Environmental Site Management Plan

Raw Materials, Water and Waste Residue Efficiency Management Plan: Mogden STW

Contents

Using this standard

This standard is controlled and managed by EMS & Air and Waste Permitting Teams, and a copy is held on SharePoint at the following location: Environmental Management Systems

If you have any feedback, please send this to: airandwaste.permitting@thameswater.co.uk

This standard works in combination with other corporate documents including the Asset Standards, Site Operating Manuals, site Odour Management Plans, Health and Safety Standards, and regulatory permits.

Document Control & Procedures

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Figures and Tables:

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1 Glossary of Terms

TERM	DESCRIPTION
AD	Anaerobic Digestion
CHP	Combined Heat and Power
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EMS	Environmental Management System
EPR	Environmental Permitting Regulations
FFT	Flow to Full Treatment
ICA	Instrumentation Control & Automation
IED	Industrial Emissions Directive
OCU	Odour Control Unit
OMC	Operational Management Centre
OMP	Odour Management Plan
PFT	Picket Fence Thickener
PM	Process Manager
PS	Pumping Station
PST	Primary Settlement Tank
Receptors	Sensitive receptors are any fixed buildings or installations where odour annoyance may occur, such as residential homes, schools, hospital, offices, shops or garden centres. Open areas such as playgrounds and public footpaths should also be listed where these are known to have been affected by odour.
SAP	Thames Water's enterprise resource and planning system
SCADA	Supervisory Control and Data Acquisition
SOM	Site Operating Manual
STW	Sewage Treatment Works
TW	Thames Water
UWWTD	Urban Waste Water Treatment Directive

2 Executive Summary

In accordance with the consolidated IED Environmental Permit for Mogden; Waste BAT, specifically BAT3; and associated written management systems, this is the site management plan covering use of raw materials, water and residues. Thames Water Utilities Ltd is required to review and record at least every 4 years whether there are suitable alternative materials that could reduce environmental impact or opportunities to improve the efficiency of raw material and water use and to carry out a waste minimisation review.

The prime function of the sludge treatment facility at Mogden Sewage Treatment Works (STW) is to capture the energy potential from the treatment of sewage sludges. The plant is run 24/7 due to the continuous supply of sewage received at the treatment works either from the surrounding catchment, or via tanker discharge.

This document forms part of the Thames Water Environmental Management System (EMS) for the permitted Sludge Treatment Centre (STC) within Mogden STW.

Thames Water is committed to continual environmental improvements, including materials management, water resources and waste management. This commitment is delivered through efficient control of processes, capital investments, and environmental training.

3 Process Responsibility

The Operational Manager for the site has overall responsibility for reviewing the processes on the site that use raw materials, raw water and create residual wastes. This document is reviewed 4-yearly, but the review process is ongoing as part of the regular performance monitoring for the site.

There are many drivers for reducing use of raw materials, and creation of wastes within our processes, including environmental, financial, and resourcing, so it is in our best interests to undertake these reviews regularly, and to include representatives across the full chain of specialist teams involved in the decisions. For example, from initial procurement processes, and contractor management, through to operations, alarms, and the regular maintenance of the installation. These all work together to ensure that the processes utilise the minimum amount of raw materials/water (such as overdosing of chemicals), and that wastes are minimised (such as worn parts or broken machinery).

4 Raw Materials and Water Management

There are a limited number of raw materials used in the process. All materials used at the installation are subject to storage and handling procedures, as laid out in relevant Asset / Essential Standard and the Site Operating Manual (SOM). There are no dusty or potentially wind conveyed materials used on the installation.

The use of raw materials is carefully monitored and benchmarked for cost reasons, and in many cases the correct quantity has to be precisely used for proper processing to take place, so there are controls in place through monitoring and optimisation of the process.

Regular maintenance of the installation, is carried out in accordance with the site's preventative maintenance programme, and the SOM. This ensures that there are minimal energy losses from worn parts, thereby maintaining its inherent efficiency.

4.1 Biogas

The principal fuel used in the installation is biogas resulting from the anaerobic digestion of sludge from the sewage treatment centre. There is no alternative fuel used in the Combined Heat and Power (CHP)

Engines as the biogas utilisation is the primary reason for the installation's existence. Biogas from the sludge digesters is captured in roof mounted Biogas Storage holders on top of each of the Primary Digester Tanks. The Biogas Storage roof holders rise and fall depending upon the levels of biogas in each holder, before being drawn off and into a common biogas line, where the biogas is passed through activated carbon gas scrubbers to remove impurities. This common biogas line is fed to gas compressors which either pressurise the gas and feed the CHP Engines and boilers or diverts unpressurised biogas to the Emergency Flares.

