Code of Practice for the Environmentally Sound Management of Chemical Substances in the Chemicals, Plastics and Rubber Sectors

January 2023

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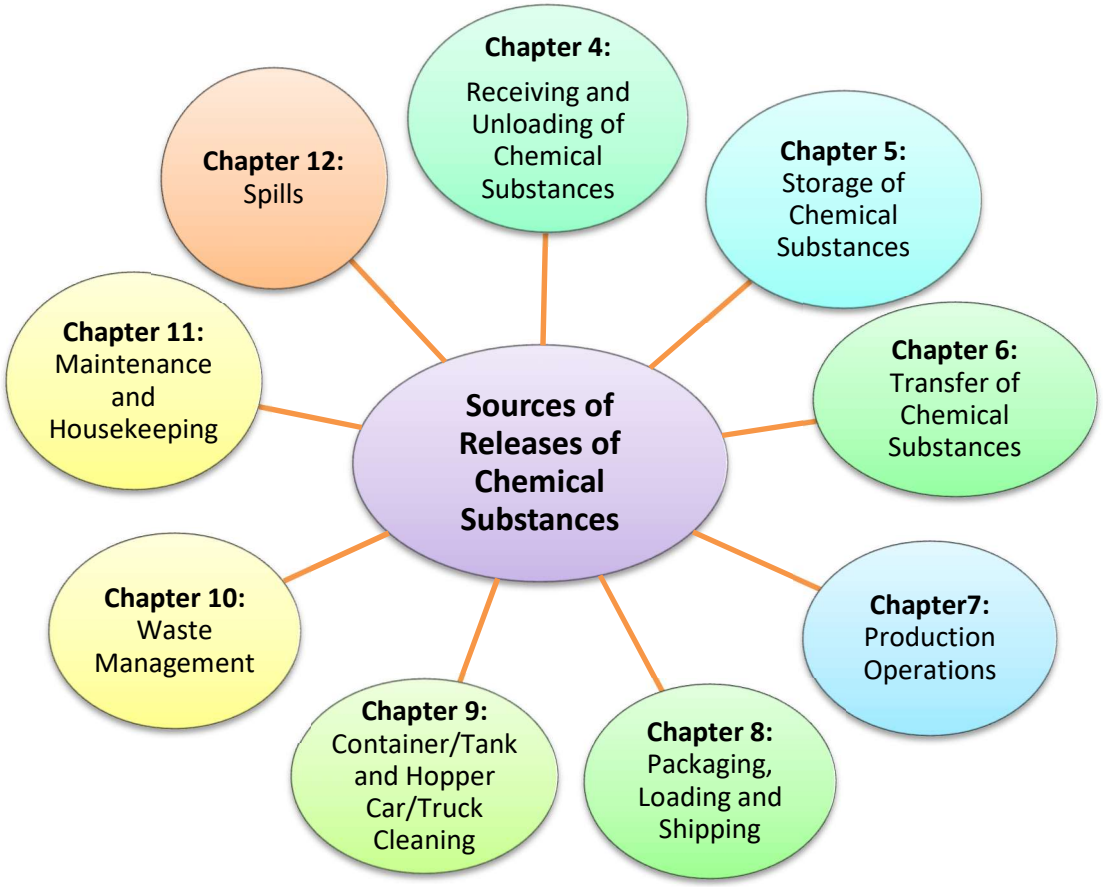
1. Introduction and Objective

Within the chemicals, plastics and rubber manufacturing/distribution industries, releases of chemical substances to the environment can originate from a variety of sources and activities within a facility. Sources and activities can include industrial effluents from the rinsing of tanks, air emissions from the granulation of solid raw materials, contaminated clothing that came into contact with chemical substances during the cleaning of equipment, or spills. These releases may be prevented or mitigated through the adoption of best practices related to the management and handling of chemical substances.

The objective of this Code of Practice (Code) is to identify and promote best practices in the management and handling of chemical substances in the manufacturing and distribution of chemicals, plastics, and rubber products in order to prevent releases of these substances into the environment.

In addition, the Code has been developed for use as a supporting risk management instrument to address specific substances used in the chemicals, plastics and rubber sectors.

Figure 1: Sources of Chemical Releases to the Environment Considered in the Sound Management of Chemical Substances



1.1 Sector Description

This Code is intended to apply to manufacturers, formulators and distributors in the chemicals, plastics and rubber sectors, which fall under the following North American Industrial Classification (NAICS) codes:

- 3251 - Basic Chemical Manufacturing;
- 3252 - Resin, Synthetic Rubber, and Artificial and Synthetic Fibers and Filaments Manufacturing;
- 325991 - Custom Compounding of Purchased Resins;
- 3261 - Plastics Product Manufacturing; and
- 3262 - Rubber Product Manufacturing.

1.2 Scope

The best practices identified in this Code should be applied based on the activities undertaken in relation to all chemical substances in use at individual facilities. The specific activities or operations within a facility will dictate which practices are relevant and applicable.

The best practices identified in the Code are not prescriptive and the use of alternative technologies and practices that can achieve an equivalent or better level of environmental protection is encouraged.

The Code does not have the force of law, and, therefore, it is not a substitute for existing regulatory requirements of the municipal, provincial/territorial, and federal authorities. Commitment by companies to conform to the Code recommendations does not remove obligations to comply with all applicable statutory and regulatory requirements.

1.3 Code Development

The Code was developed by ECCC based on information from a consultant's report, and literature listed in Appendix 2.

Industry associations in the chemicals, plastics and rubber sectors were consulted on a draft of the Code and feedback was considered and incorporated where applicable.

1.4 Code Structure

The Code identifies best practices that can be incorporated in various activities/operations within a facility where chemicals are handled, as follows:

Chapter 3 – Environmental Management System, Training and Record-Keeping
Chapter 4 – Receiving and Unloading of Chemical Substances
Chapter 5 – Storage of Chemical Substances
Chapter 6 – Transfer of Chemical Substances
Chapter 7 – Production Operations
Chapter 8 – Packaging, Loading and Shipping
Chapter 9 – Container/Tank and Hopper Car/Truck Cleaning

Chapter 10 – Waste Management
Chapter 11 – Maintenance and Housekeeping
Chapter 12 - Spills

Appendix 1 provides an evaluation checklist to be completed and submitted on an annual basis by facilities that are covered by the scope of the Code.

Appendix 2 lists the literature sources used to prepare the Code.

1.5 Reporting on the implementation

To assess the degree of implementation of this Code and to help identify areas of improvement, companies are requested to annually submit a report (provided in Appendix 1) on their progress in implementing this Code. Reports should be submitted by March 31st of each year, and emailed to the Chemical Production Division of Environment and Climate Change Canada at the following address: pgpc-dppc-cmp-cpd@ec.gc.ca.

If a company is implementing the Canadian Industry Association of Canada (CIAC)'s Responsible Care® program, Operation Clean Sweep (OCS), Responsible Distribution® or ISO 14001, the company may indicate this in the annual report using Appendix 1 of this Code.

1.6 Verification

ECCC will review and verify annual evaluation reports submitted under subsection 1.5 on an annual basis for completeness and accuracy. Practices that have not been implemented but would contribute to the overall objective of the code will be identified and taken into consideration in the evaluation of the overall performance of this Code. If necessary, ECCC may request additional information to understand how this Code is being implemented, such as evidence of implementation of best management practices identified in Appendix 1 of this Code. Where applicable, ECCC may rely on other verification methods, such as using data from other sources, conducting site visits, etc.

Participating facilities will complete and submit annual evaluation reports and confirm accuracy in writing by signing the evaluation report (Appendix 1).

1.7 Performance measurement and reporting

Based on the review and verification of information submitted under this code, ECCC will assess the effectiveness of the code in meeting its objectives, and publish progress reports biannually, or more frequently as applicable, on the Government of Canada's website.

2. Definitions

"chemical substance" means any substance that is not found naturally in the environment and any other substance that poses or is suspected to pose an immediate or long term threat to human health or to the environment, if not managed correctly.

"harmful (substance)" means any substance that poses or is suspected to pose immediate or long-term threat to human health or to the environment, if not managed correctly.

"hazardous (substance, product)" means any substance that is hazardous to the safety or health of a person exposed to it as regulated under the *Hazardous Products Act*. Note that this is separate from the definition of hazardous waste, which is defined in provincial regulations and in the *Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations*.

3. Environmental Management System, Training and Record-keeping

3.1 Establishment of an Environmental Management System

Facilities should develop, implement and maintain an Environmental Management System (EMS) consisting of a set of policies and procedures for the responsible management of chemical substances. The EMS should include the following activities and be consistent with nationally recognized EMS standards (e.g., ISO14001 and Responsible Care®):

a. A corporate environmental policy, including a product stewardship plan to minimize the product's environmental impact throughout all stages of the product's lifecycle.

b. Training on environmental policy and procedures, including clear definitions of roles and responsibilities with respect to environmental management work.
   - The training program should ensure that all management, employees and contractors are familiar with the EMS and associated best practices. Training could also be extended to customers.
   - Training should cover task-specific (e.g., equipment cleaning) and facility-wide activities (e.g., chemical storage, spill response) while providing employees with context regarding the importance of following procedures.
   - A list of the environmental emergency training that has been or will be provided to prepare personnel at the facility should be maintained.

c. A pollution prevention plan with a procedure for assessing its implementation. Where possible, this assessment should be carried out by people trained in auditing and evaluation. A plan may include the following aspects:
   - Process flow diagrams, list of equipment and corresponding use instructions, procedures for use and storage of chemical substances, and waste handling practices.
   - Identification of substances that are of potential concern for the environment or for human health.
   - Quantification of chemical substances manufactured, imported, sold, consumed and disposed and estimation of environmental releases. Recording this data will serve to highlight opportunities for process flow optimization.
   - Identification of options to minimize or eliminate chemical substance use and release.
   - Procedures for senior management to:
     a. Consider proactive environmental risk management in awarding business to contractors and suppliers; and
     b. Favour the purchase of returnable or recyclable packaging.
   - A regular review of the procedure for tracking progress and identification of corrective actions.

d. Written procedures of best practices for receiving, storing, shipping and handling chemical substances and their packaging. Many of these best practices can be drawn from chapters 4 through 12 of this document.

e. A maintenance plan for pollution control, safety and other critical equipment.
f. An emergency preparedness and response plan which includes:
    - If subject to the *Environmental Emergency Regulations, 2019*, an Environmental Emergency Plan as required under those regulations.
    - Spill prevention, containment, clean up and spill reporting procedures including procedures for notifying the public who may be adversely affected by a spill.
    - Investigation procedures as well as measures to prevent reoccurrence.
    - Maintenance of an up-to-date inventory of all substances present that could be hazardous to human health or the environment.
g. A waste management plan that includes waste minimization, re-use, recycling, storage and disposal procedures.
h. Housekeeping policies and procedures.
i. Inspection and verification procedures on environmental management.
j. Procedures to prevent chemical substance spills and releases from service providers, transportation partners and customers. Contractors should adhere to the same standards and procedures as facility employees.

3.2 Continuous Improvement.

Senior management should champion the EMS and undertake the following:

a. An annual or more frequent review of the EMS to identify and implement EMS improvement.
b. Update of the EMS each time there is a significant change in operational activities (e.g. handling of new products, use of new equipment, changes in operating procedures or container/package types).
c. Evaluate all new projects at an early stage, to assess the acceptability of the risks to the environment and human health.
d. Encourage staff to continue to improve environmental performance.
e. Include environmental responsibilities in job descriptions and evaluations of all staff, including management.
f. A regular review of environmental performance to ensure procedures for managing actual or potential releases are established, implemented and maintained.

3.3 Record-keeping

Documentation supporting the validity of the information outlined below should be maintained for a period of at least seven years (or, if applicable, the duration prescribed under regulations, whichever is longer) after they were made. These records should include the items listed below.

a. Internal and external EMS training completed by employees.
b. The annual quantity of each chemical substance manufactured, imported, sold, used, or disposed.
c. Documentation for handling and disposal of toxic and hazardous waste as described in section 10.5.

d. A copy of the paperwork and bill of lading related to the shipping of empty returnable packaging (i.e. non-bulk) to a supplier showing the date, number of containers and designated receiver.
e. Documentation attesting that the receivers of the waste materials, non-reusable packaging or returnable packaging meet the applicable regulatory requirements.
f. The spill response plans.
g. Records of any spill incident including the date, amount, and root cause analysis of the spill, remedial actions taken, steps taken to prevent future incidents and spill notification.
h. A record of all events that may have caused harm to the environment or human health, such as unsafe conditions, near misses and technical problems, should be reported to senior management (or its representative for environmental matters) and, if required, to relevant authorities.
i. Maintenance records for all pollution abatement equipment.
j. Training records.
k. Any documentation that must be kept based on local, provincial, federal or territorial requirements such as the *Environmental Emergency Regulations, 2019* and the National Pollutant Release Inventory.

