

***TITLE V OPERATING PERMIT
MODIFICATION APPLICATION EVALUATION
AND REVIEW
(Permit No. 00701-01TV)***

***City of Memphis,
T. E. Maxson Wastewater Treatment Facility
Source No. 00701***

October 2024

**SHELBY COUNTY HEALTH DEPARTMENT
AIR POLLUTION CONTROL SECTION
MAJOR SOURCES BRANCH**

PERMIT APPLICATION EVALUATION

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TITLE V OPERATING PERMIT MODIFICATION APPLICATION EVALUATION AND REGULATORY REVIEW

This narrative was prepared to assist the reviewer in understanding the facility and sources being permitted, and the content, the regulatory basis, and decisions made in preparing this Title V operating permit renewal. This document was also prepared to meet the requirements for the statement of basis in 40 CFR § 70.7(a)(5). This document will become a part of the permanent facility record maintained by the Pollution Control Section of the Shelby County Health Department.

I. FACILITY INFORMATION

Facility Name: City of Memphis, T. E. Maxson Wastewater Treatment Facility

Facility Address: 2685 Steam Plant Road, Memphis, Tennessee 38109

Mailing Address: Same

Facility Owner: City of Memphis

Owner Address: Same

Responsible Official, Title: Mr. Don Hudgins, Administrator

Mailing Address: 2303 North Second Street, Memphis, Tennessee 38127-7500

Telephone: (901) 576-7122

Site Contact: Michael L. Brower, Plant Manager

T. E. Maxson Wastewater Treatment Facility

Telephone: Office: (901) 636-0303

Cell: (901) 581-8183

Billing Contact: Mr. Don Hudgins, Administrator

Billing Address: 2303 North Second Street, Memphis, TN 38127-7500

Telephone: (901) 576-7122

Facility's Primary Activity: Sewage Treatment/Biogas Treatment

NAICS Code: 221320 (Sewage Treatment Facilities)

Existing Permits:

Permit No.	Type of Permit	Description	Issued	Expired
00701-01TV	Operating	Wastewater Treatment Facility Sludge Lagoon with Gas Collection System (5 Flares)	10/04/2019	10/04/2024

II. APPLICATION INFORMATION

Application Received: April 3, 2024

Application Dated: April 3, 2024

Completeness Determination: N/A

Permit Engineer: Jianing Li

Surrounding States Notice: October 30, 2024

Public Notice: October 30, 2024

Public Hearing: Not requested

Comments Received: None

Response to Public Notice Not applicable

EPA Notice: December 16, 2024

EPA Comments: TBD

Response to EPA Comments: TBD

Initial TV Permit Issue Date: October 4, 2019

Facility classification:

- Major-NSR/PSD
- Major-Title V (NO_x and SO₂)
- NSPS
- NESHAP
- MACT

Type of permit:

- New Construction
- Synthetic Minor
- Initial Title V Operating Permit
- Title V Operating Permit (Permit Renewal)
- Modification TV: Minor Major

Emission change:

- Emissions increase
- Emissions decrease
- Emissions the same

III. SPECIFIC REASON FOR APPLICATION

The City of Memphis, T. E. Maxson Wastewater Treatment Facility (TEM) requested a Title V operating permit renewal for this source pursuant to 40 CFR §70.4(b) and removal of the Continuous Assurance Monitoring (CAM) Plan from the permit based on the biogas treatment H₂S reduction system (BioRem) being a biogas process device, not an emission control device pursuant to 40 CFR 64 Compliance Assurance Monitoring. The purpose of this device is to clean the gas for potential fuel use and primarily odor control.

IV. EMISSION UNITS, POINTS and CONTROLS

Emission Unit	Emission Points	Controls	Pollutants
Biogas collection system	F1 - F5 (5 Flares)	None	PM, NO _x , CO, SO ₂ , VOC

Proper design and operation of the collection system and flares will yield a methane destruction efficiency of 98% or greater. The Department considers the flares at this WWTP as process devices used for odor control and not control devices, as methane is excluded as a volatile organic compound (VOC).

The five (5) flare design assures the destruction of the biogas during TVA curtailment or other event that prevent distribution of the biogas. In the event that the flares are inoperable and TVA cannot receive biogas, the lagoon system is equipped with a passive bypass vents to the atmosphere. The bypass vents open manually.

