# BAT considerations report for Antec Biogas facility: Malm Biogass

## 1. Introduction

This document assesses the relevant BAT (Best Available Techniques) for Antec Biogas's technology and operational model, compared with the BAT conclusions in the BREF document for waste treatment (2018) - Commission Implementing Decision published on 17 August 2018 C(2018) 5070. This enables the **Malm Biogass** facility to comply with the requirements of the EU Industrial Emissions Directive (IED).

Antec Biogas uses a flow process with biofilm reactors combined with CSTR technology (Continuous Stirred Tank Reactor), suitable for organic waste and livestock manure. The assessment covers the treatment activities at the facility and associated emissions to air, water, and odour.

## 2. BAT conclusions

The text below refers to Best Available Techniques (BAT) Reference Document for Waste Treatment, Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control, 2018). General BAT conclusions (BAT 1-12) and biological treatment (BAT 25-35) where used for our assessment.

| **BAT references for BREF for waste treatment (2018/1147)** | | | |
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| **BAT ID** | **BAT conclusions** | **BAT status** | **BAT action plan** |
| General BAT Conclusions (BAT 1-12) | | | |
| BAT 1. Environmental management system | Ensure adequate sitting and design to minimize environmental impact. | Site selected based on distance to sensitive receptors. Plant design incorporates odour control and noise reduction measures. | Implementation of an environmental management system (EMS), through internal quality assurance, HSE and continuous environmental monitoring. Monitoring of waste |

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| | | The emission levels marked with BAT-AEL (BAT-Associated Emission Levels) are legally binding, meaning that the limit value may not exceed the highest value in the specified range. | streams, within the emission levels.<br>Procedures for documentation, communication, maintenance and control.<br>Accident prevention plan through the Seveso legislation.<br>Planned site layout review after 5 years of operation. |
| BAT 2: Waste acceptance procedures | Implement appropriate waste acceptance procedures to prevent contamination and protect process stability. | a) Establish and implement procedures for waste characterization and pre-approval<br>b) Establish and implement procedures for approval upon waste reception<br>c) Establish and implement a waste tracking system and a waste inventory<br>d) Establish and implement a quality management system for process outcomes<br>e) Ensure segregation of waste<br>f) Ensure that waste types are compatible before mixing or merging waste<br>g) Sort | Enhance digital tracking of incoming waste batches for improved traceability. That will include documentation of waste origin, pre-treatment checks, and batch testing. |
| BAT 3: Waste pre-treatment and pre-acceptance procedures | Use waste pre-treatment to improve process efficiency and reduce emissions. | Mechanical and biological pre-treatment of feedstock performed before digestion. | Assess feasibility of additional feedstock to optimize quality input into the CSTR and plug-flow reactors. |
| BAT 4: Process control and monitoring to optimize efficiency | Ensure proper process control and monitoring to optimize biological treatment efficiency. | Continuous monitoring of temperature, pH, and biogas production via SCADA. SCADA monitors temperature, pH, organic loading rate, gas composition. | Plant will implement an integrated advanced process analytics for real-time optimization.<br>Prevention of process disturbances. |

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| BAT 5: Minimize emissions to air | Control and reduce emissions to air through best available techniques. | Gas-tight digesters. Gas storage. Flare system for emergency use. | All biogas is handled within a dedicated gas system with process monitoring and regular checks for possible methane slip will be performed.<br>Exhaust air from the substrate reception hall is directed through channeled flows to odour treatment equipment.<br>Performance test for the odour treatment is planned. |
| BAT 6: Noise management through design and operation | Manage noise emissions through design and operational measures. | Noise barriers installed. Equipment maintained to minimize noise levels. | When possible, strategic placement of noise-generating equipment on site.<br>Conduct regular noise measurements and implement improvements as necessary, e.g., appropriate sitting of equipment, operational measures, outdoor use of vegetation barriers. |
| BAT 7: Minimize water use | Minimize water consumption and ensure efficient wastewater management. | Closed-loop water systems employed; wastewater monitored per permit requirements. | Investigate water recycling opportunities to reduce freshwater intake. Monitor the annual consumption of water, tracking the use of recycled water and purchased water.<br>Wastewater from bathrooms is connected to the municipal sewage system.<br>Water management for optimizing wash water use and reducing water consumption.<br>Wastewater generated is recycled into the system, same for overflowing of contend collected from impermeable surfaces and spill collectors. |
| BAT 8: Storage and handling to | Maintain proper storage and handling of waste | Digestate stored in sealed tanks with secondary containment. | Guarantee sufficient storage capacity. Storage capacity is assessed based on mapping of |

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| prevent leaks/spills | and digestate to prevent leaks and spills. | Spill response plan in place. | available quantities, experience with seasonal variations from similar operations, storage properties of different materials, and process optimization.<br>Guarantee optimum storage location.<br>Separate area for the storage and handling of hazardous waste. |
| BAT 9: Accident prevention through risk management | Ensure safety and prevent accidents through risk assessment and safety management systems. | Risk assessments conducted regularly. Safety training provided to all staff. | Review and update safety protocols annually.<br>Preventive maintenance schedules followed.<br>Planned continuous improvement of routines and general training. |
| BAT 10: Record keeping and reporting for compliance and improvement | Implement and maintain record-keeping and reporting systems to demonstrate compliance and support continuous improvement. | Maintain records on: plant operational parameters, input materials (including waste origin, type, and quantity), output materials (biogas, digestate, separated fractions, etc.), environmental performance (emissions to air, water, noise, odour), wastewater discharge characteristics, maintenance and inspection logs, incidents and corrective actions.<br>SCADA logs all of the operational data (temperature, pH level, gas flow, biogas composition, feedstock input rates).<br>Weighbridge tracks all inputs and outputs.<br>Emission logs maintained. | Develop automated monthly compliance reporting, including operational data, incoming waste deliveries, outgoing digestate, and emissions to air and water.<br>Digital archive system.<br>Annual internal reviews.<br>Preventive maintenance schedules and inspection reports are documented.<br>Any abnormal events (odour complaints, spills, equipment failures) are logged, investigated, and reported to the authorities when required. |