4. Receiving and Unloading of Chemical Substances

4.1 Introduction

These recommendations are for operations receiving chemicals (in solid, liquid or gaseous state) and plastic pellets.

Facilities should ensure that delivery vehicle drivers are provided with clear instructions that include the exact unloading location, route and the unloading instructions (e.g. maximum unloading pressure, where to connect to for unloading, specific limitations or requirements). They should also assist the driver if reversing to the loading point is necessary.

4.2 Design and Layout Considerations for the Facility Area

Location

a. Ensure that the unloading area is easily accessible. The access road should provide sufficient space to manoeuvre to and from the unloading point and there should be no obstacles, including no overhead obstructions. If there is a risk of hitting obstructions, install signage or a physical barrier, especially when reversing is required.
b. Locate the unloading area under cover and within the site premises, away from traffic (e.g. other vehicles, personnel), waterbodies or other sensitive environmental areas and restrict access during operations. If this is not possible, consider the following options.
    - Close the street during unloading activities or install high visibility cones around the discharging vehicle, encouraging passing vehicles to slow down and keep a greater distance.
    - Install physical barriers at either end of the discharging vehicle, forcing pedestrians to use the walkway on the other side of the street.
    - Allow unloading activities only outside rush hours, at quieter times of the day.
c. Ensure adequate lighting for discharge operations during the hours of darkness.
d. Clearly display general environmental and security requirements and information at the entry to the unloading area (e.g. traffic rules, vehicle access restrictions such as height, weight, size)
e. Clearly define and mark the danger zone for delivery vehicles (area surrounding the delivery vehicles that is necessary to provide for the safety or security of these vehicles).
f. Protect hazardous equipment (e.g. equipment handling dangerous goods, steam lines, power cables) next to unloading area.
g. Ensure that the truck driver is able to observe the unloading process from a shelter or a safe location with an unobstructed view to the back of the truck.
h. Ensure that the surface of the unloading area is firm, even, properly drained and not on an incline. It should be anti-slip, and frequently cleaned and kept free of snow, ice and tripping hazards. Allowance for equipment designed to discharge on an incline should be

established. A slight slope of the unloading place is acceptable in longitudinal line (i.e. in the same plane as the tipping of the container/silo) in the case of bulk solid shipments where there is tipping involved. Lateral angles of slope are not acceptable.

i. Ensure that the unloading area has adaptors available for different couplings (type and size).

j. Ensure the unloading area has an adequate spill cleanup kit (e.g. proper absorbent in sufficient quantity, dustpan, and broom) and disposal receptacles.

k. Ensure that spills can be contained, easily cleaned up, and prevented from entering sewers or waterways. Designate the area for unloading and isolate this area from the drainage system for surface water (e.g. with ramps, sumps or drainage shut-off valves and, when unloading takes place, with a spill mat installed on any drain that leads to a sewer or waterway).

Silo/tank

a. Ensure that the intake point to a silo/tank or other storage area is readily accessible for connection. The intake point should be clearly identified and should be locked when not in use.

b. Install controls and/or alarms to prevent overfilling of bulk storage silos/tanks. The high-level alarm/trip should automatically stop the unloading operation. If this is not possible, the high-level alarm should be set to allow sufficient response time. Regularly test the alarm system.

- If an automatic shut-off valve, which closes in the event of excessive flow or of a high-level alarm in the silo/tank, is installed in the inlet line, install an alarm in the unloading area to warn the driver that the valve is closed and the line system between the truck and the automatic valve is still under pressure.

c. Air vented from silos during bulk solid material transfer process may need to be filtered to prevent releases of dust to the environment. Similarly, controls should be considered for the release of vapours when transferring bulk liquids to tanks.

d. As atmospheric storage silos have very little resistance to over-pressure, it is important that these silos have sufficient venting capacity in order to prevent over pressure during the unloading process.

4.3 Receipt of Packaged and Bulk Material - Totes, Drums, Pails and Bags/Boxes

a. Take care when opening the doors of the delivery vehicle as the load may have shifted in transit.

b. Inspect and document the condition of packaging before offloading (particularly chemical substances bagged in unreinforced paper or corrugated bulk boxes).

- If sampling is required, ensure it is done by qualified personnel and samples should be taken without material loss. Do not allow releases to the environment. Procedures should be reviewed prior to taking any samples to eliminate potential spillage. Samples should be taken only in areas protected by containment equipment.

c. Inspect raw materials, packages, and containers before acceptance (e.g. check the seals and integrity of the delivery vehicle) from suppliers. This process also confirms that the proper material is being received.
d. Ensure that the correct product is being delivered and request product acceptance with a certificate of analysis.
e. Emergency brakes on the delivery vehicle should be applied. Place wheel chocks under the tire of the trailer chassis as well as the rear tires of the tractor to prevent movement in either direction.
f. When using forklifts to unload totes or drums, ensure they are configured with the proper tote or drum handling apparatus to move the containers.
g. Implement handling procedures aimed at minimizing the puncture of containers with forklift tines. For example, never use the forks to pick up a drum by the chimes.
h. Train forklift operators in damage prevention as well as proper cleanup.
i. Repair, or replace, punctured packages immediately.
j. During unloading activities use spill pans, track pans, tarps or other devices at locations when handling liquids.
k. The unloading may require a fit for purpose and well-marked grounding connection, preferably with a positive ground proof indicator.

4.4 Receipt and Unloading of Bulk Solid and Liquid Shipments

a. Ensure that the receiving area (e.g. silo, tank) has enough capacity to accommodate the quantity to be transferred and that the valve is open to the storage vessel.
b. Ensure all equipment, at both the receiving site and on the delivery vehicle, is in good working order.
c. Minimize the use of adapters as the sequencing of connection pieces adds to the risks of leaks. Adaptors and their respective gaskets should be clean and in good condition.
d. When applicable, inspections and verifications should include the activities listed below. Corrective actions should take place, as required, before unloading.
    - Ensure that baghouses or filters are not damaged and are operating normally.
    - Ensure that nitrogen or dry air tanks are checked and connected, gauges are working properly and connections are secure.
    - Ensure unloading hoses are in good condition, clean and compatible with the material to be unloaded.
    - Ensure that quick disconnect fittings and gaskets are in good working order, clean and free of splits or cracks that could prevent a good seal or that could cause a leak or spill.
    - Ensure that all gaskets exposed to a product are of a material that is compatible with the product.
    - Ensure gaskets do not protrude into product lines or air supply lines.
    - Ensure couplings fit to the size of the discharge hose.
e. Ensure that the operator is aware of where the container's remote emergency shut-off is located.

f. Ensure, in the case of flammable products and bulk solids, that the delivery vehicle is ground connected and there is no source of fire or ignition in the area.

Connection of Unloading Hoses and Couplings

a. Ensure that the driver is familiar with the equipment of the vehicle (e.g. unloading valves, pressure/vapour return connections, number and capacity of compartments, hoses, couplings and gauges). The driver should make and break all connections to the delivery vehicle and operate the container valves as well as all other delivery vehicle equipment.
b. Regularly inspect and test hoses (at least annually). Ideally, all hoses are product- or product-range dedicated, and owned and maintained by the receiving site.
c. Ensure all hoses and gaskets are made of materials suitable for the products handled and resistant to the pressure and temperatures used.
d. Spare gaskets for every coupling should be available at all times.
e. Ground hoses when necessary to prevent static electricity from creating a spark and causing ignition of combustible materials.
f. Ensure good coordination and cooperation between the receiver and driver when connecting and disconnecting connections to avoid incidents.
g. Ensure the transport tank and site equipment are not under pressure before making (or breaking) any connections.
h. Exercise care when connecting and disconnecting transfer hoses to prevent spillage of residual materials.
i. Securely cap lines to prevent contamination and to avoid spillage of residual materials.
j. Connecting hoses should be equipped with valves that close automatically when the connection is broken.
k. Ensure that the site operator is responsible for correctly connecting/fitting product hoses to the storage silo/tank. The operator should also operate all of their own valves in the unloading piping and in the receiving silo/tank.
l. Fit hoses with a restraint system (safety clamps/collars/locking pins) to prevent them from becoming detached under pressure.
m. Ensure that all holes are filled with a bolt and nut (e.g. not only two when there are four holes) for those couplings where holes have to be aligned.
n. Ensure that the unloading hoses run as straight as possible from the delivery vehicle to the silo/tank intake point. Hoses should be kept free of twists.
o. Ensure that no granules/liquid remain in the connection between the coupling and hose.
p. Ensure that the product is being delivered to the correct silo/tank.

4.4.1 *Unloading of Bulk Solid and Liquid Shipments*

a. Delay unloading if weather conditions may cause a spill (e.g., icy conditions).
b. Ensure that explicit approval is provided to the driver to start unloading.
c. Ensure that the operator is in attendance at the unloading site in order to monitor the transfer of the product.
d. Monitor the level of product in the receiving tank/silo. An automatic shut-off system for the unloading process should be employed.
e. Maintain positive pressure on the transport container.

f. Do not unload into small receptacles of chemical substances, (especially hazardous and harmful substances), such as totes, drums, octabins or big bags, even in the event of insufficient capacity in the dedicated silo(s)/tank(s).

g. Do not manipulate couplings (including tightening of valves) during unloading operations. Stop unloading operations first.

h. Monitor for changing conditions that may create a dangerous situation. If this occurs, stop unloading operations.

i. Prohibit vehicle movements during unloading in the unloading zone (e.g. forklifts, cars).

j. When unloading bulk liquids, consider the following 4 common scenarios:

1) Bottom Unloading by Pump and Vapour Return

The liquid flowing from the vehicle to the site tank will simultaneously create more vapour-space in the vehicle and less in the site tank. A flexible hose connecting both vapour-spaces will balance the pressure and prevent vacuum in the vehicle. Any obstruction in the vapour return line will create an overpressure in the site tank and a vacuum in the vehicle. Positive proof of flow in the vapour return line is required.

2) Bottom Discharge by Pump without Vapor Return

The liquid flowing will simultaneously create more vapour-space in the vehicle and less in the site tank. The site tank's vapour will exit the tank to the atmosphere (possibly through a scrubber or vapour-recovery-unit). The vehicle's tank needs to be opened to allow air to enter the tank. The pump should be of self-suction design and not require the tank to be put under pressure. Putting the tank under pressure to flood the pump means the tank has to be opened quickly as soon as the pump starts to avoid vacuum damage. Treatment of the vapour exiting the site tank needs to be considered. Depending on the nature of the product, a scrubber or vapour recovery unit might be required to eliminate emissions of chemical substances to the environment.

3) Bottom Unloading by Compressed Air or Inert Gas

The site tank's vapour will exit the tank to the atmosphere (possibly through a scrubber or vapour-recovery-unit if installed). After discharge, the vehicle's tank needs to be brought to atmospheric pressure before the vehicle can be allowed to exit the site. Simply opening a vapour valve en-route is environmentally unacceptable. Treatment of the vapour exiting the site tank needs to be considered. Depending on the nature of the product, a scrubber or vapour recovery unit might be required to eliminate emissions of chemical substances to the environment.

4) Top Discharge

Some vehicles are designed with 'dip-pipes' to accommodate top-discharge. Clear indications of which connection is 'liquid' and which is 'vapour' is critical. Loading the truck with connections reversed will immediately flood the vapour-return lines.

k. After unloading, ensure that the unloading hose is empty (e.g. purging, bleed pressure, non-return valve) before disconnecting.

l. Ensure that the entire load has been discharged, that all hoses are disconnected, drained, blanked off (if necessary) and properly stored.

m. Ensure that open valves, outlet caps and top hatches are secured and sealed once unloading has been completed and prior to moving the delivery vehicle. Ensure that site operators properly put-away all equipment once operations are complete. For example:
    - Flush and clean transfer lines.
    - Disconnect grounding cables and hoses.
    - Clear away any other loose equipment.
n. Ensure that the transport tank and other equipment are not under pressure before breaking any connections and communicate this with the driver. Upon the driver's request, the operator shall provide a means to safely depressurize the vehicle.
o. Clean the unloading site area, such as the inside of container trucks, transfer lines, dock area, and surface where the unloading took place.
p. Ensure that the vehicle is safe to leave the unloading point by undertaking a visual inspection of the entire vehicle.

