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Project Report

application of the Ydro Process® biotechnology at **Andratx,** wastewater treatment plant, Spain, Mallorca

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Summary

- Andratx WWTP
- Project objectives and dosing point of YDRO microorganisms
- Influent and effluent characteristics
- The reduction of the excess sludge
- Conclusion and recommendations

Project Customer: ABAQUA

Project Executor:

BIO RAN Ltd UK

www.bio-ran.com

Project Initiation: 21.06.2021

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Andratx WWTP

Characteristics	Data
Population equivalent	20,000
Type of WWTP	Carrousel System
Design capacity (5000 m3/day)	Actual capacity 2,500 m3/day (only one line in operation)
Flowrate (average flowrate during 12 months)	2,500 m3/day

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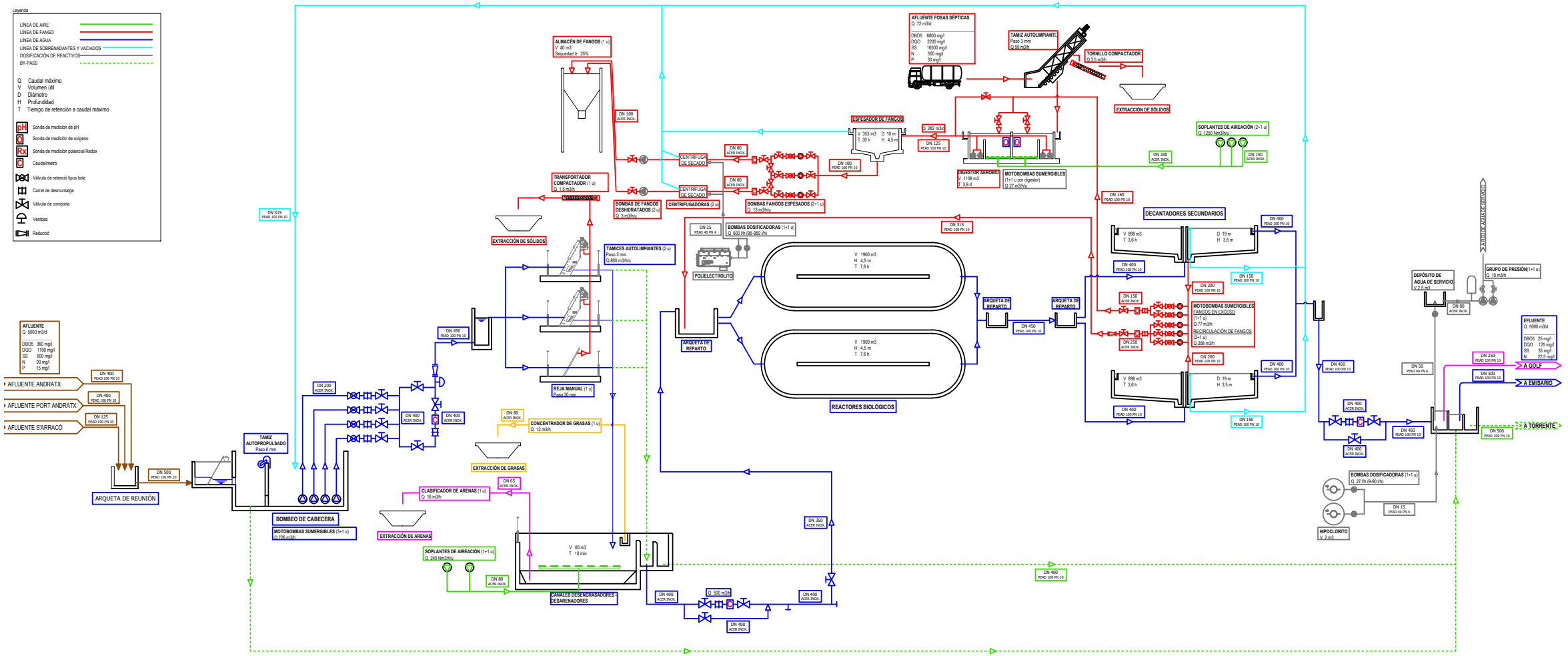
Andratx WWTP Diagram



