QMS04 Process Monitoring V2.0

INTRODUCTION

This plan outlines the process monitoring plan for the Bio Dynamic UK Ltd. AD Facility, and the range of corrective actions that may be taken in response results observed resulting from these activities.

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

PROCEDURE

The table below outlines the regular monitoring schedule for the Bio Dynamic UK Ltd. AD Facility:

Sample Point	Frequency	Sample Method	Analysed For	Location of Record
Digesters (CCP4)	Online	Continuous	Temperature Level	SCADA
	Weekly	Grab	pH FOS/TAC	Site Diary and KPI Spreadsheet
	Ad Hoc	Grab	DS ODS Ammonium	KPI Spreadsheet
Pasteuriser/ABPr Digestate	Every 6 weeks	Multiple Grab	Bacteria	KPI Spreadsheet and digital file
Digestate PAS110	Every 3 months or every 6,000m^3 digestate whichever is the soonest	Multiple Grab	PTE's Total Nitrogen Ammoniacal Nitrogen Dry Matter LOI	Digestate Quality History Spreadsheet
	6 monthly	Multiple Grab	RBP and VFA	Digestate Quality History Spreadsheet
Gas line	Online	Continuous	Pressure Methane Hydrogen Sulphide Oxygen	SCADA and KPI Spreadsheet

Sample Point	Frequency	Sample Method	Analysed For	Location of Record
			Carbon Dioxide Flow Rate	
Attritor Blade/Screen (CCP 2)	Daily	Visual check	Integrity of screen and paddles	Maintenance record
Waste Input types – ABP category and EWC codes (CCP1)	Every load	Visual check of paperwork and material	Cat 3 ABP and authorised Cat 2 ABP only EWC codes listed on QP appendix B and WML only	Waste transfer notes, commercial documents, waste input record, waste return, rejection records
Pasteurisation Process (CCP3)	Every batch	Temperature monitoring	Temperature at 72 degrees C	SCADA

INDICATIVE LIMITS

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
		>2

Parameter		Limit
	Ratio acetic acid: propionic acid	1-2
		>2
FOS:TAC Ratio		<0.3
		0.3 – 0.6
		>0.6
Ammonia (mg/l)		<5000
		>5000
pH		7 - 9
		<7
		>9
Input Carbon: Nitrogen Ratio		20 – 30:1
		<20 – 30:1
		>20 – 30:1
Biogas Methane Content		>50%
		<50%
Biogas Hydrogen Sulphide Content		<1000ppm
		>1000ppm

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.

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.

CORRECTIVE MEASURES

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 (propionic 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.
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 High FOS:TAC Low or reducing concentration of CH_4 in biogas	If high pH – add acid If low pH add alkali (bicarbonate, lime or feedstock type). Increase/decrease OLR.

Problem	Issue	Indicator	Response
		Lower than expected volumes of biogas.	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.	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.