4.5 Receipt of Gas Cylinders

a. Do not allow cylinders to be dropped off vehicles or docks, to strike each other or to have heavy objects fall on them when unloading.
b. Perform a thorough external inspection of cylinders being received before moving them to the point of use or to storage. The cylinder surface should be clean and free from defects such as cuts, gouges, burns and dents. Such damage could create a danger of failure, or it could make the cylinder unstable and more likely to tip over. The cylinder should stand steady on its base and not wobble. If damage is identified during the inspections, the cylinder should be returned to the supplier.
c. Check the cylinder valve to be sure it is not bent or damaged. A damaged valve could leak or fail, or it might not make a tight connection once in use. Inspections should also make sure that the valve is free from dirt and oil, which could contaminate the gas. Dirt particles propelled in a high velocity gas stream could cause a spark, igniting a flammable gas. Oil and grease can react with oxygen and other oxidizers, causing an explosion.
d. Return any cylinder received with missing or unreadable labels and markings to the supplier. If a cylinder's contents are not clearly identified by the proper cylinder labels, it should not be accepted for use.
e. Test the cylinder valve for leaks after completing the external inspection. If a leak is detected, appropriate actions should be undertaken to avoid any harm to the environment or human health.

5. Storage of Chemical Substances

5.1 Purchasing and Inventory

a. Keep an up-to-date inventory of products manufactured, purchased and used (including chemical substance name, quantity of product, manufacturer and Material Safety Data Sheet/Technical Data Sheet).
b. Purchase chemical substances according to need, minimizing storage times and waste from expired products.
c. Monitor inventory in storage to reduce accumulation of over-aged products.
d. When possible, purchase chemicals in pre-weighed, sealed bags that can be placed directly in mixers or other process equipment to avoid the storage of opened packaging.

5.2 General Storage of Chemical Substances

During storage, the following practices should be followed.

a. Review Material Safety Data Sheets to ensure that storage conditions are understood.
b. Maintain precise storage temperatures.
c. If appropriate, stir substances at defined intervals during storage.
d. Store substances away from all sources of heat and ignition such as open flames, electrical devices and heating equipment.
e. Store substances away from other incompatible chemical substances.
f. Store substances away from direct sunlight.
g. Store substances away from water, either rainfall or internal operations.
h. Store substances in the original containers.
i. Store substances in antistatic containers when appropriate.
j. Avoid subjecting stored material to mechanical shocks.
k. Never put unused or surplus substances back into their original container as this could lead to contamination.

5.3 Storage of Packaged Chemical Substances

The following best practices are for chemical substances in flexible intermediate bulk containers (FIBCs)[1], intermediate bulk containers (IBC[2] or totes), drums, pails or other smaller containers and can apply to liquid and solid substances.

a. Store chemical substances in a dedicated, enclosed, ventilated, dry, clean and secure facility with a roof and a paved/concrete floor. Ensure that substances are not exposed to moisture or the elements.

[1] "Flexible intermediate bulk containers (FIBCs)" also known as bulk bags, are woven plastic bags with an impervious polymer liner and integral flexible lifting straps.

[2] "Intermediate bulk containers (IBCs)" also known as totes are pallet mounted, industrial grade reusable containers that are used for storing and transporting bulk liquids and powders.

b. Store chemical substances in an area protected from unauthorized access.
c. Store chemical substances away from heat or flame, within the temperature range recommended in the Material Safety Data Sheets.
d. Ensure that chemical substance containers are sealed, covered and stored upright in order to avoid potential leaks, spills and evaporation.
e. Protect containers from accidental damage by mechanical devices or vehicular traffic by storing containers in designated secure storage areas where there is a low volume of forklift and personnel traffic.
f. Follow manufacturer's recommendations for maximum safe stacking heights to avoid falls, and spills. Avoid stacking of full drums on top of partially filled drums when returning chemical substances to storage.
g. Store chemical substances away from sewers, drains, and other openings that may allow environmental releases in the event of a leak. Close floor drains in the area, or use a secondary containment mechanism around containers to contain leaks and spills. Secondary containment devices include oversize drums, dikes and spill pallets. Consider installation of leak detection equipment.
h. Periodically inspect chemical substance containers in storage; container corrosion could occur from denting, rupturing, or cracking of container liners. Inspect containers prior to emptying to prevent the occurrence of leakage/spills. If a container is damaged, ensure that actions are taken to prevent any release of the chemical substance in the environment.
i. Ensure that sealed containers have air space between the chemical substance and the container cover to minimize spills and reduce "puffing" losses when the container is opened.
j. Clearly display the date and label for stored chemical substances so they can be easily identified. Do not store chemical substances with different hazard symbols together - clear guidance on the compatibility of different chemical substances can be obtained from Material Safety Data Sheets. Ensure that incompatible chemical substances are stored such that there is no possibility of accidental contact between the containers.
k. Record and display the date that containers are initially opened to ensure that they are used before they expire to reduce waste from expired products.
l. Ensure that only trained Hazardous Material specialists handle bulging containers.
m. Use non-sparking tools and appropriate personal protection equipment.
n. Conduct work in an open, well-ventilated area free from sources of ignition.
o. Release container pressure gradually.
p. Consult the material supplier for further instructions.

5.4 Storage of Flexible Intermediate Bulk Containers (FIBCs)

FIBCs, also known as bulk bags, are woven plastic bags with an impervious polymer liner and integral flexible lifting straps. Best practices for storing FIBCs include the following activities.

a. Do not stack FIBCs unless sure of stability. When FIBCs are stacked in order to make space, ensure that the stack is stable. Form stacks against a minimum of two retaining walls, preferably three, to achieve maximum stability. Where only free stacking is possible, use a pyramid method. Do not push FIBCs into a stack as this can damage the sides or back of the FIBC.

b. Ensure that FIBCs do not hang over the edge of a pallet.
c. If FIBCs are stored outside, ensure that the top closure is properly tied off. Cover FIBCs with waterproof, U.V. protected material to avoid exposure to rain, prevent water from collecting on the top of the FIBC and to prevent damage from sunlight. Do not leave FIBCs standing in water.

5.5 Storage of Bulk Chemical Substances

5.5.1 *Location*

Locate storage sites such that spills and leaks of chemical substances are unlikely to drain to soil or stormwater drainage systems. Consider exposure to fire hazards. Consider exposure to vandalism when selecting sites for bulk storage and establish security procedures or equipment as necessary (e.g. fencing and lighting).

5.5.2 *Storage of Solid Bulk Chemicals Substance*

The storage of solid bulk chemical substances primarily occurs in silos and hoppers.

Silos and hoppers are normally equipped with a dust filter to filter the displaced air during loading or unloading, as a significant amount of dust may be generated during filling and some dust is also generated when emptying. The supplier of bulk material can also reduce dust generation by following the measures listed below:

a. Screen or classify bulk material
b. Coat bulk solids with a thin, adhesive layer making very fine particles stick to coarser particles.
c. Reuse dust collected by dust filters, where possible in the process. If not possible to reuse the dust and including cartridges should be disposed of properly as described in subsection 10.2.2.

5.5.3 *Storage of Liquid Bulk Chemical Substances*

Typical guidelines for aboveground storage tanks include the following activities.

a. Ensure that bulk storage tanks are made of a material suitable for contact with the product to be stored. Check with the supplier for a list of compatible materials for each liquid.
b. Ensure that the capacity of the storage tank is large enough to accept a full tanker load in addition to any remaining contents at the time of delivery.
c. Place liquid bulk storage tanks inside a diked containment area (to contain the liquids in the event of a tank failure).
d. Ensure that the dike and diked area, including the area underneath the tank, is built or lined with a material that will not be degraded by the material being stored and is liquid tight. Ensure that the dyke is located away from sewers, drains, and other openings that may allow environmental releases in the event of a leak.
e. Ensure that the diked area is kept clean to prevent contamination by any other material in the dike. Inspect the diked area each month. Ensure that the storage tank/dike is subjected to periodic integrity tests to identify leaks.
f. Consider the installation of a firewall to protect the storage tank from flames.

g. Avoid evaporation losses by venting storage tanks through proper filtering devices. Comply with applicable laws and regulations for venting of bulk storage tanks and workplace exposure to chemical substances.

5.6 Storage of Chemical Substances in Gas Cylinders

Due to the hazardous nature of gas cylinders, ensure that applicable codes and regulations are followed and Material Safety Data Sheets from the supplier are reviewed in order to identify storage requirements for specific gas cylinders.

Best practices related to the storage of chemical substances contained in gas cylinders include the following activities.

a. Keep the size and number of gas cylinders in storage as small as practicable. Storage arrangements and practices should ensure for adequate turnover of stock.
b. Store cylinders in a purpose-designed and dedicated cylinder area that is not located within a closed-in or underground location. The location should be:
    - in a dry, cool, well-lit, well-ventilated area protected from the weather and explosion risk,
    - in a secure area, away from heavy traffic and emergency exits and designed to prevent unauthorized entry,
    - free and clear access to cylinders for delivery vehicles, cylinder handling and in the case of an emergency,
    - away from combustible materials in an area free from the risk of fire and well away from sources of artificial heat, open flame or ignition (e.g. flames, heaters, combustible materials, flammable liquids),
    - away from the edges of platforms,
    - separate from other products, particularly oil, paint or corrosive liquids, and
    - on a reasonably level and firm surface (preferably concrete).
c. When stored outside, ensure that the storage area protects the cylinders from the weather and direct sunlight.
d. Keep storage area clean at all times.
e. Store empty cylinders separately from full cylinders and identify with clear markings. Ensure that empty cylinders have their valve shut to prevent contaminants from entering the cylinder. Note that gas cylinders should never be run to zero pressure and left totally empty.
f. Ensure that cylinders are separated by gas type and stored in assigned locations that can be readily identified. For example, keep hazardous, harmful and corrosive gases away from all other gases.
g. Store cylinders containing flammable gases separately from oxidizer cylinders with a fire-resistant barrier.
h. Do not allow gas cylinders to come into contact with electrical equipment.
i. Ensure that cylinders are prevented from falling or being knocked over by securing them with a racking system, bench/wall clamp or a non-abrasive, coated chain that will not damage the cylinder markings and paint work. Store cylinders upright in compact groups, interlocking them so that each cylinder physically contacts those around it.

j. Ensure that valve outlet seals and valve protection caps are in place to help prevent dirt or dust or other contaminants entering, which may affect gas quality, cause corrosion and prevent a good seal being obtained when connecting to process equipment.

k. Ensure that when storing cylinders containing hazardous gases, the cylinder valve outlet threaded plug or cap is replaced in the valve outlet when the cylinder is not in use or connected to a manifold or regulator.

l. Store cylinder close to the point of use and move to storage as soon as possible after use.

m. Ensure that the stored cylinders are visually inspected on a routine basis, at least weekly, for any indication of leakage. Consider using leak detection fluids and gas monitors if the content may cause harm to the environment or human health. If a leak is detected, ensure that appropriate actions are taken to avoid any harm to the environment or human health.

6. Transfer of Chemical Substances

6.1 General Best Practices for the Transfer of Chemical Substances

All employees involved in the transferring of chemical substances should have adequate training in best practices for discharging the contents of the container and preventing spills. Handling and transfer areas should be designated and clearly marked, and the floor should be flat, impermeable and isolated from the public wastewater or surface water systems.

Procedures aimed at preventing releases to the environment should be documented in work instructions or protocols. Some general best practices include the following activities.

a. Use automated dispensing equipment for chemical substances to avoid spills from manual dispensing and to provide quality control.
b. Purchase pre-weighed chemical substances in sealed bags instead of manually weighing to avoid fugitive air emissions and spills.
c. Use drip pans to capture residual product drips from valves and connections.
d. In procedures that involve the handling of powder materials, such as the loading of reactor vessels, the use of a local exhaust capture system will avoid dust emissions.
e. Close windows and doors near transfer operations in order to avoid interference with the exhaust system. Where local exhaust ventilation is used, ensure that air passes through an appropriately designed filter system before discharge to the environment.