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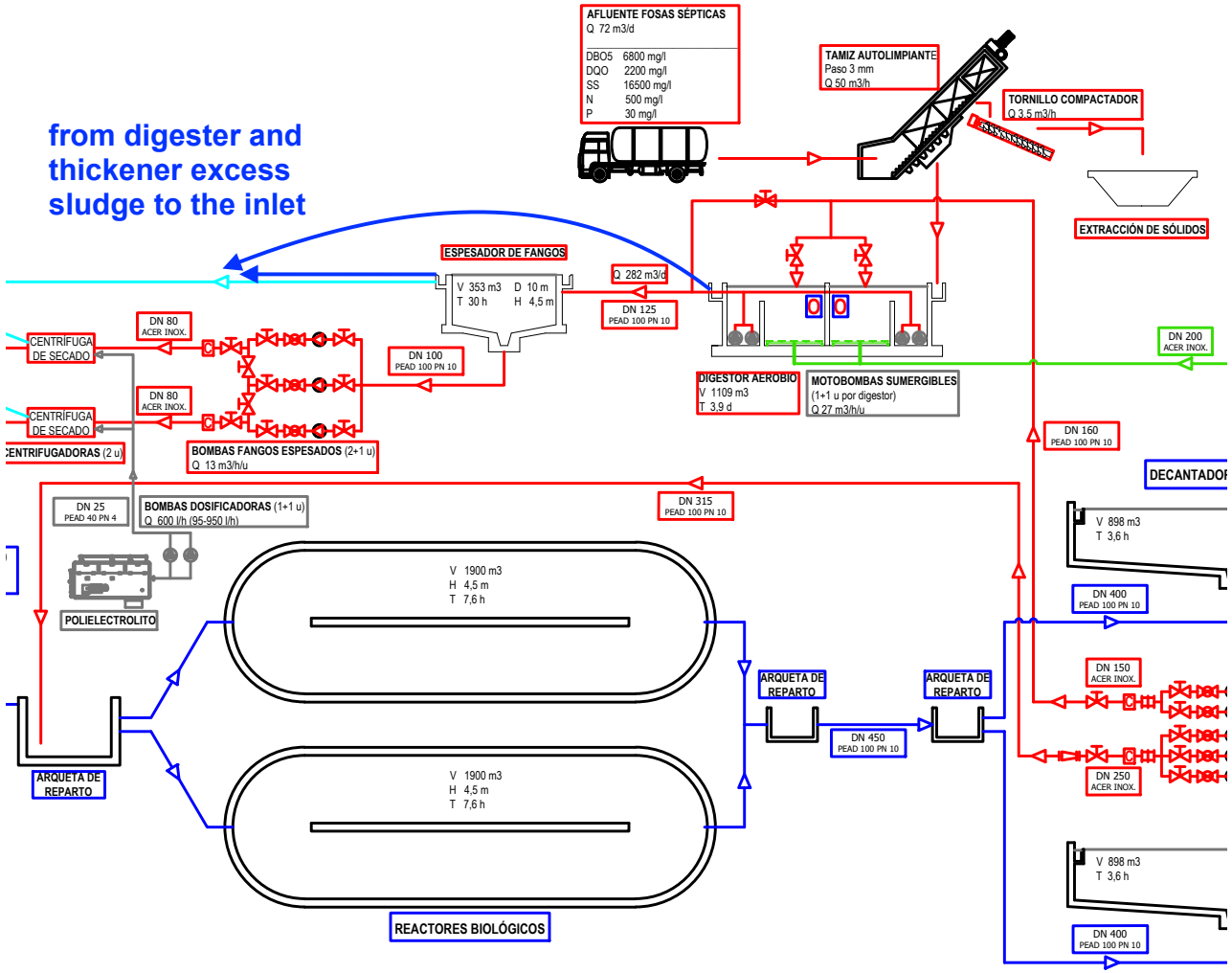
Project Objectives and Requirements



Objectives:
Reduce production of the excess sludge

Requirements:
Recirculation of 150 - 300 m3/day of the excess sludge into the aerobic digester and thickener and after by overflow into the inlet of the WWTP:

1) Initiate the bacterial activity in the digester and thickener as the excess sludge will contain hydrolyzing bacteria;
2) Reduce solids % in the digester and thickener as the excess sludge will be hydrolyzed and as a result, organic acids will be produced;
3) The organic acids are degraded downstream the operation to Carbon Dioxide (CO_2) and water (H_2O) in aerobic conditions.

