Example Odour Control Report for a Pet Food Manufacturing Facility that Cooks and Dries Animal Products

**Sample Pet Food Company**

**Anytown, ON**

#

# Introduction and Scope of Odour Control Reports

## Purpose of the Example Odour Control Report

A person engaging in an activity prescribed for the purposes of the Environmental Activity and Sector Registry (EASR) by Ontario Regulation 1/17 (Air Emission EASR regulation) is required to have available at all times an Odour Control Report (OCR) if any of the circumstances set out in paragraph 5 of Section 24 of the regulation exists at the facility. If an OCR is required, the facility must prepare a facility-specific OCR that includes all the administrative and technical requirements set out in section 27 of the Air Emissions EASR Regulation. In order to provide appropriate guidance materials and tools for facilities tasked with preparing an OCR, a total of six example OCRs have been developed by the Ministry of Environment and Climate Change (MOECC). One OCR is available for each activity with NAICS Codes listed in Table 3 – Odour – Processes and Setback Distances of the EASR publication, and for each specific process listed in Table 4 – Odour – Processes and Setback Distances, as follows:

* Dog and Cat Food Manufacturing NAICS 311111 and Cooking or Drying Animal Products
* Sugar Manufacturing NAICS 311310
* Breweries NAICS 312120
* Spraying Operation (≥ 10 L/hr) and Printing (> 400 kg/hr ink usage)
* Wastewater Treatment – Lagoons, Uncovered Clarifiers, Sludge Management
* Food Frying

The Dog and Cat Food Manufacturing and Cooking or Drying Animal Products OCR was prepared such that it is applicable to NAICS 311111 listed in Table 3 and Cooking or Drying Animal Products, a Table 4 process. One combined OCR for Spraying Operations (Painting) and Printing was prepared. Where appropriate, the wastewater treatment OCR may be combined with the other OCRs.

The purpose of the example OCRs is to simplify the level of effort required by facilities when developing an OCR. These example OCRs contain useable information and are presented in a recommended OCR format.

Some sections in the example OCRs can be used as a draft for facilities, particularly with respect to the jurisdictional review and odour control options provided in Section 4. This information can be incorporated by facilities into their site-specific OCR. It is imperative, however, that the information be reviewed and validated as it reflects information available at the time this example OCR was prepared (January 2017). There may be advancements in control technologies or other changes to the sector or process that would need to be considered. It is the responsibility of the person preparing an OCR for a facility to ensure that the information, including the jurisdictional review and odour control options is complete.

As well, a number of sections of the OCR will require site-specific inputs and considerations, in particular, Section 2 where unique attributes at a specific facility should be detailed, Section 5 which presents the assessment of control option technical feasibility, and Section 6 which summarizes the status of current odour control measures at the facility.

These example OCRs include narrative guidance text boxes throughout for instructional purposes, as well as Appendices with further guidance materials and resources.

As there are numerous facilities that prepare dog and cat food or cooks and dries animal products, this report should not be considered comprehensive for all facilities with these activities. A facility-specific OCR must be prepared to include all odorous sources at a facility, the different types of equipment, raw materials, and other process inputs or materials used. All reasonable effort must be made to identify odour reduction measures and procedures that are available from publicly accessible resources.

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**Statements of Certification**

## Licensed Engineering Practitioner

I confirm that based on the information provided to me, the information in the report is accurate as of the date it is signed and sealed.

Signature:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Name of Licensed Engineering Practitioner:

PEO License Number:

Date:

## Facility Representative

I confirm that all information provided to the Licensed Engineering Practitioner in order to prepare this report was complete and accurate, and I have the authority to bind the company.

Signature:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Name of Facility Representative:

Position

# Introduction

## Odour Control Report for Pet Food Manufacturing or Facilities that Cook and Dry Animal Products

This Odour Control Report for the Sample Pet Food Company (Co.) (the ‘OCR’), a pet food processing facility that has both a dry food and wet food production line, was prepared to comply with the odour requirements of Ontario Regulation 1/17 – Activities Requiring Assessment of Air Emissions (the ‘Air Emissions EASR Regulation’) for facilities that meet the following criteria:

* The facility is required to register their activities in the EASR under the Air Emissions EASR Regulation;
* The facility has completed an odour screening report in accordance with Section 25 of the Air Emissions EASR Regulation;
* The facility engages in Dog and Cat Food Manufacturing with NAICS Code 311310, which is an activity set out in Table 3 of Chapter 4 of the “Environmental Activity and Sector Registry – Limits and Other Requirements” (EASR Publication) published by the Ministry of Environment and Climate Change (MOECC), and available on a government website, as well as Cooking or Drying Animal Products, which is a process set out in Table 4 of Chapter 4 of the EASR Publication; and,
* The distance between the facility and the closest point of odour reception is less than the distance set out opposite the process in Tables 3 and 4 (Chapter 4 of the EASR publication explains what a point of odour reception is and how the distance between a point of odour reception and the facility must be measured).

A facility is required to prepare an OCR if any of the circumstances set out in paragraph 5 of Section 24 of the Air Emissions EASR Regulation exist at the facility. If an OCR is required, the facility must prepare a site-specific OCR that includes all the administrative and technical requirements set out in Section 27 of the Air Emissions EASR Regulation.

While this example OCR report pertains to industrial processes which engage in Dog and Cat Food Manufacturing or Cooking or Drying Animal Products, it can also be used to assist facilities outside of this sector that have similar sources and emissions of odour in preparing their OCRs.

A facility is required to prepare a Best Management Practices Plan for Odour (BMPP) if any of the circumstances set out in paragraph 3 of Section 24 of the Air Emissions EASR Regulation exist at the facility at the time the most recent odour screening report is prepared. BMPPs must be prepared on a facility-basis. In this example, the Sample Pet Food Facility must, in addition to this OCR, develop and implement a BMPP. Best Management Practices (BMPs) are practices or procedures to prevent or minimize odorous effects. These may be general in nature and applicable to a wide range of facilities, or they may be facility-specific and intended to help reduce odorous releases from process operations or activities at an individual site. These practices are most easily implemented and most effective if they are incorporated into Standard Operating Procedures (SOPs) and training programs and workers are assigned responsibility and accountability. BMPs in general would not require additional engineering or significant process modifications or the installation of pollution control equipment.

Senior management at the facility must participate in the development of the OCR, and support the Licensed Engineering Practitioner by providing comprehensive and accurate information regarding site processes, activities, and emissions. The accuracy and completeness of the information provided for the preparation of the OCR must be certified by a representative of the facility.

## Sector Description

Canada currently has a large pet food industry, and pet ownership continues to increase annually. Dry food makes up a larger percentage of sales of pet food in North America compared to wet food. The majority of Canadian pet food manufacturing occurs in Ontario, although there are facilities across Canada. The odour sources commonly associated with pet food manufacturing are from the cooking process stages, specifically dry food extruding, drying, coating and cooling and wet food cooking.

It is not a mandatory requirement of the OCRs to include a sector description. However, it is recommended that a facility demonstrates that the activities and operations carried out at their site are consistent with other facilities in their sector (Section 1.4), and to highlight the differences or aspects of operations that are unique to their operation (Section 2.6).

### Dry Pet Food

While there are numerous ways to make dry pet food, the most commonly used process is extrusion. The process stages are described in detail in Section 3 for the Sample Pet Food Co. which operates a typical dry pet food manufacturing production line.

### Wet Pet Food

Wet pet food, sold in cans, pouches, and trays, is produced in the same manner as food for human consumption. The process stages are described in detail in Section 3 for the Sample Pet Food Co. which operates typical dry and wet pet food manufacturing production lines.

## Odour Control Report for Sample Pet Food Co.

An OCR is required for the Sample Pet Food Co., a large pet food producer with a NAICS Code 311111, producing more than 140,000 metric tonnes of dry pet food annually via extrusion and 100,000 tonnes of wet pet food annually via canning operations; the NAICS code triggers the requirement for an OCR. There are no live animal abattoir operations or rendering at this sample pet food facility. All raw meat sources are received pre-processed. The closest point of odour reception is less than 300 metres from the nearest source of odour at the facility.

Chapter 4 of the EASR publication explains what a point of odour reception is and how the distance between a point of odour reception and the facility must be measured. The required setback distance for both Dog and Cat Pet Food Manufacturing and Cooking or Drying Animal Products is 500 metres as listed in Tables 3 and 4 of the EASR Publication.

## Odour Control Report Content

This OCR for the Sample Pet Food Facility has been prepared in accordance with the Air Emissions EASR Regulation, and therefore includes the following required elements:

* Legal name of each facility owner and name under which the owner carries on business, if different from the legal name;
* If the facility operator is not an owner of the facility, the legal name of each facility operator and name under which each operator carries on business, if different from the legal name;
* Facility address;
* A facility description and a detailed process description;
* Measures and procedures used by facilities in this sector, or at facilities with similar sources of odour or activities, to prevent or minimize the discharge of odour, including control equipment, engineering controls, process optimization, pollution prevention, or other associated measures. In many cases, these measures were intended to abate specific contaminants but have the net effect of reducing odour emissions. For example, heat recovery units could be used to condense steam and thereby serve to control odours;
* An analysis of the technical feasibility of implementing the measures and procedures identified, or potential combinations thereof at the facility;
* For the control measures identified as technically feasible but not implemented, rationale for why the control measures are not implemented at the facility to prevent or minimize odour;
* A discussion of the adequacy of measures and procedures currently implemented and set out in the BMPP, to prevent or minimize odour effects from the facility;
* A statement by the Licensed Engineering Practitioner confirming that based on the information provided to the practitioner, the information in the report is accurate as of the date it is signed and sealed; and,
* A statement signed by the person engaging in the prescribed activity confirming that all information the person gave to the Licensed Engineering Practitioner in order to prepare the report was complete and accurate.

# Facility Description

## Site Location and Location of Points of Odour Reception

The facility is located at 100 Sample Drive, in Anytown, Ontario.

The UTM co-ordinates for the facility are:

* Zone – 17
* UTM Easting - 723000 m
* UTM Northing - 4840000 m

The Sample Pet Food Co. is located in an industrial area that lies adjacent to a residential development. The closest point of odour reception is a residence located 200 metres from the fenceline of the facility and 300 metres from the nearest odour source at the facility, which is less than the required setback distance of 500 metres from Tables 3 and 4 of the EASR Publication. There are other residences, as well as a public sports field, within 500 metres of the facility.

## Facility Owner Legal Name and Contact Information

Legal name of the owner: Ms. Cathy Pellerton

Contact Information: 519-123-4567; cathy.pellerton@samplepetfoodco.ca

## Facility Operator Legal Name and Contact Information

The facility is operated by the owner.

The Air Emissions EASR Regulation requires that the OCR sets out the legal name of each owner of the facility, and the name under which each owner carries on business, if it is not the owner’s legal name. Further, if the person who operates the facility is not an owner, the report must set out the legal name of each person who operates the facility and the name under which each operator carries on business, if it is not the operator’s legal name.

