Example Odour Control Report for a Food Frying Facility

**Sample Fryer 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 operate fryers within their production facility, 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. 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 in the Company:

Date:

# Introduction

## Odour Control Report for Food Frying

This Odour Control Report for the Sample Frying Company (the ‘OCR’), a food processing facility with a food fryer, 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 food frying, which is a process set out in Table 4 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; and,
* The distance between the facility and the closest point of odour reception is less than the distance set out opposite the process in Table 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 Food Frying, 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 Fryer 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

Ontario’s food and beverage manufacturing sector encompasses approximately 3,000 companies; however, there are no specific statistics available on how many companies may have fryer-based operations. The typical odours from food deep frying are volatile organic compounds (VOCs). The VOCs may be released as a gas or the oil mist and grease droplets (particulate) may be the odour carrier. There is also the potential for sulphur-containing compounds to be emitted as a result of decomposition of organic materials or from wastewater treatment at some facilities.

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).

## Odour Control Report for Sample Fryer Company

An OCR is required for the Sample Fryer Co., a large snack food manufacturer with NAICS Code 311919, producing more than 450MT/year of assorted fried snack foods; the food frying at the facility triggers the requirement for an OCR. 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 Food Frying is 500 metres, as listed in Table 4 of the EASR Publication.

## Odour Control Report Content

This OCR for the Sample Fryer Co. 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 Fryer 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 Table 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: Mr. Chip Potaterson

Contact Information: 519-123-4567; chip.potaterson[@samplefryerco.com](mailto:beer.malterson@samplebrewery.com).

## 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 24 hours per day, 5 days per week, with occasional weekend work as required. There is one week of scheduled shutdown per year.

The facility produces up to 450 MT of snack foods annually.

## 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 Fryer Co. there is both a fried meat product and a fried snack food product. Food manufacturers will generally specialize in one of these types of food products and not have multiple products in the same facility.

Each food manufacturing 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 specific product that is fried, recipes, batter, frying mediums, pre‑handling, mixing, forming, 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

At the Sample Fryer Co., food production involves the following main process stages:

* Bulk materials handling and storage;
* Preparation;
* Frying;
* Flash Freezing;
* Packaging; and,
* Auxiliary services.

### Bulk Materials Handling and Storage

The bulk handling of materials includes the following:

* Storage silos for flour;
* Bin receiving of potatoes and chicken parts;
* Cloth silo and totes of ingredients;
* Large liquid holding and storage tanks for oils ingredients; and,
* Sumps and trenching to collect spillage.

### Preparation

The Sample Fryer Co. has preparation stages for both the potato chip (PC) and the chicken wing (CW) operations.

*Potato Chip*

The preparation of the raw materials includes the transfer from the receiving bins to the sorting process through a washing and peeling system and then to the slicing line. The bins are automatically loaded onto a sorting conveyor where the potatoes are separated from any foreign materials and forwarded to the washing/peeling line. The cleaned and peeled potatoes are then transferred to the slicing system where the raw potato disks are cut. The disks are spread onto a conveyer to be directed into the fryer system.

*Chicken Wing*

Fresh chicken wings are received at the Sample Fryer Co. and stored in the chiller until required by production. The CWs are manually loaded into the coating system conveyor where they are metered into the pre-coating drum where the dry spice pre-dusting is done or a liquid marinade is added to a tumbler system. Both of these systems are operated under a slight vacuum to capture the loose spice mix and minimize ingredient loss. This also reduces particulate loading to the immediate work area. The dry spice is also added to assist in the liquid marinating process. For some product types, the coated wings are conveyed to the liquid batter application. The prepared wings are then conveyed to the oil fryer system.

### Frying

*Potato Chip*

The PCs are transferred into the hot oil bath and moved through with a series of paddles. Once the PCs have met the sufficient time and temperature they are transferred to a mesh conveyer to allow removal from the oil bath, drainage of excess oil and cooling. Flavouring can be added and quality control can remove any product not meeting customer specifications at this stage. The material is conveyed to the Packaging from this stage.