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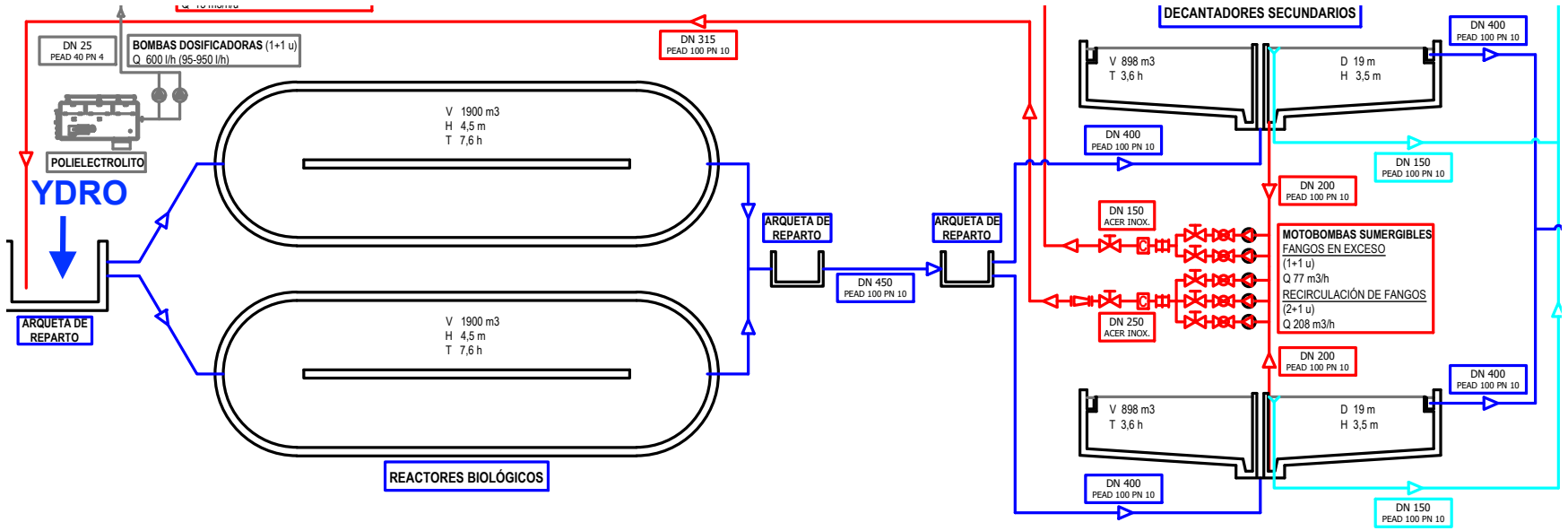
Dosing Point of Microorganisms



- The dosing point is the aeration tank inlet;
- Dilution rate is 1:10 i.e. up to 1kg of product in 10 lt;
- The maturation duration is at least 12 hours, which can go up to 24 hours accordingly to personnel availability;
- Product usage: 160 g/day (first 30 days double amount 320 g/day).

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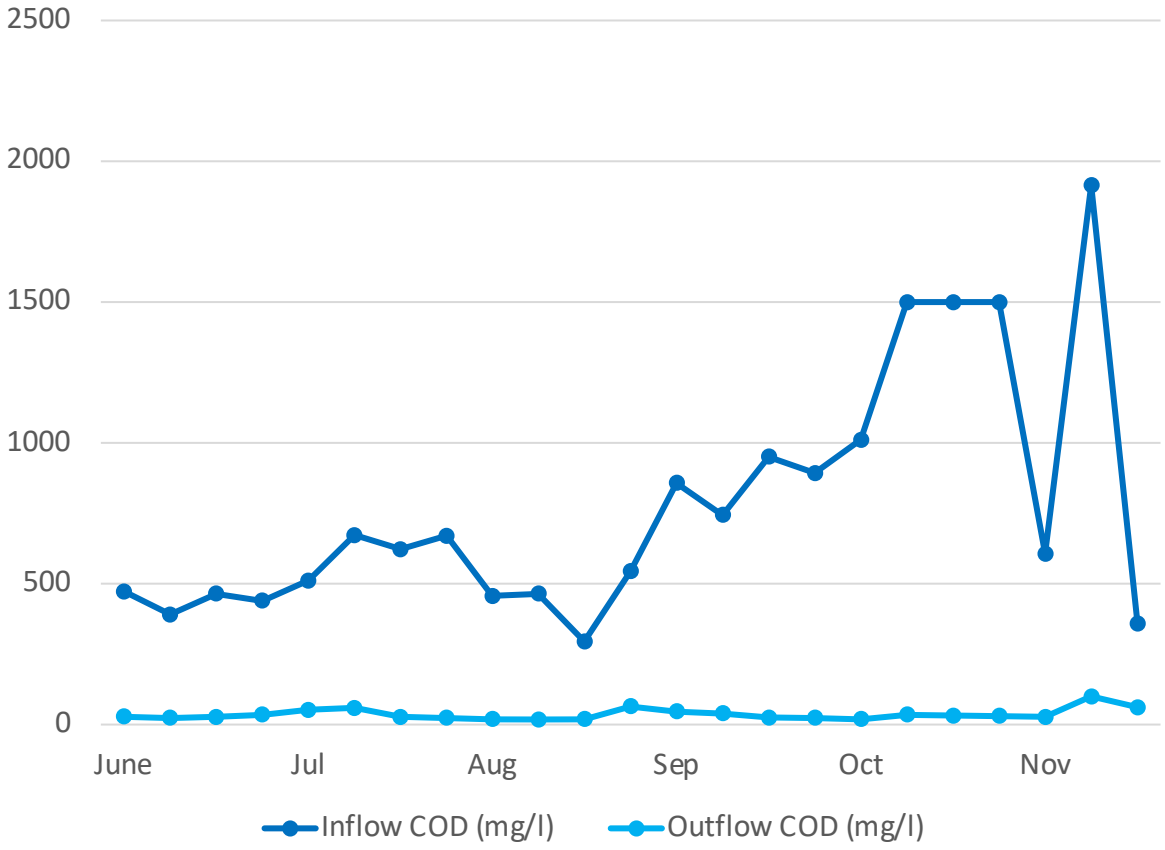
Inlet and Outlet parameters for COD



