LERIG 2019

NEXT-GEN

Next-Gen Technologies for Leather Sector: Approaches towards Industry 4.0.,
Central Leather Research Institute (CLRI), Chennai.

TANNERY WASTEWATER TREATMENT & MANAGEMENT

SILVANO STORTI,

CEO - EUROPROGETTI SRL.,

PADOVA, ITALY.

EUROPROGETTI S.R.L. recovery water technology

INNOVATION WATER TREATMENTS & RECOVERY SERVICES (P) LTD

EUROPROGETTI S.R.L.
recovery water technology

- Europrogetti S.r.l., is a company, which offers more than 30 years of design and management experience in water treatment plants. This experience has allowed us to update and develop best technological solutions in terms of process efficiency, cost management and choice of the equipment quality, offering plants with a reuse of the treated water of 98% in the production process up to the “Zero Discharge” plant.

- Europrogetti has a great experience in the purification from different sectors, such as tanning, textile, paper, food and chemical industry, slaughterhouses, beverages, etc.

- Our systems are able to treat volumes of wastewater from 50 to 300,000 m^3/day and adopt technological solutions studied for the specific production requirements and the various kinds of wastewater.

- Europrogetti can also offer a service of supervision and management of the installed systems, ensuring the maintenance of the management costs, quality and quantity of the treated water.

INNOVATION WATER TREATMENTS & RECOVERY SERVICES (P) LTD

- IWT & RS is a sister concern of Europrogetti S.r.l., Italy specially started for wastewater business in India.
- This company not only involves in installing new plants but also operates and maintains wastewater plants all over India.
- IWT & RS offers a full O & M service to ensure water quality and running cost control.

Our References

CONCERIA LEONICA	Lonigo - VI - Italy
Kind of industry	All round tanning
Flow	500 m^3/g
Kind of plant	Biological
CONCERIA AECO	S.M. Buonalbergo - VR - Italy
Kind of industry	All round tanning
Flow	700 m^3/g
Kind of plant	Biological
ANZOLIN	Grancona - VI - Italy
Kind of industry	leather dyeing
Flow	500 m^3/g
Kind of plant	Chemical physical
CONCERIA AGO	Lonigo - VI - Italy
Kind of industry	All round tanning
Flow	450 m^3/g
Kind of plant	Biological
CONCERIA FAEDA	Chiampo - VI - Italy
Kind of industry	All round tanning
Flow	300 m^3/g
Kind of plant	Biological
CONCERIA AGOSTI	Castelgomberto - VI - Italy
Kind of industry	Wet blue
Flow	100 m^3/g
Kind of plant	Biological

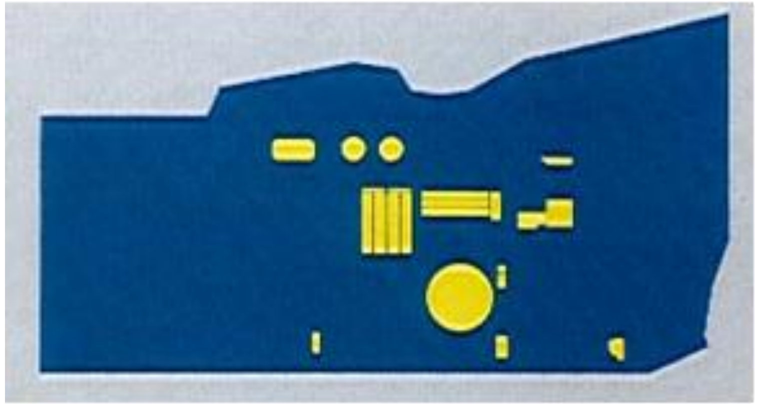
Our References

CONCERIA FABRIS	Vicenza - VI - Italy
Kind of industry	Fine tanning - wet blue
Flow	700 m^3/g
Kind of plant	Chemical physical + Biological
CONCERIA BASSANESE	Vicenza - VI - Italy
Kind of industry	All round tanning
Flow	800 m^3/g
Kind of plant	Chemical physical + Biological
CONCERIA ZONTA	Tezze s/Brenta - VI - Italy
Kind of industry	All round tanning
Flow	400 m^3/g
Kind of plant	Chemical physical + Biological
SCAMOSCERIA del BRENTA	Tezze s/Brenta - VI - Italy
Kind of industry	Wet blue
Flow	300 m^3/g
Kind of plant	Chemical physical + Biological
IGUALADA - Spain	Spain
Kind of industry	Mixed water from tannery + Civil water
Flow	25.000 m^3/g
Kind of plant	Design of the adjustment from chemical-physical to biological
MONTEBELLO	Montebello – VI - Italy
Kind of industry	Municipality plant
Kind of plant	Discontinuous consultation for upgrading
ARZIGNANO	Arzignano – VI - Italy
Kind of industry	Municipality plant
Kind of plant	Discontinuous consultation for upgrading

Arzignano

- In Italy, the environmental problems linked to the tanning industry have been chiefly tackled by the two biggest districts Arzignano and S.Croce, since the mid seventies.
- In particular, the Arzignano district is well known in the world for its product quality which has around **500 tanneries** with an annual turnover of **25,000 crore rupees** and a daily wastewater discharge quantity of around **15,000 m^3**.
- The environmental impact of these tanneries have been know from 70s which in turn helped to undertand a long evolution of tannery wastewater treatment technology and management.

Arzignano

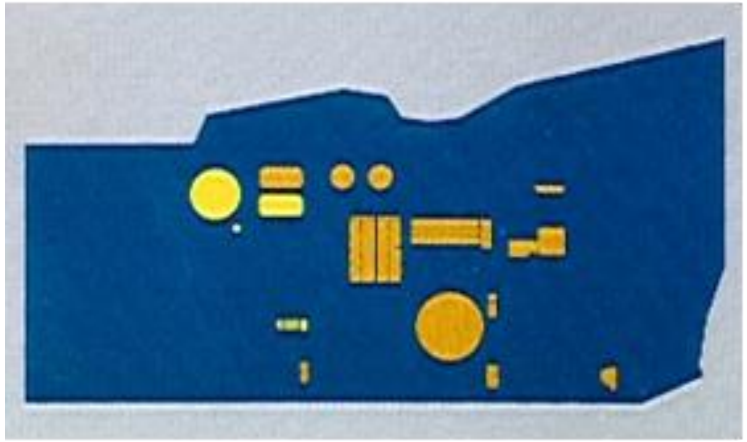


<u>1974:</u>

Homogenization stage with chemical-physical treatment

Investment = 3.000.000 $

Arzignano

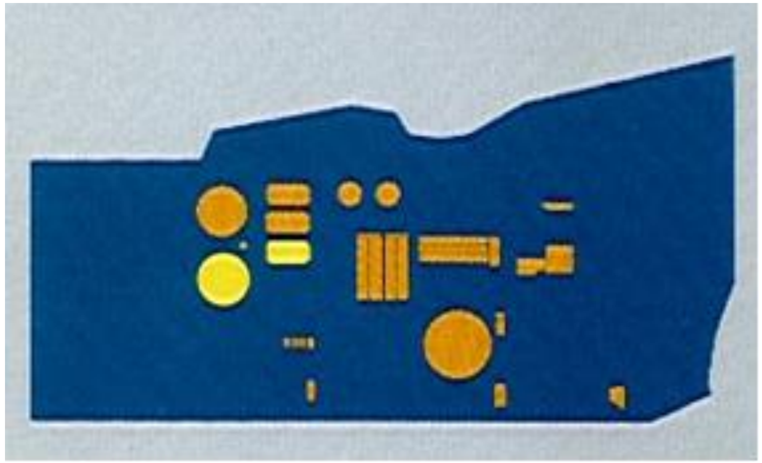


1976:

Addition of the first biological treatment to further lower the COD discharged from chemical-physical treatment

Investment = 2.500.000 $

Arzignano

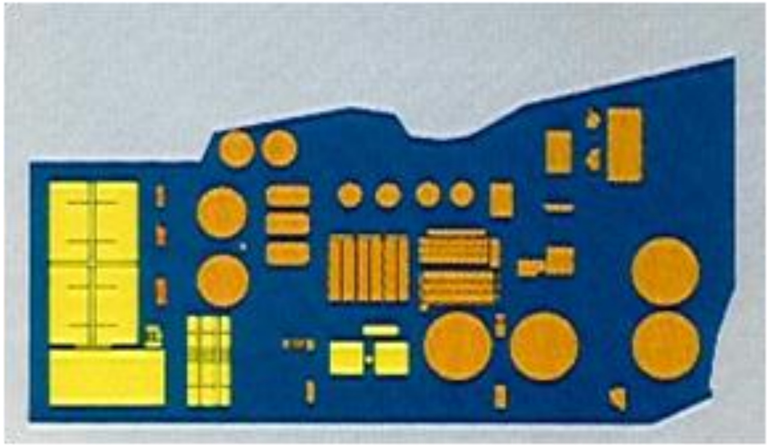


1978:

Further extension of the Biological stage, in particular the final sedimentation.

Again only to lower COD.

Arzignano

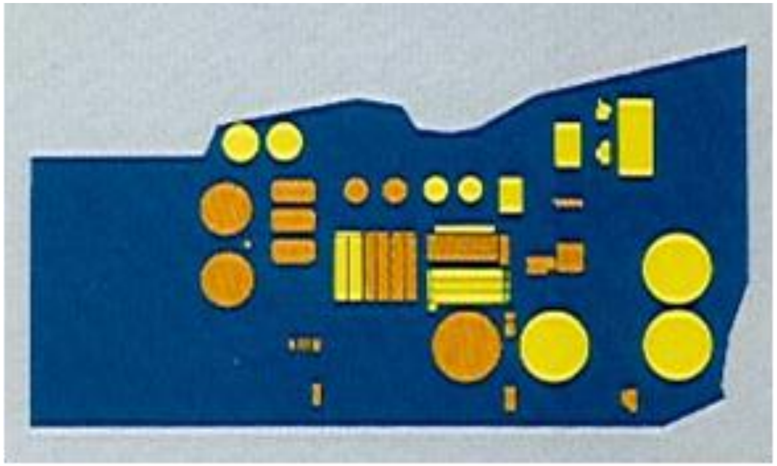


<u>1980:</u>

Extension of Homogenization stage, Chemical – Physical treatment stage and sludge treatment line.

Investment = 7.500.000 $

Arzignano

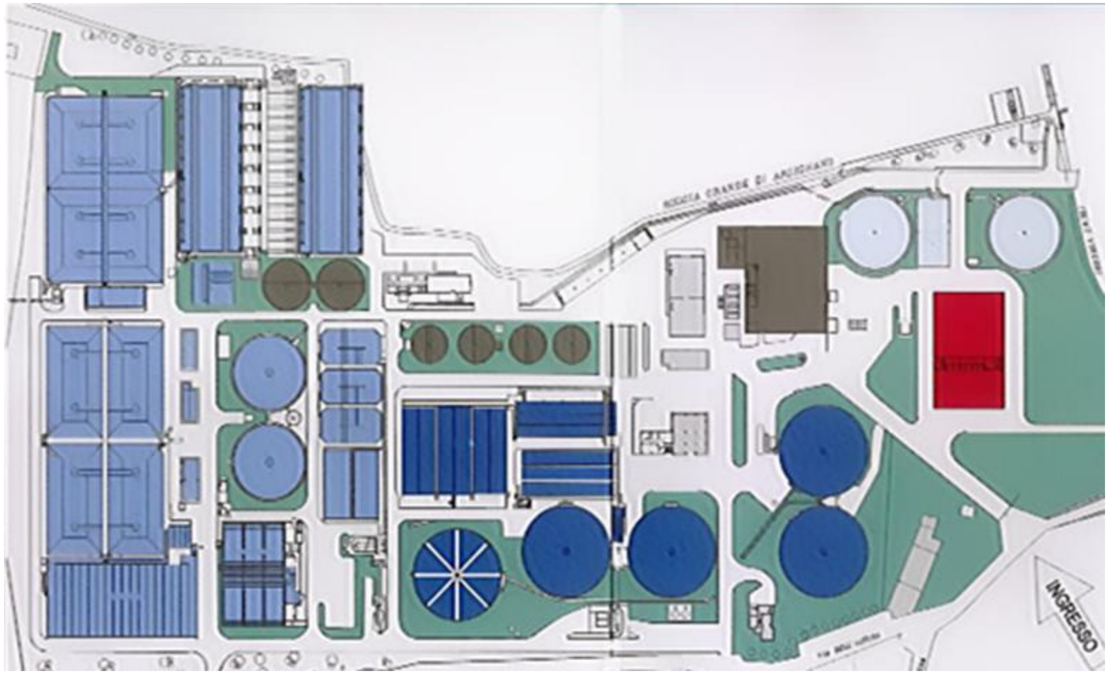


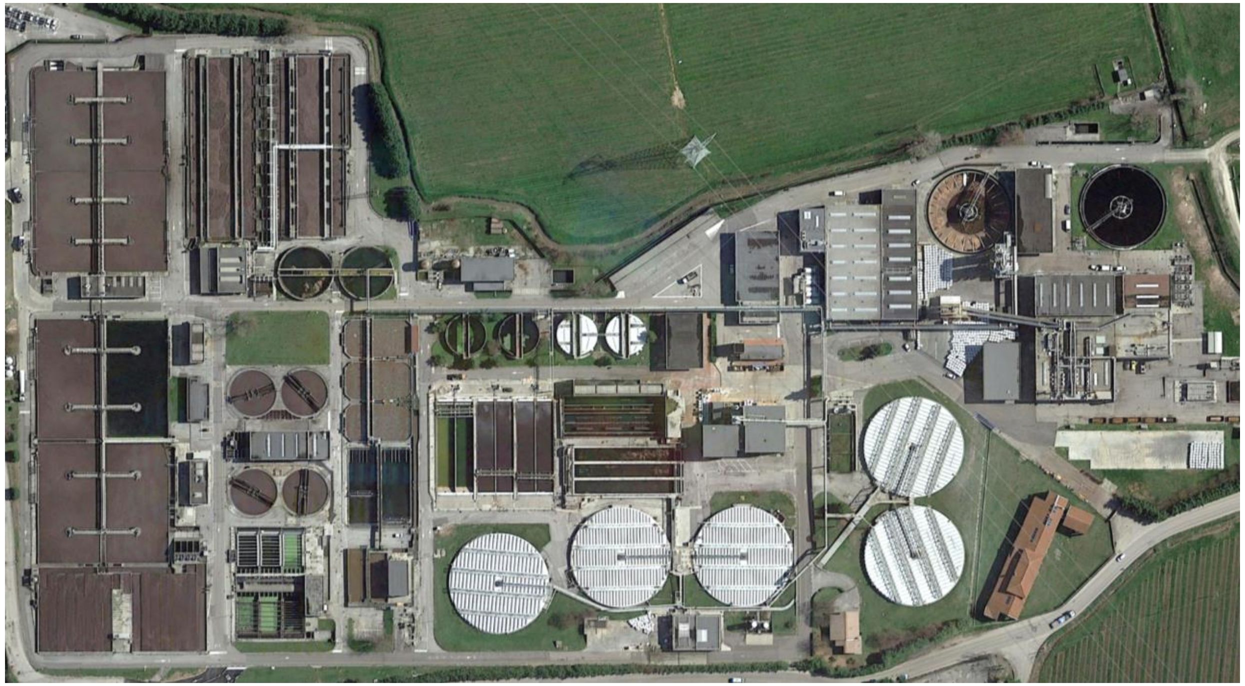
<u>1984:</u>

Extension of industrial biological line with separation of the industrial and domestic sewer water effluents, lowering of nitrate compounds (9000 m³ denitrification 28000 m³ nitrification) and final flotation instead of final sedimentation.

