IPCS INTERNATIONAL PROGRAMME ON CHEMICAL SAFETY

Health and Safety Guide No. 101

HYDROQUINONE HEALTH AND SAFETY GUIDE

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Health and Safety Guide No. 101

HYDROQUINONE HEALTH AND SAFETY GUIDE

This is a companion volume to
Environmental Health Criteria 157: Hydroquinone

Published by the World Health Organization for the International Programme on Chemical Safety (a collaborative programme of the United Nations Environment Programme, the International Labour Organisation, and the World Health Organization)

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INTRODUCTION

The Environmental Health Criteria (EHC) monographs produced by the International Programme on Chemical Safety include an assessment of the effects on the environment and on human health of exposure to a chemical or combination of chemicals, or physical or biological agents. They also provide guidelines for setting exposure limits.

The purpose of a Health and Safety Guide is to facilitate the application of these guidelines in national chemical safety programmes. The first three sections of a Health and Safety Guide highlight the relevant technical information in the corresponding EHC. Section 4 includes advice on preventive and protective measures and emergency action; health workers should be thoroughly familiar with the medical information to ensure that they can act efficiently in an emergency. Within the Guide is a Summary of Chemical Safety Information which should be readily available, and should be clearly explained, to all who could come into contact with the chemical. The section on regulatory information has been extracted from the legal file of the International Register of Potentially Toxic Chemicals (IRPTC) and from other United Nations sources.

The target readership includes occupational health services, those in ministries, governmental agencies, industry, and trade unions who are involved in the safe use of chemicals and the avoidance of environmental health hazards, and those wanting more information on this topic. An attempt has been made to use only terms that will be familiar to the intended user. However, sections 1 and 2 inevitably contain some technical terms. A bibliography has been included for readers who require further background information.

Revision of the information in this Guide will take place in due course, and the eventual aim is to use standardized terminology. Comments on any difficulties encountered in using the Guide would be very helpful and should be addressed to:

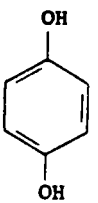
The Director
International Programme on Chemical Safety
World Health Organization
1211 Geneva 27
Switzerland

THE INFORMATION IN THIS GUIDE
SHOULD BE CONSIDERED AS A
STARTING POINT TO A COMPREHENSIVE
HEALTH AND SAFETY PROGRAMME

1. PRODUCT IDENTITY AND USES

1.1 Identity

Common name:	hydroquinone
Molecular formula:	$C_6H_4(OH)_2$
Chemical structure:	



CAS chemical name:	1,4-benzenediol
Trade names:	Black and White Bleaching Cream, Diak S, Eldopoque, Eldoquin, Tecquinol, Tenox HQ
Synonyms:	1,4-benzenediol; *p*-benzenediol; benzohydroquinone; benzoquinol; 1,4-dihydroxybenzene; *p*-dihydroxybenzene; *p*-dioxobenzene; *p*-dioxybenzene; hydroquinol; hydroquinole; α-hydroquinone; *p*-hydroquinone; *p*-hydroxyphenol; quinol; β-quinol
CAS registry number:	123-31-9
RTECS register number:	MX 3500000

1.2 Physical and Chemical Properties

Hydroquinone is a white crystalline substance when pure and is highly soluble in water. Hydroquinone is combustible when preheated. It is a reducing agent that is reversibly oxidized to semiquinone and quinone.

Other properties of hydroquinone are given in Table 1.

