AMERICAN
INDUSTRIAL HYGIENE
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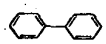
HYGIENIC GUIDE SERIES

Diphenyl

(Biphenyl, Phenylbenzene)



Significant Physical Properties

Diphenyl is a colorless to light yellow solid with a distinctive aromatic odor.

Molecular weight:	154.20
Flash point:	235°F (113°C) closed cup
Explosive limits:	Lower, 0.6% at 232°F; upper, 5.8% at 311°F
Solubility:	Insoluble in water, slightly soluble in ethanol, soluble in hydrocarbons
Melting point:	70.5°C
Boiling point:	256.1°C
Vapor pressure:[1]	mm Hg 0.001 0.005 0.008 (calc) 0.010 0.050 °C 6.2 20.4 25 27.0 43.5
Odor threshold:[2]	0.06 to 0.29 mg/m³
At 25°C and 760 mm Hg:	Saturated air contains 66 mg/m³ (10.5 ppm) 1 ppm = 0.00631 mg/liter 1 mg/liter = 158 ppm

I. Hygienic Standards

A. RECOMMENDED MAXIMAL ATMOSPHERIC CONCENTRATIONS (8 hours): No formal value has been established. The animal experiments of Deichmann *et al.* have led them to conclude that a concentration of 5 mg per cubic meter should be considered dangerous for continuous exposure.[3]

B. SHORT EXPOSURE TOLERANCE: Not known but moderate air concentrations are irritating and this limits voluntary exposure to levels which are presumably not hazardous.

II. Toxic Properties

A. INHALATION: No cases of acute or chronic intoxication attributed solely to diphenyl have been reported for man in the published literature.[4] Inhalation exposures of ten rats to diphenyl dust impregnated on diatomaceous earth caused irritation of the nasal mucosa, respiratory difficulty with bronchopulmonary lesions, and slight toxic effects in the kidneys and liver at a concentration of 300 mg per cubic meter diphenyl for 64 days, seven hours per day. Five rats died between the 29th and 49th exposure days. The five surviving rats lost weight. Three rabbits exposed under the same conditions showed no evidence of harm. Mice that inhaled 5 mg per cubic meter for 62 days showed signs of respiratory difficulty, but rats at the same concentration showed no evidence of injury.[5]

B. SKIN CONTACT: Repeated application of a 25% solution of diphenyl in olive oil to the clipped skin of rabbits at a

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dosage of 0.5 gram per kilogram body weight per day, five days per week, caused no local irritation but did cause the death of one rabbit after eight applications, and weight loss of the three survivors after 20 applications.[3] A 25% solution of diphenyl in dimethylphthalate poulticed onto the clipped trunks of rabbits for 24 hours resulted in an LD_{50} of 2.5 (1.1 to 5.5) grams per kilogram, with some necrosis.[3] Intradermal injections in guinea pigs produced local necrosis and some evidence of allergenic response.[6]

C. EYE CONTACT: Mild to moderate irritation is reported by humans exposed to the vapor. No irritation was observed in tests on animals.[6] Molten diphenyl can cause a serious thermal burn.

D. INGESTION: The oral toxicity is moderate. The LD_{50} for rats has been reported as 2.18, 3.28 and 5.04 grams per kilogram,[7,8,9] and for rabbits 2.41 grams per kilogram.[3] Dogs fed at the rate of 25 mg per kilogram per day for five days per week for 52 weeks showed no gross or microscopic pathology when compared to controls.[9] Two year oral studies in rats show that in feeding levels of from 0.001% to 1.0% of the diet, the only lesions attributable to diphenyl occurred in the kidney of both sexes at 0.5 and 1.0% levels. These lesions were reversible when the affected animals were returned to diets containing no diphenyl.[10]

III. Industrial Hygiene Practice

A. INDUSTRIAL USES: Diphenyl is used as a heat transfer medium and as a fungistat for citrus fruits.

B. EVALUATION OF EXPOSURES:

1. *Air sampling and analysis:*
   a. Direct field methods: None
   b. Laboratory methods: Diphenyl may be collected in a suitable solvent and determined by its absorption properties. It absorbs ultraviolet light maximally at 246 millimicrons in cyclohexane,[11] at 246 to 251 millimicrons in hexane,[11,4] and at 252 millimicrons in chloroform.[12] Diphenyl in isopropanol fluoresces with activation at 260 millimicrons and emission at 310 millimicrons.[12] It may also be determined by infrared absorption at 14.34 microns.[13]
2. *Sampling and analysis of biological materials:* Biological materials may be extracted with suitable solvents and diphenyl determined by ultraviolet or infrared absorption.[4] Diphenyl can also be determined colorimetrically by converting it to the nitro compound, reducing this to the amino derivative with subsequent diazotization and coupling with N-(1-Naphthyl)-ethylene-diamine. This purple dye is then read colorimetrically.[14] Diphenyl is converted to the hydroxyl derivatives in animals and excreted as such in the urine; none was excreted unchanged.[15] The glucosiduronic ester of 4-hydroxybiphenyl with some phenols and ethereal sulfates have been identified.[16]

C. HAZARDS AND THEIR RECOMMENDED CONTROL:

1. *Inhalation:* Inhalation is not a serious hazard in industry due in part to the low vapor pressure at room temperature and the relatively good warning properties of this material. There is no reference in the literature or in the records of one of the major producers that inhalation of diphenyl presents a serious hazard.
   Respirators (U. S. Bureau of Mines approved) equipped with static web filters placed over chemical cartridges which will protect against organic vapor up to 1000 ppm can be used for diphenyl dust. Respirators (U. S. Bureau of Mines approved) for organic vapor can be used for diphenyl vapor.
2. *Skin contact:* Animal data indicate that diphenyl shows little irritating potential but do indicate that diphenyl can be absorbed through the intact skin. Contact with the skin should, therefore, be avoided to eliminate the possibility of systemic injury.
3. *Eye contact:* Eye protection should be worn where there is a possibility

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of splashes from heated diphenyl. An organic vapor mask with full face piece will give protection against splashes and vapors.

4. *Ingestion:* Ingestion of diphenyl is not a problem in industry.
5. *Fire and explosion:* The fire hazard is negligible at room temperature, but is increased at elevated temperatures or when the material is dispersed as fine particles in air.

IV. Medical Information

A. EMERGENCY TREATMENT: Skin surfaces exposed to diphenyl should be thoroughly washed with soap and water at once. If clothing has been contaminated it should be removed promptly.

Particles of diphenyl in the eye should be removed by flushing with water for at least 15 minutes. Splashes of molten diphenyl require prompt medical attention to treat the thermal burn.

Victims of a severe exposure should be removed to fresh air and kept at rest until seen by a physician.

Most persons with acute or chronic irritation of the eyes, skin or respiratory tract recover promptly in fresh air. Occasionally symptomatic therapy is required.

B. SPECIAL PROCEDURES: None indicated.

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