## Production Rate and Operating Hours

The operating hours are typically 12 hours per day (7am to 7pm), 5 days per week, with occasional weekend work as required. There is one week of scheduled shutdown per year.

The facility produces up to 140,000 metric tonnes of dry pet food annually via extrusion and 100,000 tonnes of wet pet food via canning operations.

## Facility Complaint History

The facility maintains accurate records of all complaints received and the measures taken to investigate and respond to each complaint following the process outlined in the facility BMPP. This includes complaints made to the facility directly, as well as those made to the local MOECC office. There have been no complaints received over the last 5 years.

It may be beneficial for a facility to document all complaints received and their resolution in the OCR. Some complaints may have been resolved or were the result of a process upset. Resolved complaints could lead to changes or improvements in the facility’s BMPP for odour. However, documenting complaints in an OCR is not a legal requirement.

## Unique Facility or Process Attributes

At the Sample Pet Food Co., the following processes, activities, or sources may be considered unique when compared to other facilities:

* The facility operates both wet and dry pet food production lines; and,
* The recipes used are proprietary, and require ingredients, cooking times, and cooking temperatures that may differ from other facilities.

Each pet food production facility is unique and source to source variations in process, source configurations or location at the facility can significantly affect emissions and off-property impacts. The emission variations result from differences in the raw materials and product recipes, time and temperature of cooking stages, the type and age of equipment used, total production, etc. All of these factors and production details need to be clearly described in a facility’s OCR.

# Process Description

## General Process Description

The Sample Pet Food Co. manufacturing involves the following main processes:

1. Raw materials receiving and storage
2. Dry food production lines
	* Raw material preparation
		+ Grinding
		+ Compounding and mixing
	* Cooking
		+ Extrusion process
		+ Drying
		+ Cooling
		+ Coating
	* Packaging and Shipping
3. Wet food production lines
	* Raw meat preparation (grinding)
	* Raw material preparation and blending
	* Cooking
		+ Steam Processing
		+ Canning
		+ Retorting
	* Packaging and Shipping
4. Auxiliary services

### Bulk Materials Handling and Storage

Raw materials (grain, meat products, concentrated vitamins and fat) arrive via trucks or railcars. Dry bulk materials are conveyed or transferred to the appropriate holding areas and storage bins. Grains are generally stored in silos and smaller quantity materials are stored in totes and dedicated containers. Bulk liquid ingredients are received by trucks and transferred to the appropriate bulk storage areas and the smaller quantity materials are shipped and stored in totes and drums. The closed bins, totes and drums have no odours associated with them as they are closed systems and/or the meat products are received frozen and stored in the freezer until used. The silos and open storage systems have passive ventilation systems.

### Dry Food Process

#### Grinding

Raw materials that are required to be of a specified particle size to increase the availability of nutrients, as well as improve the ease which they are processed, are ground in an initial processing stage. The hammer mill is used for this process, followed by the sifter to accomplish grinding and sorting of ingredients to the appropriate sizes. Larger particles are recovered and reprocessed back for additional grinding and sorting. There is one stack exhausting the hammer mill, sifter, and the grinding process area. There is the potential for odours to be generated from these processes; however, they are specific to grains and not highly odorous.

#### Compounding and Mixing

Dry ingredients are combined in the mixing blender with vitamins and micro-nutrients that have been metered-in corresponding to the pet food recipe being made. The total dry mix is blended for an appropriate time to create a consistent product prior to extrusion. There is minimal odour associated with this activity as the rate of mixing achieves a consistent texture but does not further mechanically separate the material or create airborne emissions.

#### Extrusion Process

The mixed dry ingredients are preconditioned to start the gelatinization of the starches. The dry mix then has liquid ingredients added in accurately measured amounts according to the recipe. The liquid ingredients can include fat, oils, flavours, additional water and steam. Additional ingredients are added at this time such as meat products and flavourings. The resulting wet mix is thoroughly blended and partially cooked before being conveyed to the extruder. The extruder is the system that forms the pet food to the shape required for the final product. The partially cooked blended mix is forced through a die where it is cut to the desired length by a knife and as it is moving through the extruder it also completed the cooking process. As it leaves the extruder system the material is now identified as “kibble”.

#### Drying

The kibble leaving the extruder is conveyed to the dryers to achieve the final product moisture content, and then passed over a series of vibratory extractors and a final sifter to ensure uniform product size prior to the final coating, product cooling, and packaging. The odours associated with this process are directed to a baghouse prior to discharge via one common process stack.

#### Coating-Cooling

A coating for flavour is added to each kibble prior to entering the cooling stage using a vacuum coating system. This coating system can use either a liquid or dry ingredient flavour system depending on the product requirement. Once the coating has been added the kibble is sent to the cooler to finish the processing and cool the product for optimum handling and packaging. Two exhausts serve this process unit: one for the cooler that is controlled by a cyclone and one for the coating process.

### Wet Food Process

#### Grinding

The raw ingredients used in the wet pet food include vegetable, grain, meat, by-product and/or fat products. Initial ingredient preparation is limited to the cuts of meat used in the recipe. When starting with frozen meat in blocks, the first stage involves breaking them into convenient-sized chunks for the coarse grinder.

#### Compounding and Mixing

Once the meat ingredients are sufficiently reduced in size, they are pre-cooked and reground to produce a more uniform consistency. The remaining raw ingredients are then added; these can include fruits, vegetables, grains, oils, fats, eggs, vitamins and micro-nutrients, all metered in corresponding to the pet food recipe being made. The total wet mix is ready for the final cook within the steam kettle.

#### Steam Kettles

Semi-thawed meat is loaded into steam kettles to initiate the cooking phase. The steam kettles are brought up to temperature which cooks the meat, creates the ‘gravy’ to be used in the final product and the internal cutting blades reduce the meat to appropriately sized chunks, specific to the feed recipe. The steam kettles are pressurized to maximize efficiency so potential odour emissions will occur at the end of the cooking cycle when the pressure is released from the steam kettle and the wet food is transferred to the can filling line.

#### Can Filling

The cooked wet feed is pumped to the can filling station where the cans are automatically filled and the lids seamed. The temperature of the feed mixture is still maintained at a specific quality control value to ensure animal health and welfare criteria are ensured. The sealed cans are conveyed to the Retort process.

#### Retorting

The filled cans are transferred to a large sterilization chamber. The batch of canned wet food is loaded into the retort and sterilized under high pressure steam. This provides a secondary cook time for the food materials, reaches sterilization temperatures for the feed internally and also results in cleaning the outside of the cans. Since the cans are sealed at this stage there are no expected odour emissions.

### Packaging and Shipping

#### Dry Pet Food

Most of the finished kibble is conveyed from the cooler to overhead load-out bins for direct loading of bulk shipments to trucks/trailers. There is minimal odour emission associated with storage and loading. Overhead bin loading systems are utilized where telescopic chutes ensure the material is conveyed directly into the bed of the trucks/trailers to reduce the loss of product and the associated generation of odour associated with particulate matter.

There is also an individually bagged finished kibble packaging line in which the product is conveyed from the cooler to the final sifting and vibratory extraction process before entering the packaging machine where the product is packaged for sale. There is a dust collection system attached to the sifting and extraction process of the finished kibble packaging line that recirculates its exhaust back into the general shipping area.

#### Wet Pet Food

The sterilized cans are conveyed from the Retort via conveyor belt and travel with enough distance to allow sufficient cooling by the time the labeling machine is reached. Appropriate labelling, boxing and shrink-wrapping is completed. The cartons are palletized and prepared for direct shipment or in-house storage.

Newly packaged product is stored in the warehouse portion of the facility building. When required it may be loaded on trucks using the facility lift trucks.

### Auxiliary

The auxiliary equipment and processes are those of any large manufacturing facility, and include:

* Combustion boilers for process heat and building heating;
* Small unit heaters, radiant heaters, make-up air units, or other HVAC;
* Quality assurance / quality control laboratory;
* Cooling systems using ammonia or other refrigerant;
* Maintenance welding and painting;
* Wastewater handling, treatment, and discharge;
* Solid waste collection and trash compaction; and,
* General (non-process) building exhausts (office space, cafeteria, and washrooms).

## Identification of Odorous Contaminants

In this pet food facility, the expected odorous contaminants are various Volatile Organic Compounds (VOCs), minerals and organic materials released during the grinding and cooking processes. There is the potential for sulphur-containing compounds to be emitted as a result of decomposition of organic materials or specific process operations.

Odours generated from pet food processing facilities are generally a result of the physical processing of ingredients in which biological or chemical reactions form VOCs. These reactions occur through processes like heating, drying and cooling of foods and are carried in the exhaust stream.

The intention of the OCR is to focus efforts on odour emissions that are associated with facilities that have these activities. The speciation of odour in the exhaust gases by specific contaminant is not required.

However, a better understanding of the nature of the odour and the expected chemical composition of odorous emissions may be useful, if available, in determining which control options have been proven effective on similar processes. For example, control options for VOC odours may not be effective or technically feasible on odours from sulphur-containing emissions. This detail also allows for discussion of the offensiveness of the odour and the identification of potential contaminants with low odour detection thresholds.

## Identification of Odour Sources and Source Groupings

Each odour source at the Sample Pet Food Co. facility has been classified as a primary odour source, secondary source, or a negligible odour source based upon the source’s relative contribution to potential odour effects. For each odour source, a general description of the associated process, unit operation, equipment, or activity, expected contaminants in the exhaust gas, typical odour loadings, factors which may affect the odour loading, and potential constraints were provided, where applicable. The key parameters are presented in tabular format.

For these sources, organics are the predominant source of odours. The control of particulate matter is not discussed in detail; however, those sources that may impact odour do have industry best management practices in operation at this sample facility.

Dispersion modelling is not a requirement of the OCR. If no previous odour assessment with dispersion modelling has been completed for the facility, other methods of assessing the relative significance of odour sources may be employed to identify odour sources.

If dispersion modelling for odour has previously been completed, the model output should be reviewed as it may be useful in assessing odour effects and classifying sources as primary, secondary, or negligible. Even if accurate emission data are not available, dispersion modelling for odour and the use of a dilution factor is an effective tool in ranking odour sources by considering the dispersion (i.e. dilution) characteristics of different sources such as tall stacks and wall mounted vents. A dilution or dispersion factor is the modelled odour strength or concentration at a receptor (OU/m³) divided by the source strength as an emission rate (odour units per second OU/s) that can be used for screening purposes to evaluate the effects of odour emissions from one individual odour source at an odour receptor.

**Estimating Odour Loading (Concentration OU/m³ and Emission Rates OU/s)**

Estimating the odour loading from sources may be done using emission factors, data from similar processes at other facilities, or source measurement. In many cases the only available emission factors are for VOCs as little data on odour loadings is publicly available and difficult to apply on a generalized basis. The odour and VOC emissions may not be directly proportional; however, these values will also assist in site-specific determination of the VOC concentration and emission rate for individual sources to allow for comparisons, ranking of sources, and discussion of the suitability of control measures.