Investiment = 8.500.000 $

Arzignano – At present

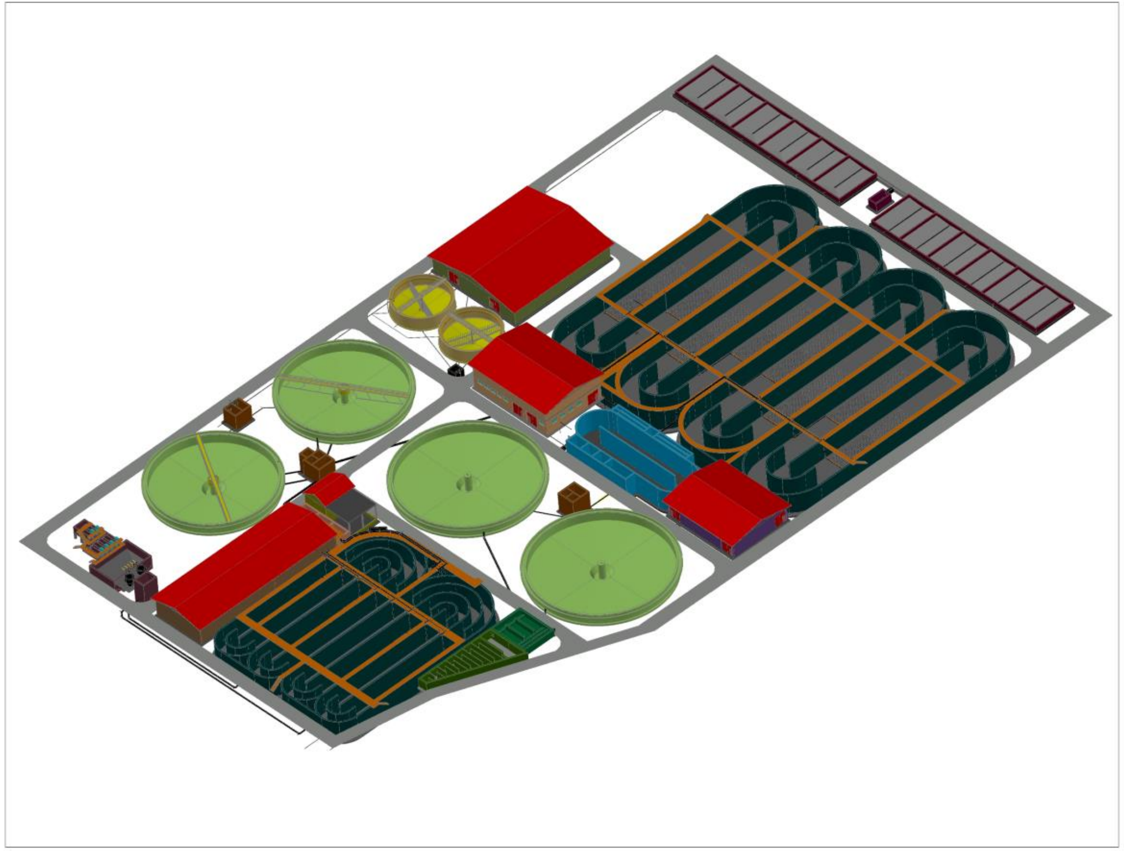


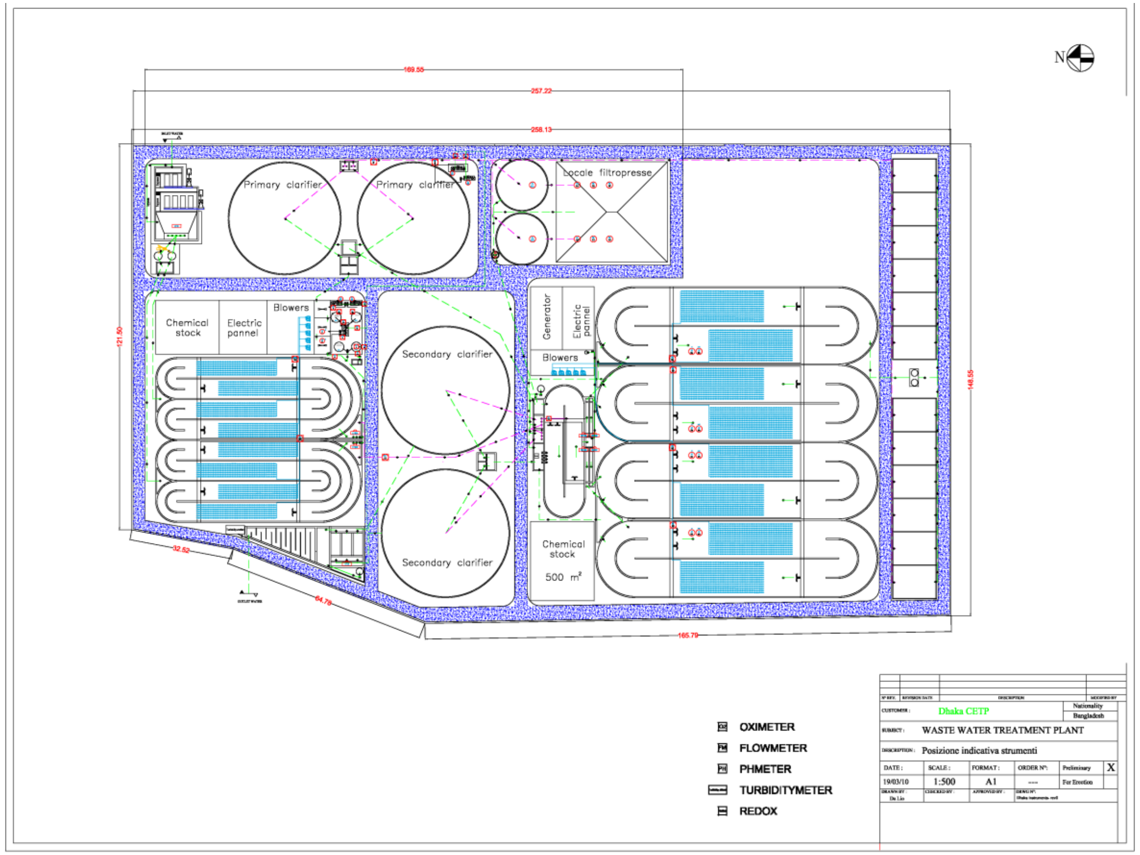


CETP Arzignano - average discharge parameters

PARAMETER	U.M.	INPUT VALUES	OUTPUT VALUES
PH		9-11	6.5 – 8.5
COD	mg/l	6,000 - 7,000	160 - 180
BOD_5	mg/l	3,000 – 3,500	40
SST	mg/l	3,500 - 4,000	40 - 60
TKN	mg/l	450 - 500	20 - 40
NH_4	mg/l	250 - 300	1 - 2
NO_2	mg/l		0.2
NO_3	mg/l		15
CHROMIUM VI	mg/l	ASS.	N.R.
CHROMIUM Tot.	mg/l	100 - 120	0.3 - 0.5
CHLORIDES *	mg/l	3,500	3,500
SULPHATES *	mg/l	2,000	2,000
SULPHIDE	mg/l	100 - 150	Trace
TENSIOACTIVES	mg/l	40 - 50	0.2
OILS AND GREASES	mg/l	150 - 200	10

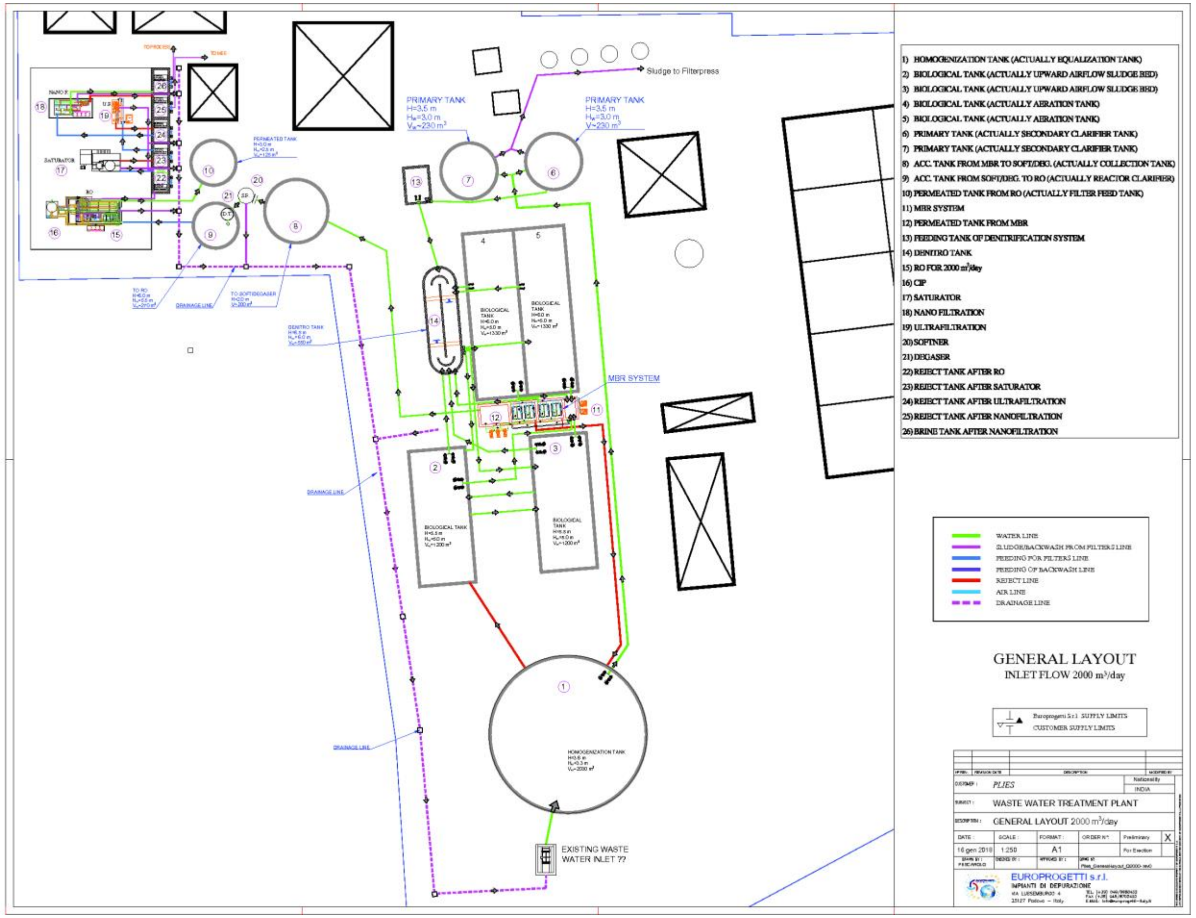
Dhaka



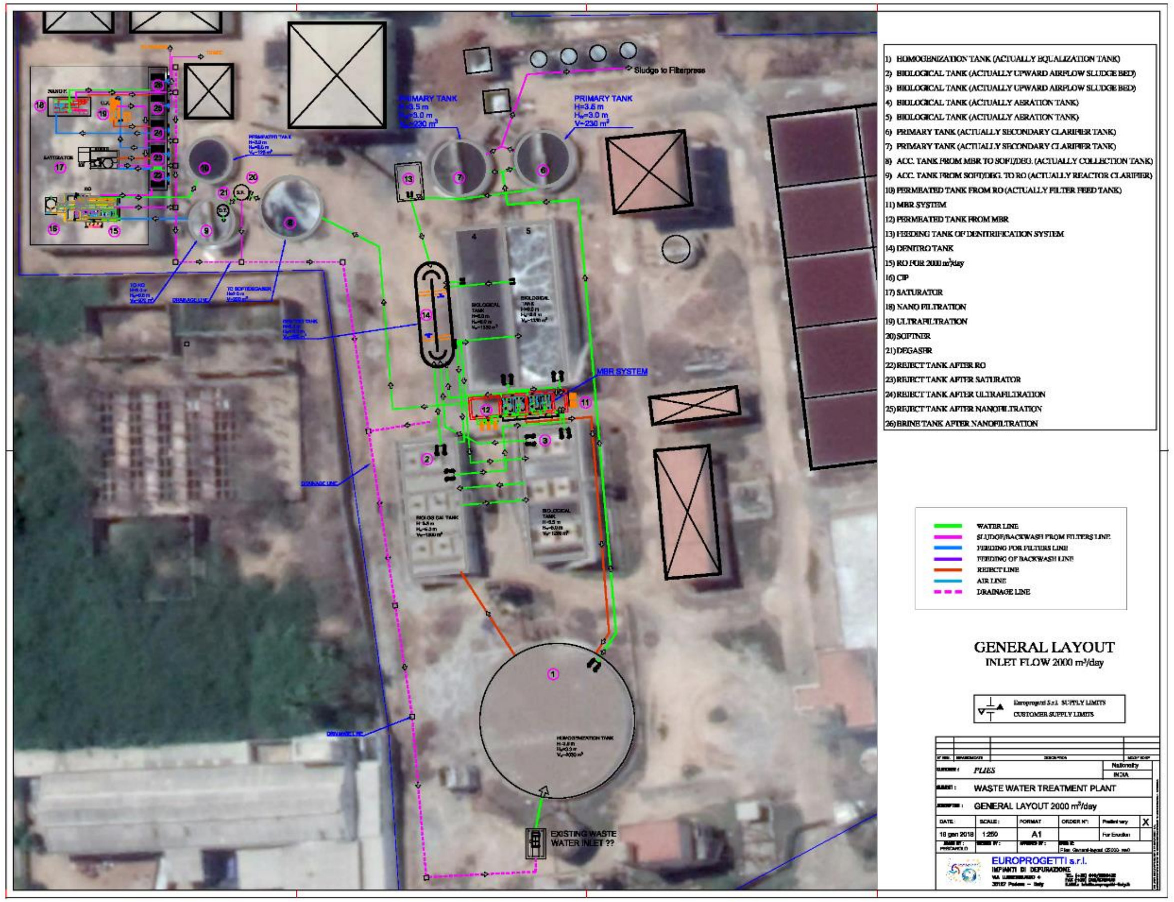


N
Primary clarifier
Primary clarifier
Locale filtropresse
Chemical stock
Electric pannel
Blowers
Secondary clarifier
Secondary clarifier
Generator
Electric pannel
Blowers
Chemical stock
500 m²
OXIMETER
FLOWMETER
PHMETER
TURBIDITYMETER
REDOX
CUSTOMER : Dhaka CETP
Nationality
Bangladesh
SUBJECT : WASTE WATER TREATMENT PLANT
DESCRIPTION : Posizione indicativa strumenti
DATE : 19/03/10
SCALE : 1:500
FORMAT : A1
ORDER N°: ---
Preliminary X
For Erection

