

## Industrial Wastewater

### Synthite Industries

#### Executive Summary

Synthite is widely acclaimed as the leader in the Spice Oleoresin industry with over 30% share of the global market. The company's effluent treatment plant (ETP) in Kerala, India deals with challenging circumstances: effluent varies substantially on a daily and often hourly basis due to the wide variety of raw materials processed in the factory.



In May 2009, Synthite and IWA/Environment began a collaborative pilot project to adopt BiOWiSH™ as a technological platform to improve the plant's effectiveness in treating effluent. In 110 days, the project achieved three remarkable performance outcomes:

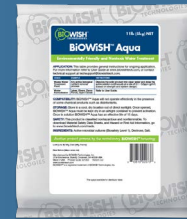
1. Reduced aeration energy consumption by 50%; and
2. Completely eliminated the use of chemicals for settling solids; and
3. Rendered the plant totally sludge-free.

Collectively these results have reduced the annual operating cost of the plant from Rs. 1,343,000 (US\$ 28,600) to Rs. 717,000 (US\$ 15,200) – an annual cost reduction of almost 50%.

The benefits to Synthite extend beyond simple economic measures: the plant's performance has been totally stable since June 2009; final effluent is consistently beating the standards; and operator intervention has been completely eliminated.

These results are a consequence of a transformation in the biology of Synthite's ETP process. The plant now relies on high-speed BiOWiSH™ enzymes and is no longer solely dependent on biomass to treat effluent.

#### BiOWiSH™ Aqua



- Reduces sludge production and handling
- Increases plant capacity by reducing contact time (capital avoidance)
- Delivers substantial energy savings due to reduced aeration
- Minimizes need for chemical additives
- Stabilizes and improves plant treatment performance
- Natural and non-toxic

#### Available Sizes

- 3.5oz/100g
- 2.2lb/1kg
- 11lb/5kg



*"In less than 3 months we achieved stability and chemicalfree operation in our ETP. We've saved money on energy and chemical costs, and no longer have solid waste. BiOWiSH™ is phenomenal. The results were simply beyond our expectations!"*

