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Pulse Oxidation System at GEA Farm Technologies Warminster Chemical Production Facility

EXECUTIVE SUMMARY

This report documents the successful integration and performance of the Pulse Oxidation water treatment system within the RO water storage and distribution network at GEA Farm Technologies UK in Warminster. The site had experienced persistent and severe Pseudomonas contamination within its process water, leading to production interruptions and the inability to manufacture certain chemical products.

Despite existing treatment measures including filtration, softening, reverse osmosis, and ultraviolet disinfection, Pseudomonas levels remained unmanageable. The Pulse Oxidation system was installed within the RO water system to provide continuous aqueous activated oxygen treatment throughout the distribution network.

Following system cleaning and continued operation of the Pulse Oxidation unit, the recirculating distribution loop was maintained at non-detectable Pseudomonas levels despite daily inflows of up to 12,000 litres of RO water containing bacterial counts considerably over the permitted production limits. The system has demonstrated its ability to control biofilm regrowth and maintain water quality without the addition of residual chemicals or frequent cleaning of the system and pipework.

This reduction allowed the site to restart production of previously restricted chemical products while maintaining compliance with internal microbiological limits. The report confirms the Pulse Oxidation system as an effective, chemical-free solution for maintaining microbiological control in high purity process water systems.

GEA

SITE BACKGROUND AND OPERATIONAL CHALLENGE

GEA Farm Technologies UK operates a chemical production facility at its Warminster site. Process water quality is critical, as the water is directly used in chemical manufacture and must remain free from residual disinfectants such as chlorine or peracetic acid.

The site sources water from mains which passes through a series of storage and treatment stages before use: mains storage tank → filtration → softener beds → reverse osmosis → RO storage tank. From the RO storage tank, water is continuously recirculated around the plant via a distribution ring before returning to the tank. This ring main includes multiple branches and potential dead legs, increasing the risk of biofilm formation. The site can use up to 12,000 litres per day.

Over time, the site experienced persistent and escalating Pseudomonas contamination throughout this system. Historical laboratory data could only report results as greater than 100 CFU per 100 ml, the upper reporting limit of their routine testing method. This contamination ultimately forced the site to halt production of some chemical products until readings could be reduced below 10 CFU per 100 ml.

Prior to the Pulse Oxidation system, GEA had implemented a UV disinfection unit installed at the end of the RO recirculation loop. The UV unit treated only the water passing directly through it and could not address established biofilm within the RO tank, pipework, or dead legs. As a result, Pseudomonas counts remained high and unpredictable across the site.

This highlighted the need for a treatment solution that could actively circulate throughout the entire distribution network and continuously suppress biofilm regrowth.

PULSE OXIDATION SYSTEM INTEGRATION

The Pulse Oxidation system was installed at the start of the RO distribution ring immediately downstream of the RO storage tank. This location was selected to ensure that aqueous activated oxygen could be distributed throughout the entire recirculation loop, reaching all downstream pipework points of use and return lines.

The system generates a low level of activated oxygen directly within the water stream 24/7, providing a powerful oxidant capable of penetrating biofilm and inactivating Pseudomonas throughout the system. As the activated oxygen concentration is low and naturally degrades back into oxygen, it leaves no chemical residue within the process water.

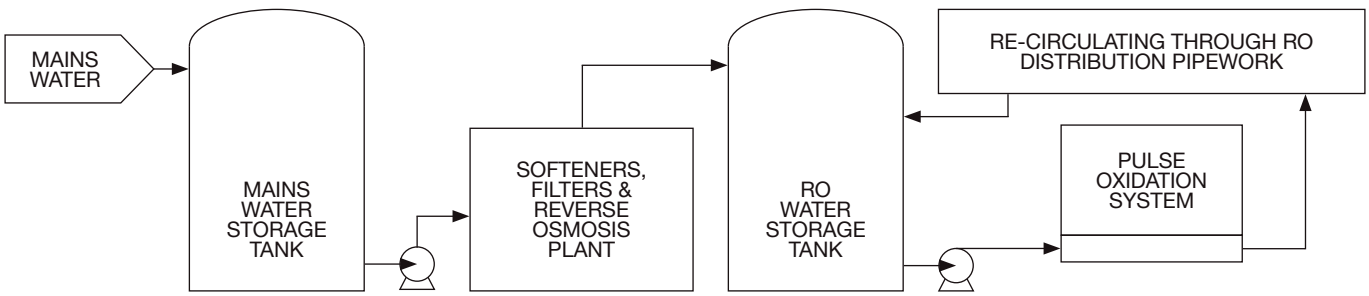
INITIAL PERIOD AND EXPANDED TESTING

During the initial months of operation, there was no visible improvement in reported microbiological results based on the site's routine laboratory testing. The majority of results continued to be reported as greater than 100 CFU per 100 ml.

