Resource for Greening Plastics and Rubber Products Manufacturing Pollution Prevention Information

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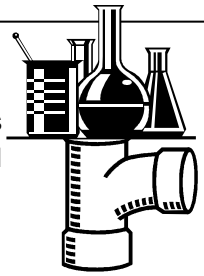
Greening of Plastics and Rubber Products Manufacturing

Toronto's ChemTRAC program includes an Environmental Reporting and Disclosure Bylaw (Municipal Code Chapter 423) that requires local businesses to track and report their use and release of 25 priority substances. The ChemTRAC program provides an opportunity for you to identify strategies for improving your environmental performance. Strategies include those that reduce the use and release of the 25 priority substances. Strategies may also reduce the use and release of other chemicals that may have a health and/or an environmental impact. This Greening Resource for Plastics and Rubber Products Manufacturing will help you understand the chemicals that you are using and find ways to reduce or eliminate their use. For additional resources, including a Guide to Reporting, visit http://www.toronto.ca/chemtrac/.

Plastics and Rubber Products Manufacturing



This business sector processes new or spent (i.e., recycled) plastics resins, as well as natural, synthetic, or reclaimed rubber materials into intermediate or final products. Within most of these industries, a wide variety of products can be made, including plastic bags, bottles, plumbing fixtures, floor covering, and rubber tires, hoses, and belting.

Note: Plastic resins are covered in A Guide to Greening Chemical Manufaturing

Priority Substances and Other Chemicals of Concern

Toronto Public Health has identified 25 substances of priority heath concern that are commonly used and released by businesses in the City of Toronto. As part of ChemTRAC, the Environmental Reporting and Disclosure Bylaw requires businesses and facilities to track and report on any of the listed priority substances that a facility manufactures, uses or releases to the environment if the amounts are equal to or above the reporting limits. In addition to the priority substances, industrial processes commonly use and release other chemicals of concern that may have a health and/or an environmental impact that are not subject to the by-law.

The Plastics and Rubber Products Manufacturing sector may use and produce some of these priority substances and other chemicals of concern. Each of these chemicals may have an impact on human health and/or the environment. Below are the substances that may be used or produced by your facility and its operation. This is not an exhaustive list.

Substances that may be used or produced by your plastics and/or rubber products manufacturing facility and its general operations

Chemical Sources	Priority Substances Tracked by ChemTRAC	Other Chemicals of Concern*
Chemical additives may contain or produce:	• Heavy metals: - Lead - Cadmium • Volatile Organic Compounds[1] (VOCs)	• Zinc compounds • Ammonia • Selenium compounds • 1,1-Dichloro-1-Fluoroethane 1-Chloro-1,1-Difluoroethane • Carbon disulfide • Lubricants (e.g., stearic acid, waxes, fatty acid esters, and fatty acid amines) • Antioxidants (alkylated phenols, amines, and esters) • Anistats (e.g., quaternary ammonium compounds, anionics, and amines) • Blowing/foaming agents (e.g., azodicarbonamide) • Colourants (e.g., titanium dioxide, iron oxides) • Flame retardants (e.g., antimony, trioxide, chlorinated paraffins, and bromophenols) • Plasticizers (e.g., phthalates, phthalates)
Air emissions from processes throughout rubber and plastics manufacturing may contain:	• Heavy metals: - Lead - Cadmium - Manganese - Nickel - Chromium • VOCs (e.g., styrene, toluene, xylene, methanol, methyl ethyl ketone (MEK), methyl isobutyl ketone (MIBK), methanol, methylene chloride, heptanes, hexane, acetone, vinyl chloride) • Polycyclic Aromatic Hydrocarbons (PAHs) • Dichloromethane • Formaldehyde • Trichloroethylene • Tetrachloroethylene • Acetaldehyde • Particulate Matter[2] ($PM_{2.5}$)	

Chemical Sources	Priority Substances Tracked by ChemTRAC	Other Chemicals of Concern*
Wastewater from cleaning, heating and cooling processes may contain:	• Formaldehyde • VOCs (e.g., methanol, ethylene glycol)	• Bis(2-ethylhexyl) phthalate (BEHP) • Biochemical oxygen demand (BOD5) • Esters • Oil and grease • Total suspended solids (TSS) • Chemical oxygen demand (COD) • Total organic carbon (TOC) • Total phenols • Nitrate compounds • N,N-dimethylformamide • Zinc compounds • Ammonia
Equipment cleaning / maintenance operations may produce:	• VOCs	
Solid wastes generated throughout processes may contain:		• Sodium nitrite • Zinc compounds • Methyl acrylate • Acrylonitrile

Notes:

* Chemicals that may have a health and/or an environmental impact.

