

Rubber Industry Hazards

The Occupational Health Clinics for Ontario Workers



Historic photo of the Dominion Tire Factory in Kitchener, Ontario.

OHCOW Rubber Worker Project Team

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This document provides summary information about key rubber industry hazards of concern to worker health.

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Note: This document is in progress and we will continue to add information. Please check back for updates, and feel free to provide us with any feedback at rw@ohcow.on.ca.

N-nitrosamines

What are they?

- Group of chemical compounds that have a nitroso functional group (-NO) attached to an amine.
- Generated during the rubber heating and curing process.
- Common N-nitrosamines in rubber manufacturing include:
 - N-Nitrosodimethylamine (NDMA)
 - N-nitrosodiethylamine (NDEA)
 - N-Nitrosomorpholine (NMOR)
 - N-nitrosopiperidine (NPIP)

Why and how are they used?

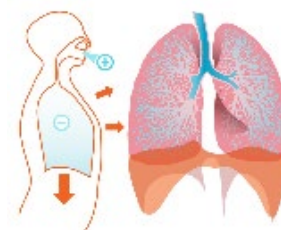
N-nitrosamines are formed during the production of rubber/rubber-based products:

- They are not used in the manufacturing process of rubber, but rather, are formed as a by-product during the manufacturing process. They can form from a reaction between amines present in the rubber and nitrogen oxides that may be generated during the heating and curing process.
- Chemical accelerators and vulcanization agents (such as amines, tetra-methyl-thiuram disulfide etc.) are added during vulcanization (which is when rubber is combined with sulphur to make the rubber tough) as accelerators. The accelerators and agents may react with other compounds used in the process and can produce N-nitrosamines as a by-product released into the air.
- Over time, industry practice has evolved to minimize the formation and release of N-nitrosamines with the use of secondary and tertiary amines.

How can workers be exposed?

Prolonged and excessive exposure to N-nitrosamines in the rubber industry can occur through:

- **Inhalation (Breathing it in):** Inhalation of N-nitrosamines during hot rubber processes and vulcanization may occur. Inhalation of high levels of nitrosamine vapours can lead to respiratory system risks. Prolonged, long-term exposure may lead to an increased risk of respiratory cancers.
- **Skin Contact (Touching it):** Direct contact with N-nitrosamines or nitrosamine-containing materials may cause skin irritation or sensitization in some individuals. They are well-absorbed through the skin, which can lead to entry into the bloodstream, causing systemic exposure.
- **Consumption (Eating or drinking):** Emerging evidence has highlighted the presence of N-nitrosamines in some medications and food, including some meat products.



Where has exposure been documented in Ontario rubber plants?

- All Rubber Plants: Given that N-nitrosamines are by products of vulcanization, it is expected that these are present in all rubber manufacturing plants via vulcanization.
- **Suspected at-risk jobs:** Mixing, curing, and finishing.

What are potential health impacts?

- Many N-nitrosamines have been classified as "probably carcinogenic to humans" (Group 2A) or "possibly carcinogenic to humans" (Group 2B).

Additional Resources

1. IARC Monograph on Rubber Industry Exposures, including N-nitrosamines:
<https://www.ncbi.nlm.nih.gov/books/NBK304412/>

Carbon Black

What is it?

- Extremely fine, powdery substance composed of nearly pure carbon. It may contain carbon compound contaminant such as Polycyclic Aromatic Hydrocarbons (PAH).
- Produced by the incomplete combustion of heavy petroleum products or natural gas.
- Significant use in the manufacturing of rubber tires.



Why and how is it used?

It is added to rubber compounds to improve key characteristics of the tires:

- **Reinforcement:** Carbon black increases the strength, durability, and resilience of rubber tires, improving its resistance to cuts, abrasions, and impacts.
- **Tread Wear Resistance:** Carbon black is added to tire treads to help enhance resistance to wear caused by friction with the road surface. This improves the tire's life span and promotes safer driving conditions.
- **Traction:** Carbon black enhances the tire's grip on the road. This is especially important for ensuring proper handling, stability, and control of vehicles in various weather conditions.
- **UV Protection:** Carbon black acts as a UV stabilizer, protecting the rubber from breaking down over time due to sun exposure.

How can workers be exposed?

Prolonged and excessive exposure to carbon black dust in the rubber industry can occur through:

- **Inhalation (Breathing it in):** Inhalation of carbon black dust in high concentrations can cause respiratory issues. Dry sweeping of the material, an inappropriate control method, can generate dust. Exposure can be controlled following the hierarchy of controls. This would include the use of proper ventilation and respiratory protection in the work environment.
- **Skin and Eye Contact:** Direct contact with carbon black can cause skin and eye irritation. Personal protective equipment, such as gloves and safety goggles, can reduce these risks.
- 1980 – American Conference of Governmental Industrial Hygienists Threshold Limit Values (ACGIH TLV) exposure limit was 3.5 mg/m³
- 2010 – Ontario adopted exposure limit of 3.0 mg/m³

Where has exposure been documented in Ontario rubber plants?

