

Waste-to-Energy Biomass Benefits at Sierra Nevada Brewing Company

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Energy Generation - Chico



Energy Generation - Chico



Closing the Biogas Loop - Chico

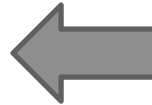


Spent brewing process water is pretreated onsite.



The first treatment phase is an anaerobic digester.

The biogas is recovered, cleaned up, compressed and used to offset the natural gas needed for our boilers.



Boilers provide the heat source in order to boil wort.



Moving East

Sierra Nevada's New Brewery at Mills River, NC



Wastewater Treatment Goals

- Maximize biogas production and produce renewable electrical energy – qualifies for tax credit
- Treat spent yeast and grain
- No solids screening be required
- Capability of 750,000 bbl/year
- Discharge to City sewer
- Robust, simple, yet compact



No Screening Prior to Treatment System

Wastewater Treatment Goals

- Minimize energy consumption, chemicals and capital investment
 - Eliminate biogas H₂S treatment
 - Eliminate effluent clarifier or DAF
 - Reduce No. of tanks
 - Minimize O&M expense
 - Gravity flow from brewery (no Influent pumps)
 - Minimize waste solids (digest solids)
 - Minimize chemicals (polymers, caustic, nutrients)
 - Minimize Hp (electrical use)



No H₂S Treatment Required

Basis of Design - Influent

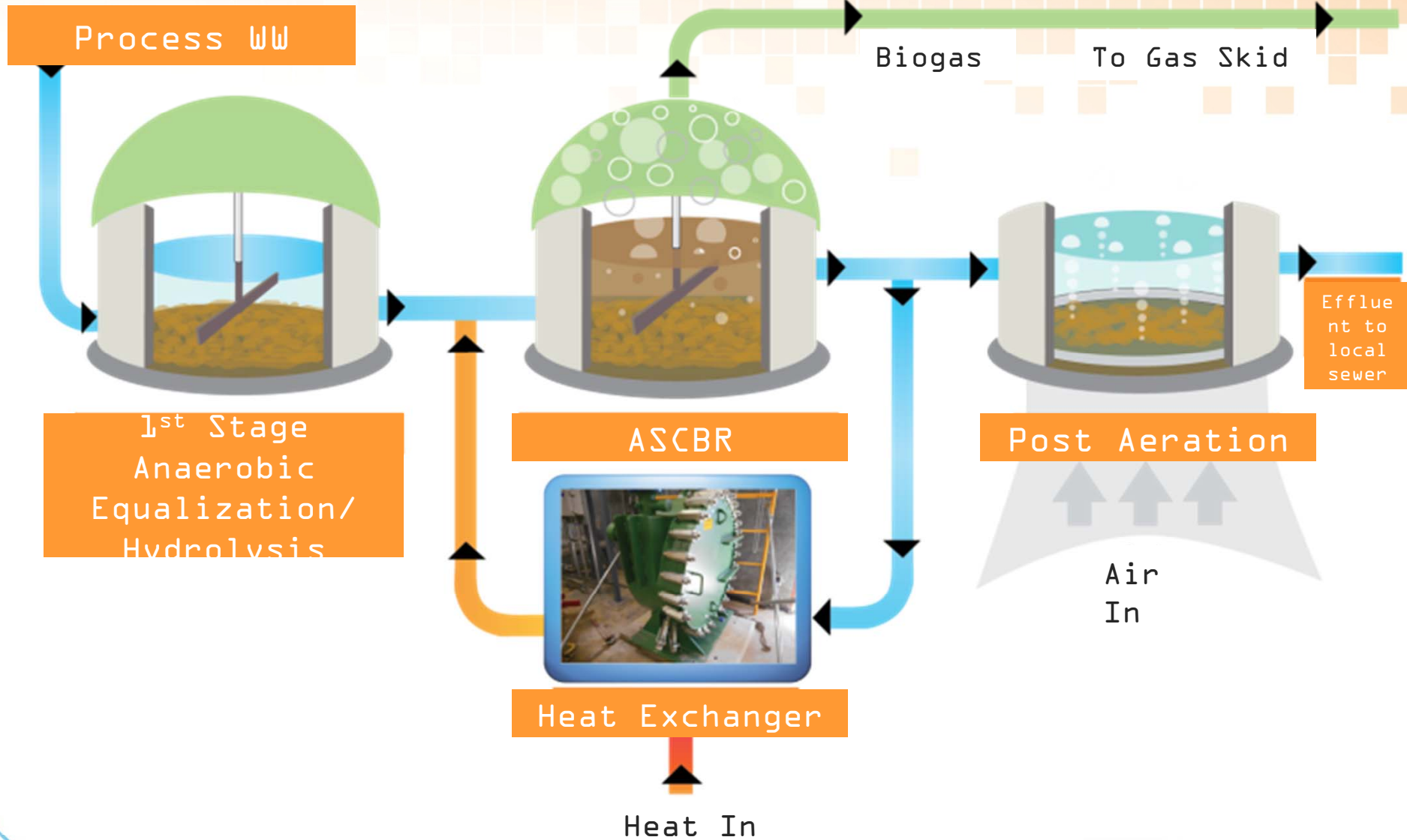
Influent Raw Wastewater Based on 700,000 bbls/year Production			
Parameter	Process WW	Yeast	Combined WW /Yeast
Volume of wastewater (gal/day)	212,000	10,600	222,600
BOD (mg/L)	3,500	75,000	6,900
COD (mg/L)	6,000	186,000	14,600
COD(lb/day)	10,608	16,443	27,100
TSS (mg/L)	800	61,000	3,700
NH ₃ N (mg/L)	30	420	50
TKN (mg/L)	120	5,200	400
Total P (mg/L)	50	1,000	100
Temp (°F)	50-120		
pH (s.u.)	4.5-12		
SO ₄ (mg/L)	50	50	50