Odour measurement at the source may be conducted on-site to determine the odour concentration and emission rate in OU/m³ and OU/s, respectively. Odour sampling methodology is published in the MOECC Source Testing Code, and odour concentrations are frequently measured using an olfactometer. An odour unit (OU) is a measure of the intensity or strength of an odour. One odour unit is the level at which half the population would detect or respond to an odour, and the odour concentration, in OU/m³, refers to the number of times the sample must be diluted to reach 1 OU.

### Primary Sources of Odour

The primary odour sources from the Sample Pet Food Co. facility were identified based upon a previous odour survey conducted to rank the sources by potential for off-site effects. The previous odour survey is up to date and reflects current operations.

The Sample Pet Food Co. has combined a number of sources on the dry pet food production line so that they discharge to one common stack that has been optimized for odour dispersion.

The following are considered to be major odour sources and are all associated with the cooking or drying stage of production:

* Extruding – process of cooking the dry pet food portion at elevated temperatures as the raw mixture is forced through a screw die form.
* Drying – the extruded cooked pet food portion is conveyed to a dryer to achieve a specific product moisture content, material leaving the drying process is identified as kibble.
* Coating – coating is applied to the dried kibble to improve palatability as well as an additional source of vitamins and some minerals. The coatings are generally spray applied and then the product is conveyed for final processing.
* Cooling – the final stage of the process is to allow the kibble to cool to the optimum temperature for packaging. This ensures the moisture content is sufficient to maintain freshness and palatability but will not promote spoilage or odour issues for the consumer.
* Steam Kettle – cooking of meat products is done in a sealed kettle with direct steam under pressure however there is the release of the pressure and the transfer of feed from the kettle to the canning system.

These sources are described in Table 1A.

Wastewater collection, handling, treatment, and discharge, may potentially be a significant source of odour. Due to the complexity of wastewater treatment and odour control measures, a separate sample Wastewater OCR has been developed to provide guidance with systems operated to achieve the requirements of municipalities for liquid discharge to the sanitary sewers or the requirements for direct discharge that would likely involve advanced treatment systems.

The example OCR for industrial wastewater handling and treatment should be reviewed if applicable as it pertains to the potential to generate odours from wastewater processes. If wastewater is identified as a source of odours, the overall OCR for the facility should include both the sector specific and wastewater aspects.

### Secondary Sources of Odour

The secondary odour sources are presented in Table 1B and have the potential to contribute to odour effects, but not to the same extent as those deemed primary sources of odour.

Individual sources are provided or, where possible, sources are grouped where it is reasonable to do so. Grouping is useful when sources are associated with the same process stage, same production area, or have similar odour and exhaust characteristics. These sources may be combined and directed to individual pollution control equipment or dealt with as an aggregate.

Secondary sources of odour at the Sample Pet Food Co. include:

* Receiving Source Group – silos, tanks and receiving areas;
* Dry Preparation Source Group – hammer mill, sifters and blenders/mixers;
* Dry Packaging Source Group – load-out bins/chutes, sifters/vibrating extractors and bagging; and,
* Wet Packaging Source Group – can filling process.

Packaging and general building exhausts can also be source of nuisance odours at pet food facilities and should be considered.

### Sources Not Considered Odorous

The following air emissions sources are not considered as significant odour sources at most dry pet food facilities, including the Sample Pet Food Co. facility:

* Handling and Storage of Dry Grains;
* Boilers;
* HVAC equipment (comfort heating and cooling);
* Chillers and refrigeration equipment;
* Parts washers (aqueous);
* Product label gluing;
* Laser / ink printing;
* Cafeteria exhausts and other employee comfort areas; and,
* Office Areas.

All potentially odorous sources have been included in the BMPP for the facility.

All potentially odorous sources should be included in the BMPP for the facility, if applicable. For the Sample Pet Food Co., the product label gluing was included in their BMPP to ensure proper management of glues and glue residues. There is no odour associated with the other insignificant sources.

**Table 1A – Sample Odour Source Identification Table for Sample Pet Food Co. (Primary Odour Sources)**

| **Source Description**  | **Odorous Contaminants** | **Odour Loading** | **Exhaust****Characteristics**  | **Flow****Rate** | **Continuous or Intermittent Discharge** | **Current Odour Control Measures** |
| --- | --- | --- | --- | --- | --- | --- |
| Cooking Exhaust - Extruder | VOCs | Moderate to High | Exhaust ducted to one common tall stack | High (combined) | Continuous | BMPPStack Optimization |
| Cooking Exhaust - Dryer | VOCs | High | Exhaust ducted to one common tall stack | High (combined) | Continuous | BaghouseStack Optimization |
| Cooking Exhaust - Cooler | VOCs | Moderate to High | Exhaust ducted to one common tall stack | High (combined) | Continuous | CycloneStack Optimization |
| Cooking Exhaust - Coating | VOCs | Moderate | Exhaust ducted to one common tall stack | Low | Intermittent | BMPPStack Optimization |
| Cooking Exhaust - Steam Kettle / Steam Retort (wet food) | VOCs | Moderate | Exhaust Stack | Moderate | Intermittent | BMPPStack Optimization |

**Table 1B – Sample Odour Source Identification Table for Sample Pet Food Co. (Secondary Odour Sources)**

| **Source Description**  | **Odorous Contaminants** | **Odour Loading** | **Exhaust****Characteristics**  | **Flow****Rate** | **Continuous or Intermittent Discharge** | **Current Odour Control Measures** |
| --- | --- | --- | --- | --- | --- | --- |
| Grinding | VOCs | Low | Dedicated exhaust vented to a cyclone | Moderate | Intermittent | Cyclone |
| Mixing | VOCs | Low | General Building Exhaust | Low | Continuous | BMPP  |
| Raw Material Unloading and Storage | VOCs | Low | Dedicated exhaust vented to a dust collector | High | Intermittent | BMPP |
| Packaging and Shipping (Dry Food) | VOCs | Low | Dedicated dust collector for sifter and extractor | Moderate | Continuous | BMPP |
| Packaging and Shipping (Wet Food) | VOCs | Low | Hooded, exhaust directed to vertical roof-mounted stack | Moderate | Intermittent | BMPP |

**Site-specific Source Description**

General indicators of the odour loading, stack parameters, and exhaust gas flow rate are provided in Tables 1A and 1B. Facilities should ensure that all available source and stack data, available through their Emission Summary and Dispersion Modelling (ESDM) report, is used to describe the odour sources as accurately as possible.

# Sector Odour Control Measures

This section of the OCR is provided as a summary of general industry practices and BMPs for pet food manufacturing that are considered when dealing with uncontrolled or problematic odour sources, where appropriate.

In Ontario, the need to implement odour control measures depends upon many factors, including the presence of odour receptors, a history of odour complaints, or siting in an area with multiple industrial sources. In the absence of off-site odour impacts, there is typically no motive for additional control equipment, engineering controls, or abatement measures specific to odour.

A review of publicly available information was completed to identify what measures and procedures are in use to control air emissions. Sources included Environmental Compliance Approvals (ECAs) for Ontario facilities, European Union BAT reference documents (BREFs) and associated guidance materials, US EPA Title V Permits and Reasonably Available Control Technology (RACT) Analysis documents, among others. In many cases, the control measures were implemented to reduce total VOC discharges, which had the added benefit of reducing odour emissions. A review of measures that can be used on similar sources was also completed to identify any that are potentially transferrable.

The odour control measures identified in this section have been demonstrated to be effective at pet food manufacturing operations within potentially larger production sites. Current practices for odour control range from the implementation of BMPs for smaller processes to control equipment on all odorous sources at larger operations or those that have nearby odour receptors.

A review of a number of facilities or organizations within Ontario, the US, the EU, and Australia was conducted to identify what measures, if any, have been implemented.

## Current Practices at Pet Food Facilities

The odour control measures and procedures identified are currently in use at processes similar to each odour source or source grouping identified at the Sample Pet Food Co. and are presented in Table 3 for the primary sources and Table 4 for the secondary sources.

### Ontario

There are thirty-two animal feed mills listed in the Ontario Agribusiness Association Membership director for 2016, further searches identified fifteen manufacturers that specialize in solid dry pet food either for individual retail sales or wholesale bulk sales. Of these fifteen facilities approximately half of the sites also produce other dry animal feed recipes such as food for goats, rabbits, lambs, pork and other livestock in conjunction with domestic dry pet foods. Of these fifteen sites, information for eight facilities in Ontario with MOECC Environmental Compliance Approvals (ECAs) was available through the MOECC Access Environment database of historical and current approvals; one of these manufacturers is a home based speciality order business and there are two facilities that manufacture dehydrated dog and cat treats but not food kibbles. No information was available for the other sites.

The publicly available data was reviewed, and the following was found from the available pet food manufacturers’ ECAs:

* One large facility is located in a rural area, having an odour receptor approximately 400m from its property line and has a major highway system approximately 250m from its operations. The site utilizes a biofilter on the exhaust of the extruder, pneumatic conveyor and grinder process lines, a unit filter on the grinder process prior to the biofilter inlet, a baghouse on the raw material receiving and unloading operations, a baghouse on the central vacuum system, and an activated carbon system for odour control on the wastewater treatment building ventilation.
* Five of the facilities operate large processing facilities (500 to 100,000 tonnes per year) that also have other animal feed processing lines/facilities on the same site. The feed manufacturing operations utilize dust collection systems on mixing, weighing and batching operations, cyclones on grinding operations, cyclones on pelletizing coolers, and baghouses on screening and hammer mills. These operations are generally located in rural to semi-rural locations. The semi-rural locations have a mix of residential, retail, and recreational facilities and services. The odour receptors range in distance from approximately 200m to several kilometres. There is no specific control equipment installed to mitigate odour at these sites.
* One smaller processing site is located in a business park setting within a multi-tenant building. There is a green space located behind the building approximately 150m from the operations; however, a major highway system is also near. The facility implements an impingement scrubber system using sodium hypochlorite solution for the exhaust of the mixing tanks, the holding tank, cooking tunnels and conveyor system.
* One facility is located in a rural area that has a mix of agricultural activities and residential properties and has odour receptors located less than 200m from its operations. It has a yearly production capacity of 80,000 tonnes/year. The ECA states a baghouse collector serves the receiving elevator, pre-mix silos and pre-mix bins, one spray chamber scrubber using a chlorine scrubber solution is used for the hammer mill, extruder, cooler and re-work bin systems.

The Sample Pet Food Co. is considered to be a relatively large production facility. Though production data for other facilities is limited, it can be inferred that the more stringent emission controls in Ontario and other jurisdictions are a result of either significantly larger scale operations or where site-specific issues have warranted more extensive controls. However, facilities developing an OCR should consider all relevant controls for facilities of various sizes and specific locations.

### Other provinces

There were other pet food facilities identified as operating in Canada; however, no publicly available guidance, regulatory requirements, odour emission inventories or permits for these facilities were available that provide details on emissions sources or odour control measures.

### United States

It is important to note that “odour” is not a regulated emission in the US. The following discussions consider controls required for volatile organic compound emissions (VOCs). Some of these control systems and requirements will also reduce odour emissions.