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| | | Maintenance and inspection logs maintained.<br>Incidents and corrective actions logs maintained.<br>Records must be available to authorities and kept for a minimum period of 5 years. | |
| BAT 11: Energy efficiency and recovery | Implement energy efficiency measures and optimize energy recovery. | Heat recovery and reuse in the plant. | Heat recovery is used for heating reception and maintaining process temperature. Heat exchanged mapped in several parts of the plant process. |
| BAT 12: Residues/waste management to minimise impact | Implement procedures for managing residues and waste to minimize environmental impact. Control and reduce emissions to water. | Residues are treated and utilized according to nutrient management plans; waste disposed of according to regulations.<br>Clean reject process water treated before release into the discharge point. | Explore additional valorization options for residues.<br>Technological solutions for dewatering the liquid fraction digestate and reuse the process water into the AD system, as much as possible.<br>Clean reject water, within the emission levels, is discharged into the discharge point stated in the emission permit application.<br>Constant monitoring of relevant process parameters (e.g., pH value, temperature, COD) at key locations including inlet/outlet sampling points. |
| Biological Treatment (BAT 25-35) | | | |
| BAT 25: Production stability | Optimise anaerobic digestion for stability and yield | Feedstock composition regularly adjusted; digestion parameters monitored continuously. | Substrates quality checked previously. Pilot experiments performed. |
| BAT 26: Maintain optimal digestion | Control temperature, pH, and mixing to maintain optimal | Continuous process monitoring, including temperature and pH levels. | Sub-streams are tracked for operational optimization. |

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| conditions (temperature, pH, mixing) | digestion conditions process for biogas production. | | |
| BAT 27: Minimise methane slip via efficient capture and utilisation | Minimize methane slip by efficient biogas capture and flare or energy use. | Gas-tight digesters and gas storage. Flare system for emergency use. | Check regularly possible methane slip. Consider upgrading gas-tightness and flare efficiency. |
| BAT 28: Gas cleaning | Apply gas cleaning/upgrading to improve biogas quality. | Activated carbon filters and scrubbers used to remove $H_2S$ and moisture. | Evaluate membrane separation for upgrading biogas to biomethane. |
| BAT 29: Use automated control for optimisation and fault detection. | Use automated control systems for process optimization and fault detection. | SCADA system integrated with alarms and control loops. | Enhance predictive maintenance using AI and data analytics. |
| BAT 30: Control ammonia and odour | Monitor and control emissions of ammonia and odour (from reception of feedstocks, AD process, digestate storage and application). | Odor monitoring conducted regularly. Prevention and reduction of odour emissions through: minimize residence time of odorous waste in storage or handling systems, use of chemical treatment, optimization of odour treatment and management, monitoring of diffuse emissions, cleaning routines. | Included in the odour monitoring plan.<br>Odour treatment system will treat all air from the mapped sources of odour.<br>A complete odour monitoring plan has been performed.<br>Quality performance testing is planned.<br>The ventilation air is handled separately. Measurements of, for example, ammonia and H2S in the indoor air will be carried out to ensure a safe and healthy working environment.<br>Use of closed buffer tanks and closed reactors, besides negative pressure in reception and preprocessing.<br>Periodic odor measurements, odor logs, and visual inspections around the facility. |

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| | | | Plan to accommodate seasonal peaks in feedstocks and/or waste volumes. |
| BAT 32: Monitor groundwater near the plant | Monitor potential groundwater contamination from digestate storage and application. | Groundwater monitoring wells installed around storage areas. | Increase monitoring frequency during wet seasons. |
| BAT 33: Control vectors and pests | Control vector and pest nuisance through proper storage and handling practices. | Storage facilities secured. Regular cleaning and inspections performed. | Implementation of integrated pest management program is planned. |
| BAT 34: Maintenance programmes for all equipment | Maintain comprehensive maintenance programs for all plant equipment. | Preventive maintenance schedules followed. Maintenance logs kept. | Implement maintenance schedules and keep it up-to-date. |
| BAT 35: Continuos environmental performance review | Implement continuous environmental performance review and improvement programs | Annual environmental reports submitted. Internal audits conducted. | Establish benchmarking against industry best performers. |

Antec Biogas will implement the use of key performance indicators (KPIs) for resource consumption and emissions. KPIs will be used for water consumption, energy per ton of substrate, $CH_4$ emissions, and odor complaints.

Although no specific BAT conclusion in the Waste Treatment BREF (2018) addresses the hygienisation of animal by-products (ABPs), this process is strictly regulated under Regulation (EC) No 1069/2009 and its implementing act Commission Regulation (EU) No 142/2011, as well as national legislation administered by Mattilsynet. Antec Biogas complies with these hygiene requirements as part of its acceptance and preprocessing strategy for organic waste containing ABPs, primarily Category 3 materials.

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