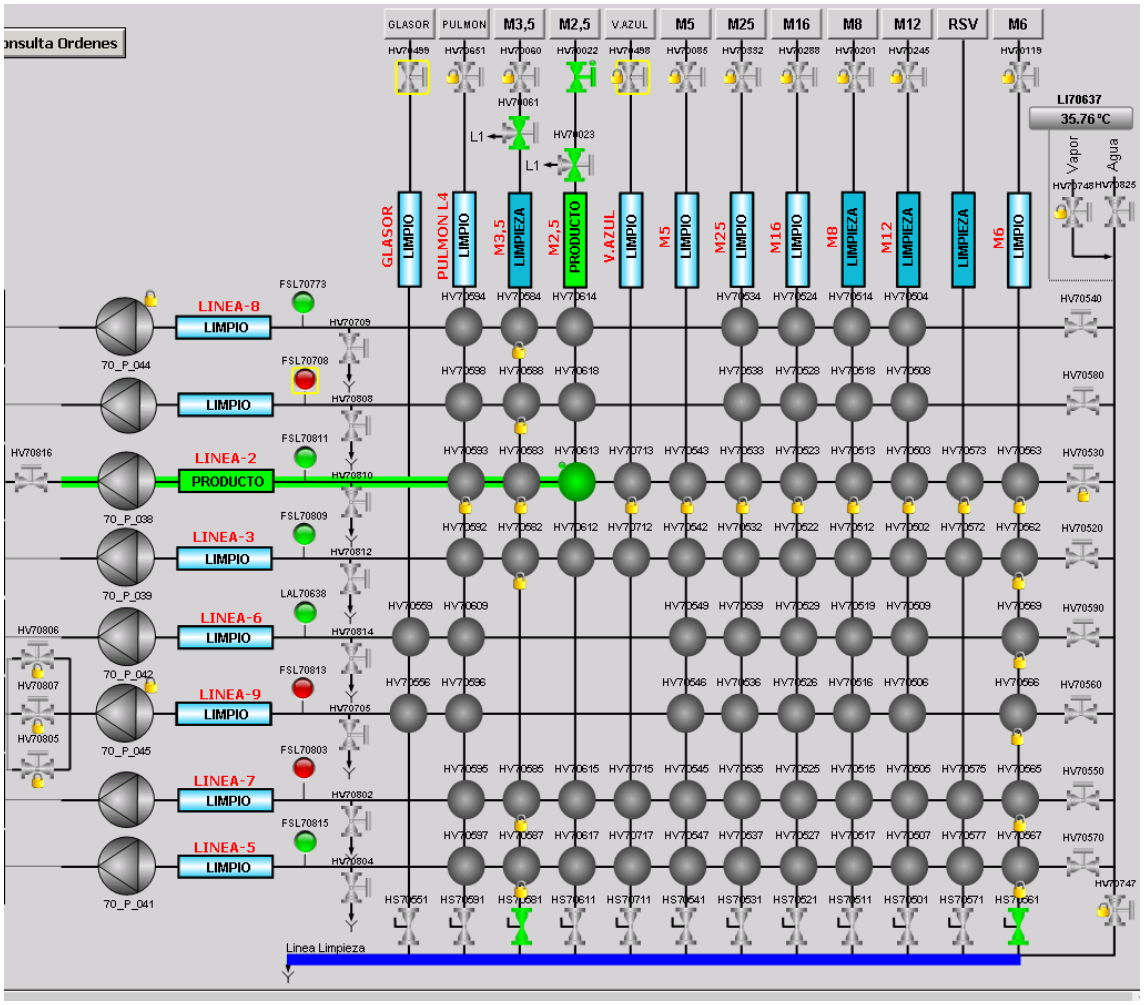

Fig. 7.14. Filling collector

7.7.1 Improvement of the cleaning operations in filling collector

The maneuver of cleaning is:

1. Demand of cleaning one line.
2. If there is not another cleaning running follows this list. If there is one activated before, must wait until finishes.
3. Open valve of selected line
4. Open valve of water inlet from the exchanger (HV-70825)
5. Open steam valve (HV-70748)
6. Every line has a time of cleaning that is being readjusted because the conditions of cleaning are different: the water enters hotter and with a higher pressure and flow rate.

