CONTRACTOR'S ENVIRONMENTAL HANDBOOK

Best Practices for THE REDUCTION OF AIR EMISSIONS from Construction and Demolition Activities

Hamilton

HAMILTON INDUSTRIAL ENVIRONMENTAL ASSOCIATION

This handbook outlines best practices for the reduction of fugitive dust emissions during construction and demolition activities.

CONTENT

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THE REDUCTION OF AIR EMISSIONS
from Construction and Demolition Activities

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INTRODUCTION

WHO IS THIS HANDBOOK FOR?

This handbook should be useful to project owners, designers, managers, forepeople, supervisors, contractors, and equipment operators interested in minimizing dust and particulate matter emissions at project sites.

FOCUS OF THIS HANDBOOK:

This handbook outlines best practices for the reduction of fugitive dust emissions during construction and demolition activities. It's content has been adapted from the document *'Best Practices for the Reduction of Air Emissions From Construction and Demolition Activities'*, March 2005, prepared for Environment Canada. **http://www.bv.transports.gouv.qc.ca/mono/1173259.pdf**. Please refer to this document when clarification or further detail is needed.

WHAT ARE CONSTRUCTION ACTIVITIES?

Any on-site activities preparatory to or related to the building, alteration, rehabilitation or improvement of property, including, but not limited to the following activities: grading, excavation, trenching, loading, vehicular travel, crushing, blasting, cutting, planning, shaping, breaking, equipment staging/storage areas, weed abatement activities or adding or removing bulk materials from storage piles.

WHAT ARE DEMOLITION ACTIVITIES?

The wrecking or taking out of any load-supporting structural member of a structure or building and related handling operations.

WHY SHOULD THIS BOOK BE USED?

There are significant health and environmental effects associated with emissions of particulate matter (PM) and other criteria air contaminants. Small airborne particulates with a diameter less than 10 microns (PM10), can be inhaled into the upper respiratory tract where heart and lungs can be affected. Particulate matter with a diameter or less than 2.5 microns (PM2.5) can be inhaled and absorbed into cells and reach the bloodstream. This can have various negative health effects, especially on the respiratory and cardiovascular systems. Particulate matter increases respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing. People with heart or lung disease, children and older adults are particularly sensitive to this pollutant.[1] Particulate matter permitted to pollute the environment can harm plants and animals directly and can impair habitat, food and water in which they need to survive.

What you should know about Ontario's designated substances:

THERE ARE 11 DESIGNATED SUBSTANCES PRESCRIBED BY THE ONTARIO MINISTRY OF LABOUR. A designated substance is a biological, chemical or physical component or combination considered hazardous and can pose a risk to workers or occupants during a planned renovation, demolition, or restoration project. Designated substances are particularly hazardous, especially when adequate controls are not in place to protect workers or occupants. They can cause cancers, strong allergic reactions, liver and lung problems, and effects on the nervous system. Some projects may therefore be subject to additional regulatory requirements. Please contact the Ministry of Environment, Conservation and Parks (MECP) office to inquire if additional permits are required.

The most common designated substances found in residential and other types of buildings include:	Other substances include:	In addition, there are other materials or conditions that are considered as hazardous. These primarily include:
• Asbestos • Lead • Silica • Mercury	• Arsenic • Benzene • Acrylonitrile • Coke Oven Emissions • Isocyanates • Ethylene Oxide • Vinyl Chloride	• Mould • Polychlorinated Biphenyls (PCBs) • Urea Formaldehyde Foam Insulation (UFFI)

The following table describes suspect Designated Substances in common building materials or locations. (Source: Infrastructure Health and Safety Association)