The heat produced by the CHP Engines allows the pasteurisation and digestion processes to be optimised in order to maximise biogas production. Overall, this allows a greater efficiency in converting sludge to biogas and power. Key to maximising the energy production of the site is the consistent and predictable production of biogas from the digestion process and the minimisation of the use of electrical power in doing so.

The generation and use of power and heat from a renewable biogas source represents a positive impact with respect to global warming potential.

Biogas is also used as the primary fuel for the boiler plant. The boilers operate if there is a temperature deficit to provide supplementary heat to the pasteurisation and digestion plant, which happens occasionally in practice.

Alternatively, biogas may be passed from the Biogas Storage holders to the biogas upgrading plant, where it is dried, CO_2 separated from the bulk biogas to leave biomethane. The biomethane then has its calorific value checked and amended as required with propane, prior to odourisation and injection into the national gas grid.

4.2 Diesel

Diesel is used in the installation as a standby for the boiler plant only in the event there is not sufficient biogas available. This happens rarely in practise. Diesel is also used in standby generators as a back-up fuel in the event of electricity grid failure and is used during the regular, monthly testing of the standby generators.

4.3 Lubrication Oil

Lubrication oil used on site in the CHP Engines, with the volume dictated by the operational requirements. Thames Water monitors the use of oil to increase its efficiency and reduce quantities required. The monitoring is carried out through a monthly oil analysis programme, which assesses the condition of the oil. The oil is changed if the quality is below pre-defined standards. This minimises consumption of oil as it will only be replaced when necessary. Once determined to be below standard, the oil is changed, and the replaced oil is sent for recycling off-site.

CHP Engine oil is monitored for contaminants, which indicate oil performance and general engine condition.

4.4 Water

Water used on the installation is mains water, for three purposes:

- General use;
- Make up of polymer; and the
- Heating loop and boiler system.

Water within the heating loop and boiler systems are treated with dosing chemicals under the management of a specialist subcontractor. It is in closed loop system which only requires minimal top up and inhibitor chemicals addition. This is to decrease water hardness that can cause scale build up within the heat exchangers. The system is inspected for leaks, particularly where excess water has to be added to top up the system.

A review has been undertaken of water use within the site, to see if lower grade water, specifically final effluent from the works can be used to replace any potable water. Savings have been identified and implemented, for example, where water is used for washing down purposes within the site, for example if a spillage of sludge occurs, this water is final effluent from the works.

4.5 Other Raw Materials

The site Odour Management Plan gives details of contractor performance and maintenance checks, so these are not covered further here.

Table 4.1 below lists all the raw materials used on site followed by Table 4.2 that gives their composition and fate.

Table 4.1 - Raw Material List

Description of raw material and composition	Maximum storage amount (tonnes or as stated)	Annual throughput (tonnes per annum or as stated)	Description of the use of the raw material
Sludge polymer: 1. Flopam FO4708 XXR 2. Flopam FO4498 SSH 3. Flopam FO4490 SSH	1. 30 tonnes in a bunded silo 2. 30 tonnes in 2x 15 tonne bunded silo system 3. 30 tonnes in 2x 15 tonne bunded silo system	1. Total site use 48 tonnes 2. and 3. Total site use 68 tonnes	Coagulating Agent used in sludge thickening process. 1. Flopam FO4708 XXR - Used for SAS belts as part of sludge thickening process 2. Flopam FO4498 SSHand Flopam FO4490 SSH - Used for primary sludge drum thickeners
Anti-foam: Flofoam H16F liquid	15 tonnes in 1 tonne IBCs on bunds	160 tonnes	Added to the digester tanks to reduce foaming, as required
Diesel: 1. Boilers (within boiler house) 2. Emergency standby generators (within Main Pumping Station) Product name: WP White Diesel	1. 40,000 litres 2. 127,000 litres Fuel is stored within double skinned fuel tanks	1. Average Whole site use per year in AMP7 is 108,000 litres 2. Approx. 1,000 litres per generator for regular testing per annum	1. Back-up fuel for the boilers. Figure is highly variable by year dependent on asset availability, operational context and temperatures. 2. Fuel supply to back-up generators, used during monthly testing for back-up generators but excludes fuel used from emergency use during periods of grid failure.
Lubricating oils Chevron HDAX 6500 LFG - SAE40	7 tonnes (estimate) stored in a double skinned bunded tank or in IBCs on portable bunds	18 tonnes (estimate)	Equipment lubricant.
Glycol coolant Delo XLC Antifreeze / Coolant	4 tonnes (estimate) stored in IBCs on portable bunds	As required by coolant changes-	CHP engine coolant.

