

Appendix 13

Wastewater Treatment System Technical Documents

MBBR specifications, drawings, treatment process description, influent/effluent standards.

15 m³/day Packaged Wastewater Treatment Plant

Moving Bed Biofilm Reactor (MBBR) Process

1. System Overview

This document provides technical specifications for a 15 m³/day packaged wastewater treatment plant utilising Moving Bed Biofilm Reactor (MBBR) technology. The system is designed for the treatment of domestic wastewater generated from residential and commercial premises, including restaurant operations, staff facilities and short-stay accommodation.

The plant processes domestic sewage, which contains organic matter (proteins, carbohydrates, fats, ammonia nitrogen) and pathogenic microorganisms. The MBBR process achieves consistent high-quality treated effluent suitable for subsurface disposal or, subject to regulatory approval, reuse applications.

Plant Specifications	
Treatment Capacity	15 m ³ /day (0.625 m ³ /h continuous operation)
Overall Plant Dimensions	5.7 × 2.0 × 2.2 m
Treatment Process	Screen → Equalisation → Anoxic → MBBR Aerobic → Settling → Clean Water Tank → UV Disinfection → Discharge
Construction	6mm carbon steel with epoxy resin coating (10–15 year service life)
Control System	Siemens PLC with touchscreen — automatic, manual and fault alarm modes
Warranty	One year

2. Design Parameters

2.1 Design Flow

The system is designed for a daily wastewater load of 15 m³/day, with an average hourly flow of 0.625 m³/h. The plant operates continuously, 24 hours per day.

2.2 Design Water Quality

The following table summarises the design influent water quality and guaranteed treated effluent standards:

Parameter	Influent (mg/L)	Treated Effluent (mg/L)	Notes
COD	250–500	≤ 80	Maximum value guaranteed
BOD ₅	150–300	≤ 20	Maximum value guaranteed
SS	150–300	≤ 30	Maximum value guaranteed
TN (Total Nitrogen)	40–70	≤ 35	Maximum value guaranteed
Ammonia Nitrogen	15–40	≤ 25	Maximum value guaranteed
TP (Total Phosphorus)	4–8	≤ 2	Maximum value guaranteed
pH	6–9	6–9	Within range
E. coli	10 ⁶ –10 ⁷ CFU/100mL	≤ 1,000 CFU/100mL	Typical range

3. Treatment Process

3.1 Process Overview

Wastewater is treated through the following sequential process stages:

1. Screening — Removes large suspended solids and floating debris to protect downstream equipment.
2. Equalisation Tank — Balances flow and load variations to ensure stable, consistent operation of all downstream treatment units.
3. Anoxic Tank — Denitrification stage in which nitrate nitrogen is biologically reduced and removed from the wastewater stream.
4. MBBR Aerobic Tank — Aerobic biological treatment using suspended media carriers. Aerobic microorganisms decompose residual organic matter and further reduce pollutant concentrations.
5. Settling Tank — Secondary clarification stage in which biological sludge settles and is separated from the treated water. Settled sludge is recirculated or discharged to the sludge tank.
6. Clean Water Tank — Treated effluent is held prior to final disinfection and discharge.
7. UV Disinfection — Ultraviolet irradiation eliminates residual pathogenic microorganisms, including bacteria and viruses, to achieve discharge-standard effluent quality.
8. Discharge — Treated effluent meeting the specified quality standards is discharged in accordance with applicable regulatory requirements.

3.2 MBBR Technology

The Moving Bed Biofilm Reactor (MBBR) is a continuous-flow biological treatment process in which microorganisms grow as a biofilm on small, free-floating plastic media carriers suspended within the reactor. The carriers move freely through the water under aeration in aerobic zones, and by mechanical mixing in anoxic zones.

Key design advantages of the MBBR process include:

- Continuous operation without the need for backwashing or periodic media cleaning.
- Large specific surface area and high void ratio, supporting dense active biomass and high treatment efficiency.
- Rapid biofilm establishment — typically 3 to 15 days — facilitated by hydrophilic surface treatment and trace element enhancement of the media.
- Minimal head loss and no clogging risk.
- Robust performance under variable load conditions with strong resistance to hydraulic and organic shock loads.
- Compact footprint relative to treatment capacity.