Effluent Discharge to City

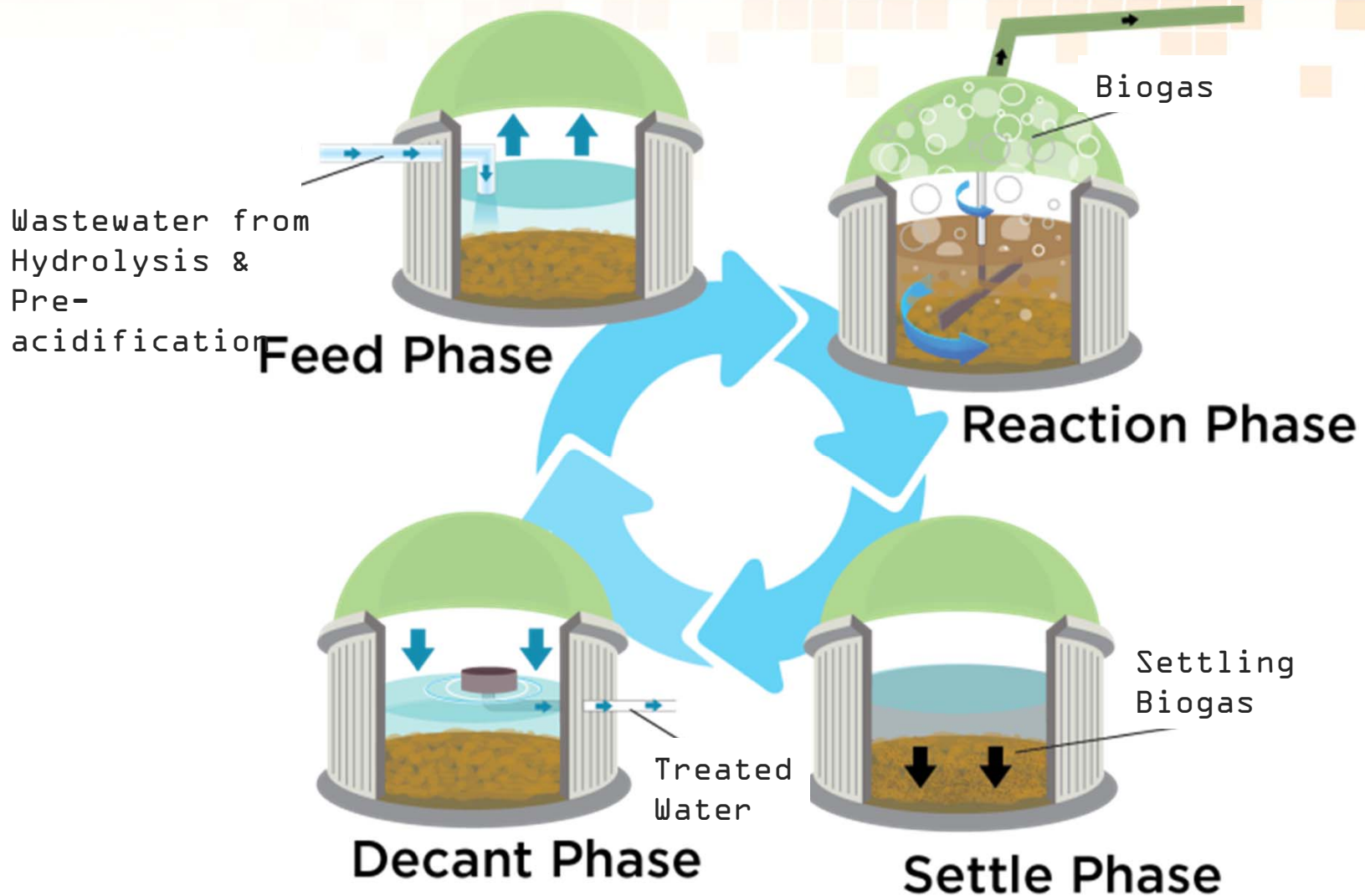
Municipal Sewer Surcharge Limits

Parameter	Surcharge Value
BOD (mg/L)	210
TSS (mg/L)	210
pH (s.u.)	6.0-10.0

Treatment Process

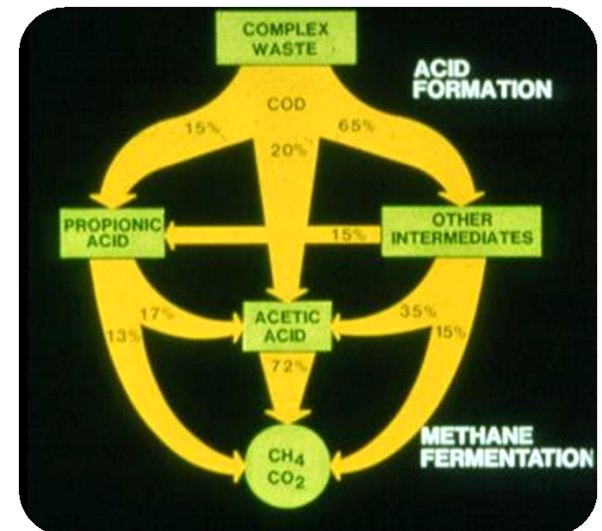


Process of ACSBR Technology

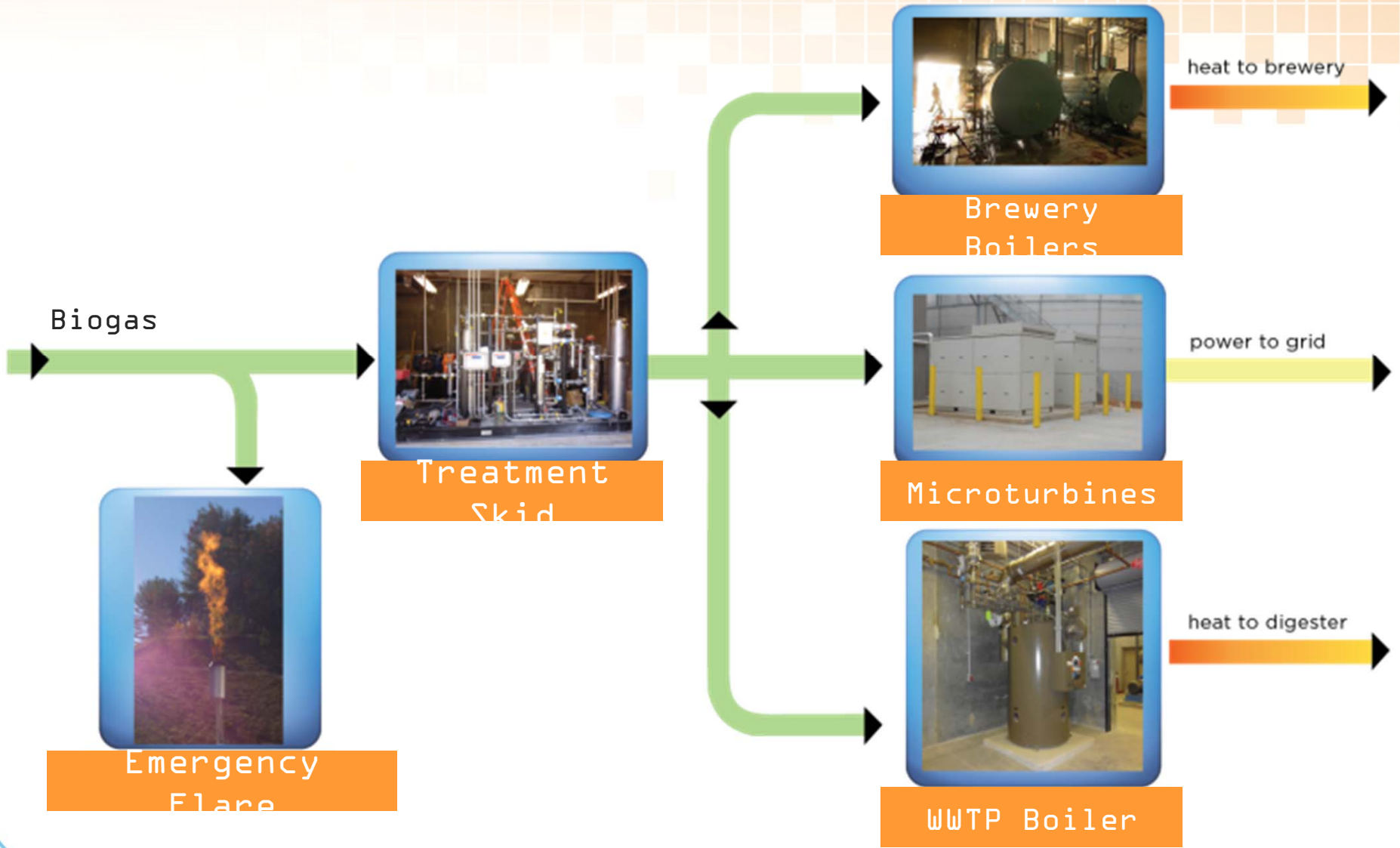


ACSBR System Advantages

- No pretreatment required
- Feast / famine operation for better COD removal
- Organics and solids removal
 - TCOD loading up to 25,000 mg/L
 - Influent TSS up to 5,000 mg/L
- Extensive capacity in the reactor for biomass accumulation
 - $F/M < 0.05/\text{day}$
 - No solids wasting for the first year
- Low chemical use
 - (No chemicals required for solids clarification)
- No internal settlers, mixers, or equipment
 - (All equipment easily accessed from outside for service)
- Low effluent TSS (< 300 mg/L)
- Controlled biogas production tailored for end use
- No biomass wasting for over a year