In the US, Title V operating permits are federally mandated for major stationary sources of air pollution with actual or potential emissions at or above the major source threshold for specified air pollutants defined by regulation (the major source threshold list can be found at the [Air Toxics Web Site](https://www3.epa.gov/airtoxics/pollsour.html)). The permitting is administered by state or district agencies. A limited number of smaller sources also require Title V permitting.

In addition to the requirement for operating permits, New Source Review (NSR) is a Clean Air Act program that requires industrial facilities to install modern pollution control equipment when they are built or when making a change that increases emissions significantly. The NSR permitting varies depending upon the attainment status of the district in which the facility is located. For major sources, Best Available Control Technology (BACT) would be required in attainment areas under the Prevention of Significant Deterioration program, Lowest Achievable Emission Rate (LAER) in non-attainment areas, there are no specified controls for minor sources or minor modifications to major sources. No documentation is available for facilities that do not trigger Title V permit or NSR requirements.

Information on four large facilities with major sources in two US states was available from their Title V permits as posted on their associated state environmental agency websites. The list demonstrates the range of potential control measures that have been installed to control either boiler emissions or particulate matter and are therefore not specific to odour control. It should be noted that all four have some form of pollution control equipment installed but none are identified as odour controls. It is not intended to suggest that control measures are required on any or all sources identified. The list is based on available data for facilities as although twenty-three animal feed manufacturers were identified as operating in the US, not all the Title V permits and/or specific State permits were found. It is not known if all facilities have appropriate permits, meet operational criteria or if the state from which they operate provide publicly available permitting documentation. It should also be noted that not all of these facilities produce only pet food. The may also produce livestock feed for cattle, sheep and pork. The data reviewed indicated that:

* One facility has a baghouse on the hammer mill operations, a baghouse to control particulate emissions from raw material receiving, material handling and conveying; and a cyclone on the pellet cooler system.
* One facility has a baghouse on ingredient receiving systems, a baghouse for the hammer mill and BMPPs for general operations. Extruding, drying and cooling are connected to a cooler system, while the product storage bins utilize aeration systems.
* One facility has a baghouse for the food milling, hammer mill and raw mix storage processes, and cyclones for the extruding processes.
* One facility is required to operate a baghouse on the hammer mill grinder and separation plenum space, cyclones on the extruding, drying cooling and material handling processes, a baghouse for filter receivers above ground ingredient distributors, implementation of best available technologies for particulate emissions from the receiving of bulk ingredients including but not limited to the use of drive-through tunnel receiving pits, use of aspiration system vented to a baghouse serving the transferring and conveying of raw bulk ingredients, and telescopic chutes.

The information on control measures provided in the publicly accessible Title V permits from state or district environmental agencies are for facilities identified as major sources. Small and medium sized facilities are unlikely to reach the release-based thresholds that would trigger requirement of a Title V permit. The odour control measures required, if any, depend upon production levels at the facility. Caution should be used when comparing controls from large facilities as the control measures identified may not be appropriate for smaller facilities.

### European Union

The Best Available Techniques (BAT) for European food, drink and milk manufacturers (FDM) are published in a Best Reference Document on Best Available Techniques (BREF). The FDM BREF provides discussion of dry pet food, moist pet food, and semi-moist pet food. The BAT conclusions are presented in two tiers. The first tier shows the sections listing BAT for all FDM installations and the second tier shows the sections where additional BAT is available for some of the individual sectors or activities (BREF, 2006).

The following are the General BAT for the whole FDM sector (BREF Section 5.1) that may help to minimize air emissions from processes and activities at pet food manufacturing facilities through the use of BMPPs, process optimization, or engineering controls. These BAT have been considered in the preparation of the BMPP for odour, and where applicable, have been considered as potentially feasible options for the control of odour. BAT 15, 17, and 20 are intentionally excluded as they do not pertain to the prevention of odour emissions.

1. ensure, e.g. by training, that employees are aware of the environmental aspects of the company’s operations and their personal responsibilities

2. design/select equipment, which optimizes consumption and emission levels and facilitates correct operation and maintenance, e.g. to optimize the pipework system for the capacity to minimize product losses and install pipes at a gradient to promote self-draining

4. operate regular maintenance programmes

5. apply and maintain a methodology for preventing and minimizing the consumption of water and energy and the production of waste incorporating:

5.1 obtaining management commitment, organisation and planning

5.2 analysis of production processes, including individual process steps to identify areas of high water and energy consumption and high waste emissions to identify opportunities to minimize these, taking into account the water quality requirements for each application, hygiene and food safety

5.3 assessment of objectives, targets and system borders

5.4 identification of options for minimizing water and energy consumption, and waste production, using a systematic approach, such as pinch technology

5.5 carrying out an evaluation and doing a feasibility study

5.6 implementing a program for minimizing the consumption of water and energy and waste production and

5.7 ongoing monitoring of water and energy consumption, waste production levels and the effectiveness of control measures

6. implement a system for monitoring and reviewing consumption and emission levels for both individual production processes and at site level, to enable actual performance levels to be optimized. Examples of parameters to monitor include: energy consumption; water consumption; waste water volumes; emissions to air and water; solid waste generation; product and by-product yield; consumption of harmful substances and frequency and severity of unplanned releases and spills

7. maintain an accurate inventory of inputs and outputs at all stages of the process from reception of raw materials to dispatch of products and end-of-pipe treatments

8. apply production planning to minimize associated waste production and cleaning frequencies

9. transport solid FDM raw materials, products, co-products, by-products and waste dry

10. minimize storage times for perishable materials

11. segregate outputs, to optimize use, re-use, recovery, recycling and disposal and minimize waste water contamination

12. prevent materials from falling on the floor

13. optimize the segregation of water streams, to optimize re-use and treatment

14. collect water streams, such as condensate and cooling water separately to optimize re-use

16. apply good housekeeping

18. apply storage and handling methods, noting that controls may be required to provide and maintain the required hygiene and food safety standards

19. optimize the application and use of process controls to prevent and minimize the consumption of water and energy and to minimize the generation of waste and in particular:

19.1 where heat processes are applied and/or materials are stored or transferred at critical temperatures, or within critical temperature ranges, to control the temperature by dedicated measurement and correction,

19.2 where materials are pumped or flow, to control flow and/or level, by dedicated measurement of pressure and/or dedicated measurement of flow and/or dedicated measurement of level and using control devices, such as valves,

19.3 where liquids are stored or reacted in tanks or vessels, either during manufacturing or cleaning processes, use level-detecting sensors and level-measurement sensors, and

19.4 to use analytical measurement and control techniques to reduce waste of material and water and reduce waste water generation in processing and cleaning and in particular to:

19.4.1 measure pH to control additions of acid or alkali and to monitor waste water streams to control mixing and neutralising prior to further treatment or discharge,

19.4.2 measure conductivity to monitor levels of dissolved salts prior to water re-use and detect levels of detergent prior to detergent re-use, and

19.4.3 where fluids may be cloudy or opaque due to the presence of suspended matter, measure turbidity to monitor process water quality and to optimize both the recovery of material/product from water and the re-use of cleaning water.

21. select raw materials and auxiliary materials which minimize the generation of solid waste and harmful emissions to air and water

Further, a number of environmental management techniques are identified as BAT, including the implementation of an Environmental Management System (EMS) and the prevention of accidental releases. Application of an air emissions control strategy that combines process optimizations and BMPs and the use of abatement techniques is also BAT for the FDM Sector.

The following additional BAT specific to fish and shellfish are applicable to the Sample Pet Food Co. for the control of odours:

* For preservation in cans, apply automated filling system with closed-circuit recycling of spilled liquids; and,
* Minimize storage times for fish and shellfish.

The FDM BREF also provides additional BAT for the meat sector, fish and shellfish sector, and for specific unit operations at pet food manufacturing facilities such as frying and preservation in cans. The FDM BREF document should be reviewed to identify if any of the techniques may potentially be feasible at a facility.

### Australia and New Zealand

Environment Australia publishes guidance materials for the purpose of supporting emission estimation for the federal reporting program. The document states that air emission control technologies, such as dispersion, scrubbing, incineration, adsorption on to a solid and biofiltration are commonly considered for point sources from process industries in general as there was no specific guidance on pet food manufacturing operations. The common air emissions associated with dry pet food manufacturing processes are particulate matter, ethanol, NOx, CO and SO2. Point source emission control for these substances are dry and wet scrubber systems.

The individual Australian territories have also published technical handbooks to guide the management of odours; however, there are no specifics on control measures or abatement techniques that are identified for pet food manufacturing. The installation of control equipment, increasing of stack heights, or other measures to reduce odour effects is determined on a case-by-case basis that depends on whether a source is new, modified, or existing, and the proximity of nearby residents (odour receptors).

There were fourteen pet food manufacturing facilities identified on an Australian Industry Association that range from custom orders to large scale production facilities for livestock feed as well as domesticated pet foods. There is no publicly available facility-specific information on emission or odour controls for the identified pet food manufacturing operations.

### Additional Control Measures Suitable for Pet Food Manufacturing Activity

In addition to the most common approaches to controlling odour emissions from pet food manufacturing unit operations, the following alternative control measures that may be effective but are not as widely used have been identified in Table 2.

**Table 2 – Potential Alternative Odour Control Measures for Sample Pet Food Co.**

| **Control Measure** | **Applicability and Limitations** |
| --- | --- |
| Thermal Treatment | Process exhaust streams are directed to the site boiler combustion chamber or thermal oxidizer for incineration. |
| Biofilter: Trickling | An organic-rich liquid stream with high odour intensity is directed to a trickling filter for biological treatment by the microorganisms.  |
| Condensation | Condensation of vapour phase VOCs and collection of liquid phase stream. |
| Non-Thermal Plasma | Non-thermal plasma is an end-of-pipe control that creates a reactive treatment zone where odorous VOCs are broken down.  |
| Ozonation | Concentrated ozone is injected to oxidize odorous compounds.  |
| Process Optimization:Enhance automation  | Reduce leaks, spills, manual transfers and other potential sources of odour.  |
| Engineering Controls:Enclose areas, systems, or processes  | Capture multiple exhausts and direct to one central exhaust to optimize stack or implement one effective treatment system. |

## Control Measures for Primary Sources at Sample Pet Food Co.

The primary sources of odour for most pet food manufacturing facilities are the cooking sources. At the Sample Pet Food Co. cooking involves the following unit operations associated with the dry and wet pet food production lines: extrusion, drying, coating, cooling, steam kettle and retort.

These sources are typically controlled with specific control equipment or technologies combined with process optimization to minimize odorous emissions.

Table 3 provides the methodology, equipment and techniques implemented at other facilities to control the odours from these primary sources.

The control measures considered include the following:

* Installation of control equipment;
* Process optimization;
* Stack or discharge optimization;
* Engineering controls (odour capture, combined exhausts, recirculation, as examples);
* Pollution prevention; and,
* BMPs.

Where appropriate, measures from other industrial sectors are considered if the technology or measure may be transferrable to this sector.