Line	Time of cleaning before new installation	Time of cleaning with new installation
Line 2	8′	7′
Line 3	12′	10′
Line 4	10′	8′
Line 5	2′	2′
Line 6	10′	8′
Line 7	8′	7′
Line 8	12′	10′
Line 9	5′	5′

Table 7.4: Time of cleaning filling lines before and after the implementation of the project.

7. When the time is done, the valve HV-70825 and the valve HV-70748 closes.
8. Opens the valve of emptying the line that has been cleaned.
9. Opens the valve HV-70747 to make an air inlet and making easier to drain the line.
10. The drain ends when de FSL of the line detects that the line is empty and all valves closes.
11. If the FSL do not detect the line empty, the drain finishes at 10 minutes.

8. Interlock diagram

Software PLC ON/OPEN = 1
Software PLC OFF/SHUT = 0

Hardware ON/OPEN = 3
Hardware OFF/SHUT = 4

Loop -Condition							Actuator Valve/ Motor drive	Pump from V-015&V-016 to producti	Pump from V-019 to V-074&V-075	Pump from V-074&V-075 to V-019 o	Pump from V-015&V-016 to WBA	Valve to WBA	Valve from OP to tank V-019	Valve from OP to tank V-016	Valve from V-074&V-075 to V015&V	Valve from V-074&V-075 to V019	Steam valve	Emptying valve	Valve to boiler		Alarm: low level	Alarm: high level	Alarm: safety level	Alarm: No water - POP-UP	Alarm: Bad conductivity - POP-UP				
							TAG	70-P-31	70-P-33	70-P-53	70-P-32	HV-70921	HV-70915	HV-70916	HV-70912	HV-70911	HV-70748	HV-70747	HV-70926	PRIORITY	Alarms								
			Indication																										
TAG	Criterion	Location	local	control cabinet	safety relevant	Logic																							
Demineralized water																													
LSHH70441	LSHH	TANK V019		X																**250**		X						
LT-70440	LAHH	TANK V019		X																**500**		X						
	LALL	TANK V019		X					0										0	**250**	X							
LSHH70919	LSHH	TANK V016		X																**500**		X						
LT-70920	LAHH	TANK V016		X																**500**		X						
	LAL	TANK V016		X																**250**	X							
	LALL	TANK V016		X				0				0								**1**	X							
LSHH70922	LSHH	TANK V015		X																**500**		X						
LSHH70658	LSHH	TANK V074		X					0											**250**		X						
LT-70658	LAHH	TANK V074		X																**500**		X						
	LALL	TANK V074		X						0										**1**	X			X				
HV-70921	NOT OPEN	WBA		X							0																	
HV-70825	NOT OPEN	MANIFOLD		X													0											
HS-70551	OPEN	MANIFOLD		X														0										
HS-70591	OPEN	MANIFOLD		X														0										
HS-70581	OPEN	MANIFOLD		X														0										
HS-70611	OPEN	MANIFOLD		X														0										
HS-70711	OPEN	MANIFOLD		X														0										
HS-70541	OPEN	MANIFOLD		X														0										
HS-70531	OPEN	MANIFOLD		X														0										
HS-70521	OPEN	MANIFOLD		X														0										
HS-70511	OPEN	MANIFOLD		X														0										
HS-70501	OPEN	MANIFOLD		X														0										
HS-70571	OPEN	MANIFOLD		X														0										
HS-70561	OPEN	MANIFOLD		X														0										
LI70637	LAHH	MANIFOLD		X													0			**500**		X						
HV-70825	NOT CLOSE	MANIFOLD		X														0										

		Date	Name	Remarks	**Interlocking Sheet**
Henkel	A	14/03/2017	Oriol	Checked with production and developers	Demineralized Water
	B				page 1 Project MPT
	C				
	D				

