

Simple Chemical Interventions at WWTW of Prestigious Hotel in County Donegal, Ireland Help Achieve Effluent Parameters Which Protect Beautiful Local Lough

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In February 2023, I was contacted by an engineering consultant in Ireland to help one of their clients achieve permitted effluent parameters on their RBC WWTW. The client is a prestigious hotel on a beautiful Loch, so the area was naturally protected as an AONB.

The client had low pH, high ammonia, high P (Phosphorus), high SS (suspended solids), high BOD (Biological Oxygen Demand) and high COD (Chemical Oxygen Demand) in the effluent which was alarming the Environmental Agency. The RBC (Rotating Biological Contactors) process had reached its limits and the dip in pH was worrying the client and the authorities.

Below I present the successful pilot test that we conducted and the improved results that we achieved.

A quick water analysis of the source water in the area allowed us to discover that the water is soft and low in alkalinity. When nitrification kicks in, the pH dips by the very nature of the chemistry/biochemical reaction. A quick intervention by dosing Sodium Carbonate, a readily, cheaply available chemical (Soda Crystals used in laundry) that is quite safe to handle, corrected the pH problem. The pH levels increased from as low as 4 to 7.5. We were dosing the soda crystals in the sewage lifting station which allowed good mixing.

The second problem that we had to address was the high ammonia. Again, by its very nature, the influent lacked Magnesium, an essential nutrient for Nitrifying bacteria. We started to dose Magnesium Chloride, an inexpensive readily available and safe chemical, we started to see an improvement in the levels of ammonia. BOD munching bacteria compete with Nitrifying bacteria which are slow to grow, so BOD needs to be removed first on the early stages of the RBC before ammonia can start to be removed. This can be seen in the colour of the biofilm which changes from dark brown thick biofilm to being less dense biofilm.

To address the Phosphate problem, we resumed the dosing of Poly Aluminium Chloride which had been interrupted and this problem was solved too. Aluminium reacts with Phosphorus chemically and precipitates out of the water in the final settling tank. The trick is to have good mixing before the final settling tank.

In the process of the pilot test, we performed a lab analysis on the final effluent and we proved that the BOD is carrying over as light flocs and that there was filamentous bacteria in the effluent too. So to improve settleability and help reduce the COD we started to dose Powdered Activated Carbon. This brought us to the finish line and helped reduce BOD, SS and COD. PAC also helps polish off any Ammonia that was not removed biologically.

Since December 2023, we are achieving consistently good effluent parameters which has made the team very proud and happy. This pilot test has proven that sometimes good knowledge of water chemistry and microbiology is essential to solve water treatment problems. One of the other options that we considered to reduce SS and BOD, was to dose a flocculent polymer before the final settling tank but that required a high OPEX intervention. There was a lot of trial and error that we had to go through to find the optimal dosing points of the chemicals, but we pulled through.

Below are some of the tabulated results:

Date	Date	Date	Date	Date	Date	Date	Test	Unit
3/3/22	6/4/22	3/5/22	7/6/22	7/6/22	2/8/22	5/9/22		
5.82	6.27	4.21	7.45	6.25	7.42	7.49	pH	pH units
44.93	41.6	26.3	81.1	89.45	113	111	BOD	mg/l
81	65	56.5	98	152	144	307	SS	mg/l
146	108	105	196	251	243	451	COD	mg/l
							Total P	mg/l
9.2	7.58	6.83	6.23	7.28	7.58	9.9	Ortho P	mg/l
2.35	4.65	2.34	8.16	10.23	13.33	14.1	Ammonia	mg/l
22.3	24.3	29.13	8.9	23.54	5.25	<.1	Nitrates	mg/l
3.33	2	1	2	6	8.67	32	FOG	mg/l
							Nitrite	
7.00	40.00	N/A	65.00	40.00	97.00	97.00	Total Alkalinity	mg/l
0.1	0.09	0.14	0.18	0.14	0.17	0.39	Total Aluminium	

Figure 1. Effluent Parameters from 2022 Show low pH, high BOD, SS, COD, P, and Ammonia

Test	Unit	Parameter	Date	Date	Date	Date	Date	Date	Date
pH	pH units	6 - 8.5	11/4/23	17/4/23	24/4/23	2/5/23	8/5/23	15/5/23	22/5/23
BOD	mg/l	20	112	64.1	69.1	32	95.8	96.4	14.9
SS	mg/l	35	122	74	151	79	110	124	31
COD	mg/l	80	574	143	211	147	169	227	69.1
Total P	mg/l								
Ortho P	mg/l	2	8.4	6	>6	>6	>6	>6	>6
Ammonia	mg/l	5	6.13	5.15	5.57	7.92		6.65	13.23
Nitrates	mg/l	37.5	8.4	15.6	3.18	3.26	3.85		0.13
FOG	mg/l	10	1	36	1	NA	14	NA	8
Nitrite		N/A							
Total Alkalinity	mg/l		105.00	73.00	144.00	146.00	114.00	82.00	0.06
Total Aluminium			0.3	0.24	0.05	0.09	0.09	0.1	0

Figure 2. Effluent Parameters from 2023 Show improved pH, high BOD, SS, COD, P, and Ammonia

Test	Unit	Parameter	Date	Date	Date	Date	Date	Date
			21/11/23	27/11/23	5/12/23	11/12/23	2/1/24	9/1/24
pH	pH units	6 - 8.5	6.6	7.26	4.73	7.79	6.85	5.09
BOD	mg/l	20	22.1	73	17.3	44.4	62.8	14.9
SS	mg/l	35	58	217	55	87	59	33
COD	mg/l	80	87.1	210	62.1	116	136	95
Total P	mg/l							
Ortho P	mg/l	2	2.93	0.55	0.93	0.36	0.99	1.73
Ammonia	mg/l	5	1.43	5.43	0.12	0.12		
Nitrates	mg/l	37.5	10.2	5.78	25.1	9.88	14.1	25.2
FOG	mg/l	10	<1	9	<1	6	2	5
Nitrite		N/A						
Total Alkalinity	mg/l		14.00	92.00	2.00	60.00	68.00	6.00

Figure 3. Final breakthrough with BOD, SS, COD, Ammonia achieved in late 2023 and early 2024

A site visit in October 2024 by an RBC expert showed that there was carryover of scum from the PST and that the sludge pump was not working optimally. We expect these mechanical interventions to further improve the parameters.

I hope you have enjoyed this article. Feel free to contact us for any complex chemistry/water treatment issues you may have. The solution could be surprisingly simple !

Acronyms:

BOD = Biological Oxygen Demand

COD = Chemical Oxygen Demand

SS = Suspended Solids

FOG = Fat Oil and Grease

RBC = Rotating Biological Contactor, a type of sewage treatment plant

OPEX = Operational Expenditure

P = Phosphorus