Ministry of Environment, Conservation & Parks

Wastewater Evaporators Ministry Technical Review

Air Practitioners Meeting

February 2, 2023



Wastewater Evaporators – Purpose & Outline

Purpose:

to share information from ministry's ongoing technical review of wastewater evaporators and plan for a follow up meeting with interested air practitioners

Outline:

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- Wastewater Evaporators Overview
- Technology Basics
- Ontario Context
- Challenges
- Ministry Technical Review Team
- Request for Follow-up with Air Practitioners



Wastewater Evaporators – Overview

- Evaporators are used to reduce the volume of wastewater that is being sent to municipal sewer systems as a potential cost savings measure
- Alternative to wastewater treatment systems to meet effluent discharge criteria or where effluent discharge not an option
- Potential elimination of wastewater discharge; however, requires management of generated waste concentrate stream
- Evaporators can also be used at waste processing facilities as a volume reduction measure prior to final disposal



Wastewater Evaporators – Technology Basics

Basic Types of Wastewater Evaporators

- Atmospheric Evaporators
 - Simplest type with lowest capital cost
 - Air emissions concern: wet plumes that can contain volatile organic compounds (VOCs)
 - Various commercially available designs
- Many other evaporator types with much reduced air emissions, such as:
 - Humidification-dehumidification (HDH); vacuum; mechanical vapour compression; multiple-effect; multi-stage flash evaporators, etc.
 - No wet plumes and significantly reduced VOC emissions potential
 - Thermo-oxidizer flash evaporator is a unique type; VOCs inherently destroyed by thermal oxidation/combustion.



Wastewater Evaporators – Ontario Context

- 36 ECAs issued to date and 3 in pre-submission discussions
- Unknown number across the province in various sectors under EASR and potentially under air ECAs with limited operational flexibility
- Anticipate more applications as municipalities increase enforcement of sewer-use bylaw limits and/or impose more stringent limits
- Over the last several years, the Ministry has received a number of complaints from neighbours



Wastewater Evaporators – Complaints & Concerns

- Observed issues related to evaporator exhaust included:
 - Visible ground level fog/mists
 - Precipitation on neighbours including sensitive population
 - These plumes had a chemical odour
 - Caused watering eyes, sore throat, coughing, discomfort
 - Resulted in neighboring businesses sending employees home
- Review of ESDM indicated wastewater streams contained VOCs
- Monitoring around some sites confirmed the presence of VOCs



Wastewater Evaporators – Complaints & Concerns (cont'd)

- Potential cause:
 - Wet/saturated plumes containing VOCs
 - VOCs volatilizing from the WW stream but then becoming reabsorbed/re-entrained when the plumes condensed as they entered the atmosphere
- The wet plumes did not rise/disperse sunk to ground level relatively quickly, forming a trail
- Long plumes were most visible/most likely to come down to ground quickly during spring/fall months (for example, cool temperatures and high relative humidity)
- Wastewater stream compositions often not well characterized



Wastewater Evaporators – Modelling Limitations

- Neither AERMOD nor Fog models address these situations appropriately
- "Fogging incidence" not relevant
- POI concentrations are not representative
- Air dispersion modelling for evaporators
 - Currently requiring CALPUFF in full mode to model the mists/vapour plumes with justified assumption of VOC composition
 - Proponents must submit a modelling plan that outlines the input data, settings and switches to be used in both CALMET and CALPUFF
 - Checklists are available from EMRB upon request
 - MECP follows a stepwise review and approval process for each phase (WRF, CALMET, CALPUFF)
- Modelling required only if there are VOCs or volatile metals in the evaporator feed stream
 - No issue if all the volatiles are removed before evaporation
 - Will likely have to verify/quantify stream composition via regular sampling



Wastewater Evaporators – Mitigation

Potential Mitigative Measures for Atmospheric Evaporators

- Pretreatment of wastewater to reduce VOCs content prior to evaporation; applicable technologies include:
 - Air stripping
 - Steam stripping
 - Granular activated carbon (GAC) adsorption
 - Advanced oxidation process (AOP)
- Treatment of evaporator exhaust vapour
 - Demister for droplets removal
 - Thermal oxidation, catalytic oxidation, AOP, adsorption (with GAC or specialized media), or biofiltration for VOCs removal (not seen often in practice)
- Operational controls



Wastewater Evaporators - Alternatives

- Depending on wastewater composition and the contaminant(s) requiring removal, cost-effective alternatives to evaporators may exist
- Examples of alternative membrane-based technologies include:
 - Ultrafiltration (UF); removal of colloidal matter or emulsified oils
 - Nanofiltration (NF) or reverse osmosis (RO); removal of dissolved inorganic ions, metal complexes, and organic substances
 - Electrodialysis / electrodialysis reversal; removal of inorganic ions



Ministry Technical Review

- Technical team includes experts from across the ministry specializing in air pollution control, compliance and air dispersion modelling.
- Review air / waste / wastewater permissions. The intent of the review is to:
 - characterize evaporator issues observed
 - gain a better understanding of evaporator design, operation, maintenance, troubleshooting and other jurisdictions' approaches
 - identify alternative approaches or other recommendations
- The team has met with several wastewater evaporator suppliers to understand more about wastewater evaporator design, operation, maintenance and troubleshooting and has carried out a preliminary jurisdictional review.



