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Evaluating Additive To Increase Biomethane Yields In Anaerobic Digesters

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Water Pollution Control Facility Ridgewood, N.J.

The Village of Ridgewood located in Bergen County, New Jersey, is the fourth largest community in Bergen County, with a population of 25,500 and land area of 5.79 square miles.

The Department of Public Works - Division of Water Pollution Control, operates the wastewater treatment plant (WPCF) and the sewage collection system. The Ridgewood, NJ WPCF receives an average daily flow of 2.6 - 3.0 MGD.

The WPCF is operated as an activated sludge plant: with primary clarifiers, secondary aeration, secondary clarifiers, and anaerobic digesters. It concentrates digested sludge prior to sending it off-site for incineration. The village entered into a 20 year public/private partnership with Ridgewood Green (RME's) to provide on-site electricity to the village at the WPCF and 3 building. RME sells power back to the village.

RME equipment install included 240kW CHP and Solar panels to generate 100% onsite requirements, along with export back into the grid. A FOG receiving station installed and the operation began operation in Feb, 2013.

Ridgewood Project Description

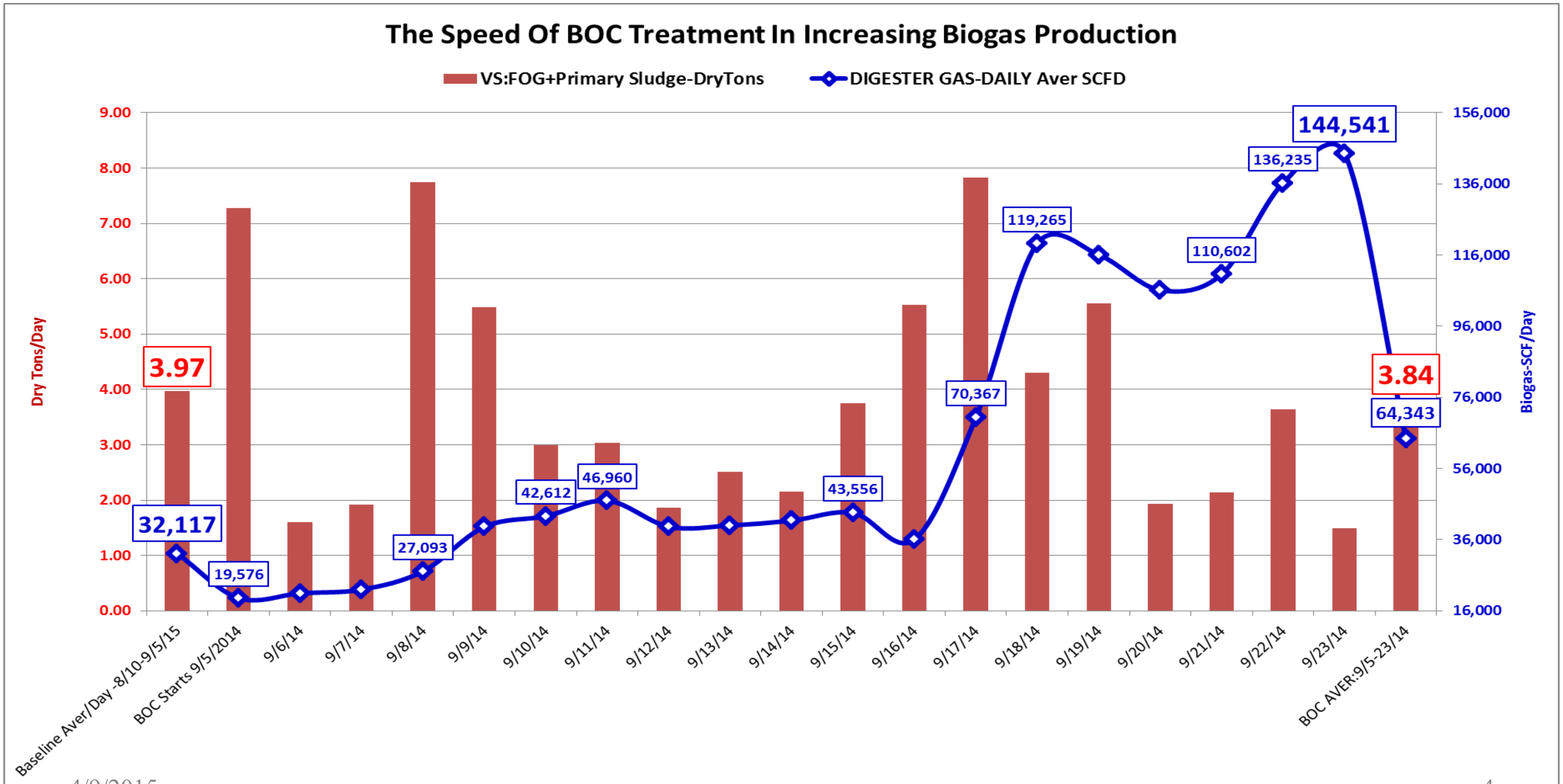
The issue that developed in August/2014, involving the formation of a mat of grease on the which was 4-6 Ft thick, on the surface of the digester due to poor mixing .This prevented adequate biogas flow to the CHP system.
Working with the Village, the operator was able to alleviate this issue through a combination of addition of Bio-Organic Catalyst which began on 9/5/14 and installation of a digester sludge recirculation pump that discharges recirculated sludge into the headspace of the digester to agitate the grease accumulation. BOC was injected into the FOG mixing/feed tank @ the rate of 1.89 liters/dry ton of VS. In order to accelerate the Solubization and the breakdown of the grease cap, an additional 8 liters/day was added manually into the digester sludge recirculation pump . This was stopped after 10 days as the FOG cap was drastically reduced.
This strategy was deemed successful and after 5 days after BOC injection began, Biogas production increased dramatically and CHP engine output was very high.