COD concentrations in the inlet vary from 450 mg/l to 1500 mg/l. Despite COD peaks and the return of the excess sludge into the inlet, the effluent parameters remain within limits (below 35 mg/l).

Higher COD outflow parameters are the result of the solids washout during wet weather or sludge drift caused by floating sludge in the secondary clarifier.

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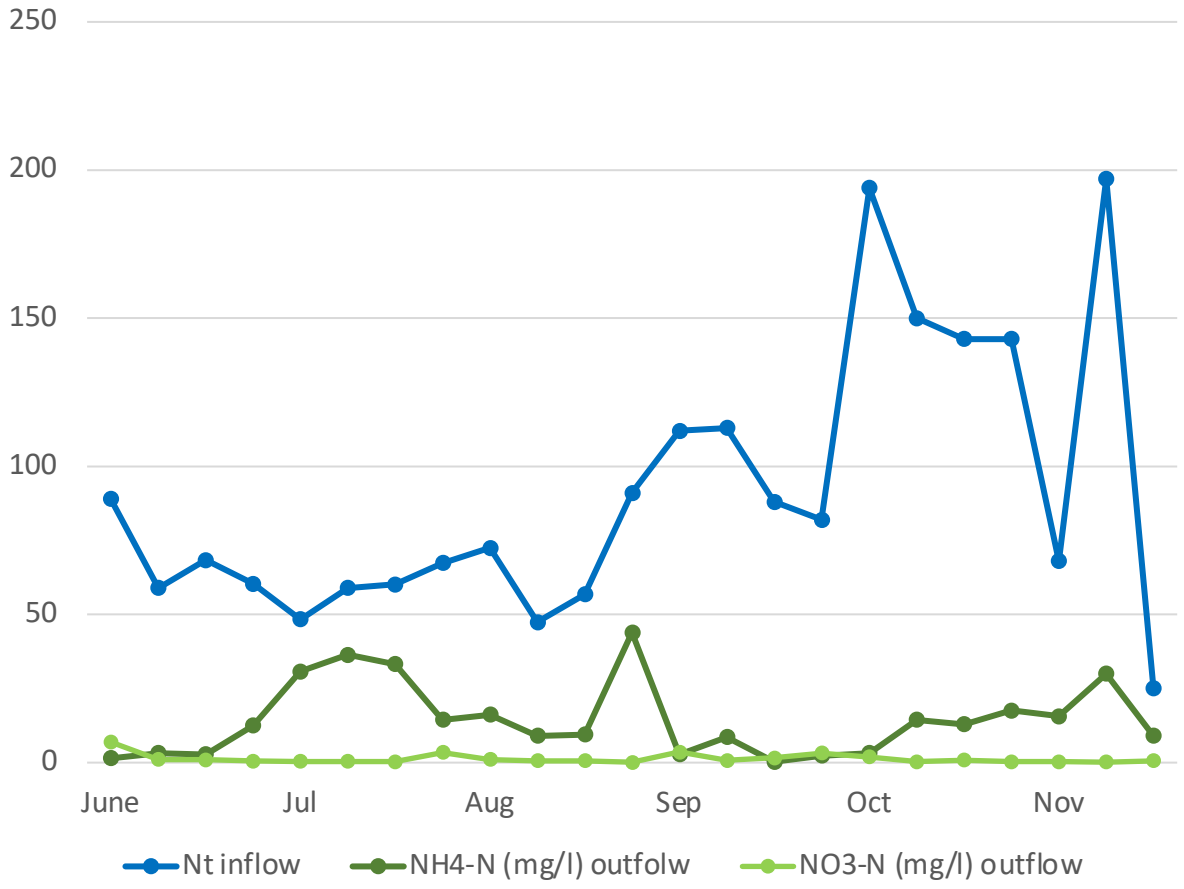
Inlet and Outlet parameters for Nitrogen



Inlet and outlet concentrations for the nitrogen parameters are shown in the left figure.