**- Mr. George Paul, Director, Synthite Industries**

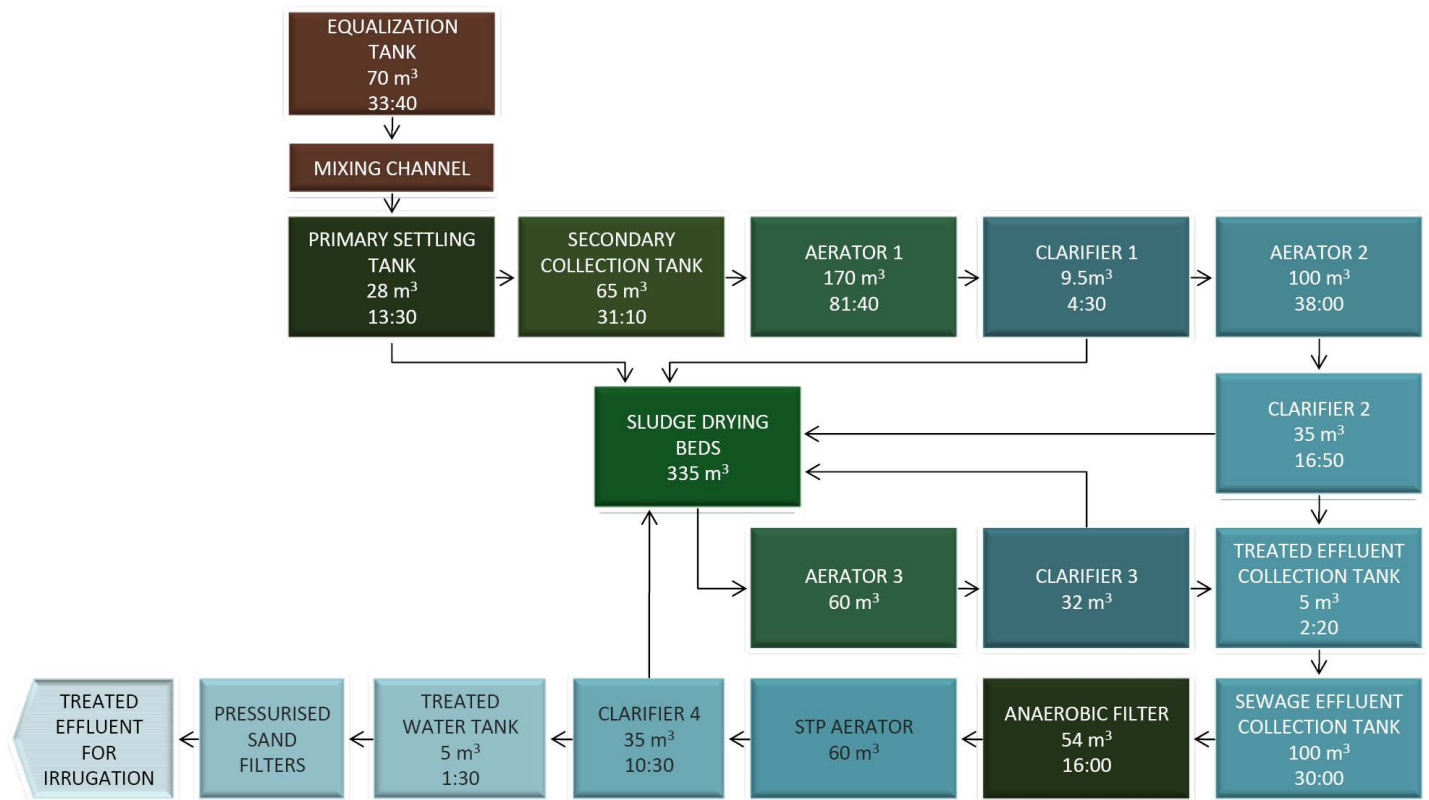
## Background

Located at Kolenchery in the state of Kerala, South India, Synthite is a multimillion dollar enterprise and the preferred supplier-partner to leading flavor houses world wide, with presence in Europe, Asia and Latin America.

The company manufactures a wide spectrum of Spice Products including Oleoresins, Essential Oils, Natural Food Colors, Health Ingredients, Herb Extracts, Organic Extracts, Fair Trade Extracts, Floral Concretes, Absolutes and Spices – whole, ground and crushed.

Synthite's ETP processes around 100 KL of effluent per day. The plant's visible state of good maintenance reflects Synthite's attitude of care towards the environment. Even the architecture is harmonized with the landscape – the hilly contours of the site have been cleverly used to minimize lifts.

The ETP is designed to process effluent through five stages: chemical settling, aerobic treatment, anaerobic treatment, final aerobic treatment and filtration. The treated effluent is used for irrigation on the factory's grounds.



Anaerobic digestion is a bacterial process that is carried out in the absence of oxygen. The process can either be thermophilic, in which sludge is fermented in tanks at a temperature of 55°C, or mesophilic, at a temperature of around 36°C. On the other hand, Aerobic digestion is a process that occurs in the presence of oxygen. Under aerobic conditions, bacteria consume organic matter and convert it into carbon dioxide. The operating costs are usually much greater for aerobic digestion because of the energy used by the equipment needed to add oxygen to the process.

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## The Issues

### Energy Consumption

The ETP employs the activated sludge technology to treat Synthite's production effluent. Like all activated sludge systems Synthite's ETP also required a substantial energy input for aeration to sustain the microbial population of the system. Annual costs for aeration energy prior to implementing BiOWiSH™ amounted to Rs. 7.88 lakhs (US\$ 17,000).

### ETP Process Instability

Oleoresins are produced from chilies, garlic, green tea, onions, rosemary, pepper, and a host of other spices. Factory production varies from day to day and often from hour to hour. Effluents received at the ETP vary in color, turbidity and pH – often several times in a day.

Prior to implementing BiOWiSH™ the ETP operators had to track pH values on an hourly basis and make corresponding adjustments to lime dosage. This manual and error prone process was needed to control pH within the narrow range that optimized chemical settling of solids. Any lapse in pH measurement or lime dosage would immediately impact settling and generate very undesirable effects on all of the downstream processes.