- Biogas production increased 117 % over baseline during a 56 day period.
- BOC Benefits:

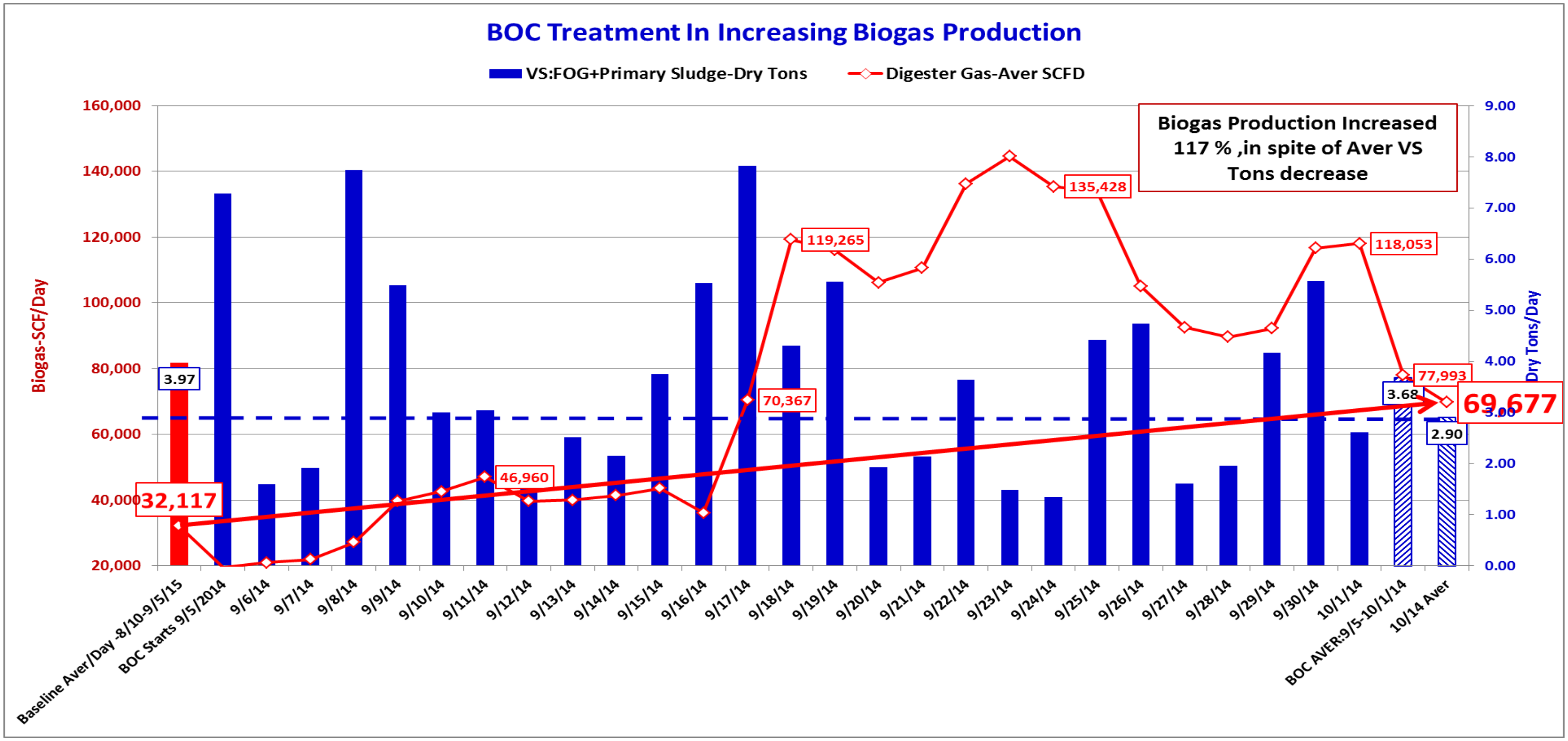
1. Allows increased VS Loading while maintaining increased biogas yields.
2. Improves Dramatically biogas production in chronically underperforming Anaerobic Digesters