6.2 Transferring Chemical Substances from Flexible Intermediate Bulk Containers (FIBCs)

Best practices when dispensing chemical substances from FIBCs include the following activities.

a. Ensure that the FIBC is free from damage before initiating the emptying process.
b. Use recommended devices for handling a full FIBC. This includes ensuring that your apparatus is rated to handle the weight of a full FIBC.
    - These devices should be rounded and free of protrusions, with the rounded edges meeting a minimum measurement of 5 mm.
c. Follow recommended procedures for installing and opening the FIBC and take appropriate measures to control dust and spillage.
d. Ensure that lifting straps are not twisted.
e. Ensure that FIBCs are not dragged.
f. Ensure that the FIBC is placed on a stable surface, preferably slightly inclined in such a way that the discharge valve is at the lowest point.
g. Ensure that when unloading FIBCs, care is taken to prevent the build-up of static electricity and loss of material by improper use of the discharge valve.
h. After dispensing, clean the valve and remove any residual product. Ensure that the valves are closed on FIBCs to prevent loss of residual product and reduce the possibility of contamination.

6.3 Transferring Chemical Substances from Bags

Many facilities purchase raw materials in bags. One of the most significant potential release sources of chemical substances to the environment are residues left in the packaging. Powders tend to stick to package walls or get trapped in the folds. An empty bag that contains chemical substances should be handled carefully. It is generally best to try to minimize the amount of packaging used and to use appropriately-sized bags that are recyclable. However, it may happen that smaller bags are preferred to avoid partial use of content associated with a bigger bag and potential leaks/spills related to reclosing/handling.

Best practices to use when dispensing chemical substances by bags include the following activities:

a. Carry out bag-breaking operations in an area where dust and spills can be controlled and collected. Bag breaking stations are commercially available to assist the operator in controlling dust and disposing of empty bags.

b. Carry out dispensing operations in a controlled manner to avoid the creation of airborne dust or spills onto floors and other surfaces.

c. Ensure that all contents of the bags are discharged, unless a lesser quantity is required.

- In cases, where small quantities of material are required, use scoops to transfer small quantities. Ensure that the bags are tightly closed and taped before returning to storage.

d. Empty plastic or paper bags are likely to contain residual materials. Place bags in a sealed container for disposal as described in section 10.1. Compactors or balers may be used to reduce the volume of bags to be sent for disposal. Ensure that dust created during the compression cycle of these machines is captured and sent for disposal.

e. For harmful chemical substances, use a ventilation system to capture dust emitted while emptying bags. Route the captured air stream to a particulate control device, such as a filter, scrubber, baghouse and/or electrostatic precipitator. In addition, after the bag has been carefully and completely emptied, consider the following steps.

- While still near the vent opening, roll up each bag to remove all the air.
- Place rolled up bags in a plastic bag for disposal.
- Close the plastic bag and put this bag full of empty bags in a shipping container for proper disposal such as hazardous waste landfill or incineration.

6.4 Transferring Chemical Substances from Drums, Pails and Intermediate Bulk Containers/Totes (IBCs)

Ensure that drums, pails and IBCs used for chemical substance dispensing are placed on, or in, an impermeable secondary containment system. Secondary containment systems are designed to catch leaks or spills from the primary container during its use. This will also allow the recovery of any spilled material. Ensure that the secondary containment does not have any drainage.

Where dispensing liquids from storage containers through hoses or pumps, ensure that connections are secure and hoses are in good working order. Inspect hoses, pumps and connecting devices as well as containers regularly for signs of damage or leakage. Repair or replace damaged equipment promptly.

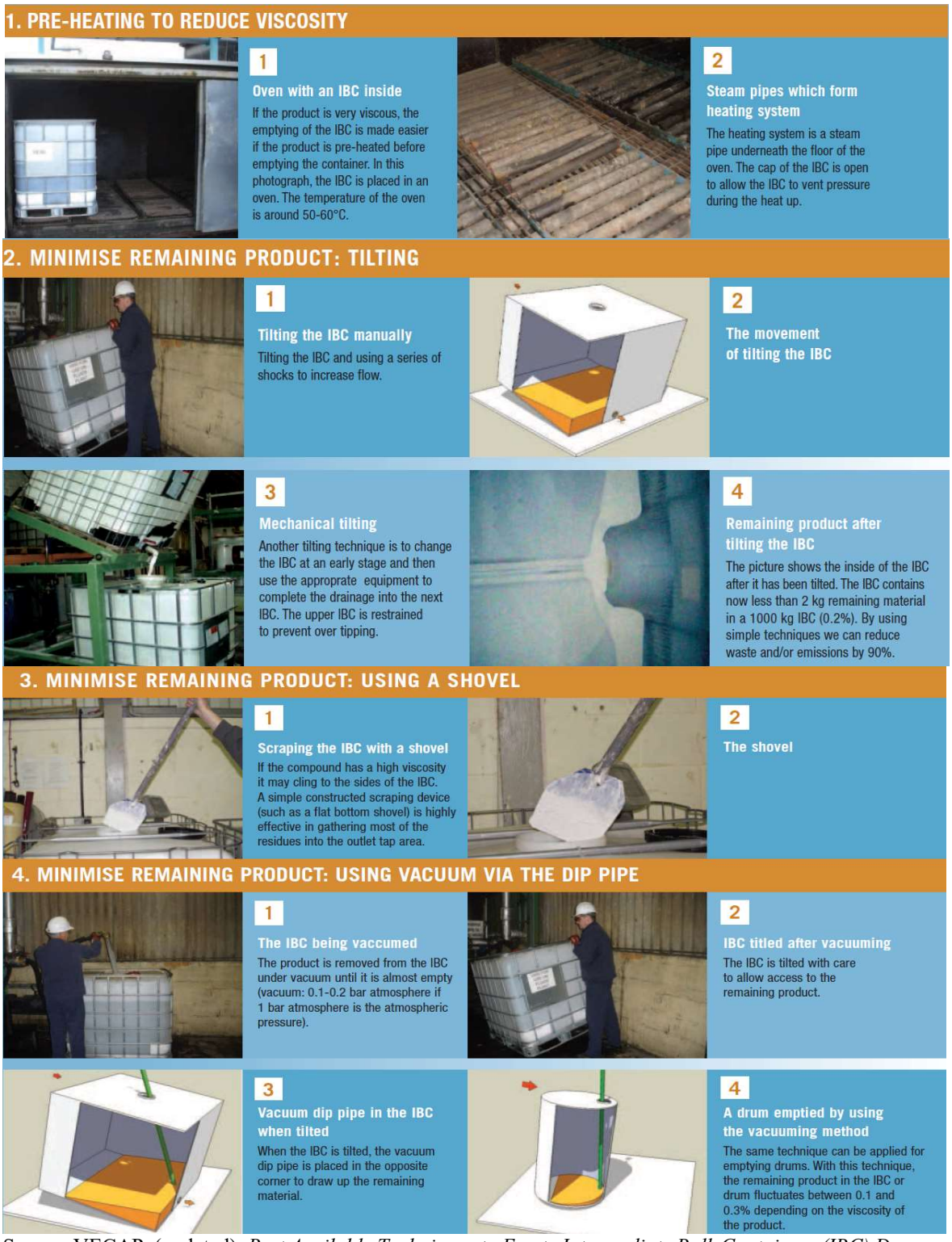
Best practices to use when dispensing chemical substances by drums and pails include the following activities.

a. Ensure that drum overpacks are available.
b. Do not use pressure to empty drums.
c. Provide adequate venting.
d. Ensure that drums and pails returned to storage without being fully discharged are resealed with original lids or bungs.
e. Fully discharge drums and pails and inspect for signs of residuals before disposal. Consider heating liquid products – as suitable for the type of product − to help improve the flow of material out of the container and scraping out the remaining material.
f. Dispose of empty drums and pails as described in section 10.1.
g. Drums and pails may be lined with a Low Density Polyethylene (LDPE) liner to prevent contamination of the contents. When the contents of the container have been consumed, carefully remove the liner, place in a sealable container and dispose of as described in subsection 10.1.2.

Best practices to use when dispensing chemical substances by IBC include the following activities.

a. The contents of an IBC should be fully discharged. Following are recommended practices to maximize the emptying of the material in an IBC. Each of these steps is pictorially displayed in Figure 1.
    - Consider heating the material in order to reduce its viscosity – as suitable for the type of product − and enable the material to flow out of the container more easily.
    - Tilt the IBC, either manually or mechanically.
    - Use a shovel to scrape out the remaining material. When the material is highly viscous it may cling on the sides of the IBC.
    - Use a vacuum on the dip pipe within the IBC.

Figure 2: Steps to Empty an IBC of its Contents



Source: VECAP, (undated), *Best Available Techniques to Empty Intermediate Bulk Containers (IBC) Drums or Small Containers Containing Chemicals*

6.5 Gas Cylinders and Related Equipment

6.5.1 *Transporting Gas Cylinders*

a. Do not roll, drag or slide a cylinder horizontally along the ground (even for short distances) as this may damage or open the cylinder valve. Similarly, do not allow cylinders to strike each other during transfer.

b. Transport cylinders in an upright position.

c. When moving cylinders, securely fasten them to a suitable cylinder-transporting device.

d. Once in place, secure the cylinder with wall brackets, fasteners/clamps, cylinder stands or other devices, before ancillary equipment is connected. Secure the cylinder before removing the valve protection cap.

e. Position the cylinder to enable immediate access to the cylinder valve and regulator in case of emergency.

f. The cylinder label is the primary means of identifying the contents of a gas cylinder and the nature of hazards associated with gas contained in the cylinder. Do not use a gas cylinder if the label is missing or illegible or if the heat tag has been damaged.

6.5.2 *Connecting/Disconnecting and Using Gas Cylinders*

a. Before use, remove the valve protective cap and inspect the cylinder valve for damaged threads, dirt, oil or grease. Never open a damaged valve. Remove dust or dirt present with a clean cloth. If oil or grease is present on the valve of a cylinder that contains oxygen or another oxidant, do not attempt to use it. Such substances in contact with an oxidant are explosive. Leak-test lines and equipment with an inert gas before using.

b. When connecting ancillary equipment, do not over-tighten or use excessive force. Ensure that fittings and connection threads meet properly – never use force. Ensure that pressure regulators are dedicated to a single valve connection even if they are designed for different gases. Do not Cross thread or use adapters between non-mating equipment and cylinders. Do not use thread sealant tape on the valve threads to prevent leaking – small pieces can break free and get caught on the regulator.

c. Never insert an object such as a wrench or screwdriver into valve cap openings to remove a stuck cylinder cap. Doing so may damage or open the valve. Use an adjustable strap wrench to remove over-tight or rusted caps.

d. Use gas cylinders in a vertical position, unless specifically designed to be used otherwise.

e. Never tighten fittings when the equipment is under pressure.

f. Disconnect equipment from the cylinder when not in use and return the valve protection cap to the cylinder. Do not remove valve guards or valve protection caps/rings. It is essential when handling cylinders containing harmful or hazardous gases that the cylinder valve outlet threaded plug or cap always be replaced when the cylinder is not in use or connected to a manifold or regulator. This provides additional safety against leakage.

g. Do not open cylinder valves unless a pressure regulator has been fitted. Check the pressure regulator to ensure that it is designed for use with high-pressure gas cylinders and that the inlet spigot thread matches the cylinder valve outlet. Ensure that the O-ring or seal is in place, clean and undamaged.

h. Slowly open the cylinder valve using the hand wheel or the cylinder valve key. Ensure that an opened valve is not left against the backstop (i.e. fully opened until resistance is

encountered), and it is turned back at least half a turn to avoid seizure in an open position. This can occur if the valve is left open for a long period.

i. When closing the valve, turn it clockwise just enough to stop the gas completely. Never over-tighten.

j. Ensure that hose connections conform to stipulated pressure and mechanical property requirements. Purge hoses and check for leaks or visible signs of damage before use. Protect hoses from heat, mechanical damage, traffic, sparks and oil or grease. Dispose of hoses showing signs of deterioration. Regularly check connections and ensure that hoses are as short as possible.

k. Where appropriate, use a flashback arrestor to limit the potential damage that may result if a flashback occurs. Flashback arrestors have a sensitive non-return valve that stops the gas flow and can be reset once inspection of equipment has taken place. Test flashback arrestors each year.