Similar to COD inflow parameters, the inflow concentrations for the Nt fluctuate a lot. Thus, when daily average oxygen concentration drops below 1mg/l, NH4-N removal decreases in a way that it peaks up to 15 mg/l. However, when oxygen content decreases the denitrification process improves (NO3-N is below 1 mg/l).

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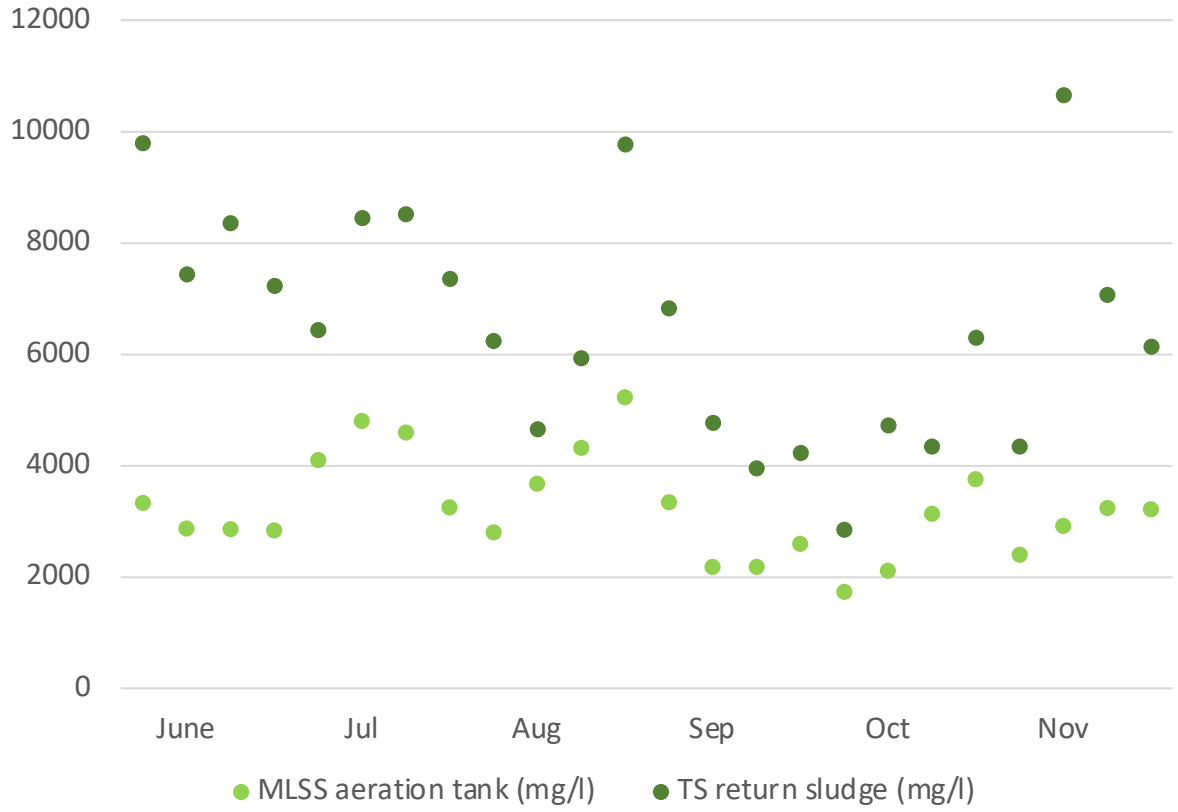
Aeration Tank and Return Sludge Concentration



The dots in the green tones are the solids concentration in the aeration tank and return sludge.

It can be seen that the solids content in the aeration tank is constant and the return sludge concentration is reducing despite continuous excess sludge overflow from the aerobic digester and thickener (6 m3/h) into the inlet of the WWTP.

The sludge blanket in the secondary clarifier remains relatively low and is in the range of 0.5 - 1m.