Date	Digester Gas-Aver SCFD	Biogas % Increase Over Baseline	VS-FOG & Prim Sludge-Dry Wt Lbs	VS: FOG+ Primary Sludge-Dry Tons
Baseline Aver/Day -8/10-9/5/14	**32,117**		**7,932**	**3.97**
BOC Aver. : 9/5 thru 10/31/14	**69,677**	**117 %**	**5,797**	**2.90**

The Speed Of BOC Treatment In Increasing Biogas Production



BOC Increased Biogas Production 117% Over Baseline



Ridgewood Green RME's BioGas Clean Up and CHP Equipment

- 240 kW Mann CHP
- With biogas piped from AD's into biogas storage bladder, flowing into clean up equipment for removal of moisture, particulates,h_2s and siloxanes prior entering into CHP

Ridgewood Green RME's FOG Receiving Station And Existing AD's Operation

FOG receiving began operation in Feb, 2013. Original design was 11,000 Gallon, which has been expanded to 30,000 gallons, with automatic mixing and temperature control.

2-AS's operated as complete mix, **mesophilic**, with primary and was sludge and FOG's. With 1 Primary and 1 secondary AD (500,000 gal./AD).

Introduction

Anaerobic digestion offers excellent opportunities to convert organic waste streams into environmentally safe bio-solid while generating renewable energy through the bio-methane produced by the microbiological populations processing the wastes.

- Anaerobic digestion offers an effective organic waste stream treatment solution that reduces pollution loadings to environmentally safe discharges.

- The bio-gases produced within the microbial populations of the AD systems contain renewable energy potential from the percentage of bio-methane in the bio-gases that are generated through the biological reactions.

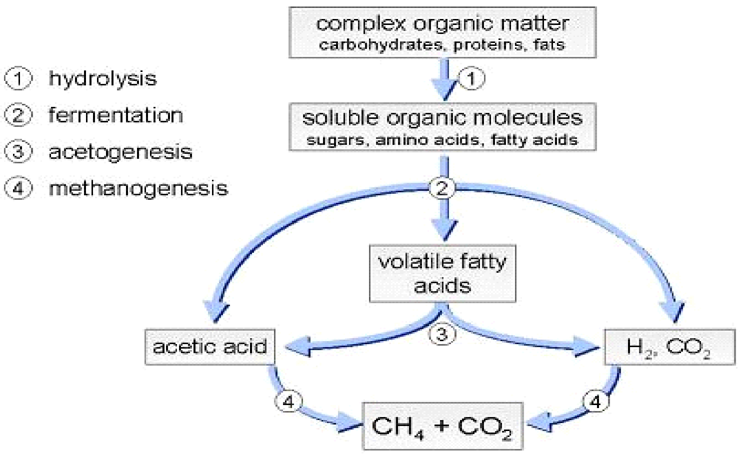
These two characteristics comprise the twin pillars of the economic value proposition to the AD system operator/owner.