Water Softener Product Name: Aquasol Salt Pebbles	Ordered in pallets as 25 KG bags stored within a building	8 Tonnes	Used within water softening within boiler plant, PAS Plant, Gas Forwarding Compressors and Odour Control Units.
Liquified Propane Gas	12 tonnes contained within three, 4 tonnes tanks	624 tonnes	Propane is fed into the biomethane to increase its CV for injection into the grid
Granular Activated Carbon	9.85 tonnes contained within two tanks. One tank for H2S filtration (5.25 tonnes) and one tank for siloxane filtration (4.6 tonnes)	34.8 tonnes	To filter raw biogas of contaminants prior to removal of CO2 at the biogas upgrader.
Tertiarybutylmercaptane and Dimethylethylsulphide blend	50 litres	40 litres	Added to the biomethane to odorise the gas, as required for safety and to enter the gas distribution network.
Helium	100 litres	4,563 litres	Calibration of sampling equipment on biomethane plant.
Nitrogen, other inert gas mixtures	Minimal	Minimal	Calibration of sampling equipment on biomethane plant.
Sodium Hydroxide	42,000 litres (though Bulk Storage Tank is considered significantly oversized by Mogden Operations).	None currently dosed	Available for use for chemical dosing on OCU12 associated with sludge thickening assets.
Sodium HypoChlorite	42,000 litres (though Bulk Storage Tank is considered significantly oversized by Mogden Operations).	None currently dosed	Available for use for chemical dosing on OCU12 associated with sludge thickening assets.

Table 4.2 - Composition and Fate of Raw Materials

Raw Material	Composition	Fate	Viable Alternative
Biogas	Methane (57.2%) Carbon dioxide (41.6%) Other (1.2%)	Electrical and heat energy Air emissions of carbon monoxide, carbon dioxide, sulphur dioxide and nitrogen oxides	No Alternatives: CHP engines require biogas fuel.
Sludge polymer 1. Flopam FO4708 XXR 2. Flopam FO4498 SSH 3. Flopam FO4490 SSH	Adipic acid (<=2.5%) Sulphamidic acid (<=2.5%)	Absorption into sewage sludge or centrifuged cake. Leftover polymer returned to head of works via filtrate liquors.	No viable alternative.
Anti-Foam Product name: Flofoam H16F	1-Hexanol, 2-ethyl-, manufacture of, by-products from, distillation residues (<10%) Distillates hydrotreated light paraffinic (DMSO <3%) (<10%) Petroleum distillates, hydrotreated heavy naphthenic (10%) Petroleum distillates, hydrotreated light naphthenic (<10%) Petroleum distillates, hydrotreated heavy paraffinic (<10%) White mineral oil (petroleum) (<10%) Distillates (Fischer-Tropsch), heavy, C18-50-branched, cyclic and linear (<10%)	Absorption into sewage sludge. Absorption into digested sludge centrate and returned to the head of the works with liquors. Waste product to be recycled.	No viable alternative.
Diesel Product name: WP White Diesel	Fuels, diesel (>92%)	Electrical and heat energy Air emissions of carbon monoxide, carbon dioxide, sulphur dioxide and nitrogen oxides	No Alternatives: Back-up fuel for the boilers used rarely in practise.
Lubrication oil Product name: Chevron HDAX 6500 LFG - SAE40	Highly refined mineral oil (C15-C50) (70-99% weight) Phenol, paraalkylation products with C10-15 branched olefins (C12 rich)	Waste – Recycled	None known.