1. VOCs are emitted as gases from certain solids or liquids. When combined with nitrous oxides (NOx) in sunlight, smog forms.
2. Particulate matter (PM) consists of airborne particles in solid or liquid form (e.g., dust). $PM_{2.5}$ is airborne particulate matter with a mass median diameter less than 2.5 micrometre.

Understanding Your Company's Impacts: Plastics and Rubber Products Manufacturing

In plastics and rubber products manufacturing, there are several activities or processes that contribute to the use and/or release of priority substances and chemicals of concern. The use and release of chemicals depends on the type of process, as well as the equipment and chemicals that are used.

Priority substances and chemicals of concern may be found at various steps of plastics and rubber manufacturing processes. Spills and leaks can occur at any point of the manufacturing process, but the main source of priority substances and chemicals of concern come from chemicals added prior to the forming and/or molding process. These chemical additives can contribute to point emissions through confined air streams as found in stacks, ducts, or pipes and fugitive air emissions from losses from equipment leaks or evaporative losses from impoundments, spills, or leaks. Air releases can be traced primarily to the curing, mixing component preparation, and building/assembly stages of the rubber products manufacturing process and to the forming and molding, solvent cleaning and finishing stages of the plastics products manufacturing process. Water contamination can also occur through direct contact cooling processes, in which water is used to cool and finish products, and from machinery cleaning. Releases of chemicals to land occur from the use of various chemicals in the rubber and plastic mixing processes and from clean up wastes.

Although the plastic and rubber manufacturing processes are similar, this guide shows them as two distinct processes because facilities typically produce products made of just one material, either plastics or rubber.

This guide outlines the general processes for plastics and rubber products manufacturing, indicating where the priority substances and chemicals of concern may be used or released. Your facility may have more specialized processes or only engage in some of these processes; however, it is possible that these priority substances and chemicals of concern may still be present.

The following diagrams show the raw materials that may go into each process and the pollution that may come out of each process. Symbols show whether the wastes typically go to air, landfill, sewer systems and/or treatment facilities (as liquid or hazardous wastes).

Plastics Manufacturing

Plastics manufacturing involves processing new or spent (i.e., recycled) plastic resins into intermediate or final products. As shown in Figure 1, generally plastics manufacturing processes consist of:

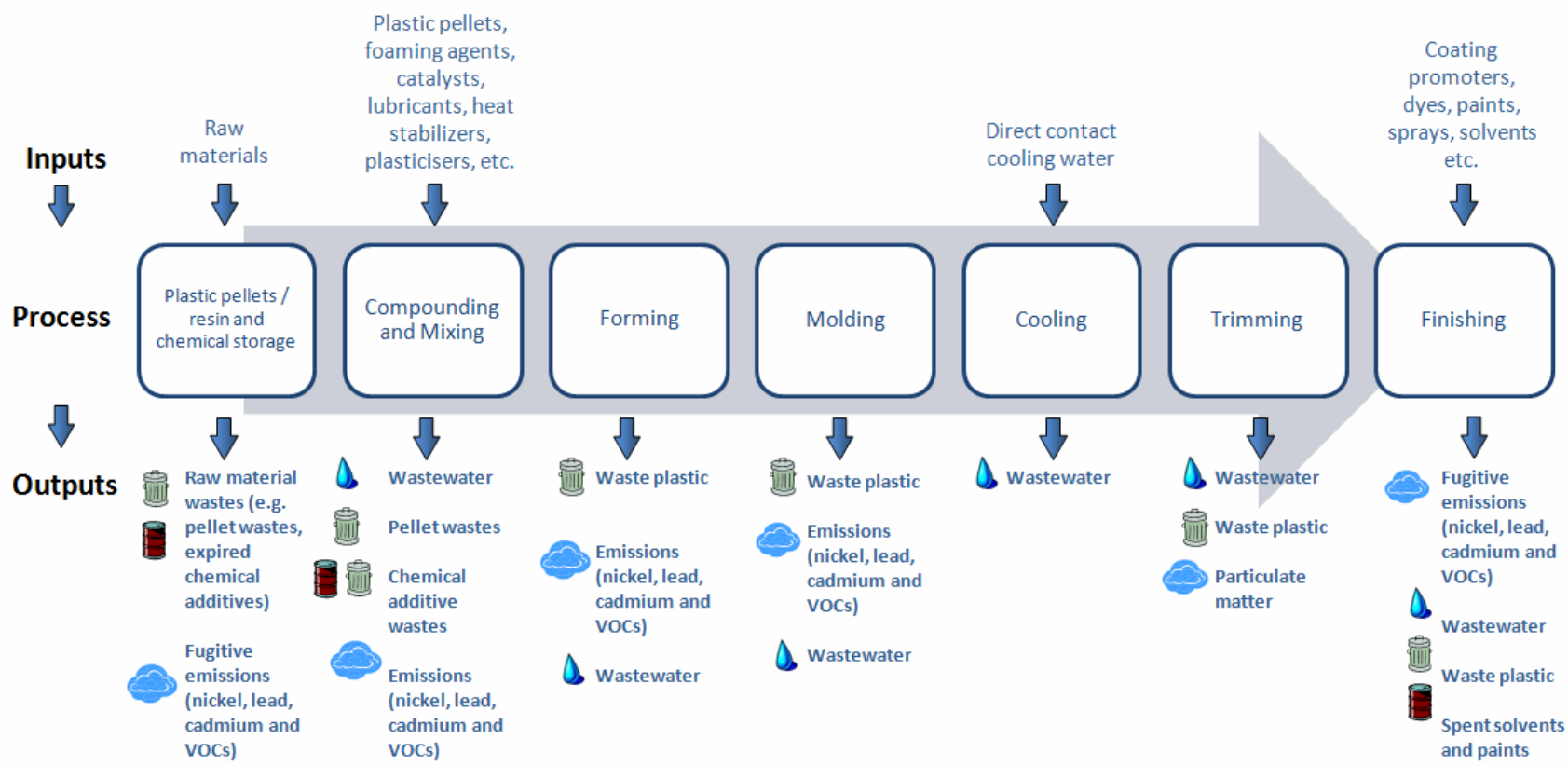
- adding chemical additives to the plastic resin to achieve appropriate material characteristics, such as stability, flexibility, durability, and flame retardancy;
- converting raw plastic materials in the form of pellets, granules, powders, sheets, fluids, or preforms into either intermediate or final formed plastic shapes or parts via molding operations; and,
- finishing the product.

