DRAFT FOR REVIEW

ODOUR STUDY REPORT

WOOLWICH BIO-EN
ANAEROBIC DIGESTION FACILITY
ELMIRA, ONTARIO

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1.0 INTRODUCTION

This report summarizes the operations and odour abatement measures planned for the proposed Woolwich Bio-En Inc. (Bio-En) biogas facility (Proposed Facility) to be located in Elmira, Ontario.

Bio-En is a renewable energy company committed to developing leading edge anaerobic digestion (AD) facilities with environmentally sustainable energy producing technology. Bio-En is working with an Austrian design firm that specializes in biogas facilities to design the Proposed Facility.

The Proposed Facility will process up to 70,000 tonnes of organics annually to generate biogas and an agricultural soil amendment[1] or fertilizer. The biogas will be combusted in a combined heat and power (CHP) cogeneration system to produce 2,850 kilowatts (kW) of electricity and 3,020 kW of heat. Long-term, sustainable renewable energy generation and diversion of organic materials from landfills will be ensured through the responsible and profitable operation of the Proposed Facility.

The Facility is committed to controlling odour from its operations to mitigate any negative environmental impacts that may result from odour discharge at the Facility.

Air dispersion modelling has been performed for the significant sources of odour at the Facility and the resulting odour concentration is below the Ontario Ministry of the Environment (MOE) odour concentration guideline. A memorandum outlining the odour modelling performed is provided in the Emission Summary and Air Dispersion Modelling (ESDM) report.

Odour emissions from the Proposed Facility are an indication of a loss in biogas production potential. Less biogas translates directly to less renewable energy generation and is therefore a loss of revenue for Bio-En. The Proposed Facility will be designed and operated to prevent generation of odour as much as possible in order to maximize biogas production. Where odour generation is unavoidable, odorous air will be collected directly from the source and treated using state-of-the-art technology.

Sections 2.0 to 5.0 outline potential sources of odour and key features of the design and operation of the abatement measures for the potential odours.

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[1] An agricultural soil amendment is a material applied to agricultural fields that is beneficial for crop production or soil health and does not degrade the natural environment.

2.0 BACKGROUND

The Proposed Facility will be located at 40 Martin's Lane in Elmira, Ontario. The general layout of the Proposed Facility will include two buildings, four smaller concrete tanks, three larger concrete tanks, and a storm water management (SWM) pond.

Organics to be processed at the Proposed Facility include, but are not limited to:

- Organics from food processing facilities, grocery stores, food distribution companies, and milling facilities (0 to 40,000 tonnes/year)
- Livestock manure (0 to 13,000 tonnes/year)
- Glycerol (0 to 3,000 tonnes/year)
- Kitchen waste (0 to 40,000 tonnes/year)
- Fats, oil, and grease (FOG) (0 to 20,000 tonnes/year)
- Renewable energy crops (i.e., corn silage) (0 to 12,000 tonnes/year)
- Organic solids skimmed from a dissolved air flotation (DAF) tank (0 to 20,000 tonnes/year)

The AD process to be employed at the Proposed Facility can be summarized as follows:

a) Incoming renewable energy crops and other solid wastes are unloaded onto the floor in the Solids Receiving area in the Process Building.

b) Liquid or slurry manure is unloaded from tankers into the first pretreatment tank or into one of the liquid storage tanks.

c) Incoming dissolved air flotation solids (DAF) and fats, oils, and greases (FOG) materials are unloaded into 175 m^3 storage tanks outside of the Process Building. The DAF and FOG materials are pumped to a Liquid Organics Mixing Unit in the Process Building. The incoming feedstock storage tanks are contained by a concrete barrier wall for secondary containment.

d) Incoming glycerine is unloaded into a 20 m^3 storage container and fed into the Liquid Organics Mixing Unit to be combined with the other feedstock materials.

e) Incoming kitchen waste and food processing organic materials are processed in the Solid Organics Pre-processing and Mixing Unit and are mixed with the other organic materials and recycled process water so they can be pumped to a storage tank or pretreatment tank. Materials are pumped from the storage tank, Solid Organics Pre-processing and Mixing Unit to the Pretreatment Tanks.

