

Optioneering and BAT Appraisal Report: Thermal Oxidiser

TWMA PETERHEAD

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Executive Summary

TWMA Peterhead requires robust abatement of odorous and VOC emissions from waste treatment processes. This report documents the optioneering process conducted in line with SEPA Odour Guidance, BAT Reference Documents, and site-specific criteria. Multiple technology options were rigorously assessed based on technical feasibility, compliance, sustainability (notably the ability to use site-derived Processed Fuel Oil/PFO), cost, and operational fit.

After comparative evaluation, the Comtherm Direct Oil-Fired Thermal Oxidiser was selected as the best available solution. It is uniquely able to burn PFO, achieves destruction efficiencies >99.9% at high temperature and residence time, is compact and future-proofed for energy recovery, and delivers the lowest whole-life cost among robust options. All alternative technologies were systematically ruled out due to technical, operational, or economic drawbacks for the site's emission profile.

This report, with supporting appendices, is submitted to SEPA as the formal optioneering assessment justifying the final technology selection.

In 2024, TWMA commissioned A.S.K. Pearcey to provide independent Assessment of Abatement Options for TWMA Peterhead³. This report summarised the odorous emissions and the requirements for a thermal oxidiser. This report was sent to UK and European thermal oxidiser manufacturers, and six proposals were received by TWMA.

TWMA commissioned A.S.K. Pearcey to appraise the proposals and support TWMA through the optioneering and selection process.

TWMA commissioned Redmore Environmental Ltd. to undertake an odour assessment and stack height analysis⁷ of abatement options throughout the selection process. The assessment utilises “a treated air concentration of 3000_{OE}/m³” in the calculation of the modelled emissions, therefore representing a worst-case scenario.

Following installation of the thermal oxidiser and associated stack, TWMA will commission Redmore Environmental Ltd. to undertake odour monitoring onsite and update the odour assessment for the Peterhead facility, thus ensuring emissions meet regulatory requirements.

Introduction

TWMA's Peterhead facility processes oilfield wastes, generating odorous and VOC-laden air emissions requiring abatement. In line with regulatory and operational requirements, an extensive optioneering exercise has been conducted to select the most appropriate abatement technology, considering:

- Ability to use on-site PFO as fuel
- Compliance with BAT² and SEPA odour Guidance limits⁶
- Performance and reliability
- Cost
- Physical and operational integration

Option Appraisal and Rationale

Technologies Considered

Option 1: Biofiltration/Bioscrubbing

Rejected: Poor efficacy for high molecular weight aliphatics, aromatics, and sulphur/halogenated VOCs; high technical risk for TWMA profile; large footprint.

Option 2: Chemical Scrubbing

Rejected: Ineffective for hydrophobic, insoluble VOCs; impractical for mass emission load; significant chemical/waste management overheads.

Option 3: Stand-alone Carbon Adsorption

Rejected (primary abatement): Rapid media exhaustion under high TVOC; excessive OPEX; only viable as a post-TO polishing stage / extraction system abatement.

Option 4: Cryogenic Condensation/Solvent Recovery

Rejected: Technically infeasible due to diverse, high-boiling/solidifying VOCs; very high energy and capital cost.

Option 5: Catalytic Oxidation (CATOX)

Rejected: Catalyst susceptible to poisoning by sulphur and halogens; uncertain efficacy on full emission range; annual catalyst replacement cost.

Option 6: Regenerative Thermal Oxidiser (RTO)

Rejected: High capex and footprint; cyclic flow risks short-term emission spikes; less compatible with circular PFO use.

Option 7: Recuperative/Direct Fired Thermal Oxidiser (DFO)

Selected: Highest confidence for compliance and reliability; proven performance at >850°C, >2s residence, >99.9% DRE (destruction efficiency); fully compatible with PFO; future heat recovery ready; lower capex and OPEX.

Decision Summary

The Comtherm Direct Oil-Fired TO best meets all regulatory, operational, and sustainability requirements. It is the only option that combines robust, proven performance on the TWMA emission profile with compatibility for circular fuel use and manageable cost and footprint. “The DFO has the advantage of being the easiest install and fastest delivery of all options and so it can be in place controlling odour and VOC with all the monitoring and control functionality that goes with every oxidiser.”⁴

With reference to Table A4.1: Summary of generalised criterion for selecting odour abatement techniques from [SEPA Odour Guidance 2025](#) thermal oxidation is favourable over adsorption and catalytic oxidation techniques in the case of flow rate and high relative humidity. Thermal oxidation is also suited to both high and low temperatures, which is an advantage over adsorption.

“The heat from the DFO is high grade heat that could be used in a process to provide process heating or steam by adding the appropriate type of heat exchanger.”⁴ In line with Section 3.3 Heat recovery and cooling of BAT Reference document for Energy Efficiency¹, “It is essential to evaluate the quality and quantity of waste/surplus heat...it is crucial to have relevant, quantified information and...detailed measuring and recording of operating data provides an excellent start for planning”. TWMA will monitor and measure the heat from the DFO for 18 months to gather sufficient data to allow the correct sizing of a heat recovery unit and evaluate if primary or secondary heat recovery is best suited for the heat profile. Gathering sufficient data on the quality of the surplus heat is aligned with BAT for energy efficiency.

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Technology Comparison Table (compiled with reference to Table A4.3.2: Incineration of SEPA Odour Guidance 2025)⁶

Option	Capex	OPEX	Destruction efficiency/ Compliance	PFO Compatible	Foot-print	Key Drawbacks/ Notes
Biofilter	£180k	Med	Low	No	Large	Not effective for site VOC/odour mix
Chem Scrub	£150k	High	Low	No	Large	TVOC not removed; high waste
Carbon	£160k	High	Low (primary)	N/A	Med	Unmanageable OPEX as primary abatement
Cryo/ Recovery	£300k+	High	Low	N/A	Large	Technical infeasibility – not feasible for diverse VOC mix
CATOX - Airprotekt	£270k	High	Medium	N/A	Small	Catalyst poisoning risk; catalyst cost, heavily reliant on electricity
RTO – EIS UK Ltd	£300k	Med	Medium	Limited	Large	Cost; emission spike risk, requires natural gas feed
RTO / DFO - Spooner	High	High	Medium	N/A	N/A	TWMA process flow 10% of the smallest RTO size, require natural gas to pre-heat dilution air required. Long lead time
Babcock Wanson – Recuperative / DFO	£180k	Med	High	Yes	Med-Small	Double lead-time of Comtherm, requires natural gas feed
Airprotech (Envirocombustion) - RTO	£296k	Low	High	Yes	Med	Requires natural gas feed & high-volume feed, non-committal to lead time
Comtherm TO	£180k	Low	High	Yes	Med-Small	Best balance, future-proofed

Chosen Solution – Comtherm Direct Oil-Fired Thermal Oxidiser

- **Operation:** typically 900°C, ≥2 seconds residence time, >99.9% destruction of VOCs/odours.
- **Fuel:** Site PFO (circular economy).
- **Emissions:** TVOC <5 mg/m³ (BAT), odour <1,000 ouE/m³.
- **Stack/ducts:** Sized with margin; includes rapid cooling to prevent dioxin reformation.
- **Modularity:** Heat recovery/recuperator ready.
- **Cost:** Equipment £114k; total installed with ancillaries ~£180k.
- **Integration:** Compact footprint, easy tie-in with site utilities.