DESIGNATED SUBSTANCE	MEDIUM OR LOCATION FOUND IN	
ASBESTOS Other names include chrysotile, amosite, crocidolite	• Insulation (boiler, pipe, and sprayed on/fire-stop/ fireproofing materials) • Transite pipe or panels • Loose-fill vermiculite as attic or block insulation • Wallboard • Asphalt	• Adhesives and caulking • Ceiling tiles • Vinyl floor tiles and sheet flooring • Gaskets • Drywall joint-filling compound • Plaster (smooth, texture, stipple) • Roofing shingles and felts
LEAD	• Old paint (homes built before 1960 and if built between 1960 and 1990, the exterior may contain lead-based paint)	• Old mortar • Old water pipes • Lead sheeting (radiation or sound control)
SILICA Other names include quartz, tridymite, cristobalite	• Brick/block • Granite • Abrasives used for blasting • Concrete	• Sandstone • Cement • Mortar
ISOCYANATES	• Fresh polyurethane spray foam insulation • Sealants • Rock support in underground mining	• Paint shops and auto-body repair • Finishes • Adhesives
MERCURY	• Fluorescent lights • Switches • Contamination in laboratory drains	• Pressure gauges • Electrodes
ARSENIC	• Wood preservatives • Smelters	• Glass production
COKE OVEN EMISSIONS, BENZENE, ACRYLONITRILE, VINYL CHLORIDE, ETHYLENE OXIDE	• Chemicals that are typically used in, or are by-products of, manufacturing facilities and health-care settings.	

The following table describes the health risks and how to reduce your exposure to the most common designated substances.

DESIGNATED SUBSTANCE	HEALTH RISKS	HOW TO REDUCE RISK OF EXPOSURE
ASBESTOS	Breathing in asbestos fibres can cause cancer and other diseases, such as: • Asbestosis, a scarring of the lungs, which makes it difficult to breathe • Mesothelioma, a rare cancer of the lining of the chest or abdominal cavity • Lung cancer; people who smoke can be at a greatly increased risk	Hire a professional to test for asbestos when undertaking a home renovation, an addition or demolition. If asbestos is found, hire a qualified asbestos removal specialist to get rid of it before beginning work. Avoid disturbing asbestos material yourself.
LEAD	Exposure to lead is associated with harmful effects on the brain, heart, and kidneys, and to reproduction.	If you think the paint in your building may contain lead, have it tested. If you have lead-based paint in good condtion, it is best to leave it alone, paint over it, or cover it with wallpaper, wallboard or paneling. If the lead-based paint is chipping, cracking, peeling or flaking, use a chemical paint stripper and don't use sanders, heat guns or blowlaps to remove paint in older buildings.
SILICA	Inhaling crystalline silica can lead to serious, sometimes fatal illnesses including: • Silicosis • Lung cancer • Tuberculosis (in those with silicosis) • Chronic obstructive pulmonary disease (COPD).	Prevent the dust from becoming airborne by using engineering controls to reduce exposures. Water can be used to suppress the dust and vacuums can be used to capture it at the source. When water or vacuums are not feasible, or if the exposures are still high even with these controls, a NIOSH (National Institute for Occupational Health and Saftety) approved respirator should be used; however, respirators won't protect those working close by. Other ways to reduce or eliminate exposures include using different materials, such as aluminum oxide instead of sand for abrasive blasting, or using work practices that help minimize dust.

DESIGNATED SUBSTANCE	HEALTH RISKS	HOW TO REDUCE RISK OF EXPOSURE
MERCURY	Mercury can be absorbed through your skin as a liquid, or inhaled as a vapour. The health effects appear to be the same for both types of exposure. Repeated, long-term exposure to mercury can cause: • Kidney damage • Central nervous system problems (stupor, tremors, nervousness) • Vision and hearing changes • Hearing loss • Cognitive and behavioral abnormalities	Use appropriate PPE such as chemical safety goggles, a face shield, protective clothing such as gloves, and a respirator. Do not use mercury where it could contact a hot surface and vaporize. Avoid inhaling mercury vapour. Put mercury waste in a special waste container, do not combine it with other wastes and do not dispose of it down a sink.

Other benefits to reducing PM/dust and other pollutant emissions include:

- Improved health benefits for workers (i.e. reduced risk of developing respiratory illnesses, breathing problems, irritation of the nose and throat, and dermatitis)
- Dust control safeguards enhance efficiency with a cleaner, safer work environment thus increasing productivity
- Reduction in lost-time incidents for employees
- Improved corporate/company image
- Avoid involvement with regulators
- Development and transfer/sale of knowledge and technology

WHAT DOES THIS HANDBOOK COVER?

This handbook describes technologies and work practices that can reduce emissions associated with construction and demolition activities. Proponents should consider the economic, environmental and technical circumstances with an emphasis on worker safety when choosing the elements of this document that best suit the unique features of each project, with the goal of eliminating off-site dust emissions whenever possible.