f) Residual material that is not suitable for AD is sorted from incoming kitchen and food processing waste and is stored in the Process Building in a dedicated area and are transported off-Site when the 40 m^3 bin has reached capacity.

g) Surface runoff water collected in the SWM pond or fresh municipal or off-Site water is used to supplement the recycled process water as required to balance water losses in the AD process.

h) The organic materials are pumped from the Mixing Units to a Pretreatment Tank equipped with two mixers to further homogenize the materials and increase the temperature of the organics to approximately 50-60°C.

i) The mixed organic materials are then pumped to one of the two other Pretreatment Tanks, equipped with only one mixer each, for a hydraulic retention time (HRT) of approximately 20 hours. The Pre-treatment Tanks are operated in batches. While the material in one of the tanks is undergoing pretreatment, the other tank is being emptied and filled with new material.

j) After pretreatment, the organic material is periodically pumped to one of two Digestion Tanks to complete the AD process and generate the desired biogas. Unlike the Pre-treatment Tanks, the Digestion Tanks are operated under continuous mix and the material from the Pretreatment Tanks is intermittently dosed in to the Digestion Tanks. The digesters are insulated and heated to maintain a temperature of approximately 35 to 45°C and have an HRT of approximately 15 to 25 days. During the AD process, the fermenter conditions and resulting biogas is continuously monitored as part of an overall control process to optimize biogas yields and energy production.

k) The methane-poor gas from the Pretreatment Tanks is injected into the Digestion Tanks through the floor to facilitate vertical mixing and maximize methane collection efficiency of the entire AD process.

l) The biogas from the Main Digester Tanks and the Secondary Digester and Repository Tank is collected in biogas storage membranes and is piped to a CHP cogeneration unit, or to a flare if the CHP unit is not operational and the biogas storage is full.

m) Electrical and thermal energy are generated in the CHP units that are specifically designed for the combustion of biogas. Thermal energy is recovered from the CHP unit using a heat exchanger.

n) The digestate is pumped from the Digestion Tanks through a solids separator to remove the solids (approximately 4 percent dry matter) for recycle water or directly to the Secondary Digester and Repository Tank to await off-Site transport and eventual land application. The liquid portion of the digestate is either recirculated back to the Mixing Unit as an inoculant for the AD process or

pumped to the Secondary Digester and Repository Tank. The Secondary Digester and Repository Tank will have approximately 30 days storage capacity.

o) The solid portion of the digestate (approximately 27 percent dry matter) is stored in a bin in the Process Building and transported off-Site when the bin reaches capacity. The digestate solids are land applied as a nutrient source and soil conditioning agent (fertilizer), similar to the digestate liquids.

3.0 POTENTIAL SOURCES OF ODOUR

The following sources at the Facility have been identified as potential odour sources:

- Generation of Biogas - Pretreatment, Main Digestion, and Secondary Digester and Repository (Digestate Storage) Tanks – Biogas is generated in digestion tanks when organic materials at the Facility undergo anaerobic digestion.
- Unloading of Organic Material – Solid and liquid organic material is transported on Site and is unloaded in the process building as described in Section 2 steps a to d.
- Organic Separation, Preprocessing and Storage - Once the organics are unloaded at the Facility, they undergo some separation and pre-processing in the operations building as described in Section 2 steps d to f.
- Fugitive building emissions- Fugitive odour emissions resulting from unloading and preprocessing could be released from the operations building if there is not adequate negative pressure in the building.
- Digestate loading to be shipped off-Site - The liquid digestate will be collected by a hauling company. The digestate will be pumped into trucks that will park beside the Secondary Digester and Repository Tank for loading. The solid digestate will be loaded on trucks in the building.
- Biofilter – The biofilter is used to treat the air that is used for the building ventilation in the unloading and processing areas.

4.0 PLANNED ODOUR ABATEMENT MEASURES

4.1 GENERATION OF BIOGAS –PRETREATMENT, DIGESTION AND DIGESTATE STORAGE TANKS

The Pretreatment tanks are sealed and the Main Digestion and Secondary Digester and Repository Tanks are sealed with double membrane covers. All of the biogas from these AD process tanks is combusted in two cogeneration units. If either or both of the cogeneration units are incapacitated for any reason or more biogas is generated than can be consumed by the cogeneration units the automated backup flare will combust the biogas. Combustion of the biogas eliminates odour in the biogas. This eliminates the potential for odours being emitted from the Proposed Facility during the actual AD process.

