Trowbridge Bioresources Centre 11799

Digestion Process Monitoring Description

Scope:

This document provides a framework for anaerobic digestion monitoring at Trowbridge BC. It covers how monitoring is conducted, how the results are assessed and where the information is recorded.

Introduction:

Trigger point records, updated daily, are used to assess the performance of the digestion process and are available on site via SCADA (supervisory control and data acquisition) and Wessex Water telemetry (PRISM) for full visibility. SCADA and PRISM are used to monitor each parameter and to generate alarms for deviations outside the operating ranges. Any alarms generated are passed out to operational staff as per procedure ROCP200 'Guidance on response to telemetry alarms', who can then respond to the problem or issue using the mitigations available to them.

Any issue not easily rectified will be escalated to the Site Manager, Area Scientist or Technical Supervisor.

As well as SCADA and PRISM; operational staff also have Amulet available, this is an electronic data recording system which has the advantage of being able to access telemetry data from Prism and other Wessex Water systems such as the laboratory sample system and WAM (Work and Asset Maintenance). Therefore, reports can be run which combine trends such as tank levels and recent sample data to provide a more comprehensive review of the digestion process and identify any issues more readily. Amulet allows data export for performance reports for senior management, Asset Strategy and other departments and teams.

The digestion monitoring table is included below and details the various parameters checked and monitored to ensure the digestion process is stable, and any negative trends are quickly picked up and resolved. The table also specifies frequency of monitoring and where information is stored as well as actions available for operational staff.

Sampling and data recording:

Digesters are routinely tested for operating parameters. The data is recorded and graphed using real time monitoring software to monitor the process performance as detailed in the table below.

Essential parameters such as throughput volume, temperature, PH, dry solids, biogas are monitored daily to determine the system performance and efficiency. Parameters like Volatile Fatty Acids (VFA), pH, Alkalinity, Organic Loading Rate (OLR) are monitored weekly using lab analysis. Responsibility for the weekly digester sampling rests with trained operators. The quality measurements and performance analysis is the responsibility of the Site Manager and Area Scientist.

Liquid and Solid Sludge Sampling

Once the samples are analysed the data is stored on Scientific Systems (SciSys) our online archive from LIMS (Laboratory Information Management System) and available under a unique pre-assigned sample point number. The data from the sample analysis is initially checked in the lab and then by site manager and area scientist. Any sample with analysis exceptions (where the result is outside prescribed limits) is flagged on a daily exception report and will be investigated.

Historical data for each sample point is available to spot any change in trends and imbalances in the digestion process. Sample results and flows can be used to calculate a mass balance. The trending data will help maintain a proper biological balance for h a stable digestion process.

Sampling points such as drainage valves are available, accessible and clearly labelled at various points in the process including digester influent and effluent sampling points.

Samples are usually taken downstream while the feed pumps are in operation. The digester feed sample is mixed and equalized and representative of the sludge feedstock. Digester effluents are also mixed and sampled prior to any solid separation.

Prior to any sampling, valves are opened for a short period of time to flush any accumulated material in the taps and pipes. Samples are collected in sealed and clean bottles designed for the applicable analysis. To protect sample integrity, on-site samples will be analysed immediately. Samples that need lab analysis will be refrigerated on site and collected the from site and transported to our laboratories in a refrigerated vehicle.

Furthermore, to maintain sample integrity and chain of custody, all samples are dated, timed, and labelled.

Gas Sampling

Daily digester combined biogas composition is continuously being analysed using a gathered as an inline gas analyser prior to gas consumers and is calibrated as per the manufacturer requirements.

Additionally, gas composition analysis is done threetimes a year and analysed by an external laboratory, as required by EPR permit monitoring. Samples are sent in dated and timed containers as required for the analysis. Determinands include siloxanes, methane, hydrogen sulphide, carbon dioxide and hydrogen.

Digestion Monitoring Table:

Digester Key Parameters	Parameter	How is monitoring conducted	Frequency of Monitoring	Allowable ranges / Triggers	How do systems monitor parameters?	What controls are in place to prevent allowable range to be not met / exceeded	Specific actions in response to trigger	Where is data stored?
	% dry solids (%DS)	Operator task & Periodic Lab samples	Onsite checks as required and & cWeekly lab samples	4-6 % DS	Onsite Sataroius moisture analyser & online data	Operator controlled	Modulate thickening performance of gravity belt thickener	SCISYS
	Digester Feed Volume / Sludge Feed	On-line	Continuous and daily manual recording	Refer to TRTWPL008 HACCP CCP* See sub-table below.	In line flowmeter	Alarms and maximum volume set points	Operator intervention using PLC (control panel) (Programmable logic controller)	Online – SCADA archive
	Actual Tank Volume **	On-line	Continuous	Tank Specific Level Setpoints	Level monitor	High Level alarm – inhibit	High tank level will result in automatic inhibit on digester feed	Online – SCADA archive
	Foaming	visual Check daily online level sensor	Continuous	High level	Visual check is recorded on WAM / log sheet and then escalated / online trends	Dose antifoam	Modulate the digester feedstock in terms of volume and or %DS thickness	Radar level sensor on SCADA
	Volatile Fatty Acids (VFAs)	Manual (Lab samples)	Periodic	>300 mg/l in MAD >9000mg/l in APD reactor 6	Online data trends	Weekly checks of lab sample	Modulate digester feedstock in terms of volume in line	SCISYS

