BiOWiSH™ TECHNOLOGIES

Wastewater Treatment

Case Study

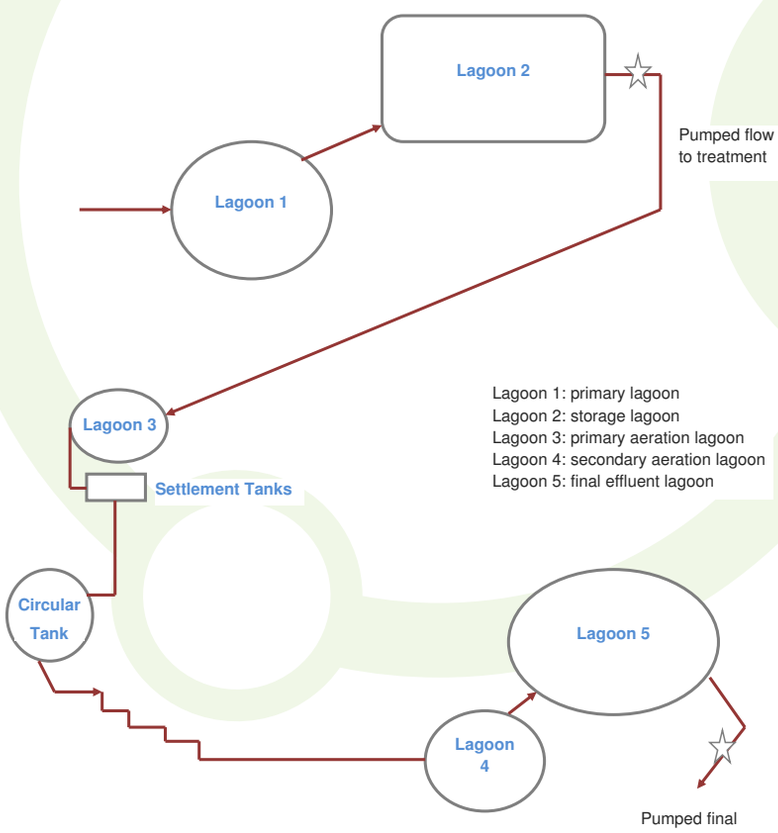
Thatchers Cider Company Ltd, United Kingdom

Background

Thatchers Cider Company Ltd is a manufacturer of cider and fruit juices situated in the county of Somerset, UK with an estimated annual (cider) production of around 28 million litres. Effluent from cider and juice production is treated at a separate site situated half a mile from the factory. The effluent is pumped through a private 4 inch main to the 11 acre treatment site.

The schematic of effluent treatment is shown in Figure 1. Treated effluent is pumped into the public sewer for treatment and disposal at Weston-super-Mare municipal sewage treatment works.

Figure 1. Schematic of Effluent System



BiOWiSH™ Aqua Benefits

- Reduces sludge production and handling
- Increases plant capacity by reducing contact time
- Eliminates odorous emissions
- Delivers substantial energy savings due to reduced aeration
- Minimizes need for chemical additives
- Stabilizes and improves plant treatment performance
- Lowers hydrogen sulphide, ammonia and nitrate levels
- Pre-treats influent in collection systems
- 100% natural and non-toxic

Available Sizes

- 100g/3.5oz
- 1kg/2.2lb

Production at the factory is divided into two key parts.

1. The on-going manufacture of cider from apple juice; this takes place all year round
2. The processing of fruit to produce cider and other products such as blackcurrant juice; this takes place from July to December

Both of these processes produce effluent resulting from the washing and cleaning of process equipment, fruit and product packaging.

The organic strength of effluent produced during the manufacture of cider is approximately double that of the effluent produced during fruit processing. Fruit processing uses evaporators to reduce the volume of the juice for long term storage; the resulting effluent is diluted by large volumes of condensate and is significantly weaker in strength.

Effluent from the various production processes are discharged via the factory drainage system into a large sump. It is then pumped to the treatment site using a series of floats to regulate the flow.

As a result of the seasonal nature of Thatchers' cider processing, the effluent discharged from these two production regimes require a treatment system that can accomodate a large variation in flow and load.

Objectives

The two main environmental objectives of Thatchers' were:

- Odor control
- Sludge reduction

The treatment site contains a large volume of stored untreated effluent. This creates strong odors, especially during warm weather. The elimination of these odors is a high priority.

The removal and disposal of waste sludge is expensive, typically £250/tanker (US$410/tanker), with up to four loads a week during the high season. Thatchers were obviously keen to reduce these costs and they decided to trial *BiOWiSH*™ *Aqua* for an initial period of six weeks beginning in May.