It is likely only two or three flares will operate at any given time, based on gas flow. The flares are designed with a continuous pilot lighting system and will automatically shutdown gas flow in the event of a loss of flame condition.

V. PROCESS DESCRIPTION

The TEM started operation in 1975 and is responsible for treating wastewater generated by both residential and industrial sectors located in southern Shelby County and small areas of north Mississippi.

The wastewater generated by these sectors, approximately 90 Million Gallons per Day (MGD) is primarily gravity fed to the facility via a sanitary sewer system. In Shelby County, the storm sewer system is independent of the sanitary sewer system and is not included in the water throughput for the facility.

Due to the hydrogen sulfide emission, the TEM received odor complaints, so an odor study was conducted in late 1997. Biofilter odor control system was constructed to treat foul air from the influent junction box, headworks, grit chambers, fine bar screens and primary clarifiers (construction Package 2a completed in 2022). Yard waste composting media was used as the biofilter and was changed out every 4-5 years.

Lagoon cover was originally installed in 2003 with polypropylene material for an area of about 15 acres, later other part of the lagoon was covered by 100mil HDPE somax membrane in 2011. In

2013, an odor control committee was established, and another odor control study was performed. In 2017, a construction permit was issued to the TEM to construct a new biogas flare system. The new biogas flare system was intended to replace the old single flare biogas system.

The TEM completed installation and testing of a system designed to remove hydrogen sulfide (H₂S) from the biogas prior to flaring and reduce odor (The “BioRem” system) in 2017. The TEM currently operates a biogas collection and flare system (5 flares) to destroy biogas from the lagoons. It is likely only 2 - 3 flares will operate at any given time, based on biogas flow.

Specifications for the biogas flare system are as follows:

- 1) Five (5) candlestick flares
- 2) The average flow rate - 2,300 scfm or 1,210 MMcf/yr
- 3) Maximum flow rate - 4,100 scfm or 2,155 MMcf/yr
- 4) Average fuel value - 500 Btu/cf
- 5) Maximum fuel value - 600 Btu/cf
- 6) H₂S = 200 ppmv

BioRem System and Biogas Flare System

Biogas is generated from the onsite sludge storage lagoons and is burned off with five (5) candlestick flares. The biogas collection system operates in a fashion to maximize the collection of the gases generated by the decomposition of the sludge materials.

Biogas is treated in a BioRem system designed to remove hydrogen sulfide (H₂S) from the gas prior to flaring and reduce odor. The BioRem system consists of four (4) biotrickling filters (BTF) (biological reactors) that use microorganisms under anaerobic conditions (i.e. 2% to 4% Oxygen) to convert H₂S present in the biogas to elemental sulfur and sulfates.

The BioRem system is designed to treat 4,100 standard cubic feet per minute (scfm) of biogas with a concentration of 4,000 parts per million (ppm) of H₂S. The system efficiency for H₂S degradation can be as high as 95%.

Proper temperature and moisture levels are achieved with a hot water recirculation system that maintains a temperature between 95°F and 100°F with a design flow rate of 77 gallon per minute (gpm) per reactor. Oxygen levels are maintained by a 20 horsepower (HP) blower at a minimum of 2% oxygen in the biogas. Each BTF reactor has a bed of synthetic media that supports growth of the microorganisms. Biogas enters the bottom of each reactor and flows upward through the media bed while the hot water flows counter-current to the biogas flow. The treated gas exits the top of each reactor and is sent to the flare system. When the biogas reactors are down for maintenance or repairs for extended periods the raw biogas is routed directly to the flares to be combusted.

The biogas flare system consists of 5 x 30-foot tall flare stacks each designed to handle an average flow of 600 scfm and a combined maximum flow of 4,160 scfm. The permit limits maximum flow to 2,155 million cubic feet per year (MMcf/yr). The WWTP reported a flow rate around 1,000 MMcf each year from 2005 to 2015, but dropped to half from 2018.

Each stack is equipped with a continuous propane pilot light. The biogas flare system control is based on the header pressure. As the pressure increases beyond an incremental setpoint, an additional flare is automatically started to combust the increased volume of gas. The same control logic will automatically call for stopping a flare as the pressure in the header decreases. In this manner, if any flare fails during the ignition sequence it will automatically roll over to another flare ensuring that the correct number of flares are in service.