Wastewater Biogas-to-Energy Process



Treatment Process



Site Under Construction



Dual Gas Boiler



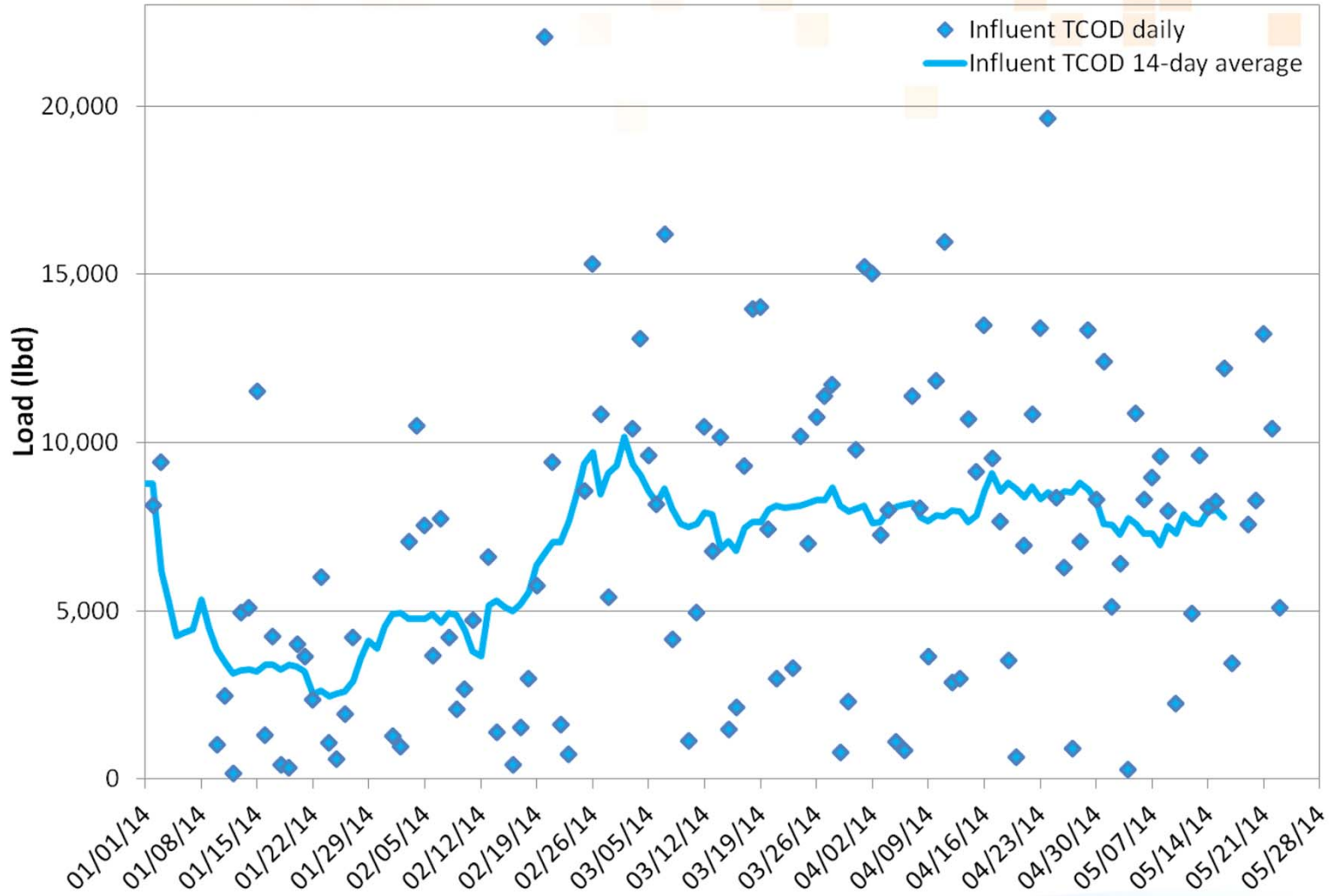
Biogas Compression Skid



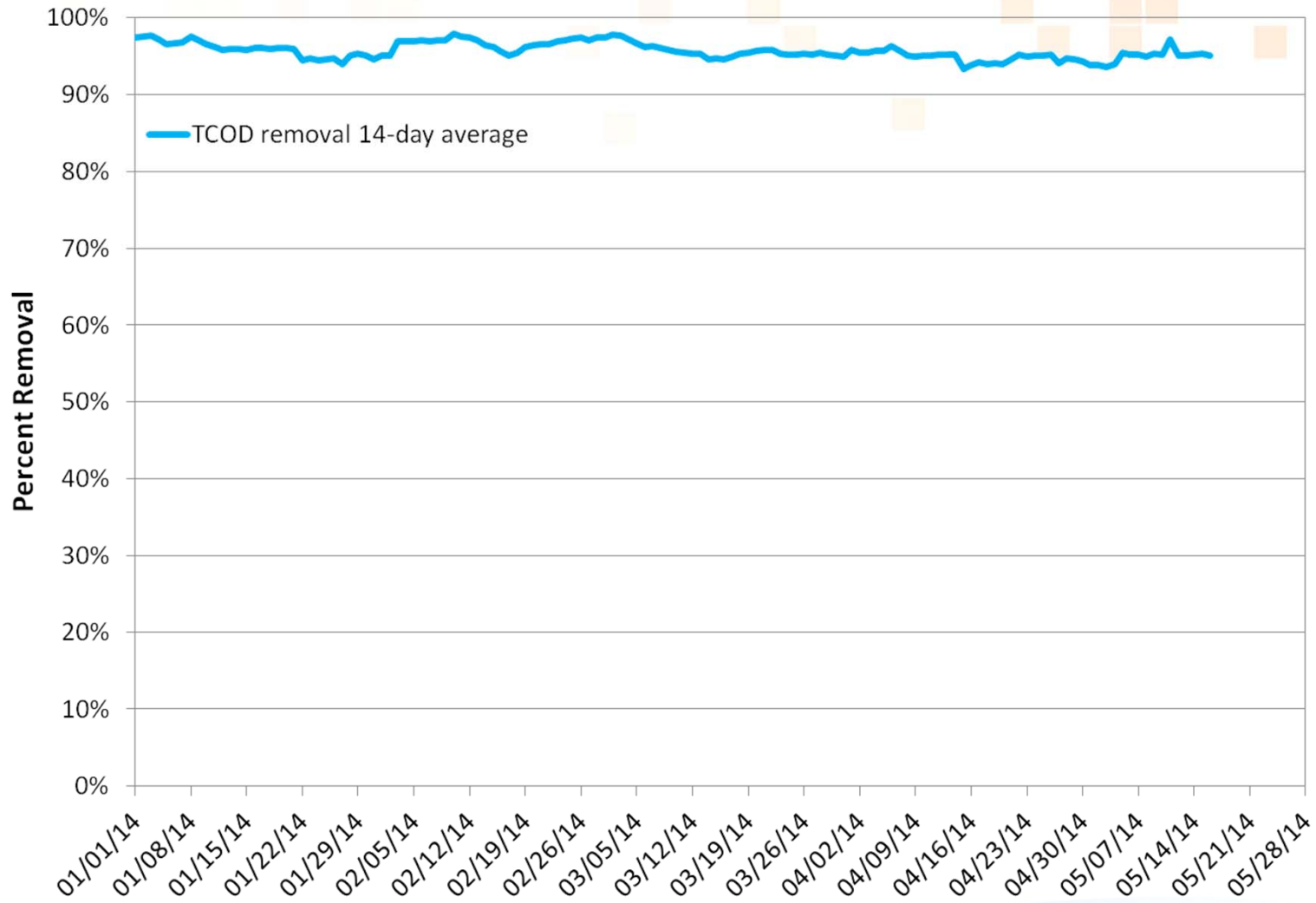