Synthite was understandably very keen to find a system that would manage the nutrient load despite substantial influent pH variations.

### Hazardous Waste

The use of lime, alum and polyelectrolyte chemicals at the plant transformed Synthite's sludge from a purely organic waste to a substance designated as a hazardous waste. Instead of being a substance suitable for use as a fertilizer, Synthite's sludge was subject to several onerous regulatory controls and needed diligent management oversight.

## The Solution

In early May 2009, IWA/Environment (the authorized BiOWiSH Technologies distributor in India) approached Synthite's management with a proposal: Reduce operating and environmental costs of the ETP by implementing the revolutionary BiOWiSH™ technology.

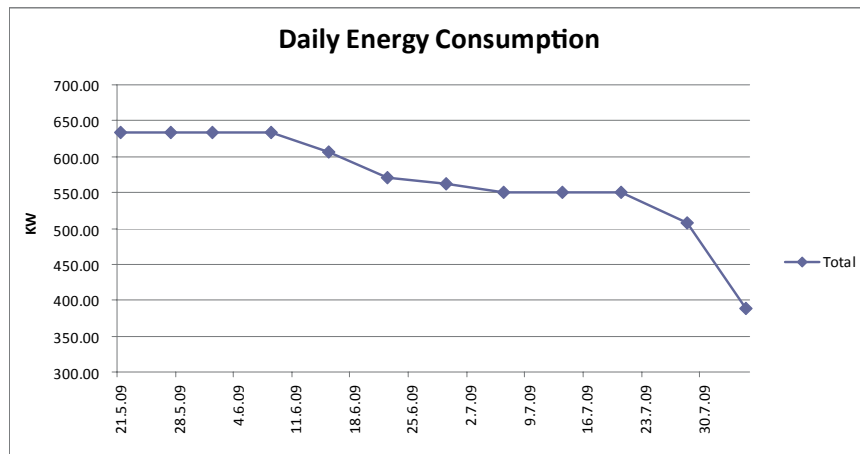
IWA/Environment proposed a two-stage project: (1) reduce aeration and capture energy savings and (2) eliminate chemical use.

*"We wanted to eliminate the application of chemicals because that was a key source of plant instability. Anytime we got the pH wrong it would take days to recover from the spike in suspended solids."*

**- Mr. B Shanavas, Engineering Manager, Synthite Industries**

## The Results

Aeration energy reduced by 50% in less than 100 days.



Shortly after the implementation began the project team started to progressively reduce aeration. On the 84th day of the implementation the plant was operating its aerators on a 30 minute on / 30 minute off cycle to capture a stunning 50% reduction in aeration energy.

### No more chemicals

On the 90th day dosage of lime, alum and polyelectrolyte were turned off. Since 10th August 2009 there has been no dosing of chemicals and the plant's final output has consistently outperformed the regulatory standards for final discharge.

### No more sludge

Before implementing BiOWiSH™ the ETP generated 10 m<sup>3</sup> of sludge each day: 4 m<sup>3</sup> at chemical settling and 6 m<sup>3</sup> of bio-solids. The plant today generates zero sludge. Sludge has been completely eliminated by two mechanisms: the high speed action of the BiOWiSH™ enzymes digested 6 m<sup>3</sup> and the remaining 4 m<sup>3</sup> was transferred to the Anaerobic Digester where it is completely consumed.

### Measurable commercial benefits

Cost Element	Baseline Annual Cost (In Rs. Lakhs)	Annual Cost Reduction (In Rs. Lakhs)
<b>Aeration Energy</b>	7.88	2.36
<b>Chemicals</b>	4.95	4.95
<b>Sludge Handling</b>	0.60	0.60
<b>BiOWiSH™ Investment</b>	0.00	(1.65)
<b>TOTAL</b>	13.43	6.26

*"Synthite's leaders approved a pilot project when others in India were understandably reluctant to be pioneers with BiOWiSH™. Their willingness to experiment has delivered stellar results – unprecedented stability, substantial recurring cost savings and a complete elimination of bio-solid sludge."*

**– Mr. Itty Varugis, IWA/Environment**

## Key Success Factors

### Ground Breaking Technology

By accelerated digestion of waste through a high-speed enzymatic process, BiOWiSH™ completely altered the Synthite plant's reliance on biomass for nutrient removal.