Even though odour control measures are designed for specific applications, not all implementations are successful.  This section of the OCR is provided as guidance on general industry practices for the sector. It is possible that some measures may not be effective at odour control due to site-specific process or exhaust conditions. The selection of odour control measures requires engineering, and possibly pilot testing, to ensure odour reduction is achieved.

The measures presented in Tables 3 and 4 are examples that reflected the information available at the time the sample OCR was prepared. It is the responsibility of the facility to ensure that the odour control measures presented in the OCR are reviewed and updated as needed to reflect current information on control measures and best practices.

Further information on the control equipment is provided as an Appendix to this example OCR.

The measures presented have been demonstrated as reasonable and effective to prevent or minimize the discharge of odour, and will be carried forward to assess technical feasibility at the Sample Pet Food Co.

**Table 3 – Potential Odour Control Measures for Sample Pet Food Co. Primary Sources**

| **Odour Source** | **Control Measure** | **Applicability** |
| --- | --- | --- |
| Cooking Exhausts  | Stack optimization  | Effective stack design will improve dispersion to reduce off-site effects. Vertical, unimpeded discharge at optimal stack height and velocity. |
| Cooking Exhausts  | Non-Thermal Plasma  | Activated plasmas gas is injected into waste gas stream to oxidize VOCs. |
| Cooking Exhausts  | Biofilter | Process exhausts are directed to a conditioning system and biofilter where microorganisms biologically degrade the organic compounds. A trickling biofilter may be suitable.  |
| Cooking Exhausts  | Thermal Treatment: Oxidizer | Thermal oxidation is highly effective at removing odorous VOCs.  |
| Cooking Exhausts  | Thermal Treatment:Boiler Incineration | Process exhaust streams are directed to the site boiler combustion chamber for incineration. |
| Cooking Exhausts  | Oxidation Scrubbers | Chemical scrubbers that oxidize odours using hydrogen peroxide, bleach or caustic soda may be suitable for gaseous air pollutants, especially organic pollutants and odours.  |
| Cooking Exhausts  | Carbon Filter | Activated carbon effective on low VOC concentration streams.  |
| Cooking Exhausts  | Condensation | Capturing and condensing steam can reduce emissions of water soluble compounds or VOCs condensable at lower temperatures that are odorous.  |
| Cooking Exhausts  | Ozonation | Concentrated ozone is injected into waste gas stream to oxidize VOCs. |
| Cooking Exhausts  | Engineering Controls:Process Automation  | Use process monitoring, transfer flow monitoring in conjunction with automated shut-off to avoid overfills or spills. Reduced ingredient wastage and less potential for human error results in potential of reduced fugitive odour emission sources. |
| Cooking Exhausts  | Process Optimization:Scheduling | Scheduling of process stages or activities/production runs to avoid simultaneous odour releases from multiple sources.  |
| Cooking Exhausts  | Best Management Practices | Develop SOPs and train employees on BMPs for process and control equipment maintenance and operation, good housekeeping, spill prevention and response, reducing chemical and cleaner usage, and managing wastes beyond what is described in the current BMPP for odour.  |

## Control Measures for Secondary Sources as Sample Pet Food Co.

The Secondary Sources identified at the Sample Pet Food Co. facility includes raw material handling, dry material grinding and mixing, and packaging. The odour source, or grouped odour sources, and the associated control measures, as well as potential alternative control measures, are provided in Table 4. It should be noted that the options presented in Table 4 are also considered as EU BAT for odour control measures for general food and drug manufacturing.

**Table 4 – Potential Odour Control Measures for Sample Pet Food Co. Secondary Sources**

| **Odour Source** | **Control Measure** | **Applicability** |
| --- | --- | --- |
| Raw Material Unloading and Storage | Engineering Controls:Emission Capture or Containment | Improved emission capture from specific process units and operations to reduce the fugitive emissions and increase capture for directing to appropriate odour control measures, such as constructing an enclosure or establishing negative pressure in receiving areas. This creates a more concentrated exhaust stream and eliminates the need to treat large volumes of general ventilation air. Combining multiple exhausts to one common stack is possible to allow for stack optimization or to implement one odour treatment system. |
| Raw Material Unloading and Storage | Engineering Controls:Material Handling Management Practices | Maintain cooler temperatures in the storage area and limit the storage time of non-frozen raw materials.  |
| All Secondary Sources | Stack Optimization:  | Connect individual exhausts to the combined cooking exhaust source. Effective stack design will improve dispersion to reduce off-site effects with vertical, unimpeded discharge at optimal stack height and velocity. |
| All Secondary Sources | Thermal Treatment: Oxidizer | Thermal oxidation is highly effective at removing odorous VOCs.  |
| All Secondary Sources | Thermal Treatment:Boiler Incineration | Odorous exhaust flow is directed to the site boiler combustion chamber for incineration. |
| All Secondary Sources | Biofilter | Process exhausts are directed to a conditioning system and biofilter where microorganisms biologically degrade the organic compounds. A trickling biofilter may be suitable. |
| All Secondary Sources | Non-Thermal Plasma  | Activated plasmas gas is injected into waste gas stream to oxidize VOCs. |
| All Secondary Sources | Ozonation | Concentrated ozone injected into odorous gas stream to oxidize contaminants. |
| All Secondary Sources | Oxidation Scrubber  | Chemical scrubbers that oxidize odours using hydrogen peroxide, bleach or caustic soda may be suitable for gaseous air pollutants, especially organic pollutants and odours.  |
| All Secondary Sources | Carbon Filter | Activated carbon effective on low VOC concentration streams.  |
| All Secondary Sources | Engineering Controls:Process Automation  | Use process monitoring, transfer flow monitoring in conjunction with automated shut-off to avoid overfills or spills. Reduced ingredient wastage and less potential for human error results in potential of reduced fugitive odour emission sources.It is a BREF BAT to implement process automation for can filling with closed-circuit recycling of spilled liquids. |
| All Secondary Sources | Process Optimization:Scheduling | Scheduling of process stages or activities/production runs to avoid simultaneous odour releases from multiple sources.  |
| All Secondary Sources | Best Management Practices | Develop SOPs and train employees on BMPs for process and control equipment maintenance and operation, good housekeeping, spill prevention and response, reducing chemical and cleaner usage, and managing wastes beyond what is described in the current BMPP for odour.It is a BREF BAT to implement process automation for can filling with closed-circuit recycling of spilled liquids.  |

# Feasibility Assessment

The control measures identified in Section 4 have been shown to be effective in preventing or reducing odour effects at pet food manufacturing facilities with similar sources and/or other similar operations/processes. There are, however, site-specific limitations that would affect the ability of a facility to implement particular measures or procedures.

The results of the facility technical evaluation for the feasibility of implementation of the potential measures and procedures are summarized below in the form of a table (Table 5). Those justified as not technically feasible are not considered further in the OCR. Those measures deemed technically feasible are discussed in Section 6 (Discussion of Feasible Measures and Procedures). It should be noted that most of the technically feasible control measures described in Table 5 may be used in combination to achieve greater odour reduction. An example of this is the use of both control equipment and stack optimization. In general, any BMPP, process optimization, engineering control or stack optimization can be used in combination. In some cases, combinations of control equipment may also be feasible (e.g. using a carbon filter as a polishing step in combination with another type of control equipment). However, multiple end-of-pipe control equipment is uncommon for these types of sources.

It is a requirement of the Air Emissions EASR Regulation to provide an analysis of the odour control measures and procedures, and potential combinations of them, to determine which would be technically feasible to implement at the facility in order to prevent or minimize the discharge of odour. Table 5 summarizes the individual control measures and the findings of the feasibility assessment for the Sample Pet Food Co. The feasibility assessment must consider potential combinations of the control measures identified.

The technical feasibility of a control measure is a factor of the effectiveness of the mitigation, safety considerations, physical implementation as well as consideration of the impact of the other processes at the facility that could be detrimentally impacted. Although a control measure could be implemented on one specific odour source, the treatment could generate a new waste stream that contains a difficult substance to handle or cause a synergistic effect that results in a new odour source associated with a solid or liquid carrier.

The Sample Pet Food Co. has previously implemented a significant number of control measures at its operations. Combinations of stack optimization, BMPPs, process optimizations and engineering controls are utilized throughout the operations.

The ability to isolate an odour source and direct the exhaust gases to an optimized stack, process optimization, and/or the implementation of BMPs for odour are the preferred approaches for odour control for the Sample Pet Food Co. Where possible, maintaining a negative pressure in a specific process area will allow for isolation of an odour source that can be discharged from an optimized stack or, if need be, controlled; this will help to prevent or minimize poorly dispersing fugitive odour releases.

It may be possible and beneficial to combine exhaust streams to one common exhaust; however, this must be evaluated as there are potential synergistic effects (e.g back pressure on some ventilation areas, increased flows causing increased pressure drop through the system that cannot be handled by the fan and stack design). If there is no net negative impact to the operations resulting from the combining of individual sources to one common stack, this may allow for the design of one unimpeded vertical discharge at an optimized height and exhaust velocity to enhance odour dispersion, or the future installation of odour control equipment on one combined exhaust stream.

Non-thermal plasma and ozonation are both energy intensive, and considered to be emerging technology and there is limited documentation on demonstrated control efficiency or applicability on VOC and odour destruction. There are limitations to both of these technologies as the control medium must come into direct contact with the odorous substance or contaminant to complete the reaction. If there is moisture or particulate matter in the air flow to be treated, the odorous compounds may not have the contact residence time or sufficient exposure to the ozone to completely react. The majority of sources have high moisture content so additional pre-treatment systems would be necessary.

The use of caustic solutions in an oxidizing scrubber would generate a new liquid waste stream that must be treated as an additional wastewater; however, the oxidizing agents make this wastewater incompatible with the current system. Oxidation scrubbers using caustic require the balance of oxidation chemicals and can result in the emission of odours if not maintained properly. In addition, the current facility equipment and operations do not allow for sufficient physical space to install a scrubber with all supporting equipment such as a pump system, make-up solution tank, piping, and process control system close enough to the odour source to provide efficient and effective control. Siting a scrubber on the roof would not be feasible due to the risk associated with potential spills as the roof could not accommodate the required spill containment.

An adsorption system using activated carbon was deemed to be not technically feasible. Carbon filtration would require substantial pre-treatment of the high humidity exhausts to reduce both temperature and moisture content prior to introducing the exhaust gas into the carbon scrubber. Several of the processes have high VOC concentration that would require sizing of a very large carbon scrubber. There is insufficient space at the facility for an indoor or outdoor installation with all the required pre-treatment equipment. A smaller carbon unit would require frequent carbon replacement that involve complete shut-down of the process, and there would be a risk of odours released due to breakthrough occurring where the carbon filter is saturated and untreated exhaust is discharged to atmosphere.

**Technical Feasibility Assessment**

The feasibility assessment requires an analysis of the measures and procedures identified, as well as potential combinations thereof. This assessment should be undertaken in conjunction with facility management to determine which would be technically feasible to implement. This discussion would take process or site-specific constraints into account. Technical feasibility can consider commercial viability of the control for the specific source, experience and use in the industry or for similar sources, other environmental considerations (wastewater impacts), availability of materials (e.g. if natural gas is not available, RTOs are not technically feasible), and site-specific considerations (e.g. space).