Technical Schedule (SQ-00004025D)

Application	Odour Abatement	
Oxidiser Type	TO	
Operating Temperature	Maximum	*1250°C
	Minimum	**800°C
Burner Duty (running)	150 kW	
Fuel Main	PFO Gas Oil	
Fuel Pilot (Intermittent)	LPG	
Burner Turndown	4:1	
Provision of Combustion Air	Separate fan	
Burner Operation	Modulating	
Control Signal	4-20mA	
Flame Failure System	Siemens LME75	
Flame Failure Type	UV	
Burner Configuration	Skid Mounted	
Electrical Supply	Motors	415V 50Hz 3ph
	Controls	110V 50Hz 1ph
Standards	ISO 13577-2 (EN746-2)	

* The unit lining can withstand 1400 °C.

**The value states unit capability. Set points in the control panel will be established at commissioning to ensure BAT minimum 850 °C is met.

Equipment Description

Comtherm TO Direct thermal oxidisers destroy the pollutants through thermal means at temperatures in excess of 850°C and with an excess of oxygen to promote complete conversion to CO₂, NO_x and SO_x and water vapour. In this system the process gas and waste organics are directly injected in the combustion chamber in their raw state. Gas combustion

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takes place almost instantly but oil takes longer. It is therefore necessary to equip an oil fired unit with a pre combustion chamber to allow the flame to develop fully. This means that an oil fired unit will require a small amount of capital outlay (typically 20% more than a gas fired unit).

Waste Gas Inlet

The waste gas inlet to the oxidiser will be 150 mm diameter and suitable for the injection of all the waste streams connected together. The unit will handle all streams.

With full rate the chamber may reach 1250°C internally, therefore, the lining will cope with at least 1400°C.

Scope of Supply

The unit consists of an oil burner system, control panel, pre-combustion chamber and burn out chamber. The pre combustion chamber is designed to fully house the flame at high fire and the burnout chamber is designed to allow for two second residence time to allow for complete destruction (over 99%) of all compounds including Dioxins. Please note that Dioxins can re-form if cooling of the exhaust gasses is not rapid enough, we have therefore now included for a cooling fan incorporated into the oxidiser outlet ductwork. The control panel looks after the operation, safety and control of the system.

Burn Out Chamber

This unit will comprise a ceramic lined mild steel combustion chamber which has been sized to accommodate 20% excess flow to ensure complete burn-out of all incoming waste products, allowing for two second residence time. In addition it will have a hard refractory lined pre-combustion chamber. The unit will be fitted with at least one viewing port to enable viewing of the operation. This will be provided with a small air purge to ensure that the viewing window remains clear. The chamber will be fitted with a second skin to ensure that the touch areas are below 50°C with an ambient of 15°C and in free air. This is a piece of thermal plant and it is inevitable that some areas will be in excess of this, where this is the case then the positions will be marked “HOT SURFACE” or guarded or shielded to prevent contact.

Commissioning

Comtherm have allowed a 5-day commissioning period, subject to review following site visit scheduled on 15th July 2025, which is ahead of the thermal oxidiser delivery date. Commissioning plan will be tailored to the bespoke unit and designed in accordance with ISO 13577-2 Industrial Furnaces and associated processing equipment – Safety – Part 2: Combustion and fuel handling systems (for Standard contents page see appendix A). Commissioning plan will be issued to TWMA from Comtherm as a dedicated section of the bespoke instruction manual. An initial version has been issued to TWMA and shared with

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SEPA. Examples of complete instruction manuals issued by Comtherm are available on their [website](#). This instruction manual will be managed internally by TWMA under their integrated management system and will inform the internal work instruction.

TWMA-606-RA Peterhead Facility is the document number for the site risk assessment which will be updated following Comtherm site visit to consider potential TO and stack hazards.

The thermal oxidiser will be capable of fully autonomous operation (to be used during commissioning or maintenance activities) but will be able to be remotely commanded by means of an interface with a master plant control system. The chamber will be fitted with 3 thermocouples and additional sample points to measure combustion gas temperature at evenly spaced axial locations from the burner to the chamber outlet. These can be used during commissioning to determine an optimal temperature control position.

Monitoring of emissions to air will be conducted by third party experts in accordance with Reference Report on Monitoring of Emissions to Air and water from IED Installations⁵.

Maintenance

The bespoke solution being provided by Comtherm is simple and robust, designed for maximum uptime and reliability. Maintenance will be carried out on the unit as per Comtherm's recommendations and scheduled to align with planned maintenance of our processing assets to ensure the odour abatement is BAT during times of processing.

Supplier recommendations regarding servicing and maintenance requirements will be provided within the manual to accompany the unit. This manual is currently under draft and will be finalised following Factory Acceptance Test (FAT) to be completed at the manufacturer site prior to dispatch to our site. Examples of Comtherm supplied manuals including servicing and maintenance schedules are available on their [website](#).

In the event of a power failure on site, safety is number one priority. It is essential that emergency systems and lighting are fully operational and if these are not functioning, site operations would be shut down in a controlled manner until such systems are restored to ensure staff safety.

Odour Contingency

Short term contingency measures

In the very unlikely event that there is an issue with the thermal oxidiser either at the commissioning stage or in the long term, the site has contingency to operate with ability to divert the oxidiser feed line to the carbon abatement box. Trials conducted with carbon granules on site has demonstrated the effectiveness of carbon in terms of odour abatement over short term periods i.e. one to two months. In the short term, additional carbon abatement units can be hired to temporarily replace / supplement the thermal oxidiser if

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repeat odour monitoring deems this necessary. Low-Flo odour abatement system has been hired previously from Exeon with demonstrable efficacy in the short-term (see Appendix B for specifications for the unit hired in 2023). Recent enquiry with Exeon indicates the current lead-time for similar unit is 8-10 weeks. The unit comes pre-assembled on skid with integral extraction fan with venturi style capture hood and set extraction rate to prevent discharge being pulled by strong cross winds. This is in effect a “plug and play” solution which has been tried and tested on site therefore once delivered to site the kit can be installed and running within 1-2 hours. TWMA have dedicated site mechanics and electricians to support the installation of such equipment. Once running, the equipment requires a daily visual inspection and VOC check as per current internal monitoring requirements.

A minimum of 2.5 mt of activated carbon is kept on site, lead time for carbon order is 2-3 weeks. Therefore, in the unlikely event the thermal oxidiser failed or required supplementation, TWMA would be able to divert odorous flows to the carbon abatement box which is to be used for treatment of fugitive emissions. (This box is sufficiently sized that the carbon will last for a year treating air changes). An order for replacement carbon and a Low-Flo odour abatement system from Exeon would be placed simultaneously. The carbon would sustain site compliance whilst awaiting arrival of the Exeon system.