The nearby Tennessee Valley Authority Allen Combustion Turbine Plant (TVA) has contracted with the city of Memphis to utilize all biogas produced from the TEM covered lagoons, as a green-energy source. Biogas treated by the BioRem system is transferred to the TVA via a buried pipeline. The TVA has not consumed the BioRem treated biogas since 2017 due to the unstable quality.

Sludge Storage Lagoons

A portion of the microorganisms that settle to the bottom of the secondary clarifiers are recycled and pumped back to the Activated Biological Filter Towers (ABF towers). The remainder of the waste from the facility is termed waste activated sludge (WAS). The WAS is pumped to a series of five sludge storage lagoons where it is held for over a year. This air permit covers the methane collection system, BioRem system (H₂S reduction) and associated flares used to destroy emissions from the lagoons.

The TEM operates using a primary sludge storage lagoon, approximately 15 acres. A polypropylene material covers the lagoon trapping the biogas. The cover system, divided into quadrants, each quadrant equipped with its own collection piping, and includes a passive bypass vent to atmosphere for emergencies.

Biogas is drawn out from the covered lagoons using two (2) biogas blower systems. Each system is equipped with three (3) centrifugal blowers. The rates of biogas conveyed from the covered lagoons are controlled by the number of biogas blowers turning on or off at any time, which is determined by facility operations.

This aerial photograph below shows the existing lagoons.



VI. REGULATORY ANALYSIS

1) Through 4)

No change, reference to PAE 2019.

5) Compliance Assurance Monitoring (CAM)

This Part is applicable to emission units that are subject to an emission limit or standard (that is not exempted therein), have potential pre-control device emissions of the applicable regulated air pollutant equal to or greater than 100 percent of the amount, in tons per year, required for a source to be classified as a major source, and use a control device to achieve compliance with any such emission limitation or standard. This Part is not applicable to this facility.

The H₂S is not a regulated pollutant to define a major source. Major source is defined by criteria pollutants or HAPs and their emission amount. The BioRem system was used either for odor control or selling biogas. Thus, the BioRem system is a process device, not an emission control device in the facility.

Flaring biogas without use of the BioRem system may trigger PSD applicability for SO₂.

6) Greenhouse Gas (GHG) (40 CFR Parts 52, 70 and 98)

Maximum potential annual CO₂e emissions from the five (5) flares at this facility, as calculated using the EPA Simplified GHG Emissions Calculator (SGEC) spreadsheet, (assuming 50% methane in the biogas and a maximum throughput of 2,155 MMcf biogas/yr) is approximately 60,000 U.S. tons (54,400 metric tonnes).

- 40 CFR Parts 52 and 70 (PSD Applicability and Title V Permitting)

The GHG Tailoring Rule sets the threshold for both Title V permitting and PSD applicability at 100,000 tons per year. These parts are not applicable to this facility because potential CO₂e emissions are less than 100,000 tons annually.

- U.S. Supreme Court Decision in *Utility Air Regulatory Group v. EPA*

On June 23, 2014, the U.S. Supreme Court issued its decision in *Utility Air Regulatory Group v. EPA* (No. 12-1146). The Court said that EPA may not treat greenhouse gases as an air pollutant for purposes of determining whether a source is a major source required to obtain a PSD or title V permit. The Court also said that PSD permits that are otherwise required (based on emissions of other pollutants) may continue to require limitations on greenhouse gases emissions based on the application of Best Available Control Technology.

- 40 CFR Part 98 (Mandatory Greenhouse Gas Reporting)

The WWTP may be subject to this rule because potential CO₂e emissions are greater than the 25,000 metric tonnes per year applicability threshold.

Reporting is based on actual emissions. Although subject, this is not an “applicable requirement” and will not be incorporated into the permit. The WWTP is required to submit these reports directly to the EPA.

7) Control of Sulfur Dioxide Emissions (City of Memphis Code Section 16-82)

- Rule 1200-03-14-.03 (SO₂ Process Emission Standards)

This rule states “On and after July 1, 1975, the owner or operator of an air contaminant source located in a Class IV, V or VI county shall not cause, suffer, allow, or permit the emission from that source of sulfur dioxide in excess of 2,000 parts per million, 0.20 percent by volume, dry basis (one hour average).”

The Department does not consider this rule practically enforceable for an open flare system. Furthermore, The Department considers monitoring of hydrogen sulfide (H₂S) concentration with a continuous H₂S monitor and containing the sulfur dioxide (SO₂) emission limits in the permit to be sufficient.