Conversion factors (at 25 °C and normal atmospheric pressure)

$$1 \text{ ppm} = 4.5 \text{ mg/m}^3$$
$$1 \text{ mg/m}^3 = 0.222 \text{ ppm}$$

Table 1. Properties of hydroquinone

Physical state	long needles
Colour	white (analytical grade)
Odour	odourless
Melting point	173-174 °C
Boiling point	287 °C
Flash point	165 °C (closed cup)
Autoignition temperature	515 °C
Flammability	combustible when preheated
Explosion limits	slight when exposed to heat; reactive at high temperature or pressure
Vapour pressure	2.4×10^{-3} Pa (1.8×10^{-5} mmHg) at 25 °C
Specific gravity	1.3 at 15 °C
Vapour density	3.81
Log *n*-octanol/water partition coefficient	0 59
Solubility in water (25 °C)	70 g/litre
Solubility in organic solvents (w/w at 25 °C)	
ethyl alcohol	57%
acetone	20%
methyl isobutyl ketone	27%
2-ethylhexanol	12%
ethyl acetate	22%

1.3 Analytical Methods

Hydroquinone in the air is sampled either by trapping in solvent or on a mixed-cellulose-ester membrane filter.

Analysis of hydroquinone is carried out by titrimetric, colorimetric, spectrophotometric, or, most commonly, chromatographic techniques.

1.4 Production and Uses

Hydroquinone is produced industrially in several countries. In 1979, the total world capacity for production exceeded 40 000 tonnes, while in 1992 it was approximately 35 000 tonnes. Hydroquinone is extensively used as a reducing agent, as a photographic developer, as an antioxidant for many oxidizable products, as a stabilizer or polymerizing inhibitor for certain materials that polymerize in the presence of free radicals, and as a chemical intermediate for the production of antioxidants, antiozonants, agrochemicals, and polymers. It is a skin-lightening agent and is used in cosmetics, hair dyes, and medical preparations.

2. SUMMARY AND EVALUATION

2.1 Environmental Transport, Distribution, and Transformation

Hydroquinone occurs in the environment as a result of man-made processes, as well as in natural products from plants and animals.

Because of its physical and chemical properties, hydroquinone will be distributed mainly to the water compartment when released into the environment. It degrades as a result of both photochemical and biological processes; consequently, it does not persist in the environment. Bio-accumulation has not been observed.

2.2 Environmental Levels and Human Exposure

No data on hydroquinone concentrations in air, soil, or water have been found. However, hydroquinone has been measured in mainstream smoke from non-filter cigarettes in amounts varying from 110 to 300 μg per cigarette, and also in sidestream smoke. Hydroquinone has been found in plant-derived food products (e.g., wheat germ), in brewed coffee, and in teas prepared from the leaves of some berries, where the concentration sometimes exceeds 1%.

Amateur photographers can be exposed to hydroquinone dermally or by inhalation. However, data on exposure levels are not available. Dermal exposure may also result from the use of cosmetic and medical products containing hydroquinone, such as skin lighteners. The European Economic Community (EEC) countries have restricted its use in cosmetics to 2% or less. In the USA, the Food and Drug Administration has proposed concentrations between 1.5 and 2% in skin lighteners. Concentrations up to 4% may be found in prescription drugs. In some countries, even higher concentrations may be found in skin lighteners.

Few industrial hygiene monitoring data are available for hydroquinone. Average concentrations in air during the manufacturing and processing of hydroquinone have been reported to be in the range of 0.13 to 0.79 mg/m^3. Occupational air exposure limits (time-weighted average) in different countries range from 0.5 to 2 mg/m^3.

2.3 Kinetics and Metabolism

Hydroquinone is rapidly and extensively absorbed from the gut and trachea of animals. Absorption via the skin is slower but may be more rapid with vehicles such as alcohols. Hydroquinone distributes rapidly and widely among tissues. It is metabolized to *p*-benzoquinone and other oxidized products, and is detoxified by conjugation to monoglucuronide, monosulfate, and mercapturic derivatives. The excretion of hydroquinone and its metabolites is rapid, and occurs primarily via the urine.

Hydroquinone and its derivatives react with different biological components, such as macromolecules and low relative molecular mass molecules, and have effects on cellular metabolism.

