Oxi-Tech

Chemical-free, CIP, Pulse Oxidation™ technology.

Validation of the Oxi-Tech Pulse Oxidation™ system within a dairy farm Clean In Place (CIP) process at Yeo Valley Farms' Yoxter Farm

EXECUTIVE SUMMARY

This report evaluates the performance of the Oxi-Tech Pulse Oxidation (PO) system within Yeo Valley Farms' Yoxter Farm CIP process, focusing on its suitability as a method to reduce reliance on traditional chemical and hot water cleaning for dairy applications. The system is used to reduce the use of conventional hot CIP chemical washes, by replacing them with cold Pulse Oxidation, reducing chemical consumption and hot water usage while maintaining hygiene performance, and supporting a more sustainable CIP process.

At Yoxter Farm, the replacement level was progressively increased from 1:1 to 2:1 and then 3:1, allowing performance to be assessed as system utilisation increased. At a 3:1 replacement ratio, this equates to a 75% reduction in chemical and hot water usage.

Milk quality performance was reviewed using Bactoscan results from the operating period of the Pulse Oxidation system and compared against matched historical data from the same time of year, using results from 2019 to 2024. This seasonal comparison approach was used to reduce distortion from factors such as weather and cow drying-off patterns.

Across the full study period, the geometric mean Bactoscan level during Pulse Oxidation operation was 17.8 IBC x1000/mL, compared with 25.3 IBC x1000/mL for the matched historical comparator. **This represents a 30% reduction in Bactoscan level during Pulse Oxidation operation, achieved while replacing a significant proportion of conventional chemical washes. At a 3:1 replacement ratio, this corresponds to a 75% reduction in hot water and chemical usage within the CIP system.**

The data shows that the Oxi-Tech Pulse Oxidation system can be integrated into a live dairy CIP process while maintaining competitive milk hygiene performance as wash replacement increases. This supports a strong case for dairies looking to reduce chemical use, cut hot water demand, lower ongoing CIP running costs, and simplify day-to-day cleaning operations, while also reducing the environmental impact associated with chemical consumption, chemical discharge, and hot water heating. Use of this cold process represents a reduction in energy bills to assist with profitable and efficient farm operations.

BACKGROUND

Dairy producers rely on effective CIP cleaning to maintain hygienic conditions across milking and associated process equipment. Conventional programmes typically require hot chemical washes, which add operating cost, safety handling requirements, and environmental impact.

Oxi-Tech Pulse Oxidation system generates a solution from cold water using diamond electrodes and low voltage current to energise oxygen molecules within the water. The system is designed to reduce the use of chemical and hot water in a conventional CIP chemical programme. For dairy sites, it offers a route to reduce chemical and hot water use while still maintaining hygienic performance across the parlour.

At Yoxter Farm, the Pulse Oxidation system was introduced in a staged manner. The study began at a 1:1 replacement ratio, then moved to 2:1, and finally to 3:1, with the 3:1 ratio equating to a 75% reduction in chemical and hot water usage. This phased approach allowed confidence to be built progressively while generating performance data at increasing levels of chemical wash replacement.

Milk Bactoscan results were used as the main performance indicator for this study. Historical site data dating from 2019 to 2024 was reviewed, and only results from the same part of the year were used as the benchmark comparator so that seasonal effects were reflected in the comparison. Bactoscan results can be influenced by a range of factors beyond the CIP system itself, including herd health, milking hygiene, equipment condition, weather conditions, and other day-to-day farm or process variations. Peaks are therefore common and expected and were seen in both the historical data under conventional chemical cleaning and during Pulse Oxidation operation. For that reason, individual peaks should not automatically be attributed to the CIP unit alone, and the data is best interpreted through the overall trend across the study period.

DATA OVERVIEW

The dataset covers PO (Pulse Oxidation) operation from 02 December 2025 to 16 March 2026 and includes three staged operating periods: 1:1 wash replacement, 2:1 wash replacement, and 3:1 wash replacement.

To create a fair comparison, the historical benchmark was taken from Bactoscan results occurring at the same time of year as the PO operating period, using data from 2019 to 2024. Historical results within this period were linked to the closest PO data point, and a geometric mean was applied across those matched values. These derived values are shown as the scatter points. A rolling geometric mean (RGM) was also applied to the trend line to smooth high spikes and show the underlying sustained performance trend more clearly, rather than allowing isolated peaks to dominate the interpretation.