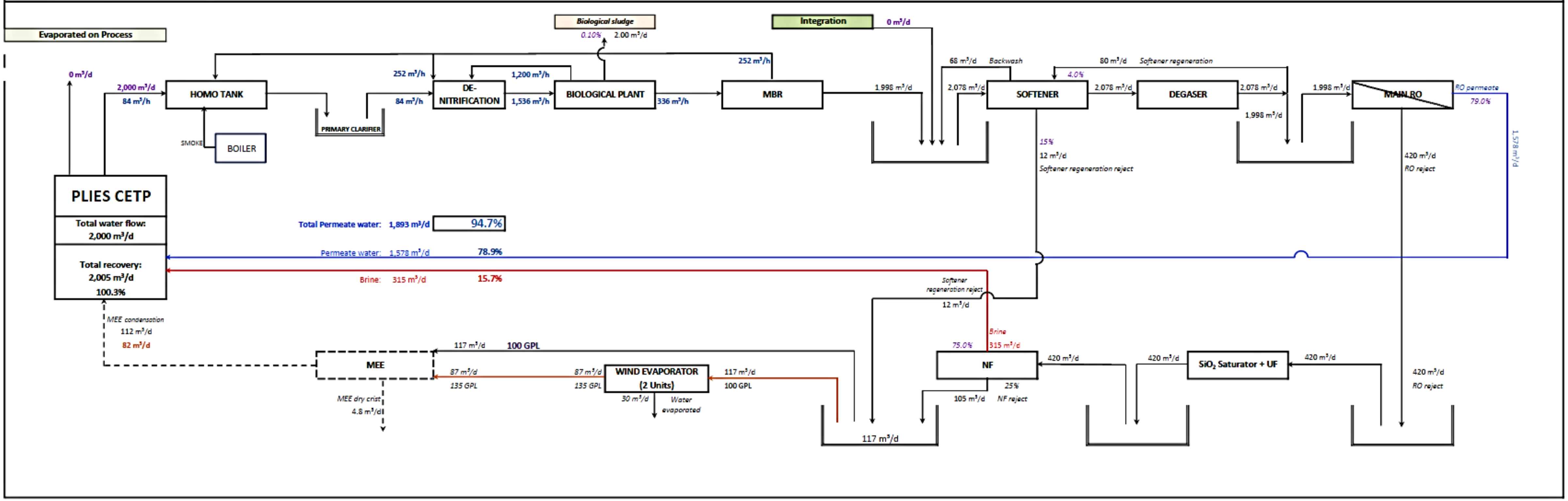
Layout for revamping



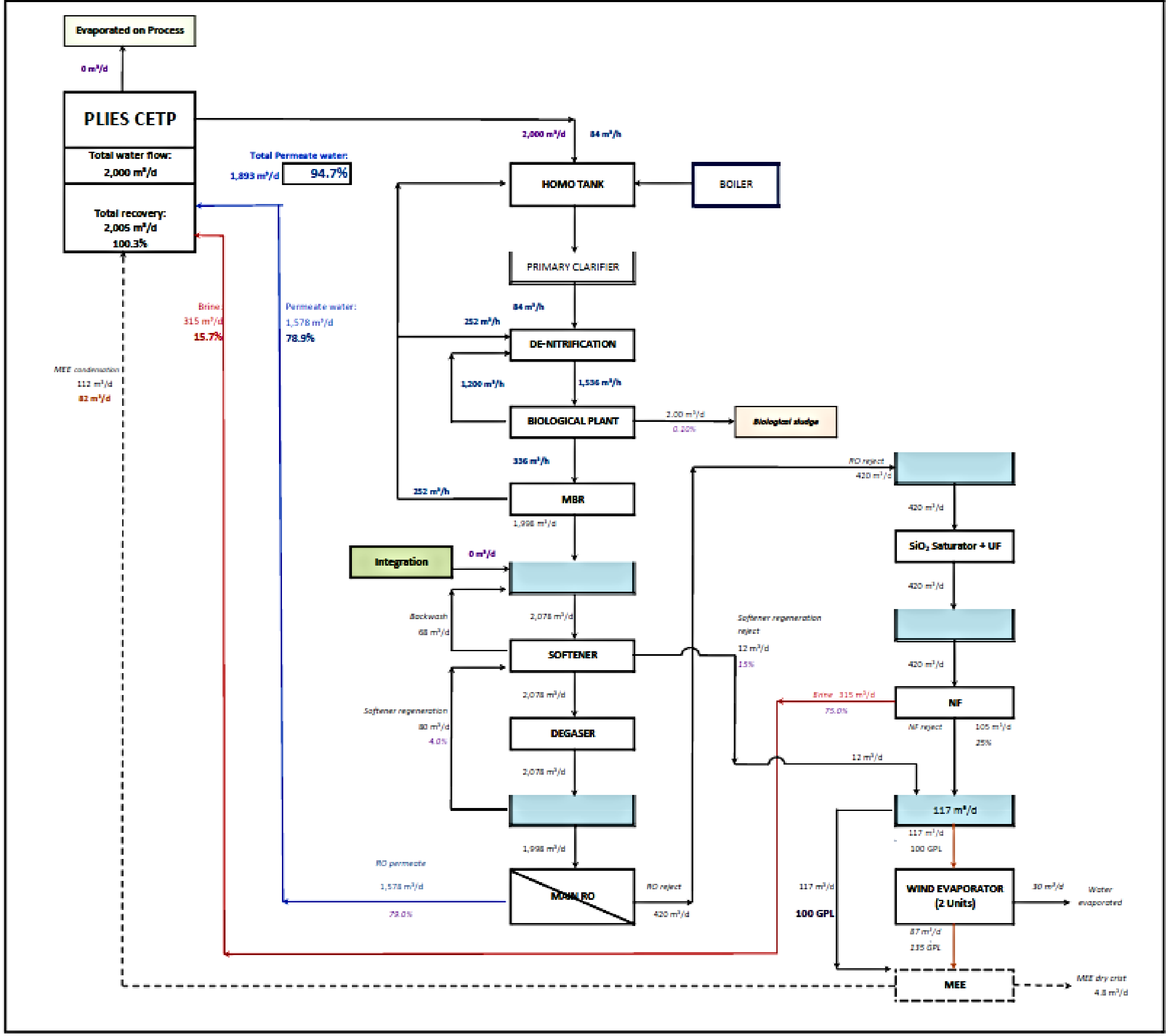
Layout for revamping



PLIES Q 2000 - ZLD plant flow scheme



PLIES Q 2000 - ZLD plant flow scheme



Screening

- Screening is the first unit operation used at wastewater treatment plants (WWTPs).

- Screening removes coarse and medium-fine solids to prevent damage and clogging of downstream equipment, piping, and accessories.

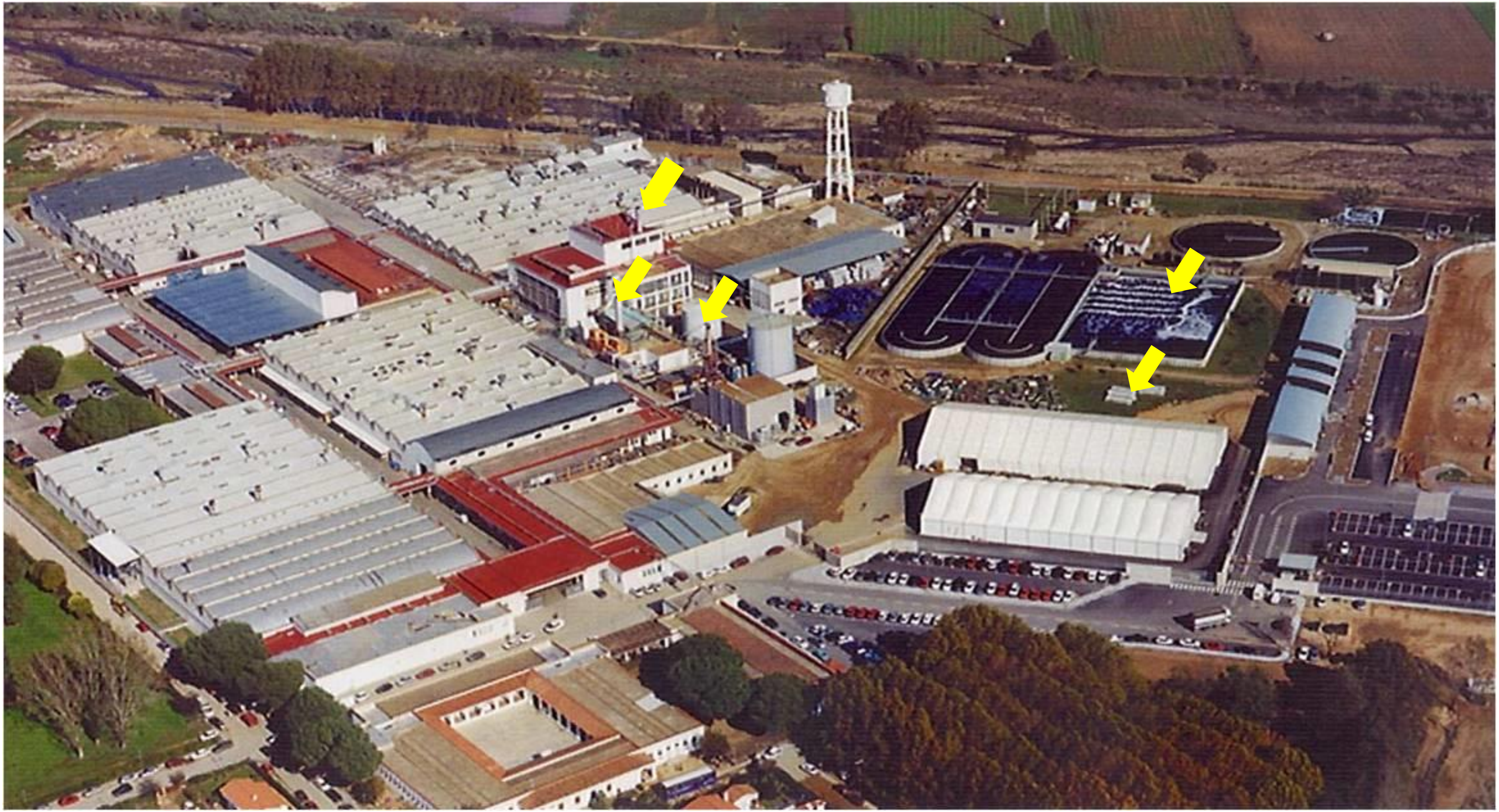
- Typical opening sizes for screens are 1.5 to 6 mm (0.06 to 0.25 in)

Neutralization with flue gas

- In the chimney's flue gas, produced by the combustion of natural gas, naphtha and gas oil, there is a 6 – 12% concentration of CO_2, which can be used for neutralization.

- In addition, the sulphur content in the flue gas combines with condensate to form dilute sulfuric acid which further helps neutralization.

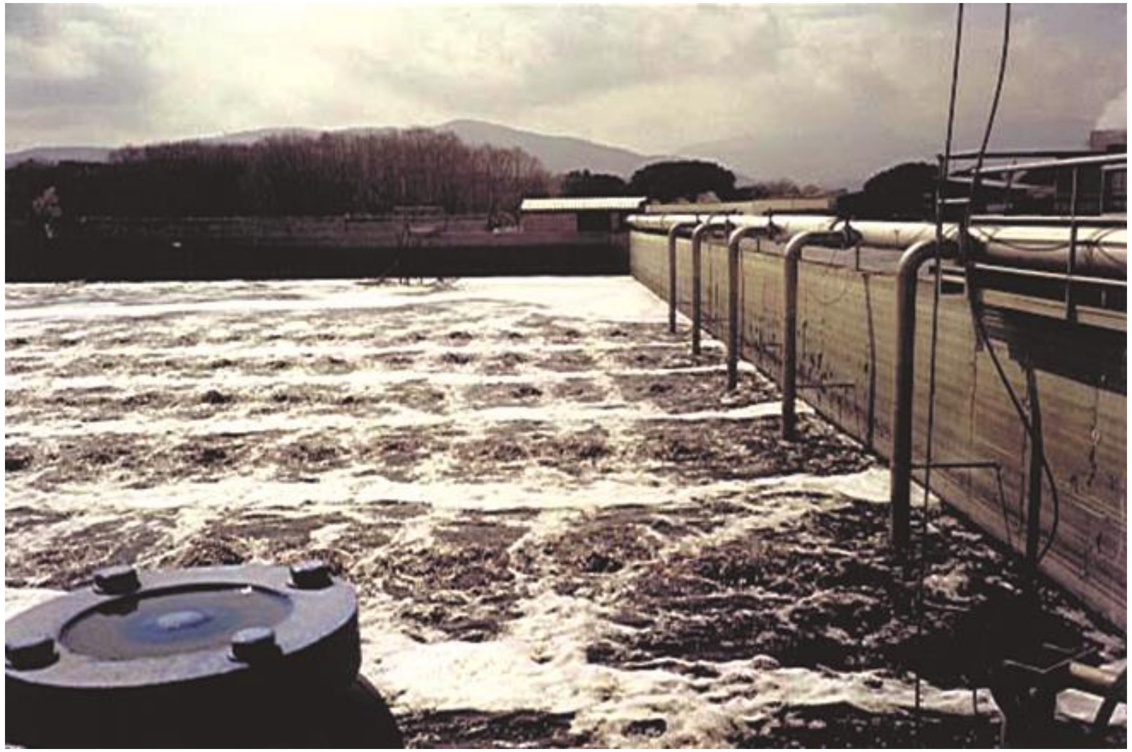
- When inlet pH is very high, the use of chimney smokes reduces a lot neutralization costs instead the use of sulphuric acid.



Neutralization with flue gas

The advantages of using flue gas are:

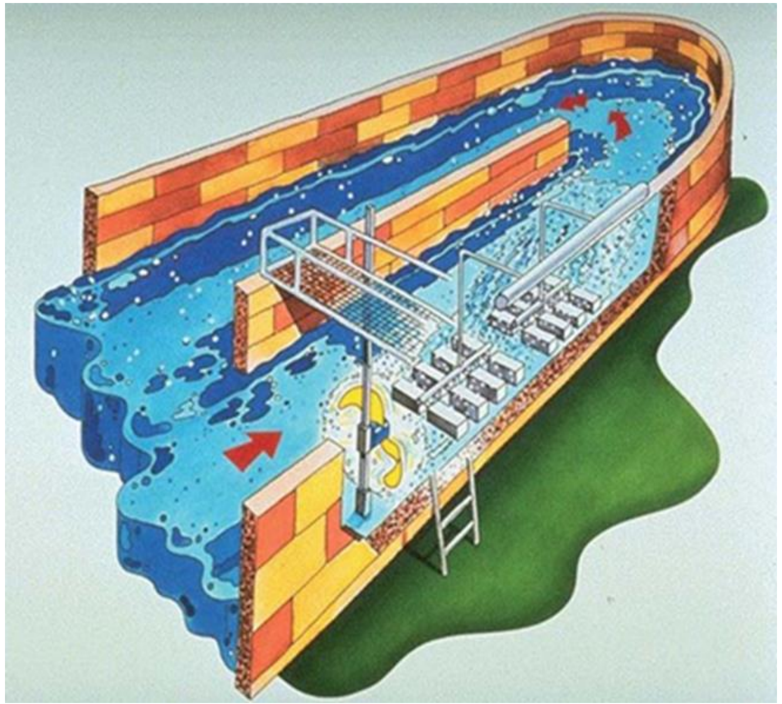
- Possibility of using CO_2 at zero cost and avoiding GHG emission;
- Impossibility of super-acidify discharges over the limit value of 7.5 – 8;
- The concentration of SO_4 or Cl^- already present in the waste is not increased.
- The use of smoke chimney reduces the concentration of TDS with consequent reduction of cost for RO and quantity of crystallized salt in MEE.



Biological oxidation

$$COD + O_2 + NH_3 \xrightarrow{\text{Bacteria}} New\ cells + CO_2 + H_2O$$

- The carousel tank has the great advantage due to its optimal mixing and a perfect oxidation through the use of big size flow-makers.
- In addition, with the help of micro-bubbles air-diffusers allows to reduce the power absorbed from blowers of at least 25%.