7. Production Operations

7.1 Preventing Chemical Substances Releases to Air

7.1.1 *Particulate Matter Emissions*

Dust or particulate matter emissions may be generated when solid raw materials or finished products are conveyed, granulated, pelletized, compounded, cut, machined, filed, transported, loaded into mixers or weighed. These emissions can be reduced at facilities through a combination of measures.

Dust Minimization

The most effective way to control dust emissions is to prevent their release in the first place. Approaches to help minimize dust generation include the following activities.

a. Ensure that conveying systems are designed and operated to treat the solid materials gently. Avoid collisions and impacts with hard surfaces and other solid materials, thereby avoiding fracture. Cover conveyors to contain dust and ensure that conveying equipment is appropriate for the task and maintained in good condition.
b. Minimize drop distances from conveyors to receiving vessels.
c. Use dustless spouts.
d. When pelletizing or flaking, ensure that cutting equipment is kept in good condition with sharp blades.
e. When machining solid materials, use an appropriate machine set up for the material in order to minimize dust.
f. Where possible, use solid materials in small, pre-weighed, sealed bags for direct addition to the mixer (instead of having to remove the materials for weighing).
g. Use enclosed mixing and storage vessels and extraction and ventilation systems.
h. Ensure that storage silos, tanks and containers are kept in good condition.
i. Ensure that loading/unloading and transfer equipment are maintained with good seals to help avoid leaks.

Dust Collection

Dust collection systems should be operated and maintained by specialists in accordance with regulatory requirements and the manufacturers' instructions. Best practices include the following activities.

a. Keep a maintenance schedule for the dust collectors including cleaning and/or replacing filters as recommended.
b. Inspect ductwork regularly to ensure that there is no build-up of material in the duct. Promptly remove built-up materials in a manner that does not create dust and store in a sealable container for future reuse or disposal. Identify and resolve the underlying cause of the material build-up.
c. Install bag break monitoring systems (in the case of fabric filters) to detect the onset of material losses from the dust collector and alert operators or shut down processes. Note that a broken or damaged filtration element can cause the sudden and rapid discharge of collected dust to the environment.

- Consider installing a secondary baghouse to capture dust released as a result of a failure in the primary filtration system.
- Repair bag or filter breaks immediately to prevent the release of particulate matter into the environment.

d. Where possible, return dry dust or dewatered sludge back into the process from which it was derived. If not possible, investigate the feasibility for an alternate treatment other than disposal. If disposal is necessary, ensure that releases to the environment are prevented during the disposal process, including from:
   - removing dust from the hopper of the dust collector,
   - conveying the dust,
   - storing the dust, and
   - treating the dust for final disposal.

e. To prevent recirculation of fine dust, ensure that collected dust is removed from the hopper to prevent recirculation within the dust collector and ensure that dry dusts are bagged or wetted so that they are less prone to becoming re-dispersed.

f. If the waste dust from dust collection must be disposed, dispose of as per subsection 10.2.2.

7.1.2 *Volatile Organic Compounds and Gases*

To reduce volatile organic compound (VOC) and gaseous emissions, the reduction of stack, fugitive and venting emissions is important. In general, stack emissions refer to emissions of which the source and direction of gas flow is clearly definable. They enter the atmosphere by passing through a stack or a duct designed to direct and control their flow. Sources of fugitive emissions typically include equipment leaks from pumps, compressors, flanges, valves, open-ended lines and pressure relief valves. Volatile pollutants from fugitive emissions enter the atmosphere without passing through a stack or duct designed to direct or control the emissions. Venting is the intentional releases of gas to the atmosphere. Measures to control or prevent stack, fugitive and venting emissions, are available. A distinction is made between primary and secondary measures.

Primary Measures

Examples of primary measures to reduce VOC and gaseous emissions include the following activities.

a. Use of high quality equipment and materials of construction that minimize leakage (e.g. appropriate corrosive resistant materials).

b. Effective maintenance of equipment and optimization of operating conditions.

c. Implementation of changes in processes such as closed circuit systems, or structural changes such as transfer of activity to locations where emissions are reduced more efficiently.

d. Substitution of VOCs (e.g. use of low-organic solvent, organic-solvent-free materials, or high-pressure water systems).

e. Reduction of fume levels by optimizing temperatures of the process.

f. Implementation of a formal Leak Detection and Repair (LDAR) program.

Secondary Measures

When primary measures are not sufficient to achieve high emission reductions or are not technically applicable, add-on control technologies such as the following activities can be applied.

a. Techniques based on destruction of VOCs/gases present in captured gases such as:
   - oxidation (thermal or catalytic, recuperative or regenerative),

- flaring,
- biological destruction, and
- for destroying non-halogenated VOCs, using VOC-laden gas streams as secondary air or fuel in existing energy-conversion units.

b. Techniques enabling recovery of VOCs/gases for possible reuse in the process such as:
   - adsorption on activated carbon or zeolite substrates,
   - absorption in adapted scrubbing liquors (e.g. water, heavy oils),
   - condensation and cryogenic condensation, and
   - membrane separation associated to other processes such as cryogenic condensation and adsorption.

The most appropriate technique should be selected according to case-specific conditions. In some instances, installation of ventilation systems is necessary to capture VOCs and direct them to the installed secondary control technology.

7.2 Preventing Chemical Substance Releases to Water

7.2.1 *Process-Integrated Prevention Techniques*

Below are examples of techniques to consider to prevent the release of chemical substances in the environment.

a. Countercurrent product washing.
b. Countercurrent extraction.
c. Reactive extraction.
d. Substance recovery from mother liquors and substance retention.
e. Use of high purity materials (contaminated raw materials and/or auxiliaries can import pollutants into the production chain and thus into the wastewater system).
f. Source segregation of wastewater (specific pretreatment can be applied).

7.2.2 *Floor / Storm Drains*

a. Floor/Storm drain screens are the last line of defence against accidental solid material release. Ensure that they are installed in all storm drains at every facility. Ensure that the mesh of the screening is smaller than the smallest solid material handled at the facility. Pay particular attention to cleaning screens after every rain. Two-stage screens minimize clogging problems.
b. Regularly clean storm drains to prevent drain clogging and overflow.
c. Install baffles, skirts and/or booms in containment ditches or ponds. Use surface skimmers or vacuum systems to remove accumulated solid materials. Ensure that the containment system can handle heavy rains and flooding.
d. Close non-necessary drains.
e. Be aware of discharge points of the floor/storm drains and sump pump system at all times and ensure that they are highlighted in work instructions and practices to prevent spills and leaks.

f. Prevent entry of solid materials such as plastic pellets into the wastewater or stormwater systems. Should they enter, filter or separate out solid materials out of the wastewater to prevent them from reaching the public wastewater system or surface waters. Drainage sieves or temporary covers are examples of physical means to prevent the intrusion of plastic pellets into the water system.
g. Ensure that inspection and monitoring of water filtration and treatment equipment is part of the regular maintenance protocol. In order to prevent solid material (e.g. plastic pellets) loss, consider implementing more stringent protocols, such as shorter cleaning intervals. Regularly inspect, clean and, where appropriate, repair specific water treatment equipment close to the source, especially after heavy rainfall or in periods of high water levels.

7.2.3 *Wastewater Treatment Operations*

Several facilities within the chemicals, plastics and rubber product manufacturing sectors operate their own wastewater treatment plant as a means to prevent chemical substance releases to the environment. Wastewater treatment includes the following measures.

a. Initial pH adjustment.
b. Particulate removal.
c. Oil and grease removal.
d. Removal of metals.
e. Removal of biodegradable pollutants using biological processes.
f. Chemical treatment of wastewaters for removal of organics, acids, non-biodegradable pollutants, and harmful pollutants, among other substances.
g. Processes such as activated carbon, membranes or reverse osmosis.

Optimal operation of internal wastewater treatment facilities is key to prevent the release of chemical substances to the environment. Facilities should review their individual wastewater treatment operations to ensure that they are operating at peak performance and to make any necessary modifications that would improve the performance of the system with respect to preventing the release of chemical substances to the environment.

A key step in wastewater treatment selection and optimization is wastewater characterization. This includes, but is not limited to, identifying key pollutants and their concentration, sources and volumes, selecting sampling strategies and determining main pollutants to be removed.

8. Packaging, Loading and Shipping

8.1 Package Selection and Means of Transportation

When selecting the appropriate packaging and means of transportation, select a means of transportation and packaging that is going to reduce the likelihood of release of chemical substances in the environment. Only competent and appropriately registered carriers should be used to transport chemical substances.

The following steps provide basic guidance on how to select appropriate packaging materials.

a. Ensure that packaging materials or internal liners are compatible with the chemical substance being handled.
b. Ensure that packaging, including bulk boxes, are designed to minimize the possibility of breakage and subsequent chemical substance leakage. Where possible, line containers with puncture-resistant material, especially larger containers.
c. Use reinforced containers/bags if breakage is a recurring problem.

8.2 Packaging, Loading and Securing Small Packaging Containers

8.2.1 *Packaging Area*

The release of chemical substances can occur when product is loaded into small shipping containers (e.g. drums, bags, IBC/FIBCs) before transport to customers as well as when these shipping containers are being loaded into transport vehicles.

It is important to ensure the following steps are taken in the packaging of chemical substances.

a. The surface of the packaging area is impermeable to the products being packaged and designed to ensure that spills are contained and prevented from entering sewers or waterways, and to facilitate clean up in the event of a spill.
b. The packaging area is equipped with an adequate spill cleanup kit (e.g. proper absorbent in sufficient quantity, dustpan and brooms).

8.2.2 *Small Container Packaging*

Following are general best practice applicable to small shipping containers such as drums, bags, IBC and FIBCs, as well as any other small containers used to send chemical substances to the end consumer.

a. Prior to filling a container, check for damages or defects. Do not fill or ship a container that is not suitable for shipping.
b. Ensure that practices are put in place to prevent the spill of chemical substances and overfilling while packaging into small containers.
c. When filling containers, consider heat expansion so that the container does not break or overflow.
d. Where possible, use filling equipment designed to prevent loss of solid and liquid chemical substances.

e. Collect spilled solid or liquid chemical substances without delay and dispose of as described in section 10.3.
f. Minimize the use of valve bags. If valve bags are used, ensure that they are sealed immediately after filling or moved and stacked immediately after filling to avoid seepage.
g. Replace or seal leaking bags properly.
h. Ensure that FIBCs are filled with the base of the bag supported by the ground or a pallet, and the body of the bag supported by the top with a lift device.
i. Ensure that the FIBC discharge spout is tied off or closed before filling.

8.2.3 *Palletizing Methods for Small Containers*

Products contained in small containers (e.g. bags) are often shipped on pallets. Containers shipped in this manner need to be properly secured. Best practices with respect to palletizing bags include the following activities.

a. Ensure that pallets used for shipping are inspected for protruding nails or broken boards; especially important for reducing damage in bags.
b. Stack bags on the pallet in tight, interlocking patterns.
c. Place corrugated cardboard caps on the top and bottom of pallets to minimize the puncturing or tearing of bags and to contain loose solid chemical substances.
d. Shrink-wrap pallets to stabilize stacks and help contain loose solid chemical substances.
e. Ensure that outbound loads are blocked and braced to avoid broken bags in transit.
f. Ensure that drums shipped on pallets are secured to prevent vertical and horizontal movement. If steel or nylon bands are used, avoid over or under tightening as it could result in damage to the drums. Stretch wrap may be used to secure drums.

8.2.4 *Transport Device Inspections*

A checklist should be used to verify that the transport device is suitable for loading and transportation. Contents of the checklist may vary depending upon each facility's practices, mode of transportation, and their specific needs. Best practices for trailers or containers include the following activities.

a. Ensure that after a trailer has been parked at the loading dock, measures are taken to prevent accidental movement, such as the use of wheel chocks.
b. Inspect the inside of the trailer to verify that it is suitable for loading and free of insects and debris. Following are examples of defects to look for.
    - Roof (holes and cracks).
    - Floorboards (loose, broken boards).
    - Walls (loose or broken walls or scuff boards).
c. Use a shovel or the flat side of a squeegee to detect protruding nails or screws in the floor of the trailer. Remove protruding nails, screws, or imbedded sharp objects prior to loading.
d. Inspect tie down loops to see that they do not protrude into the container storage area; a common cause of damage to containers while in transit. If they protrude, readjust so that they are positioned within the trailer walls.
e. Conduct a walk-around inspection to verify the walls, support rails, and lifting corner posts are in good condition.

f. Ensure that the door closure devices are working properly and that doors are capable of being closed and secured without affecting the load during transit.