Raw Material	Composition	Fate	Viable Alternative
	derived from propene oligomerization, calcium salts, sulfurized including distillates (petroleum), hydrotreated, solvent-refined/dewaxed, cat. Dewaxed, light/heavy paraffinic C15-C50 (1-5% weight) Benzenesulfonic acid, methyl-, mono-C20-24- branched alkyl derivs., calcium salts (0.1 - <1% weight) A mixture of: calcium bis(C10-14 branched alkylsalicylate); calcium bis(C18-30 alkyl salicylate); calcium bis(C18-30 alkyl phenolate); calcium bis(C10-14 branched alkyl phenolate); lubrificating oil (C15-30) (0.1 - <1% weight)		
Glycol coolant Product name: Delo XLC Antifreeze / Coolant	Ethylene Glycol (34-<80%) Sodium 2- ethylhexanoate (1-<3%)	Waste – recovery or recycling	No viable alternative.
Water Softener Aquasol Salt Pebbles	Sodium chloride (>99%)	Recirculation through boiler and brine tank which is drained occasionally to onsite effluent.	No viable alternative.
Liquified Propane Gas	Propane and Propene (99-100%) Ethyl mercaptan (<0.01%) Methanol (<0.1%) Butadiene (<0.1%)	Use as a product. Blended with biogas to produce biomethane generated for injection into gas grid.	No viable alternative
Granular Activated Carbon (GAC)	Activated carbon (100%)		
Tertiarybutylmercaptane and Dimethylethylsulphide blend	2-(2-butoxyethoxy)ethanol (5-15%) Triethanolamine (5-15%) Isotridecanolethoxylate (<5%)	Use as a product. Absorption into biomethane generated for injection into gas grid.	No viable alternative

Raw Material	Composition	Fate	Viable Alternative
	Ethanol (<5%) PEG-15 cocamine (<5%)		
Helium	Helium (100%)	Vented via GEU process vents	Safety requirement
Nitrogen, other inert gas mixtures	Nitrogen (100%)	Vented via GEU process vents	Safety requirement
Sodium Hydroxide	Sodium Hydroxide (100%)		No viable alternative.
Sodium HypoChlorite	Sodium Hypochlorite (100%)		

5 Waste Gas and Water

5.1 Waste Gas Streams

Waste gases are generated in a limited number of locations within the site, primarily the air emission points associated with the biogas handling, storage and utilisation system.

Biogas comprises a mixture of approximately 40% carbon dioxide and 60% methane; with low levels of other volatile organic compounds and Hydrogen Sulphide and entrained moisture. Moisture is removed using moisture traps within the biogas handling system, so both the exact composition and volume of biogas handled at the site vary dependent upon the precise location where sampling occurs. This contains five main potential sources:

- Pressure relief valves;
- Boiler emissions;
- CHP Engine stacks; and,
- Emergency Flare stacks.

There are potentially low volumes of waste gases not captured from one open topped Contingency Storage Tank.

Pressure relief valves, if operated, will release raw biogas.

CHP Engine stacks, boilers and Emergency Flare stacks combust biogas, so will release primarily CO_2, and NOx with low volumes of SO_2, volatile organic compounds (VOCs) and CO.

The CHP Engines and stacks are subject to routine maintenance and annual air emission monitoring. The Emergency Flare stacks are not monitored unless its operational hours exceed 10% of the year.

There are also low volume emissions from the odour control units on site, although the full composition of these is not analysed.

5.2 Waste Water Streams

Waste water is returned to the works inlet from operational areas of the site via the site's drainage system. Waste water is then treated through the UWWTD stream. Where such transfers leave the permitted area for the digestion process, these are marked on the site plan.

Waste water arises from a number of sources within the works. These include:

The majority of surface water drainage is rainfall related, however most rainwater, which falls on site is absorbed by soakaways and does not enter the drainage system.

At present, waste water returns to the works inlet are not metered or measured directly.

5.3 Waste Water Drainage

Note that the drainage system at the works includes both process waters and surface water drainage within the same system. This reduces the risk of any spillages being released into a separate surface water drainage system and diverted directly to the adjacent water body. Instead, all water in the drainage system is captured and returned to the works inlet for processing within the UWWTD stream at the site. Where drainage leaves the permit boundary, it may include waste waters from within areas of the site which sit outside of the permit boundary, due to the design and configuration of the drainage system within the works.

At present, no direct monitoring of site drainage is carried out where it leaves the permit boundary, with regards to chemical composition; loading; volume or variability. Liquor returns are assessed periodically with regard to ammonia loading in particular, as this can impact on the operation of the works. All process returns within the drainage system originate within the incoming sludge derived from the main works flow. As such, the loading originates within the works and does not need confirmatory checking. The following substances may be present at elevated concentrations in the drainage leaving the permitted area before return to the head of works:

- BOD;
- COD;
- Suspended Solids;
- Ammonia; and
- pH.