*Chicken Wing*

The pre-coated CWs are conveyed into a scaling tank to blanch and initiate the cooking process which results in the transfer of chicken fats and oils into the water and improves the overall quality of the fried product. The blanched CWs continue to be conveyed from the blanching tanks to the fryers where they are maintained at a sufficient temperature to meet food quality specifications. The CWs are removed and excess oil allowed to drain with some cooling along the conveyer during a cooling stage. Sauce may be added at the end of this production line if required for the batch. Once the saucing is complete the CWs are conveyed into the flash freezer.

### Flash Freezing

The sauce coated CWs are conveyed to flash freezers along an open mesh conveyance system to allow for excess sauce to drain. The CWs are flash frozen to appropriate temperatures and delivered to the packaging section for appropriate containment and storage and/or direct shipment. There are no odour sources associated with the flash freezing process.

### Packaging

*Potato Chip*

There is an automatic scale and bag fill at the end of the conveying system once the PCs have cooled and the optical sorting and quality control has been completed. The bags are formed from plastic flat wrap, filled, sealed and conveyed for carton filling, robotic stacking and inventory.

*Chicken Wing*

CWs are boxed according to customer demand. There are bulk box orders for restaurants as well as consumer orders for retail stores. The flash frozen CWs are conveyed to bagging machines and appropriately weighed, boxed and placed in cartons. The cartons are stacked and stored in refrigerated or freezer storage depending on customer requirements.

### Auxiliary

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

* Large 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;
* Solid waste collection and trash compaction; and,
* General (non-process) building exhausts (office space, cafeteria, and washrooms).

## Identification of Odorous Contaminants

In this food manufacturing facility, the expected odorous contaminants are various volatile organic compounds (VOCs) released during the frying process. There is the potential for sulphur-containing compounds to be emitted as a result of decomposition of organic materials or specific process operations.

Typical odorous compounds encountered in food frying and associated wastewater treatment operations can include VOCs such as benzene and dioxane, hydrogen sulphide and the specific odours of specific ingredients (e.g. spices).

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 Fryer Co. facility has been classified as a primary odour source, secondary source, or a negligible odour source based upon the source’s odour emission rate as well as the 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 this sector, VOC emissions and volatilized grease are the predominant sources of odours.

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 Fryer 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 following are considered to be major odour sources associated with the fryer operation:

#### Fryer for the Potato Chips; and,

#### Fryer for the Chicken Wings.

These Sources are identified 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 Fryer Co. include:

* Dry Seasoning Application; and,
* Wet Seasoning Application.

### Sources Not Considered Odorous

The following air emissions sources are not considered as significant odour sources at most frying facilities, including the Sample Fryer Co.:

* Silo storage for flour;
* Packaging;
* Boilers;
* HVAC equipment (comfort heating and cooling);
* Chillers and refrigeration equipment;
* Parts washers;
* 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 Sample Print & Paint 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 - Odour Source Identification Table for Sample Fryer Co. (Primary Sources)

| **Source Description** | **Odorous Contaminants** | **Odour Loading** | **Exhaust**  **Characteristics** | **Flow Rate** | **Continuous or Intermittent Discharge** | **Current Odour Control Measures** |
| --- | --- | --- | --- | --- | --- | --- |
| Fryers – Chicken Wings | VOCs | High | Dedicated Stack | High | Continuous | Mist eliminators |
| Fryers – Potato Chips | VOCs | Moderate | Dedicated Stack | High | Continuous | Mist eliminators |

**Table 1B - Odour Source Identification Table for Sample Fryer Co. (Secondary Sources)**

| **Source Description** | **Odorous Contaminants** | **Odour Loading** | **Exhaust**  **Characteristics** | **Flow Rate** | **Continuous or Intermittent Discharge** | **Current Odour Control Measures** |
| --- | --- | --- | --- | --- | --- | --- |
| Dry Seasonings –Pre-dust drums | VOCs | Low | Passive Vents and Pressure Relief Valves | Low | Continuous and Intermittent Sources | Bin vent filter |
| Wet Seasonings – Marinators, Sauce Applicators | VOCs | Low to Moderate | Vertical Stacks,  Horizontal Exhausts, and Passive Vents | Low | Continuous | Vertical Stacks, unimpeded with appropriate discharge velocity |

**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 fryer operations and methods 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 for frying operations within potentially larger production sites. Current practices for odour control range from the implementation of BMPs for smaller operations 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 Food Processing Facilities with Frying Processes

The odour control measures and procedures identified are currently in use at similar facilities for each odour source or source grouping, and are presented in Table 3 for the primary sources and Table 4 for the secondary sources.