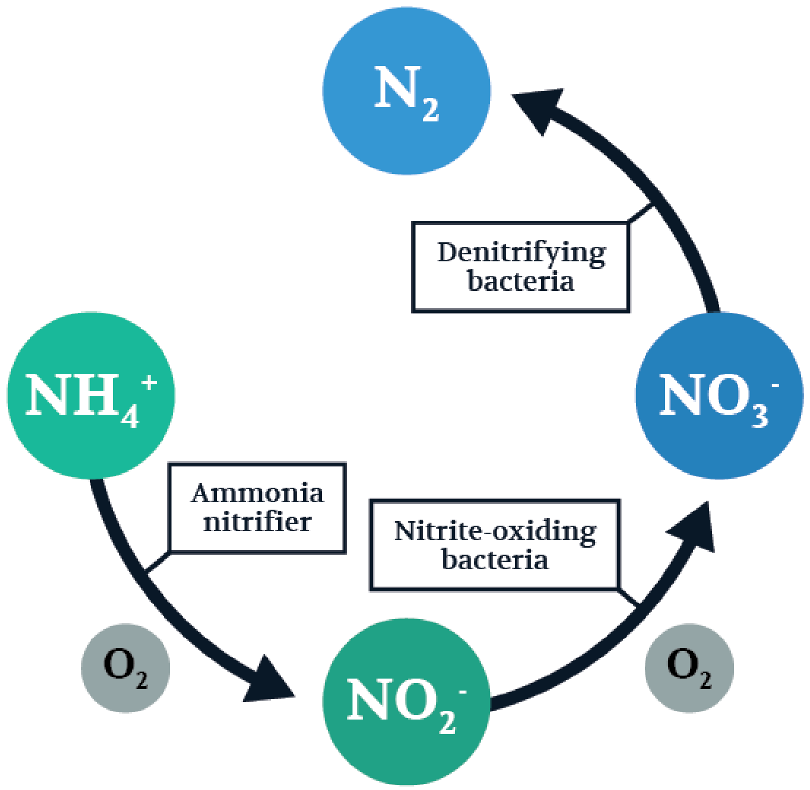


Biological oxidation

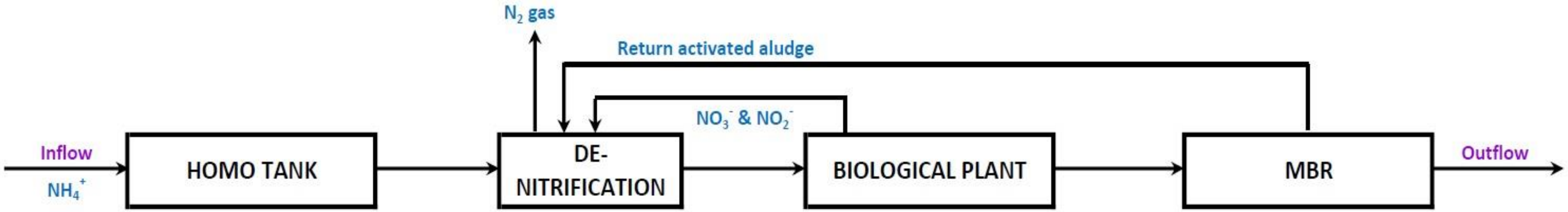
Nitrification – Denitrification

- Nitrification is the biochemical oxidation of ammonia nitrogen by means of autotrophic aerobic bacteria whereas Denitrification is the process by which nitrates are reduced to gaseous nitrogen through the action of facultative heterotrophs bacteria, under anoxic conditions.

- The speed of growth ("yield") of the nitrifying bacteria is much slower than the heterotrophic bacteria, which increases the sludge age and hydraulic residence time.



Denitrification



- For the Denitrification process, it is necessary that the nitrates produced in the aerobic tank are then recirculated to the anoxic tank.
- So, the **recirculation rate** should ensure the amount of nitric nitrogen, pumped to the anoxic reactor is suitably greater than that which must be removed.
- In addition, the recirculation of the activated sludge from the MBR ensures the sufficient concentration of biomass in the tank.

Denitrification

This process ensures:

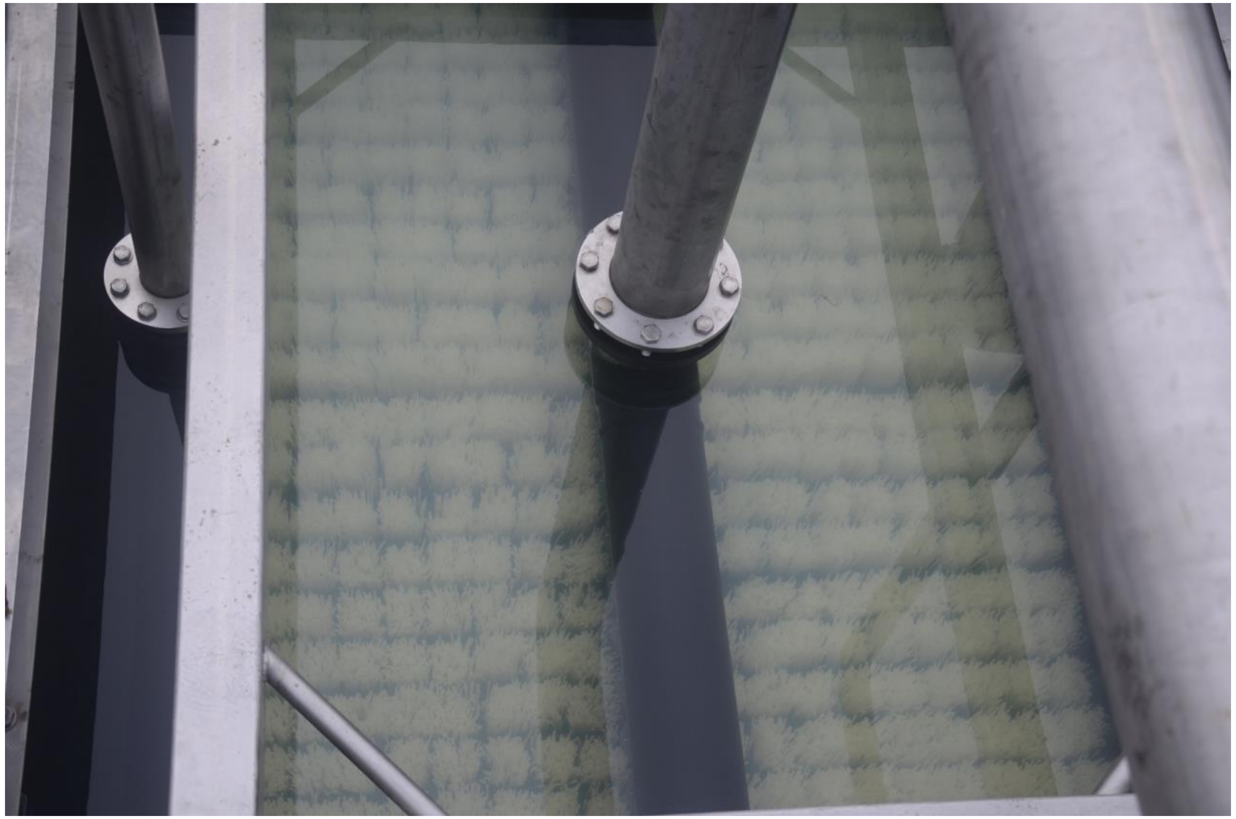
- A sufficient amount of organic load as energy source (electron donor), coming from the water to be treated and, thereby, an increase of the denitrification speed;
- A partial reduction of the inlet organic load (from 30 to 50%) to the next stage of biological oxidation;
- A partial balancing of the consumption of alkalinity which is present in the next nitrification phase;
- Better sedimentation of sludge;
- The reduction of nitrates without any dosage of extra carbon.

Water characteristics

PLANT UNIT	U.M.	Inlet Water	PRE BIO TECH	NITRO - DENITRO
Daily flow rate	m3/day	1000	1000	1000
COD	ppm	3500	2500	500
BOD5	ppm	2000	1200	100
TDS	ppm	15000	15000	15000
pH		12.0	8.0	
Temperature	°C	30		
Colour	Pt/Co	1000	500	500
TKN	ppm	400	250	20
Phosphorous	ppm	50	25	10
Surfactants	ppm	40	20	2
TSS	ppm	2000	200	100
Total Hardness	ppm CaCO3	300	250	250
Alkalinity	ppm CaCO3	1000	800	
Na+	ppm	6600	6600	6600
Cl-	ppm	9500	9500	9500
SO42-	ppm	800	800	800
Iron	ppm	2.5	1.0	1.0
Silica	ppm	50	30	30
Oil and greases	ppm	100	60	2
Ca2+	ppm	200	200	200

MBR

- The aim of MBR system is to replace sedimentation step with a filtration stage which allows to completely remove the suspended solids.
- Technical advantages of using MBR are:
  - Due to the shorter hydraulic retention time (HRT), it permits to treat greater wastewater flows in a lower space.
  - It also allows an easier control of a constant flow and a more effective treatment.



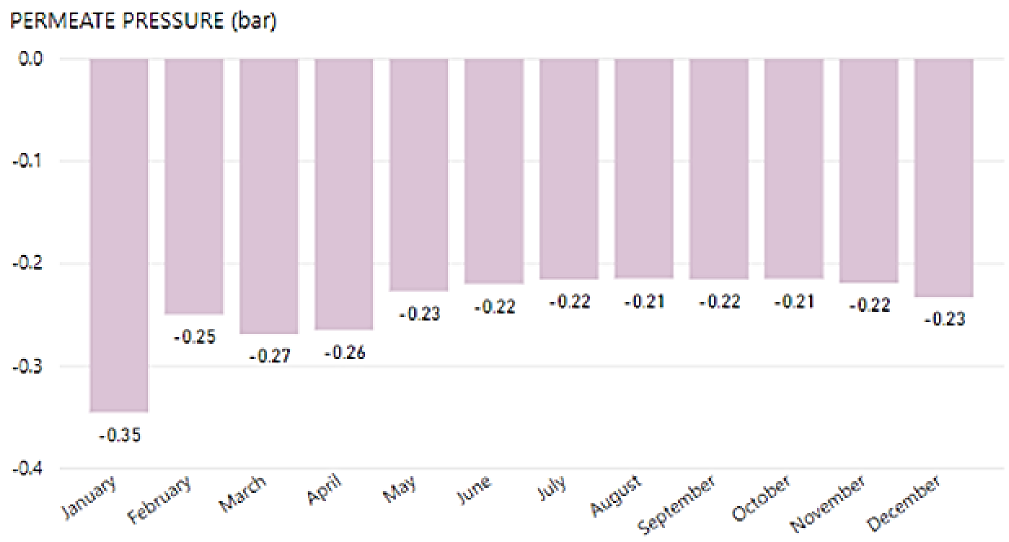
MBR

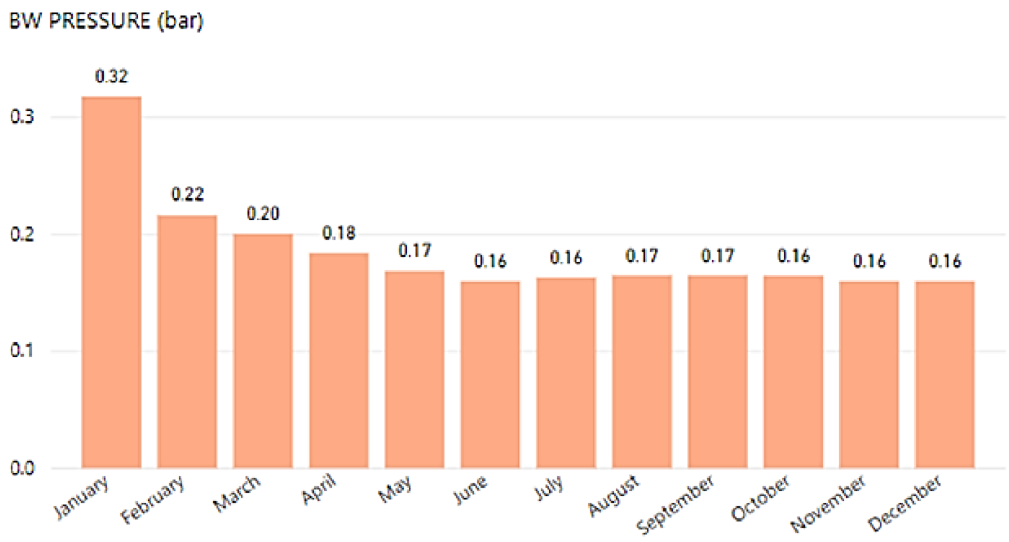
- complete removal of suspended solids and increase of concentration of activated sludge; in this way, we obtain greater consumption of incoming organic load, longer age of sludge with a great reduction of excess sludge.
- the output water after MBR is quite similar to the one produced with ultrafiltration systems, having values of SDI less than 5 and with molecular size of about 0.05 micron, which makes it suitable for the feeding of RO membranes.
- really compact treatment units, allowing so future expansions of the plant, lower environmental impact, lower maintenance costs, more available space for other usages.

Water characteristics

PLANT UNIT	U.M.	Inlet Water	PRE BIO TECH	NITRO - DENITRO	MBR out
Daily flow rate	m3/day	1000	1000	1000	1000
COD	ppm	3500	2500	500	150
BOD5	ppm	2000	1200	100	15
TDS	ppm	15000	15000	15000	15000
pH		12.0	8.0		7.5
Temperature	°C	30			30
Colour	Pt/Co	1000	500	500	300
TKN	ppm	400	250	20	10
Phosphorous	ppm	50	25	10	5
Surfactants	ppm	40	20	2	1
TSS	ppm	2000	200	100	1
Total Hardness	ppm CaCO3	300	250	250	250
Alkalinity	ppm CaCO3	1000	800		1000
Na+	ppm	6600	6600	6600	6600
Cl-	ppm	9500	9500	9500	9500
SO42-	ppm	800	800	800	800
Iron	ppm	2.5	1.0	1.0	0.5
Silica	ppm	50	30	30	30
Oil and greases	ppm	100	60	2	0
Ca2+	ppm	200	200	200	200
					100%

MBR – Performance control





Softener

- One of the most important water quality parameters in industrial applications is the hardness which is the sum of Ca^{2+} and Mg^{2+} ions which are present in the water.
- If untreated, this hardness causes fouling in the RO membranes.
- Softener lowers the value of hardness using ion exchange resin where the calcium and magnesium ions gets trapped when the water flows through the resin.

Degasser

- Degassing is a process that allows the carbon dioxide (formed during softening process) removal, through a decarbonating tower.
- The consequent reduction of TDS in the treated effluent involves a further advantage in the subsequent RO treatment.