8.2.5 *Loading and Securing Small Containers*

To ensure a proper loading and transport process, all the equipment should be selected, assembled and used in such a way that containers will not be damaged and there will be no spills under normal transport conditions, including the use of emergency brakes, sudden maneuvers, shunting operations (during intermodal carriage), handling, and container terminal operations. Best practices include the following steps.

a. Establish a loading plan that provides maximum freight protection, stability and proper distribution of weight in the trailer.
b. Ensure that for trailers or containers, the weight of pallets, bracing, dunnage and items to secure the freight is calculated to avoid exceeding the maximum allowable weight for transport.
c. Use proper dunnage materials such as airbags, cardboard, plywood, foam, rubber friction mats or other suitable materials to provide a safe method of securing freight.
d. Consult with the driver to ensure proper weight distribution of the load.
e. Ensure that when preparing to load a container with other freight already on board, that the freight on board is secure and compatible with the chemical substances being prepared for loading.
f. Prior to transporting drums on pallets, consider the gross weight of drums being palletized and select an appropriate pallet to support the drums and prevent movement under normal transportation conditions.
g. Ensure that when placing drums onto a trailer, the drum is rested on a flat surface and not on top of the adjacent drum chimes. Overlapping chimes can lead to damage and/or leaks in transit.
h. Ensure that containers with chemical substances are fastened with restraint systems to prevent movement during transport. Facilities should consult relevant regulations when using restraint systems to immobilize cargo. Note that container doors (such as trailer doors) are not recommended as a restraint system.
i. Ensure that the transport container is closed and secured prior to transportation. Ensure that security seals are properly used. The type of seal used will vary based on company requirements, mode of transportation and origin/destination regulations.

8.3 Loading Bulk Vehicles

Bulk-handling equipment designed to minimize chemical substance leakage and closed loading systems are preferred to minimize releases of chemical substances to the environment. If closed loading systems are not possible, spill protection devices or sealed filling systems can be installed.

Following are some best practices for loading trucks/railcars.

Prior to Loading

a. Provide regular training to loading personnel and truck drivers.
b. Ensure that the facility operator regularly checks the equipment owned by the site (e.g. product hose, vapour return or nitrogen/air pressure line, couplings, gaskets and seals) to

ensure that it is in good condition, free of blockage or clogging, fit for purpose and product and pressure resistant.

c. Ensure that the driver checks the equipment owned by the hauler (e.g. product hose, vapour return or nitrogen/air pressure line, couplings, gaskets and seals) to ensure it is in good condition, fit for purpose and product and pressure resistant.
d. Ensure that the truck/railcar is immobilized for the duration of the loading operation. Use wheel chocks and barrier installations if there is no interlock system provided on the road tanker.
e. If required, connect the grounding cable of the road tanker to the gantry structure and ensure that the vehicle tank is properly bonded.
f. Ensure the couplings are properly connected, without use of undue force, before loading and check for any sign of leakage before and during loading. Use connecting hoses equipped with valves that will close automatically when the connection is broken.
g. Use catch pans under all connections.
h. Before loading, ensure that the facility operator checks the capacity of the transport tank or tank compartment with the driver, and confirms that it is the correct transport tank and does not already contain other substances.

During Loading

a. Ensure that the operator is in attendance at the loading site in order to monitor the transfer of the product.
b. Establish procedures to avoid overfilling, exceeding the maximum permissible axle weight and insuring even distribution of the weight.
c. Ensure that there are no manipulations of couplings (including no tightening) during loading operations. Stop operations prior to tightening a leaking valve or coupling.

After Loading

a. Ensure that, before disconnecting hoses, all valves are closed and all hoses are depressurised and free of product.
b. Flush transfer lines after each loading operation is completed.
c. Ensure that before departure, the driver checks that it is safe to leave the loading point by walking around the vehicle confirming all hoses are disconnected, drained, blanked off (if necessary) and properly stored, that all manhole covers and valves are closed and properly tightened and the grounding cable and any loose equipment is cleared away.
d. Do not disengage anti-drive-away interlocks/installation barriers until it is verified that the vehicle can be safely moved
e. Properly seal bulk transportation vehicles prior to shipment.

9. Container/Tank and Hopper Car/Truck Cleaning

9.1 Introduction

It is recommended to send empty drums and totes to specialized facilities that have appropriate filtration systems and provincial permits for cleaning/reconditioning. Equipment cleaning done on-site should consider the following practices to prevent releases of chemical substances to the environment.

9.2 Container Cleaning

There are a number of methods for cleaning drums and totes, but a method that produces the least waste is environmentally, and often economically, preferable.

a. Any wash-water generated should be incorporated into the process where practical.
b. For drums, a triple rinse method is recognized as a thorough rinsing process. Every attempt should be made to generate as little wash-water as possible when using this method, while still ensuring that the drum is free of all residues.
c. If wash-water cannot be re-used, pressure rinsing should be considered as it produces less liquid waste than a triple rinsing method.
d. Chemicals, such as hot caustic or acid, may also help to minimize liquid waste volume if these chemicals do not cause additional environmental problems.

9.2.1 *Triple Rinsing of Drums*

The typical procedures used for the triple rinsing of drums are as follows:

a. Empty as much material out of the drum as possible, including easily removable residues. See section 6.4 for best practices to empty drums.
b. Perform the following steps three consecutive times:
    1) If the material is water-soluble, fill drum with water to 25% of capacity. If the material is not soluble in water, use a suitable solvent for the first two washes (use 4-20 litres of solvent for a 205-litre drum) and water (25% of the drum capacity) for the final rinse.
    2) Replace and tighten bungs of the drum.
    3) Tip drum on to its side and roll it back and forth, ensuring at least one complete revolution for 30 seconds.
    4) Stand the drum on its end and tip it back and forth several times to rinse the corners.
    5) Turn the drum over on to its other end and repeat this procedure.
    6) Carefully empty the rinsate into a suitable container.
    7) Use a brush or other mechanical aid to facilitate the cleaning.
c. Additional wash cycles may be used if the drum does not appear to be clean after three cycles.

Ensure that the rinsate from all cycles is collected and subsequently managed according to the appropriate waste handling procedures as described in subsection 10.3.3.

9.2.2 *Pressure Rinsing of Drums*

The following procedures provide a list of steps to pressure rinse drums.

a. Ensure that the drum is completely empty. See section 6.4 for best practices to empty drums.
b. Turn water on and rotate the nozzle inside the drum to rinse all sides.
c. Rinse drum for at least 30 seconds or until rinsate runs completely clear.
d. Drums containing rinsate should be placed on a secure level surface prior rinsing to prevent splashing or spillage of the rinsate.

Ensure that the rinsate is collected and subsequently managed according to the appropriate waste handling procedures as described in subsection 10.3.3.

9.2.3 *Cleaning Totes*

a. Use omni-directional spinner heads and pump sets in conjunction with high-pressure water to clean totes.
b. Where the product is resistant to water, perform a post wash preparation with a chemical added to the wash water to assist product breakdown.
c. Ensure that the rinsate from all cycles is collected and subsequently managed according to the appropriate waste handling procedures as described in subsection 10.3.3.

9.3 Tank Cleaning

Typical tank cleaning methods include “boiling out” or “fill and drain,” manual cleaning, wetting (static spray balls), rotary wetting (rotary spray balls) and rotary impingement cleaning. Cleaning efficiency is impacted by several factors, including dilution, time, chemical action, temperature and mechanical force. Altering any of these factors will impact cleaning efficiency.

Boiling-out or fill-and-drain methods involve filling tanks with a concentrated chemical solution then heating the tank to remove residues. These procedures use significant quantities of water and should only be used when necessary. Alternate technologies/methods that use less fluid are listed below.

a. Manual cleaning / scrubbing - The process of entering the tank and manually cleaning with a hose and scrub brush.
b. Static spray balls and rotary spray heads that rely on small orifices or narrow passages to distribute the wash fluid.
c. Rotary impingement machines that combine pressure and flow to create high-impact cleaning jets.

In all cases, ensure that the rinsate is collected and subsequently managed according to the appropriate waste handling procedures as described in subsection 10.3.3.

9.4 Cleaning of Plastic Pellet Cars and Trucks

Hopper cars and trucks used for plastic pellet transportation should be cleaned in such way as to prevent pellet losses in the environment. Based on the *Operation Clean Sweep* program, the following is recommended in cleaning empty hopper cars and trucks.

a. Use an air lance procedure to make total pellet removal easier.
b. Ensure that hopper car and truck cleaning areas have wastewater collection and pellet filtration systems installed.
c. Recover all pellets from wash water.
d. Dispose collected pellets properly. Consider recycling or resell.

9.5 Cleaning of Batch Process Equipment

Batch processes often involve equipment cleaning/rinsing between batches to prevent cross contamination. The following best practices should be used to prevent the release of chemical substances in the environment from batch process rinsing.

a. Design processes to minimize chemical substance residues.
b. Modify batch scheduling to minimize tank cleaning.
c. Recycle or reuse rinsate.
    - Pre-rinsing and collection of the first rinsate for reuse.
    - Rinsate from additional rinsing stages can then be collected and sent to municipal wastewater treatment systems.
d. Minimize waste residue by totally emptying tank and piping. When possible, dry clean/flush, using compressed air or vacuum, to maximize chemical substance recuperation for its end purpose.
e. Dispose harmful substances in a secure landfill or by incineration as per subsection 10.2.2.

10. Waste Management

10.1 Used Packaging

Whenever possible, process materials should be purchased in returnable packaging that can be returned to the supplier or to a designated handler. The supplier should be contacted for questions regarding recycling/disposal options. If a container has been used for dangerous goods, requirements of the *Transportation of Dangerous Goods Regulations* must be followed. Best practices for reusable and non-reusable packaging are listed below.

10.1.1 *Reusable Packaging*

a. Establish returnable container handling procedures, including sealing, cleaning and reuse of the packaging.
b. After the contents of the packaging have been used, properly seal the empty package to prevent loss of residual materials during storage and transport. This also eliminates the possibility of foreign materials entering the container, which could have an adverse effect on the reuse of the package.
c. When returning empty packaging to the supplier or designated handler, ensure that the previous contents of the packaging are indicated on the bill of lading.
d. For reusable drums/totes:
    1) Follow the supplier's requirements for returnable packaging.
    2) For drums/totes that cannot be returned to the supplier, check a professional drum/tote reconditioner to verify if the containers can be reconditioned to be used again.
    3) For reconditioning of empty containers, a list of registered drum reconditioners is available from Transport Canada.
    4) The Reusable Industrial Packaging Association (RIPA – www.reusablepackaging.org) may also be contacted if a drum/tote recycler cannot be found.
    5) Contact the product manufacturer for additional guidance.
    6) If drum/tote reconditioners are utilized, ensure that these companies demonstrate that their rinsate is managed properly.
    7) If a reusable tote or drum needs to be disposed of due to damage or age, follow the instructions on non-reusable packaging, outlined below.
    8) Do not reuse containers unless they have been professionally cleaned and reconditioned by appropriate entities.

10.1.2 *Non-Reusable Packaging*

For harmful chemical substances, and particularly ones that are persistent and bioaccumulative, it may be preferable to not re-use or recycle packaging. For non-reusable packaging, measures to prevent re-use or misuse of the packaging are listed below.

a. Follow manufacturer's recommendations on how to properly decontaminate drums.
b. Disposal must be in accordance with all applicable waste regulations.
c. For empty non-reusable packaging that held harmful or hazardous chemical substances, ensure appropriate disposal according to laws of the jurisdiction where the facility is located.

d. Ensure that prior to transporting an empty package that has not been properly decontaminated, the container is sealed in a manner that will prevent any leaks of residual product to the environment.
e. Clearly indicate on the bill of lading for transporting the empty packaging what specific chemical substances are contained in the packaging and what shipping procedures must be followed.
f. Ensure that the contracted company hired to manage the empty packaging is operating in accordance with the laws of the jurisdiction where the facility is located.
g. Ensure that rinsate from packaging that contained hazardous or harmful chemical substances is managed as described in subsection 10.3.3.

