BLAISE BIOGAS AD FACILITY

Process Monitoring Plan

August 2019

BIOCONSTRUCT

Client: Blaise Biogas Limited

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REPORT SCHEDULE

Operator: BioConstruct NewEnergy Limited

Client: Blaise Biogas Limited

Project Title: Blaise Biogas AD Facility Permit Application

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Project Director: Joanna Holland

Project Manager: Jo Chapman

AUTHOR	DATE
Jo Chapman	31st August 2019
REVIEWER	DATE
Joanna Holland	7th September 2019
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1. INTRODUCTION

1.1. Introduction

1.1.1. This plan outlines the Process Monitoring Plan for the Blaise Biogas AD Facility, and the range of corrective actions that may be taken in response results observed resulting from these activities.

1.2. Scope

1.2.1. This plan applies to all sampling process monitoring activities to be carried out at the facility.

1.3. Definitions

BMP – Biomethane Potential

DS – Dry Solids

LOI – Loss on Ignition

ODS – Organic Dry Solids

OLR – Organic Loading Rate

PTE's – Potentially Toxic Elements

RBP – Residual Biogas Potential

VFA – Volatile Fatty Acid

FOS:TAC - Volatile organic acids / Total inorganic acids

2. PROCEDURE

2.1. Blaise Biogas AD Facility Monitoring Procedure

2.1.1. The table below outlines the regular monitoring schedule for Blaise Biogas AD Facility:

Sample Point	Frequency	Sample Method	Analysed For
Primary and Secondary Digesters	Online Continuous	Continuous monitoring via in situ monitoring sensors – data represented on SCADA monitoring system and monitored by trained staff. Alarm sent to staff if parameters outside of set point ranges	Temperature Level Foam Present on Digesters Hydraulic Loading of Digesters Data logged and interrogated on SCADA system by trained staff on an ongoing basis.
	Daily	Grab Calculation	pH FOS/TAC OLR Analysis carried out in onsite lab by trained staff or sent to external lab.
	Weekly	Grab	DS ODS Ammonium Analysis carried out in onsite lab by trained staff or sent to external lab.
	Monthly	Grab	VFA Specification Analysis carried out in onsite lab by trained staff or sent to external lab.
Digestate PAS110	Every 3 months or every 6,000m^3 digestate whichever is the soonest	Multiple Grab Samples	PTE's Physical Contaminants Total Nitrogen Ammonical Nitrogen Dry Matter LOI

Sample Point	Frequency	Sample Method	Analysed For
			Analysis carried out by external approved laboratory
	6-monthly	Multiple Grab	RBP and VFA Analysis carried out by external approved laboratory
Gas line – primary and secondary digesters	Online Continuous	Continuous monitoring via in situ monitoring sensors – data represented on SCADA monitoring system and monitored by trained staff. In situ gas monitor will carry out continuous cycle of gas quality monitoring. Analysis results sent to SCADA system for monitoring and action from trained staff.	Pressure Methane Hydrogen Sulphide Oxygen Flow Rate

3. INDICATIVE LIMITS

3.1. Indicative Limits

3.1.1. The following parameters are based on industry practice and will be used as a guide to indicate a stable process. Green indicates a stable 'healthy' range, yellow indicates risk of instability and the need to monitor more closely, and red indicates that corrective actions should be taken to bring measures under control.

Parameter		Limit
Total VFA (mg/l)		< 1000
		1000 - 4000
		>4000
VFA Species (mg/l)	Acetic Acid	< 1000
		1000 - 4000
		>4000
	Propionic Acid	<250
		250-1000
		>1000
	Longer chain VFA (butyric,valeric)	<50
		>50
	Ratio acetic acid: propionic acid	>2
		1-2
		>2
FOS:TAC Ratio		<0.3
		0.3 – 0.5
		>0.5
Ammonia (mg/l)		<5000
		>5000
pH		7 - 8
		<7
		>8
Input Carbon:Nitrogen Ratio		20 – 30:1
		<20 – 30:1
		>20 – 30:1

Parameter	Limit
Biogas Methane Content	>50%
	<50%
Biogas Hydrogen Sulphide Content	<1000ppm
	>1000ppm

3.1.2. Anaerobic digesters benefit from stable process conditions. The following parameters have been identified as being key to maintaining process stability. Where possible they will be maintained at constant values.

- Temperature – Design temperature is mesophilic range.
- Organic loading rate – Is feedstock dependant, which will be calculated on a daily basis. Loading rate can be decrease significantly if required, however should only be increased by 10% per day to maintain process stability.
- Mixing – It is essential that the digester tanks are mixed thoroughly to ensure bacteria have access to fresh material and no hot spots occur, maintaining process stability.