The media carriers are manufactured from polyethylene or polypropylene with specific gravity close to that of water, ensuring effective fluidisation and three-dimensional flow dynamics within the reactor. Aeration is provided via perforated diffuser tubes on one side of the tank, causing continuous carrier circulation throughout the reactor volume.

4. Plant Structure

The treatment plant is a fully integrated, factory-assembled unit with an overall footprint of $5.7 \times 2.0 \times 2.2$ m. All treatment chambers are constructed in 6mm carbon steel with epoxy resin coating, providing a service life of 10 to 15 years. The following table details the individual treatment units and their dimensions:

Treatment Unit	Dimensions (m)	Qty	Construction
Equalisation Tank	$1.2 \times 2.0 \times 2.2$	1	Carbon steel, epoxy coated, 6mm
Anoxic Tank	$0.6 \times 2.0 \times 2.2$	1	Carbon steel, epoxy coated, 6mm
MBBR Aerobic Tank	$1.4 \times 2.0 \times 2.2$	1	Carbon steel, epoxy coated, 6mm
Settling Tank	$0.6 \times 2.0 \times 2.2$	1	Carbon steel, epoxy coated, 6mm
Clean Water Tank	$0.6 \times 1.0 \times 2.2$	1	Carbon steel, epoxy coated, 6mm
Sludge Tank	$0.6 \times 1.0 \times 2.2$	1	Carbon steel, epoxy coated, 6mm
Equipment Room	$1.3 \times 2.0 \times 2.2$	1	Carbon steel, epoxy coated, 6mm

5. Equipment Schedule

The following table provides a complete schedule of installed equipment for the treatment plant:

Zone	Equipment	Specification	Qty	Material / Notes
Screen Channel	Screen Channel	400×400×400mm, 2mm spacing	1 set	SS304
Equalisation Tank	Lift Pump	40WQ6-7-0.37 Q=6m³/h, H=7m, N=0.37kW	2 pcs	1 duty / 1 standby, CNP cast iron
	Pre-aeration Pipe	UPVC	1 set	—
	Level Switch	0–2.0m, 4–20mA	1 pc	—
Anoxic Tank	Submersible Mixer	QJB0.85/8-260/3-740/S N=0.85kW	1 set	—
	Media Packing	D200mm	40 pcs	—
MBBR Aerobic Tank	Biological Media	Polyurethane, 20% fill ratio	1 m³	—
	Air Diffusers	QMZM-215 0.4–0.8m² service area, O₂ utilisation 22–40%	12 pcs	ABS + EPDM
	Aeration Piping	Matching	1 set	ABS
	Water Retention Screen	Matching	1 set	SS304
	Recirculation Pump	40WQ6-7-0.37 Q=6m³/h, H=7m, N=0.37kW	1 pc	CNP cast iron
Settling Tank	Sludge Return / Discharge Pump	40WQ6-7-0.37 Q=6m³/h, H=7m, N=0.37kW	1 pc	CNP cast iron
	Diversion Tube	Matching	1 set	Carbon steel
	Overflow Weir	Matching	1 set	Carbon steel
Equipment Room	Air Blower	JYSR50 Q=1.03m³/min, 24.5kPa, 0.75kW	2 sets	1 duty / 1 standby
	UV Disinfection Unit	Q=2.0m³/h	1 set	—
	Phosphorus Dosing System	PE120L, GS010 Q=13L/h, 25W, lime dosing	1 set	—
	Control System	Siemens PLC with touchscreen — auto/manual/alarm, Schneider accessories	1 set	—
General	Electromagnetic Flowmeter	DN32 Q>0.625m³/h	1 set	—
	Manholes & Access Ladders	Matching	1 set	—