6 Inventory

6.1 Water usage

At present, water usage is not metered at the site.

6.2 Biogas

Biogas production is not subject to direct measurement, due to the difficulty of measuring volumes with or without moisture content. Instead, biogas production is monitored by CHP Engine output over time. Flare use is monitored and recorded, and an allowance made for gas based on flare capacity. Thames Water operate an ISO50001 Energy Management System, with the aim of continuous improvement. Energy reviews occur frequently, with energy performance reports being produced weekly and monthly.

As the production is dependent upon sewage inputs and flows, the volume produced in any month varies.

7 Residue Management

This section outlines the measures Thames Water take to:

- Minimise the generation of residues arising from the treatment of waste;
- Optimise handling of wastes in accordance with the waste hierarchy; and
- Ensure the proper treatment, recycling, or disposal of residues.

A residue is defined as the solid waste generated by the permitted waste treatment activity. With that definition, this document does not focus on the general wastes created from activities outside the scope of the permit, for example, office buildings even if they are collocated on the same site, or on gaseous emissions from the processes. Nor does it include the solid sewage cake produced by dewatering digested sewage sludge, which is not produced at the Mogden site. Instead this is transferred offsite for dewatering and spreading to land.

There are only a limited number of residue streams that require off-site disposal, treatment or recycling because this sludge treatment facility is co-located with Thames Water’s sewage treatment works.

The residues are stored within designated areas.

Oil filters and some contaminated maintenance wastes are hazardous and are, therefore, segregated from non-hazardous wastes for disposal in line with appropriate legislation.

Where waste is required to be sent offsite, it is sent to a suitably permitted facility for disposal / treatment by approved third party waste management contractors.

A Waste Management Framework Contract ensures that approved contractors have been pre-vetted and helps ensure they have the relevant expertise, competency and access to appropriately permitted facilities appropriate to each transferred waste stream. Our waste contractors will supply us with a Waste Transfer Note (WTN) and/or Waste Consignment Note (WCN) - dependant on what type of waste is being removed from site. All waste documentation for the installation is retained for the appropriate length of time at the site (two years for WTN and three years for WCN).

The residues produced by the permitted processes including management in line with the waste hierarchy and areas for potential improvement and future review are detailed in Table 7.1 below:

Table 7.1 - Residue List

Residue Type	Current Measures	In line with Waste Hierarchy	Potential Improvements
Waste lubricant oil	The quality of the oil is monitored so as to minimise its replacement. Any waste oil is recycled. Waste oil is stored in a tank within a bunded area inside the installation boundary. Off-site recovery at appropriately permitted facility	Recycled	No improvement opportunities foreseen. Current route considered to be BAT
Biogas condensate	Condensate is removed from the biogas lines using moisture traps Released to site drainage and returned to works inlet for processing within the UWWTD stream	Disposal following treatment	No improvement opportunities foreseen. Current route considered to be BAT
Oily rags, oil filters, air filters	Stored within appropriate segregated containers in the waste storage area. Disposed of (as hazardous waste) by specialist contractor	Disposal	No improvement opportunities foreseen. Current route considered to be BAT
Filter media from OCU	Removed from OCU during servicing for regeneration. Off-site recovery at appropriately permitted facility	Recovery	No improvement opportunities foreseen, as returned to manufacturer for refreshing. Current route considered to be BAT
Siloxane filters	Siloxane media is regenerative, reducing disposal requirements. At end of life, media is removed from siloxane filter unit during servicing. Off-site recovery at appropriately permitted facility.	Recovery	No improvement opportunities foreseen, as returned to manufacturer for refreshing. Current route considered to be BAT
Grit and screenings from digester cleansing	As much grit and screenings as possible are screened out during earlier processes (outside the scope of this permit) to minimise that entering anaerobic digestion process.	Grit: Landfill Screenings: Landfill	No improvement opportunities foreseen. Current route considered to be BAT Grit / screenings fate reviewed on a periodic basis to identify alternative routes for this waste stream

8 Summary and Recommendations

Currently, there are no additional techniques or raw material alternatives known, which could be implemented on site to reduce environmental impact or improve the efficiency of raw materials or water usage.

Where raw, potable, water can be replaced with lower grade water on site, for example for washing down small spillages, this has already been implemented.

Due to the small number and type of residue streams, there was very little scope for further reduction of those generated on site.