4. CORRECTIVE MEASURES

4.1. Corrective Measures

4.1.1. There are no specific measures that can be prescribed for process control management, as each situation presenting will be the product of a unique set of conditions which will need to be managed giving due consideration to all known factors influencing operations at the time. Below is a list of measures that should be considered within the scenarios presented.

Problem	Issue	Indicator	Response
Significant rise of volatile fatty acids in the digesting medium (i.e. >>1500 mg/l)	Over loading/feeding the digester with biodegradable materials leading to process inhibition and death of process	High VFA's Low pH High OLR Low or reducing concentration of CH_4 in biogas	Reduce or stop feeding to the digester. Increase monitoring of VFA's Add alkali (bicarbonate, lime or feedstock type) to neutralise acids. Analysis material for micronutrient deficiencies. Increase blending between digester tanks.
High concentrations of longer chained VFA's (propoic acid +)	Plant process not optimised	High levels in speciated VFA analysis High C:N Increase in ammonium levels Low or reducing concentration of CH_4 in biogas Lower than expected volumes of biogas	Increase feedstock testing for nitrogen content and reassess blend constituents. Increase the C:N ratio if possible. Analysis material for micronutrient deficiencies. Increase blending between digester tanks.
High FOS:TAC	Unable to balance if there any changes to VFA concentration. Could lead to Inhibition and death of process	High VFA's Low alkalinity Low pH High OLR Low or reducing concentration of CH_4 in biogas	Add alkali (bicarbonate, lime or feedstock type). Reduce or stop feeding to the digester. Increase monitoring. Increase blending between digester tanks.
Ammonia	Inhibition and death of process	High ammonium Low C:N Low or reducing concentration of CH_4 in biogas Lower than expected volumes of biogas	Increase feedstock testing for nitrogen content and reassess blend constituents. Increase the C:N ratio if possible. Analysis material for micronutrient deficiencies. Increase blending between digester tanks.
pH – increase or decrease	Inhibition and death of process	High/low pH High/low OLR High/low VFA	If high pH – add acid

Problem	Issue	Indicator	Response
		High FOS:TAC Low or reducing concentration of CH_4 in biogas Lower than expected volumes of biogas.	If low pH add alkali (bicarbonate, lime or feedstock type). Increase/decrease OLR. Analysis material for micronutrient deficiencies. Increase blending between digester tanks.
Poor temperature control (low)	Poor calibration or failure of temperature control	Reduced gas production, fouling (at greatly reduced temperature)	Check digester temperature manually, calibrate temperature control, investigate heat exchangers
Poor temperature control (high)	Poor calibration or failure of temperature control	Digestate, increase VFA, increased temperature	Check digester temperature manually, calibrate temperature control, and consider mixing efficiency
Excessive Foaming	Damage to process equipment. Activation of pressure relief valves and spillages.	Visualisation in samples and digestate storage Visual assessment of foam through tank sight glasses. Foam sensors trigger alarm if foam present	Reduce or stop feeding to tank. Decrease tank level. Increase OLR monitoring. Monitor the VFA levels at regular intervals and control pH around 7.0. Add anti foaming agent. Increase agitation.
High C:N	Inefficient biogas production	Low or reducing concentration of CH_4 in biogas Lower than expected volumes of biogas. Low ammonium in digestate	Increase feedstock testing for nitrogen content and reassess blend constituents. Decrease the C:N ratio.
Low C:N	Inhibition and death of process via an excess of ammonia	Low or reducing concentration of CH_4 in biogas Lower than expected volumes of biogas. High ammonium in digestate	Increase feedstock testing for nitrogen content and reassess blend constituents. Increase the C:N ratio.
High hydrogen sulphide	Increased cost in carbon filter management Decrease utilisation in biogas	High hydrogen sulphide in biogas. High sulphate in feedstock	Evaluate performance of air injection system. Add ferric chloride. Increase feedstock testing for sulphate content and reassess blend constituents.

5. DOCUMENTATON AND METHODOLOGY

5.1. Documentation

5.1.1. All internal lab analysis results will be recorded and retained within the management system record archive for a minimum of 6 years.

5.1.2. All analyses undertaken by third parties will be sent to a lab with the necessary registration/accreditation relevant to the sample in question.

5.1.3. All samples will be taken in accordance with relevant guidance documents and standards.

5.1.4. Sampling and monitoring will be carried out by competent staff, and if required staff will have access to external biological specialist services for additional support.

h&c consultancy

Registered office:
Staffordshire House
Beechdale Road
Nottingham NG8 3FH
Company No. 7861810

0115 923 2253
07506 658098 / 07525 211381
www.hc-consultancy.co.uk