ENVIRONMENTAL MANAGEMENT PLAN

Every construction and demolition project should have a site-specific environmental management plan (EMP) before work begins. The plan will organize and document features of the project as they relate to communities and ecosystems, and note baseline conditions and sensitive receptors that need protection.

ACTIONS TO MITIGATE EMISSIONS
FROM THE CONSTRUCTION AND DEMOLITION SECTOR

1 USING WATER AND CHEMICAL DUST SUPPRESSANTS AT CONSTRUCTION SITES

1.1 WATER APPLICATION

1.1.1 Benefits/Effectiveness

- Most common alternative, is affordable and effective at reducing dust by causing particles to stick together
- Water can be applied via trucks, water pulls, canons, hoses, sprinklers, etc.

1.1.2 Challenges/Cautions

- Affected areas need to be sprayed at least three times/day or more frequently if required (i.e. During hot summer months).
- Can trigger other environmental challenges such as runoff issues, soil instability, spreading contaminants, and erosion. Runoff prevention measures such as silt curtains may be required, depending on the proximity to water courses, drainage ditches, stormwater grates, and so on.
- Over-application can lead to equipment mobility problems as the strength for supporting traffic can be diminished.

Above: This photo illustrates wet suppression, an additional best management practice for stockpiles.

1.2 DUST SUPPRESSANTS

1.2.1 Benefits/Effectiveness

- More expensive than water but more effective and applied less frequently.
- There are a variety of chemical versions available. Soil particles are bonded together forming a “crust” when it dries that strengthens the soil surface.

1.2.2 Challenges/Cautions

- Consideration should be taken to reduce potential environmental impacts when deciding on the extent to which water and chemical dust suppressants are utilized. Environment consequences to keep in mind are:
  - The hazardous, biodegradable and water-soluble properties of the substance;
  - Effect on surrounding environment such as waterbodies and wildlife;
  - Are watershed considerations for protecting fish and fish habitat from surface runoff in place?

1.3 PROS AND CONS OF WATER AND CHEMICAL DUST SUPPRESSANTS

CONTROL METHOD	ADVANTAGES	DISADVANTAGES
WATER	Inexpensive and generally available.	Dries out fast, needs frequent application. Excess application creates muddy conditions.
DUST SUPRERSSANTS MIXED WITH WATER SUCH AS SALT	Can help form a longer lasting seal.	May be expensive to ship supplies. Application may require special equipment. May impact vegetation and water quality.

2 DESIGN CONSIDERATIONS TO REDUCE EMISSIONS FROM CONSTRUCTION AND BUILDINGS

2.1 SITE PLANNING

Create a site-specific dust management plan that identifies potential fugitive emission sources from the construction operation. Start with a facility site map and note all roads, stockpiles, material transfer points, staging areas, material conveyances, parking lots, and other open areas subject to wind erosion. Also, note the prevailing wind direction on the map.