2.4 Effects on Laboratory Mammals and *In Vitro* Test Systems

Oral LD_{50} values for several animal species range between 300 and 1300 mg/kg body weight. However, LD_{50} values for the cat range from 42 to 86 mg/kg body weight. Acute high-level exposure to hydroquinone causes severe effects on the central nervous system (CNS) including hyperexcitability, tremor, convulsions, coma, and death. At sublethal doses, these effects are reversible. The dermal LD_{50} value has been estimated to be >3800 mg/kg in rodents. Inhalation LC_{50} values are not available.

A formulation containing 2% hydroquinone in a single-insult patch test on rabbits resulted in an irritation score of 1.22 (on a scale of 0 to 4). Daily topical applications for three weeks of 2 or 5% hydroquinone in an oil-water emulsion on the depilated skin of black guinea-pigs caused depigmentation, inflammatory changes, and thickening of the epidermis. The depigmentation was more marked at higher concentrations, and female guinea-pigs were more sensitive than males.

Sensitization tests on guinea-pigs have shown weak to strong reactions, depending on the methods or vehicles used. The strongest reactions were obtained with the guinea-pig maximization test. A cross-sensitization of almost 100% between hydroquinone and *p*-methoxyphenol was also seen in guinea-pigs, but only restricted evidence of cross-reactions to *p*-phenylenediamine, sulfanilic acid and *p*-benzoquinone was obtained.

SUMMARY AND EVALUATION

A 6-week, oral toxicity study on male F-344 rats resulted in nephropathy and renal cell proliferation. Thirteen-week oral gavage studies on F-344 rats and $B6C3F_1$ mice resulted in nephrotoxicity in rats at 100 and 200 mg/kg, and tremors and convulsions in rats at 200 mg/kg; reduced body weight gain was seen in both rats and mice. Dosing at 400 mg/kg was lethal in rats. In mice dosed for 13 weeks at 400 mg/kg, tremors, convulsions, and lesions in the gastric epithelium were reported. Thirteen-week hydroquinone exposure of Sprague-Dawley rats resulted in decreased body weight gain and CNS signs at 200 mg/kg. CNS signs were also observed at a dose level of 64 mg/kg body weight, but not at 20 mg/kg.

Hydroquinone injected subcutaneously reduced fertility in male rats, and prolonged the estrus cycle in female rats. However, the effects on male rats were not found in oral studies (a dominant lethality study and a two-generation study). In a developmental study in rats, oral doses of 300 mg/kg body weight caused slight maternal toxicity and reduced fetal body weight. In rabbits, the no-observed-effect level (NOEL) for maternal toxicity was 25 mg/kg per day, and it was 75 mg/kg per day for developmental toxicity. In a two-generation reproduction study on rats, hydroquinone caused no reproductive effects at oral doses of up to 150 mg/kg body weight per day. The no-observed-adverse-effect level (NOAEL) for parental toxicity was determined to be 15 mg/kg per day; for reproductive effects through two generations, it was 150 mg/kg per day.

Hydroquinone induces micronuclei *in vivo* and *in vitro*. Structural and numerical chromosome aberrations have been observed *in vitro* and after intraperitoneal administration *in vivo*. Furthermore, the induction of gene mutations, sister-chromatid exchange, and DNA damage has been demonstrated *in vitro*. Intraperitoneal injection of hydroquinone caused chromosomal aberrations in male mouse germ cells of the same order of magnitude as in mouse bone marrow cells. Induction of germ-cell mutations could not be established in a dominant lethal test on male rats dosed orally.

In a two-year study, oral administration of hydroquinone caused a dose-related incidence of renal tubular cell adenomas in male F-344/N rats. The incidence was statistically significant in the high-dose group. In high-dose males, renal tubular cell hyperplasia was also found. In female rats, a dose-related increased incidence of mononuclear cell leukaemia occurred. Female $B6C3F_1$ mice developed a significantly increased incidence of hepatocellular adenomas. In another study, hydroquinone (at a dietary level

of 0.8%) produced a significantly increased incidence of epithelial hyperplasia of the renal papilla and a significant increase in renal tubular hyperplasia and adenomas in male rats. No increased incidence of mononuclear cell leukaemia was observed in female rats. In mice, the incidence of squamous cell hyperplasia of the forestomach epithelium was significantly increased in both sexes. In male mice, there was a significantly increased incidence of hepatocellular adenomas and also of renal tubular hyperplasia. A few renal cell adenomas were observed.