A notable challenge faced with identifying current practices at facilities that use fryers was the fact that the OCR is required for an activity and not a specific industrial sector NAICS code; the facilities that use fryers span a number of NAICS codes and are included in a sector together with facilities that do not use deep frying.

### Ontario

Information on 11 similar facilities in Ontario with MOECC ECAs was available through the MOECC Access Environment database of historical and current approvals. No data is available concerning the number of total facilities in Ontario that have fryer operations. The 11 facilities operate fryers and process a variety of foods including potato chips, corn chips, won tons, egg rolls, breaded fish/chicken and chicken wings.

The publicly available data was reviewed, and the following was found for food manufacturing facilities with fryers:

* One facility, located within 200m of an odour receptor and having a facility size of approximately 4300 m2 has two fryer systems both with independent rotoclone and stack emission exhaust systems.
* One facility, located within approximately 300m of an odour receptor, having a facility size of approximately 7500m2 has one fryer system with a mist eliminator prior to discharge.
* One facility located within approximately 400m of an odour receptor, having a facility size of approximately 4700m2 has one fryer system with a screen separator prior to the stack discharge.
* Two facilities, each located within 200m of an odour receptor, and each having a small production volume and two fryers operating on-site, one fryer with no control on the exhaust and one fryer with screen separators prior to stack discharge.
* One facility, located within 250m of an odour receptor, having a facility size of approximately 5000 m2 has two fryer systems that operate with demisters prior to the stack discharge and two fryer systems that operate with no control systems prior to discharge.
* One facility, located greater than 1500m from an odour receptor, having a large production volume, has one fryer with a mist eliminator prior to the stack discharge and one fryer with no control prior to the stack discharge.
* Two facilities, each located approximately 400m from an odour receptor, and each having small production volumes with one fryer system discharging directly from a stack with no associated emission controls.
* One facility, located within 100m of an odour receptor, having two fryers with a wet scrubber using either water or caustic as the scrubber solution and a facility size of 4600m2.
* One facility, located within 250m of an odour receptor, having a facility size of approximately 5000 m2 and four fryers in operation. Two of the fryers have demisters prior to the stack discharge, and two fryer exhaust directly from a stack with no associated control system.

Note that this summary is not comprehensive and there are other facilities operating fryers in Ontario for which there was no data available, nor was production data available for any of the facilities.

The Sample Fryer 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 no specific guidance, regulatory requirements, or odour emission inventories for facilities in other provinces that provide details on odour control measures utilized by facilities that operate fryers.

### 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 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 five large facilities with major sources in four US states was available from their Title V permitting posted on state environmental agency websites. The list demonstrates the range of potential control measures that have been installed to control either particulate matter (oil mist) or VOC, and are therefore not specific to odour control. It should be noted that all five have some form of pollution control equipment installed; however, it is not intended to suggest that control measures are required on all fryers. The list is based on data available for facilities which have installed control equipment. Data was not found for smaller facilities, or facilities without controls, nor were the total number of facilities utilizing fryers in the US available. The data is as follows:

* One facility has a wet scrubber on one frying line and an oil mist eliminator on another frying line;
* Three facilities have oil mist eliminators installed; and,
* One facility operates a regenerative thermal oxidizer (RTO).

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 BAT conclusions are presented in two tiers. The first tier lists BAT for all FDM installations and the second tier indicates where additional BAT are listed for certain individual sectors (BREF, 2006). The BREF is considered to be applicable to facilities that use animal raw materials of greater than 75 tonnes per day and for vegetables, raw materials of greater than 300 tonnes per day (averaged on a quarterly basis).