VII. POTENTIAL to EMIT (PTE) EVALUATION and EMISSION CALCULATIONS

Without this flare system in place, the facility has an annual potential to emit (PTE) of 889 tons of SO₂ from the flares. The facility has requested an SO₂ limit of 249.0 tons per year to avoid “Prevention of Significant Deterioration” (PSD) applicability. Until the BioRem system is fully functional, the facility will need to limit the amount of flared gas to avoid triggering PSD. Actual emissions have historically been less than 100 tons per year but reached 236.8 tons in 2018 due to increased biogas production (associated with improved sewage lagoon biogas capture and increasing TEM throughput) and an increasing H₂S content in the biogas. The Department noted that the average H₂S content in 2018 (4,960 ppm) was twice that of 2017 and five times that of 2016 and might have been an aberration.

This facility is permitted based on potential to emit. Emission calculations for NO_x and CO from the flares were originally based on EPA’s Compilation of Air Pollutant Emission Factors, AP-42, 5th Edition, Chapter 13, Section 13.5 (Industrial Flares), Tables 13.5-1 (NO_x 0.068lb/MMBut) and 13.5-2 (CO 0.311lb/MMBut). Now emission factors from Chapter 3, Section 3.1 (Stationary Gas Turbines), Tables 3.1-1 (NO_x and CO, Digester Gas-Fired Turbines) are applied. 3.1-2b (VOC, Digester Gas-Fired Turbines). SO₂ emission limits assume 100% of H₂S (1,400 ppm) is converted to SO₂.

The VOC content of the WWTP biogas varies from 0.4% - 3.6%. The TEM recommended using AP-42, 5th Edition, Chapter 13, Section 3.1, Table 3.1-2b, which contains an emission factor for “digester gas fired turbines”. Although the function of the flare and turbine are different, the combustion of biogas and digester gas is similar.

Potential to Emit

Pollutant (tons per year)				
PM	NO _x	CO	SO ₂	VOC
Negligible	103.6	11.0	889 ¹	3.8

¹ Based on 5,000 ppm H₂S to flares, 4,100 scfm flow rate, and 100% conversion to SO₂.

Allowable emissions of NO_x and SO₂ from this facility are greater than 100 tons per year, but less than 250 tons per year; therefore, this facility is not subject to PSD, but is classified as a Title V major source. The PTE of all other criteria pollutant emissions are well below 100 tons per year.

Following data and assumptions were used in calculation of allowable emissions:

Annual biogas flow:	2,155 MMscf/yr
Biogas energy rate:	147.6 MMBtu/hr
Annual propane flow:	25,000 gal/yr
Propane energy rate:	0.258 MMBtu/hr
Propane unit energy:	90,500 Btu/gal
Total combustion energy rate:	147.9 MMBtu/hr
Average Biogas unit energy (wet):	600 Btu/scf
Average H ₂ S Concentration:	1,389 ppmv (2019-2020)
SO ₂ air emission limit:	249.0 tons/yr
Operation hours in a year:	8,760 hrs

Allowable Emissions Calculation (12-month rolling period):

Pollutants	Throughput	EF (lbs/MMBtu)	Max. rate (lb/hr)	Method/Reference	PTE (TPY)
PM	NA	NA	NA	Smokeless flare PM emissions expected to be negligible	< 1.0
SO ₂	Dependent on biogas H ₂ S Conc.	NA	56.85	Source request	249.0
VOC	54.4 MMBtu/hr	0.0058	0.86	AP42- Table 3.1-2b, (D*)	3.8
CO	54.4 MMBtu/hr	0.017	2.57	AP42- Table 3.1-1, (D)	11.0
NO _x	54.4 MMBtu/hr	0.16	0.86	AP42- Table 3.1-1, (D)	103.6

Notes: TPY - Tons per consecutive 12-month period

* - Emission factor rating

Allowable Emissions Summary (12-month rolling period):

Emission Unit	PM/PM ₁₀	SO ₂	NO _x	CO	VOCs
Biogas collection system	<1.0 ¹	249.0 ²	103.6	11.0	3.8

Notes: 1. Smokeless flare PM emissions expected to be negligible.