Results

Odor Reduction

BiOWiSH™ has reduced the odor emanating from the primary lagoon. The installation of the aerator was beneficial and aided distribution of the biocatalysts. During peak flows, odor from the storage lagoon had also diminished. However, as production decreased and the factory discharge declined, the spill over of effluent from the primary to the storage lagoon reduced to a low daily volume (328m^3 in summer to 123m^3 in winter). This resulted in an increase in odor because insufficient biocatalysts were being transferred to the storage lagoon during low flow conditions. To counter this outcome, BiOWiSH™ dosing was modified so that 1kg was divided equally between the three lagoons. The odor emanating from the storage lagoon has since improved.

Sludge Reduction

The application of BiOWiSH™ has been highly successful in breaking down organic matter, thereby reducing sludge. This outcome has been observed in the primary and aeration lagoons.

Prior to the application of BiOWiSH™, the sludge level in the primary lagoon was 0.4m above the base, a major source of odor and septicity. Throughout the application period, dips were taken and sludge levels measured. In January, the sludge level was measured at 0.15m above base.

The reduction in mixed liquor solids in the primary aeration lagoon can be measured by the volume of sludge settling in the clarifiers. On average, throughout the BiOWiSH™ application period, 75% of settled sludge has been eliminated. The sludge reduction is also depicted by the number of tanker loads taken off-site from Thatchers as shown in Figures 2 and 3. The remaining 25% of settled sludge is now returned to the aeration lagoon to maintain the biomass.

Figure 2. Reduction in Solids using BiOWiSH™

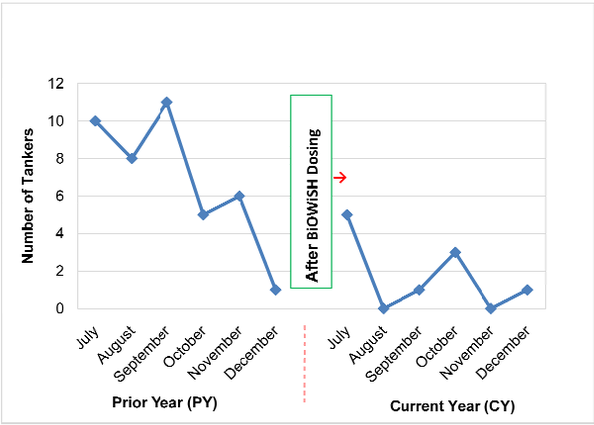
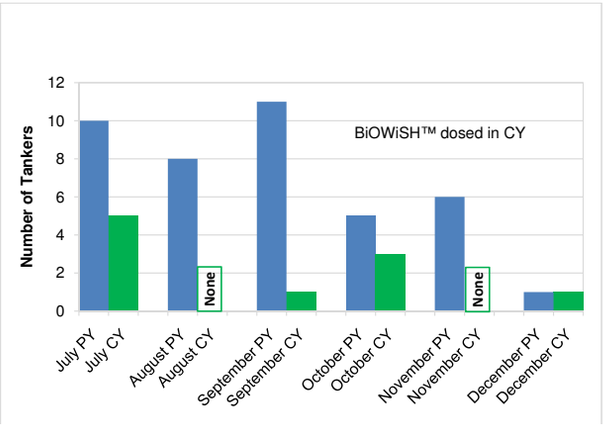


Figure 3. Reduction in Solids using BiOWiSH™



Increase in Biological Capacity

Although general effluent quality has remained static after using BiOWiSH™, the biological loading to the aeration lagoons has been increased. This was particularly noticeable during early November when the effluent strength in the storage lagoon exceeded 7000mg/l and the temperature was low. At this time, flow to treatment was running at 173m^3/day, equating to 1211kgCOD/day. During the winter, even with mixed liquor temperature at 3.5^{0}C, biological activity was taking place albeit at a lower flow rate of 123m^3/day.