In vivo (intraperitoneal injection) and *in vitro* studies on mice demonstrated that hydroquinone has a cytotoxic effect by reducing the bone marrow and spleen cellularity and also an immunosuppressive potential by inhibiting the maturation of B-lymphocytes and the natural killer cell activity. Results also indicate that bone marrow macrophages may be the primary target for hydroquinone myelotoxicity. Myelotoxic effects were not observed in a long-term bioassay on rodents.

In a 90-day study on rats using a functional-observational battery, dose levels of 64 and 200 mg hydroquinone/kg produced tremors, and a level of 200 mg/kg produced a depression in general activity. The results of neuropathological examinations were negative.

2.5 Effects on Humans

Cases of intoxication have been reported after oral ingestion of hydroquinone alone or of photographic developing agents containing hydroquinone. The major signs of poisoning included dark urine, vomiting, abdominal pain, tachycardia, tremors, convulsions, and coma. Deaths have been reported after ingestion of photographic developing agents containing hydroquinone. In a controlled oral study on human volunteers, ingestion of 300-500 mg hydroquinone daily for 3-5 months did not produce any observable pathological changes in the blood and urine.

Dermal applications of hydroquinone at concentrations in different bases of less than 3% caused negligible effects in male volunteers from different human races. However, there are case reports suggesting that skin lightening creams containing 2% hydroquinone have produced leukoderma, as well as ochronosis. Hydroquinone (1% aqueous solution or 5% cream) has caused irritation (erythema or staining). Allergic contact dermatitis due to hydroquinone has been diagnosed.

Combined exposure to airborne concentrations of hydroquinone and quinone causes eye irritation, sensitivity to light, injury of the corneal epithelium, corneal ulcers, and visual disturbances. There have been cases of appreciable loss of vision. Irritation has occurred at exposure levels of 2.25 mg/m^3 or more. Long-term exposure causes staining of the conjunctiva and cornea, and also opacity. Slowly developing inflammation and discoloration of the cornea and conjunctiva have resulted after daily hydroquinone exposure, for at least two years, to levels of 0.05-14.4 mg/m^3; serious cases have not occurred until after five or more years. One report described cases of corneal damage occurring several years after the exposure to hydroquinone had stopped.

There are no adequate epidemiological data to assess the carcinogenicity of hydroquinone in humans.

2.6 Effects on Other Organisms in the Laboratory and Field

The ecotoxicological behaviour of hydroquinone has to be related to its physical and chemical properties, which induce sensitivity to light, pH, and dissolved oxygen. Its ecotoxicity, which is generally high (e.g., < 1 mg/litre for aquatic organisms), varies from species to species.

Algae, yeasts, fungi, and plants are less sensitive to hydroquinone than the other organisms generally used for toxicity testing. However, within the same taxonomic group, the sensitivity of different species to hydroquinone may vary by a factor of 1000.

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 Conclusions

The general population may be exposed to hydroquinone through consuming plant-derived foods that contain this chemical as a natural component, through smoking (active or passive), or through using cosmetics and skin-lightening creams. Amateur photographers who develop film manually may be exposed through skin contact and inhalation.

Ingestion of large quantities may produce vomiting, convulsions, and coma. Repeated skin contact can lead to depigmentation, allergic contact dermatitis, and sensitization. Long-term occupational exposure to airborne hydroquinone can result in eye irritation, sensitivity to light, and visual disturbance.

Hydroquinone is highly toxic for most organisms in the environment, though the toxicity varies considerably from species to species. However, the substance is readily degraded and does not persist in the environment.