10.2Waste Process Materials

10.2.1 *Recycling/Reuse of Waste Materials*

Wherever possible, priority should be given to reduction of wastes generated, and recovery and re-use of raw materials. Examples include:

Chemicals

a. Recondition and reuse solvents (e.g. distillation on site or off site) and catalysts.
b. Liquid hydrocarbon and flammable solvent waste could be used as fuel.

Plastics

a. Separate plastic wastes produced during operations for recycling. Scrap could be reground and mixed with virgin materials. Where possible, separate mixed plastics into single resin types. End products from single resins are often of higher quality than those from mixed resins.
b. Waste pellets, flakes and powders may also be used in a fuel-blending program.

Rubber

a. Segregate waste streams (e.g. uncured rubber, cured rubber, and off-specification products) thereby facilitating their recycling back into the process. Where possible, recycle and reuse waste streams at the facility.

10.2.2 *Disposal of Solid Waste*

When chemical substance waste materials or waste dust from dust collection system cannot be reprocessed internally, or cannot be sold as low-grade material, it should be disposed of in an environmentally sound way.

General best practices with respect to the disposal of solid waste are listed below.

a. Ensure that the waste is clearly labelled and disposed of through an authorized waste contractor. Ensure that the waste carrier and disposal site have suitable permits and proper handling and storage procedures are in place. Ensure that the disposal company provides written confirmation that the waste will be disposed of in the manner agreed to.
b. Waste storage, disposal, packaging and transport methods used must comply with applicable laws, regulations, guidelines, codes and standards. Harmful wastes should be

transported in completely sealed containers to prevent the possibility of releases to the environment.

c. When incineration is used to address waste, ensure that incineration of these materials occurs at properly licensed incinerators. Similarly, when landfills are used to address waste, facilities should ensure that it occurs at properly licensed landfills.
d. All solid waste containing hazardous or harmful substances should be disposed according to jurisdictional requirements.
e. Explore non-conventional means of waste management. For example, hydrolysis can convert some substances to a water-soluble salt that can be disposed of as non-hazardous waste.
f. Do not mix incompatible wastes (e.g. oxidizing agents with solvents, chlorinated solvents with ketones, metal dusts or alkalis).
g. Ensure that solid wastes contaminated with harmful substances, including non-re-useable packaging, spent dust filtration media, soiled rags and contaminated personal protection equipment, are disposed of at a landfill or incinerator that is certified to handle the materials (i.e. hazardous waste management facilities).
h. Ensure that prior to the disposal of plastic waste landfill, (e.g. plastic pellets, flakes and powder), that the waste is confined in such a manner that prevents their loss due to rain, wind, and flooding.

10.2.3 *Disposal of Liquid Waste*

Chemical substance liquid waste will, in most jurisdictions, be regarded as hazardous waste. General best practices with respect to the disposal of liquid waste are listed below.

a. Dispose of liquid waste, including any aqueous solutions used for cleaning of chemical substance laden surfaces, through a facility certified to handle liquid and hazardous industrial waste.
b. Ensure that applicable laws and regulations are followed and the receiving facility consulted for packaging and transporting requirements.
c. Ensure that the facility treating the waste is well informed of the liquid waste content in order to be able to correctly treat it and dispose of it.
d. Ensure that harmful chemical substance residues are disposed of according to jurisdictional requirements.

10.2.4 *Quality Control Samples*

Samples for quality control should be collected and stored in identified containers. When samples are no longer required, they should be disposed of as described above for solid or liquid wastes. Consideration should be given to recycling these in the process.

10.3 Management of Waste

10.3.1 *Contaminated Clothing*

All contaminated protective equipment and cleaning equipment should be disposed of properly, or thoroughly cleaned and decontaminated after use. Employees should be advised on appropriate storage and disposal for contaminated clothing. Professional cleaning of contaminated clothing in an environmentally sound manner should be used to prevent the releases of chemical substances to the environment.

10.3.2 *General Housekeeping*

Waste dust generated on-site may contain chemical substances. Best practices related to the management of contaminated waste dust are listed below.

a. Dispose of waste dust as chemical substance/hazardous waste.
b. Place contaminated waste dust in a specified storage container.
c. Clearly label contaminated waste dust and dispose of through an authorized waste contractor.
d. Ensure that waste containers are tight, readily opened and resealed and sturdy enough to prevent the contents from accidental release resulting from damage to the container.
e. Ensure that pellet, flake, powder disposal or other housekeeping waste containers are strategically placed on site where they are likely to be needed.
f. Use separate containers for recyclable and non-recyclable process materials.

10.3.3 *Aqueous Rinsate*

Aqueous rinsate from tanks, totes, drums, pails or lines containing chemical substances should be collected and sent for off-site disposal as described in subsection 10.2.3. If it is not technically or economically feasible to treat non-harmful substances off-site, efforts should be made to prevent the release of any chemical substances in the environment. Appropriate and effective wastewater treatment technologies should be used. Applicable laws, regulations and discharge limitations must be met.

10.3.4 *Chemically Reactive Wastes*

Many chemical substance wastes (e.g. amines, alcohols, aqueous acids, and alkali) are chemically reactive and need to be segregated from other wastes. Material Safety Data Sheets available from the supplier should be reviewed in order to apply safe handling procedures. Proper segregation measures and handling procedures are listed below.

a. Keep pure chemically reactive waste separate from all other wastes.
b. Inform waste disposal contractors of the nature of the chemically reactive waste and of specific disposal requirements.
c. Ensure that the containers used for storing chemically reactive process waste are suitable for the purpose and correctly labelled.
d. Do not use containers that held the chemically reactive process material to hold other wastes.

10.3.5 *Liquid Wastes Generated From Fighting Fires*

Best practices for treating spent liquids used to fight or extinguish fires are listed below.

a. Develop a collection plan for firewater runoff. Ensure that the plan aims at listing and making available the required equipment that will capture the runoff water and contain it in a holding area or tank, allowing later treatment. Ensure that spill and containment equipment are located on-site and additional resources are identified in the plan.
b. Block sewer drains - this is a common practice used to prevent contaminated runoff from entering the sewer system.
c. Use portable dikes to collect run-off - these are usually used for land-based operations.
d. Use portable booms - these are used for marine-based operations, and are set up to contain firefighting runoff in a defined area.

e. Use holding tanks or areas where the contaminated runoff can be collected, treated, and disposed of as described in subsection 10.2.3.

10.4Waste Storage

Applicable laws for the quantity of waste stored on site, the duration of storage and other waste storage requirements/limits by local, provincial, territorial or federal authorities must be followed.

Best practices related to the storage of waste containing chemical substances are listed below.

a. Regularly check that solid waste storage equipment is in good condition, waste storage areas are clear of debris and waste containers are covered/sealed to prevent waste escaping/evaporating.
b. Store waste holding containers in such a manner that potential for accidental damage, exposure to sunlight, and extreme climatic conditions are avoided.
c. Ensure that a designated safe storage area is available for hazardous and liquid waste.
d. Ensure that wastes are designated, clearly labeled and kept in closed areas in appropriate containers.
e. Update waste stock inventory on a regular basis and ensure that the time that waste is onsite is minimized.
f. Store chemically reactive wastes in designated containers and do not mix with other wastes.

10.5Waste Documentation

Provincial and territorial governments license hazardous-waste generators, carriers, and treatment facilities. Generators of hazardous waste materials may be required to register both the designated waste management facility and the generating facility with the appropriate authority. Facilities accepting hazardous waste will require special permits to handle these materials. It is the responsibility of the waste generator to ensure that the contracted waste management provider (e.g. waste hauler, waste receiver) is properly licensed and is operating in accordance with the applicable laws and regulations[3].

It is recommended to keep copies of the following documents, at a minimum, relating to harmful and hazardous substance waste.

a. The waste manifest, movement document or a permit, if applicable, showing the date, amount, waste class and receiver of any wastes transferred off-site.
b. The bill of lading and any other documentation relating to the shipment of waste material or waste packaging showing the date, type and number of pieces, the original product in the waste package and the designated receiver.
c. Documented evidence of correct disposal/management by authorized waste companies.

[3] Environment and Climate Change Canada regulates transboundary movements (province-to-province and outside Canada) of hazardous wastes through the *Cross-border Movement of Hazardous Waste and Hazardous Recyclable Material Regulations*

11. Maintenance and Housekeeping

Maintenance of equipment and housekeeping are essential in minimizing releases of chemical substances to the environment. Formal written maintenance and housekeeping guidelines should be prepared and made available to all employees and management should make sure these practices are enforced and kept up to date.

11.1 Maintenance of Equipment

Best practices for the maintenance of equipment are listed below.

a. Ensure that all equipment (owned, leased or subcontracted) is adequately maintained to prevent and detect defects before they cause spills or leaks, and to prevent fugitive emissions of chemical substances.
b. Repair leaks and other problems as soon as possible in order to prevent the release of chemical substances to the environment.
c. Establish a maintenance schedule for the equipment employed at the plant and ensure that the schedule is followed.
d. Ensure that employees are aware of the environmental risks associated with release of chemical substances during maintenance functions.
e. Ensure that maintenance procedures address the control of chemical substance losses, disposal of process materials and proper handling of personal protective equipment and tools that may have been exposed to chemical substances.

11.2 Preventing Leaks

Regular inspections for leak detection should be performed and procedures should be put in place to ensure corrective actions are taken without undue delay. Leak detection programs usually address, at a minimum, the sources of emissions listed below.

a. Pump seals
b. Compressor seals
c. Agitator seals
d. Valves
e. Flanges
f. Connectors
g. Open-ended lines
h. Pressure relief devices
i. Sampling connections

11.3 Cleaning and Housekeeping

11.3.1 *Cleaning of Equipment and Tools*

In order to prevent the release of chemical substances in the environment, regular inspection and removal of accumulated process materials and fugitive dust from equipment surfaces and tools should be part of a comprehensive housekeeping plan. Best practices for the cleaning of equipment and tools are listed below.

a. Carefully remove materials from equipment and tools by vacuuming or manual removal such as scraping, brushing or wiping. Using compressed air as a method of cleanup should be a last resort as it may disperse materials in the environment.
b. Ensure that vacuums are equipped with appropriate filters to prevent the release of airborne particles. In order to minimize airborne dust from vacuuming and other cleaning procedures, keep a maintenance schedule for the dust collectors including cleaning and/or replacing filters as recommended.
c. Place materials contaminated with chemical substances, including wipers and rags used for cleaning, in sealable containers for future reuse or proper disposal. See chapter 10 for proper disposal practices.
d. Ensure that equipment cleaning is coordinated with maintenance operations.
e. Ensure that "fit for purpose" cleaning equipment are available at the facility.
f. Ensure that an approved list of cleaning tools and procedures for the safe disposal of spent cleaning tools is prepared and made available to all employees.
g. Ensure that employees at the facility are aware of, and have access to, a list of cleaning procedures that they are expected to undertake and checklists to assist.

11.3.2 *Housekeeping*

General housekeeping includes all activities that keep the facility clean including the removal of fugitive dust from floors, walls, ceilings, beams, pipes, light fixtures, and stored inventory. Best practices for general cleaning operations are listed below.

a. Ensure that cleaning methods do not create airborne dust. Where a possibility that fugitive dust may contain chemical substances, capture the dust and place in a sealable container and dispose of as described in chapter 10.
b. To minimize the need to treat liquid wastes, use dry cleaning methods as an alternative to washing and rinsing. Common cleaning methods for dry powder or dust may include vacuuming, brushing and wiping with rags. Ensure that vacuums are equipped with appropriate filters to prevent the release of airborne particles. Avoid use of compressed air jets.
c. If water or other solutions (including high pressure or steam cleaning) are used in the cleaning process, ensure that water containing chemical residues, including plastic pellets, is captured and sent for treatment. Protect floor/storm drains (e.g. screens) to prevent the entry of chemical substances.
d. Consider the use of eco-friendly cleaning products.

11.4 Personal Protective Equipment/Clothing

Spent personal protective equipment, such as gloves, dust masks, disposable coveralls and boot covers that have been in contact with chemical substances should be placed in appropriate containers and disposed of as described in chapter 10.