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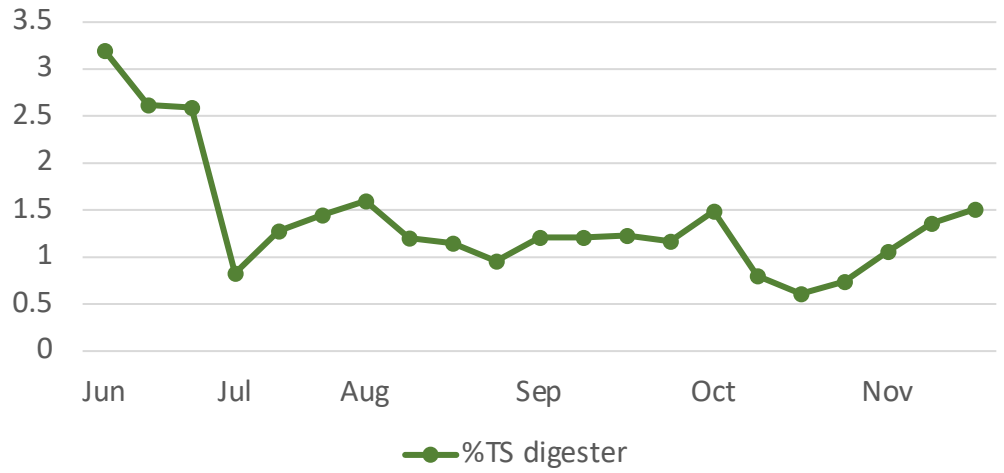
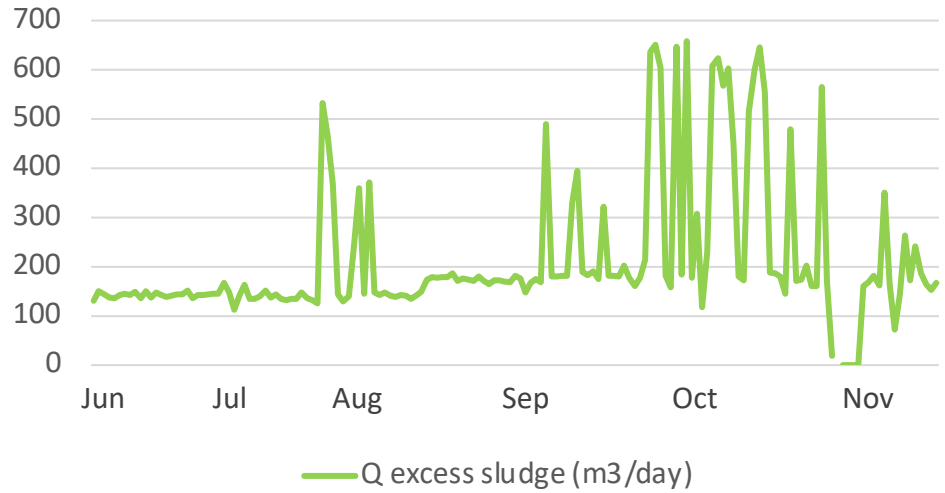
Reduction of the Solids Content in Aerobic Digester





Reduction of the total solids (%TS) form 3.2% to 0.83% in the aerobic digester without adjusting any parameters happened within the first 30 days of YDRO application and it can be seen in the top left figure.
Furthermore, despite increased recirculation of the excess sludge (ES) from 140 to 300 m3/day into the aerobic digester in October and November (bottom left figure), the solids content in the aerobic digester remain unchanged (top left figure).

The total solids reduction in dry solids (DS) in the aerobic digester when compared before and during YDRO application is: 3.2% - 1.5% = 1.7%
1109 m3 (digester) * 17 kg/m3 (TS) = 18,85 tonnes.

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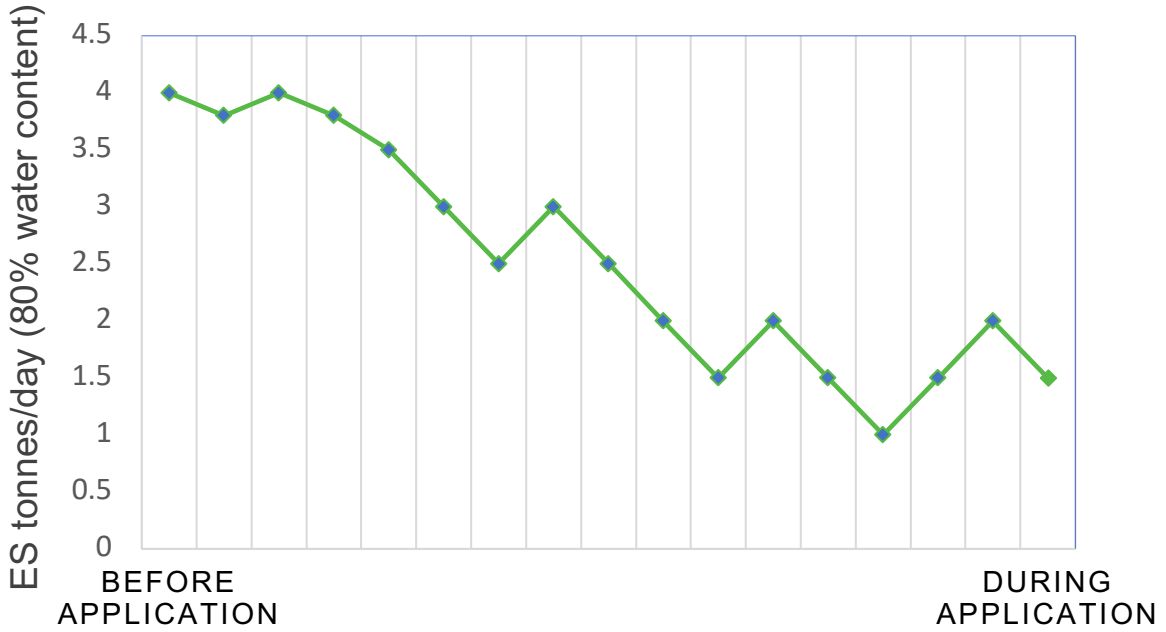
Reduction of the Excess Sludge

