

IC submission (IC2,3,4,5 & 7),

IC2 – Waste characterisation and segregation

Technique	Description	How Biogen complies
2a. Set up and implement waste characterisation & pre-acceptance procedures	These procedures aim to ensure the technical (& legal) suitability of waste treatment operations for a particular waste prior to the arrival of the waste at the plant. They include procedures to collect information about the waste input and may include waste sampling and characterisation to achieve sufficient knowledge of the waste composition. Waste pre-acceptance procedures are risk-based considering, for example, the hazardous properties of the waste, the risks posed by the waste in terms of process safety, occupational safety and environmental impact, as well as information provided by the previous waste holder(s).	Biogen have an established <u>“Feedstock Pre-acceptance Procedure”</u> (attached), which demonstrates how Biogen meets the BAT requirements and those in sections 2.1.2. of Sector Guidance Note IPPC S5.06. The pre-acceptance requires a 3-stage sign-off by a representative from the Operations, Compliance and Laboratory/Research team. Samples are requested and analysed where appropriate, this is done on a risk basis. The procedure also details the need to obtain: • Information on the nature of the waste. • The composition and characterisation of the waste. • Handling requirements. • And associated hazards. • Where appropriate a representative sample of the waste will be taken from the customer and analysed ensuring the collected sample is representative providing justification for any deviations. The procedure is directly linked to the <u>Feedstock Pre- Acceptance Form</u> (attached) which is completed prior to any of the waste being accepted. The form, in addition to the above, also ensures the relevant information stated as part of the guidance is obtained:

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		• Information and contact details for the current holder of the waste. • Description of the waste. • Description of the process giving rise to the waste. • Whether it is considered a high-risk feedstock, an example could be a liquid feedstock high in fat/oils or yeast which require careful management to preserve biology, or one where it is deemed a risk because of the nature in the way waste is collected. This requires additional sign-off at Director level. • The EWC/LOW code assigned to the waste. • The SIC code assigned to the producer of the waste. • The physical form the waste is in, e.g. solid, liquid, sludge. • Whether it contains Animal By-Products Regulations (ABPR) material, if yes, which category. • Whether it contains packaging, if yes, what type of packaging and estimated %. • The anticipated quantities of waste. • Waste testing (this is primarily for liquid-based feedstocks). Biogen undertake an extensive sampling program and work with an external laboratory to cover the following determinands: Total Solids % w/w, Organic Dry Matter % w/w, Total Nitrogen % w/w, Ammonium Nitrogen (mg/kg), Total Phosphorus (P) (mg/kg), Total Potassium (K) (mg/kg), Total Magnesium (Mg), Total Copper (Cu), Total Zinc (Zn), Total Sulphur (S), Total Molybdenum (Mo), Total Lead (Pb), Total Cadmium (Cd), Total Mercury (Hg), Total Nickel (Ni), Total Chromium (Cr), Total Sodium (Na), pH, Chloride,
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		Fluoride, Total Arsenic (As), Total Selenium (Se), Water Soluble Sodium, CLS Fat Test (g / 100g), Microbial inhibition at pH 6.0, Microbial inhibition at pH 7.2, Microbial inhibition at pH 7.4, Microbial inhibition at pH 8.0, Biological Methane Production (LCH4/kg VS), Electricity Production (kWh/ AD tonne), COD (g/L). Routine samples are taken prior to acceptance and then either on a 6-monthly or 12-monthly basis, this is decided on a risk basis (<i>example of results for a customer attached</i>). In instances where there is cause of concern over variance, the research team will increase the frequency of testing for determinants of concern. Biogen have an agreed <u>Feedstock Agreement</u>; it stipulates that the customer must notify Biogen if there is a deviation from the feedstock described in their Agreement. This is a legally binding document that had input from legal advisors. It is signed by the customer. • Whether there are any special handling requirements with respect to H&S of personnel or in respect of the environment. Any hazards associated with the waste. • Haulier details, including Waste Carriers License (WCL), ABPR approval where applicable. • The type of vehicle the waste will be transported in.
2b. Set up and implement waste acceptance procedures	Acceptance procedures aim to confirm the characteristics of the waste, as identified in the pre-acceptance stage. These procedures define the elements to be verified upon the arrival of the waste at the plant as well as the waste acceptance and	Biogen has a <u>Delivery Offloading Procedure</u> , this includes a requirement for the weighbridge operator to confirm the load with the driver at the point of weigh-in and prior to tipping. Here they will also check the EWC/LOW code, and the Waste Transfer Notes