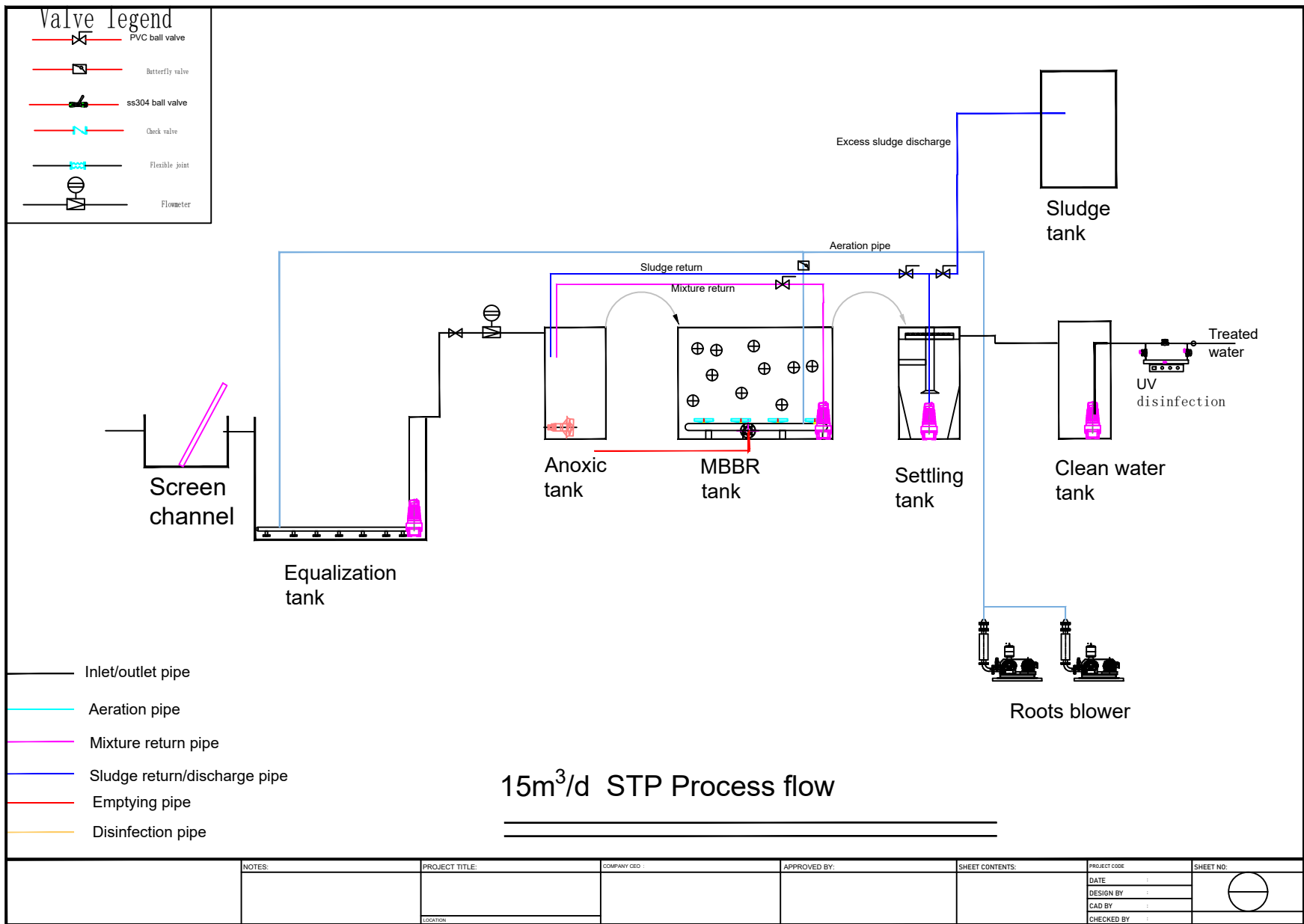
6. Installation Requirements

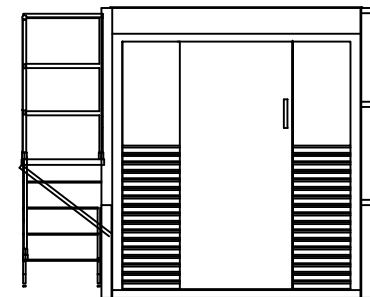
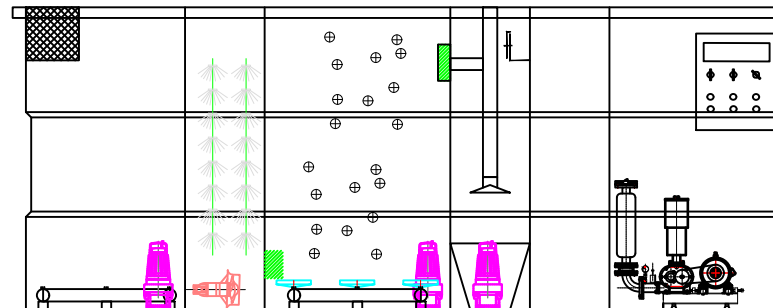
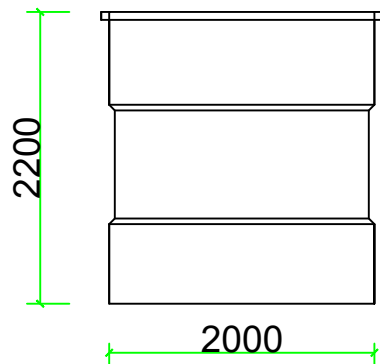
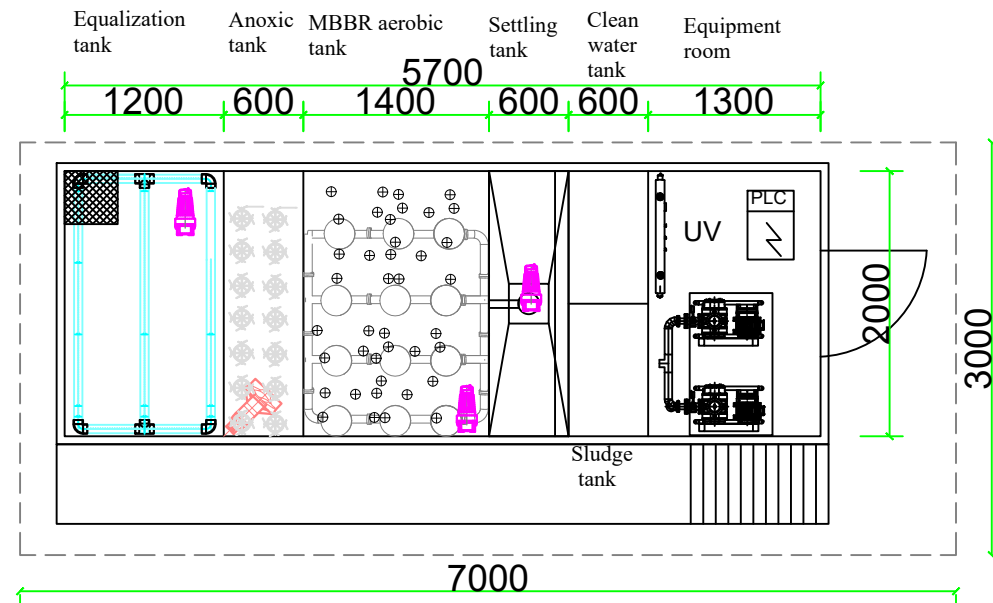
6.1 Civil Foundation

The treatment plant shall be installed on a reinforced concrete foundation of sufficient load-bearing capacity. The foundation is to be constructed using C30 grade concrete with double-layer, two-way steel reinforcement, designed in accordance with the plant weight and site-specific geotechnical conditions.

6.2 Protective Coating

The plant is supplied with a factory-applied epoxy resin coating to all external and internal steel surfaces. This protective system is designed for a service life of 10 to 15 years under normal operating conditions. Periodic inspection and maintenance of the coating is recommended as part of routine plant servicing.





15m³/d STP layout

NOTES:	PROJECT TITLE:	COMPANY CEO :	APPROVED BY:	SHEET CONTENTS:	PROJECT CODE	SHEET NO:
					DATE : DESIGN BY : CAD BY : CHECKED BY :	
	LOCATION					