**Economic Feasibility**

The intention of the OCR is to establish technical feasibility of odour control measures and procedures. The discussion of economic feasibility is important; however, a complete economic assessment is not required as part of the OCR.

The MOECC provides guidance on undertaking an economic feasibility study in the “Guide to Requesting A Site-Specific Standard, Version 2.0”. The US EPA also provides site-specific guidance for consideration of economic hardship and cost-effectiveness of pollution abatement in the Economic Impact Analysis and Industry Profiles by Sector Resource Documents published by the US EPA Office of Air Quality Planning and Standards (2016). These references can be used as a basis for developing an economic feasibility assessment, if needed.

**Table 5 – Summary of Feasibility Assessment for Sample Pet Food Co.**

| **Odour Source** | **Description of Control Measure** | **Technically Feasible?** | **Notes** |
| --- | --- | --- | --- |
| Cooking Exhausts All Secondary Sources | Stack optimization  | Technically Feasible - previously implemented | Several exhaust stacks have been modified to optimize air dispersion. All stacks now have vertical discharges, a number of stacks have been combined to one common discharge, some stack heights were extended, and a velocity cone was added to increase gas exit velocity. |
| Cooking Exhausts All Secondary Sources | Non-Thermal Plasma  | Technically Not Feasible  | Non-thermal plasma is an emerging technology and there is limited documentation on demonstrated control efficiency or applicability on VOC and odour destruction. It is also not suitable for exhaust gases with high moisture content. |
| Cooking Exhausts All Secondary Sources | Biofilter | Technically Feasible | There is sufficient space at the facility to install a biofilter. A trickling filter is also a technically feasible option for some sources. This option will be evaluated should additional measures be needed. |
| Cooking Exhausts All Secondary Sources | Thermal Treatment: Oxidizer | Technically Feasible | Thermal treatment will be evaluated should additional measures be needed to control fugitive odours from the dryers. |
| Cooking Exhausts All Secondary Sources | Thermal Treatment:Boiler Incineration | Technically Feasible | This option will be evaluated should additional measures be needed to control fugitive odours from the dryers. |
| Cooking Exhausts All Secondary Sources | Chemical Scrubber  | Technically Not Feasible | Due to the footprint of the existing equipment there is no space available to install a packed column scrubber and supporting pump, make-up solution tank and process control system close enough to the odour sources to be effective. |
| Cooking Exhausts All Secondary Sources | Carbon Adsorption / Filter | Technically Not Feasible | Activated carbon is effective on low VOC concentration streams. Moisture from wet pet food process stages and high humidity sources may be problematic and could require pre-treatment. Elevated exhaust temperatures will also reduce efficiency of odour removal on carbon.  |
| Cooking Exhausts All Secondary Sources | Condensation | Technically Feasible | This option will be evaluated for use on the steam kettle should additional measures be needed to control odours from the wet pet food process. |
| Cooking Exhausts All Secondary Sources | Ozonation | Technically Not Feasible | Ozonation is an emerging technology and there is limited documentation on demonstrated control efficiency or applicability on VOC and odour destruction. |
| Cooking Exhausts All Secondary Sources | Engineering Controls:Process Automation  | Technically Feasible - previously implemented | Multiple process optimizations have been implemented at the site. As different options are identified they will be evaluated for odour control opportunities and implemented accordingly.Other options that will be considered include: use of tank volume monitoring, transfer flow monitoring in conjunction with automated shut-off to avoid overfills or spills. Reduced ingredient/product wastage and less potential for human error results in potential of reduced fugitive odour emission sources. |
| Cooking Exhausts All Secondary Sources | Process Optimization:Scheduling | Technically Feasible - previously implemented | The BMPP for odour and the site operations plan detail the strategic scheduling of activities to avoid simultaneous releases from multiple odour sources, where possible.  |
| Cooking Exhausts All Secondary Sources | Best Management Practices | Technically Feasible - previously implemented | Sample Pet Food Co. has prepared a BMPP for odour that details SOPs, training, EMS and practices designed to reduce or eliminate odour emissions.Of specific note, procedures are in place to ensure off-spec materials are segregated, handled, stored and disposed of in a manner that limits the potential for fermentation and spoilage. |
| Cooking Exhausts Raw Material Unloading and Storage | BREF - BAT | Technically Feasible - previously implemented | Raw material handling and storage practices are detailed in the BMPP for odour.  |
| Raw Material Unloading and Storage | Engineering Controls:Emission Capture | Technically Feasible | Improvements to enclose bulk receiving area or activities, and/or improve capture efficiency to prevent fugitive emissions will be considered should additional measures be needed to control odours. |

Many of the technically feasible control measures described in Table 5 may be used in combination to achieve greater odour reduction. An example of this is the use of both control equipment and stack optimization. In some cases, combinations of control equipment may also be feasible.

# Discussion of Feasible Measures and Procedures

This section of the OCR provides the rationale for why the technically feasible measures identified are required or not necessary at this time, to adequately prevent or minimize the discharge of odour from the facility.

The Sample Pet Food Co. Best Management Practices Plan (BMPP) for Odours was prepared in 2010, and most recently updated in 2017 to be compliant with the Air Emissions EASR. The odour BMPP was signed, dated and sealed by Ms. J. Engineer on Feb 2, 2017 (PEO License 1234-9999). The BMPP documents all feasible measures that have been implemented to prevent or minimize odours from process stages, activities, or material storage. In addition to BMPs, control measures that are in place to mitigate odours are detailed in the BMPP.

In 2010, a site-wide odour assessment was prepared as part of an ECA application process. This assessment identified, quantified, and ranked all odorous sources for the potential to cause an off-site odour effect. It was determined that with the control measures and BMPs there were no appreciable odour effects off-site based upon the existing operations, control measures, and the effective implementation of the BMPP.

The Sample Pet Food Co. implemented a Good Neighbour Policy in 2005, which includes measures to prevent off-site odour effects. There have been no odour complaints in the past 5 years that were directly related to the operation of the facility under normal operational conditions and site parameters. Any excursions in normal operations (e.g. spills, emergency situations) or specific operational issues that were successfully addressed with an odour strategy (i.e. BMPP updates) and/or control technology within the last 5 years were not considered.

In the absence of odour complaints, and based upon quarterly odour surveys conducted in the residential areas and at other odour receptors (adjacent sports fields), additional measures to control odours are not warranted at this time since the following key measures are already in place and are considered to be effective:

* For the Dryer, identified as a primary source, a baghouse controls particulate matter emissions which also serves to reduce odours associated with the dryer exhaust;
* The Sample Pet Food Co. has installed cyclones on its pellet cooler exhausts for dust control. Due to the nature of the material captured, cyclones on pellet cooler systems is a consistent odour control measure in use at several facilities in Ontario with current MOECC ECAs, as identified in Section 4.1 (Current Practices at Pet Food Facilities);
* The Sample Pet Food Co. has optimized several discharge stacks to improve air dispersion. All stacks now have vertical discharges, some stack heights were extended, and a velocity cone was added to increase exit velocity; and,
* For the Secondary Sources, the prevention of fugitive emissions and the implementation of a BMPP are effective in preventing off-site odour effects. The low flowrates, low to moderate odour concentration, and in some cases the intermittent nature of the releases do not warrant additional control measures.

The intention of odour management and control is to prevent or minimize odour effects at odour receptors off-site. The absence of off-site odour effects, supported by five years without an odour complaint, demonstrates that the current odour control measures and BMPs are effective.

**Historical Odour Management**

A facility’s success with BMPP, good community relations, and no complaint history, or a history where the facility responds quickly and mitigates the situation with respect to odours, can be considered a reasonable rationale for not implementing additional odour control measures.

It is recommended that the facility contact the MOECC District Office to confirm that no odour complaints have been registered, and incorporate any feedback provided into this section of the OCR.

However when a facility is facing on-going challenges with its surrounding community, there are upset conditions that result in complaints and the BMPP is not meeting expectations, the facility needs to consider implementing other options. An initial review should be done of the site operations to identify the major odour source(s) and evaluate the current BMPs and/or control actions being taken. Consideration of alternative BMP-BAT-BREF actions as well as re-evaluating current activities can assist in identifying the root cause of the odour issue. If the revised BMP does not mitigate the odour situation, further consideration of control optimization, technologies and equipment should be completed.

## Control Measures or Procedures to be Evaluated for Implementation

At this time, there are no additional controls or procedures that are scheduled to be implemented. However, the facility has committed to assessing the feasibility of the technically feasible control measures should odour complaints be received in the future that are the result of the pet food manufacturing.

Should the facility determine that an odour source is developing into a potential off-site issue, the BREF-BAT (BMPs) would be reviewed to determine whether additional BMPs may be incorporated into the facility’s SOP policy with appropriate employee training, monitoring, maintenance and reporting. Control technologies to manage the odour source issues would also be evaluated should compliance issues be encountered and BATs, BMPs, optimization, controls and SOP are not successful.

The next phase of evaluations would include the BMPs, Process Optimization, Engineering Controls, and then control technologies to manage the odour source issues.

This section presents the control measures that were found to be technically feasible and could be further considered by the Sample Pet Food Co. should additional odour control measures be needed in the future. Table 6 also presents those measures that are under consideration to be implemented, even though there have been no odour complaints.

Table 6 provides control measures that will be evaluated for implementation at the Sample Pet Food Co. should odour emissions become an issue for the operations and facility.

**Table 6 - Control Measures or Procedures to be Evaluated for Implementation**

| **Odour Source** | **Control Measure** | **Applicability** |
| --- | --- | --- |
| Dryer | Thermal Treatment: Boiler Incineration | Returning dryer exhaust gases for incineration in the boiler combustion chamber may be possible, but would require retrofitting of the boiler. The dryer exhaust is currently controlled by a baghouse dust collector.  |
| Steam Kettle | Condensation | Condensing steam to control odours associated with wet pet food.  |
| Raw Materials Unloading | Emission Capture | Improved enclose of bulk receiving area to prevent fugitive odours.  |
| Multiple Primary and Secondary Odour Sources | Biofilter | There is sufficient space at the facility to install a biofilter. A trickling filter is also a technically feasible option for some sources. This option will be evaluated should additional measures be needed. |

# Appendix A – supplemental guidance for developing a facility specific OCR

## A.1 Identification of Odour Sources and Source Groupings

Once a complete inventory of air emissions sources has been prepared, it is necessary to identify which of these sources should be classified as primary odour sources, secondary or minor sources, and negligible odour sources based upon their relative contribution to potential odour effects. This can be done in a number of ways, and often involves some level of judgment based upon process knowledge and experience.

It must be emphasized that the identification of odorous air emissions sources is very specific to each facility. What may be a potentially odorous source at one facility may not have any potential for odour at another. As an example within the pet food industry, the operation of a steam kettle with pressure relief valve is an odour source if it is used for food cooking, but may not be odorous if it is used for boiling other liquids in other industries.