2.2 BUILDING MATERIALS USED

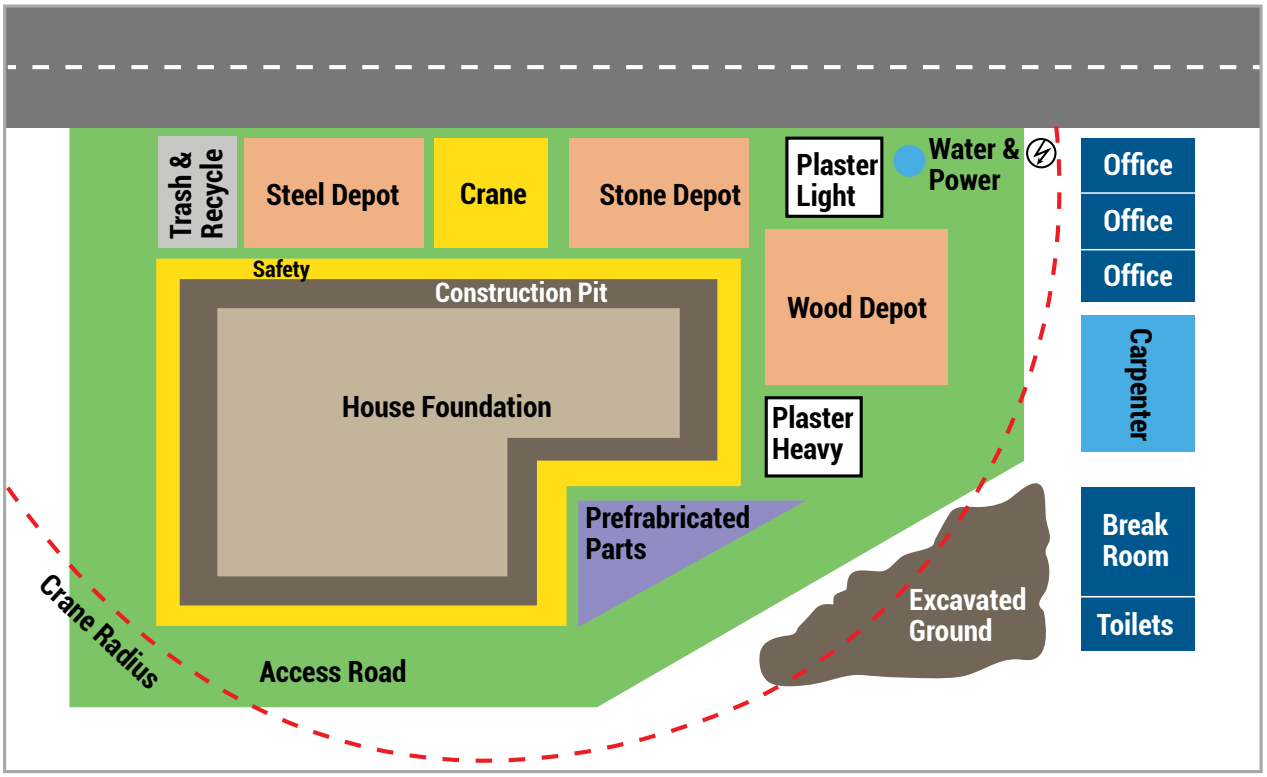
Use pre-fabricated materials/modular construction units where possible. Improving construction quality reduces the need for maintenance, rehabilitation and reconstruction of structures.

2.3 MINIMIZING VEHICLE TRAFFIC CONGESTION

Delays and road closures/lane reductions can cause increased vehicle emissions due to idling or slow-moving traffic.

2.4 MINIMIZING DISTANCES TRAVELLED FOR DELIVERY OF CONSTRUCTION MATERIALS

Deliveries of materials like concrete, asphalt and aggregates can generate road dust and increased vehicle emissions. If possible, establish temporary plants on site if financially feasible and properly managed/controlled.



3 REDUCING FUGITIVE DUST EMISSIONS FROM CONSTRUCTION AND DEMOLITION SITES

There are various technologies and work practices that can be applied to minimize fugitive dust emissions during construction and demolition activities.

3.1 SITE PREPARATION

Work, especially in drier weather, can generate significant dust emissions. Consider employing the various work practices prior to, during and after site preparation.

- Grade in phases (not all at once) and begin construction in a location that is upwind from the prevailing wind direction.
- Utilize permanent perimeter or temporary interior Wind Fencing and install as early as possible. Examples include trees or shrubs left in place during site clearing, sheets of plywood, wind screen material such as that used around tennis courts, snow fences, hay bales, crate walls, sediment walls, burlap fences, etc.
- Stabilize surfaces of completed earthworks with vegetation.
  - Surfaces of completed earthworks (including landscaping) should be re-vegetated (i.e., seeded and mulched) within 10 days after active operations have ceased.
  - It is recommended that existing trees and large shrubs (and other live perennial vegetation) be allowed to remain in place to the greatest extent possible during site grading processes.
- Stabilize surfaces of completed earthworks with stone/soil/geotextiles.
- Create ridges to prevent dust getting picked up by the wind. Ridges run on contours of slopes can deflect and raise wind 5 or 6 inches above the soil surface.
- Compact disturbed soil with rollers or other similar equipment to reduce the erosion potential. Compacting soil could potentially increase runoff so measures such as silt fences, catchbasin covers, etc. should be considered.
- Where possible, reduce dust-generating (e.g., concrete cutting, earth moving, etc.) activities during windy conditions and utilize best control practices at all other times (i.e. water spray, etc).
- Capture fugitive dust emissions escaping through building openings by installing removable filters over appropriate building openings.
- To reduce fugitive dust emissions on road surfaces within the construction site, the following may be considered:
  - Establish on-site vehicle restrictions for haul roads being watered, and post speed limits.
  - Properly maintain roads.
  - In winter, use low silt content de-icing materials and plow instead of sanding.