3.2 Recommendations

a) In view of the widespread inappropriate use of skin-lightening creams, it is recommended that over-the-counter sales of creams containing hydroquinone be restricted. Health education programmes should be developed to discourage the use of hydroquinone-containing creams for whole-body skin lightening.

b) Sufficient time should be allowed for the degradation of hydroquinone in wastewater effluent before it reaches the recipient water.

4. HUMAN HEALTH HAZARDS, PREVENTION AND PROTECTION, EMERGENCY ACTION

4.1 Human Health Hazards, Prevention and Protection, First Aid

The human health effects associated with certain types of exposure to hydroquinone, together with preventive and protective measures and first-aid recommendations, are listed in the Summary of Chemical Safety Information (section 6).

Repeated or prolonged contact with skin may cause dermatitis and skin sensitization. The substance may have effects on the eye and skin, resulting in discoloration of the conjunctiva and cornea, loss of vision, skin depigmentation, and discoloration of nails and hair.

4.1.1 *Advice to physicians*

At room temperature and in the presence of moisture, hydroquinone oxidizes to quinone, which causes much worse eye irritation than hydroquinone itself; there is a consequent risk of conjunctivitis and corneal erosion. Lung oedema symptoms usually develop several hours after severe inhalation exposure and are aggravated by physical exertion; rest and hospitalization are essential. As first aid, administration of corticosteroid spray should be considered.

In cases of dermatitis due to hydroquinone, removal from exposure will quickly clear up the symptoms.

4.1.2 *Health surveillance advice*

Depending on the extent of exposure, regular medical check-ups are advisable. Careful examination of the eyes, including visual acuity and slit lamp examinations, should be carried out in pre-employment and periodic examinations. The skin should also be examined.

4.2 Explosion and Fire Hazards

4.2.1 *Explosion hazards*

A hydroquinone dust cloud may explode if ignited in an enclosed area. It is important to prevent dispersion of dust and to use a closed system and dust explosion-proof electrical equipment and lighting.

4.2.2 *Fire hazards*

Hydroquinone is combustible when preheated, and forms toxic gases. It reacts with oxidizing agents, and a violent reaction occurs with sodium hydroxide.

Solid hydroquinone should be handled in such a way that particles do not become airborne. In areas where it is used, there should be no open flames and no smoking. In the event of a fire, extinguishers containing dry chemical, alcohol-resistant foam, water, or carbon dioxide should be used. Water used to control fires should be contained, or diked, for subsequent disposal.

4.3 Storage

Hydroquinone should be stored in light-proof, tightly closed containers in a cool, dark place, away from heat and oxidizing agents. It should be labelled as corrosive.

4.4 Transport

Containers should be in good condition and labelled appropriately. Transporters should comply with national and international requirements regarding the transport of hazardous material.

4.5 Spillage

Rubber gloves and boots should be worn while clearing up the spillage. The spilled substance should be swept into metal or glass fibre containers and removed to a safe place. If available, a P2 respirator should also be worn. Any remaining hydroquinone should be flushed away with water, but it is important to prevent run-off entering water-courses.

4.6 Disposal

The recommendation of the International Register of Potentially Toxic Chemicals (IRPTC) Expert Consultation (May 1985) was:

> "Incineration (1000 °C, 2 seconds minimum), then scrub to remove harmful combustion products".

The peer-review conclusions from this IRPTC Expert Consultation were:

> "Oxidation produces quinone. Small amounts only: dilute to 100 mg/litre and discharge to sewer".

5. HAZARDS FOR THE ENVIRONMENT AND THEIR PREVENTION

Because of its physical and chemical properties, hydroquinone will be distributed mainly to the water compartment when released into the environment. It is, in general, highly toxic for organisms in the environment, though the sensitivity of different species within the same taxonomic group varies greatly. However, hydroquinone degrades as a result of both photochemical and biological processes; consequently, it does not persist in the environment. Bioaccumulation has not been observed.