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	rejection criteria. They may include waste sampling inspection and analysis. Waste acceptance procedures are risk-based considering, for example, the hazardous properties of the waste, the risk posed by the waste in terms of process safety, occupational safety and environmental impact, as well as the information provided by the previous waste holder(s).	(WTN)/Duty of Care (DOC) paperwork and ensure they are booked in on the pre-agreed Commercial schedule. The initial sampling is undertaken prior to waste acceptance due to the turnaround times; however periodic sampling thereafter will be coordinated by Biogen's Research Team. When waste is tipped the load is visually inspected for any non-conforming items, and material is again visually assessed for any obvious contamination prior to loading into the hoppers. In the event contamination is identified, it is quarantined to one side and photographs are taken and the relevant persons notified as per the <u>Contaminated Feedstock Procedure</u> (note the tables in the procedure are currently under review by the Executive Leadership Team (ELT) & a new version will be issued accordingly)). The team are familiar with the waste acceptance criteria for the site and the need to report deviation from this. Likewise, the team will raise any other hazards resulting from waste streams that could impact on process safety, occupational safety or the environment. Biogen undertake frequent occupational and environmental monitoring, the frequency of which may be reviewed if necessary following feedback on feedstocks. Contamination tends to be objects which could cause mechanical damage to front end processing equipment as opposed to hazardous waste materials. However, to ensure this does not pose a risk, training is also provided to employees on hazardous waste, and this is also covered under the <u>Disposal of Hazardous Waste Procedure</u>.
2c. Set up & implement a waste tracking system and inventory	A waste tracking system and inventory aim to track the location and quantity of waste in the plant. It holds all the information generated during waste pre-acceptance procedures (e.g. date of arrival at the plant and unique reference number of the waste, information on the previous holder(s), pre-acceptance	Biogen's IMS utilises an electronic management software system that stores all data relating to pre-waste acceptance (as described in detail above, including but not limited to ongoing analysis results). This same management system captures any issues with loads and the action taken via the "incident log" module. In addition to the electronic IMS, our weighbridge software captures

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	and acceptance analysis results, intended treatment route, nature and quantity of the waste held on site including all identified hazards), acceptance, storage, treatment and/or transfer off site. The waste tracking system is risk based considering, for example, the hazardous properties of the waste, the risk posed by the waste in terms of process safety, occupational safety and environmental impact, as well as the information provided by the previous waste holder(s).	all input and outputs to the site. This is done in accordance with the Wastemetrics Work Instruction for Weighbridge Staff , which also highlights where a load can be marked as “rejected”. Biogen’s monitoring of incoming waste with unique customer references, dates, time of arrival, tank level monitoring, digestate outloads, etc allow for accurate monitoring of tank volumes. However, as the process operates on a continuous flow process it is not possible to definitively pinpoint the exact location (albeit with the knowledge of retention times at each stage it is possible to give an indication), this differs to a batch process that allows full identification at each stage. However, on a risk basis, we take low risk material (i.e., food waste that was intended for consumption), and where liquid feedstocks are involved, we apply customer site visits/audits and sample analysis.
2e. Ensure waste segregation	Waste is kept separated depending on its properties in order to enable easier and environmentally safer storage and treatment. Waste segregation relies on the physical separation of waste on procedures that identify when and where wastes are stored.	The Bryn Pica facility accepts source segregated food waste that was intended for consumption. To achieve the optimum biological conditions, we agitate the contents of the Raw Waste Buffer Tank (RWBT) to ensure a homogenous mix. The waste pre-acceptance process would rule out any incoming material that couldn’t be mixed at the waste acceptance stage or in the RWBT, or at the very least, would identify maximum volumes that could be accepted at any one time/over a period. Biogen have an established Research Team who form part of the pre-waste acceptance team and provide feedback and advice on new feedstocks and process monitoring. Segregation in the Bryn Pica process therefore generally relates to the different stages of treatment where control measures are in place to ensure partially treated material cannot come into contact with fully treated material. This is controlled through engineering, including both software control and hardwired controls as part of our HAZOP process. An example of a procedure that covers these controls is the Pasteuriser Fill Discharge Procedure, the HACCP

