Avonmouth Bioresources Centre Process Description

November 2025

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Summary of Site Activities

A summary description of all activities carried out with the Avonmouth BC is provided below.

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Dewatering of treated (digested) sludge
Dewatering of untreated (raw) sludge
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Anaerobic digestion of pre-treated food waste

1. WWSL- Overview of activities

Avonmouth Bioresources Centre (BC) treats indigenous sewage sludges arising from sewage treatment processes operated within the wider Avonmouth WRC (Water Recycling Centre), as well as sewage sludges generated by smaller WW 'satellite' WRCs. The principal activities undertaken within the installation include:

- Sludge reception and screening;
- Raw sludge thickening;
- Anaerobic digestion (including associated heat generation from the digester boiler and combined heat and power (CHP) engines to support AD activities);
- Untreated (raw) sludge and digested sludge dewatering;
- Untreated (raw) sludge cake removed from site for treatment
- Treated (digested) dewatered cake removed from site for recycling
- Use of biogas (a renewable energy source) to fuel CHP, generating electricity and / or heat to support the anaerobic digestion (AD) process. Biogas used in the Gas to grid plant which removes impurities and upgrades the calorific value of the biogas to be used in the gas network.
- Raw material storage and use;
- Surface water and process liquor collection and transfer to Avonmouth WRC for treatment;
- Natural gas boiler to support AD process.

1.1 Biological treatment (Anaerobic digestion) Sludge process

List of assets involved:

- Internal pumping station (IPS) consisting of strain press feed sump [B1], liquor sump [B2], and strained sludge sump [B3].
- Primary sludge strain presses [C]
- Import sludge reception tank [D]
- Imported strain presses [E]
- APD GBTs 1, 2 and 3 feed tank [F]
- APD GBTs [G1]
- APD Poly makeup plant [G2]

- APD feed tank [H]
- Avonmouth consolidation tanks [I]
- Bellmer Feed Tank [J].
- Bellmer GBTs [K1]
- Bellmer polymer system [K2]
- Thickened Bellmer tank [L].
- SBR SAS GBTs [M2]
- SAS GBT poly makeup system [M3]
- Thickened SAS transfer tank [N]
- APD (Acid Phase Digestion) [O1-6]
- Mesophilic anaerobic digesters (MAD) [P1-8]
- Secondary Sludge Storage Tanks (SSST) [Q]
- Centrifuge feed sludge tank [R]
- Centrifuges 5 & 6 [S1]
- Centrifuges 7 & 8 [S2]
- Polymer plant for centrifuges [S3]
- Polymer plant for centrifuges [S4]
- Raw trailers [S5]
- Digested trailers [S6]
- Road Centrifuges x2 [S8]
- Polymer plant for road centrifuges [S9]
- Centrate pumping station [U]

The following text provides a summary description of the anaerobic digestion sludge treatment process at Avonmouth BC. Each asset in the summary description is provided with a corresponding letter (as detailed above) which is referenced in the Avonmouth Asset Plan to show its location within the installation.

- Sludge from the Primary Sedimentation Tanks, located at the wider wastewater treatment works, flows into the internal pumping station (IPS) and into the strain press feed sump [B1].

- Raw sludge is then processed through the 3no primary sludge strain presses [C], the strained sludge is delivered to the strained sludge sump at the IPS [B3].

- Imported sludge from satellite sites across the Wessex Water portfolio are transported by road tanker and are discharged into the import sludge reception tank [D].

- The imported sludge is then pumped to 2no imported strain presses [E] and transferred to the IPS [B3] strained sludge sump.

- The screenings from the strain presses are collected in a skip and taken for composting. Any liquors removed are returned to the head of the works via the liquor sump in the internal PS [B2].

- Strained sludge from the IPS [B3] can then take 2 routes, the primary route is to Acid Phase Digestion (APD) GBTs 1, 2 and 3 feed tank [F].

- Sludge is passed forward and thickened in the 3no APD GBTs [G1], assisted by polymer addition from the poly makeup plant [G2]. It is then pumped to the APD feed tank [H].