Furthermore, since BiOWiSH™ enzymes perform consistently under varying effluent pH levels there was no further need for error-prone manual pH interventions.

The entire result was achieved without any alteration of Synthite's plant infrastructure. BiOWiSH™ is a truly breakthrough technology: highly flexible to adapt to any existing plant infrastructure, tolerant to a wide range of operating conditions and fundamentally transformative of a treatment plant's biology.

### Openness to Change

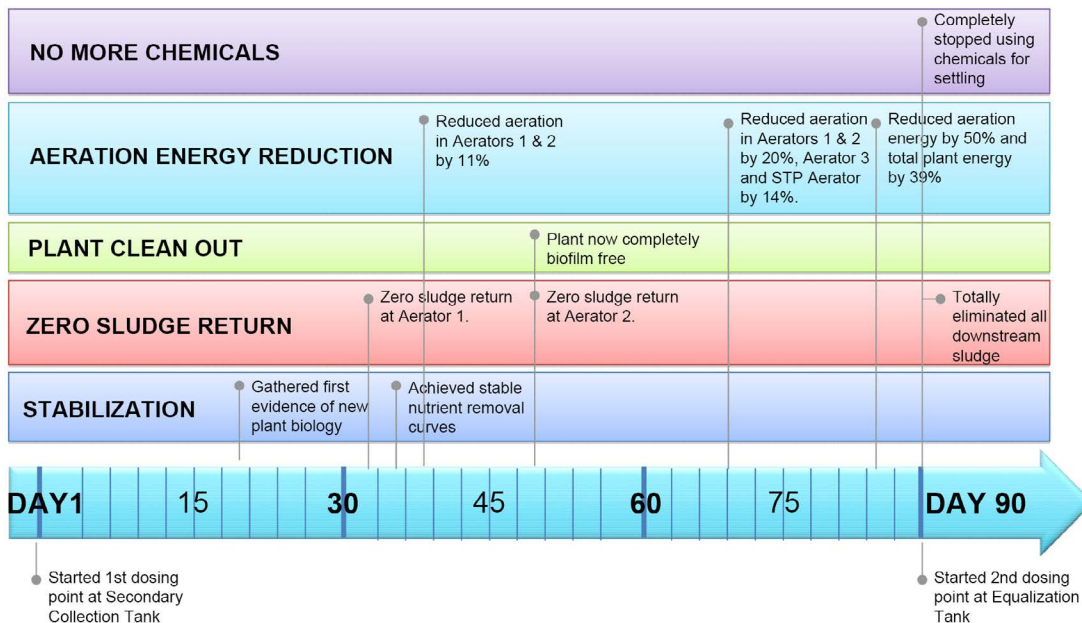
Synthite's openness to new treatment technology has been a key factor in the success of the project. Like most ETPs, the Synthite plant relied heavily on biomass to complete the waste treatment process. Plant management was willing to shift paradigms and embrace the new BiOWiSH™ technology.

### Collaboration

The BiOWiSH™ implementation was a managed process with treatment outcomes at each stage of the process diligently monitored on a daily basis. Synthite and IWA/Environment collaborated to assess progress, anticipate issues and establish counter measures.

IWA/Environment provided technical assistance and advice to Synthite plant management all throughout the project with full support from the BiOWiSH Technologies head office team, ensuring proper dosing techniques and precautionary measures were in place as well as preparing plant personnel on what to expect at every stage of the trial.