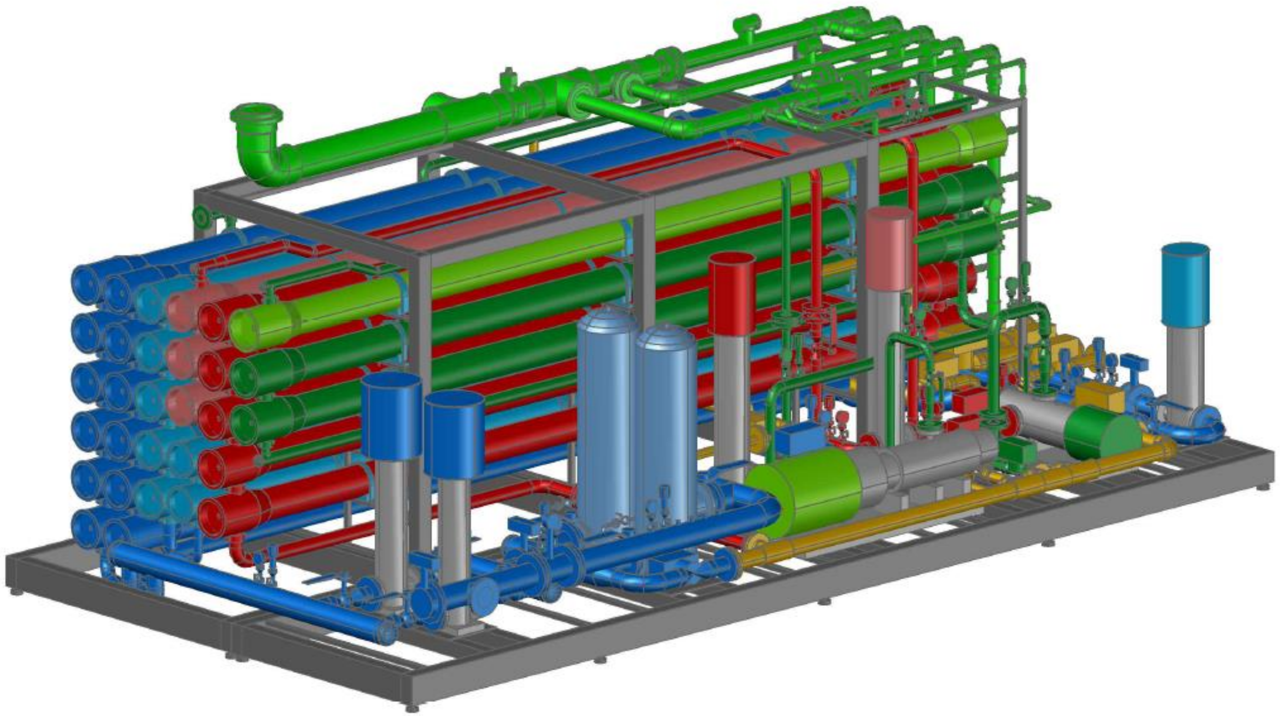
Water characteristics

PLANT UNIT	U.M.	MBR out	SF Out	Degaser Out RO Inlet
Daily flow rate	m3/day	1000	1000	1000
COD	ppm	150	150	150
BOD5	ppm	15	15	15
TDS	ppm	15000	14500	14000
pH		7.5	5.0	5.0
Temperature	°C	30	30	30
Colour	Pt/Co	300	300	300
TKN	ppm	10	10	10
Phosphorous	ppm	5	5	5
Surfactants	ppm	1	1	1
TSS	ppm	1	1	1
Total Hardness	ppm CaCO3	250	10	10
Alkalinity	ppm CaCO3	1000	700	50
Na+	ppm	6600	6600	6600
Cl-	ppm	9500	9500	9500
SO42-	ppm	800	800	800
Iron	ppm	0.5	0.5	0.1
Silica	ppm	30	30	30
Oil and greases	ppm	0	0	0
Ca2+	ppm	200	10	10
		100%	100%	100%

RO

- Reverse osmosis is part of the “membrane filtration” processes, which exploit particular properties of semi-permeable membranes that work as selective barriers, by allowing the passage of some constituents present in the water, and by keeping others.

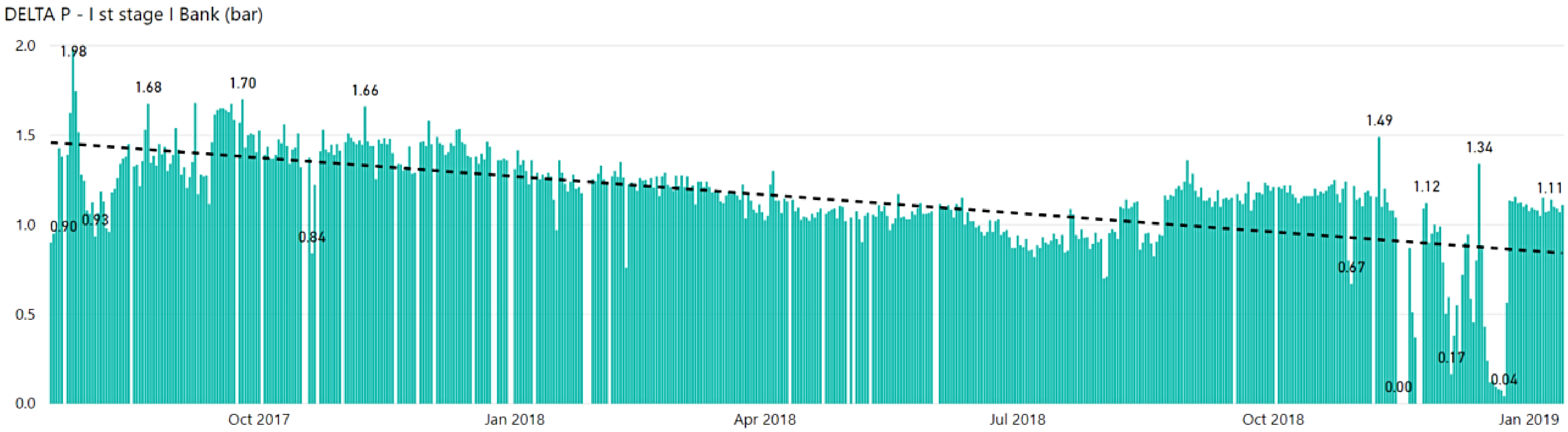
RO



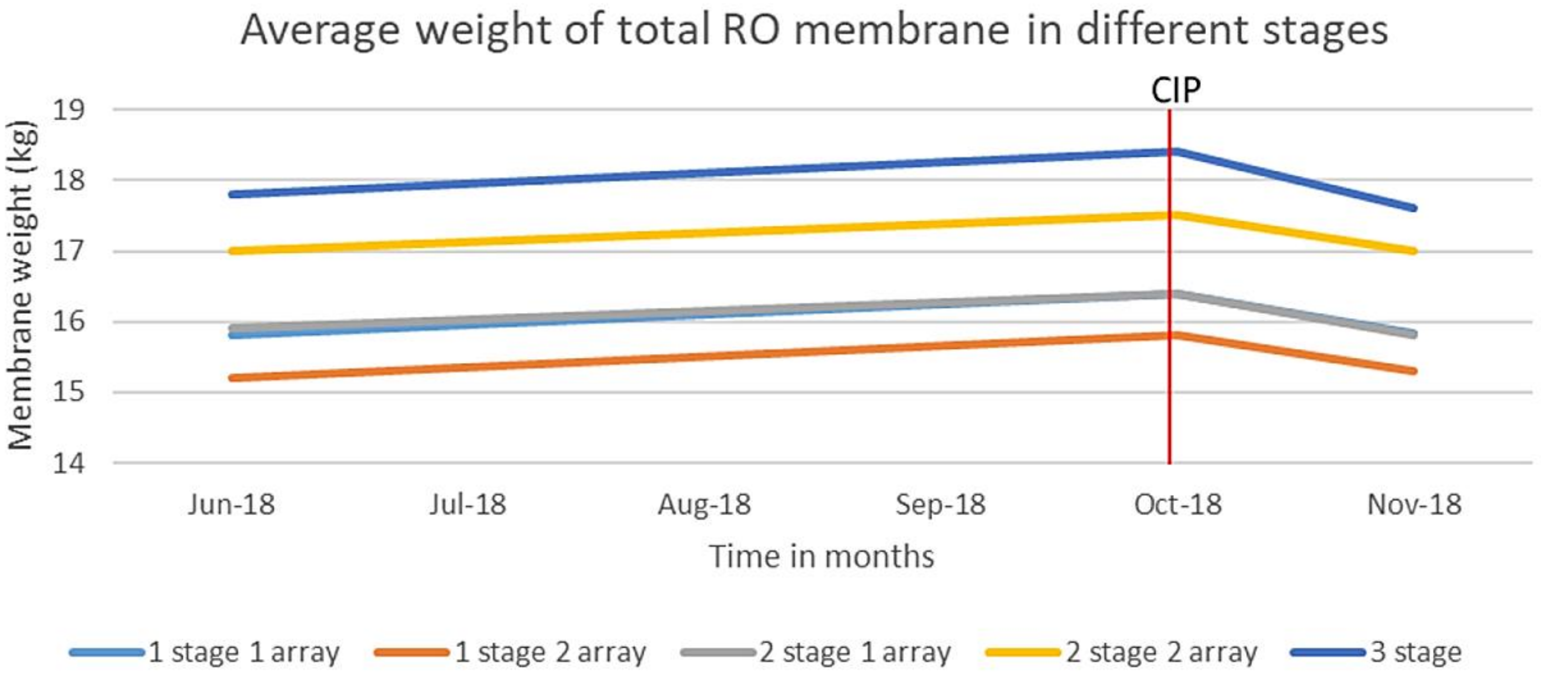
Water characteristics

PLANT UNIT	U.M.	Degaser Out RO Inlet	RO Permeate	RO reject
Daily flow rate	m3/day	1000	800	200
COD	ppm	150	5	750
BOD5	ppm	15	1	75
TDS	ppm	14000	250	81000
pH		5.0	5.0	7.0
Temperature	°C	30	30	30
Colour	Pt/Co	300	0	1500
TKN	ppm	10	0	50
Phosphorous	ppm	5	0	25
Surfactants	ppm	1	0	5
TSS	ppm	1	0	5
Total Hardness	ppm CaCO3	10	0.1	50
Alkalinity	ppm CaCO3	50	10	220
Na+	ppm	6600	110	31000
Cl-	ppm	9500	150	31000
SO42-	ppm	800	5	4700
Iron	ppm	0.1	0	1
Silica	ppm	30	0.5	150
Oil and greases	ppm	0	0	0
Ca2+	ppm	10	0.04	50
		100%	80%	20%

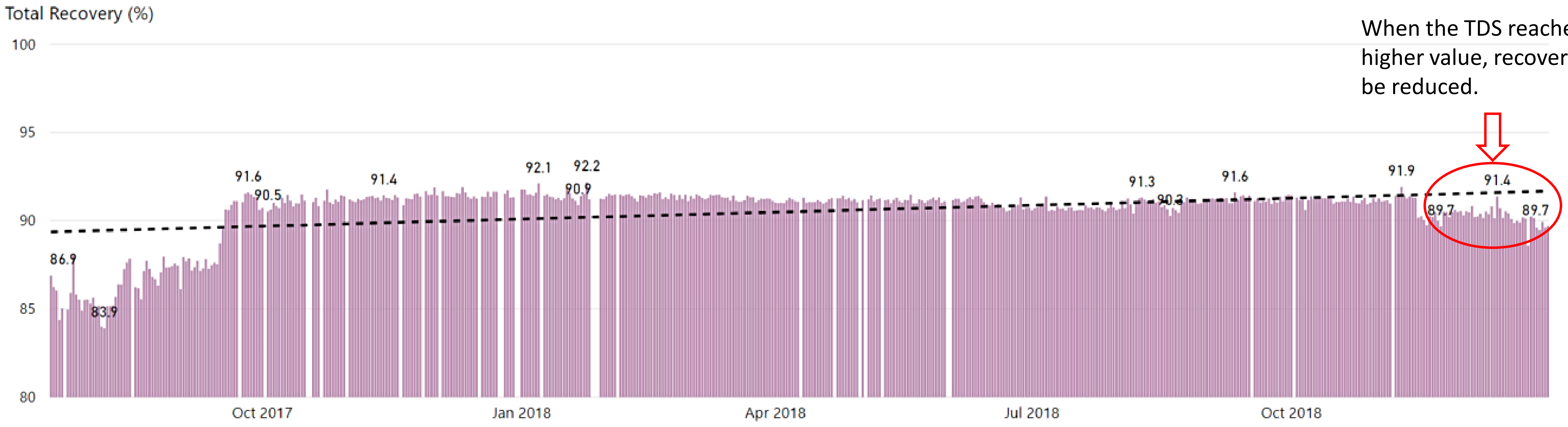
RO – delta P


DELTA P - I st stage I Bank (bar)
2.0
1.5
1.0
0.5
0.0
1.98
1.68
1.70
1.66
1.49
1.34
1.12
1.11
0.90
0.93
0.84
0.67
0.17
0.04
0.00
Oct 2017
Jan 2018
Apr 2018
Jul 2018
Oct 2018
Jan 2019

RO – membrane weight

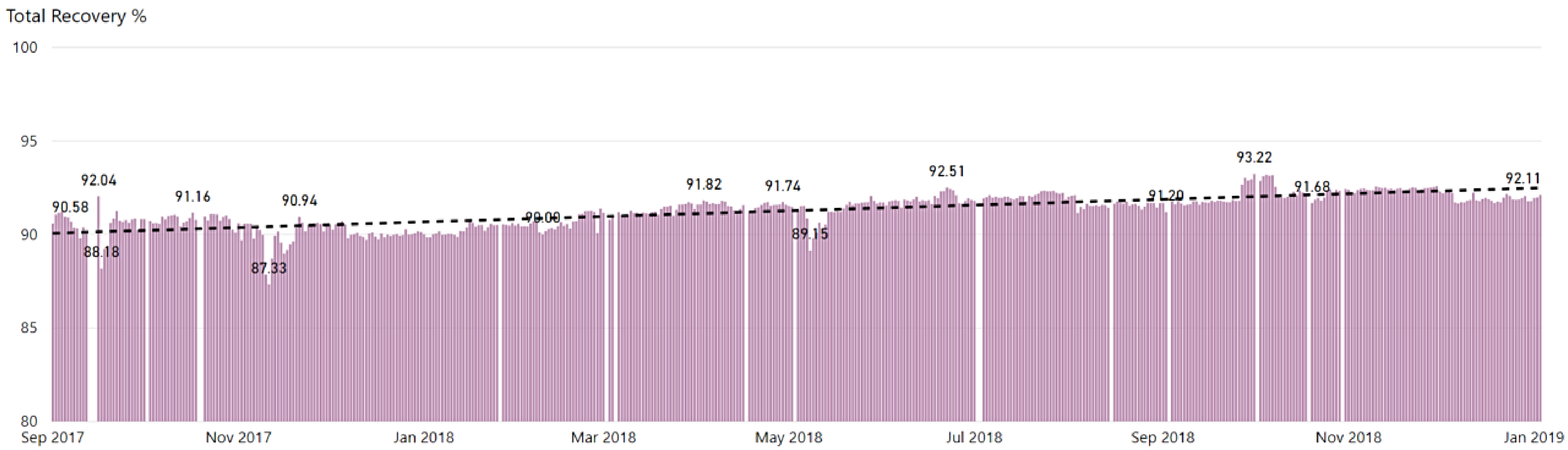


RO – Recovery



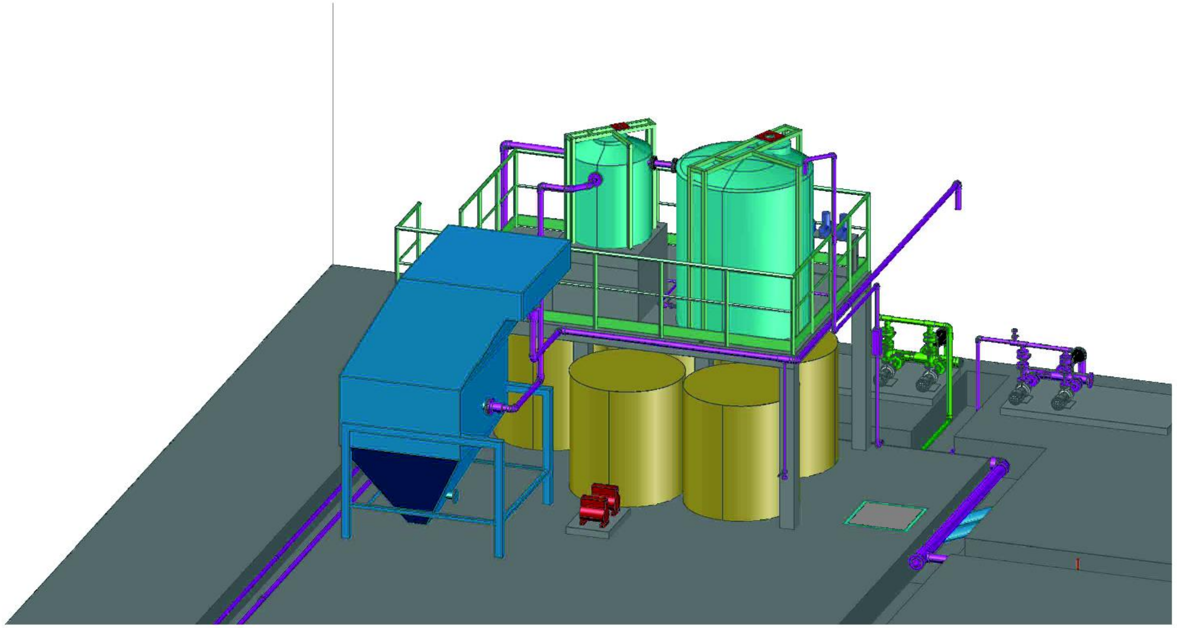
When the TDS reaches higher value, recovery will be reduced.