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		<u>Plan, and Process Flow and Hazard Identification for HACCP Production.</u> The category of ABP most prevalent at Bryn Pica is catering waste, i.e., kerbside collected food waste from local authorities, however, the site is also licensed to accept Category 3 ABP. Non-ABP and catering and category 3 ABP wastes do not require separate storage under our ABPR approval as all wastes are treated as the highest category, i.e. Cat 3 ABP, and subject to pasteurisation to the European standard of 70°C for 60 minutes.
2f. Ensure waste compatibility prior to mixing or blending of waste	Compatibility is ensured by a set of verification measures and tests in order to detect any unwanted and/or potentially dangerous chemical reactions between wastes (e.g., polymerisation, gas evolution, exothermal reaction, decomposition, crystallisation, precipitation) when mixing, blending, or carrying out other treatment operations. The compatibility tests are risk-based considering, for example, the hazardous properties of the waste, the risk posed by the waste in terms of process safety, occupational safety and environmental impact, as well as the information provided by the previous waste holder(s).	As described above, the waste sourced is materials which can be readily mixed to form a homogenous mix. To avoid undesirable wastes, a comprehensive pre-waste acceptance process is followed, and materials considered “higher-risk” are analysed prior to acceptance. Furthermore, to assess impact on biology, trial loads may be taken to allow for a fuller assessment of the characteristics. Hazardous materials are not accepted, and even with organic feedstocks great care is taken when introducing new feedstocks.
2g. Sort incoming solid waste	Sorting of incoming solid waste aims to prevent unwanted material from entering subsequent waste treatment process(es). It may include: -manual separation by means of visual examinations; -ferrous metals, non-ferrous metals or all metals-separation; -optical separation, e.g. by near infrared spectroscopy or x-ray systems; -density separation, e.g. by air classification, sink-float tanks, vibration tables; -size separation by screening/sieving	Currently the sorting relies on visual inspection to identify unwanted materials from entering the process. Biogen are currently undertaking trials on another of its AD facilities in respect of metal detectors, pending the results of these trials there may be some modifications to enhance this in the future.

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IC3 – Characteristics of the waste gas streams

Information about the characteristics of the waste gas streams, such as:	How Biogen complies
Average values and variability of flow and temperature Average concentration and load values of relevant substances and their variability (e.g., organic compounds, POPs such as PCBs) Flammability, lower and higher explosive limits, reactivity Presence of other substances that may affect the waste gas treatment system or plant safety (e.g. oxygen, nitrogen, water vapour, dust).	The applicability of this BAT is limited in scope when applied to Bryn Pica due to the nature of the wastes handled and the design incorporating minimal release points. The Biogen AD process is very simplistic in terms of emission points due to its sealed nature. All process tanks are connected to the common gas line. The common gas line feeds the site's CHPs which are subject to MCERTS emissions testing. The sample points are identified in line with M1 guidance and in conjunction with an MCERTS accredited external contractor. Annual monitoring of the flare will be undertaken if it is used for more than 10% of operational time. The waste reception hall is ducted through to its own designated cylindrical carbon filter. The air extraction in both the reception hall will achieve negative pressure and achieve a minimum of 3 air changes per hour. The <u>Odour Abatement Maintenance Procedure</u> (attached) states the parameters routinely tested. This will be subject to periodic VOC/GCMS analysis, however the variability in the feedstock is limited and the cost and time to sample is high, therefore this will not be done as frequently as olfactory. Due to the nature of the feedstocks and the wet nature of the process, dust is low risk in our process. Pre-acceptance also considers dusty feedstock, if dusty feedstocks were to be accepted going forward, independent occupational and environmental dust monitoring would be commissioned as required, it is the responsibility of the Compliance Director to commission additional testing as required. Odour via Olfactory to BS EN13725, H₂S to CEN TS 13649 and NH₃ to BS EN ISO 21877, GCMS/VOCs (extended gas suite) to LFTGN04, stack humidity to BS EN14790 and temperature and velocity to BS ISO 16911-1, are scheduled for the 24.11.22. Unfortunately, this is the first available date the MCERTS firm have to conduct the testing. The results will be shared with NRW on receipt. It should be noted that there are very few specialists accredited to this new standard and very few