## Synthite Project Milestones



*"The BiOWiSH™ trial went smoothly and the results were remarkable. Superior product performance, the ability to work on varying pH levels, as well as a very good plan and support system provided by IWA/Environment contributed to the success of the project."*

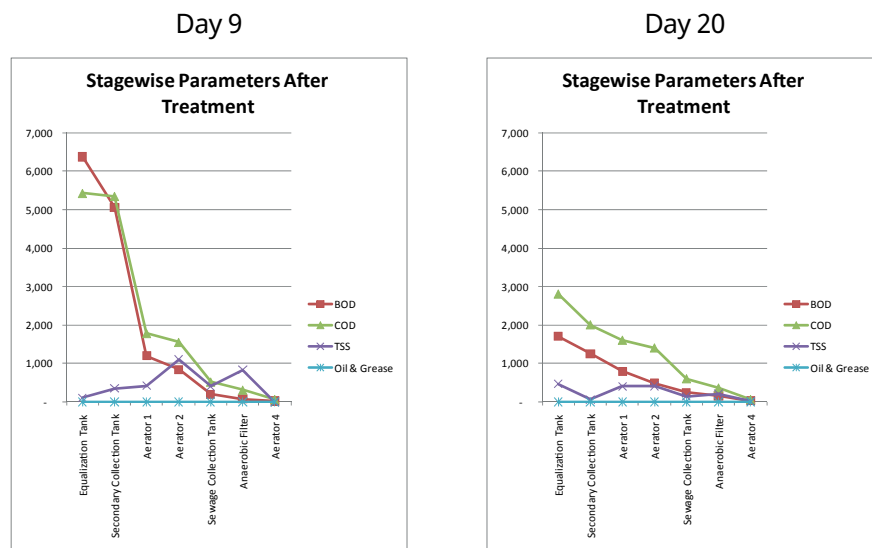
**- Mr. B Shanavas, Engineering Manager, Synthite Industries**

## The detailed implementation program

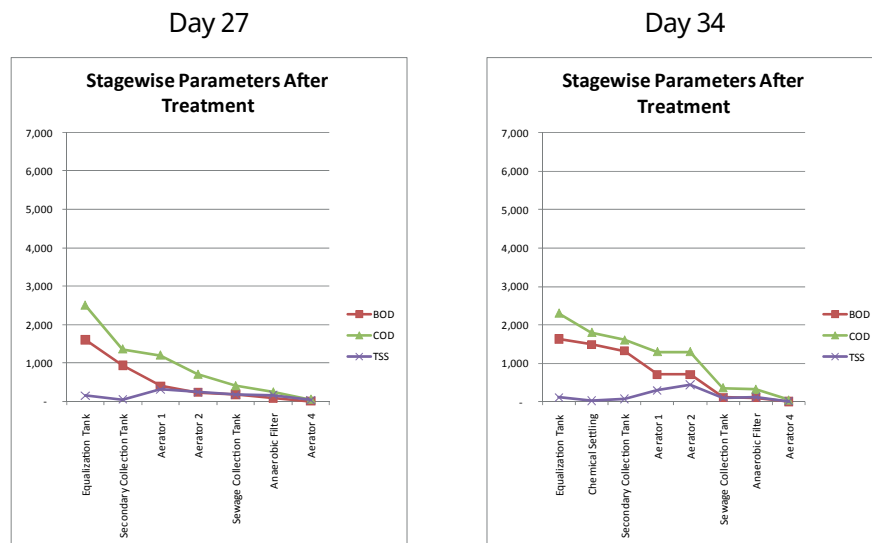
Day 1: The project team began implementation of BiOWiSH™ at the Synthite ETP on 13th May 2009. BiOWiSH™-Aqua was mixed into solution and metered into the Secondary Collection Tank to achieve the following dosing rates:

- Day 1: 20mg/l
- Day 2: 10mg/l
- Day 3: 10mg/l
- Ongoing (daily): 1mg/l

Day 20: The implementation of BiOWiSH™ radically changed the biology of the ETP. In a mere three weeks the plant's biology had been shifted from a reliance on biomass to using the high speed BiOWiSH™ enzymes to digest nutrients.