RO – Recovery


Total Recovery %
100
95
90
85
80
92.04
90.58
88.18
91.16
90.94
87.33
90.00
91.82
91.74
89.15
92.51
91.20
93.22
91.68
92.11
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018
Jan 2019

Saturator

- The main purpose of the saturator is to reduce the silica concentration of the RO reject. So, the reject can be sent to Nano filtration to recover the brine without damaging the membranes.



Ultrafiltration

- Treatment with ultrafiltration membranes can separate the colloids present to 0.1 microns in diameter, included organics that are present in the RO reject.
- This reduction of colloids allows extending the useful life of Nano filtration membranes up to three years, reducing significantly the cost of spare modules.

Water characteristics

PLANT UNIT	U.M.	RO reject	Saturator + UF Out
Daily flow rate	m3/day	200	200
COD	ppm	750	400
BOD5	ppm	75	30
TDS	ppm	81000	84000
pH		7.0	7.0
Temperature	°C	30	30
Colour	Pt/Co	1500	700
TKN	ppm	50	30
Phosphorous	ppm	25	5
Surfactants	ppm	5	2
TSS	ppm	5	5
Total Hardness	ppm CaCO3	50	15
Alkalinity	ppm CaCO3	220	300
Na+	ppm	31000	33000
Cl-	ppm	31000	36000
SO42-	ppm	4700	5000
Iron	ppm	1	1
Silica	ppm	150	60
Oil and greases	ppm	0	0
Ca2+	ppm	50	20
		20%	20%

Nanofiltration

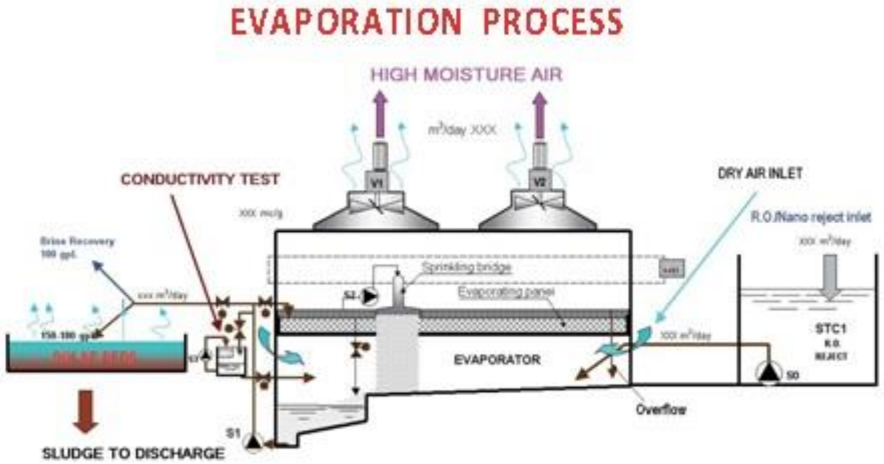
- By using selective membranes, it is possible to separate the salt content in the rejection of the RO.
- The separated salt has a high degree of purity and can be fully used in the industrial processes.
- This solution minimizes the cost of salt purchase and reduces dramatically the costs of the concentrate evaporation, allowing recovering more water.

Water characteristics

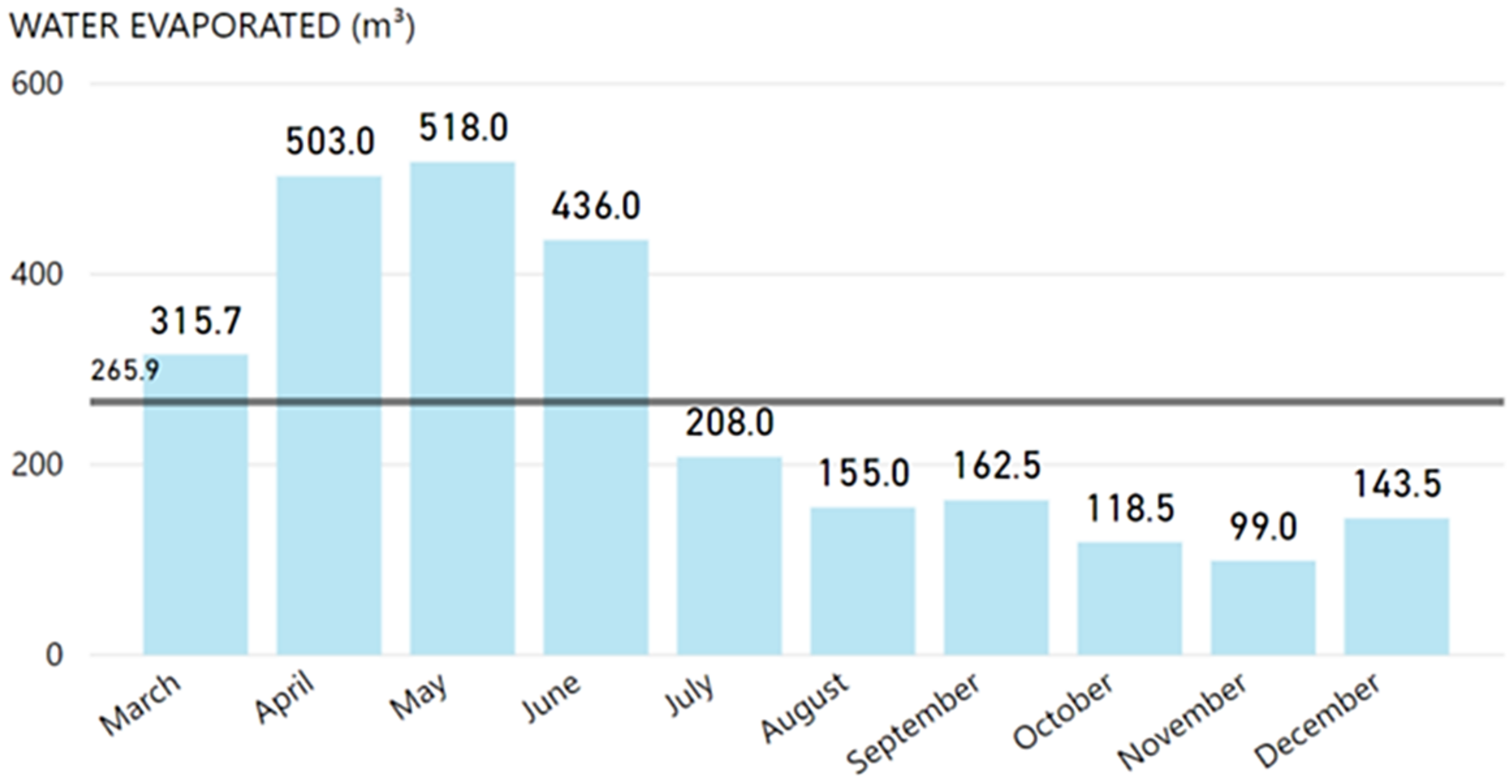
PLANT UNIT	U.M.	Saturator + UF Out	NANO Perm.	NANO reject
Daily flow rate	m3/day	200	150	50
COD	ppm	400	200	1000
BOD5	ppm	30	15	75
TDS	ppm	84000	75000	110000
pH		7.0	6.0	6.0
Temperature	°C	30	30	30
Colour	Pt/Co	700	0	2100
TKN	ppm	30	3	100
Phosphorous	ppm	5	1	15
Surfactants	ppm	2	1	6
TSS	ppm	5	0	15
Total Hardness	ppm CaCO3	15	1	45
Alkalinity	ppm CaCO3	300	35	400
Na+	ppm	33000	30000	40000
Cl-	ppm	36000	45000	48000
SO42-	ppm	5000	100	19000
Iron	ppm	1	0	0
Silica	ppm	60	60	60
Oil and greases	ppm	0	0	0
Ca2+	ppm	20	0.26	100
		20%	15%	5%

Wind evaporator

- It is a new evaporator with lower energy cost (4-5 times lower) compared to the present systems allows to evaporate and concentrate the brine for their reuse.
- Our evaporators have 0 chemical emissions and don’t foresee the use of steam.
- The energetic consumption is very less which is equal to 12-15 kW/m^3 of evaporated water.
- The indication of carbon dioxide released per m^3 of treated water is 15 times lower compared to the conventional systems.



Wind evaporator



Water characteristics

PLANT UNIT	U.M.	NANO reject	Softener regenration reject	Wind evaporator inlet	Wind evaporator outlet/MEE inlet
Daily flow rate	m3/day	50	6	56	30
COD	ppm	1000	0	893	893
BOD5	ppm	75	0	67	67
TDS	ppm	110000	25000	100893	165000
pH		6.0	1.0	5	5
Temperature	°C	30	30	30	30
Colour	Pt/Co	2100	0	1875	1875
TKN	ppm	100	0	89	89
Phosphorous	ppm	15	0	13	13
Surfactants	ppm	6	0	5	5
TSS	ppm	15	0	13	13
Total Hardness	ppm CaCO3	45	25000	2719	2719
Alkalinity	ppm CaCO3	400	0	357	357
Na+	ppm	40000	0	35714	35714
Cl-	ppm	48000	26250	45670	45670
SO42-	ppm	19000	0	16964	16964
Iron	ppm	0	0	0	0
Silica	ppm	60	30	57	57
Oil and greases	ppm	0	0	0	0
Ca2+	ppm	100	17500	1964	1964
		5%	1%	6%	3%

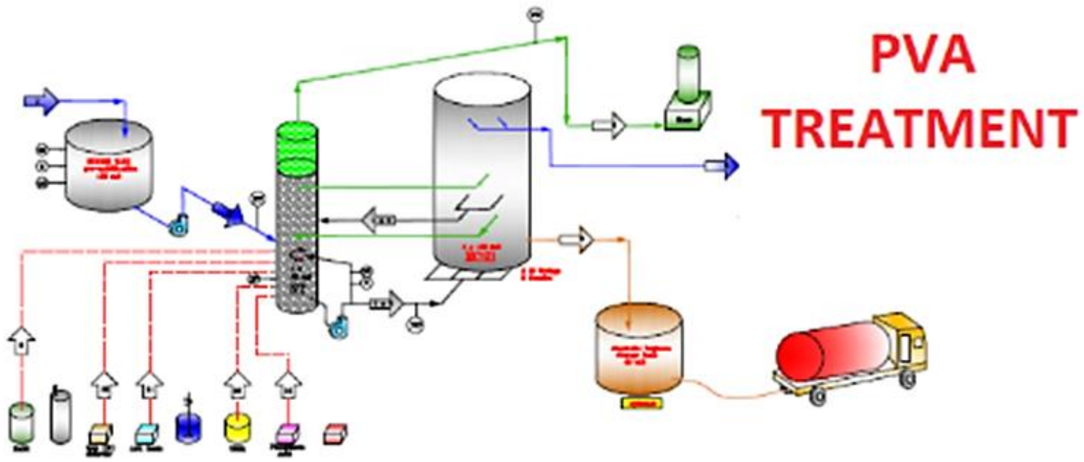
MEE

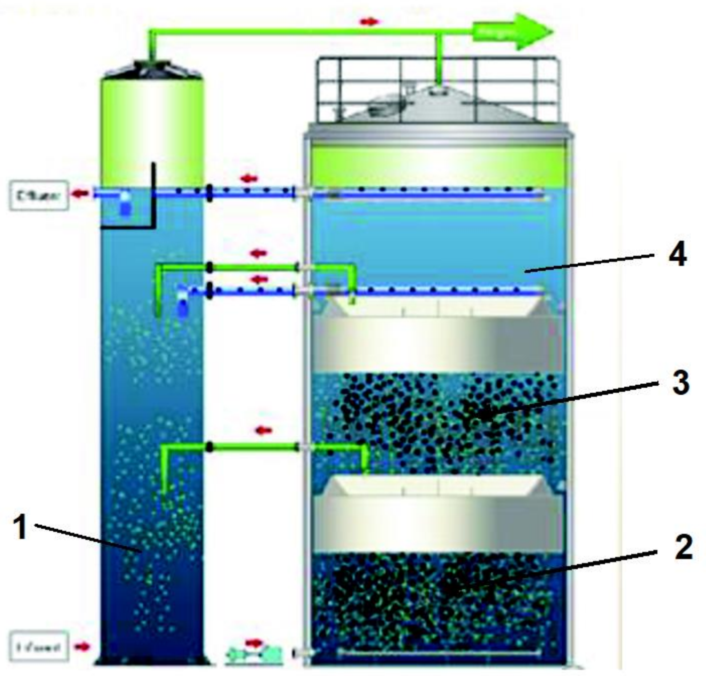
- In MEE, the saturation of a solution occurs with the solution evaporation, through a series of evaporators that operate at pressures gradually decreasing.
- Evaporators are connected each other, so that the steam developed by one of them constitutes the heating fluid for the next one.
- Condensate is then reused in the industrial process, while the crystallized salts will be disposed off.

PVA

- Europrogetti has set up a system, capable to treat the PVA used in the industrial process.

- This system can be used in the Zero Liquid Discharge wastewater treatment, and it can also prevent problems to the RO membranes, making them to last at least 3-4 years.