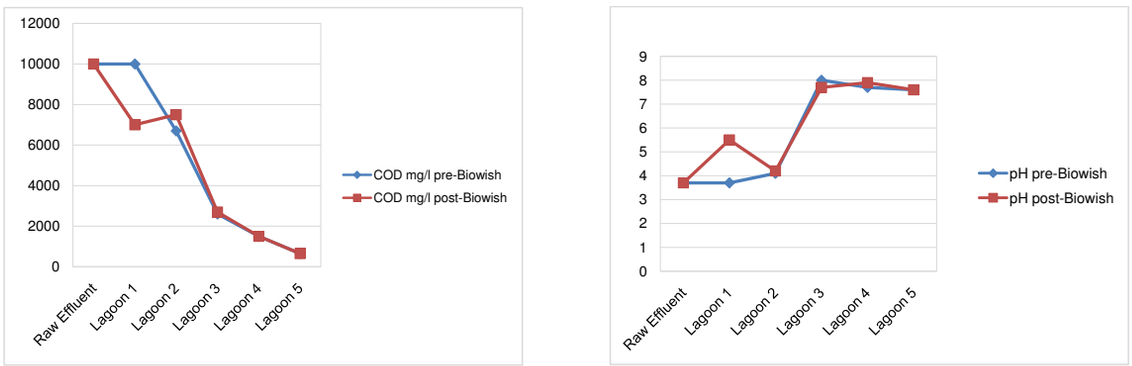
Improvement in Process Stability

The addition of BiOWiSH™ has improved the stability of the biological process in the primary aeration lagoon. Over weekends with no operational input, the quality of the effluent remains steady. It is also noticeable after overnight power cuts, that the process quickly returns to normal once power is reinstated. The biological process is now able to adapt to shock loading without negative impact – this result is noticeable when excessive sludge is returned to the system following the weekend.

Removal of Algal Bloom

Throughout this exercise, including the trial period, little has been stated regarding the overall performance of the treatment processes, particularly, the final effluent quality. The reason is that BiOWiSH™ has had little impact on the effluent quality downstream of the clarifiers. The quality remains well within consent limits as it was prior to BiOWiSH™ dosing. Thatchers effluent treatment plant performance is as shown in Figure 4.

Figure 4. Effluent Treatment Plant Performance



There is, however, one notable difference: the removal of algal bloom. The algae develops in the final lagoon during the summer, when effluent quality is good, especially after several days of strong sunlight. As a result, the effluent may double in strength and has a significant impact on trade effluent charges. The algal bloom was absent during the BiOWiSH™ dosing period.

Conclusions

In summary, the two key reasons for trialling *BiOWiSH™ Aqua* was the potential to eliminate odor and to reduce sludge production. Both objectives have been broadly achieved. Sludge reduction (75%), has been highly successful, as demonstrated by the fall in tanker receipts.

Other benefits associated with BiOWiSH™ are a bonus, namely, process stability and the removal of algae from the final effluent lagoon.

The main cost factor associated with the dosing of BiOWiSH™ is the comparison of the annual cost of the product and the cost of removing surplus sludge. During the BiOWiSH™ trial, the volume of surplus sludge removed off-site was 25% of the volume normally expected. This value is likely to decrease as experience is gained using BiOWiSH™ and the biocatalysts reach their full potential through the system.

Since the trial began in May, Thatchers has been using BiOWiSH™ for eight months. Much of the early part of the programme has required changes to the starter make-up, dosing schedule, distribution of the product, the daily sludge return and a general adaptation to the new process (refer to the succeeding section for more details). The full evaluation of how BiOWiSH™ reacts to the treatment process is still ongoing.

The Thatchers lagoon system is a major factor when analysing the cost of dosing BiOWiSH™. The large volume of untreated effluent in the primary and storage lagoons assimilated all shock doses and required considerably more product than compared with a conventional 24hr balanced system. However, once stabilised, a lower daily 'working concentration' of 1kg was shown to be effective. On this basis, comparative costs may be derived.

- Annual cost of surplus sludge disposal without treatment with *BiOWiSH™ Aqua*: 65 tankers/annum @ £250/tanker = £16250 (US$26650)
- Annual cost of *BiOWiSH™ Aqua* at £60/kg @ 6kg/week = £18720 (US$31200). Annual cost of surplus sludge disposal with BiOWiSH™ dosing = £3000 (US$4900). Total annual cost = £21720 (US$35500).

There was no significant improvement in the quality of the final effluent. Therefore, no reduction in trade effluent charges could be attributed to BiOWiSH™ dosing. However, the elimination of algae from the final effluent lagoon saved the annual cost of purchasing 4kg of general purpose bacteria (£350) (US$570).

The figures above show that the annual cost using *BiOWiSH™ Aqua* is more expensive than the previous conventional method of effluent treatment. The extra cost is £5120/annum (US$8350). This increase should be considered as the cost of eliminating odors from the site, a major environmental factor associated with effluent treatment and a fundamental objective of Thatchers Cider.