Long term contingency measures

Longer term, if odour monitoring determines additional abatement is required, TWMA will consult with Redmore Environmental Ltd. to identify which sources require further / more robust abatement, e.g. if vertical tank emissions dominate the odour footprint following thermal oxidiser installation, then tank vents can be piped to ground level for consolidated abatement. Similarly, if the powder silo odour emissions are found to be more prominent following thermal oxidiser installation, this odour source can be directed to the thermal oxidiser.

Following odour monitoring conducted in 2022, Odour Dispersion Modelling of Existing Emissions Report¹⁶ presented the following table showing “the results of the source contribution analysis on discrete modelled receptors”¹⁶

Table 5-2: Source Contribution at Discrete Sensitive Receptors						
Source	Average Percentage Contribution from Discrete Receptors					
	2015	2016	2017	2019	2020	Average
Disc Stack	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Decanter 1	12.4%	12.4%	12.3%	12.5%	12.4%	12.4%
Decanter 2	34.0%	33.8%	32.9%	33.5%	33.7%	33.6%
RotoMill	39.5%	40.8%	39.6%	40.8%	40.7%	40.3%
Powder Silo	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
Slop Tanks	4.1%	4.1%	4.1%	4.1%	4.0%	4.1%
Drill Cutting Tanks	8.1%	8.1%	8.1%	8.2%	8.1%	8.1%
Oil Disc Stack	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%

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The fourth largest potential odour contributor listed above is the drill cutting tanks with a contribution as presented in this report of “8.1%”¹⁶. A review of this report¹⁶ was undertaken by Redmore Environmental Ltd. in 2025 and findings are presented in section 3.2 of report 8420r5 Odour Assessment TWMA, Peterhead, Redmore Environmental Ltd, 2025⁷. Under this review there were matters identified in relation to the sampling of the drill cutting tanks which indicates “uncertainty in regards the validity of the emission data”⁷. A simple sense check of the data demonstrates the 8.1% contribution calculated from the 2022 report is a gross over estimation:

- Each drill cutting storage tank holds 385M³
- There are 4 drill cutting storage tanks, therefore the total, maximum volume of cuttings the site can hold at any time is **1540M³**
- The volumetric flow used as input to the odour model for the drill cutting tanks (prior to normalising) “assumed minimum velocity of 0.01 [m/s] to represent evaporation rate”¹⁶ which multiplied by the area gave **2290M³/hr** (see row highlighted in yellow in the snip from report below)
- If this rate were accurate, the tanks would evaporate at a rate which would render the contents solid or empty in less than 1 hour

4.3.7 Drill Cutting Tanks		
For the purposes of modelling, drill cutting tanks were modelled as area sources based on the size of the tanks.		
Table 4-11: Drill Cutting Tanks – Emissions and Parameters		
Parameter	Inputs*	Notes
Source Geometry	Area	Modelled as area source based on info provided by TWMA
Height (m)	6.0	Provided by TWMA
Velocity (m/s)	0.01	Open source so assumed minimum velocity of 0.01 to represent evaporation rate
Volumetric Flow – Actual (m ³ /hr)	2,290	Calculated by multiplying velocity with area of tank (63.6m ²)
Total Waste Management Alliance Ltd: Odour Dispersion Modelling of Existing Emissions (Peterhead) © 2024, Malbrett & Associates Ltd		
311055 Page 21		
Parameter	Inputs*	Notes
Volumetric Flow – Normalised (m ³ /hr)	2,364	Temperature corrected
Temperature (Degrees Celsius)	8.8	Average yearly temperatures for Peterhead. Selected as tank is an open-air source
Odour Emissions (ouE/m ² /s)	844	Calculated geometric mean emissions multiplied by normalised flow and divided by the area
*Same parameters and emissions for each of the four tanks		

It is regrettable that TWMA had overlooked this simple sense check prior to submitting the data, however they did so in good faith, trusting third party consultants to deliver quality data.

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The drill cuttings are stored within these 4 tanks at ambient temperature, therefore in the absence of heat, odorous emissions are deemed negligible. TWMA has experience of operating globally, e.g. Egypt and UAE where temperatures are continually much higher than Scotland. TWMA has a facility Risk Assessment in place for each operational site, which is reviewed every 2 years. TWMA-606-RA-Peterhead Facility is the reference for the live document managed for the Peterhead site. The tanks are not covered, therefore are not pressurised and less likely exacerbated by heat. Drill cuttings are on average one third oil, one third water and one third rock, water has a high heat capacity, thus a lot of heat is required to cause a rise in temperature. Future mitigation of the site will be managed and assessed under the facility risk assessment and weather changes and warmer conditions are future factors to be assessed in line with other TWMA operational sites.

Based on the sense check above, it is not anticipated that the drill cutting tanks will be found to be causing offensive odour following installation of the thermal oxidiser, regardless, TWMA are arranging for Redmore Environmental Ltd. to provide an updated odour model for the site and odour sampling will be undertaken of all odour sources on site using correct and robust methodology, including the drill cutting tanks using, “best practice determination of surface emissions through area specific measurement using a Lindvall hood, or appropriate alternative sampling apparatus”⁷.

Should the drill cutting tanks be found to be at risk of contributing to offensive offsite odour, TWMA will commission Redmore Environmental Ltd. to provide expert advice at pace to mitigate.

Contingency Summary

In 2024, TWMA commissioned odour expert A.S.K. Pearcey Ltd to review all odour work undertaken by third party on site to date and make recommendation for abatement technology. All thermal oxidiser proposals received by TWMA were reviewed by A.S.K. Pearcey Ltd to advise the most suitable solution for site, “the DFO in question...provides excellent and broad range destruction of even the most thermally stable VOCs.”⁴

TWMA have utilised third party experts to design an odour solution, therefore it is not anticipated that the site will be in breach of permit, BAT and/or Enforcement Notice following installation of the thermal oxidiser, however if third party odour monitoring deems this to be the case, TWMA will undertake rapid steps to regain compliance which may include, but is not limited to the following:

- Hiring additional abatement units
- Installation of back up abatement if deemed necessary
- Supplementing thermal oxidiser
- Further enclosing / abating assets which are not currently planned to be abated by thermal oxidiser

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- Temporarily utilising alternative storage / processing routes (several third-party storage / treatment solutions available in Peterhead and Aberdeen which are pre-approved vendors)

TWMA will retain Comtherm as an approved vendor beyond the delivery and commissioning stages, not only for the purposes of servicing and maintenance but for scoping heat recovery project. Therefore, in the unlikely event of severe malfunction of the thermal oxidiser, TWMA will have access to expert advice and spare parts for the unit.

Extraction Commissioning

The Process shed is served by an extraction system and fan (75kW motor). At present, this system extracts from all point sources in the shed as well as a general air extraction and directs the extracts to a carbon abatement container (6 x 2.5M).

The extraction system has been installed to provide contingency for periods of thermal oxidiser downtime whether that be planned maintenance or otherwise.

Point extractions will be treated by thermal oxidiser as sized and categorised in the Assessment of Abatement Options for TWMA Peterhead⁴. General air extraction, gathering fugitive emissions, will be treated by carbon bed.

Beyond installation of the thermal oxidiser, it is not planned for processing assets to be operational without the thermal oxidiser operational. The extraction system has however been designed to allow for diversion of the thermal oxidiser feed to the carbon bed, for use in the unlikely event of a loss of function.