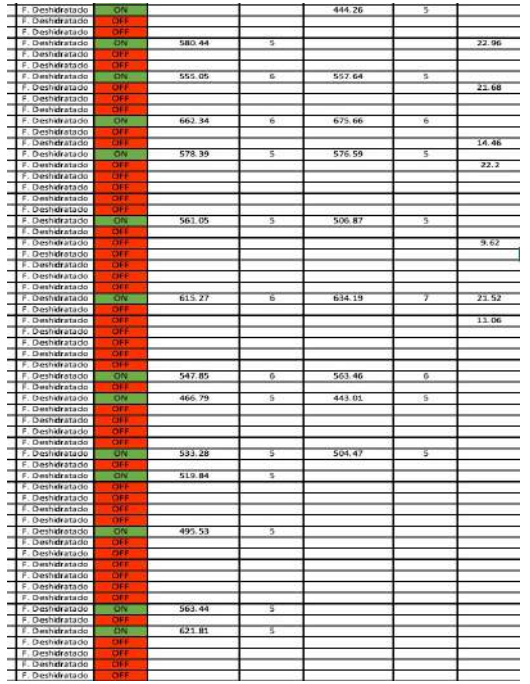
Excess sludge **reduction** more than **60%**



Before YDRO application **dewatering** process

Muestra	ON/OFF	Q.Centri 1 (m3/día)	H centri 1	Q.Centri 2 (m3/día)	H centri 2	Tn (mensual)
	OFF		5		4	22.64
F. Deshidratado	ON	516.45	5	460.6	0	
F. Deshidratado	ON	501.95	4		0	
F. Deshidratado	ON	680.33	4		2	
F. Deshidratado	ON	297.17	5	294.82	1	23.48
F. Deshidratado	ON	491.15	0	191.5	0	
F. Deshidratado	OFF		0		0	
F. Deshidratado	OFF		4		0	
F. Deshidratado	ON	389.64	0	234.59	3	
F. Deshidratado	OFF		0		0	
F. Deshidratado	OFF		5		0	23.7
F. Deshidratado	ON	483	2	487.93	5	
F. Deshidratado	ON	240.7	4	263.82	2	
F. Deshidratado	OFF		0		4	
F. Deshidratado	OFF		0		0	
F. Deshidratado	ON	483.08	5	456.39	0	24.34
F. Deshidratado	ON	129.07	1		5	
F. Deshidratado	ON		5	528.36	5	
F. Deshidratado	ON	217.13	0		0	
F. Deshidratado	ON		6	578.02	6	
F. Deshidratado	OFF		0		0	
F. Deshidratado	OFF		0		0	21.64
F. Deshidratado	ON		0	383.36	4	
F. Deshidratado	ON	475.07	4		0	
F. Deshidratado	ON		0	501.08	4	
F. Deshidratado	ON	489.64	6		0	
F. Deshidratado	OFF		0		0	
F. Deshidratado	OFF		0		0	

During YDRO application **dewatering** process



Dewatering **No dewatering**

Excess sludge (ES) during YDRO application: 1.66 tonnes per day (80% water content)

*Excess sludge before YDRO application:

- 142 m3/day (ES to digester) * SS 9.8 kg/m3 = 1392 kg/d (DS)
- 1392 kg/d (ES) * 0.6 (digester efficiency) = 835 kg/d (DS)
- 835 kg/d (ES) / 0.2 = 4.18 tonnes/d (80% water content)