Scheme 1: STP ECSB (**E**xternal **C**irculation **S**ludge **B**ed)

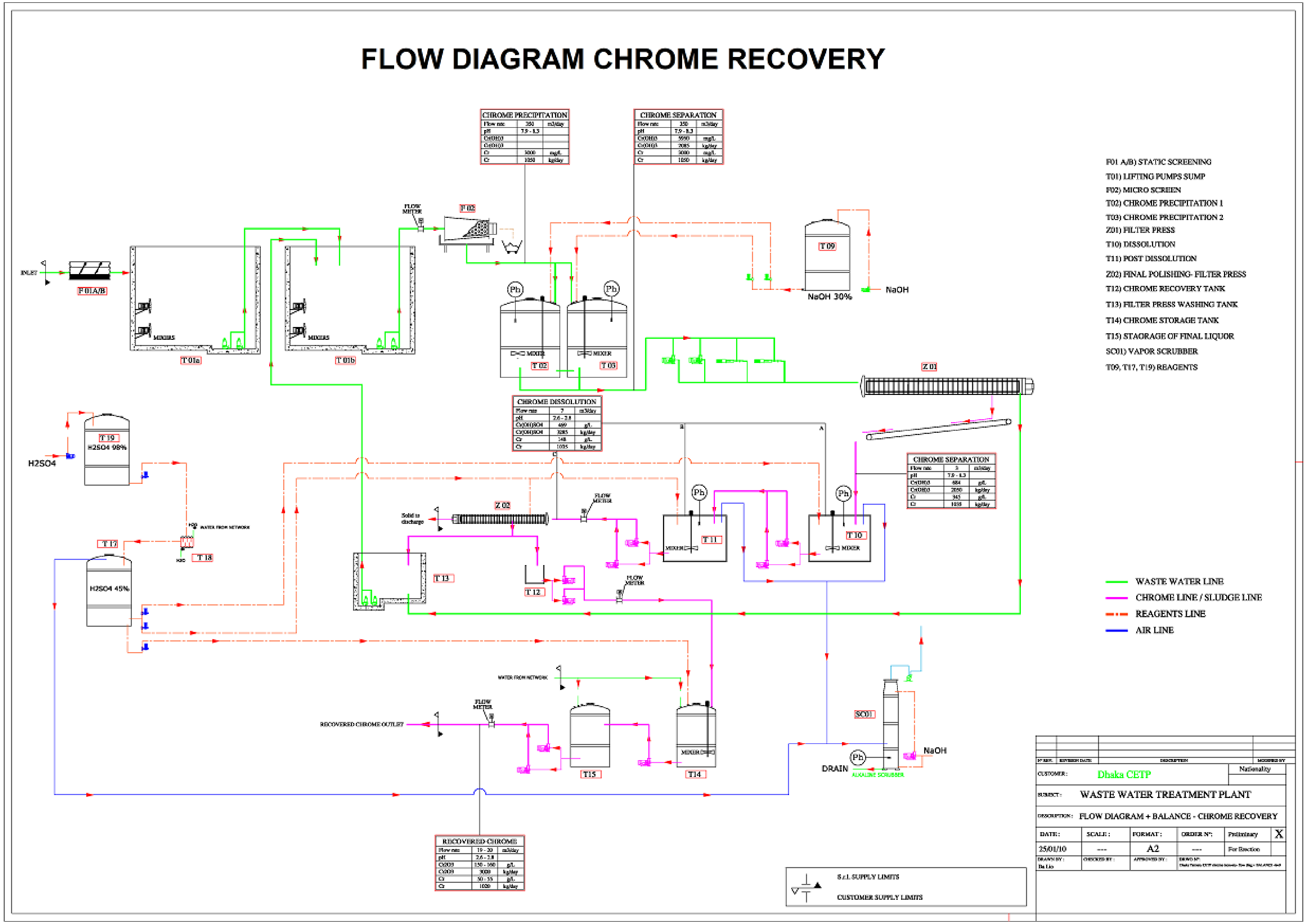
PVA

DryWa

- DryWa is an innovative system for the management of biological sludge deriving from water purification processes, capable of reducing the volume of sludge up to 95%.
- Thanks to technical and management innovations, biological sludge is dried through an accelerated process and then burned.
- The DryWa System reduces electrical costs and CO_2 emissions, since the whole process is powered only by sludge combustion with a low environmental impact.

DryWa

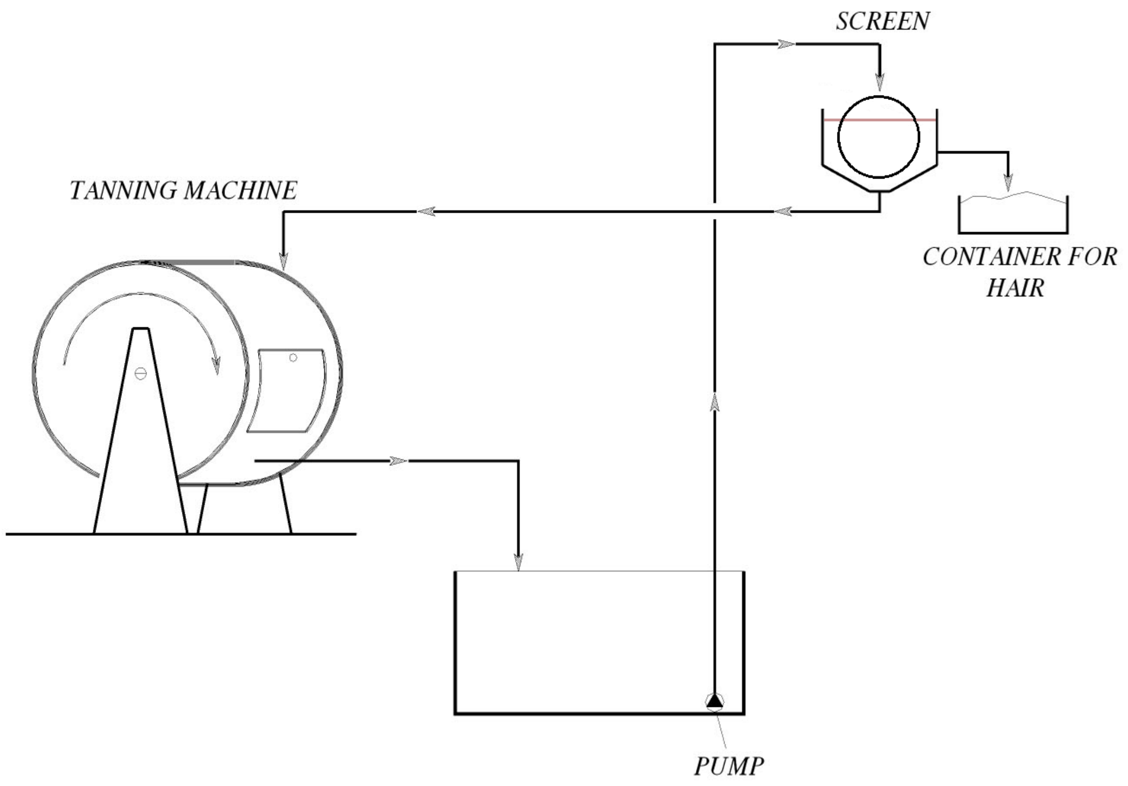
Chromium recovery



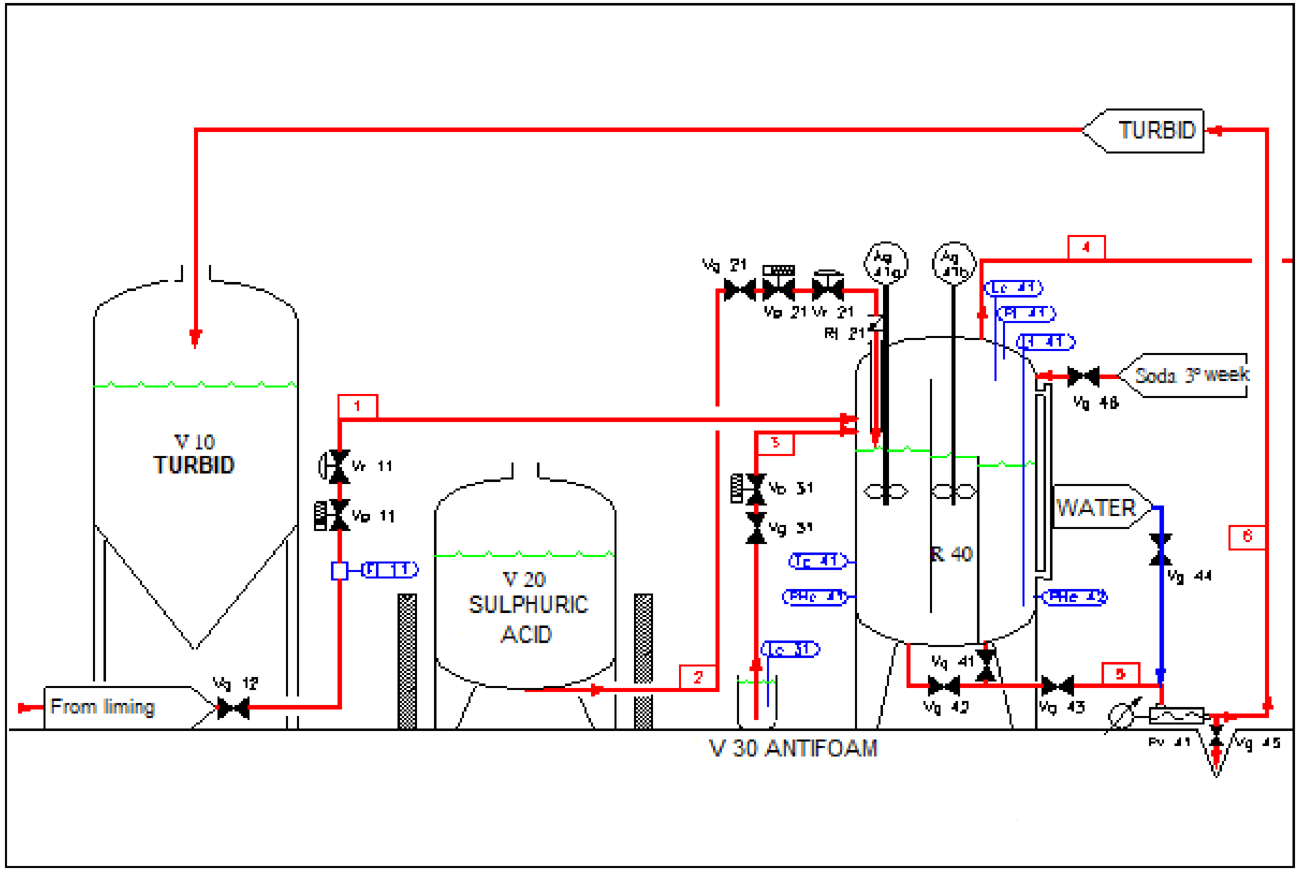
Hair recovery

- The hair removing, during phases of liming, leads to strong reduction in the organic load going to the biological process.

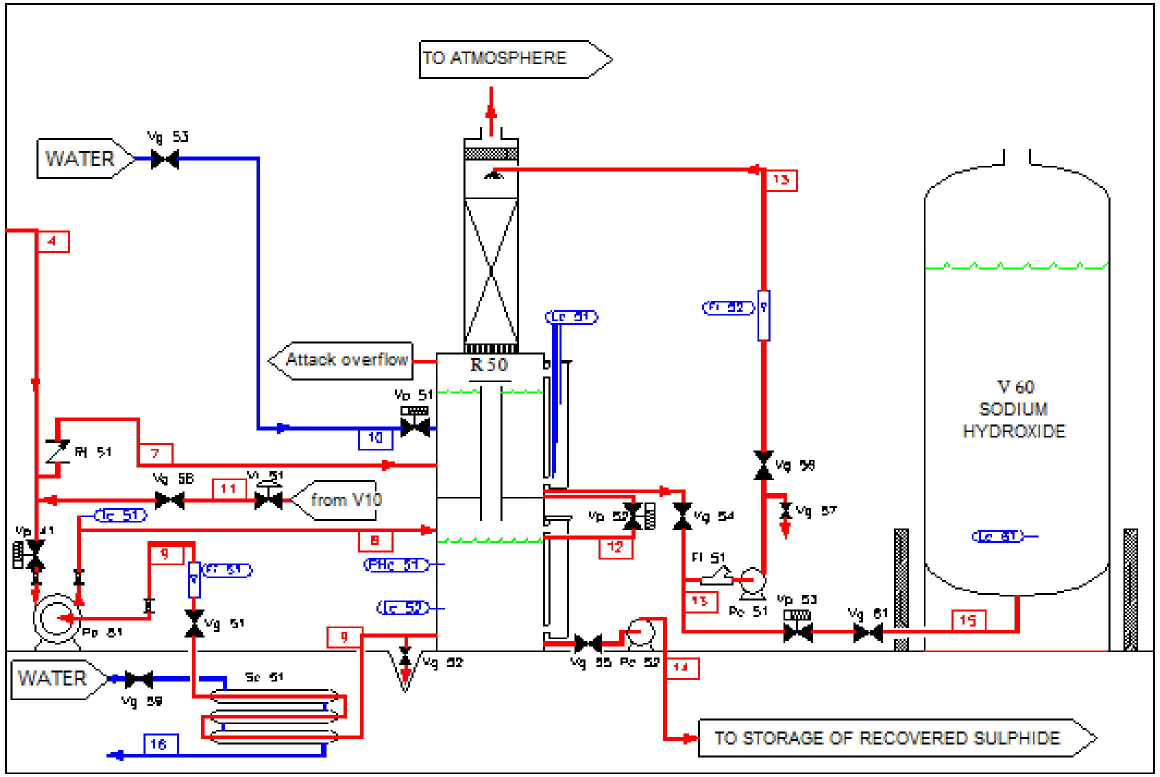
- As a consequence, this process reduces the energy costs due to the less oxygen supply for the biomass.

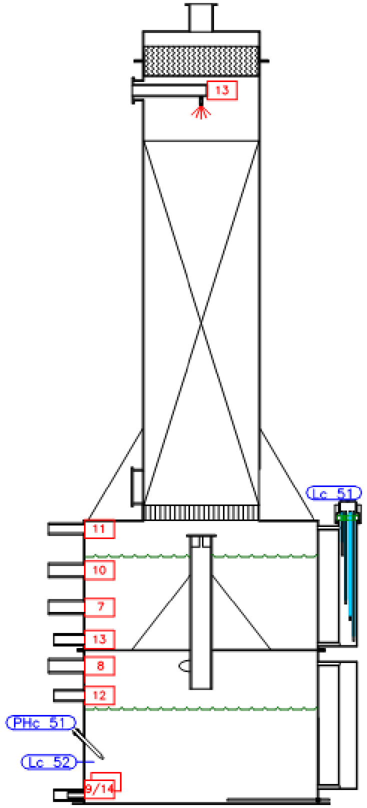


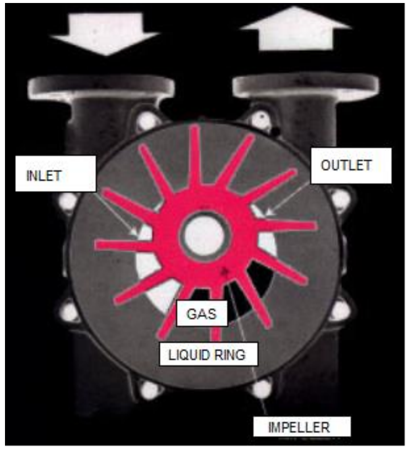
Sulphur recovery



Sulphur recovery





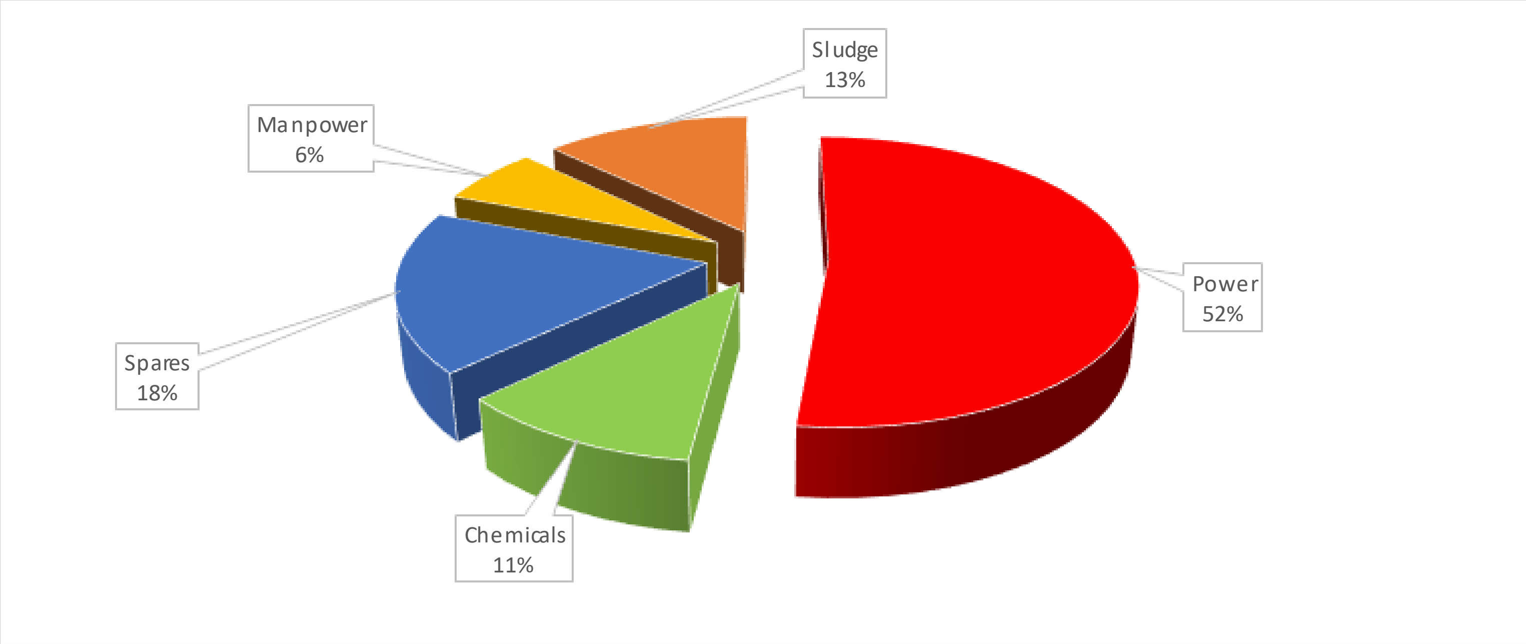


FINANCIAL & O&M OVERVIEW

O&M ETP – STUDY OF ZLD SYSTEM (Q 2000 m³/DAY)