Jurisdictional Review – Overall Approach

- A rudimentary jurisdictional review was previously conducted and the team is currently undertaking a more comprehensive jurisdictional review
- Online search
 - European Union (BREF and BAT)
 - No specific guidelines identified
 - Australia and New Zealand
 - No rules found
 - US State Rules
 - See next slide

- Approached some jurisdictions
 - Some California Air Quality Management Districts
 - Pennsylvania
 - Indiana
 - New Hampshire
 - Ohio
- Considering approaching:
 - Other California jurisdictions
 - NESCAUM
 - STAPPA/ALAPCO
 - LADCO



Preliminary Jurisdictional Review – US States

- No wastewater evaporator-specific rules identified only some guidance
- The most common approach is to recommend removing VOCs from wastewater before evaporating
- Indiana policy: evaporated wastewater cannot contain > 1 ppm volatile hazardous constituents (VHC). However, staff are not aware of any generators evaporating a wastewater with volatiles.
- US EPA RBLC: Only 3 permits found, all have VOC emission limits of 0
- New Hampshire: hazardous waste permit and air permit are required if hazardous waste like VHC is in the wastewater. According to state regulator it's "very rare" to have evaporator with VOCs in wastewater. If hazardous waste is removed then neither permit is required but the facility would need to be able to demonstrate this upon
 ¹³ NHDES request.

Preliminary Jurisdictional Review – US States (cont'd)

- Ohio: newsletter guidance indicates that evaporators that aren't totally enclosed can only be used for aqueous waste that does not contain VHCs, otherwise considered a hazardous waste disposal facility
- Massachusetts: informal guidance indicates site-specific approvals not required if the evaporator follows a number of requirements including:
 - treating hazardous waste to render it non-hazardous
 - air emissions < 1 ton per year
 - not treating off-site wastewater
- California: Santa Barbara County Air Pollution Control District senior staff have not seen wastewater evaporators for industry in their 15-20 years experience with the District



Call for Air Practitioners with Wastewater Evaporator Experience

- The ministry would like to hold a follow-up meeting(s) with air practitioners with wastewater evaporator experience to:
 - understand external participants' experience in the province and elsewhere
 - gather additional information to consider when reviewing alternative options for evaporators
- Please contact Larry Smet (<u>larry.smet@ontario.ca</u>) and/or Abby Salb (<u>abby.salb@ontario.ca</u>) if interested in attending this meeting



Preliminary air practitioner feedback / interest?



Appendix

Example Evaporator Configurations

Wastewater Evaporator Examples



Atmospheric Evaporator Schematic (Evaporative Tank; Poly Products Inc.) <u>https://metchem.com/atmospheric-</u> evaporators/ Atmospheric Evaporator (Evaporative Tank; Poly Products) https://www.environmentalexpert.com/products/polyproducts-evaporative-tank-378068



Evaporative Tank & Companion Condenser (Poly Products Inc.) [Note: condenser add-on converts atmospheric evaporator into an HDH evaporator; no air exhaust] https://www.environmentalexpert.com/products/econtention-for condenser-96826

Wastewater Evaporator Examples (cont'd.)



Thermo-Oxidizer Flash Evaporator Schematic (RGF Environmental Group, Inc.) <u>https://www.rgf.com/wp-</u> <u>content/uploads/2016/02/Evaporation_sys</u> <u>tems-2.pdf</u>

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Thermo-Oxidizer Flash Evaporator (RGF Environmental Group, Inc.) https://rgf.com/products/water/t hermo-oxidizer-flash-evaporationsystem/



Saltworks: Figure-1: Air Breather Evaporator

SaltMaker AirBreather Open-to-Air Evaporator Crystallizer (saltworkstech.com)





Figure-2 SaltMaker Air Breather contained within an ISO container SaltMaker AirBreather Open-to-Air Evaporator Crystallizer (saltworkstech.com)





Figure-3 ENCON 28gph Thermal Evaporator (Thermal Evaporator; ENCON evaporators)

Thermal Evaporation System - Thermal Evaporators | ENCON Evaporators





Figure-4 The flue gases are pulled back into the evaporator, mixed with the ambient air and drawn across the surface of the boiling water. The exhaust blower pulls the combined steam and gases through the mist eliminator and pushes them up through the stack and outside the building **Ontario**