- The IPS strained sludge sump [B3] can also pump to the 2no consolidation tanks [I]. These tanks then pump to the Bellmer Feed Tank [J]. The tank supplies the 2no Bellmer GBTs [K1] which, with the aid of polymer injection [K2], thickens sludge before it is fed into the thickened Bellmer tank [L]. Thickened raw sludge is then pumped to the APD feed tank [H].

- SAS originates from the SBRs before being thickened by injecting polymer from the poly makeup system [M3] into the feed sludge to the SBR SAS GBTs [M2]. It is then transferred via the thickened SAS transfer tank [N] to the APD feed tank [H] where it is mixed with thickened raw sludge from the Bellmer thickened tank [L] and APD GBT feed GBTS [G1].

- The liquors from all sets of GBTs are collected and returned through the site foul water drainage into the liquor sump at the IPS [B2] to be returned to the head of the works for re-treatment through the WRC plant.

- Sludge from the APD feed tank [H] is fed to APD vessel 1 [O1] and heated via a hot water/sludge heat exchanger. The feed is batch fed through a series of 6 no tanks forming the APD (Acid Phase Digestion) [O1-6] process.

- The APD sludge is pumped to 8 concrete mesophilic anaerobic digesters (MAD) [P1-8]. 6 digesters [P1-6] form what is known as MAD 1, whilst 2 digesters [P7+ P8] form MAD 2.

- Digested sludge is gravity fed to the 2 x Secondary Sludge Storage Tanks (SSST) [Q].

- Digested sludge from the SSST [Q] is dewatered to cake using the two road centrifuges [S8] and poly system [S9]. Digested sludge is also transferred to the centrifuge feed sludge tank [R] where the digested sludge is dewatered using centrifuges 5 & 6 [S1] and 7 & 8 [S2].

- Digested dewatered cake is transported using the digested trailers [S6] out of the permitted boundary for recycling.

- Heat is primarily supplied to the APD and MAD digesters from a natural gas boiler [BH], or 5x combined heat and power engines (CHPs) [BI1-5]. {WWEL}

1.2 Biogas Collection and Storage

Biogas from the anaerobic digestion process is collected, stored and transported on site to various consumers.

List of assets involved:

- Gas Holders (x2) [V]
- Waste Gas Burner (Flare Stack) [W]

The following text provides a summary description of the collection and storage of biogas at Avonmouth BC. Each asset in the summary description is provided with a corresponding letter which is referenced in the Avonmouth Asset Plan to show its location within the installation.

- The biogas generated from the digestion processes on site is collected and stored within the Gas Holders (x2) [V]

- To ensure that no biogas is vented to atmosphere the site has a Waste Gas Burner (Flare Stack) [W], this utilises excess biogas when the Gas Holders [V] reach a certain level and/or the gas cannot be used by other primary consumers.

- The primary route for biogas use is either as fuel for the site combined heat and power engines (CHP) [BI1-5] or cleaned and injected into the Gas to Grid process (G2G) depending on site requirements. These consumers are WWE activities and explained further in the WWEL section below.

- The AD process is powered through a mains supply. In the event of a power failure, backup power can be supplied by the combined heat and power engines (CHPs) [BI1-5] {WWEL}.

1.3 Untreated (raw) sludge dewatering

All sludge is destined for digestion treatment but if indigenous sludge production from the Avonmouth WRC is high then the untreated (raw) sludge is dewatered and exported from the permit area for further treatment.

- Internal pumping station (IPS) consisting of strain press feed sump [B1], liquor sump [B2], and strained sludge sump [B3].
- Primary sludge strain presses [C]
- Import sludge reception tank [D]
- Imported strain presses [E]
- Avonmouth consolidation tanks [I]
- Bellmer Feed Tank [J].
- Centrifuges 5 & 6 [S1]
- Centrifuges 7 & 8 [S2]
- Polymer plant for centrifuges [S3]
- Polymer plant for centrifuges [S4]
- Raw trailers [S5]
- Flottweg centrifuges x 2 [S7]
- Road Centrifuges x2 [S8]
- Polymer plant for road centrifuges [S9]
- Polymer plant for Flottweg centrifuges [S10]
- Centrate pumping station [U]

The following text provides a summary description of the untreated (raw) dewatering process at Avonmouth BC. Each asset in the summary description is provided with a corresponding letter which is referenced in the Avonmouth Asset Plan to show its location within the installation.