In this report, the raw PO and historical points are shown alongside their rolling geometric mean trend lines. This is particularly useful for dairy Bactoscan data where occasional spikes can distort a simple arithmetic average.

Wash	PO Geometric Mean Bactoscan [IBC, *1000/mL]	Historical Geometric Mean Bactoscan [IBC, *1000/mL]	PO vs Historical
1:1	17.2	39.8	**57% reduction**
2:1	15.7	25.4	**38% reduction**
3:1	20.0	20.3	**2% reduction**
Full study period	17.8	25.3	**30% reduction**

Table 1. Geometric mean Bactoscan comparison between PO operation and matched historical seasonal data

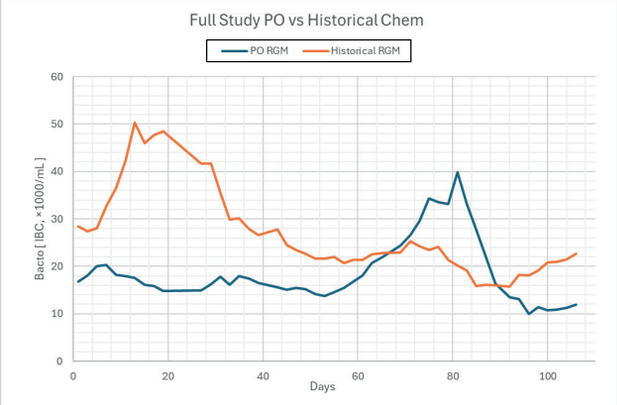

Figure 2. Rolling geometric mean Bactoscan trend for PO operation versus matched historical seasonal data across the full study period