Implementation Program

Thatchers' effluent treatment process is unusual because of the large volume of storage capacity. When full, the storage lagoon contains a very large organic load and, unlike a normal day to day discharge, the BiOWiSH™ dosing schedule should reflect this condition. On this basis it was decided to shock dose the primary and storage lagoons with the product on a diminishing scale and add a daily dose of 2mg/l to the primary lagoon. The assumption was that the biocatalytic activity would transfer through to the primary aeration lagoon and the remaining processes. Organic strength in the storage lagoon at this time was 4100mg/l COD with a flow rate to the aeration lagoon of 328m^3/day.

The BiOWiSH™ starter was mixed with water at between 5g/l and 10g/l and the temperature maintained above 15^{0}C. The starter was distributed at various points around the perimeter of the lagoons to aid mixing.

This initial trial which began in May was only partially successful. The odor was somewhat reduced and the mixed liquor quality in the aeration lagoon improved, resulting in an increase in pH from 7.9 to 8.1 under stable conditions. However, no noticeable change was observed in the volume of sludge produced. After consideration, the low start-up mixture temperature, the insufficiency of day to day dosing and the incorrect dosing location were the factors that contributed to this outcome.

However, it soon became apparent that the shock loading of BiOWiSH™ had been assimilated by the large mass of organic matter contained in the two lagoons – the primary lagoon contained sludge that was approximately 0.5m in depth; hence, insufficient BiOWiSH™ activity was reaching the aeration process despite dosing at an established rate of 2mg/l.

With the end of the trial approaching a decision was made, based on the experience gained, to continue with BiOWiSH™. The dosing regime was amended so that the product would be shared between the primary lagoon and the primary aeration lagoon. It was considered that BiOWiSH™ would be, initially, far more effective in reducing sludge if it were dosed directly into the biological process. Continuation with dosing at the front end as before would also control the odor issue.

These assumptions turned out to be broadly correct, and with the knowledge that dosing was related to load and not flow, the aeration process was transformed. This was in August when Thatchers high season's production had been running for about a month.

Within four days of dosing into the aeration lagoon, the volume of mixed liquor began to reduce; this was noticeable when emptying the clarifiers. Settleability of the sludge improved, producing a denser sludge and a clearer interface between sludge and liquid. The pH of the mixed liquor steadied at 8.2 to 8.3, and the general stability of the process improved, allowing an increase in biological loading without detriment.

BiOWiSH™ dosing, at this stage, was 1kg/day in the primary lagoon and 500g/day in the primary aeration lagoon. The high dosing of the primary lagoon was continued because of the anaerobic conditions. Considerable activity was required to reduce the volume of sludge and keep the odor under control.

After two weeks, the volume of sludge in the clarifiers reduced by 75%. Most of the sludge was returned to the aeration lagoon to maximise biological activity.

The dosing schedule continued throughout the season when production changed from blackcurrant to apple processing. The effluent from apple processing exerts greater organic loadings and can be problematic to treat. However, the biological activity in the aeration lagoon was sustained in the early stages with pH holding up at a flow rate of 328m^3/day and COD of 4750mg/l. As expected, with the season progressing, the ambient temperature started dropping and by mid-October the raw effluent strength in the primary lagoon increased to 10000mg/l. The effluent feed to the aeration lagoon increased to 5750mg/l. At this stage distribution of BiOWiSH™ in the primary lagoon was considered inadequate, so a small 1.5kw surface aerator was installed. The aim was to improve mixing and minimise septicity.

By early November, organic strength in the storage lagoon had increased to 7000mg/l requiring the flow rate to the aeration lagoon to be reduced to 172m^3/day.

The decision was taken to reduce BiOWiSH™ dosing because of the long term cost vs treatment factors. The dosing was reduced to 1kg/d shared equally between the primary and aeration lagoon.

A further reduction in the flow rate to the aeration lagoon was required (to 144m^3/day) because of the declining ambient temperature and the consequent reduction in activity – dropping pH levels, increasing COD concentrations and poorer sludge settlement all indicating the fall off in effluent quality.

During much of December, ambient temperatures remained below 0^0C, causing biological activity to further decline. Organic strength of the storage lagoon peaked at 7750mg/l and flow to treatment was reduced to 123m^3/d. However, effluent strength in the primary lagoon had decreased from 10000mg/l to 7000mg/l as a result of the improved distribution (aerator) of BiOWiSH™ and the reduction in raw effluent flow from the factory.

Throughout January, effluent treatment has remained steady with all sludge returned to the aeration lagoon and final effluent quality within consent limits.

During the winter months, the BiOWiSH™ starter solution was heated to between 20^0 and 25^0C and the dosing maintained at a rate of 1kg/day.

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