Contamination of the environment can be avoided by the use of suitable methods of storage, transport, handling, and waste disposal (see sections 4.3, 4.4, and 4.6). Sufficient time should be allowed for hydroquinone in wastewater effluent, e.g., from photographic processing, to degrade before it reaches the recipient water. In the case of spillage, the clean-up methods described in section 4.5 should be used.

6. SUMMARY OF CHEMICAL SAFETY INFORMATION

This summary should be easily available to all health workers concerned with, and users of, hydroquinone. It should be displayed at, or near, entrances to areas where there is potential exposure to hydroquinone, and on processing equipment and containers. The summary should be translated into the appropriate language(s). All persons potentially exposed to the chemical should also have the instructions in the summary clearly explained.

Space is available for insertion of the National Occupational Exposure Limit, the address and telephone number of the National Poison Control Centre, and local trade names.

SUMMARY OF CHEMICAL SAFETY INFORMATION

HYDROQUINONE

1,4-benzenediol

$C_6H_4(OH)_2$

PHYSICAL PROPERTIES		OTHER CHARACTERISTICS
Relative molecular mass	110.11	Light tan, light grey, or colourless crystals; the vapour mixes readily with air; can enter the body by inhalation or ingestion or, to a a limited extent, through the skin; corrosive to the eyes, skin, and respiratory tract; prolonged exposure to fumes, dust, or vapour can cause lung disorders
Melting point (°C)	173-174	
Boiling point (°C)	287	
Flash point (closed cup) (°C)	165	
Autoignition temperature (°C)	515	
Relative density (15 °C)	1.332	
Relative vapour density	3.81	
Vapour pressure (Pa) (25 °C)	2.4×10^{-3}	
Solubility in water (g/litre, 25 °C)	70	
Log P *n*-octanol/water	0.59	

HAZARDS/SYMPTOMS	PREVENTION AND PROTECTION	FIRST AID
EYES: Corrosive; redness, pain, blurred vision	Wear safety goggles or face shield	Rinse with plenty of water for at least 15 min (remove contact lenses); obtain medical attention immediately

SKIN: Corrosive; redness, pain, serious burns, allergic dermatitis, sensitization	Avoid skin contact; wear protective clothing and gloves	Remove contaminated clothing immediately; wash skin with soap and plenty of water; obtain medical attention
INHALATION: Corrosive; coughing, breathing difficulties, headache, dizziness, nausea, diarrhoea	Apply local exhaust or breathing protection; avoid inhalation of vapour, particularly when liberated at high temperature	Remove victim to fresh air and place in half-sitting position; obtain medical attention immediately
INGESTION: Corrosive; blue skin, confusion, dizziness, headache, vomiting, unconsciousness, haemolytic anaemia, liver effects	Do not eat, drink, chew, or smoke during work; keep out of reach of children	Rinse mouth; give water to drink (ONLY IN CONSCIOUS PERSONS!); obtain medical advice immediately
ENVIRONMENT: Presents a risk for aquatic and soil organisms	Contamination of water and soil should be avoided by proper methods of storage, transport, and waste disposal	

SPILLAGE	STORAGE	FIRE AND EXPLOSION
Wear rubber gloves and boots; clean up spilled substance and place in metal or glass fibre containers; flush away any remainder with water (additional individual protection: P2 respirator)	Store in a cool, dark place in light-proof, tightly-closed containers	Solid hydroquinone is combustible and dust explosions are possible; in case of fire, keep containers cool with water spray; evacuate personnel to a safe area; use powder, water, alcohol-resistant foam, or carbon dioxide to extinguish fire

SUMMARY OF CHEMICAL SAFETY INFORMATION *(continued)*

WASTE DISPOSAL	LABELLING
Incinerate (1000 °C, 2 seconds minimum) then scrub to remove harmful combustion products; sufficient time should be allowed for hydroquinone in wastewater effluent to degrade before reaching recipient water	National occupational exposure limit: United Nations No. 2662 Hazard Class 6.1 Packing Class III National Poison Control Centre: Local trade names:

7. CURRENT REGULATIONS, GUIDELINES, AND STANDARDS

The information given in this section has been extracted from the International Register of Potentially Toxic Chemicals (IRPTC) legal file. A full reference to the original national document from which the information was extracted can be obtained from IRPTC. When no effective date appears in the IRPTC legal file, the year of the reference from which the data are taken is indicated by (r).