As our processes have now been enclosed in a building, the extracted air will require abating for odour, A.S.K. Pearcey report³ suggests 2 air changes per hour (ACH). The extraction system was adjusted upon start up to a level of olfactory comfort within the process shed at a fan setting of 60%. To corroborate the human observations within the shed, velocities were measured within the ducting at relevant test points and converted to flow rate (M^3/hr). The flow rate for the general air extraction from the shed was determined to be $15003 M^3/hr$. The following calculation demonstrates the 60% fan setting comfortably achieves 2 ACH:

Total shed volume: $7,671 M^3$

Therefore 2 ACH: $14671 M^3/hr$

$15003 M^3/hr > 14671 M^3/hr$ therefore an excess of 2 ACH is achieved. At a fan setting of 60%, there is scope to increase this if further monitoring determines it to be necessary. These measurements and calculations have been undertaken in alignment with HSE guidance on commissioning of LEV systems⁸.

Further evaluations of air quality within the process shed were conducted collaboratively by engineering and HSEQ departments to determine appropriate extraction rates for the shed under internal document TWMA-740.

Key working locations were identified within the shed i.e. locations where operators spend most of their working time. VOC monitoring was undertaken at these locations using a calibrated MiniRae 3000 unit¹⁰. The monitoring was undertaken at fan settings of 60%, 30%, 15% and 5%. Average VOC results recorded as follows:

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Fan Setting %	Average VOC reading in working areas
60	3.4
50	3.2
30	3.4
15	3.4
5	4.3

The MiniRae 3000 unit is calibrated using isobutylene gas, chemical formula $(\text{CH}_3)_2\text{C}=\text{CH}_2$ or more simply, C_4H_8 i.e. 4 carbon atoms. The molar mass of isobutylene is 56g/mol calculated as follows:

$$(4 \times 12) + (8 \times 1) = 56\text{g/mol}$$

UK Government Indoor air quality guidelines provide limit values for selected VOCs⁹. The closest VOC in terms of carbon atoms in the guidance to that of the gas used to calibrate the unit is toluene, C₆. The short-term limit is stated as 15,000 $\mu\text{g}\cdot\text{m}^{-3}$ (15mg/Nm³). This has been used as an indicative limit to corroborate odour observations and air change calculations.

Using the ideal gas law, “a million moles of total gas mixture can be stated as a volume of 22,412 Nm³”¹¹. 1 mole of isobutylene has a mass of 56,000mg (56 x 1000) therefore 1 ppm is equal to:

$$56,000 / 22412 = 2.5 \text{ mg/Nm}^3$$

Therefore 15mg/Nm³ is equivalent to 6ppm (15 / 2.5). At all fan settings, the ppm reading on the VOC meter was comfortably below this indicative limit. Further testing at lower fan settings demonstrated this limit was not breached, at a fan setting of 5% the average meter reading increased with 1 individual reading breaching the guideline limit of 6ppm. The optimal fan setting for olfactory comfort, VOC reading and to meet 2 ACH is 60%. There is scope to increase should conditions vary from those on the days of testing.

These 3-way checks determine the extraction system is capable of meeting HSE requirements for indoor conditions.

Compliance

Table 5.9 of the BRef for waste treatment¹² states 2 second residence time for odour destruction in waste oil re-refining technologies/processes, which is considered relevant to TWMA Peterhead site. The selected thermal oxidiser has been designed for 2 second residence time and this will be honed during commissioning.

Table 6.7 of the BAT for waste treatment² provides emission limits for NH₃, odour, dust and TVOC emissions to air from the biological treatment of waste, which is considered relevant to TWMA Peterhead site. The ASK Pearcey report provided this as the start point for the design of the thermal oxidiser and Comtherm have developed the unit to meet these requirements.

The housing of the assets and installation of an extraction system meets HSE requirements for indoor workers within a comfortable operational range of the fan unit.

BAT Review

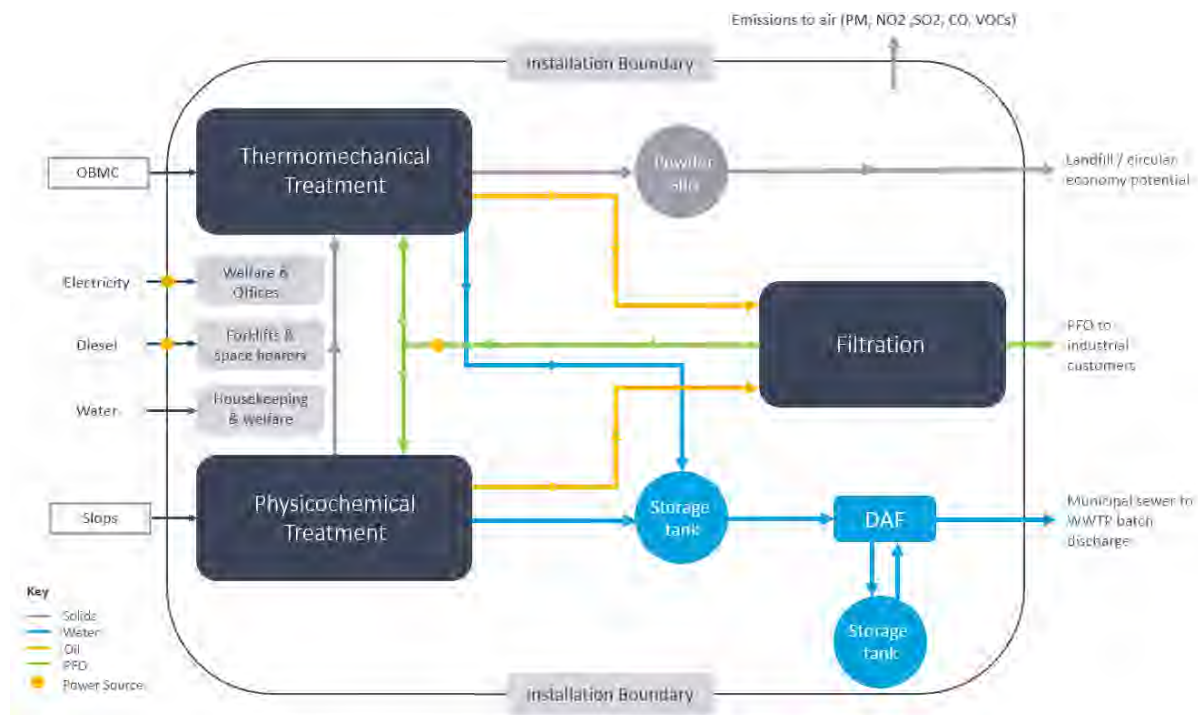
Non - Technical Summary

The TWMA site in Dales Industrial Estate, Peterhead processes drilling waste generated from offshore drilling operations namely oil based mud cuttings (OBMC) and “slops”. OBMC arrive at site in ambient temperature, closed bins and are treated onsite by means of separating the material into its 3 constituent parts rock, oil and water. OBMC are processed on site by a process called thermomechanical treatment, in our unit called a RotoMill. The process utilizes a hammer mill to spin and grind the OBMC, the internal hammers grind the rock within to fine powder, the subsequent friction generates heat resulting in the evaporation of the oil and water from the rock. The vaporised oil and water is piped to condensing units to return to liquid state, after which it is piped to the oil / water separator unit. Vapours from the condenser and oil / water separator units are currently abated using carbon bed units containing carbon pellets. Laboratory results show the carbon provides a degree of abatement but is not BAT.