Above: Construction screen on temporary panels blocks vision, dust and debris

3.2 STORAGE PILES

Several work practices can be employed to mitigate fugitive dust emissions resulting from storage piles.

Protecting a stockpile.

These work practices primarily reduce the exposure of storage piles to wind.

- Storage pile activities should be conducted downwind
- Utilize enclosures/coverings for storage piles.
  - Enclosures can include three-sided bunkers, storage silos, and open-ended buildings, or fully enclosing the pile within a building.
  - Tarpaulins, plastic or other material can be used for temporary covering, and should be anchored.

- Utilize wind fences/screens for storage piles.
- Can be human-made or vegetative in nature.
    - Use vegetation cover such as perennial grasses, trees or shrubs as a wind break around storage piles.
- Properly shape storage piles and minimize disturbance.
- Properly schedule the delivery of landscaping materials to minimize storage time and reduce the potential for emissions (i.e. carried away by wind).

EARTHWORKS are engineering works created through the processing of parts of the earth's surface involving quantities of soil or unformed rock.

source: https://en.wikipedia.org/wiki/Earthworks_(engineering)

3.3 MATERIAL HANDLING AND TRANSFER SYSTEMS

3.3.1 Control Mud and Dirt Trackout and Carryout

- Conduct street cleaning to remove trackout and carryout, at least once per day, at the end of the working day.
- If trackout extends more than 10 metres (33 feet) onto a paved public road, cleaning should be undertaken immediately.
    - Can be completed with a broom and sufficient wetting, vacuum sweeping, water flushing, or water sweeper.
    - According to a City of Toronto study, efficient street sweepers are most effective to control particulate matter pollution. The study involved extensive testing to determine the best machines on the market. (https://www.toronto.ca/legdocs/2005/agendas/committees/wks/wks050629/it009.pdf). These use a "regenerative air technology" that blasts air on the pavement, then sucks almost all of the debris and dust immediately. Old-style machines blasted water on the pavement, which often caused dirt to stick in cracks.
    - Wet vacuum sweepers and mechanical sweepers should therefore be avoided, as when they spray water on the pavement, a thin layer of road dust sludge remains on the surface of the road.
- Create paved haul roads or gravel strips early in the project. This will limit mud and dirt trackout onto public paved roads.
- Site restrictions should be considered, including the following,
    - confine load-in/load-out procedures to leeward (downwind) side of the material;
    - designate a single site entrance and exit; and
    - ensure that vehicles stay on established traffic routes within the construction site.

Above: These figures illustrate an installed grate (left) and a gravel bed (right), both of which are additional best management practices associated with track-out/carry-out.

3.3.1.1 Trackout Control Devices

- Trackout control devices, for instance a grizzly or a wheel washing system, can be installed to remove dirt and mud from truck tires and the undercarriage of motor vehicles and/or haul trucks prior to leaving the work site. Note that track-out control devices require environmental management plans to control surface deposition.
- A grizzly is also known as a wheel shaker/wheel spreading device and consists of raised dividers (rails, pipe or grates) that are at least three inches tall, at least six inches apart, at least 8 meters long and 3 meters wide.
- Wheel washers may be adjusted to spray the entire vehicle including bulk-stored material in haul vehicles.
- Grizzlies and wheel washers should be cleaned/maintained on a regular basis to ensure their effectiveness.
  - These devices should be installed on sites with a disturbed surface area of 3 hectares or more and from all work sites where 75 cubic meters (~100 cubic yards) of bulk materials are hauled on/or off-site per day.
  - All traffic should be routed over the installed trackout control devices.

3.3.2 Minimize Material Drop at the Transfer Point and Enclosure

- Drop heights should be kept to a minimum when loading materials onto vehicles and conveyors.
- Where feasible, transfer points and conveyor belts should be totally enclosed when in operation.
- Distance between material transfer points should be minimized.
- Conveyor belts should have belt wipers and proper size hoppers to prevent spills.
- Belts and area underneath should be cleaned periodically.
- The speed of the belt should be restricted to minimize spills.