N*ote: the initial part of the sludge reception process is identical to the biological treatment process, and therefore, some assets and processes are repeated here.*

- Sludge from the Primary Sedimentation Tanks, located at the wider wastewater treatment works, flows into the internal pumping station (IPS) and into the strain press feed sump [B1].

- Raw sludge is then processed through the 3no primary sludge strain presses [C], the strained sludge is delivered to the strained sludge sump at the IPS [B3].

- Imported sludge from satellite sites across the Wessex Water portfolio are transported by road tanker and are discharged into the import sludge reception tank [D].

- The imported sludge is then pumped to 2no imported strain presses [E] and transferred to the IPS [B3] strained sludge sump.

- The screenings from the strain presses are collected in a skip and taken for composting. Any liquors removed are returned to the head of the works via the liquor sump in the internal PS [B2].

- From the strained sludge sump [B3], the untreated (raw) strained sludge can be fed either to the 2no. consolidation tanks [I], the Bellmer Feed tank [J] or may also be fed directly to the Flottweg centrifuges [S7] and associated poly system [S10].

- Untreated (raw) sludge can be taken from the Bellmer Feed Tank [J] and dewatered to untreated (raw) cake using the two road centrifuges [S8] and poly system [S9].

- Untreated (raw) sludge may also be transferred from the Consolidation tanks [I] and processed using centrifuges 5 & 6 [S1] and 7 & 8 [S2] to produce untreated (raw) cake.

- Untreated (raw) dewatered cake is transferred using the raw trailers [S5] which are transported out of the permitted boundary for treatment.

- Untreated (raw) sludge and untreated (raw) sludge cake are kept completely separate from the treated (digested) cake dewatering, signage, handling and transport. Any untreated (raw) cake produced is then sent off-site for lime treatment at the adjacent Lime treatment plant, which is also subject to a permit application. There is no storage of untreated (raw) sludge cake.

- There are rare occasions, when a treated (digested) centrifuge needs to be used for untreated (raw) sludge dewatering, there is a complete drain down and clean between the batches to prevent contamination.

- Centrate from centrifuges [S1] and [S2] is returned to the centrate pumping station [U] before returning via the site foul water drainage into the internal pumping station [B2]. All other centrate liquors are returned via foul drainage system to the IPS which are returned to Avonmouth WRC for treatment.

2. WWEL- Overview of activities

Within Avonmouth BC, the Bristol Food Waste Recycling Facility (BFWRF) can recycle up to 70,000 tonnes per year of solid food waste. It is approved to handle animal by-products (ABP) category 3 material. The principal undertaken activities include:

- Food waste reception, de-packaging, blending and dilution
- Export of pre-treated food waste (soup) for off-site recycling during periods of maintenance as contingency
- Pre-treated food waste hydrolysis and pasteurisation
- Export of pasteurised food waste soup for off-site recycling during periods of maintenance as contingency
- Enhanced anaerobic digestion
- Digestate dewatering for off-site recycling (ADQP PAS110 standard).

The information below is a non-technical description of the food waste treatment process, including the key assets and associated infrastructure at Avonmouth BC. The process is displayed pictorially in the Process Flow Diagram (PFD). The location of the assets and infrastructure referred to are shown in Avonmouth Asset Plan.

2.1 Food Waste AD

List of assets involved:

- Food Waste Reception Hall [BV]
- Turbo-dissolver tanks (x2) [BK]
- Hammermill [BL]
- Odour Control Unit [BU]
- Plastics & Packaging Skip [BW]
- Hydrolysis Buffer Tank (HBT) [BM]
- Pasteurisation vessels (x3) [BN1 – BN3]
- Mesophilic Anaerobic Digesters 1&3 [BO1-BO2]
- Strain Pressers [BP1-BP2]
- Strain press buffer vessels [BY1-BY2]
- Post Digestion Storage Tank (PDST) [BQ]
- Screenings Skip [BX]
- Centrifuges 1&2 [BR]
- PAS110 Digestate Cake Skip [BS1]
- Non PAS110 Digestate Cake Skip [BS2]
- Centrate Return [BT]

- Source-segregated food waste is delivered in solid form via skips tipped into the Food Waste Reception Hall [BV] which is odour extracted by extraction fans and fed into an Odour Control Unit [BU]to channel odour emissions.