4.2 UNLOADING OF ORGANIC MATERIAL

Odours are potentially generated from the incoming organic material, depending on the type of material, as it is unloaded and stored before it is pumped into the sealed AD process tanks. Odours from the unloading will be reduced by minimizing the amount of time that feedstock material is stored prior to addition to the AD process. Fresher material has less potential for odour and greater biogas potential. The material will also be transported on-Site using covered trailers or tanker trucks. The doors at the Facility will close quickly once the truck is inside the Facility to minimize the potential release of odours from overhead doors. Unloading of all trucks will be done indoors in negative pressure unloading areas. All air that is vented from the building will be treated with a Biofilter as described in Section 4.5. The building ventilation calculation is also provided in Section 4.5.2.

4.3 ORGANIC SEPARATION, PRE-PROCESSING AND STORAGE

Odours are potentially generated from the organic materials as it is separated, pre-processed, and stored before it is pumped into the sealed AD process tanks. The Proposed Facility will be designed and operated to manage all potential odours generated as part of the pre and post-processing steps of the AD process. The Facility will have sealed storage tanks for liquid organic DAF and FOG materials, these tanks will be vented to the biofilter system. The operations occurring in the building may be regarded as fugitive sources of emissions, however, the building will be under adequate negative pressure to ensure that all air from the processing activities is vented through

the biofilter. Preprocessing and storage of incoming organics and digestate solids separation and storage will be done indoors directly under exhaust hoods that create localized negative pressure zones with three to five air exchanges per hour. All air that is vented from these exhausts will be treated with a Biofilter as described in Section 4.6. The building ventilation calculation is also provided in Section 4.6.2.

4.4 FUGITIVE EMISSIONS

The building will be kept under negative pressure when the doors are closed so that there will be no fugitive emissions from the building. This negative pressure will be maintained from the draw of air through the building by the biofilter. Air will be drawn into the building using controlled air intake louvers. Although the negative pressure may be lost during the opening and closing of doors, it is expected that the biofilter will provide adequate ventilation. No fugitive emissions are expected to be emitted to the environment as the louvers will close when the doors are open and the intake ventilation air will be drawn through the open doors. When the doors are closed, the louvers will open once more permitting air to enter the building to create the negative pressure once again.

There will be no outdoor storage piles at the Facility, all organic material will be transferred and stored indoors. The storage tanks at the Facility will be sealed, during storage tank filling, the head space of air displaced will be treated by the biofilter.

It is not expected that the storm water management pond will be a significant source of odour as it will only collect run off (i.e., rain water) from the Site.

4.5 DIGESTATE LOADING ACTIVITIES

A third party hauler will collect the digestate at the Facility and will ship it off-Site to be used as a soil amendment or fertilizer. The truck will arrive on-Site and will be filled with digestate by pumping it directly from the Secondary Digester and Repository Tank into a tanker. During the filling, the air in the empty truck will be displaced and directed to the biofilter for treatment. The solid digestate will be loaded onto the trucks indoors. The solid digestate loading area will be ventilated and the air will be treated by the biofilter.

4.6 BIOFILTER

The only significant source of odour at the Facility is the biofilter that will be used to treat the air that is exhausted from the processing building, from activities including: truck loading and unloading, organics processing and displacement of headspace from the storage tanks. There will be insignificant fugitive emissions from the building due to the fact that the building will be under negative pressure when the doors are closed and the biofilter will provide adequate airflow to pull air from outside the building when the door is open. There will be no outdoor storage piles at the Facility, all organic material will be transferred and stored indoors.

