BiOWiSH® TECHNOLOGIES

Case Study

BiOWiSH® Aqua

Bathurst Municipal Wastewater Treatment Works, New South Wales, Australia

Executive Summary

The main objective of the study was to quantify the cost savings of using BiOWiSH® Aqua. A secondary objective was to demonstrate and confirm that using BiOWiSH® Aqua has no detrimental effect, improves plant stability and operational efficiencies, and maintains the quality of effluent discharged.

The study compared two EAT (extended aeration tank) reactors at the Bathurst Municipal Wastewater Treatment Works in New South Wales, Australia. The wastewater in the first reactor was dosed with BiOWiSH® Aqua, while the other reactor was run normally. The control reactor was run using alum dosing to precipitate phosphorous while the BiOWiSH® tank was run without alum dosing.

Results of the 90-day test showed that treated effluent from the test reactor met the Bathurst Regional Council's discharge standards, proving that BiOWiSH® was able to achieve results similar to those of traditional methods, while reducing the need for additional chemicals. Furthermore, BiOWiSH® also reduced sludge production by 52.5%, according to sludge mass data.

At a time when municipal governments need to meet budget demands without raising taxes or cutting vital services to their citizens, the results of this study presents a significant opportunity for the Bathurst WWTW and other similar facilities to reduce operating and capital costs. The reduced cost of alum dosing and sludge disposal alone provides Bathurst WWTW with potential net savings in excess of $140,000 per year. Additional cost savings can be expected from reduced energy consumption, sludge handling, maintenance, and plant management.

The New South Wales Public Works, which assessed the findings, also reported that BiOWiSH® had a 50% faster sludge settling rate, which could potentially increase plant throughput without the need for additional capital expenditure.

The study also showed that BiOWiSH® had no adverse effect on the wastewater plant.

Background

The Bathurst WWTW currently treats up to 9.6 ML/day (average dry weather flow) through its two- 4.3 ML/day (EATs 6&7) and one- 1ML/day extended aeration tanks (EAT 1) . Full plant layout is as follows:

BiOWiSH® Aqua

- Rapid nitrification and denitrification in aerobic and anaerobic conditions
- Reduces sludge production
- Increases plant treatment capacity
- Reduces odors
- Reduces aeration requirements
- Reduces need for chemical additives
- Improves plant stability
- Pre-treats influent in collection systems
- Natural and non-toxic