- The Food Waste Reception Hall [BV] is designed to hold one day's worth of organic material. This timeframe was chosen to prevent the organic material from remaining in the Reception Hall for extended periods, thus reducing odour generation.

- Food waste is fed into a fixed shredder to remove any packaging or bulk contamination. The de-packaged solid waste is then loaded into two Turbo-dissolver batch tanks [BK] where the material is liquified using water.

- The shredded packaging and bulk contamination are pulped in a Hammer mill [BL] to separate any remaining organic material. Milled packaging is then collected in the Plastics and Packaging Skip [BW] to await removal for off-site recycling.

- The liquified food slurry is screened to remove any contaminants larger than 10mm particle size. It then flows by gravity into the buffer tank feed sump where it is mixed with the pulped organic material from the Hammer mill [BL].

- Oversized screenings are loaded back into the Hammer mill [BL] to recover any organic material.

- The screened food slurry is then pumped into the Hydrolysis Buffer Tank [BM] where it undergoes the natural first stage of anaerobic digestion (hydrolysis) for 1-4 days.

- Any biogas produced by the hydrolysis step in the Hydrolysis Buffer Tank [BM] is diverted to the Odour Control Unit [BU] to be treated before being released to air.

- The hydrolysed food slurry is then fed in batch to three pasteuriser vessels [BN1-BN3] where it is pasteurised at 70°C for an hour to ensure pathogen kill as required by the Animal Plant Health Agency regulations for Animal By-Product Category 3 material.

- Pasteurised slurry is then cooled down via a heat recovery heat exchanger at 45 - 55°C. and mixed into two 2,400 m^3 mesophilic anaerobic digesters [BO1-BO2]

- The digesters are also thoroughly mixed by injection of compressed biogas into draught-tube mixing tubes.

- The pasteurised slurry is digested for 18 - 30 days at ~37°C.

- The digested slurry overflows into a side chamber (limpet box) and is pumped via two strain-presses [BP1-BP2] and their respective strain-press buffer vessels [BY1-BY2] into the Post Digestion Storage Tank (PDST) [BQ]. The strain-presses remove any remaining contaminants such as glass, eggshell or other large organic fibres before the PDST to satisfy the Anaerobic Digestion Quality Protocol (ADQP) PAS110 standard.

- The removed contaminants are stored in the Screenings Skip [BX] to await removal for off-site recycling.

- The digestated slurry (digestate) is stored in the PDST [BQ] for 1 - 4 days. This 800 m^3 tank is aerated to stop biogas production and methane emissions, stabilize the slurry and to mix the liquid.

- The aerated digestate is then pumped to one of two decanter centrifuges [BR] using a polyelectrolyte solution to separate solid (fibre) from liquid (centrate).

- The liquors (centrate) are discharged into the sewer where they are then treated through the adjacent Avonmouth WRC. A portion can also be pumped via the Centrate Return [BT] to the Turbo-dissolver tanks for recycling in the process.

- The solid fibres are collected in two skips. If they satisfy the ADQP PAS110 standard, the fibres will be recycled to farmland for food crop growth via the PAS110 Cake Skip [BS1]. If they do not meet the PAS110 standard, they will be used for land reclamation instead via the Non PAS110 Cake Skip [BS2].

2.2 Food Waste Soup Exports

In periods of maintenance, where AD operations cannot occur, food waste 'soup' can be exported to other AD plants for off-site recycling as a contingency. This is to enable the BFWRF to continue recycling food waste from across Bristol Unitary Authority.