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	laboratories are able to analyse the tubes. These test results will be shared with NRW on receipt. In addition to the above testing, 6-monthly samples are taken of the carbon media and sent for absorption capacity testing. The carbon is sent to CPL Activated Carbons at Immingham. The most recent sample showed a CTC level greater than 10%. This shows there is still life remaining within the carbon, typically the lab consider it spent when it reduces below 10%. Latest results attached <u>CPL Activated Carbons.</u> To this end we are actively encouraging UKAS olfactory specialists to gain accreditation to allow for more availability and to allow for competitive pricing. Biogen will continue to utilise the gas detection tubes and will assess their accuracy against the very costly monitoring imposed under the newly varied permit, the added advantage if these are proven to be accurate against the new standard is that they also give an instant result. A schedule to allow for 6-monthly testing is being drawn up with the MCERTS firm for Biogen's national network of plants. In respect of flammability, UEL and LELs, the company has appointed specialist consultants to conduct <u>DSEAR reviews</u> and risk assessments and they consider all aspects of the site's operation in these reviews.
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IC4 – Adequate Storage Capacity

Storage capacity management:	How Biogen complies
Measures are taken to avoid accumulation of waste, such as: -the maximum waste storage capacity is clearly established and not exceeded taking into account the characteristics of the wastes (e.g. regarding the risk of fire) and the treatment capacity; -the quantity of waste stored is regularly monitored against the maximum allowed storage capacity;	The maximum waste storage capacity is well defined and controlled at the Bryn Pica site. The site primarily accepts local authority kerbside collected waste which is under contract and a known quantum throughout the year. Additional wastes will be supplemented by our Commercial Team, all waste goes through Biogen's Waste Acceptance Process. Only once approved is the waste then scheduled for the site. Loads that are not pre-booked on the weighbridge system are not authorised to discharge so the site does not accept ad-hoc unannounced deliveries, this ensures full consideration and planning for waste storage volumes and waste acceptance criteria. Waste volumes and photos of the reception bay are reported daily by the Site Team on the Duty Manager group, our Commercial Team also have full visibility of the hall and waste levels by CCTV. Weekly feedstock meetings are held with the Operations Team, Research and Commercial team to assess waste capacities across our national network, these cover any planned maintenance/downtime, unscheduled downtime due to breakdowns and the need to divert. One advantage of Biogen having 14 operational AD plants is that they serve as contingency for one another during periods of downtime, allowing for waste to be diverted as required. In respect of the raw waste buffer tank (RWBT) and tanks beyond that, all are fitted with level sensors, high level probes and hardwired controls to prevent overfilling. The level sensor allows Biogen to monitor the quantity in the RWBT and this is displayed on the SCADA homepage. This is regularly monitored and RWBT levels communicated to aid with feeding plans.