A specific recommendation in the BREF is to remove excess moisture prior to frying, and to control the frying stage such that the final moisture content is optimized at 1 to 2% in the fried (fish, meat, poultry and potato frying). This approach minimizes both frying times and air emissions.

As well the BREF discusses optimizing the frying temperature. Frying at high temperatures (180 to 200°C) can result in more rapid production of oil breakdown products which lead to increased VOC emissions and odour.

The specific BAT for frying is considered to be recirculating and burning exhaust gases (or thermal treatment of exhaust gases). Though not stated in the BREF, the implementation of an oil mist separation should be considered to eliminate grease/oil deposits in the ducting and vents from the fryer source to the combustion chamber/burner, if cooling of the gas could occur. If there is no mist separation installed, preventative maintenance should include vent/ducting inspection on a routine basis.

In addition to the thermal treatment of the exhaust gases (BAT), abatement techniques are described in the BREF document that target solid and liquid phase pollutants (oil mists), such as filtration, aerosol/droplet separation, and wet separation, and techniques that target gaseous odours including absorption, biological, thermal treatment, non-thermal plasma, and condensation. The BREF document does not provide specific guidance on where these other abatement techniques would be appropriate or effective for frying.

In summary, the applicable BAT to prevent nuisance odour effects are:

* BMPs (referred to as Process Integrated BAT in BREF documents) for moisture content and frying temperature, and;
* Recirculate fryer exhaust to burner for incineration.

### 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 electrostatic precipitators, fabric filters or baghouses, and wet scrubbers are commonly installed to reduce the concentration of particulates from point sources associated with snack food roasting and frying.

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 appropriate or applicable to frying. 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 (points of odour reception).

There was no facility-specific information available on emission or odour controls for fryers.

### Additional Control Measures Suitable for Frying Activity

In addition to the most common approaches implemented to control odours for frying operations, other 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 Fryer Co.**

| **Control Measure** | **Applicability and Limitations** |
| --- | --- |
| Ozonation | Concentrated ozone is injected into the waste gas stream to oxidize VOCs. |
| Non-Thermal Plasma | Non-thermal plasma is an end-of-pipe control that creates a reactive treatment zone where odorous VOCs are broken down. |
| Process Optimization: Enhanced automation | Use of tank volume 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. |
| Stack Optimization / Engineering Control | Combine odour sources into one single stack or grouped stacks to unimpeded flow rate, optimize vertical orientation, height, discharge characteristics and discharge velocity to improve dispersion. |

## Control Measures for Primary Sources at Sample Fryer Co.

The primary source of odour for most food processing facilities that have fryer operations is the fryer exhaust(s). Although it is a food smell, it is not always a welcome odour at some receptors and is identified as a nuisance odour source. 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 facilities to control the odours from fryers. The options presented in Table 3 are also considered BAT for odour control at EU food, drink, and milk industries.

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 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 Fryer Co.