Available Sizes

- 100g/3.5oz
- 1kg/2.2lbs
- 5kg/11lbs
- 10kg/22lbs

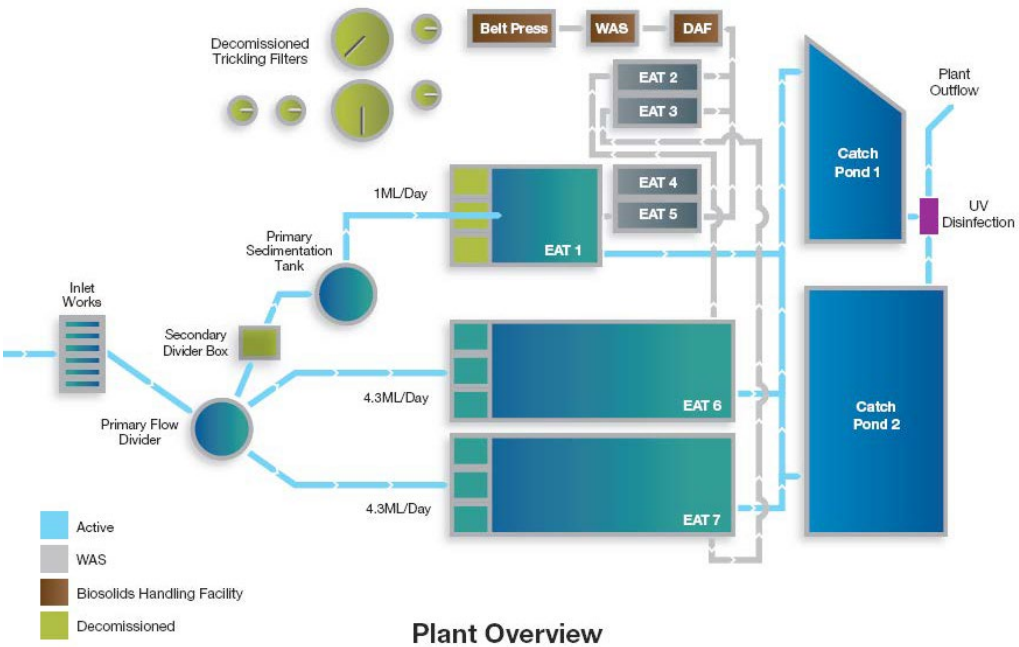


Figure 1. Plant layout and schematic

Historically, influent received by the Bathurst WWTW is a mix of 2/3 municipal and 1/3 industrial waste. The industrial loading can be comparatively high in BOD5 and has in the past contributed approximately 70% of the overall wastewater biological load on the plant. The plant, for the study, received influent typical in strength of domestic wastewater; however, the non-organic loading was considered high and varied daily in with an average COD with a standard deviation of 799mg/L and 200mg/L, respectively.

Objectives of Study

The main objective of this study was to quantify cost savings. A secondary objective was to demonstrate and confirm that using BiOWiSH® has no detrimental effect, improves plant stability and operational efficiencies, while maintaining the quality of effluent discharged.

Technology Used in Study

BiOWiSH® Aqua was selected because the influent had fat, oil and grease levels below 100 mg/L and the hydraulic retention time within the treatment process was greater than 12 hours. BiOWiSH has alternate technologies for systems with higher FOG content; however, for this particular application, BiOWiSH® Aqua was deemed the most appropriate technology.

Detailed Study Program

The 90 day study involved dosing BiOWiSH® Aqua into EAT 1 while EAT 7 was set as the control.

BiOWiSH® Reactor EAT 1

EAT 1 BiOWiSH® tank was run at a constant feed of 1 mL/day. The reactor volume is 1,480 m^3. The study started on an empty and clean tank, i.e. a “cold start”, with BiOWiSH® Aqua-dosed wastewater introduced to an empty dry reactor (no water, wastewater or biomass present) at study inception.

Wastewater to EAT 1 was dosed with BiOWiSH® Aqua at the secondary flow divider. The wastewater then progressed to an activated primary sedimentation tank where the combined sludge and settled effluent outflows were directed to EAT 1, bypassing EAT 1’s anoxic and anaerobic Bio-P chambers. However, the activated primary sedimentation tank has a detention time of more than six hours and acts as a pre-fermenter to generate volatile fatty acids (VFA) and an anaerobic selector zone that triggers initial phosphorus release by phosphorus accumulating organisms (PAOs, the work horses of bio-P), the first stage in the biological removal of phosphorous from the wastewater. While there are facilities to permit Return Activated Sludge (RAS) to be recycled from the EAT 1 reactor to its upstream activated primary tank or anoxic/ anaerobic Bio-P chambers, RAS pumping was not operated during the study.

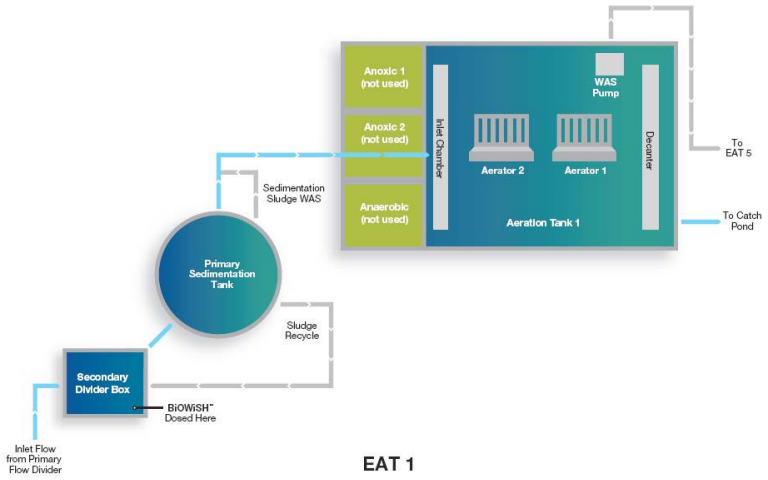


Figure 2: Schematic of Extended Aeration Tank 1

Control Reactor EAT 7

EAT 7 Control tank followed a diurnal flow pattern with an average flow of 3.3 mL/day during the study period. The reactor volume is 6,955 m^3. The arrangement for this control reactor is that wastewater enters directly into its anoxic/ anaerobic selector chamber for Bio-P treatment where it is then dispersed into EAT 7 at both ends of the reactor tank. Mixed liquor is recycled as RAS to the anoxic chambers to enhance nitrogen removal and ensure that recycled flows into the subsequent anaerobic zone are indeed anaerobic so that phosphorus release can take place on contact with the influent wastewater.