Capstone Microturbines



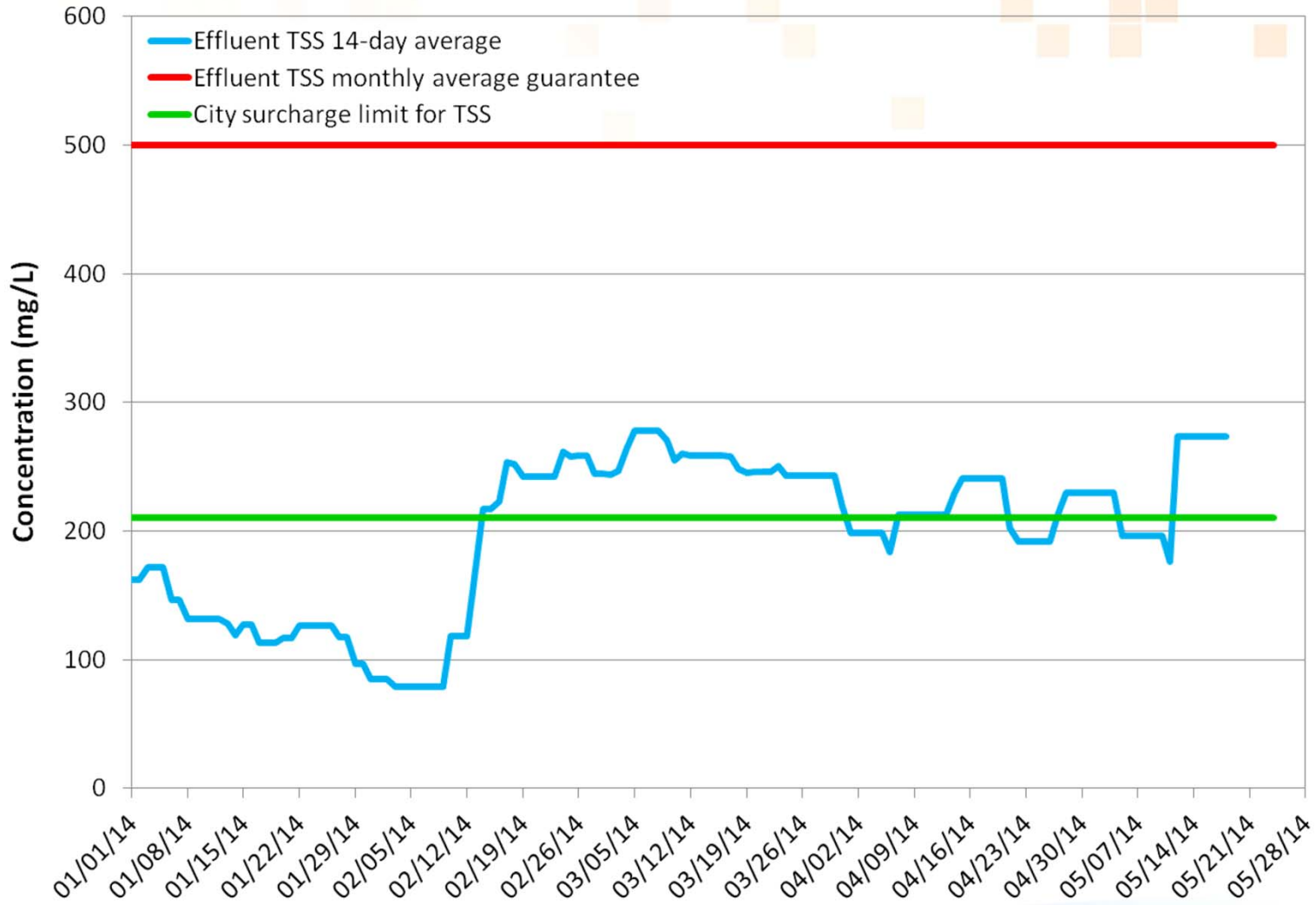
Influent TCOD (lbs)