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

| **Odour Source** | **Control Measure** | **Applicability** |
| --- | --- | --- |
| Fryers | Stack Optimization | Effective stack design will improve dispersion to reduce off-site effects. Vertical, unimpeded discharge at optimal stack height and velocity.  Combining multiple exhausts to one common stack is possible to allow for stack optimization or to implement one odour treatment system. |
| Fryers | Thermal Treatment:  Recirculate fryer exhaust gas to fryer burner | Fryer exhausts are directed to the fryer burner for incineration. Pre-treatment by demister may be required to avoid issues with particulate or grease in boiler. |
| Fryers | Thermal Treatment:  Boiler Incineration | Fryer exhausts are directed to the site boiler combustion chamber for incineration. Grease and moisture condensation and buildup in ducting and boiler intake air must be prevented by heating and/or insulation. Pre-treatment by demister may be required to avoid issues with particulate or grease in boiler. |
| Fryers | Oil Mist Eliminator / Demister / Screen Separator | Effective Grease, oil mist, and particulate matter removal, but limited VOC removal. |
| Fryers | Rotoclone | Effective Grease, oil mist, and particulate matter removal, but limited VOC removal. |
| Fryers | Wet Scrubber | Effective Grease, oil mist, and particulate matter removal, but limited VOC removal. |
| Fryers | Oxidation Scrubber | Wet scrubbers that use an oxidizing agent such as hydrogen peroxide, bleach, or others, as the scrubbing solution. Grease, oil mist, and particulate matter removal. Oxidizing agents may be problematic for wastewater treatment. |
| Fryers | Filtration | Removal of odorous particulate matter by dust collector, fabric filter, or electrostatic precipitator. |
| Fryers | Biofilter | Process exhausts are directed to a conditioning system and biofilter where microorganisms biologically degrade the organic compounds.  An open or closed biofilter may be suitable with potential for ground level or roof-top installations. Pre-treatment for grease or moisture removal needed to prevent blockages. |
| Fryers | Non-Thermal Plasma | Activated plasmas gas is injected into waste gas stream to oxidize VOCs. |
| Fryers | Ozonation | Concentrated ozone is injected into waste gas stream to oxidize VOCs. |
| Fryers | Process Optimization:  Enhanced 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. |
| Fryers | Engineering Controls:  Emission Capture | Improve emission capture with an engineered enclosure. |
| Fryers | BREF – BAT Specific:  Moisture entering the fryer | Maintaining a 1-2% moisture content in the material entering the fryer is optimal to reduce frying times and preserve the frying oils. |
| Fryers | BREF – BAT Specific:  Optimizing frying  temperature | Frying at high temperatures (180 to 200°C) can result in more rapid production of oil breakdown products which lead to increased VOC emissions and odour. |
| Fryers | Best Management Practices | Develop SOPs and train employees on BMPs for equipment and control measures, such as good housekeeping, minimizing transfer spills, reducing wastes, and managing production residues. |

## Control Measures for Secondary Sources at Sample Fryer Co.

The secondary sources at the Sample Fryer Co. include the dry and wet seasoning application processes. The potential odour effects are proportional to the type of seasoning being applied. 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 food, drink, and milk manufacturing.

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

| **Odour Source** | **Control Measure** | **Applicability** |
| --- | --- | --- |
| Wet / Dry Seasoning | Stack Optimization | Effective stack design will improve dispersion to reduce off-site effects. Vertical, unimpeded discharge at optimal stack height and velocity.  Combining multiple exhausts to one common stack is possible to allow for stack optimization or to implement one odour treatment system. |
| Wet / Dry Seasoning | Wet Scrubber | Effective grease, oil mist, and particulate matter removal, but limited VOC removal. |
| Wet / Dry Seasoning | Oxidation Scrubber | Wet scrubbers that use an oxidizing agent such as hydrogen peroxide, bleach, or others, as the scrubbing solution. Oxidizing agents may be problematic for wastewater treatment. |
| Wet / Dry Seasoning | Filtration | Removal of odorous particulate matter by baghouse, fabric filter, or electrostatic precipitator; limited ability to abate VOCs and applicable to dry seasonings only. |
| Wet / Dry Seasoning | Non-Thermal Plasma | Activated plasma gas is injected into waste gas stream to oxidize VOCs. |
| Wet / Dry Seasoning | Ozonation | Concentrated ozone injected into exhaust gases to oxidize VOCs. |
| Wet / Dry Seasoning | Process Optimization:  Enhanced 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. |
| Wet / Dry Seasoning | Engineering Controls:  Emission Capture and Negative Pressure | Improve emission capture with an engineered enclosure to minimize fugitive dust and odour and direct exhaust to a stack for improved dispersion.  Maintain a slight negative pressure to application vessel for effective capture of particulate matter and odours to prevent fugitives; food safety must be ensured. |
| Wet / Dry Seasoning | Process Optimization:  Scheduling | Scheduling of activities or product runs to avoid simultaneous releases from multiple odorous sources. |
| Wet / Dry Seasoning | Best Management Practices | Develop SOPs and train employees on BMPs for equipment and control measures, such as good housekeeping, minimizing transfer spills, reducing wastes, and managing production residues. |

# Feasibility Assessment

The control measures identified in Section 4 have been shown to be effective in preventing or reducing odour effects at food production facilities with fryer lines and other food processing facilities with similar sources and/or other similar 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. It may also be technically feasible to combine two or more of the control equipment measures; however, such combinations were not considered in the OCR as it is not typical or required for food frying.