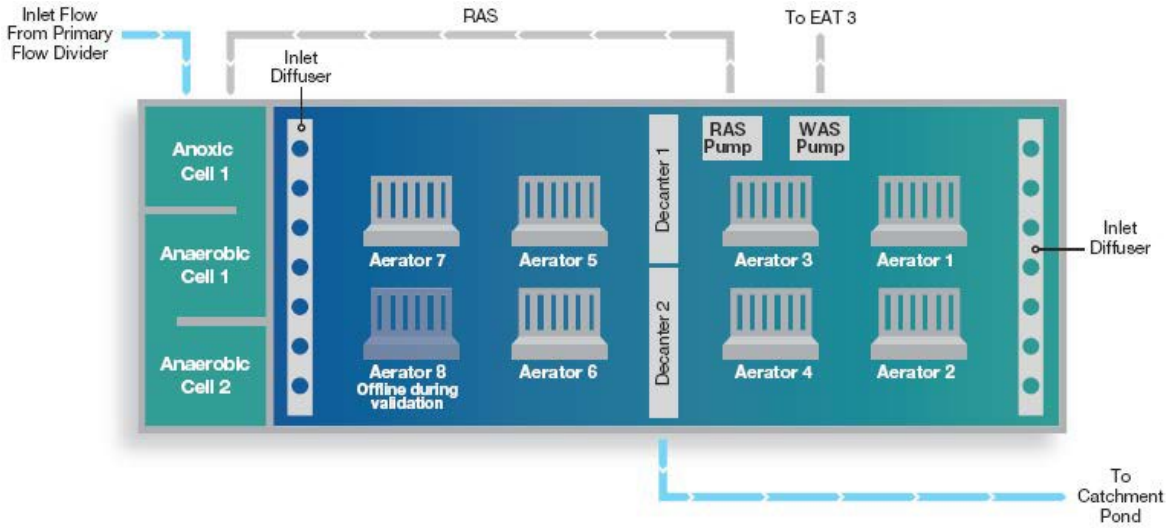


Figure 3: Schematic of Extended Aeration Tank 7

Dosing equipment and BiOWiSH® dose rates

Two 1000 liter totes/bulky bins were used for the dosing system; one tote for activation of the BiOWiSH® Aqua over a 24 hour period, the other for fixed-rate dosing over a subsequent 24 hour period. The totes were alternated allowing one tote to activate the BiOWiSH® Aqua while the other administered the BiOWiSH® Aqua dose. Each tote

Figure 4: Dosing Station

was continually mixed. Cost of the dosing station for the study was under $5,000.

BiOWiSH® Aqua was dosed to EAT 1 without the dosing of alum, making EAT 1 a fully biological process. The control reactor EAT 7 maintained alum dosing for removal of residual total phosphorus following Bio-P removal from 2 mg/L down to a final plant effluent TP target of 0.6 mg/L. Alum is a chemical treatment that causes suspended particles to flock together, making them easier to remove. These odors were also eliminated.

Day	Daily Dose (BiOWiSH® mg/L influent)
1	290 mg/l
2	24 mg/l
3	30 mg/l
Subsequent days	0.3 ppm