AVERAGE O&M COST ON 10 WORKING YEARS

		TOTAL	Power	Chemicals	Spares	Manpower	Sludge
WWTP PECIFIC COST	[INR/m³]	**229,07**	118,96	25,12	40,96	14,63	29,40
WWTP ANNUAL COST	[CRORES/Year]	**16,03**	8,33	1,76	2,87	1,02	2,06



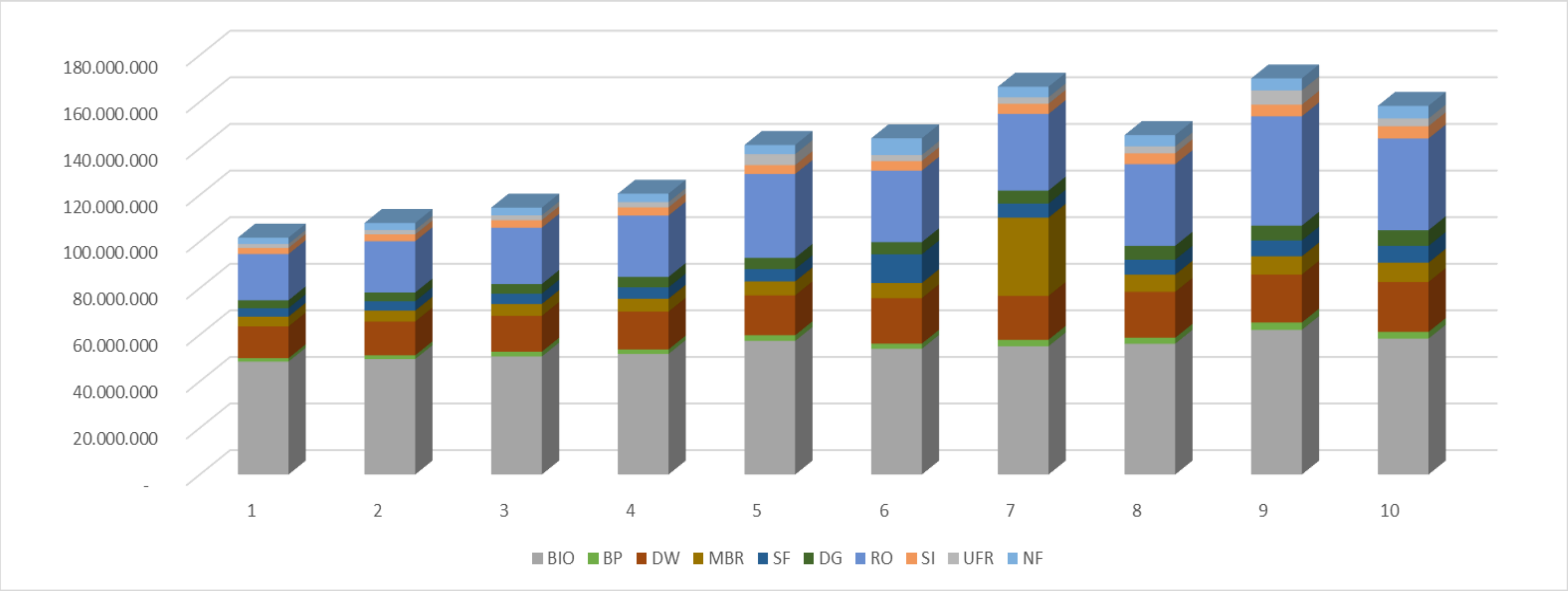
O&M – Ordinary + Extraordinary costs in 10 years

COST ANALYSIS OF THE PLANT PHASES ORDINARY PLUS STRAODINARY

[INR/year]

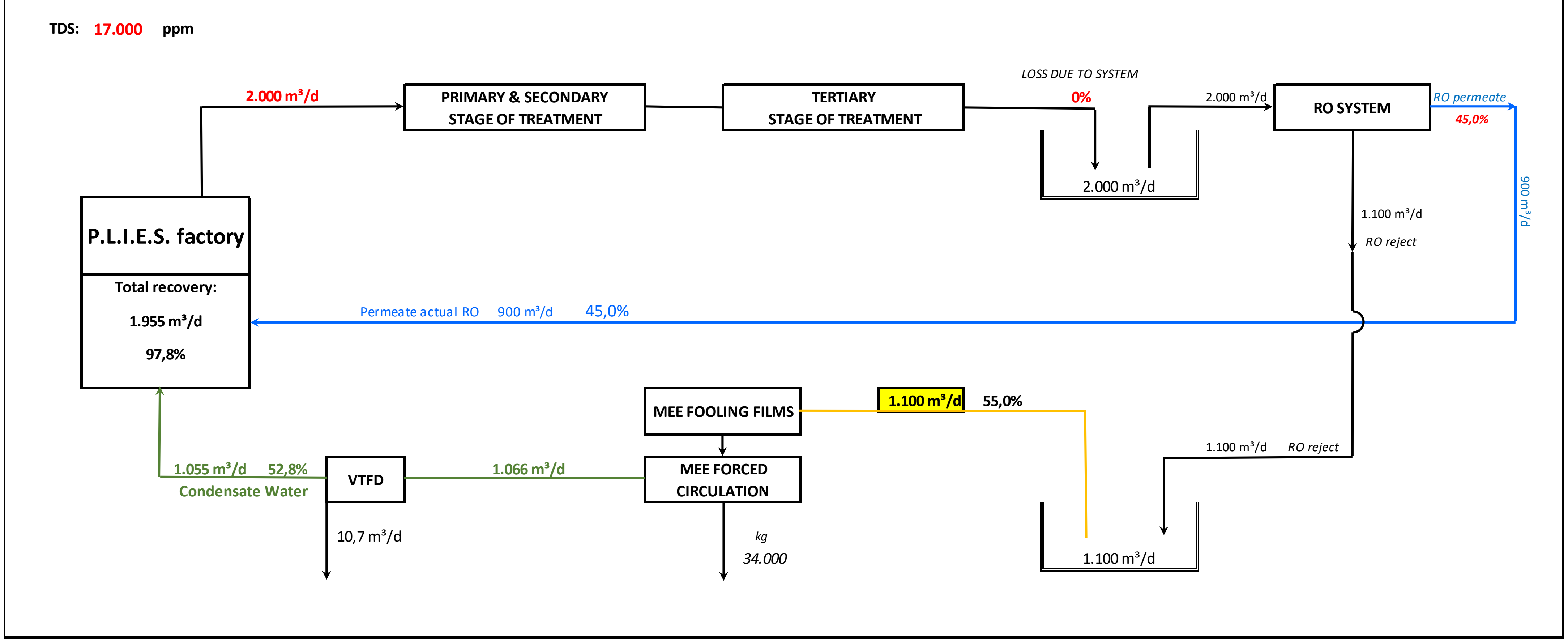
	1	2	3	4	5	6	7	8	9	10
Smoke	20.909.548	23.206.399	25.503.249	27.800.099	30.096.950	32.393.800	34.690.650	36.987.501	39.284.351	41.581.201
Biological	48.461.593	49.558.825	50.656.057	51.753.289	57.360.601	53.947.753	55.044.985	56.142.217	62.083.608	58.336.680
Belt press	1.454.851	1.612.484	2.062.918	1.927.752	2.430.985	2.243.019	2.799.052	2.558.286	3.167.120	2.873.553
DRYWA	13.629.900	14.495.694	15.361.488	16.227.282	17.093.076	19.518.870	18.824.664	19.690.458	20.556.252	21.422.046
MBR	4.208.657	4.662.009	5.115.361	5.568.714	6.022.066	6.475.418	33.586.511	7.382.122	7.835.475	8.288.827
Softner	3.642.840	4.040.353	4.437.865	4.835.378	5.232.890	12.326.402	6.027.915	6.425.427	6.822.940	7.220.452
Degaser	3.389.649	3.759.310	4.128.971	4.498.633	4.868.294	5.237.955	5.607.617	5.977.278	6.346.940	6.716.601
Reverse Osmosis	19.831.858	22.002.962	24.174.066	26.345.171	35.981.235	30.687.379	32.858.484	35.029.588	46.946.613	39.371.797
Saturator	2.651.967	2.941.284	3.230.600	3.519.916	3.809.233	4.098.549	4.387.865	4.677.182	4.966.498	5.255.815
Ultrafiltration reject	1.693.778	1.876.494	2.059.209	2.241.925	4.728.640	2.607.356	2.790.072	2.972.787	6.163.503	3.338.218
Nanofiltration	2.727.457	3.027.477	3.327.497	3.627.518	3.927.538	7.172.558	4.527.578	4.827.599	5.127.619	5.427.639
TOTAL	**122.602.098**	**131.183.291**	**140.057.283**	**148.345.675**	**171.551.508**	**176.709.060**	**201.145.393**	**182.670.445**	**209.300.917**	**199.832.830**

O&M – Ordinary + Extraordinary costs in 10 years



BUSINESS PLAN ON THE REALIZATION OF NEW ZLD PLANT

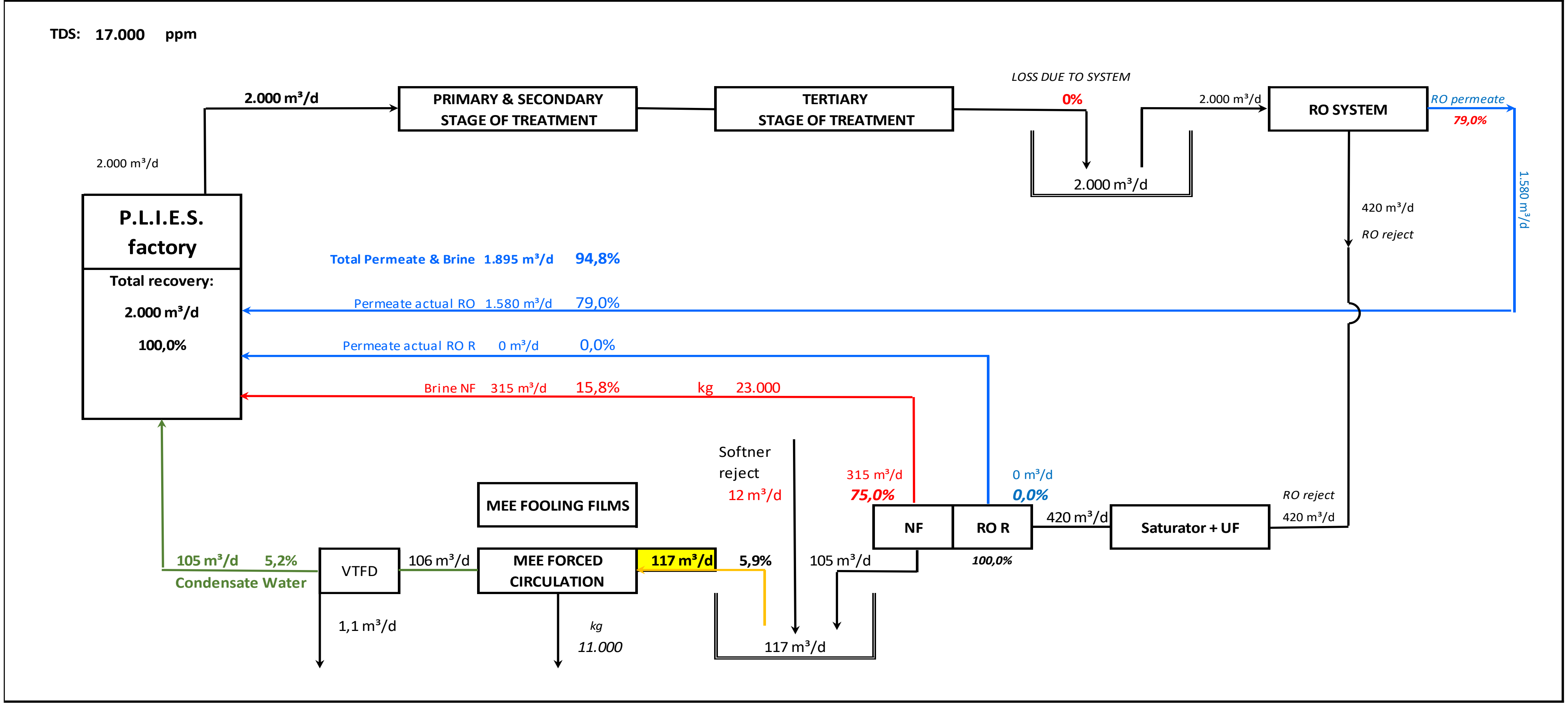
ACTUAL GENERAL FLOW SCHEME



O&M COST ON EXISTING PLANT

	INR/m³	m³/day	INR/day	CRORES/Year	€/Year
ACTUAL O&M COST BEFORE MEE	400	2.000	800.000	28	3.500.000
ACTUAL MEE O&M COST	677	1.100	744.700	26	3.258.063
TOTAL				**54**	**6.758.063**

GENERAL FLOW SCHEME WITH NANOFILTRATION



O&M COST ON NEW ZLD PLANT

	INR/m³	m³/day	INR/day	CRORES/Year	€/Year
NEW ZLD O&M COST BEFORE MEE	240	2.000	480.960	17	2.104.200
MEE O&M COST NEW ZLD	407	117	47.619	2	208.333
TOTAL				**19**	**2.312.533**

SAVING ON O&M COST

TOTAL SAVING WITH NEW SOLUTION		
	Crores/year	€/Year
TOTAL SAVING ON ETP O&M - BEFORE MEE	11	1.395.800
TOTAL SAVING ON MEE O&M	24	3.049.729
TOTAL SAVING ON BRINE RECOVERY	4	503.125
TOTAL SAVING	40	4.948.654

PAYBACK OF NEW PLANT

	CUMULATIVE COST INVESTMENT PLUS YEARLY O&M		Difference
	Existing Recovery System	New Recovery System	NEW --> EXSISTING
	Crores/Year	Crores/Year	Crores/Year
New ZLD Plant Capital cost	0,00	43,60	43,60
After 1 year	54,06	58,08	4,01
After 2 year	108,13	72,55	-35,58
After 3 year	162,19	87,03	-75,17
After 4 year	216,26	101,50	-114,76
After 5 year	270,32	115,98	-154,35
After 6 year	324,39	130,45	-193,94

Payback of the recovery system **1,1** **Years**

Saving on 6 years **193,94** **Crores**

THANKS FOR YOUR ATTENTION!!