11.5 Vehicles

11.5.1 *In-Plant Vehicular Traffic*

In-plant vehicular traffic (e.g. forklifts, pallet trucks and other material handling equipment, delivery trucks and rail cars) can retain chemical substance residuals on tires and other components. Best practices to prevent chemical substance releases from in-plant vehicular traffic are listed below.

a. Minimize the potential for fugitive dust (containing chemical substance residuals) accumulating on the surface of vehicles through regular inspection and removal of fugitive residuals on in-plant vehicles.

b. Prohibit or restrict the movement of in-plant vehicles to outdoor surfaces to the extent possible in order to prevent the release of fugitive chemical substances to exterior surfaces where they can be washed into sewers and watercourses. Where traffic between interior and exterior surfaces is unavoidable, implement measures to prevent track out of process materials. Keep floors adjacent to egress points clear of dust and debris and consider the paving of exterior surfaces of the plant to facilitate the collection of chemical substances. Restrict movement of in-plant vehicles to essential activities when chemical substances are involved.

c. Clean up spills of chemical substance materials immediately to prevent tracking of the process materials on the tires of material handling equipment.

11.5.2 *On-Road Vehicular Traffic*

On-road vehicles should not be permitted into areas of a facility where dust containing chemical substances may be present. Where it is necessary for on-road vehicles to enter an area where dusts containing chemical substances are present, ensure that these vehicles use a tire scrub pad or similar tire-cleaning device prior to leaving the facility. Inspect vehicles for residual chemical material and ensure that residues are removed and disposed of as described in chapter 10.

11.6 Maintenance and Housekeeping Contractors

Best practices for maintenance and housekeeping contractors are listed below.

a. Ensure that maintenance contractors are aware of the environmental risks associated with release of chemical substances during maintenance functions.
    1) Establish procedures for the management of these environmental risks in contractor orientation programs.

b. Ensure that maintenance procedures address the control of chemical substance losses, disposal of chemical substances and proper handling of personal protective equipment and tools that have been exposed to chemical substances.

c. Ensure that appropriate containers for materials and contaminated personal protective equipment are provided to contractors.

d. Ensure that contractors are aware of the potential to track out chemical substances on clothing and vehicles and the hazards of the release of chemical substances to the environment through inappropriate cleaning techniques and improper waste disposal. Ensure that written procedures are prepared and provided to housekeeping contractors.

12. Spills

12.1 Advanced Planning for Spill Prevention and Management

In the event of a chemical substance spill, prompt action is required to minimize the loss of this material and prevent the release of chemical substances to the environment. Facilities should undertake advanced planning to prevent and manage such incidents.[4] Examples of advanced planning that should be undertaken are listed below.

a. Review Material Safety Data Sheets and other available technical information for the chemical substances handled within the facility in order to prepare for proper action in the event of a spill.

b. Establish clear accountability for spill prevention, containment, cleanup, disposal and reporting. Ensure that specific employees are responsible for monitoring and managing chemical substance spills. Develop and implement procedures to prevent, contain and address chemical substance spills.

c. Review current procedures and identify whether there has been a history of problems in certain areas.

d. Post emergency contacts and phone numbers in a conspicuous place.

e. Ensure that relevant notification procedures, including contact numbers, to the appropriate government authorities are prepared and easily available.

f. Ensure that the worksite is designed to prevent, contain and address spills.

g. Clearly mark locations of shut-off valves.

h. Protect drains to prevent entry of spilled materials. Ensure that discharge points of the floor/storm drains and sump pump system are known at all times and considered in the work instructions and practices to prevent spills and leaks.

i. Ensure that emergency stop buttons for pumps, metering and conveying devices are readily accessible to operators and their functions clearly identified.

j. Ensure that spill cleanup kits are adequately stocked with material to contain, cleanup and securely store spilled materials (e.g., absorbents, neutralizing agents, cleanup tools, containers). Maintain spill cleanup kits on a regular basis to ensure that they are always available and fit for purpose.

k. Ensure that spill cleanup kits are immediately available and easily accessible in areas where a risk of spills has been identified.

l. Ensure that spill response plans are communicated, promoted and made available to all employees and contractors.

m. Establish a training program for emergency spill prevention and response for all employees/contractors that addresses spill containment, cleanup, material handling and reporting protocols so spills are properly and immediately dealt with and reported to relevant authorities without delay.

n. Consider a contract with a remediation/salvage company that can assist in cleaning up spills on the facility's premises. Note that the responsibility for handling a spill still resides with the facility.

[4] The *Environmental Emergency Regulations, 2019* may require developing an Environmental Emergency Plans.

12.2 Actions to Take in the Event of a Spill

12.2.1 *Initial Control of the Spill*

a. Stop/minimize the spill by isolating or interrupting the flow from the source. This can be accomplished by immediately closing a valve, rotating a drum, transferring the contents, or another appropriate action. If a drum is punctured with a forklift, leave the forks in the drum.
b. To prevent releases to other areas and the environment, the first priorities are to isolate the area where the spill occurred, stop/minimize the amount of the spill and cover all drains in the surrounding area. Do not wash any spills into the floor or rainwater drainage.
c. Consider keeping drains always covered in high risk areas for spills and remove them when necessary.
d. If applicable, enact Environmental Emergency Plans.
e. Consult relevant Material Safety Data Sheets for guidance in controlling the spill.

12.2.2 *Containing and Cleaning-Up the Spill*

a. Always refer to the manufacturer's Material Safety Data Sheet for specific instructions on containment, cleanup and disposal of spilled materials as special cleaning techniques may be indicated.
b. In some instances, special precautions are required prior to containing the spill (e.g. the spilled material may need to be neutralized according to information in the relevant Material Safety Data Sheet).
c. Collect spilled liquid chemical substance waste and place in a sealed, labelled container.
d. To stop the spread of spilled material, neutral and inert absorbent material such as clay, sawdust, sweeping compound, sand, sandbags, vermiculite or calcined diatomaceous earth, can be used to create a barrier around the spill and/or the inlet to the sewer or drain. Use spill pillows as necessary.
e. Ensure that if the chemical substance that was spilled is hazardous or harmful, waste material generated during spill clean up (e.g. brooms, mops, remaining absorbent, etc.) is disposed of appropriately according to jurisdictional requirements.
f. Use paper or rags for cleaning smaller spills.
g. Avoid release of chemical substances to the sewer drain, or to municipal water systems, waterways, or other sensitive points.
h. For larger spills, consider pumping spilled material into appropriate containers.
i. For solid materials, use containing/cleaning methods that do not create airborne dust, such as vacuuming or sweeping with dust suppressing materials. Ensure that vacuums are equipped with appropriate filters to prevent the release of airborne particles.
j. Where possible, recover chemical substances lost through a spill in a manner that permits their reuse in the manufacturing process. Prompt clean up will minimize the risks of cross contamination and improve the opportunities for chemical substance reuse.
k. Take special precautions when handling reactive waste generated from spills as described in subsection 10.3.4.
l. Dispose of waste material from a spill as described in chapter 10.

12.2.3 *Report Spills*

In the case of some spills, the facility must notify the appropriate government authorities in accordance with applicable laws and regulations. The following Environment and Climate Change Canada website provides information on when to report and who to notify: https://www.canada.ca/en/environment-climate-change/services/environmental-emergencies-program/national-centre.html#toc8.

The facility should notify members of the public who may be adversely affected by a spill.

Ownership and stewardship of the spill reporting system should rest with a nominated senior manager within the company. The system should be well understood by all personnel and by all subcontractors to ensure that all spills are reported to management. The contact numbers for spill reporting centres should be readily available to those persons responsible for the spill reporting system.

12.2.4 *Record Spills*

Records of all chemical substance spills (whether reportable or not) and near misses at the facility should be kept. These records should include the following items.

a. Contact information of the person who was responsible for managing the spill.
b. Date, time, and location of the release.
c. Date of notification of the spill and identification of all persons and authorities notified as a result of the release.
d. Name and CAS registry number of the substance released.
e. Quantity or estimated quantity of the substance released.
f. Identification of the container from which the substance was released and a description of its condition.
g. A description of the circumstances and cause of the release (if known) and of the measures taken to mitigate any negative effects on the environment or on human life or health.
h. A description of measures taken or planned to prevent similar releases.

12.2.5 *Investigate Spills*

All chemical substance spills (whether reportable or not) should be investigated and measures implemented to prevent reoccurrence. Spill reports should be periodically analyzed to search for trends and common causes. This will allow additional improvements to be de implemented which will help reduce the occurrence of spills.

Appendix 1: Evaluation Checklist

Code of Practice for the Environmentally Sound Management of Chemical Substances in the Chemicals, Plastics and Rubber Sectors

NOTE: Please indicate if you are implementing one or more of the following programs.

☐ Responsible Care® – Date of last Verification _____

☐ Operation Clean Sweep (OCS) – Date of last Verification _____

☐ ISO 14001 – Date of last Verification _____

☐ Responsible Distribution® – Date of last Verification _____

Please complete only sections that are not pre-populated.[5]

Best practices (with corresponding section of the code)	Implemented (Yes, started, no, NA)	Responsible Care®	Operation Clean Sweep (OCS)	ISO 14001	Responsible Distribution®	Comments
3.1 Environmental Management System		☑	☑	☑	☑	
3.1 Training program that include environmental best practices		☑	☑	☑	☑	
3.1 Pollution Prevention Assessment recently done		☑	☑	☑	☑	
3.2 Continuous improvement process led by senior management		☑	☑	☑	☑	
3.3 Record-keeping system that include environmental best practices		☑	☑	☑	☑	
4.2 Design and layout considerations for facility area		☑	☑	☑	☑	

[5] Note that pre-populated sections do not necessarily imply a complete overlap between programs and the Code of Practice. Evidence of the implementation of best management practices may be requested in future risk management instruments pertaining to harmful substances that incorporate the Code of Practice as part of risk management requirements.

4.3 Receipt of packaged and bulk material		☑	☑	☑	☑	
4.4 Receipt and unloading of bulk solid and liquid shipments		☑	☑	☑	☑	
4.5 Receipt of gas cylinders		☑		☑	☑	
5.1 Purchasing and inventory of chemical substances		☑		☑	☑	
5.2 General storage of chemical substances		☑		☑	☑	
5.3 Storage of packaged chemical substances		☑		☑	☑	
5.4 Storage of FIBCs		☑		☑	☑	
5.5 Storage of bulk chemical substances		☑	☑	☑	☑	
5.6 Storage of chemical substances in gas cylinders		☑	☑	☑	☑	
6. 1 General best practices for transfer of chemical substances				☑	☑	
6.2 Transfer of chemicals from FIBCs				☑	☑	
6.3 Transfer of chemicals from bags				☑	☑	
6.4 Transfer of chemicals from drums, pails and IBCs				☑	☑	

6.5 Gas cylinders and related equipment				☑	☑	
7.1 Preventing chemical substances releases to air		☑		☑	☑	
7.2 Preventing chemical substances releases to water		☑		☑	☑	
8.1 Package selection and means of transportation		☑		☑	☑	
8.2 Packaging, loading and securing small packaging containers		☑	☑	☑	☑	
8.3 Loading bulk vehicles		☑	☑	☑	☑	
9.2 Container cleaning		☑		☑	☑	
9.3 Tank cleaning		☑		☑	☑	
9.4 Cleaning of plastic pellet cars and trucks			☑	☑	☑	
9.5 Cleaning of batch process equipment		☑		☑	☑	
10.1 Used packaging		☑		☑	☑	
10.2 Waste process materials		☑		☑	☑	
10.3 Management of waste		☑		☑	☑	
10.4 Waste storage		☑		☑	☑	
10.5 Waste documentation		☑		☑	☑	

11. 1 Maintenance of equipment		☑		☑	☑	
11.2 Preventing leaks		☑	☑	☑	☑	
11.3 Cleaning and housekeeping		☑	☑	☑	☑	
11.4 Personal protective equipment/clothing		☑	☑	☑	☑	
11.5 Vehicles		☑	☑	☑	☑	
11.6 Maintenance and housekeeping contractors		☑	☑	☑	☑	
12.1 Advanced planning for spill prevention and management		☑	☑	☑	☑	
12.2 Actions to take in the event of a spill		☑	☑	☑	☑	

By March 31st of each year, email checklist to the Chemical Production Division of Environment and Climate Change Canada at the following address: pgpc-dppc-cmp-cpd@ec.gc.ca.

Signed for:

Company Name:
Facility Address:

By:
Title:
Email Address:
Signature:

_____

Date:

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