Recovered powder is pneumatically conveyed to the powder silo for bagging. Recovered powder is currently sent to landfill, however TWMA have been working for several years with SEPA to find an alternative use for this material, recently we’ve had a successful trial with a company who manufacture soundproofing material as we work towards zero process waste to landfill.

The recovered oil is filtered for use on site and / or sale offsite as processed fuel oil. The recovered water is transferred for treatment in the Tank Farm on site and final treatment via dissolved air flotation (DAF) unit prior to discharge to sewer under consent to discharge with Scottish Water (4140A/6/D). The following site process diagram demonstrates the flow of OBMC treatment onsite.

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Slops are predominantly oil contaminated water and arrive onsite via tanker and transferred to the first stage tank within the tank farm for physicochemical treatment, which separates the slops into its constituent parts of water, oil and solids. This is achieved by a combination of centrifugal force to remove solids, chemical addition and processing through disc stacks. The disc stacks are similar to those utilised in the dairy industry to achieve separation of buttermilk and processing of semi skimmed and skimmed milk. The figure above demonstrates the flow of slops treatment onsite. Similar to the RotoMill, vapours from the slops process units are abated via a carbon bed containing carbon pellets. Laboratory results show the carbon provides a degree of abatement but is not BAT.

We will be submitting a permit variation with respect to the installation of the thermal oxidiser to treat the odorous emissions from the treatment processes onsite. We have successfully housed the treatment assets into an existing site building in order the streamline the odorous flows into a single point for the treatment by thermal oxidiser. Planning permission has been submitted for the installation of the thermal oxidiser and subsequent stack: [APP/2025/0897](#). This change will directly impact the following permit condition; 1.1.5.9 *Activated carbon adsorption filtration beds for the treatment of odorous waste gases*.

The changes proposed do not entail a substantial change as defined in the Pollution Prevention and Control (Scotland) Regulations 2012 as the changes will not affect the nature of the installation, nor the functioning of the installation nor extend the installation. Having reviewed the Guidance document IED-TG-03 [Identifying a Substantial Change Variation](#) and considering the changes will improve environmental impact of the site, it is our view the proposed variation does not entail a substantial change.

BAT Review

A full BAT review was undertaken in preparation for VAR01 of the site permit in 2023 following the implementation of the BAT conclusions for waste treatment. Evidence to demonstrate how the TWMA Peterhead site meets BAT conditions have been previously submitted to SEPA under separate cover. BAT conclusions specific to the installation of the thermal oxidiser are discussed below.

BAT 3 & 8– emissions to water and air and monitoring of emissions to air

The proposed changes will have negligible impact on wastewater stream but will bring improvement to the waste gas streams which are now contained, will be effectively treated and dispersed.

In 2022, 3rd party consultants were commissioned to undertake odour monitoring, speciation and modelling to inform an optioneering exercise to identify the most appropriate course of action. Initial third party optioneering identified activated carbon to be a viable option, although this was already in use across the site, carbon beds at the time were small and not appropriately sized for the small volume but high concentration of odorous off gases.

A trial with a carbon unit hired from Exeon was undertaken in 2023 on Rotomill emissions to calculate the carbon bed requirements for the site. The result of which determined an effective carbon bed size and change out frequency which was neither practically nor financially viable, and A.S.K. Pearcey was commissioned in 2024 to undertake a revised optioneering report using the trial data and the original 2022 odour data.

The table below is taken from the Assessment of Abatement Options for TWMA Peterhead (BA0524-TWM-01) A.S.K. Pearcey³ and summarises the combined flow of all odorous streams on site. Speciation of each odour source in 2022 “suggests that there is a similar make-up for the emission streams and the mass contribution is evenly split”³

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Table 2.2a	
Parameter	Value
"Raw" emission gas flow rate m ³ /hr	483
% Oxygen (% v/v)	19-20
Temperature	Ambient Peterhead UK
TVOC mg/m ³ as Carbon	2000-6000 (normal)
TVOC mg/m ³ as Carbon Peak	14000 (spurious spike)
Expected average kg/hr mass flow	1.5-3 (up to 24 tpa VOC)
H ₂ S mg/m ³	5-15
Organo-sulphides mg/m ³	0.5-10
Halogenated species mg/m ³	0.5-6
Moisture (%v/v)	0.4-2
Emission Character mass percent of TVOC	40-85 C9-C16 range
Emission frequency/time hrs/yr	8000
Odour units OU _E /m ³	100,000-10,000,000
Target outlet TVOC mg/Nm ³ as Carbon	<30
Target outlet Odour OU _E /m ³	<1500*
Target acid gas mg/Nm ³	<10

* subject to dispersion modelling

The total odorous flows generated on site can be summarised as low in volume and high in odour / VOC, therefore thermal oxidation is suited to this as per section 2.3.4.6 of the Waste Treatment BRef, "thermal units are best suited for smaller process applications with moderate to high VOC loadings."¹²

A.S.K. Pearcey Ltd summarised TWMA Peterhead site odours in section 2.1 of the report: Assessment of Abatement Options for TWMA Peterhead (BA0524-TWM-01) A.S.K. Pearcey³:

"the heavy fraction VOCs dominate the total emission but there is significant sulphur bearing and halogen bearing components...the sulphur bearing compounds...will greatly influence the odour levels."³

Section 2.1 is titled "Data Summary". Section 2.2 of the same report is titled "Design Basis" and here the site odour speciation results are further summarised:

"the odour is going to be largely carried by the sulphur bearing compounds like DMS, CS, H₂S and the thiols (mercaptans). Xylene also has a low odour threshold and is present in significant amounts in all the emission points."³

The Pearcey report³ was provided to all potential thermal oxidiser suppliers to provide proposed abatement options. The thermal oxidiser which has been selected has been designed to treat the odorous components as summarised in the Pearcey report³. Furthermore, Comtherm advise their design "ensures that the waste stream is oxidised converting it into carbon dioxide and water vapour. Post thermal treatment can be added for the elimination of NO_x, dioxins and particulates that may not be destroyed by the combustion process."¹⁵ Comtherm have added a rapid cooling section to prevent reformation of dioxins to address this potential.