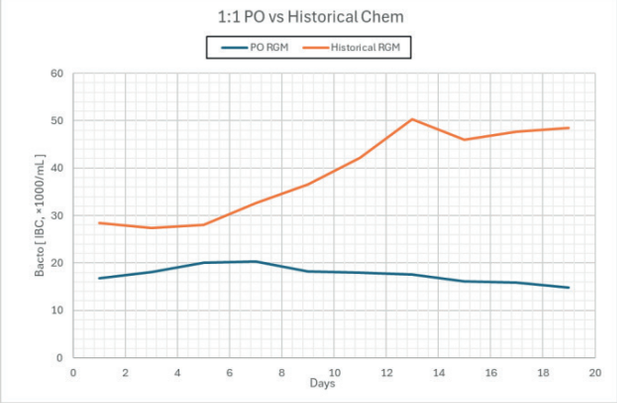

Figure 3. 1:1 wash replacement rolling geometric mean comparison

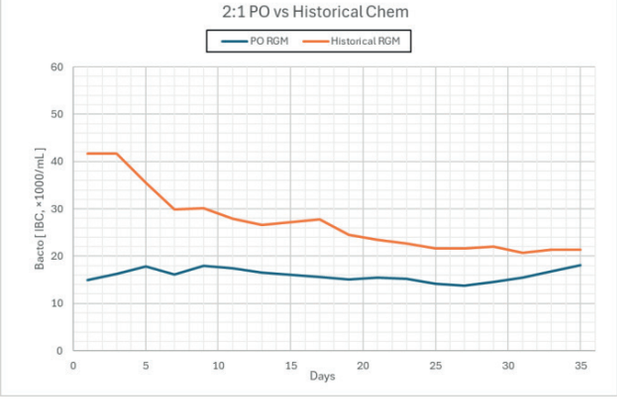

Figure 4. 2:1 wash replacement rolling geometric mean comparison

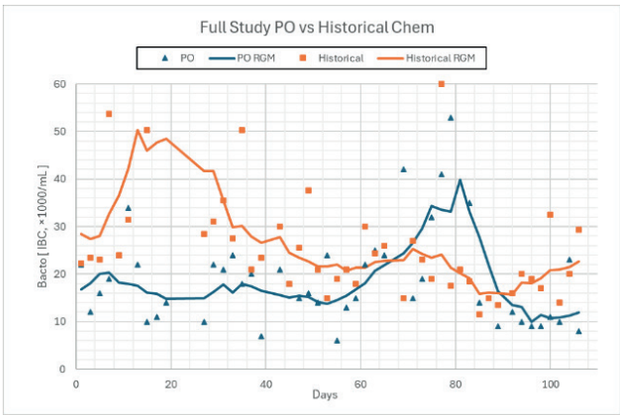

Figure 5. 3:1 wash replacement rolling geometric mean comparison

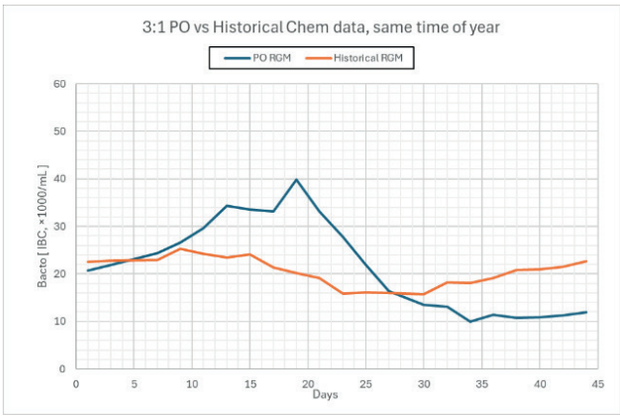

Figure 6. Full study period data and rolling geometric mean comparison

Figure 7. Pulse Oxidation System installed at Yeo Valley Farms' Yoxter Farm

FINDINGS

The full study trend shows Bactoscans during Pulse Oxidation treatment, running below the matched historical comparator for most of the operating period. This indicates that the system maintained competitive milk hygiene performance while replacing a substantial proportion of conventional hot chemical washes.

At a 1:1 replacement ratio, Pulse Oxidation achieved a geometric mean Bactoscan of 17.2 compared with 39.8 for the matched historical comparator, equivalent to a 57% reduction. At 2:1 replacement, performance remained strong at 15.7 versus 25.4, equivalent to a 38% reduction. At 3:1 replacement, the Pulse Oxidation geometric mean increased to 20.0, largely due to the peak shown in Figures 2 and 5. Even with this peak, the geometric mean still remained slightly below the historical comparator of 20.3, equivalent to a 2% reduction.

As discussed earlier in the report, individual Bactoscan spikes are expected within normal farm operation and can be influenced by factors beyond the CIP system itself. Peaks are seen in both the historical data and during Pulse Oxidation operation. As a result, isolated peaks should not be attributed to the Pulse Oxidation unit alone. The peak seen during 3:1 operation is therefore not unexpected, and similar peaks can be seen throughout the historical dataset, as shown in Figures 2 and 5.

Across the full study period, the geometric mean Bactoscan level during Pulse Oxidation operation was 17.8 IBC x1000/mL, compared with 25.3 IBC x1000/mL for the matched historical comparator. This represents a 30% reduction across the full study period while operating with progressively higher levels of chemical wash replacement. At a 3:1 replacement ratio, this equates to a 75% reduction in chemical and hot water usage within the CIP system.

Taken together, these results show that Pulse Oxidation remained effective as wash replacement increased, while also demonstrating that substantial reductions in chemical and hot water use can be achieved within a live dairy CIP process.

CONCLUSIONS

The data shows that the Oxi-Tech Pulse Oxidation system can be integrated into a live dairy CIP process while maintaining competitive milk hygiene performance as wash replacement increases. This supports a strong case for dairies looking to reduce chemical use, cut hot water demand, lower ongoing CIP running costs, and simplify day-to-day cleaning operations.

The Pulse Oxidation system also dramatically reduces the environmental impact associated with chemical consumption, chemical discharge, and hot water heating. This gives dairy operators a practical route to maintain or improve cleaning efficiency while reducing both resource use and the wider environmental burden associated with conventional hot chemical CIP programmes.

Overall, this study supports Pulse Oxidation as a lower chemical, lower hot water CIP strategy for dairy applications, with clear operational, cost, and environmental benefits.

Paul Morris, CEO,
Oxi-Tech Solutions Ltd.

Partnering with such a respected business as Yeo Valley has been a great experience for Oxi-Tech Solutions and our field engineering team.

Yeo's commitment to ensuring they reduce their impact on the planet, whilst continuing to grow their dairy and yoghurt production business is proof that they are dedicated to their mission of improving sustainability in all parts of their operation. In addition to this, they are genuinely nice people!

