Hawkhurst South Wastewater Treatment

te-cyc™ Case Study

Hawkhurst South Key Figures

Process Solution	te-cyc™
Population Equivalent	2285
Operational Date	2023
Max Flow Rate	$65m^3/hr$
Ave COD	< 125mg/l
Ave BOD	< 10mg/l
Ave SS	< 5mg/l
Total P	< 0.3mg/l
Ave Ammonia	< 1mg/l
Total Iron	< 4mg/l

The WINEP Quality drivers for the Southern Water Site Hawkhurst South WTW were to meet the new iron and total Phosphorus discharge permit limits by 31/12/2021 and a tightened ammonia permit by 31/03/2025, and to maintain compliance with all aspects of the existing discharge permit at lowest whole life cost. In addition, the population equivalent is set to rise from 1976 currently to 2285 by 2030 and the U-IMP5 driver dictates that the FFT (Flow to Full Treatment) will increase from 11 l/s to 17.1 l/s by 2035.

To meet the new consents and flow requirements, Te-Tech Process Solutions proposed the use of an advanced cyclic activated sludge technology, **te-cyc™**, which was implemented to replace the aged trickling filters and humus tanks which were decommissioned and partly re-used, respectively.

The **te-cyc™** plant was sized to treat a dry weather flow of $398m^3/d$ and to meet the following consent values:

BOD ≤ 20mg/l, **TSS** ≤ 30mg/l, NH_4-N ≤ 3mg/l, **Total-P** ≤ 0.3mg/l (annual average), Total-Iron ≤ 4mg/l.

The plant is now fully operational and achieving a good treatment performance with effluent values well below the above consent limits.

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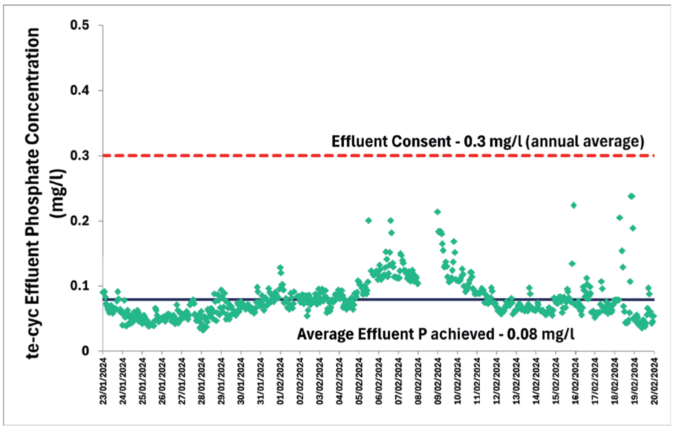
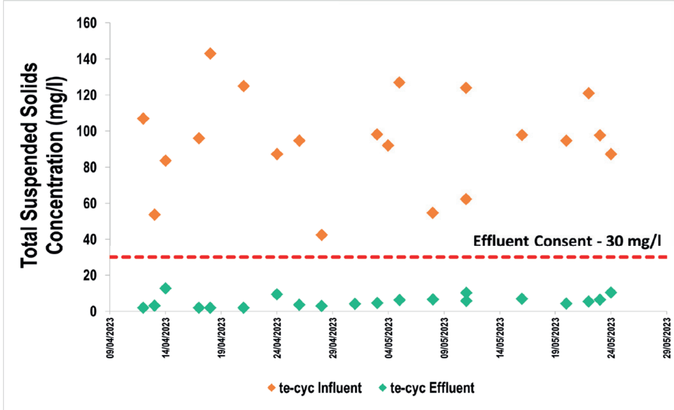
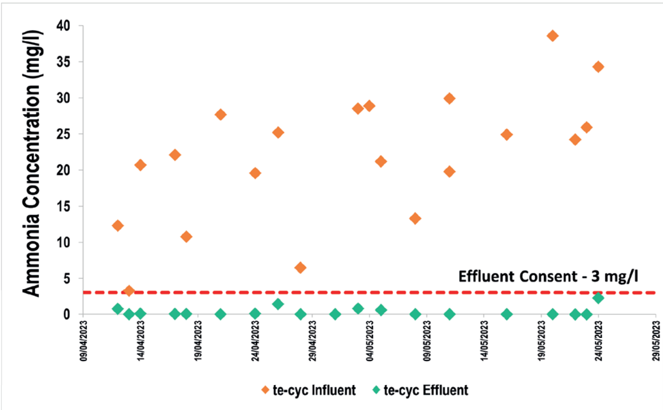