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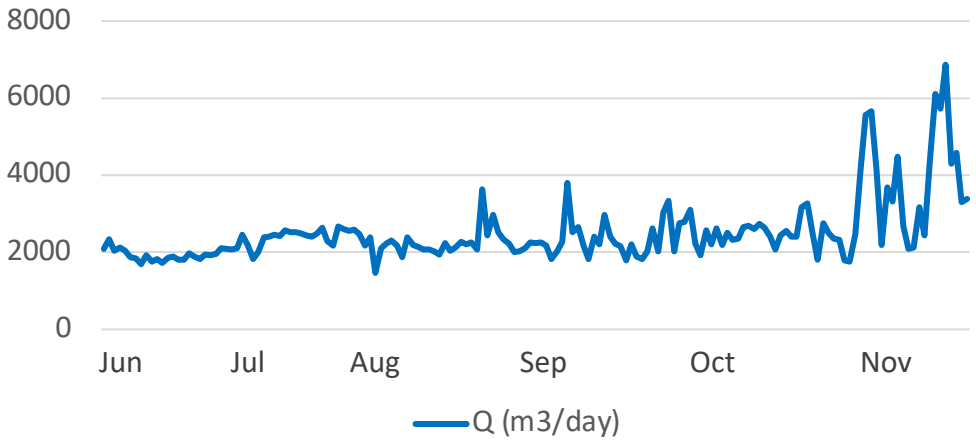
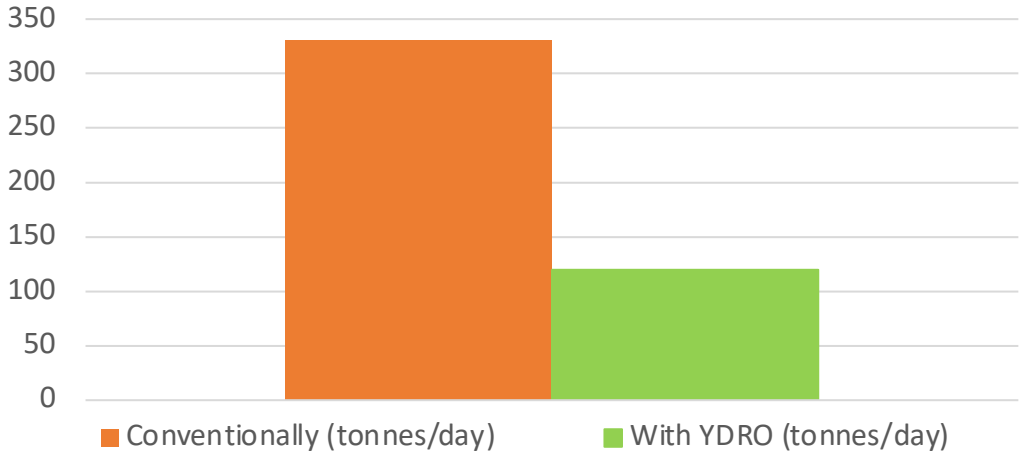
Sludge Reduction in October & November

The variation of the flow parameters (Q) in October & November > 3000 m3/day (average).



ES in October & November during YDRO application in October & November: **(reduction more than 60%)**.



Excess sludge (ES) is being discharged directly to the aerobic digester and after disposed to the inlet of the WWTP. The ES is removed (20 - 40% of the existent) only to maintain the MLSS concentration in the aeration tank > 3500 mg/l, while relatively short residence time and low dissolved oxygen concentration limit the efficiency of further degradation of the ES in the aeration tank.

*Excess sludge production in October & November (conventionally):
4.18 tonnes/day (Q 2100 m3/day) * 1.3 (Q 3000 m3/day) * 61 days = 331 tonnes (80% water content) and can be seen in the right figure.

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Conclusion & Recommendations

Conclusion

The implementation of Ydro Process® technology in Andratx WWTP shows that the wastewater treatment plant can be operated without significant sludge removal, despite high COD inflow parameters if the excess sludge is hydrolyzed in the aerobic digester and thickener and some anoxic zones of the aeration tank. As a result, the concentration of the organic acids increases, and the concentration of solids (in the aerobic digester, thickener, and aeration tank) decreases, thus it allows us to return the excess sludge into the inlet of the WWTP to maintain the balance and to retain the facultative bacteria in the system. Furthermore, the organic acids are converted to Carbon Dioxide (CO2) and water (H2O) in aerobic conditions, and a small percentage of inorganic compounds of iron, sulfur, etc.

Recommendations

It is more economically efficient if YDRO Series Microorganisms® are dosed in the sewer system as this network is converted into a bioreactor that also treats the sewage. Thus, not only the influent parameters are significantly reduced, but the sewer grid is being cleaned as well. Furthermore, the odors, FOG in the collection system, and the pumping stations will be eliminated.

In addition, it is possible to achieve an even higher reduction of the excess sludge (by over 80%) if both aeration tanks and clarifiers are used (now only one line is in operation). With two lines in use, the hydraulic retention time (HRT) will be increased, thus extending the degradation of the contaminants in the wastewater. As a result, the nitrification will improve, and the NH4-N outflow concentrations will remain within lower limits.

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