We are looking forward to building on our partnership with Yeo Valley Farms and the wider group in coming years.

Richard Greaves, Farms Manager,
Yeo Valley Farms

We're really pleased with the system; apart from the payback, POd is helping us on the right trajectory as we continue to push the boundaries with our adopted regen strategy, reduce the unit's C footprint and maintain a profitable and sustainable organic unit.

POd is enabling us to cut the chemical usage in our CIP system by 75% along with an accompanying 75% reduction in energy required to heat the water. Bactoscan has improved and we've 75% fewer blue barrels to dispose of. Furthermore, the workplace health and safety has significantly improved.

We are pioneering, continually seeking out and adopting new technologies to lower our C footprint, and POd is among them. It was a calculated risk, however before investing, we thoroughly researched the system and came to the conclusion the potential savings in chemicals and energy would contribute to those incremental gains we're already making, and equally important the bottom line would stand up.

Oxi-Tech support has been really good from installation through to backup service; any queries have been dealt with on the phone, while we've downloaded the POd NextGen app which enables us to see the herd's Bactoscan and SCC data alongside CIP performance data in one single dashboard, allowing us to respond if necessary and in turn stay ahead of any quality or hygiene issues.

APPENDIX

Appendix A: Additional graph set

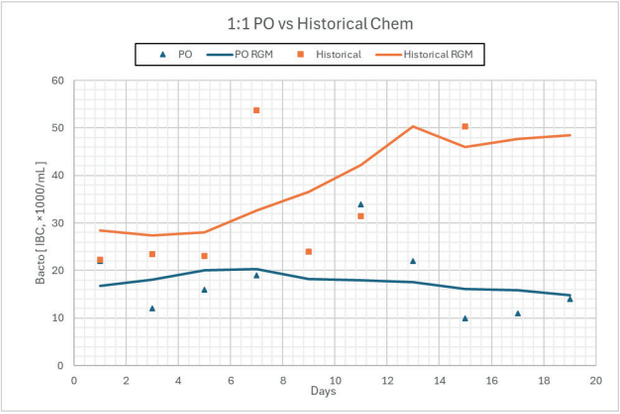

Figure A1. 1:1 wash replacement with raw data and rolling geometric mean

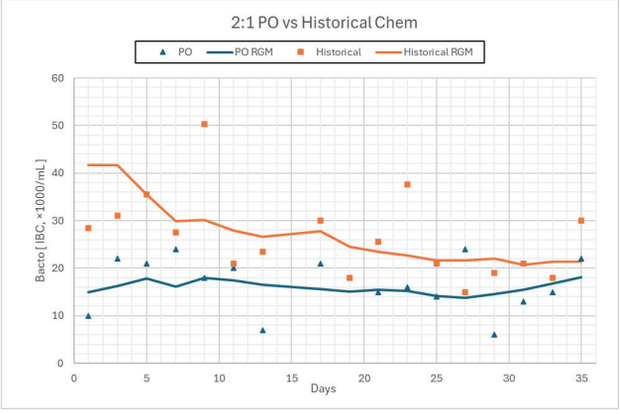

Figure A2. 2:1 wash replacement with raw data and rolling geometric mean

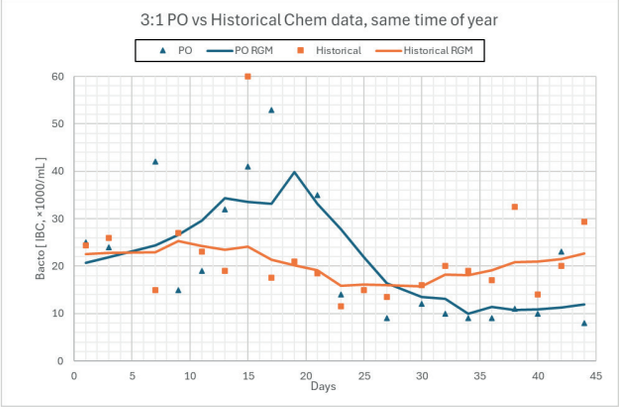

Figure A3. 3:1 wash replacement with raw data and rolling geometric mean

Appendix B: Calculation method and data analysis

This appendix sets out the calculation process used to generate the matched historical data, the stage-by-stage summary values, and the trend plots presented in the main body of this report. It is included to provide transparency on how the Bactoscan comparison was constructed and interpreted.