Above:This figure illustrates reducing drop height, a required best management practice.

3.3.3 Utilize Foam Suppression Systems

- Foam systems (combination of water and a chemical surfactant) may be used on material transfer systems to mitigate dust generation.
- The primary advantage of foam systems is that they provide equivalent control and consume less water than water spray systems.

3.3.4 Secure Loads on Haul Trucks

To minimize fugitive dust emissions from the transportation of aggregate material within a construction site, several work practices can be employed:

- Partially or totally enclose the entire work surface area of hauled bulk materials with an anchored tarp, plastic or other material. Or, use completely enclosed trucks.
- Freeboard is the vertical distance between the top edge of a cargo container area and the highest point at which the bulk material contacts the sides, front and back of the container. Where feasible, trucks may be loaded such that the freeboard is not less than 7 cm (~3 inches).
- Loader bucket materials should be emptied slowly.

3.3.5 Prevent PM Emissions from Spills

The storage and load-out of materials such as cement powder and similar dusty materials can increase fugitive dust emissions associated with the movement of mobile equipment transferring the material. If spillage cannot be prevented due to heavy traffic and transfers, the following work pratices are recommended:

- Have ready a spill response plan and equipment.
- A vacuum truck should be used to clean up dusty material spills.
- There should be regular removal of spilled material in areas within 100 metres of the storage pile.
- Assign an individual to spill response, clean-up and reporting. Reporting is required under section X of the Ontario Environmental Protection Act if there is a discharge:
  - into the natural environment,
  - from or out of a structure, vehicle or other container, and
  - that is abnormal in quality or quantity in light of all the circumstances of the discharge.

3.4 FABRICATION PROCESSES

3.4.1 Cutting, Grinding and Drilling

- Use pre-fab where possible, apply water sprays, etc.
- Consider design technique to avoid grinding and cutting.
- Should grinding be necessary, PM emissions can be mitigated by:

i. fitting tools with dust bags;

ii. prewashing work surfaces;

iii. screening off areas to be ground; and

iv. vacuuming up, as opposed to sweeping away, residual dust.

3.4.2 Sand and Grit Blasting and Facade Cleaning

- Wet processes (e.g. high-pressure water blasting or water blasting supplemented with abrasives should be used.
- Utilize enclosures such as curtains or shrouds (tarpaulins or containment screens) around the blasting operation. Contain debris in dumpsters or drums, secure lids, and dispose of properly.
- Dry blasting should be conducted indoors.
- More durable abrasives with lower dust generation potential should be used, such as non-friable abrasives.

3.4.3 Concrete and Asphalt Cutting

- The use of water in sufficient quantities to wet the cutter, the immediate surrounding work area, and the fugitive dust immediately emanating from the cutting is effective (e.g., use of a wet vacuum system).
- A vacuum should be used to collect dust when cutting materials.

Above:These photos illustrate concrete cutting and how the activity can generate dust.

3.4.4 Mixing Processes

Utilize pre-mixed concrete, plasters and masonry compounds, use correctly-sized pre-cast sections to reduce the need for cutting and drilling, mix in enclosed/protected areas, fine materials should be palletized and shrink wrapped, keep foundations moist, and use larger pours.

3.4.5 Internal and External Finishing and Refurbishment

Dust suppression/collection equipment should be attached when using sanding and cutting machinery.

3.5 DEMOLITION AND DECONSTRUCTION

- Apply deconstruction techniques rather than demolition.
- Minimize drop heights for debris.
- Enclose chutes and cover bins.
- Use fogging systems to cause dust to become heavy and fall, but only in an area that has a pocket or cover.
- Use barriers such as curtains or shrouds to prevent dispersion.
- Avoid blasting when feasible, noting that in some instances blasting would be the safest manner to take down a structure.
- Vacuum debris and accumulated dust from internal structures before deconstruction.
- Load debris into haulage trucks with a minimum fall distance to minimize dust emissions from tumbling debris. Place fine debris and dry debris into binS first.
- Avoid prolonged storage of debris and its exposure to wind.

4 REDUCING OTHER EMISSIONS AT CONSTRUCTION AND DEMOLITION SITES

If you have any questions regarding permitting in your jurisdiction, please contact the local Ministry of Environment, Conservation and Parks (MECP) about what your project is proposing to do, and inquire if additional permits are required.