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 Sample Fryer 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 Fryer Co. has previously implemented a number of significant 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 Fryer 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.

Thermal treatment in the boiler may require additional energy input to heat ducting; this may be offset if there is a heat recovery system. The use of thermal treatment can result in incomplete oxidation of the VOCs if there is significant fluctuation in the temperature of the burner or combustion chamber used for the mitigation process. There should be pre-treatment utilized to reduce the amount of grease carry through in ducting from the fryer exhaust to the combustion source. Any condensation of deposition of grease can lead to potential odour sources within the facility. Preventative maintenance protocols, SOPs and BMPs should be implemented with any mitigation or alternative treatment process used for odour control.

The removal of particulate matter would result in odour reduction if the particulate matter is the odour carrier, which is often the case with spices. However, for the removal of potential odorous associated with fryer operations, the oil and grease content in the filtered stream would have a significant potential to cause plugging of filter materials, and blockage of cyclones or other physical knockout systems. For the installation of dry particulate removal, in the case of spices and seasonings, the installation and operation of additional particulate control units would have environmental and energy implications as well as space requirements that do not meet the requirements for this operation.

The use of water or caustic solutions generates a new liquid waste stream that must be treated as a wastewater. Oxidation scrubbers using caustic also require the balance of oxidation chemicals and can result in the emission of a chemical grease odour if not maintained properly. An excess of grease can build up on the scrubber components due to the significant temperature changes and the water knockout action of the scrubber can also lead to degradation and additional odour loading if the preventative maintenance and cleaning BMPs are not exercised.

Biofiltration units would likely only be applicable at large manufacturing facilities with many frying lines or where frying is only one of many potentially odorous processes. Additional considerations for biofilter operations are maintaining a consistent food source. If the facility is only operational a limited number of days per week and/or over a limited number of hours there may not be enough nutrients provided to the micro-organisms of the filter to create and maintain a healthy biobed. The decay of the micro-organisms within the biobed can result in the potential of significant odour issues outside of the process odours of the facility. There is significant cost, energy and employee effort required to re-establish a bio-bed colony and initiate the odour mitigation activity. The energy and pre-treatment demands of the system as well as the footprint required for the biofilter system need to be evaluated for technical and economic feasibility against other mitigation options.

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 for food frying operations. 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 fryer source would potentially have a high particulate loading and/or high moisture content so additional pre-treatment systems would be necessary.