B1. Source data

Two datasets were used in the analysis. The first was the Bactoscan dataset recorded during Pulse Oxidation operation at Yoxter Farm between 02 December 2025 and 16 March 2026. The second was the site historical Bactoscan dataset used as the baseline for comparison, using results from 2019 to 2024.

Bactoscan was selected as the primary performance indicator because it provides a consistent measure of bacterial load in collected milk and was available across both the operating period and the historical reference period.

B2. Segmentation of the study period

The Pulse Oxidation operating period was divided into three sections to reflect the staged increase in wash replacement ratio: 1:1, 2:1, and 3:1. These sections were analysed separately and were also combined to create the full-study comparison.

This allowed performance to be assessed at each replacement level rather than relying only on a single overall average.

B3. Construction of the matched historical comparator

A direct comparison against the full historical record would have been misleading because Bactoscan levels can vary through the year. To control for this, the historical benchmark was built from results occurring in the same seasonal period as the Pulse Oxidation operating dates, using historical data from 2019 to 2024.

In practice, the operating dates were aligned to the equivalent position within the year and historical results nearest to those seasonal dates (typically within ±1–2 days) were used as comparator points. Where more than one historical result fell on the same nearest comparison point, those values were combined using a geometric mean to produce the matched historical value for that position.

APPENDIX (CONT'D)

This seasonal matching method was chosen so that the study compared like with like as closely as possible, rather than comparing winter and early spring performance against unrelated parts of the year.

B4. Geometric mean summary calculations

Geometric mean values were used for the main summary comparisons because Bactoscan data is typically skewed and can be strongly influenced by occasional high spikes. A simple arithmetic mean can therefore overstate the impact of short-lived peaks.

For each comparison set, the geometric mean was calculated from the valid Bactoscan values using the standard logarithmic method: the natural logarithm of each value was taken, the average of those logarithms was calculated, and the result was then converted back by exponentiation. This approach gives a more representative measure of central performance for this type of dataset.

Separate geometric means were calculated for Pulse Oxidation data and matched historical data for the 1:1, 2:1, and 3:1 sections, as well as for the full study period.

B5. Improvement ratio calculation

The reduction shown in the report was calculated by comparing the Pulse Oxidation geometric mean with the matched historical geometric mean for the same section of data. This was expressed as a percentage reduction, where a positive value indicates lower Bactoscan levels during Pulse Oxidation operation than during the matched historical comparator period.

B6. Rolling geometric mean trend lines

In addition to the stage summary calculations, rolling geometric mean trend lines were produced for the Pulse Oxidation and matched historical datasets. These were used to show the sustained performance trend across time rather than focusing only on individual results.

A consistent centred rolling geometric mean was applied across the datasets, using three neighbouring points on either side of each result to calculate a local geometric mean. This reduces the visual impact of short spikes while preserving the direction of the underlying trend.

Raw data points were retained on the detailed graphs so that short-term variation remained visible alongside the smoothed trend line. The historical raw data points had already undergone the matching and geometric mean process described in Section B3.

B7. Graph generation

The report includes one full-study comparison graph and separate staged graphs for the 1:1, 2:1, and 3:1 sections. In each case, the plotted data was derived from the Pulse Oxidation results and the matched historical comparator generated by the seasonal matching method described above.

Two styles of graph were used during the analysis: rolling geometric mean comparisons for a clear high-level view, and raw-data-plus-trend plots to show both the underlying pattern and the short-term spread of values.

B8. Interpretation of peaks and overall trend

Bactoscan results can be affected by multiple influences outside the Pulse Oxidation unit itself, including herd health, milking hygiene, equipment condition, weather conditions, and other day-to-day farm or process variations. For that reason, isolated peaks were not treated as a standalone measure of system performance.

Instead, the main interpretation of the study was based on the sustained trend over the full operating period, supported by the geometric mean comparisons for each replacement ratio. Peaks are common in both the historical data and during Pulse Oxidation operation, so the peak seen during 3:1 operation was not treated as unexpected or unique in itself. This is why the report places greater weight on the overall trend across the study period than on any single short-lived spike.

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