4.1 VEHICLE AND EQUIPMENT ENGINES

Road and heavy engineering construction activities rely on the utilization of a wide range of mobile equipment, such as bulldozers, graders, dump trucks, pavers, excavators, and bobcats. The engine exhaust from these vehicles, especially from those operating on diesel fuel, represent a source of particulate and other emissions (e.g., Sulphur Dioxide (SO2), Nitrogen Oxides (NOx), Volatile Organic Compounds (VOCs), Polycyclic Aromatic Hydrocarbons (PAHs), Carbon Dioxide (CO2)) from the construction site. Outlined below are technologies and work practices that can be employed to reduce these emissions use diesel particulate filters.

- Take out of service immediately in the event of an equipment failure
- Use diesel particulate filters
- Use fuel-borne catalysts
- Use diesel oxidation catalysts
- Ensure catalytic converters are operating efficiently
- Evaluate alternative technologies to reduce emissions from vehicle engines
- Properly maintain engines and exhaust systems and conduct daily inspections
- Use low sulphur diesel

- Use alternative fuels such as biodiesel, ethanol, propane, natural gas and various fuel additives where feasible
- Reduce or eliminate idling time to less than five minutes to provide environmental benefits as well as economic benefits. The City of Hamilton has a by-law (No. 07-160) not allowing vehicles to idle for more than three minutes in a sixty-minute period[2]. The by-law applies to construction sites
- Evaluate alternatives for heat and air conditioning for off-road vehicles
- Minimize cold starts by retrofitting engine block heaters and pre-heated catalytic converters for more efficient combustion
- Evaporative losses associated with the fuel tank should be minimized

4.2 HOT MIX ASPHALT PRODUCTION AT PORTABLE PLANTS

The focus is on work practices to reduce gaseous emissions from portable hot mix asphalt plants that occur from the combustion process. Gaseous emissions include Suphur Oxides (SOx), NOx, Carbon Monoxide (CO) and VOC's.The various work practices outlined below have been summarized from the document published by the Canadian Construction Association[3].

Above:Portable Hot Mix Asphalt Plant

- Maintain proper air to fuel ratio in the combustion system to completely and efficiently burn the fuel.
- Burner and air systems should be regularly inspected and maintained by qualified personnel, tune-ups planned annually, and repairs made as needed.
- Conduct regular inspections of other equipment such as dampers, dryer flights, primary and secondary collectors, and hot oil heater systems.
- Aggregate should not be allowed to pass through combustion zone of the burner's flame.
- Thermocouples and other sensors should be regularly calibrated.
- Low sulphur fuels should be used.

4.3 VOLATILE ORGANIC COMPOUNDS

- VOCs are primarily emitted from the construction and demolition sector through the following sources:
  i. architectural surface coatings;
  ii. traffic marking operations;
  iii. asphalt concrete paving; and
  iv. asphalt roofing kettles.

4.3.1 Architectural Surface Coatings

Outlined below are the various work practices that should be employed in order to reduce VOC emissions from these sources.

- Use durable and high-performance architectural surface coatings (paint, primer, varnish, etc.) with a low VOC content. VOC emissions from the storage, handling and preparation of coatings should be minimized by:
  - tightly sealing containers
  - open only when needed
  - cover containers when not in use
  - add small amount of solvent to empty containers to prevent paint on interior from drying and therefore reducing cleaning effort

  - add thinners to coatings just prior to application in order to avoid long dwell times
  - coatings should be thinned with water or VOC exempt compounds
  - always mix thinner with the coating according to manufacturer's instructions
  - mixing operations should be undertaken to minimize the exposure of the coating to air
- Coatings wastage through spillage and splashing should be minimized.
- Surface to be coated should be properly prepared (e.g. repair cracks, sanding, etc.).
- Paint heaters should be used instead of paint thinners.
- Technologically advanced spray guns should be utilized to apply coatings.
- Spray-gun operators should apply correct application techniques and take care to spray at appropriate distance and speed, and use proper overlap.
- Proper technique should be used when cleaning spray guns.
- Alternative cleaners or low-VOC cleaners should be used instead of solvents.
- Paint colour changes should be optimized to reduce the use of cleaning solvents.
- Alternative finishing practices should be used – non-VOC surface coverings (walls, floors, ceilings) should be used were economical and feasible.