Following installation of the thermal oxidiser, odour monitoring across site will be repeated using Redmore Environmental Ltd. and the site odour model will be updated. This round of

monitoring will include H₂S and NH₃ – there are no test methods advised in BATc for these pollutants, however, where available these will be monitored to SRM - PD CEN-TS 13649:2014 and SRM - BS EN ISO 21877 respectively (or equivalent standards). Dust and TVOC will be monitored every 6 months in accordance with the respective standards; EN 13284-1 and EN 12619 to meet BAT. If it is deemed necessary and following third party advice and liaison with SEPA the following parameters could be measured, (if a third party can be found to provide robust monitoring) to satisfy the oxidiser is suitably abating odours:

- Halogens – there is no single test method for all halogens, however HCl and HF species can be sampled and determined using the respective methods; EN 1911 and ISO 15713

Humidity

It is understood that adsorption by carbon alone is inefficient across the site for odour abatement as the carbon becomes saturated by moisture in the off gases over time. This factor is easily overcome by a thermal oxidiser due to the high operational temperatures. Third party measurement of off-gases reports a moisture result of 0.54%¹⁴ which is comfortably within the operational range of a thermal oxidiser and not anticipated to have a significant impact on energy demand nor significantly impact potential condensation issues on cool down, all of which have been considered in the design of the solution.

Temperature

The operational temperature of the DTO has been selected to abate the odour and VOCs as summarised in the table above to achieve >99% destruction rate. In terms of temperature the unit has a relatively simple temperature control system with feedback loop. The control panel looks after the operation, safety and control of the system. “The temperature is controlled by modulating the burner through its ‘firing range’ and also accounts for the exothermic nature of the combustion process expressed as the net calorific value of the contaminant (as though it was a fuel).”⁴

Looking to the future installation of a heat exchanger, Comtherm overcome the risk of failure caused by expansion and contraction in the design of the mounting plate for the inlet and outlet of the heat exchanger. The (U) shaped unit can expand and contract freely, which Comtherm have honed in their 50 years manufacturing experience.

Flow

Flows have been determined via combination of third-party measurement and in house monitoring. Following movement of assets into the process shed, in-house monitoring of the off-gases was undertaken primarily for the commissioning of the extraction system, but this data served to validate the flow values to provide robust data to Comtherm for the correct sizing of the thermal oxidiser, with flow contingency built-in.

The wastes handled on site are not subject to odorous emissions under ambient temperature, however heat, whether it be generated in the process (Rotomill) or applied (Slops) releases odorous components, the predominantly reported offensive odour being “burnt oil”.

Under BAT 8, the monitoring of emissions to air, following the installation of the thermal oxidizer and associated stack, a round of odour monitoring will be conducted on site and the odour model updated to evaluate the effectiveness of the site improvements. On a long-term basis the following parameters will be monitored, the frequency of monitoring will be subject to review and may be reduced if determined to be sufficiently stable as per the footnote to the table in BAT 8.

Substance/Parameter	Standard(s)	Minimum monitoring frequency
Dust	EN 13284-1	Once every six months
TVOC	EN 12619	Once every six months

BAT 10, 12– Monitor odour emissions

Current onsite and offsite odour monitoring will continue as per the Odour Management Plan. Coaching in effective monitoring is provided during monthly site meetings, reiterating understanding of the FIDOL methodology. HSEQ team supports site staff in conducting odour monitoring to ensure consistency in approach and appropriate moving and timing to re-sensitise nasal receptors. This will continue for as long as necessary after the project is complete and the frequency reviewed following assessment of odour measurements by Redmore Environmental Ltd. after installation of the thermal oxidiser and stack.

BAT 11 – monitoring annual consumption of water, energy and raw materials as well as the annual generation of residues and wastewater, with a frequency of at least once per year

The site reports annual consumptions under permit conditions and will continue to do so following installation of thermal oxidiser. The DFO proposed for site has been scoped to run on PFO recovered on site from the waste treatment process. PFO is currently used on site to power the treatment process with excess sent offsite. Using this fuel onsite aligns with TWMA’s ESG goals in reducing materials transported from site and increasing reuse of recovered materials at source. Use of PFO onsite to power the thermal oxidiser even in the absence of heat recovery holistically provides a more energy efficient solution for the site when compared to other forms of thermal oxidiser options, when considering the fuel availability, transport and losses.

Spent activated carbon is required to be sent offsite as special waste, installation of the thermal oxidiser will reduce activated carbon usage onsite, and the subsequent wastes generated by its use.

BAT 13 – Prevent / reduce odour emissions

The techniques described in this BAT conclusion will continue to be employed following implementation of the proposed changes i.e. residence times minimised as current practice. Deliveries of waste to site are coordinated to accommodate periods of down time. Current onsite and offsite odour monitoring will continue throughout the installation and commissioning process as per the Odour Management Plan. Coaching in effective monitoring will be provided throughout, reiterating understanding of the FIDOL methodology. HSEQ team will support site staff in conducting odour monitoring to ensure consistency in approach and appropriate moving and timing to re-sensitise nasal receptors. The treatment of the off-gases proposed will have no effect on the quality output from the process but will significantly reduce the odorous emissions from the process.

BAT 14 – diffuse emissions

The installation of thermal oxidiser and stack will provide long term improvements on this BAT conclusion.

TWMA have purchasing and design procedures in place, which are subject to external audit as part of ISO 14001, 9001 and 45001 certifications. These procedures ensure that equipment / infrastructure is purchased that is fit for purpose by design and where relevant, meets external safety standards.

Maintenance and service schedules are subject to external audit under ISO 14001, 9001 and 45001 and are compliant with environmental, quality and health and safety international standards.

To prevent or, where that is not practicable, to reduce diffuse emissions to air, in particular of dust, organic compounds and odour, BAT is to use an appropriate combination of the techniques given below. Depending on the risk posed by the waste in terms of diffuse emissions to air, BAT 14d is especially relevant.

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Technique	Comments
a Minimising the number of potential diffuse emission sources	Revised site layout has reduced diffuse emission sources on site: • 1 abatement container (6 x 2.5M) replacing 2 smaller abatement containers (1x1, 2.3x2.3) • Acoustic enclosure for RC4 – whilst predominantly designed for noise attenuation, this also provides further containment of potential diffuse emissions • Disk stack enclosure installed within process shed (formerly 1 operated in the open yard with only 1 containerised)
b Selection and use of high-integrity equipment	Installation of pneumatic slide gates for decanter discharge (enclosing active decanter process, opening only for solid discharge)
c Corrosion prevention	Considered throughout the thermal oxidiser selection process
d Containment, collection and treatment of diffuse emissions	Achieved through installation of process assets into the shed
e Dampening	Not applicable to daily site operations – no open handling processes of a dusty nature. (In the case of any construction work required, any work that is likely to generate dust i.e. breaking the ground, appropriate dampening with water will be utilised to minimise diffuse dust emission.)
f Maintenance	Assets installation into process building designed to ensure access for maintenance was retained
g Cleaning of waste treatment and storage areas	Housing of assets brings improvement in this BAT technique
h Leak detection and repair (LDAR) programme	Installation of assets into building has included additional containerisation to reduce the risk of leakage of organic compounds

BAT 17, 18 – Noise and vibrations

As per permit condition 6.4.1, TWMA maintain a Noise and Vibration Management Plan, which is subject to both regular internal and SEPA review. This document details the site improvement plan, the frequency of noise monitoring, a protocol for responding to noise reports / complaints and details of the noise sources on site and their characteristics.