List of assets involved:

- Food Waste Reception Hall [BV]
- Turbo-dissolver tanks (x2) [BK]
- Hammermill [BL]
- Odour Control Unit [BU]
- Plastics & Packaging Skip [BW]
- Hydrolysis Buffer Tank (HBT) [BM]
- Pasteurisation vessels (x3) [BN1 – BN3]

The process follows the same pre-treatment steps as Food Waste AD as follows:

- Source-segregated food waste is delivered via skips into the Food Waste Reception Hall [BV] where it is shredded, diluted (Turbo Dissolvers [BK]), and screened to create a de-packaged food slurry.

- Shredded packaging is pulped to separate any remaining organic material (Hammer mill [BL]). The organic material is then blended with the de-packaged food slurry.

- This resulting slurry (food waste soup) is then pumped into the Hydrolysis Buffer Tank [BM] for storage. Food waste soup can then be exported for off-site recycling via tanker loading point A within the Food Waste Reception Hall.

- To satisfy the APHA regulations for Animal By-Products Category 3 material, food waste soup can be pasteurised at 70°C for one hour via the Pasteurisers [BN1-BN3]. Pasteurised food soup can also then be exported for off-site recycling via tanker loading point B within the Food Waste Reception Hall.

2.3 Biogas Utilisation

Biogas produced by the anaerobic digestion processes is collected and stored as described under WWSL activities. The biogas is used by WWEL assets as described below. The assets involved include:

- Gas Holders (x2) [V] {WWSL}
- Waste Gas Burner (Flare Stack) [W] {WWSL}
- Pre-treatment plant chiller [X]
- Absorption column [Y]
- Flash column [Z]
- Desorption column [BA]
- Carbon filters [BB]
- Grid entry unit [BC]
- Propane tank [BD1]
- Biomethane waste gas burner; [BE]
- Biofilter and GAC OCU [BF]
- Dehumidifier chiller [BG]

- Combined heat and power engines (CHPs) [BI1-5].
- Natural gas boiler [BH]

The following text provides a summary description of the biogas utilisation process at the Avonmouth BC. Each asset in the summary description is provided with a corresponding letter which is referenced in the Avonmouth Asset Plan to show its location within the installation.

- Biogas can either be used as fuel for the site combined heat and power engines (CHP) [BI1-5] or cleaned and injected into the Gas to Grid process (G2G) depending on site requirements.

- The preferred consumer is G2G. The biogas is transferred from the anaerobic digesters and/or gas holders [V], and passes through a pre-treatment plant chiller [X], to remove moisture from the gas to protect the downstream gas utilisation equipment.

- The biogas is then introduced to an absorption column [Y] where undesirable compounds (H_2S and CO_2) are removed by absorption with water.

- The contaminated water then passes through a flash column [Z] to recover any remaining methane. This is then recirculated through the adsorption column [Y].

- The water from the flash column [Z] is fed to a desorption column [BA] where all contaminants are removed so the water can be recycled through the process.

- The waste gas is vented to the atmosphere through a biofilter and granulated activated carbon (GAC) odour control unit [BF].

- Clean methane (biomethane) from the absorption column is further cleaned via two carbon filters [BB] to remove any remaining impurities before it enters the Grid Entry Unit [BC]

- To achieve the National Grid requirements, the biomethane is enriched by injecting propane from the Propane Tank [BD]

- Odorant (mercaptans) is also added to comply with these requirements.

- The Grid Entry Unit [BC] checks the biomethane for quality, calorific value, soot index, incomplete combustion factor, Wobbe index, temperature, and flow rate. Any gas that is not compliant, or any surplus gas is used by the Biomethane waste gas burner [BE].

- There are 5no CHPs [BI1-5] which can run on biogas, natural gas or a blend of both. Gas fed to the CHPs is first fed through a dehumidifier chiller [BG] to remove water.

- The exhaust gas from the engines is cooled down via a heat exchanger. The water from this process is used to keep the sludge digesters [P1-P8] and the food waste digesters [BO1-BO2] at a constant temperature. In the event that the engines are not available a natural gas boiler [BH] is used to supply the necessary heat.

- The electricity is used for power of the whole site. Any surplus electricity is exported.