The reader should be aware that regulatory decisions about chemicals, taken in a certain country, can only be fully understood in the framework of the legislation of that country. Furthermore, the regulations and guidelines of all countries are subject to change and should always be verified with appropriate regulatory authorities before application.

7.1 Previous Evaluations by International Bodies

In 1977, the International Agency for Research on Cancer (IARC) Working Group concluded that the available data on hydroquinone did not allow an evaluation of its carcinogenicity.

Hydroquinone was evaluated by a Nordic Expert Group for Documentation of Occupational Exposure Limits in 1989. It was recommended that its genotoxic effects should be given attention and also its possible effects on the immune system, bone marrow, skin, and mucous membranes.

7.2 Exposure Limit Values

Some exposure limit values are given in the table on pages 26-27.

7.3 Specific Restrictions

In the European Economic Community countries, hydroquinone is restricted for use in cosmetics to 2% or less. The US Food and Drug Administration has issued a Notice of Proposed Rule-making for the use of hydroquinone as a skin lightener in over-the-counter drugs at concentrations below 1.5-2.0%.

CURRENT REGULATIONS, GUIDELINES, AND STANDARDS

Exposure Limit Values

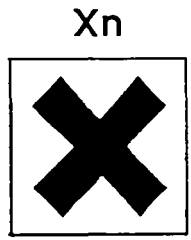
Medium	Specification	Country/ organization	Exposure limit description	Value	Effective date
AIR	Occupational	Argentina	Maximum permissible concentration (MPC) - Time-weighted average (TWA)	 2 mg/m^3	1991
		Canada	Threshold limit value (TLV) - Time-weighted average (TWA)	 2 mg/m^3	1990
		Germany	Maximum worksite concentration (MAK) - Time-weighted average (TWA) - Short-term exposure limit (STEL) (5-min)	 2 mg/m^3 4 mg/m^3	1992(r)
		Russian Federation	Maximum allowable concentration (MAC) - Ceiling value (aerosol)	 1 mg/m^3	1989
		Sweden	Hygienic limit value (HLV) - Time-weighted average (TWA) - Short-term exposure limit (STEL) (15-min)	 0.5 mg/m^3 1.5 mg/m^3	1991

		United Kingdom	Occupational exposure standard (OES) - Time-weighted average (TWA) - Short-term exposure limit (STEL) (10-min TWA)	 2 mg/m^3 4 mg/m^3	1992
AIR	Occupational	USA (ACGIH)	- Threshold limit value (TLV) - Time-weighted average (TWA)	 2 mg/m^3	1989
		USA (NIOSH)	Recommended exposure limit (REL) - Ceiling value	 2 mg/m^3	1990(r)
		USA (OSHA)	Permissible exposure limit (PEL) - Time-weighted average (TWA)	 2 mg/m^3	1990(r)
AIR	Ambient	Russian Federation	Preliminary safety level (PSL)	0.02 mg/m^3	1983
WATER	Surface	Russian Federation	Maximum allowable concentration (MAC)	0.2 mg/litre	1989

7.4 Labelling, Packaging, and Transport

The United Nations Committee of Experts on the Transport of Dangerous Goods classifies hydroquinone as a toxic substance (Hazard Class 6.1), and, with regard to packing, as a substance presenting minor danger (Packing Group III).

European Economic Community legislation requires labelling as a harmful substance using the symbol Xn.



The following label statements are required:

R 20/22	Harmful by inhalation and if swallowed
S 2	Keep out of reach of children
S 24/25	Avoid contact with skin and eyes
S 39	Wear eye/face protection

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