VOLATILE ORGANIC COMPOUNDS (VOCS) are a family of organic compounds that contain one or more carbon atoms and have high vapour pressures so that they evaporate readily into the atmosphere.

source: https://www.canada.ca/en/environment-climate-change/services/managing-pollution/sources-industry/volatile-organic-compounds-consumer-commercial/overview.html

4.3.2 Traffic Marking Operations

Includes marking of highway centre lines, edge stripes, directional markings and parking lots. The following painting materials, typically used for traffic marking, emit VOCs:

- Non-aerosol traffic paint;
- Aerosol marking paint – paints used to apply stripes or markings to outdoor surfaces, such as streets, golf courses, athletic fields, etc.; and
- Preformed tapes applied with adhesive primer

Alternatives to solvent-based traffic paints are water-based paints, thermoplastics, preformed tapes, field-reacted systems and permanent markers. Some of these alternatives can be used in the summer but consideration should be given to refraining from traffic line painting completely when smog alerts have been issued in the area.

4.3.3. Asphalt Concrete Paving

Three categories of asphalt concrete:

i. Hot-mix which is a mixture of aggregate (rock) and asphalt cement (glue) that can be customized to specific paving applications.

ii. Cutback asphalt is made by adding petroleum distillates (e.g. naphtha, kerosene, etc. to asphalt cement. Also contains the highest levels of VOCs per tonne used and are banned in some parts of North America.

iii. Emulsified asphalt is made by adding water and an emulsifying agent (such as soap) to asphalt concrete. Can be used in most of the same applications as cutback asphalt, but emits less VOCs.

4.3.4 Asphalt Roofing Kettles

VOCs are emitted from the installation and repair of asphalt roofs on commercial and industrial buildings, specifically from roofing kettles. A **roofing kettle** is a device used to heat and melt asphalt or coal tar pitch so that it can be applied onto a rooftop to provide a protective coating. To limit VOC emissions:

Above: A roofing kettle

- The temperature of asphalt inside a kettle should not exceed 260°C and coal tar pitch should not exceed 200°C. Temperature controlling devices should be installed and properly maintained.
- Close fitting lids should be used.
- Kettle vent should be kept closed.
- All roofing kettles should be equipped with afterburner lids to eliminate VOCs by destroying them at the source.

5 MEASURING/MONITORING AND RECORD-KEEPING

5.1 MEASURING/MONITORING

Establishing a fugitive dust emission measurement and monitoring program can determine the need for dust actions as well as their effectiveness. This typically takes the form of maintaining a daily record-keeping log. The recommended procedures to measure and monitor opacity, stabilized surfaces and wind speed are provided below. Please see http://www.bv.transports.gouv.qc.ca/mono/1173259.pdf for detailed steps to these procedures.

5.1.1 Opacity Monitoring

The opacity of dust leaving the property line where the activities are taking place should not exceed 20%. This test is conducted standing 5 meters away from a source with the sun behind, and observing the plume at zero seconds and five seconds. Repeat 12 times consecutively and average the readings. If the average is equal to or below 20%, the source is below the recommended opacity standard for construction and demolition sites. Make opacity observations approximately 1 meter above the ground. Record opacity observations making notes of the location, source type, method of control if any, observer's name, etc. Consider using commercial opacity monitors for the most accurate analysis. Visually montitoring opacity requires a trained and certified Visible Emission Observer, and is only a general determination.

5.1.2 Stabilized Surfaces

This test determines whether a property is sufficiently crusted to prevent windblown dust. It requires a steel ball with a diameter of 1.6 cm and mass of 16 – 17 grams. Hold the steel ball one (1) foot over your survey area and drop it. Make observations. If it causes an indentation or sinks and disturbs loose grains of dirt, it has failed the test. If only causes slight indentation but there are no loose grains of dirt, it has passed. Repeat test 3 times in at least 3 areas. If one fails the surface is insufficiently crusted.

5.1.3 Wind Speed

Monitoring wind speed will only be practical for the largest of construction sites and for sites who have regulatory requirements.

5.2 RECORD KEEPING

Construction/demolition projects should maintain daily self-inspection records, and records retained for at least 3 years after project completion. Records such as inspections, fuel use and chemical dust suppression use, should be retained on site and made available to local permitting authorities upon request.

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