To form solid plastics products, a variety of forming and/or molding processes are used. The choice of which plastic forming process to use is influenced by economic considerations, the number and size of finished parts, the adaptability of particular plastics to a process, and the complexity of the post-forming operations. Within most facilities, the production processes are such that a wide variety of products can be made, such as bags, bottles, plumbing fixtures, and floor covering.

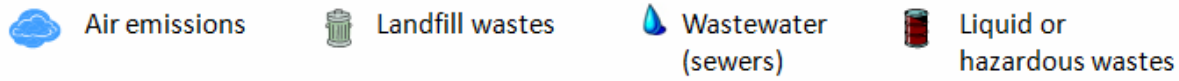
Depending on the type of plastic being produced, different chemicals may be used or released from the manufacturing process. Priority substances and chemicals of concerns come from several key sources including: chemical additives, wastewater, pellet release, fugitive emissions and solid waste. Releases of chemical additives typically result from spills during weighing, mixing, general handling of chemicals, leaks from chemical containers and molding machines, and fugitive emissions from open containers.

Waste materials from various stages in plastic manufacturing are also an environmental concern. Plastic pellets, the raw material used in plastic manufacturing, are often lost to floor sweepings during transport or while being loaded into molding machines, and may end up in wastewater. Eventually the pellets can end up in wetlands, estuaries, or lakes where they may be ingested by birds and other aquatic species.