General areas/jobs across the industry:

- **Receiving Dock:** Raw materials, including carbon black, were unloaded. Exposure could occur during spills, or off-loading materials from rail car or tanks to storage tanks and bins.
- **Mixing Area:** Hot rubber processing fumes from bales of synthetic and natural rubber on the belt with pre-weighed chemicals from compounding, including carbon black and processing oils.

- **Compounding:** Pre-compounding exposures: Dust from carbon black materials from dispensing of carbon black, leading to dust.
- **Suspected at-risk jobs:** Banbury Operator, Banbury Cleaner, Banbury Belt Loader, Banbury Trucker, Forklift Operator, Unloading Operators.

Goodrich Drive Plant:

- Carbon black was used as a filler in rubber tire manufacturing
- 100,000 lbs of carbon black per day, was automatically fed to Banbury mixer through chutes of hoppers on the upper level.
- Unloading of raw carbon black in two receiving docks. Material was discharged from the bottom of transports through canvas conduits and into hoppers.
- Polycyclic Aromatic Hydrocarbons (PAHs) are found in carbon black.
- Carbon black trade name Raven-22 was added to daily rubber adhesive mixed used in the cement house by compounding operators.

Strange Street Plant:

- Carbon black is conveyed within 3-inch pipes (conveyor tunnel) by air supplied by a compressor pump. At times, sections of the pipe were removed to fix plugged material. This may have resulted in worker exposure.

King Street Plant:

- Spilled materials carbon black was observed in the weighing and Banbury charging areas.

What are potential health impacts?

- Lung irritation and coughing
- Eye, nose, and throat irritation
- More severe impacts may include bronchitis, COPD, and lung cancer
- Carbon Black has been classified as “Possibly carcinogenic to humans” (Group 2B) by the International Agency for Research on Cancer, based on sufficient evidence in experimental animals and inadequate evidence from epidemiological studies (i.e. human studies).

Additional Resources

2. IARC Monograph on Carbon Black, Titanium Dioxide, and Talc:
<https://publications.iarc.fr/Book-And-Report-Series/Iarc-Monographs-On-The-Identification-Of-Carcinogenic-Hazards-To-Humans/Carbon-Black-Titanium-Dioxide-And-Talc-2010>
3. Wisconsin Dept. of Health Services on Carbon Black:
<https://www.dhs.wisconsin.gov/chemical/carblack.htm>

Toluene

What is it?

- Colourless, substituted aromatic hydrocarbon solvent
- Sweet and strong smell
- Often used as a solvent in industrial processes including rubber production
- In 1980, the Ontario exposure limit was set to 20 ppm
- Technical grades often contained benzene

Why and how is it used?

It is added to rubber compounds to improve key characteristics of the tires:

- **Rubber Solvent:** Serves as a solvent for natural, synthetic and vulcanization agents. Dissolves and disperses these materials which helps with the blending and processing of rubber compounds.
- **Tire Surface Treatment:** Used as a surface treatment to enhance durability and weather resistance for tires.
- **Adhesive:** Toluene-based adhesives were used to help bond different layers of rubber and metal components during tire construction.

How can workers be exposed?

Prolonged and excessive exposure to toluene vapour in the rubber industry can occur through:

- **Inhalation (Breathing it in):** Inhalation of toluene vapour is the most common type of exposure most often occurring during mixing, and adhesive application.
- **Skin Contact (Touching it):** If direct contact is made with a substance containing toluene, it can be absorbed through the skin.

Where has exposure been documented in Ontario rubber plants?

Goodrich Dr. Plant

- Cement house – dry ingredients mixed with liquid ingredients. One of the liquid ingredients included toluene.

Strange St. Plant

- Toluene solvent used at this facility, which also contained a small percentage of benzene.

King St. Plant

- Toluene (Epton Code 1205) was used at the facility and contained <0.1% benzene.
- Cement House – toluene solvent was used, and samples were collected ranging from 2 to 6 ppm but at the time the TLV-TWA for toluene was 100 ppm.

Suspected at-risk jobs: Cement mixer, and workers that use cement and rubber solvents could be exposed.

What are potential health impacts?

- Toluene can impact the central nervous system.
- Can cause acute effects, including headaches, dizziness, and nausea.
- Inhalation of toluene vapour can lead to respiratory irritation, causing coughing and shortness of breath.
- Toluene vapour can also irritate the skin and eyes with direct contact.
- Prolonged or repeated exposure can lead to neurological effects (memory loss, trouble focusing and motor skill impairment).
- Long term exposure can be associated with increased hearing loss.
- The International Agency for Research on Cancer (IARC) has determined that toluene is not classifiable as to its carcinogenicity in humans (Group 3).

Additional Resources

1. CDC ATSDR ToxFAQs for Toluene:
<https://wwwn.cdc.gov/TSP/ToxFAQs/ToxFAQsDetails.aspx?faqid=160&toxid=29>