To better understand the true scale of contamination, independent samples were taken and analysed at a laboratory capable of higher enumeration limits. These results revealed extreme contamination levels across the entire water system including the mains supply, storage tank, filtration, softeners, RO system, and RO storage tank.

Measured values were in the hundreds of thousands CFU per 100 ml, with the highest recorded result reaching approximately 800,000 CFU per 100 ml in water entering the RO recirculation system. Up to 12,000 litres per day of highly contaminated water were entering the system where the Pulse Oxidation unit was situated. At this stage, the incoming microbial load combined with extensive established biofilm across the system exceeded what any continuous maintenance treatment could reasonably control without first removing the existing contamination.

Figure 1:
Schematic of Pulse Oxidation system's installation location.



SYSTEM CLEANING AND ONGOING PULSE OXIDATION PERFORMANCE

Following confirmation of the severity of contamination, GEA carried out a full system clean using hypochlorite and peracetic acid across all tanks and pipework. This intervention successfully reduced Pseudomonas levels across the system.

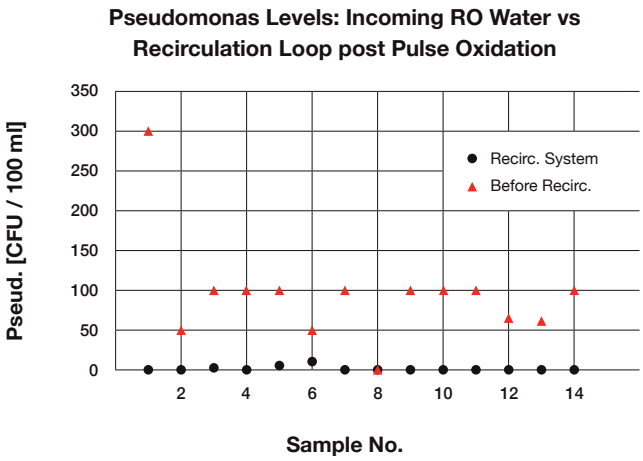
Post-clean monitoring showed that water before the RO storage tank could still exceed the maximum reported 100 CFU per 100 ml of Pseudomonas, ten times the limit that would halt production of certain chemicals. Within the RO storage and recirculation ring, the Pulse Oxidation system was able to maintain water below 10 CFU per 100 ml for over three months, even when incoming RO water contained microbial loads exceeding measurable limits.

As shown in **Table 1** and **Figure 2**, the Pulse Oxidation system consistently reduced Pseudomonas levels within the recirculation loop to near or non-detectable levels following the system clean.

Table 1:

Pseudomonas Levels: Incoming RO Water vs Recirculation Loop post Pulse Oxidation				
Date	Sample No.	Recirc. System	Before Recirc.	% Reduction
15 Oct 25	1	0	>300	>99.6%
29 Oct 25	2	0	50	>98%
30 Oct 25	3	1	>100	>99%
01 Nov 25	4	0	>100	>99%
06 Nov 25	5	5	>100	>95%
11 Nov 25	6	10	49	79.6%
14 Nov 25	7	1	>100	>99%
20 Nov 25	8	0	0	N/A
26 Nov 25	9	0	>100	>99%
06 Dec 25	10	0	>100	>99%
11 Dec 25	11	0	>100	>99%
19 Dec 25	12	0	65	>98.4%
23 Dec 25	13	0	61	>98.3%
07 Jan 26	14	0	>100	>99%
Mean		1.21	>94.6	>98.7%
Geometric mean: GM(x|x = 0 → 0.5)		<0.81	>62.7	>98.7%

Figure 2:

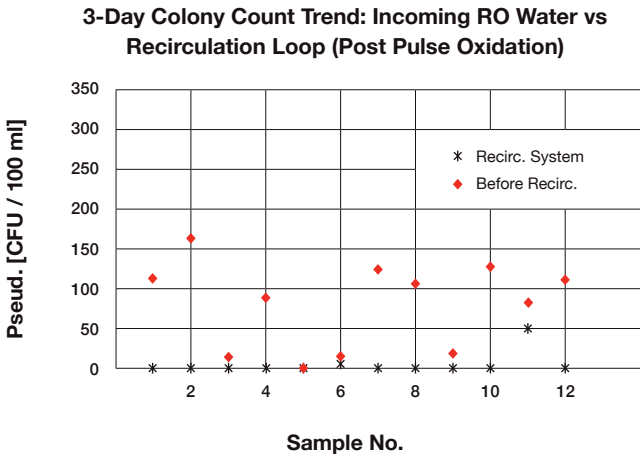


Despite incoming RO water containing counts exceeding 100 CFU per 100 ml, the recirculation system maintained mean levels of just 1.21 CFU per 100 ml, representing an average reduction of over 98%. The geometric mean reduction also exceeded 98%, confirming the system's ongoing ability to suppress biofilm regrowth and maintain water quality suitable for chemical production and other high purity industrial applications.

Table 2:

3-day colony count [CFU / ml]				
Date	Sample No.	Recirc. System	Before Recirc.	% Reduction
30 Oct 25	1	0	114	>99.1%
01 Nov 25	2	0	163	>99.3%
06 Nov 25	3	0	14	>92.8%
11 Nov 25	4	0	89	>98.8%
14 Nov 25	5	1	1	0.0%
20 Nov 25	6	5	16	68.8%
26 Nov 25	7	0	123	>99.1%
06 Dec 25	8	0	106	>99.0%
11 Dec 25	9	0	18	>94.4%
19 Dec 25	10	0	124	>99.1%
23 Dec 25	11	51	84	39.3%
07 Jan 26	12	0	112	>99.1%
Mean		4.75	80.3	94.1%
Geometric mean: GM(x|x = 0 → 0.5)		<0.94	46.5	>98.0%

Figure 3:



As shown in **Table 2** and **Figure 2**, the Pulse Oxidation system effectively controlled microbial regrowth over a 3-day incubation period within the recirculation loop. Even when incoming RO water contained colony counts up to 163 CFU per ml, levels within the recirculation system were consistently reduced to near or non-detectable levels. The mean reduction across all samples was 94.1%, with a geometric mean reduction exceeding 98%, demonstrating the system's ability to prevent biofilm reestablishment and maintain water quality suitable for high purity process applications.

This demonstrates that the Pulse Oxidation system was not only maintaining cleanliness after chemical cleaning but actively controlling incoming Pseudomonas and microbial load, preventing biofilm reestablishment within the RO distribution network.

WHY PULSE OXIDATION WAS CRITICAL FOR THIS APPLICATION

The use of aqueous activated oxygen was particularly well suited to this application due to the nature of the process water. The site requires microbiologically clean water without the presence of residual disinfectants that could interfere with chemical formulation or product quality. Unlike chlorine or other chemical based approaches, activated oxygen does not introduce residual chemistry that could interfere with downstream functionality.

Activated oxygen provides rapid and effective microbial inactivation while naturally decomposing back into oxygen. This allows continuous treatment and maintenance of the system without the need for expensive, regular shutdowns and CIP procedures.

COMMERCIAL AND OPERATIONAL IMPACT

By restoring microbiological control within the water system, GEA has been able to restart production on certain products while improving quality in others. The system reduces reliance on periodic chemical cleaning, minimises downtime, and lowers the long-term risk of biofilm-driven contamination events.

From a commercial perspective, the report demonstrates the value of Pulse Oxidation as a permanent infrastructure solution rather than a reactive cleaning tool.

CONCLUSION

The Pulse Oxidation system at GEA Farm Technologies UK has demonstrated that it can successfully control extreme microbiological contamination within a complex RO-based water distribution system. Even under challenging conditions with highly contaminated incoming water, the system maintained zero detectable Pseudomonas levels within the recirculation loop.

This case study confirms the suitability of Pulse Oxidation technology for high purity industrial water systems requiring chemical-free microbiological control across a wide range of industries using RO water storage and distribution, including chemical, food and beverage, and pharmaceutical production.

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