Extensive work in both municipal and food processing anaerobic digesters has shown that BOC's offer great potential in optimizing anaerobic digestion conversion rates, while addressing and improving chronic operational challenges of operators in obtaining optimal renewable energy production and high quality bio-solids.

Challenges of Anaerobic Digestion:

AD offers an effective organic waste stream treatment solution that reduces pollution loadings to environmentally safe discharges. The bio-gases produced within the microbial populations of the AD systems contain renewable energy potential from the percentage of bio-methane in the bio-gases that are generated through the biological reactions.

These two characteristics comprise the twin pillars of the economic value proposition to the AD system operator/owner.



The operation of (AD) system is dependent upon feeding the four (4) phase anaerobic digestion process.

The mechanism of bio-catalysis of BOCs on the waste stream components sets into motion an accelerated molecular breakdown of the biomass enabling a corresponding acceleration of the anaerobic digestion processes within the AD system. There are numerous aspects that will impact the complete biological conversion of the total organic solids (TS), and most importantly the total volatile solids (TVS).

Economics of Anaerobic Digestion

The economics of anaerobic digestion are closely tied to obtaining optimal renewable energy bio-methane yields, which offsets fossil fuel energy purchases, which are used to heat and maintain AD temperatures.

- The ability of increasing bio-methane yields directly reduces natural gas or fuel oil purchases and, increasingly, carries values in generating renewable energy or carbon reduction credits.
- Accelerating and optimizing the anaerobic digestion rates expands the capacity of anaerobic digester systems through enhanced biological vitality, and also impinges directly on the capital equipment investment (CAPEX) of combined heat and power (CHP) required to utilize bio-methane production.

Problems encountered in anaerobic digesters generally are tied to the difficulties of converting various components of the waste stream during anaerobic digestion, leading often to a decrease in bio-methane yields over time, and a reduction of usable renewable energy cash flows.

Economics of Anaerobic Digestion

Most anaerobic digesters are often challenged by biomass loadings that can result in reduced bio-methane yields and require expensive maintenance cleanings, in addition to decreasing renewable energy production. The organic materials that represent the highest bio-methane values are also the organic components that cause these problems: ***The volatile organic solids.***

BOCs directly act on these high value components of wastes, accelerating the anaerobic digestion processes into more optimized conversion efficiency. Case studies show a much higher yield per pound, or kilo, of organic waste biogas, while clearing the internal accumulations that build up over time.

BOCs require little capital equipment expenditure, as installations involve simple injection pumps, along with a reservoir of BOCs.

- Results become evident relatively quickly, as a faster release of high bio-methane value components of the waste material shifts the internal biomass within the anaerobic digester into the Methanogenesis phase, increasing the bio-methane yields and total consumption of volatile fatty acids.

Optimization of Anaerobic Digestion with BOCs

A complete mass balance analysis of using BOCs shows benefits over a number of critical costs of operations, including :

1) Higher bio-methane volume and % yields can increase electrical generation

2) Lower bio-solids hauling weight and volumes,

3) Substantial reduction of bio-solids odors.

4) Reduction in aeration energy requirements through recirculation of dewatered liquids

5) Total nitrogen reductions and Improvements in all discharge values of a facility, including BNR discharges.

Conclusion

The bio-catalytic actions of BOCs upon the AD system influent biomass, prior to their inflow into various AD systems, produces very useful and notable improvements to critical parameters to the operations of an AD system.

- Applications in municipal, food processing and Ag AD systems showed close correlations between higher TS and TVS conversion rates and higher bio-methane yields on a dry weight comparison, pointing towards an acceleration of the phased Methanogenesis cycle. This results in total overall enhancement of complete biomass vitality and microbiological population densities involved in the anaerobic processes required for optimal bio-methane yields and BTU values. The combined total mass balance analysis shows improvements in obtaining optimal bio-methane yields,

- On a dry weight TVS basis, can run from 25% – 100% over comparable baselines.

Additionally, the final biosolids quality and weight reductions (up to 25%), including substantial elimination of noxious biosolids odors, all indicate a more complete biological conversion of nutrient values.

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The authors would like to thank the BioCycle West Coast Conference, on Wednesday, April 15, 2015 for the opportunity to present this program on Evaluating Additive To Increase Biomethane Yields In Anaerobic Digesters

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