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IC5 (BAT 23) Energy Efficiency Plan

Energy efficiency plan:	How Biogen complies
An energy efficiency plan entails defining and calculating the specific energy consumption of the activity (or activities), setting key performance indicators on an annual basis (for example, specific energy consumption expressed in kWh/tonne of waste produced) and planning periodic improvement targets and related actions. The plan is adapted to the specificities of the waste treatment in terms of process(es) carried out, waste stream(s) treated, etc.	The Board of Directors set an annual target for OEE for each site, and this is then fed through into the financial budget. Biogen has a weekly OEE spreadsheet, this incorporates on a daily basis, the tonnes, target tonnes, % liquids, RWBT level and includes the reasons for any generation losses. The OEE performance is circulated weekly and a MTD performance calculated by site, this is shared with the relevant teams and provides for a comparison against all of our operational facilities. This will take into account any planned outages, like major CHP services/overhauls, or planned degrits. The variance to target is captured on a monthly basis by site and then all plants combined to give clarity on plants where greater focus is needed. The Bryn Pica target is 83.6% for this financial year, in the next few weeks we will be reviewing the performance YTD and targets for next year. It is important to note that Bryn Pica routinely achieves >93%, however due to the planned major CHP service and the RWBT degrit it was adjusted. The Commercial Director also has a target for sourcing higher KWOT (kilowatt per organic tonne) feedstock. Biogen test commercial feedstock at the pre-acceptance stage to assess it's KWOT amongst the other test parameters to inform the viability of taking it and the benefit in terms of overall kWh/tonne of waste processed. Biogen have greater flexibility on plants where there is a greater percentage of commercial feedstocks, AD Plants like Bryn Pica where it is under long-term contract for kerbside collected waste have less influence over this. However, efficiency savings in other environmental initiatives have a direct influence too. One example would be water efficiency, by reducing water usage in the plant (either potable mains water, or bund water return) Biogen in effect reduce any watering down of the feedstock and therefore KWOT thus maximising efficiency per tonne. Biogen have a number of initiatives such as this that will effectively improve overall energy efficiency. Again, targets are set and monitored. Biogen are looking for continual improvement in efficiency, however it is important to note that our targets are already very high (we know this through business

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	acquisitions where we get an insight into plant performance). So, whilst Biogen continually strive to improve in our annual targets, there is little scope to show significant increases. A review of the annual Energy 1 report form which stipulates the energy usage will be reviewed as part of the 4-yearly review. Biogen are also looking to gain accreditation to ISO 14064 for Carbon Reduction in 2023, this will inevitably also generate some additional actions/KPIs relating to this subject matter.
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IC7 – BAT 38 –

Biogen's Research Team & Environment Manager have put together the following summary which details the parameters and the acceptable ranges.

The **Operational Process Parameters** (attached) includes the trigger levels and Biogen's response/action to be taken once a trigger level is met or exceeded.

The laboratory data is kept for a minimum of 6-years in accordance with the permit. The process data referred to as continuous is a visual spot check at any given time.

Emission point reference or source or description of point of measurement	Parameter	Monitoring frequency	Monitoring standard or method	Other specifications
Digester feed	pH	3 times per week	HACH Titrator Serial no 699R066N010	Acceptable pH 4.000 – 5.999 <u>Operational Process Control Parameters</u> <u>Determination of Alkalinity & pH Procedure</u> Calibration and service of titrator carried out by HACH annually. Last calibrated 16/09/2022.

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	Alkalinity	NIL	Method would be to monitor carbonate, bicarbonate and ammonia present in the feed material.	Alkalinity analysis not carried out on feed material as no useful information would be gained, and regularly wouldn't be possible as the materials pH is regularly lower than 5 (the end point required to obtain an alkalinity reading)
	Hydraulic and organic loading rates	Daily	OLR = organic material fed (kg) / digester volume (m ³)	<u>Plant Monitoring Spreadsheet Procedure</u> <u>Operational Process Control Parameters</u> Acceptable OLR 2.5 - 4.999 kg ODM m3 day-1
Digester	Operating temperature	Daily	SCADA records temperature from temperature probes.	Acceptable 37.1 - 40.4°C <u>Operational Process Control Parameters</u> <u>Laboratory Monitoring Spreadsheet</u> <u>Plant Monitoring Spreadsheet Procedure</u> Temperature probes calibrated annually by Status Instruments.
	Liquid and foam levels	Continuous	SCADA control	Pressure sensors to determine levels in the digester
	Concentration of ammonia	Monthly	Calculation using pH, temperature and Ammonium-N results	Accredited Laboratory – NRM UKAS 2334 and ISO 14001 and ISO 45001
	Concentration of VFAs	Twice monthly	External Laboratory – NRM	Accredited Laboratory – NRM UKAS 2334 and ISO 14001 and ISO 45001 Acceptable < 2,500 mg/l <u>Operational Process Control Parameters</u> <u>Laboratory Monitoring Spreadsheet</u>

