

# Occupational Health Guideline for Quinone

## 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:  $OC_6H_4O$
- Synonyms: p-Benzoquinone
- Appearance and odor: Pale yellow solid with an acrid odor.

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for quinone is 0.1 part of quinone per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 0.4 milligram of quinone per cubic meter of air ( $mg/m^3$ ).

## HEALTH HAZARD INFORMATION

### • Routes of exposure

Quinone can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

### • Effects of overexposure

If quinone comes in contact with the skin or the lining of the nose and throat, it may cause irritation, discoloration, redness, swelling, and blistering. Prolonged contact with the skin may cause ulceration. Contact with the eyes may cause irritation, discoloration, and damage which may produce vision difficulties and may be permanent.

### • 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 quinone.

### • Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to quinone 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. Persons with a history of congenital or acquired eye defects would be expected to be at increased risk from exposure. Persons with poor visual acuity from high degrees of astigmatism, keratoconus, or pre-existing corneal injury should be excluded from repeated, uncontrolled exposure to quinone vapor. Examination of the eyes and skin should be stressed.

—Ophthalmic examination: Quinone causes eye damage in humans. An ophthalmic examination should be performed, including visual acuity and slit-lamp inspection of the cornea.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

### • Summary of toxicology

Quinone is a solid with appreciable vapor pressure, and the vapor or dust is very hazardous to the eyes. Acute exposure causes conjunctival irritation, and in some cases corneal edema, ulceration and scarring; transient eye irritation may be noted above 0.1 ppm and becomes marked at 1 to 2 ppm. Chronic exposure causes the gradual development of changes characterized as: (1) brownish discoloration of the conjunctiva and cornea confined to the intrapalpebral fissure, (2) small opacities of the cornea, and (3) structural corneal changes which result in loss of visual acuity. The pigmentary changes are reversible, but the more slowly developing structural changes in the cornea may progress. Although pigmentation may occur with less than 5 years of exposure, serious injury. Skin contact may cause irritation and

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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.

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this is uncommon and usually is not associated with serious injury. Skin contact may cause irritation and staining. Systemic effects from industrial exposure have not been reported. Skin cancer has been reported in mice painted with a quinone solution. A 0.1% or 0.25% solution of quinone in benzene was applied to the skin of mice daily or every other day; of 87 mice surviving for 200 days, 9 had papillomas of the skin, 3 had cancer of the skin, and 8 had lung cancer.

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: 108.1
2. Boiling point (760 mm Hg): Sublimes
3. Specific gravity (water = 1): 1.32
4. Vapor density (air = 1 at boiling point of quinone): 3.7
5. Melting point: 113 C (235 F)
6. Vapor pressure at 20 C (68 F): 0.1 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 quinone fumes and carbon monoxide) may be released in a fire involving quinone.
4. Special precautions: Quinone will attack some forms of plastics, rubber, and coatings.

### • Flammability

1. Flash point: Data not available
2. Autoignition temperature: Data not available
3. Flammable limits in air, % by volume: Data not available
4. Extinguishant: Water spray, dry chemical, carbon dioxide

### • Warning properties

1. Odor Threshold: According to the AIHA *Hygienic Guide*, the "odor of quinone is not readily apparent at 0.1 ppm." Grant, however, reports that the "vapors are perceptible by smell to human beings at about 0.1 ppm in air." According to the *Hygienic Guide*, olfactory fatigue occurs upon exposure to quinone.

2. Eye Irritation Level: The *Hygienic Guide* states that "transient eye irritation may be noted above 0.1 ppm and becomes marked at 1 to 2 ppm." Grant states that "at 0.5 ppm the vapors are irritating to the eyes and at 3.0 ppm they are very irritating."

3. Evaluation of Warning Properties: The *Hygienic Guide* states that "exposure evaluation by odor and irritant effects is not adequate to assure safety because: 1) the odor of quinone is not readily apparent at 0.1 ppm, 2) olfactory fatigue occurs, and 3) repeated exposure to levels causing sensory irritation may cause

chronic eye injury." For these reasons, quinone is treated as a material with poor warning properties. The concentration of quinone in saturated air at 20 C could result in a significant exposure relative to the permissible exposure.

## 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

An analytical method for quinone is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 4, 1978, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00317-3).

## 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 skin contact with quinone, where skin contact may occur.

• If employees' clothing has had any possibility of being contaminated with quinone, employees should change into uncontaminated clothing before leaving the work premises.

- Clothing which has had any possibility of being contaminated with quinone should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of quinone from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the quinone, the person performing the operation should be informed of quinone's hazardous properties.

- Where exposure of an employee's body to solid quinone or liquids containing quinone 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 quinone should be removed immediately and not reworn until the quinone 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 quinone or liquids containing quinone contacting the eyes.

- Where there is any possibility that employees' eyes may be exposed to solid quinone or liquids containing quinone, an eye-wash fountain should be provided within the immediate work area for emergency use.

## SANITATION

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

- Workers subject to skin contact with quinone should wash with soap or mild detergent and water any areas of the body which may have contacted quinone at the end of each work day.

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

- Employees who handle quinone 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 quinone may occur and control methods which may be effective in each case:

### Operation

Use as an oxidizing agent in synthesis of organic chemicals and intermediates; in photography—developer  
hydroquinone; in agriculture in production of insecticides and fungicides; in pharmaceutical industry for production of cortisone and addition compound with barbituates

Use in polymer and resins industry as an inhibitor and retarder-antioxidant, curing agent, and catalyst

Use as a toner and intensifier in photographic industry; as a tanning agent for leather industry

Use in manufacture of quinhydrone electrodes for use for pH determinations

### Controls

Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

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## 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 solid quinone or liquids containing quinone get 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 quinone gets on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If quinone penetrates through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

### • Breathing

If a person breathes in large amounts of quinone, 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 quinone has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

- **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 AND DISPOSAL PROCEDURES

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

- If quinone is spilled, the following steps should be taken:

1. Ventilate area of spill.
2. For small quantities, sweep onto paper or other suitable material, place in an appropriate container and burn in a safe place (such as a fume hood). Large quantities may be reclaimed; however, if this is not practical, dissolve in a flammable solvent (such as alcohol) and atomize in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

- Waste disposal methods:

Quinone may be disposed of:

1. By making packages of quinone in paper or other flammable material and burning in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.
2. By dissolving quinone in a flammable solvent (such as alcohol) and atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

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## RESPIRATORY PROTECTION FOR QUINONE

Condition	Minimum Respiratory Protection* Required Above 0.1 ppm
Particulate or Vapor Concentration	
5 ppm or 20 mg/m <sup>3</sup> or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
75 ppm or 300 mg/m <sup>3</sup> or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 75 ppm or 300 mg/m <sup>3</sup> 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 and particulates. Any escape self-contained breathing apparatus.

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