**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 Fryer Co.**

| **Odour Source** | **Description of Control Measure** | **Technically Feasible?** | **Notes** |
| --- | --- | --- | --- |
| Fryers, Seasoning | Stack Optimization | Technically Feasible | If the odour loading results in off-site effects on the immediate surroundings, improved dispersion by optimizing the stack parameters can be effective.  Combining multiple stacks to one optimized stack may improve dispersion. |
| Fryers | Thermal Treatment:  Recirculate fryer exhaust gas to fryer burner | Technically Feasible | Thermal treatment will be evaluated should additional measures be needed to control fugitive odours from the dryers.  Modifying the characteristics of the exhaust gas by adding recirculation back to a burner for incineration as part of the air make-up would reduce odour emissions. The particulate matter, oil mist, and grease present in the exhaust gas must be considered. |
| Fryers | Thermal Treatment:  Boiler Incineration | Technically Feasible | Thermal treatment will be evaluated should additional measures be needed to control fugitive odours from the dryers. This may require additional energy input to heat lines; this may be offset if there is a heat recovery system. |
| Fryers | Oil Mist Eliminator / Demister / Screen Separator | Technically Feasible –  previously implemented | Systems have been previously installed and result in the removal of particulate matter, grease, and oil mist by mist eliminators which result in mitigate of odours. |
| Fryers | Rotoclone | Technically Feasible | A mist eliminator is currently installed for removal of particulate matter, grease, and oil mist. |
| Fryers, Seasoning | Wet Scrubber or Oxidation Scrubber | Not Technically Feasible. | The production area where the seasoning process is done is directly connected to the Fryer output by a series of conveyors. Depending on the seasoning or marinating activity the appropriate conveyor system is automatically activated. Once the product leaves the seasoning or marinating process it is conveyed to freezer or packaging processes, again by automated conveyors. Due to the footprint of the existing equipment and the number of conveyor systems 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 source to be effective. |
| Fryers, Wet Seasonings | Filtration – Fryer Exhaust or Wet Seasoning Application | Not Technically Feasible. | High moisture content sources, oil, mist or grease will result in blockage or plugging of the filtration material. |
| Dry Seasonings | Filtration –Dry Seasoning Application | Technically Feasible | Filters have been previously installed on Storage Bin Vents. The removal of particulate matter may also control odours. However due to the high moisture content in the area of the dry seasoning applicator it is not feasible to install a filter system on that application. |
| Fryers | Biofilter | Not Technically Feasible | The amount of free space required for a biofilter footprint large enough to achieve the appropriate residence time, as well as the humidification chamber and all the other support equipment, is not available at this facility. There may also be an issue with inconsistent fryer feed causing variability in the biofilter loading. |
| Fryers / Seasonings | Non-Thermal Plasma | Not Technically Feasible | Non-thermal plasma is an emerging technology and there is limited documentation on demonstrated control efficiency or applicability on fryer exhaust VOCs and odour destruction. |
| Fryers / Seasonings | Ozonation | Not Technically Feasible | Ozonation is an emerging technology and there is limited documentation on demonstrated control efficiency or applicability on fryer exhausts VOC and odour destruction. |
| Fryers / Seasonings | Process Optimization:  Enhanced automation | Technically Feasible | 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: tank volume monitoring, transfer flow monitoring 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. |
| Fryers / Seasonings | Engineering Controls:  Emission Capture and Negative Pressure | 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.  Improvements to the collection hoods at the fryers will be evaluated should additional measures be needed to control fugitive odours from the fryer room. |
| Fryers | BREF BAT for Frying:  Moisture entering the fryer | Technically Feasible | This BAT will be evaluated should additional measures be needed to control fugitive odours from the dryers.  SOPs can be developed to routinely test the moisture content of the raw product prior to frying. Adjustments to the moisture content can be evaluated against food safety, Hazard Analysis Critical Control Point (HACCP) regulations and scheduling limitations. |
| Fryers | BREF BAT for Frying:  Optimizing frying temperatures | Technically Feasible | This BAT will be evaluated should additional measures be needed to control fugitive odours from the dryers.  SOPs can be developed to implement continuous monitoring of fryer oil temperature and link to an automatic temperature control system to maintain the oil temperature in an optimum range for fryer quality as well as product quality and aesthetic criteria. |
| Fryers / Seasonings | Best Management Practices | Technically Feasible –  previously implemented | Sample Fryer 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. |
| Seasonings | 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 odorous sources, where possible. |

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.

# Adequacy of Current Odour Control Measures and BMPP

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 Fryer 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 Fryer 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 general operational conditions and site parameters. Any excursions in normal operations (e.g. spills, emergency situations) or specific operational issues that have been successfully addressed with an odour strategy 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 primary sources identified (Fryers), the Sample Fryer Co. has previously implemented at least one of the technically feasible control measures described in Section 4. There are oil mist eliminators on the stacks, and the stacks discharge vertically and at a flow rate that optimizes dispersion;
* The use of oil mist eliminators is consistent with the control measures in use at several facilities in Ontario with current MOECC ECAs, as identified in Section 4.1;
* The Sample Fryer Co. relocated several discharge points in 2014 to increase the separation distance between the fryer exhaust stacks and the odour receptors; 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 flow rates, 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 fryer emission.

Should the facility determine that an odour source is developing into a potential off-site issue, the BREF-BAT (BMPs) for fryers 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 further complaints 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.