Figure 1: Plastics Product Manufacturing Process



Symbols used in the flow diagrams



Rubber Products Manufacturing

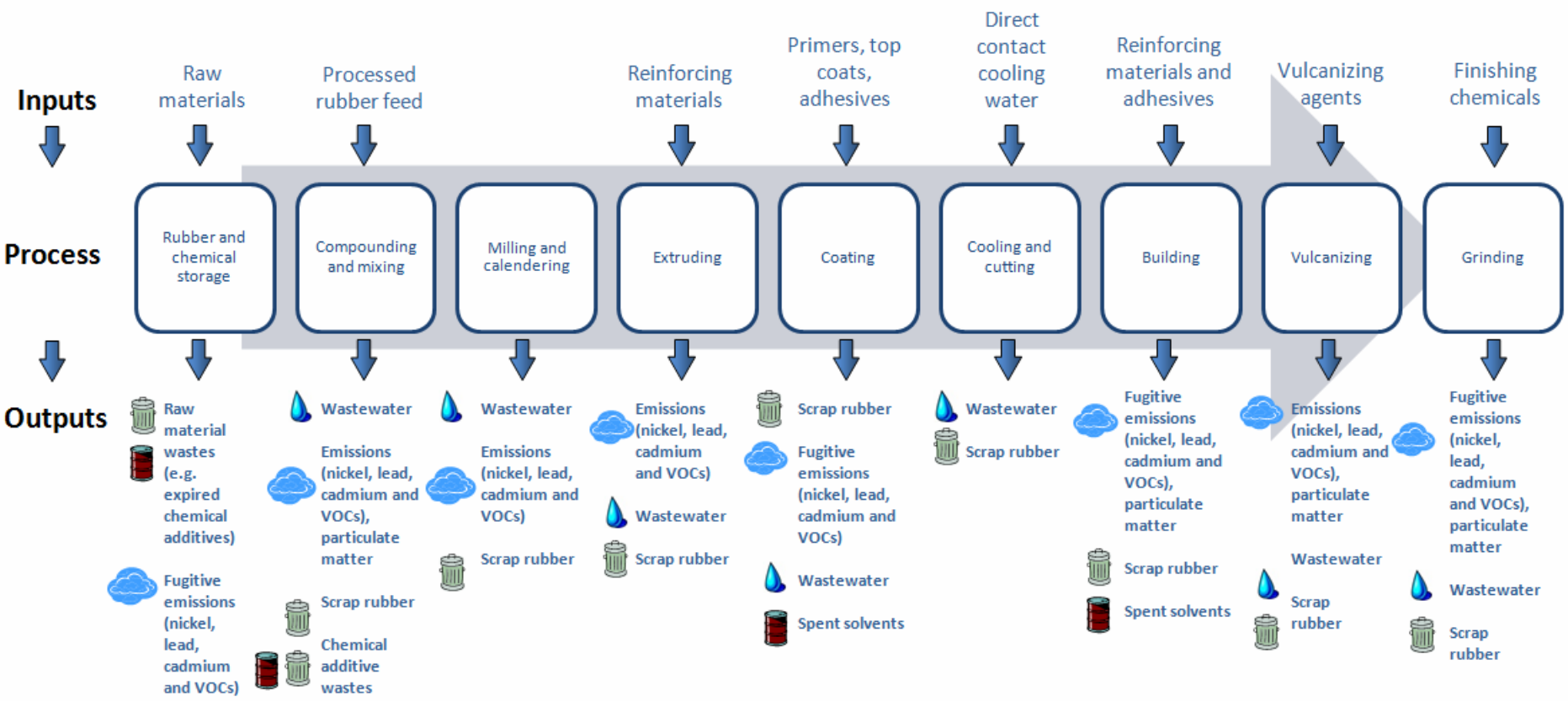
As shown in Figure 2, rubber products manufacturing involves processing natural, synthetic, or reclaimed rubber materials into intermediate or final products using several basic, common processes including:

- mixing;
- milling;
- extruding;
- calendering;
- building;
- vulcanizing (curing); and,
- finishing.

The process begins with the production of a rubber mix from polymers (i.e., raw and/or synthetic rubber), carbon black (the primary filler used in making a rubber mixture), oils, and miscellaneous chemicals including processing aids, vulcanizing agents, activators, accelerators, age resistors, fillers, softeners, and specialty materials. The rubber mixture will differ depending on the desired characteristics of the product being manufactured and not all of the processes shown in Figure 2 are necessary for every product. For example, many plants do not mix rubber but instead purchase uncured rubber from other facilities. Common final rubber products include tires, hoses, and belting.

Depending on the type of rubber product being produced, different priority substances and chemicals of concern may result from the manufacturing process. The primary concerns are releases from fugitive emissions, solid wastes, wastewater and hazardous wastes. Releases of VOCs typically result during weighing and transferring of chemical additives in the compounding step and from leaks and spills of chemical additives. Solvent and adhesive evaporation is another source of VOCs. Solvents are used in various capacities during the rubber product manufacturing process (e.g., to degrease equipment and tools). Typically, releases of solvents occur either when the spent solvent solutions are disposed of as hazardous wastes or when degreasing solvents are allowed to volatilize. Wastewater from cooling, heating, vulcanizing, and cleaning operations is also an environmental concern. Priority substances and chemicals of concern can also be added to wastewater through direct contact cooling applications.