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	Alkalinity	3 times per week	H2SO4 0.1N added to a sample of digester contents and measure volume of acid added until pH falls to 5.75	Determination of Alkalinity & pH Procedure Laboratory Monitoring Spreadsheet Calibration and service of titrator carried out by HACH annually. Last calibrated 16/09/2022
	FOS/TAC ratio (VFA/TA)	3 times per week	Alternative analysis method used – alkalinity ratio	See explanation below for information regarding alkalinity ratio analysis Acceptable 0.200 – 0.499 Operational Process Control Parameters Laboratory Monitoring Spreadsheet Determination of Alkalinity & pH Procedure Calibration and service of titrator carried out by HACH annually. Last calibrated 16/09/2022
	pH	3 times per week	HACH Titrator Serial no 699R066N010	Acceptable pH ≥ 7.00 Operational Process Control Parameters Laboratory Monitoring Spreadsheet Determination of Alkalinity & pH Procedure Calibration and service of titrator carried out by HACH annually. Last calibrated 16/09/2022
Digestate	Concentration of VFAs	Monthly	External Laboratory - NRM	Accredited Laboratory – NRM UKAS 2334 and ISO 14001 and ISO 45001
	Ammonia	Monthly	Calculation using pH, temperature and Ammonium N results	Records maintained in the site Plant Monitoring Spreadsheet Plant Monitoring Spreadsheet Procedure Accredited Laboratory – Eurofins Food Testing ATL Ltd UKAS 2262; Accredited to ISO/IEC 17025:2017
Biogas from digesters	Flow	Continuous	SCADA	
	Quantity	Continuous	SCADA	

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	Pressure	Continuous	SCADA	
	Composition	Continuous	Awite Gas Analyser 1769	Gas Analyser Serviced by Allison Engineering Ltd
	Methane	Continuous	Awite Gas Analyser 1769	Gas Analyser Serviced by Allison Engineering Ltd
	Hydrogen Sulphide	3 times per week	H ₂ S RAE tube readings are taken from the gas sampling point.	Acceptable <300ppm Operational Process Control Parameters Plant Monitoring Spreadsheet Procedure
	Carbon Dioxide	Continuous	Awite Gas Analyser 1769	Gas Analyser Serviced by Allison Engineering Ltd
Biogas from digesting tank, biogas holder, waste reception building and external storage areas	Odour	Daily	Olfactory Monitoring	Odour detection at site boundary
Bund sump and storm water inspection chambers	Oil/grease and ammonia no >0.3ppm	Weekly	Instantaneous ammonia reading using CHEMetrics ammonia test kit.	The CHEMetrics Ammonia test kit employs the well-established Nessler reagent to determine ammonia concentrations are applicable to drinking water, clean surface water, good-quality nitrified wastewater effluent, and sea-water testing. Prior to any discharge from the front apron, a test is undertaken to ensure the water does not exceed 0.3ppm. In the event it exceeds it is returned back to the process for full treatment through the AD process where it ultimately then forms part of the PAS 110 digestate. A visual check is undertaken for any signs of oil/grease.

[Alkalinity Ratio Analysis](#)

Alkalinity and acidity are monitored by carrying out alkalinity analysis using a auto-titrator. Method used by Biogen as an alternative to FOS/TAC analysis:

- To determine alkalinity (also called partial alkalinity) – add H₂SO₄ 0.1N to a sample of digester contents and measure volume of acid added until pH falls to 5.75
- To determine acidity (also called intermediate alkalinity) – continue to add H₂SO₄ 0.1N to the same digester contents sample, until pH falls to 4.3
- Alkalinity ratio = Intermediate alkalinity / Partial alkalinity

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