For each odour source, a general description of the associated process, unit operation, equipment or activity, expected contaminants in the exhaust gas, typical odour loadings, factors which may affect the odour loading, and potential constraints should be identified, where available. These details are necessary in order to properly assess any potential control or BMP for its technical feasibility. An odour source summary table is an effective way to summarize the odorous emission sources for further assessment, and will be useful should odour dispersion modelling be required.

Published emission factors are useful in quantifying odour loadings from common sources; however, when evaluating site potential emissions or impacts, these factors should be used by someone with technical experience. In many cases the only available emission factors are for VOCs as little data on odour loadings is publically available. The odour and VOC emissions may not be directly proportional; however, these values will also assist in site-specific determination of the VOC concentration and emission rate for individual sources to allow for comparisons, ranking of sources, and discussion of the suitability of control measures.

Site-specific details of why the facility is unique or different from conventional facilities should be provided in order to help in identifying sources and determining their relative contribution to facility odour classifying sources.

The location and characteristics of the discharge point must also be considered when determining which sources are major sources of odour at the facility, which are minor, and which are negligible.

The odour source inventory is another tool to consider sources that may become odorous under upset or unexpected conditions; however, these situations are more commonly addressed by BMPs. For example, the discharge from a scrubber may not be odorous when the scrubber is operating effectively; however, scrubber malfunction, insufficient liquid flow rate or insufficient makeup rate may result in odorous discharges.

It may be effective to group sources for the purposes of the OCR if they are associated with the same process stage, same production area, and have similar odour and exhaust characteristics.

Wastewater collection, handling, treatment, and discharge, may potentially be a significant source of odour. An example OCR has been prepared that is specific to industrial wastewater, and if applicable, this OCR should be reviewed.

## A.2 Quantifying Odour Loadings and Odour Source Ranking

There are a number of reference documents that may provide expected odour emissions, emission factors for odour or VOCs, or other data that may reasonably be used to describe sources at the facility. The US EPA AP-42 Emission Factor Compendium, the Australian National Pollutant Inventory Emission Estimation Technique (EET) Manuals for Meat Processing, the EET for Seafood Processing, and the Canadian National Pollutant Release Inventory Toolbox, are examples of sources of VOC emission factors. In addition, source testing for odours may be considered in the absence of high quality emission data. Appendix C provides links to these resources.

## A.3 Identifying Primary or Secondary Odour Sources

In order to classify the sources as primary or secondary, it would be helpful to rank the sources in terms of their potential to cause off-site odour impacts and prioritize accordingly. The ranking could be done on the basis of potential odour emissions (strength of odour), offensiveness of odour, frequency of occurrence and source configuration. The source ranking may be supported by screening level dispersion modelling for each significant source to determine the amount of dilution (i.e. dispersion) for each source. For example a tall stack source would provide much greater odour dilution at off-site locations than a horizontal exhaust at the property boundary.

## A.4 Sources Not Considered Odorous

There are a number of sources at facilities that are not identified as odour sources for the purposes of the OCR. These sources either:

* Do not emit odorous contaminants, such as heating and cooling equipment and process boilers; or,
* Discharge of odours that are not of the same characteristic that is generally attributed to the sector and have no appreciable off-site impacts.

Examples of such sources may include trash compaction, cafeteria exhausts, parts washers, product label gluing, laser / ink printing, or ammonia leaks from refrigeration equipment.

## A.5 Indoor Fugitive Emissions

BMPs are generally more appropriate for the prevention or mitigation of odours from general building exhausts and indoor fugitive sources. At specific facilities, BMPs may prove inadequate for some sources, and the installation of capture hoods or fume collection may be necessary. Once the odours are captured, they may then be directed to control equipment, or other measures may be implemented to reduce the potential off-site odour effects.

## A.6 Excess Emissions Due to an Upset or Abnormal Condition

An upset or abnormal condition may arise due to sudden and reasonably unforeseeable events beyond the control of the facility. These situations require immediate corrective action to restore normal operation. The identification of all possible odour sources during upset or emergency conditions is beyond the scope of the OCR. It is expected that the facility will include the preventive maintenance, accident prevention, spill containment, and effective response to upset conditions in the BMPP.

## A.7 Control Measures and Procedures

### Pollution Control Equipment

Often referred to as end-of-pipe or add-on controls, exhaust gases are directed to pollution control equipment to capture or destroy the odorous contaminants. Equipment that captures the contaminants often results in the generation of a new waste stream that could be either solid, liquid, or gas that may still be odorous. An example of a gaseous waste stream is air discharged during the regeneration cycle of an activated carbon bed or tower. These activities may also reduce odours or change the character of the odours making them less intense or offensive.

Destruction of VOCs in the waste stream may be achieved by thermal oxidation, catalytic oxidation, chemical oxidation, or other chemical reaction. This type of pollution control unit may result in the permanent removal of airborne contaminants that are odorous.

### Engineering Controls or Process Changes for Pollution Prevention

Although there may be some redundancy between these measures and those outlined as BMPs in the facility BMPP, the measures detailed here are differentiated from BMPs as they require actual modifications or engineering changes. In contrast, BMPs are by definition, practices or procedures would not require additional engineering or significant process modifications, or the installation of additional control equipment.

The following are examples of measures that have been shown effective in odour mitigation:

* Optimized stack design to improve dispersion;
* Process or building fugitive odour capture to prevent fugitive odours from roof exhausts or building doors, windows, louvers, or vents;
* Process optimization and control, including adjustments to pressure and temperature on pressure vessels, monitoring aeration of waste stream or improving aeration/agitation, or others; and,
* Reducing cooling water temperature of condensers to improve odour control efficiency.

### Masking Agents or Odour Modification

Although the applicability to the pet food manufacturing sector may be limited, there are chemical additives, masking agents, deodorants, and odour neutralizers that may be employed to either theoretically reduce the odour loading or alter the nature of the odour to change its character or hedonic tone.

Masking agents, also called deodorizers, contain perfumes to superimpose a pleasant odour upon an unpleasant one. Although this approach can be considered an alternative for managing odour complaints, it should be considered on a site-specific case and potentially bench tested as it has been found in some cases that the deodorant or making agent may itself become an odour nuisance or the impact on odour receptors has not changed.

Neutralizers differ from masking agents as they are able to react with the odour molecules and are generally dispersed as a fine aerosol into the odorous gas.

### Best Management Practices

BMPs are practices or procedures that in this context are intended to prevent or minimize odorous effects. These may be general in nature and applicable to a wide range of facilities, or they may be facility-specific and intended to help reduce odorous releases from process operations or activities at an individual site.

The Facility is required to prepare a BMPP which will outline operational practices and other measures that will be carried out in order to reduce odour emissions or odour effects.

The intention of the OCR is to identify process controls, engineering controls, or add-on control measures. Specific BMPs for the odorous sources identified should be presented if they are currently implemented at similar facilities or recommended in applicable Codes of Practice.

# Appendix B – Control Equipment Descriptions

Appendix B provides general information about the control measures identified in this example OCR. Details such as a technology description, applicability, limitations, etc., are given. Facilities may also consider contacting equipment suppliers for further information to determine whether a particular control measure may be technically feasible at their site.

This information is provided in order to illustrate what may be considered when assessing the feasibility of a control measure. This level of detail is not a requirement of the OCR and is provided as reference material only.

## B.1 Oil Mist Eliminator

### B1.1 Technologies

* Demister / Screen Separator

### B1.2 Emission Characteristics

* Exhaust gas with oil mists or liquid droplets.

### B1.3 Air Emission Sources

Common Applications:

* Oil Fryers
* Brine Desalination
* Petroleum Refining
* Cooling towers

### B1.4 Description

A demister or mist eliminator is a device that enhances the removal of liquid droplets in a vapor stream. Demisters may be mesh type, vane demisters, swirl mist eliminators, Brownian diffusers, or other structure. Due to the influence of the demister, the mists aggregate into droplets that are heavy enough to separate from the vapor stream.

### B1.5 Applicability and Performance

Direct impact demisters have high removal efficiencies of up to 100% over 5 micron. Demisters are simple structures with low capital and maintenance costs.

### B1.6 Limitations

Routine maintenance required to prevent demister pad clogging or flooding, increasing the pressure drop.

### B1.7 References

Boegger Industrial. 2017. Demister Pad - Maintenance, Classification and Specification.

IEAGHG / Global CCS Institute. 2012. Gaseous Emissions from Amine Based Post Combustion CO2 Capture Processes and Their Deep Removal Section 3.4 Demisters to remove fine droplets of liquid.

## B.2 Thermal Treatment

### B2.1 Technologies

* Flaring
* Thermal Incineration in Boiler or other combustion unit
* Regenerative Thermal Oxidizer (RTO)
* Recuperative Thermal Oxidizer
* Catalytic Oxidation

### B2.2 Emission Characteristics

* Gaseous Pollutants (Odour, VOCs)

### B2.3 Air Emission Sources

Common Applications:

* Petroleum and Coal Products
* Lumber
* Printing
* Food Processing
* Surface Coating
* Paint Manufacturing

### B2.4 Description

Thermal treatment uses high temperatures to oxidize VOCs, as well as some particulate matter. The conventional type of thermal oxidizers have a direct flame in contact with the airflow. RTOs use ceramic packed beds to preheat and partially oxidize VOCs prior to incineration to increase efficiency, and catalytic oxidizers use a catalyst material rather than ceramic in the packed beds. Recuperative units incorporate a heat exchanger to recover heat for the purpose of preheating the incoming air.

### B2.5 Applicability and Performance

A properly designed and operated thermal oxidizer or flare can achieve a destruction efficiency of 95-100%, with most achieving more than 99% VOC control. Thermal oxidation is generally used for the treatment of low gas flowrates, with notable cost increases associated with heating greater volumetric flowrates. It may be suitable for malodorous streams with variable contaminant concentrations and some variability in flowrate. Some form of heat recovery is nearly always warranted to reduce operating costs and fuel consumption. Flaring may be appropriate if gas flowrate fluctuates significantly. A concentrator may be used prior to an RTO or other oxidizer for large air flows of low VOC concentration to minimize supplemental fuel requirements.

It may be possible to direct malodorous gases to an existing on-site boiler for thermal treatment, particularly if the volume of waste gas is notably less than the combustion air requirements.

### B2.6 Limitations

Supplemental fuel may be needed if the heating value of the gas is insufficient to sustain the incinerator temperature, and may be significant if the exhaust gas stream is variable or VOC concentrations are low. Water vapour present in the airstream may quench the flame, resulting in poor combustion. For safety reasons, organics present in the waste gas must be well below the respective lower explosive limit (LEL); if the organic concentration is above the relevant explosive limits, a flameless type of system may be appropriate. Pre‑treatment for particulate material removal may be required. By-products, including NOx, SO2, GHGs, acid gases and other pollutants may be generated depending upon the composition of the waste gas to be treated. When halogenated VOCs are present, the potential for dioxins formation exists.