BAT 18	Technique	Description	Site status
a	Appropriate location of equipment and building	Noise levels can be reduced by increasing the distance between the emitter and the receiver, by using buildings as noise screens and by relocating building exits or entrances	Processing assets have now been housed within an existing building located to the rear of the site. Thermal oxidiser will be sited in front of this building for ease of collection of off-gases from the housed processes and to the rear of the existing office building to serve as a barrier between this source and sensitive receptors. It is not possible to locate the TO behind the process shed as this would restrict sufficient access to the unit for maintenance and service. Third party noise measurements will be conducted in accordance with British Standard BS 4142:2014+A1:2019 following thermal oxidiser installation and commissioning to ensure compliance with permit conditions.
b	Operational measures	This includes techniques such as: i. inspection and maintenance of equipment;	i. TWMA will maintain and service the thermal oxidiser as per Comtherm (supplier) recommendations. These requirements will be added to TWMA maintenance and service schedules which are subject to external audit under ISO 14001,

		9001 and 45001 and are compliant with environmental, quality and health and safety international standards. OEM maintenance schedules are adhered to and only use recognised industry experts to maintain the equipment. ii. closing of doors and windows of enclosed areas, if possible; iii. equipment operation by experienced staff; iv. avoidance of noisy activities at night, if possible;	ii. Processing assets are now enclosed within each section and furthermore within the process shed. The thermal oxidiser and associated stack is to be supplied with the manufacturer recommended cladding / enclosures in accordance with ISO 13577-2. iii. Commissioning of the thermal oxidiser will be undertaken by the supplier (Comtherm) in accordance with ISO 13577-2. During this stage, training will be given to site operatives by Comtherm in conjunction with operational manuals etc. TWMA have a training and competency department and training matrices are maintained for all staff to ensure relevant experience and training is provided, reviewed and refreshed at appropriate intervals. TWMA training processes are included in the scope of certification to ISO 14001, 9001 & 45001, audited by an external 3rd party, UKAS accredited body. ISO standards require an annual internal audit schedule, the schedule and subsequent internal reports are in turn subject to external audit as part of certification to the standards. iv. Yard, general forklift movements, deliveries and fabrication shed are not operational overnight. No deliveries accepted out of office
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		v. provisions for noise control during maintenance, traffic, handling and treatment activities	hours. Thermal oxidiser will run 24/7 in line with processing assets. v. Where possible, maintenance is conducted during office hours. Traffic booking system in place to minimise the number of vehicles at site at any one time, reducing both traffic congestion and noise of vehicles in the site vicinity.
c	Low-noise equipment	This may include direct drive motors, compressors, pumps and flares	Thermal oxidiser will be supplied in accordance with ISO 13577-2 with all component parts designed and selected fit for purpose.
d	Noise and vibration control equipment	This includes techniques such as: i. noise reducers; ii. acoustic and vibrational insulation of equipment; iii. enclosure of noisy equipment; iv. soundproofing of buildings	i. TO and stack designed for optimal odour dispersion and running conditions ii. TO and stack both to be insulated primarily for safety (i.e. heat) which also insulates for noise iii. Anticipated noise level of TO below noise levels of assets which have been enclosed i.e. enclosure potential has been maximised. iv. Existing building cladding specification included in updated NIA and adjusted to account for age.
e	Noise attenuation	Noise propagation can be reduced by inserting obstacles between emitters and receivers (e.g. protection walls, embankments and buildings).	TO will be located behind the existing office building to exploit attenuation from this building.

BAT 21 – Emissions from accidents and incidents

TWMA have engaged third party consultant to conduct fire risk assessment of process facility.

TWMA's EMS is certified to ISO 14001:2015, clause 8.2 of the standard states the requirements for emergency preparedness and response, TWMA's internal procedures are subject to internal audit and audited externally by 3rd party to ensure they meet the requirements of the standard.

TWMA-786-PRO Incident reporting, investigation and follow up details how incidents are reported and investigated on site. All incidents are recorded within TWMA system with corrective action assigned accordingly. Open incidents are discussed at incident meetings attended by operations and HSEQ staff. TWMA-387-PRO Emergency response plan Peterhead gives direction on responding to emergency situations. The site is surrounded by security fences and is manned 24 hours. There is also CCTV onsite.

TWMA-790-PRO spill response provides instruction for responding to spills. Spill training is provided to all onsite staff with refreshers managed through training matrices under training and competency team. Spill drills are conducted every 6 months. Fire wardens are in place at Peterhead site and evacuation drills completed every 6 months in accordance with TWMA-387-PRO Emergency response plan Peterhead.

The above procedures provide sufficient protection measures, management of incidental/accidental emissions and registration of any such incident /accident and remain valid beyond the proposed changes on site. The procedures noted above are subject to third-party, UKAS accredited audits to ensure compliance with the following international standards for environmental, quality and health and safety management systems: ISO 14001, 9001 and 45001 respectively.

Comtherm have advised that conversion of the DTO to a recuperative TO will utilise an air-to-air heat exchanger i.e. there will be no oil in the heat recovery system which therefore reduces potential for fire risks. The maintenance of such a recuperative oxidiser is standard for any thermal plant and well within the expertise of Comtherm. In comparison, a regenerative thermal oxidiser typically requires more extensive maintenance.

BAT 23 – Energy Efficiency

TWMA-761-POL TWMA Integrated HSEQ Policy, states CEO commitment to energy efficiency. The site complies with permit condition 2.6.1 resource utilisation by monitoring and reporting energy usage across the site each year and undertaking more in-depth review every 4 years. TWMA commission third party consultants to monitor and report on ESG (Environmental, social and governance) metrics with a focus on scope 1, 2 and 3 GHG (Greenhouse gas

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emissions). This in turn drives KPI setting across the company and within each site to assess and deliver improvements in energy efficiency.

“The heat from the DFO is high grade heat that could be used in a process to provide process heating or steam by adding the appropriate type of heat exchanger.”⁴ In line with Section 3.3 Heat recovery and cooling of BRef for Energy Efficiency¹, “It is essential to evaluate the quality and quantity of waste/surplus heat...it is crucial to have relevant, quantified information and...detailed measuring and recording of operating data provides an excellent start for planning”. TWMA will monitor and measure the heat from the DFO for 18 months to gather sufficient data to allow the correct sizing of a heat recovery unit and evaluate if primary or secondary heat recovery is best suited for the heat profile. The immediate site requirements are to address offensive odour. Effective heat recovery requires a dedicated project scope to optimise recovery efficiencies.

The thermal oxidiser in its original DFO state, delivers a holistic improvement in energy efficiency for the site as excess PFO recovered from the waste treatment process will be utilised as a fuel source for the oxidiser, which reduces the greenhouse gas emissions associated with the transport of the oil offsite.

TWMA Peterhead site currently does not have a natural gas supply, which had the potential to negatively impact timescale for the odour mitigation project, if the solution required installation of a gas supply. Utilisation of recovered oil as the fuel source improves the overall site resource footprint and minimised the time scale for project delivery. From an economical perspective, natural gas prices fluctuate widely, therefore recovered fuel provides long term stability in the running costs of the chosen abatement solution.

Comtherm are providing a custom solution with spacing permitted to convert the thermal oxidiser to a recuperative model in the future once this has aspect has been effectively assessed under a dedicated project scope.

