AQUACYCL

CASE STUDY: TREATING SUGARY WASTEWATER WITH BETT®

Eliminating dilution and land application for a confectionery's wastewater

At a glance

A confectionery company faced challenges with a specific waste stream from process wastewater with an extremely high sugar content. They used Aquacycl's BETT® system to treat the wastewater onsite and remove up to 95% of organics.

KEY RESULTS

Aquacycl's BETT® Demo Unit of 12 reactors treated 160 gpd of sugarwater with an incoming COD concentration of 100,000-300,000 mg/L:

97.6%
Less sludge production than anaerobic digesters

1.6 kWh/kg-COD
Net Energy Recovery (NER)

50,000 mg/L
COD removal at full efficiency

4-hour HRT

CHALLENGES

A confectionery company faced challenges with a sugary waste stream from process wastewater that contains high brix (which translates to high Chemical Oxygen Demand or COD) and total suspended and dissolved solids (TSS and TDS). This specific waste stream ("sugarwater") requires pretreatment or dilution prior to land-application; and cannot discharge to the onsite aerobic treatment facility due to carbon toxicity issues that would occur.

SOLUTIONS

Aquacycl's BioElectrochemical Treatment Technology (BETT®) is the first commercially-viable technology able to handle the high-sugar content wastewater cost-effectively, without dilution. The confectionery installed a 12-reactor demonstration unit (BETT® Demo Unit) to treat 160 gpd of sugarwater at COD concentrations of 100,000-300,000 mg/L.

The Demo Unit demonstrated its applicability and efficiency in treating high-strength sugar containing wastewater, with an ability to remove up to 95% of organics when scaled. Its limited biomass production and Net Energy Recovery (NER), without methane generation, make this a sustainable, cost-effective solution for confectionery wastewater treatment.

BENEFITS

Compliance Guarantee
Aquacycl provides a 100% compliance guarantee so the facility is never at risk of being out of compliance.

Predictable Monthly Pricing
With a monthly payment structure, the facility does not experience surcharges and fluctuating bills as a result of varying wastewater concentrations.

Hands-Off Treatment as a Service
Aquacycl provides 24/7 remote monitoring, control, and maintenance for onsite systems, offloading the operational burden.

AQUACYCL

www.aquacycl.com

info@aquacycl.com

+1 760-508-2154

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THE "SUGARWATER" CHALLENGE

Sugar processing is one of the most water-intensive industries. The wastewater from sugar refining and processing contains high brix (which translates to high Chemical Oxygen Demand or COD), total suspended and dissolved solids (TSS and TDS), color, low pH and odor. The composition of the effluent makes it difficult to treat or discharge.

A confectionery company faced challenges with a specific waste stream from process wastewater with an extremely high sugar content. This specific waste stream ("sugarwater") requires pretreatment or dilution prior to land-application; and cannot discharge to the onsite aerobic treatment facility due to carbon toxicity issues that would occur.

SOLVING THE HIGH-SUGAR CONTENT CHALLENGE

Until now, attempts to commercialize a technology that can treat this waste stream have failed due to high material and production costs, scalability challenges, and efficiency losses that minimize energy recovery during the treatment process. Aquacycl is the first company to solve the technical challenges that have previously limited the commercial use of microbial fuel cell technology.

Aquacycl installed a fully automated and containerized 12-reactor demonstration unit (BETT® Demo Unit) to continuously treat 160 gpd (727 litres/day) of the sugarwater and enable a clear understanding and cost model for how BETT® systems could be applied at full-scale for sugar industry wastewater treatment. System COD removal and power production were monitored during the demonstration. The inflow sugarwater COD ranged from 100,000-300,000 mg/L under continuous flow conditions. Batch operations were also required corresponding to production shutdowns associated with holidays and other facility operations.

Table 1: Results from BETT demonstration unit with 12 reactors

COD concentration	Between 100,000 and 300,000 mg/L
BETT Demo Unit COD removal rate	10%
Biomass production	0.03 to 2.5% from COD removed
BETT Demo Unit Net Energy Recovery	22 kWh/day (enough power to offset 50% of the total energy demand of demo)

THE RESULTS

The BETT® Demo Unit demonstrated its applicability and efficiency in treating high-strength sugar containing wastewater. The BETT® Demo Unit accomplished an average 10% COD removal (18,377 mg/L) in a 4-hour hydraulic residence time with only 12 BETT® reactors in hydraulic series (Fig. 2). The COD removal capacity of the system ranged from 2,200 mg/L to 50,000 mg/L. Lower removal rates were observed when reestablishing continuous mode after planned facility shutdowns. The system only requires 24-48 hour recovery period to reach normal performance metrics after a system shut-down or batch operation. These results showcase how microbial fuel cells can be used for treatment of high-organic wastewaters. Further, the system scales modularly. By adding more reactors in a treatment train, and operating multiple treatment trains, the BETT® reactors can be used to remove up to 95% of organics with flows between 2,500 gpd to 10,000 gpd.

One benefit of Aquacycl BETT system is the limited biomass production. During sugarwater treatment the BETT Demo Unit only generated 0.03 to 2.5% biomass from the COD removed (Table 1). In comparison to other conventional technologies, this translates to negligible biomass production (Fig. 3). The biomass generated from BETT ranged between 4 to 112 mg/L VSS compared to 381 to 4,615 mg/L VSS if the wastewater was anaerobically treated; and 1,522 to 18,462 mg/L VSS for aerobic processes (assuming identical COD loading in all cases).

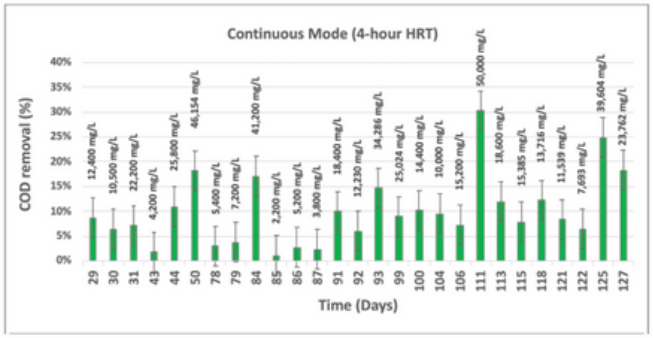

Figure 2: COD removal rates (% COD and COD concentration removed) from BETT Demo Unit operating under continuous flow

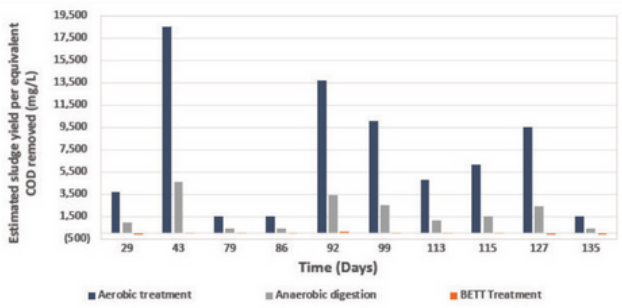

Figure 3: Estimated sludge yield per technology and per equivalent of COD removed