### B2.7 References

European Commission. 2006. Integrated Pollution Prevention and Control Reference Document on Best Available Techniques in the Food, Drink and Milk Industries (EU BREF) Section 4.4.3.11 Thermal Treatment of Waste Gases

US EPA. Air Pollution Control Technology Fact Sheets: Flares EPA-452/F-03-019, Thermal Incinerators EPA-452/F-03-022, and Catalytic Incinerators EPA-452/F-03-018.

## B.3 Rotoclones

### B3.1 Technologies

* Mechanically Aided Separator / Dynamic Separation

### B3.2 Emission Characteristics

* Primarily used to control particulate matter, may be used for oil mist droplets, grease, and sticky particulate matter.

### B3.3 Air Emission Sources

Common Applications:

* Food processing (rice, cereal, sugar)
* Vegetable oil refining
* Crushing and grinding
* Material handling and packaging
* Metal finishing

### B3.4 Description

Rotoclones are a type of mechanically aided scrubber that use a power-driven rotor to produce a spray to contact the gas. Dust and oil mist particles present in the untreated gas are brought into contact with the water droplets and become attached. The particulate is then removed from the gas stream as part of the larger droplets that are formed. A separator following the rotoclone prevents entrainment of the liquid.

### B3.5 Applicability and Performance

Particulate collection efficiency ranges from 80 to 99%. The units can handle a large range of flowrates and contaminant loadings, as well as gas streams at elevated temperatures. Water requirements may be less than for other wet scrubbers. The Rotoclone has relatively low capital and operating costs associated.

### B3.6 Limitations

A liquid or slurry waste stream is generated. VOC control is limited. Relatively high maintenance requirements due to moving parts (rotor).

### B3.7 References

American Air Filter. 2017. Type W Rotoclone.

European Commission. 2006. Integrated Pollution Prevention and Control Reference Document on Best Available Techniques in the Food, Drink and Milk Industries (EU BREF) Section 4.4.3.5 Dynamic Separation Techniques.

US EPA. Air Pollution Control Technology Fact Sheet: Mechanically-Aided Scrubber EPA-452/F-03-013.

## B.4 Filtration

### B4.1 Technologies

* Baghouse Dust Collector, Cartridge Type Dust Collector

### B4.2 Emission Characteristics

* Exhaust gas streams with dry particulate matter.

### B4.3 Air Emission Sources

Common Applications:

* Food manufacturing
* Metals processing
* Grain milling
* Mineral processing (coal, cement)

### B4.4 Description

The gas stream passes through a porous fabric or material that removes the particulate matter. Dust cake forms on the filters, which increases collection efficiency. The filters are routinely cleaned of built-up particulate matter to prevent excessive pressure drop.

### B4.5 Applicability and Performance

Particulate removal of 99 and 99.9% is expected with new dust collectors; older units may achieve more than 95% control.

### B4.6 Limitations

A solid waste stream is generated. Oils, greases, adhesive materials, or excessive moisture may result in filter plugging and affect performance.

### B4.7 References

European Commission. 2006. Integrated Pollution Prevention and Control Reference Document on Best Available Techniques in the Food, Drink and Milk Industries (EU BREF) Section 4.4.3.8 Absorption.

US EPA. Air Pollution Control Technology Fact Sheets: Fabric Filter Pulse-Jet Cleaned Type EPA-452/F-03-025, Fabric Filter Mechanical Shaker Cleaned Type EPA-452/F-03-024, and Cartridge Collector Type with Pulse-Jet Cleaning Type EPA-452/F-03-004.

## B.5 Absorption

### B5.1 Technologies

* Wet Scrubbers (packed bed absorber, plate absorber, and spray scrubber)

### B5.2 Emission Characteristics

* Wet scrubbers are most effective on exhaust gases with high concentrations of VOCs or water soluble compounds, and to a lesser degree particulate matter.

### B5.3 Air Emission Sources

Common Applications:

* Food manufacturing and cooking
* Mineral processing
* Fertilizer plants
* Asphalt plants

### B5.4 Description

The process involves a mass transfer between a soluble gas and a liquid solvent such as water. The addition of an oxidizing agent to the scrubbing solution may increase odour removal efficiency by reacting with the odorous compounds. Sodium hypochlorite, hydrogen peroxide, ozone, potassium permanganate, acids, and caustics are frequently used as the scrubbing medium.

### B5.5 Applicability and Performance

Primarily used for inorganic fumes and gases, VOCs, and particulate matter. The control efficiency for VOCs varies depending upon the type of scrubber, and a range of 70 to 90% control is expected. Wet scrubbers have relatively low capital and operating costs compared with other treatment technologies, as well as relatively small space requirements. Absorption units can handle gases with high temperature and high moisture contents.

### B5.6 Limitations

The requirements for the scrubber outlet concentrations affect the scrubber design (liquid flowrate, scrubber dimensions), and may result in unreasonably tall towers or long liquid-gas contact times and excessive liquid volumes. A liquid waste stream is generated. Spray chambers are not generally suitable for odour or VOC control.

### B5.7 References

Air & Waste Management Association. 1992. Air Pollution Engineering Manual.

European Commission. 2006. Integrated Pollution Prevention and Control Reference

Document on Best Available Techniques in the Food, Drink and Milk Industries (EU BREF) Section 4.4.3.8 Absorption.

US EPA. Air Pollution Control Technology Fact Sheets: Packed Bed / Packed Tower Wet Scrubber EPA-452/F-03-015, Spray Tower Wet Scrubber EPA-452/F-03-016.

## B.6 Biofiltration

### B6.1 Technologies

* Biological Treatment (beds, trickling filters, bioreactors)

### B6.2 Emission Characteristics

* Gaseous air pollutants (odour, VOCs, H2S) of consistent air flow rate and limited fluctuation in loading.

### B6.3 Air Emission Sources

Common Applications:

* Meat and Fish
* Coffee processing
* WWTP
* Beer yeast drying
* Oil mills
* Cocoa production
* Pump stations
* Animal feed production
* Organic processing

### B6.4 Description

The most common type of biological treatment is the biofilter where pollutants are absorbed onto a filter and degraded by microorganisms living on the filter media.

There are a variety of biofilter styles: in-ground, in-vessel, open-bed, or up-flow systems.

The filter medium may be a blend of wood chips, compost, bark nuggets or inert materials designed to maintain porosity with high surface area to provide good contact between the contaminants and the biologically active micro-organisms.

### B6.5 Applicability and Performance

Properly designed and maintained biofilters can remove most organic contaminants, H2S and reduced sulfur compounds but can produce a slight residual “earthy” odour. An operational and balanced biofilter can achieve relatively high odour removal efficiency at relatively low operating cost compared with other treatment techniques, with odour removal efficiencies greater than 90% reported. The operation and efficiency of a bioreactor is affected by temperature, pH, moisture, gas composition and pollutant concentration, macronutrient feeding, residence time, compacted bed media, and gas channeling. A biofilter may be designed to treat a wide range of air flowrates that ensure appropriate residence time, typically 20 to 40 seconds. Moisture may be added to the gas by pre-humidification.

### B6.6 Limitations

* Particulate matter and oils may need to be removed upstream of the filter to avoid clogging that may result in a large pressure drop and reduction in operational efficiency.
* Significant fluctuations in contaminant concentrations may be problematic.
* Biofilters generally have large space requirements compared to other control technologies.
* There may be a significant energy demand, particularly if preheating or humidification is required.
* Channeling through the biofilter may result in reduced control efficiency.
* Biofilters require temperature regulation, as temperatures over 40 °C may be problematic as the micro-organisms may become sterilised and the filter bed would require re-seeding, and biological degradation decreases notably below 10 °C.
* The pH of the filter material must be maintained, typically between 6.5 and 7.5, which may require alkali addition.
* A typical lifetime of an organic based filter bed is 3 to 5 years for most filter materials.

### B6.7 References

European Commission. 2006. Integrated Pollution Prevention and Control Reference Document on Best Available Techniques in the Food, Drink and Milk Industries (EU BREF) Section 4.4.3.10.1 Biofilter.

Water Environment Research Foundation WERF. 2007. Minimization of Odours and Corrosion in Collection Systems, Section 8.5 Biofilters.

US EPA. 2003. Using Bioreactors to Control Air Pollution EPA-456/R-03-003.

## B.7 Non-Thermal Plasma (NTP)

### B7.1 Technologies

* Corona or Photocatalytic Reactors

### B7.2 Emission Characteristics

* Cold plasma reactors and photocatalytic reactors are considered an emerging technology. There is limited performance data available, and the economics of the processes are unknown at this time.

### B7.3 Air Emission Sources

Common Applications:

* Food and Drink Manufacturing
* Extruders
* Dryers
* Coolers
* Hammer mills

### B7.4 Description

Non-thermal plasma treatment is an odour abatement technique that plasma to create a highly reactive treatment zone that the waste gas passes through. The plasma contains a collection of ions, electrons, charge-neutral gas molecules and other species in varying degrees of excitation. These radicals in the NTP react with the pollutants in the malodorous air stream, producing less malodorous compounds. The most active radicals in this process are nitrogen, oxygen, and hydroxyl based compounds which originate from nitrogen, oxygen and water in the waste gas. Industrial treatment systems are based on electrical discharge, where high voltages (up to 40 kV) are used to create NTP.

### B7.5 Applicability and Performance

The technique has been proven to reduce the odour emissions by 75 – 96%, with higher control efficiencies for organic compounds (VOC). This technique performs better when treating high VOC. The NTP equipment requires little space when compared to other control measures. Multiple NTP modules can be installed in parallel for higher gas volumes. There is a low pressure drop associated with the NTP, and it can be installed either on either the side of the air extraction fan.

### B7.6 Limitations

Temperature affects the performance of the plasma, with an operating range up to 70°C reported as optimal. Above 80 °C, the performance of the technique may drop significantly. Significant amounts of water condensing on the equipment may be problematic, as well as high particulate matter concentrations. Since high voltages are required to sustain the plasma, there are high operating costs from the power requirements.

### B7.7 References

European Commission. 2006. Integrated Pollution Prevention and Control Reference Document on Best Available Techniques in the Food, Drink and Milk Industries (EU BREF) Section 4.4.3.12 Non-thermal Plasma Treatment.

Water Environment Research Foundation WERF. 2007. Minimization of Odours and Corrosion in Collection Systems, Section 8.10 - Cold Plasma & Photocatalytic Reactors.

## B.8 Ozonation

### B8.1 Technologies

* This technology is considered an emerging technique.

### B8.2 Emission Characteristics

* Odorous exhaust gases.

### B8.3 Air Emission Sources

* Reported installations to treat HVAC return air in smoking rooms.

### B8.4 Description

Ozone is injected to exhaust gas dust or stack in order to react with, and break down, odorous compounds.

### B8.5 Applicability and Performance

There is limited performance data available, and the economics of the processes are unknown at this time.

### B8.6 Limitations

Ozone is less reactive in the gas phase than in liquid phase. Applications of ozone use for water treatment are more common. Hot, humid airflows may not be suitable for ozone treatment systems. Insufficient VOC-ozone contact time may result in incomplete VOC reactions and emissions may still be odorous. Excess ozone may be harmful.

### B8.7 References

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# Appendix C - References

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