9. Implementation

Id	Nombre de tarea	Duración	Comienzo	Fin	Predecesoras
1	**Project concept**	**11 días**	**jue 01/09/16**	**jue 15/09/16**	
2	Proccess description & basic parameters	10 días	jue 01/09/16	mié 14/09/16	
3	**Basic Engineering**	**25 días**	**vie 16/09/16**	**jue 20/10/16**	**1**
4	Layout	10 días	vie 16/09/16	jue 29/09/16	
5	Functional description	10 días	vie 30/09/16	jue 13/10/16	
6	Project organization	5 días	vie 14/10/16	jue 20/10/16	
7	Timing	5 días	vie 14/10/16	jue 20/10/16	
8	**Detailed Egnineering**	**50 días**	**lun 24/10/16**	**vie 30/12/16**	**3**
9	P&ID	5 días	lun 24/10/16	vie 28/10/16	
10	Commercial offers	5 días	vie 28/10/16	vie 04/11/16	
11	Equipment purchase	5 días	vie 04/11/16	vie 11/11/16	
12	Material delivery	15 días	vie 11/11/16	vie 02/12/16	
13	Installation	20 días	vie 02/12/16	vie 30/12/16	
14	**Production trials**	**5 días**	**lun 02/01/17**	**vie 06/01/17**	**8**
15	SAT	3 días	lun 02/01/17	mié 04/01/17	
16	FAT	2 días	jue 05/01/17	vie 06/01/17	
17	Start-up	4.88 días	vie 06/01/17	vie 13/01/17	14
18	Transfer	15 días	vie 13/01/17	vie 03/02/17	17

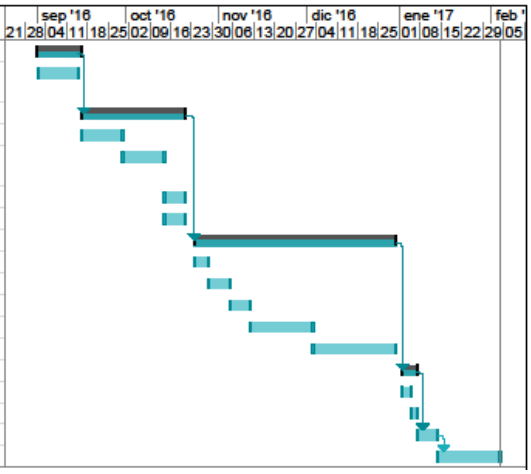

Fig. 8.1 Gant diagram for the implementation of the project

10.Environmental impact

The installation of the demineralized water ring for consumption and for storage has a positive environmental impact on the company and the environment because not only can increase the quality of the water used but reduces the quantity used because, as explained above, the water used for cleaning the mixers after every batch can be recovered and reused.

Not only the water quality is higher but also comes to consumption points to a higher pressure and flow, especially to the filling collector where also arrives to a higher temperature. This, as seen before, allows to reduce the amount of water and the time of the cleaning process making right and checking part of the savings calculated on the justification of the project.

In addition, the use of UV lamps of medium frequency allows the company to stop using sodium chlorine for water treatment reducing a potential pollutant in the environment.

11.Conclusions and future

The aim of the project was to develop and implement a new installation for the transport of demineralized water in a chemical plant.

The facility is in operation at the Henkel Iberica Operations S.L.U. plant located in Montornes del Valles, and it makes winning the requirements set out in the definition of the project.

Although not enough time has passed to ensure that the savings per year calculated have been achieved but it can be said that the installation can be considered hygienic, has eliminated the use of sodium hypochlorite and has reduced the time and amount of water used in part of the operations.

As a project, can be considered a success as it has been implemented without affecting the productivity of the plant it has been implemented on dates coinciding with stops of production.

Future steps for this projects are:

- Defining periodic maintenance
- Defining inspections and certifications of quality.
- Review and check the savings estimated.

The first and second step must be done by correspondent departments but the third step is an engineering task that will be done after enough time to evaluate the savings.

12.References

In this part of the project there are no references because every information has been developed by the author or given by suppliers but never using internet sites or books.