The inorganic media biofilters planned for the Proposed Facility will have the following key features:

- 85 percent odour removal efficiency (manufacturer guaranteed performance rating)
- Sized and configured to provide redundancy to allow maintenance and servicing on one module while still providing treatment capacity on remaining modules by maintaining an inventory of parts, altering the flow rate to the biofilter, or by using the air as combustion intake air for the engines
- Inorganic filter media depth of 1.83 m
- Temperature and humidity of incoming air controlled for optimum biofilter performance
- Permanent inorganic filter material with ten year warranty to reduce media replacement downtime
- Operator friendly automated controls compatible with Proposed Facility control system

4.6.1 INORGANIC MEDIA BIOFILTER

Inorganic biofilters have been used in waste processing applications and are being utilized more often as regulations impose more rigid standards on odour emission. In general, inorganic systems:

- Have a higher capital cost than organic systems
- Require less maintenance
- Have lower operating costs

A prime advantage of inorganic biofilters compared against organic media biofilters, is the lower total pressure drop and the deeper allowable media depth as a result. Typically an inorganic system employs a media depth of up to 2 m, which can decrease the footprint requirements by half as compared to an organic system. Additionally, the empty bed retention time for these systems is also generally lower (typically 30 to 35 seconds).

Inorganic media systems offer less frequent media refreshment cycles; some vendors offering warranties to support a 10-year life cycle for the media. Much less frequent removal schedules imply less overall maintenance, system shutdowns for media removal, and greater consistency in odour abatement performance. Additionally, odour removal efficiencies are generally higher and more consistent for inorganic systems. Of note, inorganic systems have low background odour profile and thus the theoretical maximum removal efficiency.

Bio-En recognizes that inorganic systems require attention to inlet air. Hydrogen sulphide and ammonia concentrations must be below critical operating levels, or must be removed if they are above prior to exposure of process air to the media. Humidification is critical, and while inorganic systems generally allow for pre-humidification without surface irrigation, the level of humidity must be ensured at near-saturation conditions for the media to be effective. A stack is included in the biofilter design in order to achieve good dispersion or potential emissions.

4.6.2 AIR VENTILATION CALCULATION

The following calculation has been performed to demonstrate the ventilation/air exchanges that will take place in the building based on the various processing equipment that will be operated. This air volume will be treated by the biofilter prior to discharge to the atmosphere.

This calculation includes:

- The volume of air to be ventilated from the main building at an air exchange rate of approximately two (2) exchanges per hour
- The volume of air exhausted from localized fume hoods in the processing areas at a rate of approximately three (3) to five (5) exchanges per hour
- The volume of air being displaced during tank filling at a rate of each tank being filled every hour

Estimated Flow Rate Requirements

Building Volumes (m^3)

Liquids Receiving	714
Solids Receiving	2,506
Solid Digestate Loading	497
Processing Area	1,647
Contraries Storage	274
Total Volume	**5,638 m^3**

Air Exchanges (5,638 x 2 exchanges per hour) = 11,276 m^3/hr

Fume hoods (m^2)

Separator	9
Digestate storage	21
Kitchener Waste Hopper	30
Grinder	24
Contraries	18
Truck Loading Area	24
Total Area	**126 m^2**

Assume 5 m in height = 630 m^3

Air Exchanges (630 m^3 x 5 exchanges per hour) = 3,150 m^3/hr

Storage Tanks Filling (m^3)

DAF	175
FOG	175
Kitchen Waste	175
Future Storage Tank	175
Glycerine	20
Total	**720 m^3**

Assume filled once per hour = 720 m^3/hr

Digestate Hauling Truck Filling(m^3)

Assuming 2 trucks are filled each hour

Air Displaced - 35m^3 x 2 =70 m^3

Total flow to biofilter = 15,216 m^3/hr

An additional 30% air flowrate has been added to this ventilation rate as a safety factor to account for any additional air flow that may be required to ensure adequate negative pressure, this results in a flow rate to the biofilter of approximately 20,000 m^3/hr.

5.0 OPERATION OF ODOUR ABATEMENT MEASURES

Bio-En understands that proper operation and maintenance of the odour abatement measures is essential to the success of the Proposed Facility, not only to comply with regulatory obligations and to avoid conflicts with neighbours, but also to ensure the continued profitability of the Proposed Facility as outlined in Section 1.0. Where possible, Bio-En will source equipment from local suppliers to ensure that the supplier will be able to assist with the installation, startup, maintenance, and repair of the equipment in a timely fashion. Where equipment cannot be purchased locally, the necessary training will be provided to Bio-En staff either on-Site or at the supplier's location.

Proper operation of the Proposed Facility, including the odour abatement measures, will result in a biogas facility that will not have a negative impact on the neighbourhood in which it is installed. Biogas facilities operate successfully in Europe with no negative feedback from neighbouring residents.