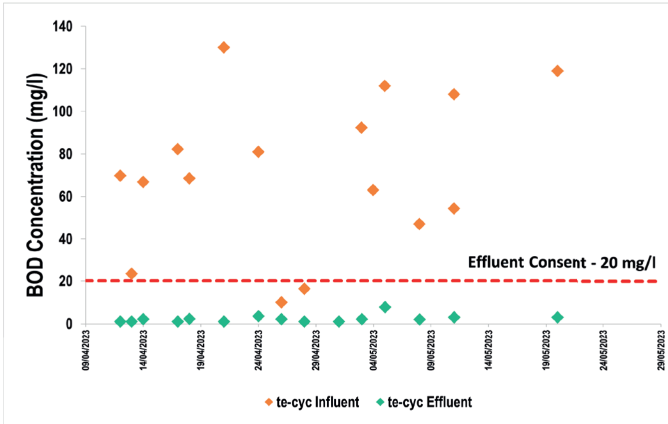
Effluent Consent Concentration



Total Suspended Solids Concentration



Ammonia Concentration



BOD Concentration

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te-cyc™ System

The **te-cyc™** process is a proven technology in Europe and the rest of the world and was selected due to several key benefits over a conventional SBR design. These include:

- Smaller tank volume and footprint due to higher allowable MLSS concentration from improved settling characteristics. The design MLSS for Hawkhurst is around 4,500 mg/l.
- Bespoke design of anaerobic selector leads to formation of larger "Macroflocs" which have an improved settling velocity and give a lower SVI, typically <100ml/g. This aids in the removal of precipitated phosphorus and with a typical effluent TSS of <5mg/l, the reliance on downstream tertiary solids removal is eliminated in most cases.
- The larger size of Macrofloc also allows for simultaneous nitrification and denitrification which means that anoxic tanks with mechanical mixers are not required. In addition, the alkalinity benefit of denitrification means that the need for additional alkalinity (NaOH) dosing is eliminated.
- Design of the anaerobic selector also promotes the growth of Polyphosphate Accumulation Organisms (PAOs) within the Macrofloc which provide an enhanced level of biological phosphorus removal and hence less ferric is required. Based on the design wastewater characteristics, there will be around a 55% saving in annual ferric consumption compared to a solution that does not employ enhanced biological phosphorus removal.

The fact that several drivers are satisfied simultaneously with the **te-cyc™** process combined with the benefits listed above means that the process provides a lower whole life cost when compared to a conventional upgrade solution. The whole life cost savings are attributed to the reduced infrastructure required; a smaller footprint required which meant that additional land did not need to be purchased; and reduced chemical costs due to lack of alkalinity dosing required and enhanced biological phosphorus removal.

Process Description

The **te-cyc™** process is based on a sequencing batch reactor (SBR) in that biological treatment and solids separation are combined in a single process that operates on a batch cycle. As seen in Figure 2, a **te-cyc™** plant is made up of several individual basins. Always with two or more batch basins, the process allows for a continuous flow through the system as the basins are installed in parallel with their sequences out of phase with each other. This means that a buffer tank with mechanical mixing is no longer required when compared to other SBR based processes, and hence a reduced overall site footprint and energy cost.

Figure 1 shows the cycle timings for a 4-tank **te-cyc™** system. As can be seen, for every hour of the 4-hour cycle, there are always 2 tanks filling and 1 tank decanting which means that both a continuous influent and effluent will be achieved. With 4 tanks or more installed, continuous influent and effluent will be maintained even if 1 of the tanks is taken out of service for maintenance.

Basin 1	Fill/Aerate		Settle	Decant
Basin 2	Settle	Decant	Fill/Aerate	
Basin 3	Fill/Aerate	Settle	Decant	Fill/Aerate
Basin 4	Decant	Fill/Aerate		Settle
Hour	1	2	3	4

Figure 1: **te-cyc™** Cycle Timings

The process is broken down into 3 distinct stages that operate on a cycle: fill/aerate, settlement, and decant.

1 Fill/Aerate

During the fill/aerate stage, water enters a **te-cyc™** basin into the aerated zone via the anaerobic selector. Throughout this fill stage, the aeration zone is continually aerated at a rate controlled by the OUR (Oxygen Uptake Rate) control system, and a portion of the sludge is constantly recycled to the inlet of the selector. Employing the OUR control system prevents over-aeration of the reactor basin generating additional energy savings. The design of this selector and recycle rate combined with the OUR control system allows for the formation of macroflocs in which simultaneous nitrification/denitrification, BOD removal and biological phosphorus removal occurs. To meet particularly stringent phosphorus consents (<1mg/l), top-up chemical precipitant can be dosed during this phase at the exit of the selector zone to precipitate the phosphorus that is then removed with the waste sludge.

2 Settlement

During the settlement phase, the inlet to the particular basin is closed, the internal recycle is stopped, and the sludge formed in the previous stage aggregates as a blanket and settles to the base of the reactor tank leaving a top layer of clear treated effluent. In typical wastewater applications, the settled sludge layer has a mean biomass concentration of around 10 g/l.

3 Decant

In the decant phase, the mechanically driven decanter moves from the top water level to the bottom water level to remove approximately one third of the reactor volume which will be clear treated effluent. The decant arm also features a scum guard which prevents floating solids from discharging into the decanter. At the end of the decant phase, the decant arm is returned to its parked position. Towards the end of the decant phase, a portion of the settled surplus sludge is discharged.