Figure 2: Rubber Product Manufacturing Process



Symbols used in the flow diagrams

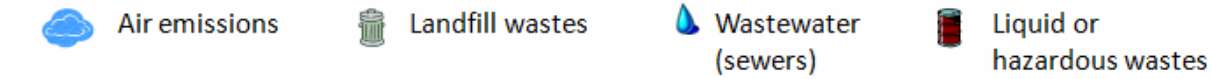
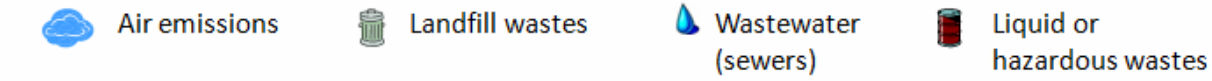


Figure 1: Equipment Cleaning and Maintenance – Plastics and Rubber Product Manufacturing

Symbols used in the flow diagrams



Pollution Prevention Steps You Can Take

This resource identifies steps you can take to reduce or eliminate your use of the priority substances and other chemicals that may have a health and/or an environmental impact, and to prevent pollution in the Plastics and Rubber Products Manufacturing sector.

The pollution prevention measures identified in this information sheet can reduce costs and/or increase profits.

Pollution Prevention Assessments – A Good First Step

Before you go too far with any given measure, you may want to do a Pollution Prevention Assessment of your business. You may need an outside expert to help. A typical Pollution Prevention Assessment will include mapping process flows, reviewing equipment uses, evaluating the way you use and store chemicals, evaluating the way you use energy, as well as reviewing waste handling practices and discharges. This assessment helps you to identify many pollution prevention opportunities (and any regulatory compliance issues) and decide which steps to take first.

Pollution Prevention - A Key to Good Management

Good management of your chemical purchases, chemical use and waste disposal is very important. You can improve your environmental performance through pollution prevention by:

- identifying how you are using the priority substances and other chemicals of concern that may have a health and/or an environmental impact
- figuring out how much you are using of each chemical and estimating the related emissions (see the earlier description for more information on how to estimate chemical use and emissions)
- discussing the options to reduce or to eliminate these chemicals and, where feasible, taking action. Actions could include:
    - using a different product
    - changing how you apply or clean up the chemical product/waste
    - training staff on how best to apply and clean up the chemical product/waste, or
    - installing new technology
    - maintaining equipment to ensure that leaks and general efficiencies are managed
- tracking the amount of chemicals you use and see if it goes down over time, and
- reviewing progress and identifying whether or not you need to make changes to the company's practices and procedures.

Changes you could make in your facility

The following table lists many options to help you reduce or stop using the priority substances and other chemicals of concern in your facility. Some measures will cost more than others, and some will be easier to implement than others. Operators can implement certain measures by making minor changes in their day-to-day approaches; while others will require management to invest in new technologies.

The table provides a quick and simple way to take stock of what measures your business has already put into place and those measures that your business could apply. In completing the table, you are encouraged to prioritize the actions you would take. While it is not exhaustive, the table identifies many pollution prevention opportunities for the Plastics and Rubber Products Manufacturing sector. When assessing the options, please consider your facility-specific conditions and how each option might affect pollution releases to the air, land and water.

The table identifies three general types of options and distinguishes each with a symbol:

Low-cost, good operating procedures – These measures involve operational and managerial changes that can reduce chemical use. They include simple changes to normal practices, process improvements, as well as training and good housekeeping opportunities. This measure does not need new technology purchases.

Choosing an alternative chemical – These measures involve replacing traditional products (such as solvents and cleaning products) with products that have less harmful properties. The ease and cost of these measures depends on the product and the process used.

New technology or system – These measures involve the installation of a new system, machine or process. The cost varies depending on the technology / system.

See **More Resources** for a list of helpful resources related to pollution prevention in the Plastics and Rubber Products Manufacturing sector.

Pollution Prevention Opportunities	Type of Activity	Is the opportunity in place? Yes	No	N/A	If 'No', indicate the level of priority for action (High, Medium or Low)		
Processing							
Use automated dispensing equipment for chemicals to reduce waste due to spills from manual dispensing, and to provide quality control.		☐	☐	☐	H	M	L
To reduce VOCs from styrene reacting with air, implement styrene reduction strategies for fiber reinforced plastics (FRP) such as: • Use low styrene resins • Maximize transfer of resin into mold • Cure resins in closed mold system		☐	☐	☐	H	M	L
Modify products or product design or reformulate products to reduce chemicals used (e.g. thin-walling plastic products).		☐	☐	☐	H	M	L
Filter air exhaust from material handling, mixing areas and granulation areas using a cyclone and/or baghouse to reduce VOCs.		☐	☐	☐	H	M	L
Capture and control fugitive emissions through a primary cyclone and secondary baghouse or electrostatic precipitator.		☐	☐	☐	H	M	L
Purchase pre-weighed chemical additives in sealed polyethylene bags instead of manually weighing to reduce fugitive air emissions and spills.		☐	☐	☐	H	M	L
Adjust process temperature or pressure, if feasible, to reduce and monitor energy use.		☐	☐	☐	H	M	L
Consider new equipment that may use less energy to operate.		☐	☐	☐	H	M	L
Waste, Wastewater and Residue							
Use activated carbon to remove soluble organics from contact cooling and heating water.		☐	☐	☐	H	M	L
Recycle process water through a sedimentation tank to remove suspended solids so process water can be reused.		☐	☐	☐	H	M	L
Pre-treat wastewater prior to discharge to the municipal sanitary sewer.		☐	☐	☐	H	M	L
Install a closed-loop water cooling or heating system to reduce water contamination through reuse and recycling.		☐	☐	☐	H	M	L
Substitute lubricating grease for oil in milling equipment to reduce the amount of waste.		☐	☐	☐	H	M	L