Comtherm have advised that a future recuperator fitted to the system would return 60% of the heat, which is the optimal percentage for longevity of the system i.e. designing the heat recovery system to be more than 60% efficient risks weld failure. Any future recuperator will be designed with reference to Best Available Techniques for Energy Efficiency.¹

TWMA engaged A.S.K. Pearcey to appraise the thermal oxidiser proposals received to provide expert support in the selection process. Fuel consumption and cost were evaluated as part of this exercise and summarised in the table below:

Supplier	Gas Flow	PFO kW	Electricity	Fuel	Electricity	Total
Babcock	23	249.2	3	£95,775.68	£ 9,696.96	£105,472.64
EIS	8.8	150.0	4	£91,728.00	£ 12,929.28	£104,657.28
AirProtech RTO	6.5	70.4	7	£43,061.20	£ 22,626.24	£65,687.44
Airprekt HC (Catox)	0	0.0	40	£0.00	£ 129,292.80	£129,292.80
Comtherm		150	3	£57,657.60	£ 9,696.96	£67,354.56

The option requiring the lowest total fuel consumption was the catox, however, reliant solely on electricity as power source, this had the highest operational cost. The next favourable option in terms of energy consumption was the AirProtech RTO, however this option required natural gas feed and had unfavourable lead-times. Given the availability of PFO on site and the GHG reduction associated with the transport of PFO offsite, the Comtherm proposal on balance was favourable in terms of fuel efficiency, with the built in futureproofing in terms of heat recovery and energy efficiency. Under TWMA commitment to ESG & GHG reporting, energy consumption and potential savings will be transparent and reportable.

Heat recovery

Primary heat recovery, “simply exchanges heat between the exhaust and the incoming air to be treated,” reducing “the fuel usage of the thermal oxidiser itself.”⁴

Secondary heat recovery utilises a heat exchanger to “pass heat to a working fluid. This might be used to generate hot oil in a thermal oil heater or indeed a boiler to raise steam.”⁴

Chapter 1 of the Best Available Technique reference document for Energy Efficiency¹ provides a framework and structure for evaluating the most efficient use of surplus heat for the site i.e. selecting a recuperator for primary heat recovery, may make the thermal oxidiser more energy efficient, however at site level, secondary heat recovery may offer the maximum energy efficiency at installation level.

The thermal oxidiser option selected has meant offensive odours can be addressed in the shortest possible timescale. The option chosen is future-proofed for subsequent fitting of a recuperator, demonstrating the consideration of energy efficiency. This 2-stage approach ensures TWMA have the most robust solution to address offensive odour which then allows a systematic appraisal of heat recovery options to avoid, “investment in incorrectly sized equipment and missing the most effective efficiency savings.”¹

BAT 41 & 45 – Emissions to air

Following installation and commissioning of the thermal oxidizer and associated stack, the site will meet these BAT conclusions as a combination of thermal oxidation and adsorption will be used to reduce emissions of organic compounds.

Section 6.1 of the BATc describes these techniques as below:

Technique	Typical Pollutant(s) abated	Description
Adsorption	Mercury, volatile organic compounds, hydrogen sulphide, odorous compounds	Adsorption is a heterogeneous reaction in which gas molecules are retained on a solid or liquid surface that prefers specific

		compounds to others and thus removes them from effluent streams. When the surface has adsorbed as much as it can, the adsorbent is replaced or the adsorbed content is desorbed as part of the regeneration of the adsorbent. When desorbed, the contaminants are usually at a higher concentration and can either be recovered or disposed of. The most common adsorbent is granular activated carbon.
Thermal oxidation	Volatile organic compounds	The oxidation of combustible gases and odorants in a waste gas stream by heating the mixture of contaminants with air or oxygen to above its auto-ignition point in a combustion chamber and maintaining it at a high temperature long enough to complete its combustion to carbon dioxide and water.

BAT-AEL in for emissions of organic compounds to air is provided in Section 4.5 of the BATc as follows:

Parameter	Unit	BAT-AEL (Average over the sampling period)
TVOC	mg/Nm ³	5-30

(For associated monitoring, please see BAT 8 discussion above.)

Comtherm advise, gas burner recuperative thermal oxidisers are associated with elevated NO_x emissions due to the utilisation of preheated combustion air. The direct fired thermal oxidiser selected overcomes the potential of elevated levels. Comtherm have advised that NO_x will be

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formed, however the burner itself is a small unit, therefore the actual weight of NO_x generated will be small and technologies can be retrofitted if required.

Some VOCs are known to be thermally stable, requiring high temperature for complete destruction. Comtherm advise the unit has the ability to run at temperatures over 1000 °C, which in conjunction with a 2 second dwell time, reduces the risk of non-destruction of VOCs.

References:

1. [Reference Document on Best Available Techniques for Energy Efficiency](#)
2. [Commission implementing decision \(EU\) 2018/1147 of 10 August 2018 establishing best available techniques \(BAT\) conclusion for waste treatment, under Directive 2010/75/EU of the European Parliament and of the Council](#)
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13. [ISO 13577-2:2023 Industrial furnaces and associated processing equipment – Safety, Part 2: Combustion and fuel handling systems](#)
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16. Odour Dispersion Modelling of Existing Emissions (Peterhead), Mabbet & Associates Ltd, Revision 3.0, 24 February 2023

Appendix A

[ISO 13577-2:2023 Industrial Furnaces and associated processing equipment – Safety – Part 2: Combustion and fuel handling systems](#)

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Appendix B

Quote Details

Quote Ref: Q 501496

Client: TWMA (Peterhead)

FAO: [REDACTED]

RE: Rotomill Hire

Site Notes and Proposal

Exxon have been asked to provide a hire quotation for the Rotomill process at TWMA, Peterhead (Scotland)

The Rotomill has a total maximum vented flow of 20m³/hr from two outlets with the main contaminant being the 'series of unresolved C9-C16 hydrocarbons', and with the highest 'breach' reading at 323.4mg/m³ according to the speciation report. All other contaminants listed are to a much lesser degree.

It is important to have sufficient dilution of humidity, and the discharges are showing as concentrated. Due to external conditions and to prevent discharge from being pulled away by strong cross-winds we'd recommend an extract rate of 1,000m³/hr via 'Venturi' hoods. We consider the Low-Flo activated carbon odour abatement system to be suitable, which is provided with an integral extract fan and dust prefilter including ducting to the Rotomill machinery connecting to the proposed 'Venturi' capture hood located above the current discharge vent.

We suggest a dwell period of 1.0 second across the filter media to be sufficient which will equate to a total of 0.28m³ or 139Kg of carbon. The media should last for an approximate period of 50 weeks based on a 15% adsorption capacity before requiring change.

Specification

Carbon Filter Unit

Pre filter: T60 High dust loading carbon prefilter

Duty: Activated carbon odour filter system providing a minimum of 1 second dwell time against an airflow of 1,000m³/hr.

Carbon type: High grade 60CTC 4mm pellets

Filter seal: All filters individually sealed and clamped

Construction: Aluminium framed with plastisol sheet panels (galvanised inner).

Access: Via access panel in the side of filter housing, secured with twist-lock panel fixings.

Size: 690mmH x 930mmW x 1400mmD



Q 501496

26-07-2023