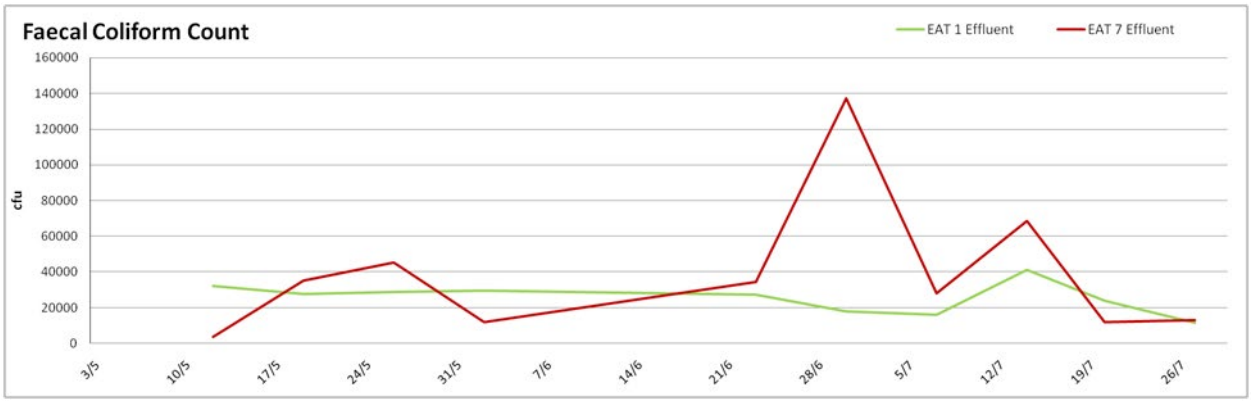
Results

Process Performance & Stability

The BOD5 and COD removal in BiOWiSH® EAT 1 were virtually identical to that for EAT 7

Unit		Raw Influent		EAT 1 Effluent Validation		EAT 7 Effluent control	
		Ave	SD	Ave	SD	Ave	SD
TP	mg/L	10.6	1.6	0.9	0.6	0.5	0.5
TN	mg/L	79.0	9.1	7.6	10.3	6.9	4.7
COD	mg/L	797.7	200.0	46.9	31.9	32.8	13.1
OrthoP	mg/L	4.5	0.8	0.6	0.5	0.1	0.1
Nitrate	mg/L	0.3	0.1	1.9	1.3	1.6	1.5
Ammonia	mg/L	35.0	5.6	3.0	5.8	3.1	5.0
pH		7.4	0.1	7.5	0.1	7.4	0.1
TSS	mg/L	414.6	141.3	3.7	6.5	6.8	5.0
Turbidity	mg/L			3.0	4.1	2.9	1.0
BOD	mg/L	273.7	76.4	6.4	4.3	7.6	8.8

It was also observed that the faecal coliform count was reduced and more consistent in BiOWiSH® EAT 1 (25,605 cfu) than EAT 7 (38,955 cfu) effluent. The study therefore confirms that BiOWiSH® has anti-pathogenic treatment benefits. The figure above shows the more consistent coliform controls in EAT 1 effluent compared to EAT 7 effluent.



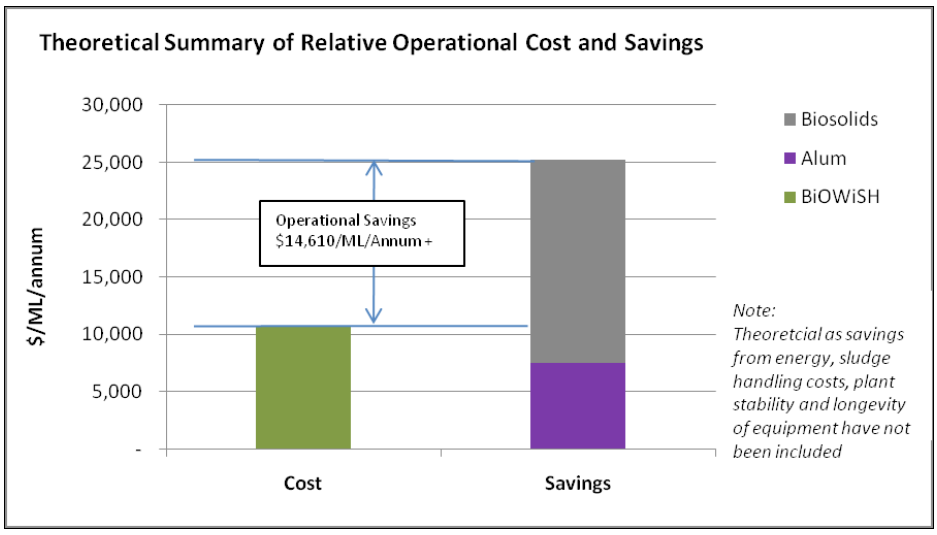
These study results demonstrate that BiOWiSH® Aqua:

- Maintains effective substrate treatment performance in conventional activated sludge process
- Assists biological treatment processes in meeting regulatory discharge limits;
- Maintains biological nitrogen removal performance within the activated sludge process
- Enhances phosphorous removal in biological treatment processes and hence appears to be a potential alternate to alum for phosphorous removal
- Improves TSS and BOD treatment outcomes
- Has ability to control and reduce faecal coliforms

It was recorded that there was only nominal difference between sludge settling characteristics between BiOWiSH EAT 1 (average SSV = 30.2 mm/min) and EAT 7 (average SSV = 33.9 mm/min). However, it is important to note that EAT 7 was chemically dosed with alum and is therefore a chemically enhanced settling regime. Typically, a chemically enhanced biomass settles from 1.5 to 2 times as fast as a non-chemical biomass, depending on the amount of chemical dosed. In the case of EAT 7, process assessment of the settling indicates that an SSV of 20 mm/min would be expected were no alum dosed. The SSV result of 30.2 mm/min for EAT 1 therefore indicates that BiOWiSH produced an increase in sludge settling by 50%.

Sludge Reduction

Sludge mass and concentration data (based on comparing average values over time of trial between BiOWiSH EAT 1 and EAT 7) indicates a reduction of more than 50% in sludge with BiOWiSH dosing. A further reduction of 5-10% is also likely, because BiOWiSH® Aqua will continue oxidizing volatiles throughout the biosolid handling facility.



Summary of Plant loadings and Sludge Production:

Average Operating Parameters	Units	EAT 1	EAT 2
Influent	L/day	988,420	3,292,682
WAS	L/day	85,398	686,945
TSS_{WAS}	mg/L	3,369	2,935
Mass of sludge	kg/day	287.7	2,016.3
Mass of sluge/mL of influent	kg/mL	291.1	612,4
Reduction	52.5%		

A definitive calculation on actual sludge (final biosolids) reductions could not be conducted as waste sludge from EAT 1 and EAT 7 are combined after wasting from the reactors and discharged to the biosolids. BiOWiSH believes that an additional 5-10% may be realized as BiOWiSH® continues to oxidize volatiles throughout the biosolid handling facility.

Aeration and plant energy usage

A direct comparison of energy use between study and control tank or historic usage of study tank was not possible due to plant instrumentation configuration. There were anecdotal observations that aerators ran less after DO set point was achieved with BiOWiSH® Aqua. At least some energy savings would be immediately realized by eliminating the need for RAS pumps.

One key observation that has significant bearing on energy usage and plant size is the rate of settling of the BiOWiSH® tank over a non-chemical dosed sludge. From their experience, the NSW Department of Public Works identified that the sludge settling rate of BiOWiSH® Aqua is more than 50% faster than non-chemically dosed plants. The higher the settling velocity, the smaller the sedimentation basin size, while the smaller the sedimentation basin size, the less energy is required for aeration. This would lead to a decreased overall energy cost.

Cost Benefit Analysis

The cost of dosing of alum calculated for this Bio-P type plant is around $7,460/ML/year (for a total P reduction from 3.0mg/L to 0.6mg/L; this plant uses 37 metric tons Alum/mL/year). Dosing BiOWiSH® Aqua would dramatically reduce the cost of alum dosing, with the potential to eliminate it completely depending on the plant's specific discharge license requirements.

The budgeted cost to dispose of sludge is around $33,900/mL/year. It's estimated that using BiOWiSH® Aqua could reduce sludge disposal by 52.5%, resulting in savings of $17,800/ML/year.

The cost of BiOWiSH® Aqua is dependent on volume of product purchased. As an indication of product, dosing system and implementation cost for first year is estimated around $10,500/mL/year. Included in the estimate are set-up costs required in the first year. The BiOWiSH® Aqua dosing system is simple, requiring access to fresh water and metering pumps capable of dosing 1,000 L in 24 hours.

BiOWiSH® Aqua is not a hazardous material. Therefore, the dosing area does not require storage bunds or the same level of safety provisions as alum or ferric products. BiOWiSH® Aqua comes in 100g, 1kg and 5kg bags and can be safely carried from dry store to dosing station by one person. Dosing is easy and no special skills or training is required. This results in little disruption to operations and negligible addition to operational costs.

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