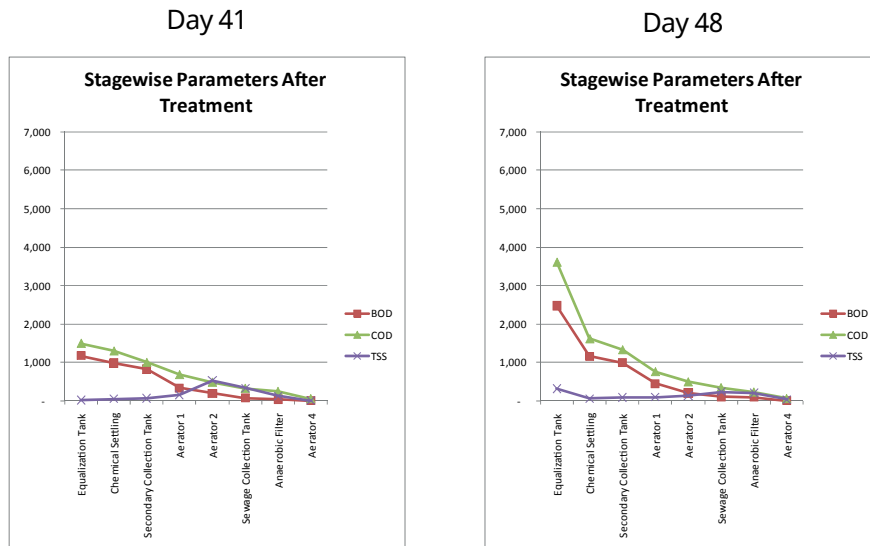


Day 32: The plant consistently demonstrated stable nutrient removal. Internal measures showed the ideal outcome of progressive improvement in at each stage of the effluent treatment process. Throughout the plant and even in the sludge drying beds, small bubbles of gas were visible. This is typical behaviour of the BiOWiSH™ biology which converts a substantial portion of waste into final end compounds of carbon dioxide, nitrogen gas, oxygen and water.

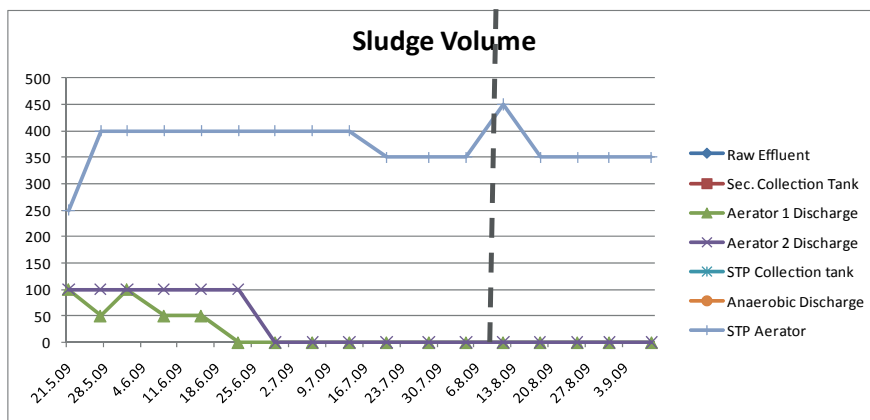


Day 38: Aeration drive motors were switched off for 30 minutes in every 4.5 hour cycle. The plant's output remained unaffected and stable nutrient removal curves were sustained. In the meantime, it was business as usual at the shop floor with a wide daily variation in production effluent.

Day 48: Stopped returning sludge at Aerators 1 and 2. Under normal circumstances this action is an unthinkable loss of biomass and effluent treatment capability. With BiOWiSH the plant's performance remained absolutely stable and nutrient removal continued to show the classic form of progressively removal through the downstream ETP processes.



Chemical Settling Stopped on Day 90



Day 89: Totally eliminated bio-solid sludge. Partly by BiOWiSH™ enzymes digesting nutrient to inert end products and partly by transferring the residual sludge to the Anaerobic Digester for complete consumption.

Day 90: Completely eliminated chemical settling; The project team installed a second dosage device at the Equalization Tank using the same dosage table the first phase implementation.

Day 110: Completely eliminated all sludge. The sludge drying beds at Synthite have been idle since and the land formerly occupied by the beds has been re-formatted for alternative use.



BiOWiSH™ is a registered trademark of BiOWiSH Technologies International, Inc.

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