	Low-cost, good operating procedures		Choosing an alternative chemical		New technology or system

Pollution Prevention Opportunities	Type of Activity	Is the opportunity in place? Yes	No	N/A	If 'No', indicate the level of priority for action (High, Medium or Low)		
Use an oil/water separator to remove oil from oily wastewater prior to disposal to reduce the volume of wastewater disposal.		☐	☐	☐	H	M	L
Perform preventive maintenance of processing, molding and curing equipment to reduce the volume of oil and grease waste discharged from worn seals and gaskets.		☐	☐	☐	H	M	L
If your facility has a direct sewage discharge, use an appropriate pre-treatment method (e.g., solids/oil/water separator or DAF unit). Ensure compliance with the City of Toronto's Sewer Use Bylaw if applicable.		☐	☐	☐	H	M	L
Regularly check operation of pre-treatment units and remove collected contaminants. Dispose collected contaminants at a waste management facility.		☐	☐	☐	H	M	L
Reduce water consumption and associated wastewater releases by: • Educating and involving employees in water conservation • Locating all water use sources (bathrooms, wash sinks, hoses, dish machines, HVAC, cooling water, etc.) in the facility and identifying and implementing water conservation options		☐	☐	☐	H	M	L
Instruct maintenance personnel to routinely inspect and repair any leaking water or steam lines as well as pumps and valves.		☐	☐	☐	H	M	L
Separate plastic wastes produced during operations for recycling to reduce waste to landfill.		☐	☐	☐	H	M	L
Separate mixed plastics into single resin types, where possible, for reuse. End products from single resins are often of higher quality than those from mixed resin.		☐	☐	☐	H	M	L
Separate waste streams so rubber scrap produced during operations can be segregated from oily wastewaters and recycled back into the process.		☐	☐	☐	H	M	L
Recycle cured or off-specification rubber waste at the facility and reuse to make other products to reduce waste to landfill.		☐	☐	☐	H	M	L
Communicate hazardous waste disposal information through the Material Safety Data Sheets. Refer to these sheets for further instruction.		☐	☐	☐	H	M	L
Transport hazardous materials and wastes in completely sealed containers to avoid the possibility of fugitive emissions of VOCs into the atmosphere.		☐	☐	☐	H	M	L

	Low-cost, good operating procedures		Choosing an alternative chemical		New technology or system

Pollution Prevention Opportunities	Type of Activity	Is the opportunity in place? Yes	No	N/A	If 'No', indicate the level of priority for action (High, Medium or Low)		
Maintenance, Management and Good Housekeeping							
Purchasing and Inventory							
Purchase only the amounts and types of chemicals needed for specific projects to minimize storage times and reduce waste from expired products. Use computer inventory control methods to minimize the amount of stock purchased.		☐	☐	☐	H	M	L
Monitor inventory in storage to reduce accumulation of over-aged products.		☐	☐	☐	H	M	L
Keep an accurate inventory of products used (including chemical name, manufacturer, and MSDS sheet).		☐	☐	☐	H	M	L
Review chemical suppliers' products regularly to look for the most environmentally-responsible products.		☐	☐	☐	H	M	L
Receiving and Sorting Items							
Inspect raw materials, packages, and containers before accepting them from suppliers and return damaged good so they do not become waste.		☐	☐	☐	H	M	L
Receive chemicals in sealed containers in closed docks, or in bulk rail or truck shipments with a minimal history of spills.		☐	☐	☐	H	M	L
Return unused, obsolete chemicals or empty containers to suppliers.		☐	☐	☐	H	M	L
Cleaning							
Substitute cleaning products for less harmful cleaning products, such as water-based biodegradable cleaners (no-VOC or low-VOC) or use recyclable solvents.		☐	☐	☐	H	M	L
Use caustic cleaning solutions instead of solvents.		☐	☐	☐	H	M	L
Substitute old solvents with cleaner, citrus-based solvents.		☐	☐	☐	H	M	L
Equipment Maintenance							
Repair leaks and other problems immediately as they occur to reduce cleaning efforts, extend life of equipment, and reduce solvent use.		☐	☐	☐	H	M	L
Perform preventive maintenance of processing, molding and curing equipment to reduce oil leaks from worn seals and gaskets.		☐	☐	☐	H	M	L