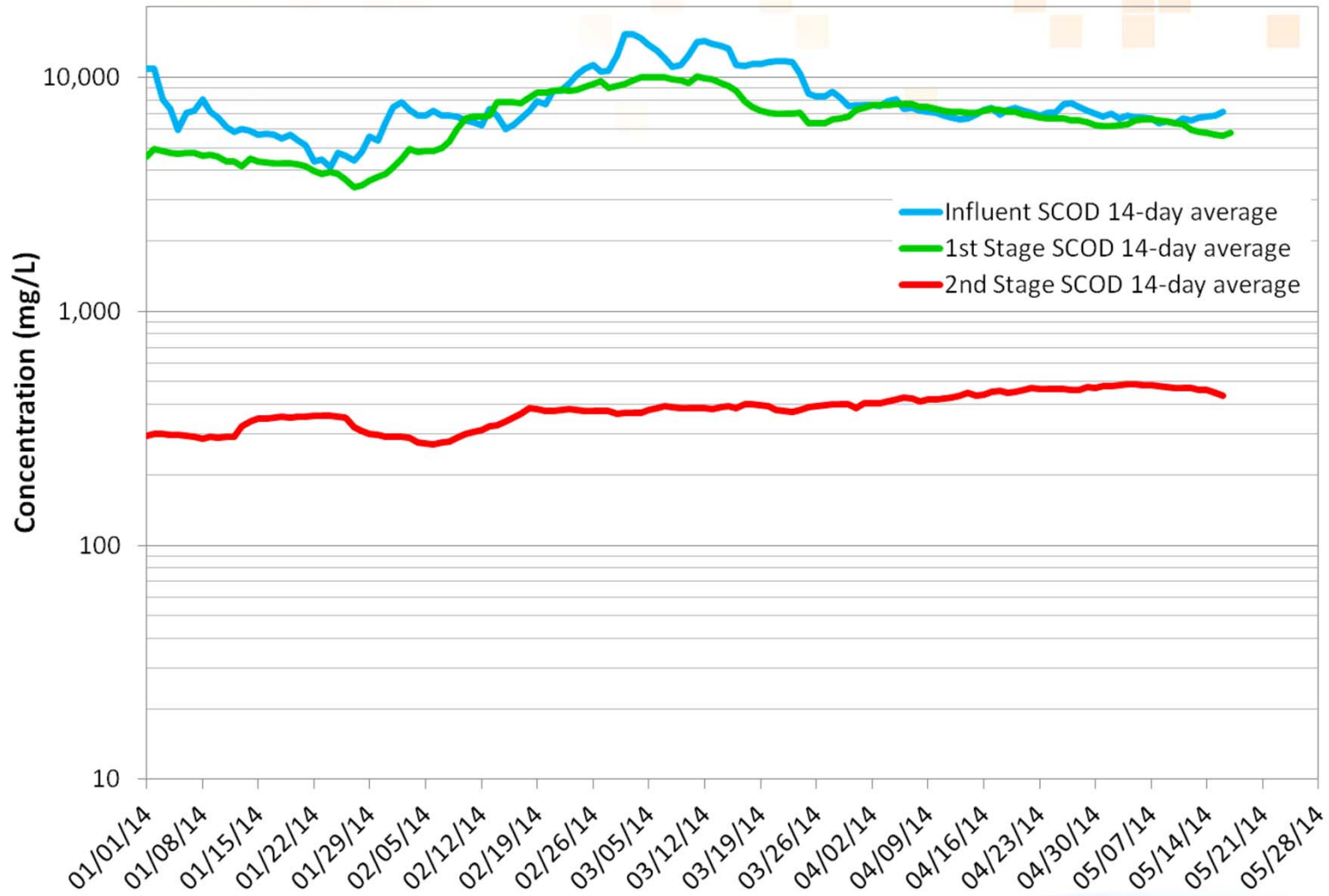
TCOD Removal



Effluent TSS



SCOD Concentration Throughout Treatment



Goals Met

- Producing biogas & renewable electrical energy
- Treat spent yeast and grain
- No solids screening
- Robust, simple, yet compact
- Eliminate biogas H₂S treatment
- Eliminate effluent clarifier or DAF
- Reduce No. of tanks
- Minimize O&M expense
- Gravity flow from brewery (no Influent pumps)
- Minimize waste solids (digest solids)
- Minimize chemicals (polymers, caustic, nutrients)
- Minimize Hp (electrical use)

Lessons Learned

- Partial Design/Build Contractor
- Microturbine grid connection
- Weather considerations



Large Brewery Segregated High Solids Digestion Alternatives

- Primary treatment solids
- Yeast
- Trub
- Small grain particles
- Waste product

ACSBR Segregated High Solids Digestion Advantages

- Produce additional biogas
- Hydrolyze solids
- Minimize
- Recover alkalinity
- Recover ammonia for macronutrient

Cheers!



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