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

This section presents the control measures that were found to be technically feasible and could be further considered by the Sample Fryer 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 - Control Measures or Procedures to be Evaluated for Implementation**

| **Source** | **Control Measure** | **Notes** |
| --- | --- | --- |
| Fryers | Thermal Treatment | Capture of fryer exhaust for incineration in fryer burner or site boiler is technically feasible. |
| Fryers / Seasonings | Engineering Controls:  Emission Capture and Negative Pressure | Should additional measures be to control odours, a review of emission capture and control efficiencies will be conducted to identify opportunities for improvement. |
| Fryers | BREF – BAT Specific:  Moisture entering the fryer | SOPs can be developed to routinely test the moisture content of the raw material prior to frying. Adjustments to the moisture content can be evaluated against food safety, HACCP regulations and production scheduling limitations. Adjustments can be done incrementally to ensure product quality is not impacted. |
| Fryers | BREF – BAT Specific:  Optimizing frying temperature | SOPs can be developed to implement continuous monitoring of fryer oil temperature and link to an automatic temperature control system to maintain the oil temperature in an optimum range for fryer quality as well as product quality and aesthetic criteria. |

# 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 judgement 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 brewing and pet food industries, the operation of a jacketed kettle with pressure relief valve is an odour source if it is used for wort boiling or meat 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 publicly 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. These sources may be combined and directed to individual control equipment or dealt with as an aggregate.

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 Manual for Snack Food Roasting and Frying, 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 odours that are not of the same characteristic that is generally attributed to the sector and have no noticeable 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 control unit may result in the permanent removal of airborne contaminants that are odorous.

### Engineering Controls or Process Changes for Prevention

Although there may be some redundancy between these measures and those outlined as BMPs in the facility BMPP, the measures detailed here may differ from BMPs in that they require actual modifications or engineering changes. In contrast, BMPs are by definition, practices or procedures that 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 food processing sector with fryer operations 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 the 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 inapplicable Codes of Practice.

# Appendix B – Control Equipment Descriptions

Appendix B provides general information on the control measures identified in this example OCR. Details such as whether the control measure is considered to be in the developmental stage, where it may be applicable, and what limitations may exist, 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.

Including this level of detail on potentially feasible control measures 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

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.

# APPENDIX C - References

[Australian National Pollutant Inventory Emission Estimation Technique Manual for Snack Food Roasting and Frying](http://www.npi.gov.au/resource/emission-estimation-technique-manual-snack-foods-roasting-and-frying-industry)

[Environment and Climate Change Canada National Pollutant Release Inventory Toolbox](https://ec.gc.ca/inrp-npri/default.asp?lang=En&n=65A75CDF-1)

[European Commission. 2006. Integrated Pollution Prevention and Control Reference Document on Best Available Techniques in the Food, Drink and Milk Industries (EU BREF)](http://eippcb.jrc.ec.europa.eu/reference/BREF/fdm_bref_0806.pdf)

[Ontario Ministry of the Environment and Climate Change.2017. Access Environment database](http://www.accessenvironment.ene.gov.on.ca/AEWeb/ae/Paging.action?lang=en&r)

Ontario Ministry of the Environment and Climate Change. 2017. Guide to Requesting a Site-Specific Standard. Version 2.0. Ontario Regulation 419. PIBS #6322e02.

[Statistics Canada. 2017](https://www.ic.gc.ca/app/scr/sbms/sbb/cis/establishments.html?code=311919&lang=eng)

[US EPA AP-42 Emission Factor Compendium](https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors)

* US EPA. 1995. AP-42: Compilation of Air Emission Factors Section 9.13.3 Snack Chip Deep Fat Frying
* US EPA. 1994. AP-42: Compilation of Air Emission Factors Section 9.13.3 Snack Chip Deep Fat Frying Background Document.
* US EPA. 1993 – 2014. Economic and Cost Analysis for Air Pollution Regulations: Economic Impact Analyses and Industry Profiles by Sector.

[US EPA AP-42 Technology Transfer Network U.S.-Mexico Border Information Center on Air Pollution (CICA)](https://www3.epa.gov/ttncatc1/cica/atech_e.html)