2. Facility-wide emission limit. Based on 1,400 ppm H₂S to flares, 4,100 scfm flow rate, and 100% conversion to SO₂.

VIII. Monitoring

The following parameters are monitored:

- Biogas flow (acfm), one meter upstream of BioRem, one meter downstream
- Flare temperature (F)
- Biogas fuel value (BTU/cf)
- Biogas H₂S concentrations

The TEM monitored hydrogen sulfide (H₂S) concentration five (5) days per week with no more than four (4) missed weekly readings per month with handheld H₂S meters before a continuous SWG100 biogas analyzer on the biogas treatment system exhaust (or pre-flare) was installed (September 2020) and operational (May 2021).

The TEM bought an identical SWG100 biogas analyzer to prevent data loss due to malfunction of another analyzer. The analyzer located close to the BioRem system collects samples automatically from six sampling locations (biogas received, four BioRem tank exhausts, pre-flare biogas). Each sampling takes two minutes. It measures BTU and H₂S concentrations.

A handheld gas analyzer measures H₂S and CH₄. When the continuous analyzer is not operational operators tank hand held measurements of gas exiting the BioRem system once per day. Monthly, biogas samples are collected in a Tedlar Bag or vacuum canister, and are analyzed at Centek Laboratories, LLC in Syracuse, NY. Unless no biogas is drawn from the covered sludge lagoons during the month.

Flares are monitored each shift for visible emissions. The temperature of the flares varies based on biogas throughput and is continually monitored. The temperature of the flares is thermocouple controlled and recorded. The temperature usually ranges between 700°F and 1,000°F.

The BioRem system worked well during the period of October 2022 and June 2023, and it could reduce the H₂S concentration to below 20 ppm.

IX. FEES

The following fees are applicable to these permit actions:

No.	Action	Description	Fee
1	Permit Renewal	5-year air permit renewal	\$0.00
2	Administrative Amendment	Remove CAM plan	\$130.00
3	Publication	Publication fee	\$250.00
TOTAL:			\$380.00

APPENDIX A

(Regulatory Applicability Overview Table)

City of Memphis, T. E. Maxson Wastewater Treatment Facility (Source No. 00701) Federal Regulatory Overview (July 10, 2023)

CFR Part	Description	Applicable Req.	Notes
40 CFR 50.1 — 50.18	National Primary and Secondary Ambient Air Quality Standards	Yes	Contains general requirements
40 CFR 52	Approval and Promulgation on TN's State Implementation Plan (SIP)	Not Applicable (NA)	Not applicable with the exception of 52.16 and 52.21 if triggered
40 CFR 60 (Subpart O)	Standards of Performance for Sewage Treatment Plants	NA	This facility does not combust waste; therefore, Subpart O is not applicable
40 CFR 63 (Subpart VVV)	National Emission Standards for Hazardous Air Pollutant Emissions: Publicly Owned Treatment Works	NA	This facility is defined as a Group 2 POTW and is not a major HAP source; therefore, this standard is not applicable.
40 CFR 70	State Operating Permit Programs	Yes	Contains general requirements for Title V major source operating permits.
40 CFR 98	Mandatory Greenhouse Gas Reporting	Yes	Contains EPA reporting requirements. Although subject, this is not an “applicable requirement” and will not be incorporated into the Title V permit.

State and Local Regulatory Overview

(Please refer to Permit 00701-01TV 2019)

APPENDIX B (Emission Summary Table)

DATE	SOURCE #	FACILITY NAME	FACILITY CLASSIFICATION			LAST INSPECTION	PERMIT ENGINEER:	JL										
10/03/24	00701	City of Memphis, T. E. Maxson Wastewater Treatment Plant	MAJOR	MINOR	SYNTHETIC MINOR	03/21/24	RECORD:	5862										
			x															
ALLOWABLE PERMITTED POLLUTANTS (tons per 12-month rolling period)																		
PERMIT #	ISSUED	REVISED	EXPIRED	TSP	PM/PM ₁₀	SO ₂	VOC	CO	NO _x	Pb	HAP	GHG's	Check if Applicable					
00701-01TV	10/03/24		10/03/29	<1.0	249.0	3.8	11.0	103.6					MACT (40 CFR Part 63)	NESHAP (40 CFR Part 61)	NSPS (40 CFR Part 60)	PSD OR NSR		
TOTAL TONS:				<1.0	249.0*	3.8	11.0	103.6										
Classification for each pollutant should be added here based on number of tons: A = Major SM = Synthetic Minor B = Minor				B	A	B	B	A										
CHECK IF NONATTAINMENT STATUS APPLIES:													Subparts:					
* Facility-wide emission limit.													Pollutant:					