	Low-cost, good operating procedures		Choosing an alternative chemical		New technology or system

Pollution Prevention Opportunities	Type of Activity	Is the opportunity in place? Yes	No	N/A	If 'No', indicate the level of priority for action (High, Medium or Low)		
Storage							
Keep storage areas free from traffic or exposure to the elements and away from floor drains.		☐	☐	☐	H	M	L
Store chemicals according to need, with minimum inventory kept on hand.		☐	☐	☐	H	M	L
Clearly date and label hazardous materials so they can be easily identified.		☐	☐	☐	H	M	L
Keep chemical containers covered to reduce potential leaks, spills and evaporation from chemical additives. Sealed containers should have air space between the chemical and the container cover to minimize spills and "puffing" losses when the container is opened.		☐	☐	☐	H	M	L
Perform periodic inspections of all chemicals in storage and install leak detection equipment.		☐	☐	☐	H	M	L
Store chemicals in sealed containers away from drains to sewers and place secondary containment mechanisms around all containers to protect from leaks and spills.		☐	☐	☐	H	M	L
Mark all containers to identify the contents to avoid improper handling or disposal.		☐	☐	☐	H	M	L
Date containers when opened to ensure you use them before they expire to reduce waste from expired products.		☐	☐	☐	H	M	L
Spills							
Develop a spill response plan and post it so that it is available for all employees.		☐	☐	☐	H	M	L
Make spill kits available at the chemical storage rooms or racks for easy access.		☐	☐	☐	H	M	L
Train workers in emergency spill response.		☐	☐	☐	H	M	L
Implement plastic pellet waste management to reduce plastic wastes in wastewater. Implement plastic resin pellet spill prevention and cleanup procedures to minimize spills. Promptly and thoroughly clean up spills. Properly dispose of pellets through: • employee education • enhanced pellet capture methods • disposal precautions		☐	☐	☐	H	M	L
Training							
Ensure employees are properly trained (WHMIS).		☐	☐	☐	H	M	L

 Low-cost, good operating procedures	 Choosing an alternative chemical	 New technology or system

Pollution Prevention Opportunities	Type of Activity	Is the opportunity in place? Yes	No	N/A	If 'No', indicate the level of priority for action (High, Medium or Low)		
Train workers to follow the standard work procedures (such as cleaning and set up), good housekeeping, and correct material handling methods to make sure all operators follow the same steps to reduce chemical use and waste.		☐	☐	☐	H	M	L
Train employees to properly handle and dispose of chemicals.		☐	☐	☐	H	M	L
Other							
Ask employees for pollution prevention suggestions.		☐	☐	☐	H	M	L
Fleet: Collecting and Delivering Items							
Train fleet drivers to reduce unnecessary idling of vehicles (there is 3 minute idle limit in the City of Toronto under the Idling Control Bylaw).		☐	☐	☐	H	M	L
Consider the purchase of fuel efficient and/or alternative fuel vehicles.		☐	☐	☐	H	M	L
Optimize your collection / delivery routes for increased fuel efficiency.		☐	☐	☐	H	M	L
Keep vehicles well-maintained (e.g., keep tires inflated; purchase 'Energy Conserving' oil; regularly replace oil)		☐	☐	☐	H	M	L

Contact us to provide your feedback on this resource or to suggest any additional pollution prevention resources (email chemtrac@toronto.ca or call 416-338-7600).

	Low-cost, good operating procedures		Choosing an alternative chemical		New technology or system

More Resources

Canadian Council of Ministers of the Environment (CCME). 1997. Environmental Guide for the Reduction of VOC Emissions from the Plastic Processing Industry.
http://www.ccme.ca/assets/pdf/pn_1276_e.pdf

- Guidance for regulatory agencies, manufacturers and operators of plastics processing plants concerning the means of reducing emissions containing VOCs released to the environment through production processes.
- Contains material, equipment, process and operating standards for plastics facilities, record keeping and training standards, recommended operating practices and testing protocols.

