

Occupational Health Guideline for o-Toluidine*

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $\text{CH}_3\text{C}_6\text{H}_4\text{NH}_2$
- Synonyms: Ortho-aminotoluene; o-methylaniline; 1-methyl-2-aminobenzene; 2-methylaniline
- Appearance and odor: Colorless to pale yellow liquid with a weak, aromatic odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for o-toluidine is 5 parts of o-toluidine per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 22 milligrams of o-toluidine per cubic meter of air (mg/m^3). The American Conference of Governmental Industrial Hygienists has issued a Notice of Intended Changes of its recommended Threshold Limit Value for o-toluidine from 5 ppm to 2 ppm.

HEALTH HAZARD INFORMATION

• Routes of exposure

o-Toluidine can affect the body if it is inhaled, comes in contact with the eyes or skin, or is swallowed. It may enter the body through the skin.

• Effects of overexposure

Exposure to o-toluidine may affect the ability of the blood to carry oxygen. The earliest effect from exposure to this chemical is a bluish discoloration of the lips, tongue, and finger nails. At first, if the oxygen lack is not severe, the exposed person may have a feeling of well being. As the lack of oxygen increases, effects such as drowsiness, headache, nausea, and vomiting may

appear. If oxygen lack is very severe, it may cause unconsciousness and even death. Liquid toluidine is irritating to the eyes. Recovery from eye exposure may take a long time unless the eyes are flushed with water immediately. In addition, exposure to o-toluidine may cause bloody urine for a short time.

• Reporting signs and symptoms

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to o-toluidine.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to o-toluidine at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the blood, kidneys, liver, and cardiovascular system should be stressed. The skin should be examined for evidence of chronic disorders.

—A complete blood count: o-Toluidine has been shown to cause methemoglobinemia. Those with blood disorders may be at increased risk from exposure. A complete blood count should be performed including a red cell count, a white cell count, a differential count of a stained smear, as well as hemoglobin and hematocrit.

—Urinalysis: Since kidney damage has also been observed from exposure, a urinalysis should be performed, including at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis. Methemoglobin determination should be performed when o-toluidine intoxication is suspected.

• Summary of toxicology

o-Toluidine absorption, whether from inhalation of the vapor or by skin absorption of the liquid, causes anoxia (due to the formation of methemoglobin), and hematu-

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

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ria. The earliest manifestations of poisoning in humans are headache and cyanosis of the lips, the mucous membranes, the fingernail beds, and the tongue. Minor degrees of hypoxia may lead to a temporary sense of well-being and exhilaration. As the lack of oxygen increases, however, there is growing weakness, dizziness, and drowsiness, leading to stupor, unconsciousness, and death if treatment is not prompt. Transient microscopic hematuria has been observed in o-toluidine workers, presumably of renal origin, since no alterations in the bladder mucosa were observed by cystoscopy. In the eye of a rabbit, the liquid caused a severe burn. Excessive drying of the skin may result from repeated or prolonged contact.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 107
2. Boiling point (760 mm Hg): 199.7 C (391 F)
3. Specific gravity (water = 1): 1.00
4. Vapor density (air = 1 at boiling point of o-toluidine): 3.7
5. Melting point: -16.3 C (-3 F)
6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 1.5
8. Evaporation rate (butyl acetate = 1): Data not available

• Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as oxides of nitrogen and carbon monoxide) may be released in a fire involving o-toluidine.
4. Special precautions: Liquid o-toluidine will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: 85 C (185 F) (closed cup)
2. Autoignition temperature: 482 C (900 F)
3. Flammable limits in air, % by volume: Lower: 1.5 (calculated at flash point)
4. Extinguishant: Carbon dioxide, dry chemical, foam

• Warning properties

1. Odor Threshold: The Manufacturing Chemists Association reports that o-toluidine has an aromatic, aniline-like odor, but no information is available concerning the odor threshold of this substance. Aniline, o-toluidine, and xylydine, however, represent a family of chemical compounds with increasing methyl substitution. Since aniline has an odor threshold of 7 ppm and xylydine has an odor threshold of 0.0048 ppm, it is reasonable to assume that the aniline-like odor of o-toluidine is detectable at a concentration between 0.0048 and 7 ppm.
2. Eye Irritation Level: o-Toluidine vapor is not

known to be an eye irritant.

3. Evaluation of Warning Properties: Since the odor threshold of o-toluidine is probably near the TLV, it is treated as a material with good warning properties.

MONITORING AND MEASUREMENT PROCEDURES

• General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Method

Sampling and analyses may be performed by collection of o-toluidine in an adsorption tube containing silica gel, followed by desorption with ethanol, and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure o-toluidine may be used. An analytical method for o-toluidine is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact with liquid o-toluidine.
- Clothing contaminated with o-toluidine should be placed in closed containers for storage until it can be

discarded or until provision is made for the removal of o-toluidine from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the o-toluidine, the person performing the operation should be informed of o-toluidine's hazardous properties.

- Where exposure of an employee's body to liquid o-toluidine may occur, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

- Non-impervious clothing which becomes contaminated with o-toluidine should be removed immediately and not reworn until the o-toluidine is removed from the clothing.

- Employees should be provided with and required to use dust- and splash-proof safety goggles where there is any possibility of liquid o-toluidine contacting the eyes.

- Where there is any possibility that employees' eyes may be exposed to liquid o-toluidine, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes contaminated with o-toluidine should be immediately washed or showered with soap or mild detergent and water to remove any o-toluidine.

- Eating and smoking should not be permitted in areas where liquid o-toluidine is handled, processed, or stored.

- Employees who handle liquid o-toluidine should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to o-toluidine may occur and control methods which may be effective in each case:

Operation	Controls
Use in dye industry in manufacture of dyes and dye intermediates; use in chemical industry in manufacture of organic chemicals and chemical intermediates	Process enclosure; general dilution ventilation; personal protective equipment
Use as a reagent chemical in blood sugar determinations	Local exhaust ventilation; general dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If liquid o-toluidine gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If liquid o-toluidine gets on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If liquid o-toluidine soaks through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Get medical attention immediately.

• Breathing

If a person breathes in large amounts of o-toluidine, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

When liquid o-toluidine has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the person to vomit by having him touch the back of his throat with his finger or by giving him large amounts of warm water. Do not make an unconscious person vomit.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

- If o-toluidine is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.

2. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

- Waste disposal methods:

o-Toluidine may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.

2. By atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

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* SPECIAL NOTE

o-Toluidine appears on the OSHA "Candidate List" of chemicals being considered for further scientific review regarding its carcinogenicity (*Federal Register*, Vol. 45, No. 157, pp. 5372-5379, 12 August 1980).

The International Agency for Research on Cancer (IARC) has evaluated the data on this chemical and has concluded that it causes cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 16, 1978.

RESPIRATORY PROTECTION FOR o-TOLUIDINE

Condition	Minimum Respiratory Protection* Required Above 5 ppm
Vapor Concentration	
50 ppm or less	Any chemical cartridge respirator with an organic vapor cartridge(s). Any supplied-air respirator. Any self-contained breathing apparatus.
100 ppm or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s). A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 100 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.