							with HACCP CCP*	
	Alkalinity	(Lab samples) Manual (Lab samples)	Periodic	< 3000 mg/l-6000mg/l>	Online data trends	Weekly checks of lab sample	Modulate digester feedstock in terms of %DS thickness and volume fed	SCISYS
	ALK/VFA ratio	Online	Periodic	> 0.5	Online data trends & calculation	Weekly check of trends	Monitor VFA and PH Test Alkalinity Modulate feedstock within HACCP CCP* volumes accordingly	Online Amulet Calculation
	APD Sludge Feed Temperature	Online	Continuously	Refer to TRTWPL008 HACCP CCP* See sub-table below	In line temperature probe	HMI minimum temperature set points	Sludge transfer inhibited until vessel reaches temperature set point	Online – SCADA archive
	MAD Process temperature	On-line	Continuous	<30*42> degrees	Online data trends	Daily reading checks , Set points and high / low alarms	Digesters automatically modulate feeding	SCADA
	Organic Loading rate (OLR)	On-line	Weekly	1.5-3.5 kg.VS/m3 /d combined	Online data trends & calculation	Weekly check of trends	Modulate feedstock with HACCP CCP*	Online Amulet Calculation
	pH	Manual (Lab sample)	Periodic	>6-9<	Online data trends & calculation	Weekly check and on-site readings	Check VFA/Alkalinity ratio Modulate feed to digester in line with HACCP CCP*	SCISYS
	Hydraulic Retention Time	On-line	Continuous	Refer to HACCP CCP*	Online data trends & calculation	Weekly check of trends	Alter digester feedstock volumes if outside HACCP CCP*	Online Amulet Calculation

	Biogas methane (%)	On-line	Continuous	<60%	Online data trends & calculation	Daily Readings	Check OLR-VFA, pH Modulate feed	Online Amulet SCADA
	Oxygen Level	Manual	Continuous	< 2%	Online data trends & calculation	Daily Readings	Modulate digester feed volume	Online Amulet SCADA
	Digestate Ammonia	Manual (Lab samples)	Periodic	>1500mg/l	Online data trends & calculation	Weekly check of trends	Modulate the feedstock-Reduce OLR, check pH, Alkalinity AND VFA	SCISYS

*HACCP : Hazard Analysis and Critical Control Point Plan

*CCP : Critical Control Point

HACCP CCP Table:

CCP 1	**Daily maximum sludge volume to APD**	**CCL**
Critical Limit Value	Max APD volume is 500 m3 /d	500 m3/d
Allowable variability	Actual volume fed +23 m3 (up to 523 m3) Feed volumes are split between 24 batches per day. Each individual batch volume is based on the APD feed setpoint. The APD plant control is only able to fed whole batches and this allowable variability is set to allow for batch completion.	

Measurement	M3/day	
Data record	Daily manual record on site log sheet TRTWF087 and TRTWF074	
Compliance Check	Daily manual check against critical limit value	

CCP 2	**APD vessel 1 temperature**	**CCL**
Critical Limit Value	Min APD temperature is 27oC	<27 ^{o}C
Allowable variability	Actual measured temperature - 0.20oC (not less than 26.80oC) The Endress and Hauser TR10 temperature probe has an accuracy at 27oC of 0.20oC (0.15 + 0.002*27 = 0.20). This data is from the technical information for the probe.	
Measurement	^{o}Centigrade	^{o}C
Data record	Daily manual record on site log sheet TRTWF087 and TRTWF073	
Compliance Check	Daily manual HMI check against critical limit value and recorded on TRTWF087	

** Actual tank volume =

Level monitoring on all tanks with high level alarms. The plant fed in 24 batches over a 24 hour period, sludge is moved through the plant in a reverse cascaded batch process. The feed is controlled by PLC and critical control points of flow and temperature.

Revision History:

Issue	Date	Description	Prepared by
1	September 2023	First Issue	Jason Littlewood Carolyn Dewhirst