Canadian Plastics Industry Association. 2010.
http://www.plastics.ca/EnvironmentalSustainability/index.php

- CPIA facilitates the development of sustainable programs to effectively manage plastics waste. CPIA acts as a one-stop resource on end-of-life management of plastics for municipalities, consumer product manufacturers and their suppliers, recyclers, provincial agencies and the educational community.
- Website provides various resources for plastic manufacturers on sustainable practices.

Canadian Pollution Prevention Information Clearing House (CPPIC). 2010. Home Page.
http://www.ec.gc.ca/cppic/En/index.cfm

- The CPPIC provides a comprehensive list of pollution prevention resources for Canadian sectors and industries, such as best management practices, fact sheets and sector profiles. Conduct a 'Sector Search' to find resources most relevant to your industry (Plastics and Rubber Products Manufacturing is found under the 'Manufacturing' sector link).

Dalhousie University - Eco-Efficiency Centre. 2008. Fact Sheet: Eco-Efficiency in the Plastic Products Industry.
http://eco-efficiency.management.dal.ca/Files/Business_Fact_Sheets/plastic_products_industry_fs.pdf

- A brief report providing pollution prevention measures for the plastic products industry.

Environment Canada. 1999. Canadian Environmental Protection Act (CEPA).
http://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=26A03BFA-1

- The main piece of federal legislation affecting the plastic products industry is the Canadian Environmental Protection Act (CEPA) administered by Environment Canada and Health Canada. It is primarily focussed on protection of the environment and human health. The provisions of CEPA that are of greatest importance to the plastic products industry are those dealing with volatile organic carbons (VOCs), chlorofluorocarbons (CFCs) and substances identified as toxic through CEPA assessments. At least four substances have been identified through CEPA assessments as having potential for impact on the plastic products industry - short chain chlorinated paraffins, bis (2-ethylhexyl) phthalate (DEHP), benzidine, and 3, 3'-dichlorobenzidine.

Environment Canada. 2006. Canadian Pollution Prevention Information Clearinghouse.
http://www.ec.gc.ca/cppic/En/sectSearch.cfm?sectSearch=step2&catId=4&sectId=280

- The Canadian Pollution Prevention Information Clearinghouse (CPPIC) is Environment Canada's online pollution prevention database and comprehensive resource providing access to pollution prevention information for a number of audiences including industry, educators, community groups, consumers, youth, government, and the general public.
- Website provides an online tool of pollution prevention opportunities in the manufacturing sectors, such as energy conservation, material substitution, re-use and recycling of materials onsite, development of new technology, and changes to operating processes to increase production efficiency.
- The Business Section provides quick access to a wealth of information on a number of environmental-based business concepts, funding programs, Canadian legislation, and Canadian

business achievements in pollution prevention, as well as a section specifically tailored to small- and medium-sized enterprises (SMEs).

Environment Canada. 2010. National Pollutant Release Inventory.
http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=4A577BB9-1

- The National Pollutant Release Inventory (NPRI) is Canada's legislated, publicly accessible inventory of pollutant releases (to air, water and land), disposals and transfers for recycling. It is a key resource for:
    - identifying pollution prevention priorities;
    - supporting the assessment and risk management of chemicals, and air quality modelling;
    - helping develop targeted regulations for reducing releases of toxic substances and air pollutants;
    - encouraging actions to reduce the release of pollutants into the environment; and
    - improving public understanding.

International Finance Corporation. 2007. Environmental, Health, and Safety Guidelines for Metal, Plastic, and Rubber Products Manufacturing.
http://www.ifc.org/ifcext/enviro.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_MetalPlasticRubber/$FILE/Final+-+Metal,+Plastic,+and+Rubber+Products+Mnfg.pdf

- A report explaining the sources of environmental impact associated with metal, plastic and rubber product manufacturing, and pollution prevention opportunities to pursue.
- Contains the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs.

U.S. Census Bureau. 2002 NAICS Definitions: 326 Plastics and Rubber Products Manufacturing.
http://www.census.gov/epcd/naics02/def/NDEF326.HTM

- Government of the United States of America website providing industry definitions and scope for the North American Industry Classification System (NAICS).

U.S. EPA. 2005. Profile of the Rubber and Plastics Industry, 2nd Edition.
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- A comprehensive document offering insight into several aspects of the rubber and plastics industry in the United States. In depth information pertaining to industry processes and pollution prevention opportunities are provided.

University of Minnesota. Pollution Prevention Assistance Tools for the Fiber Reinforced Plastics and Boat Manufacturing Industries.
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- A report on the use and make-up of fiber reinforced plastics and potential pollution prevention opportunities.