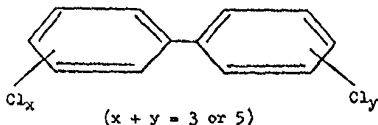


HYGIENIC GUIDE SERIES

Chlorodiphenyls

(Containing 42% and 54% Chlorine)



Significant Physical Properties¹

The chlorodiphenyls are light straw-colored mobile (42% chlorinated) and viscous (54% chlorinated) liquids with typical chlorinated aromatic odors. These compounds are chlorinated to specific weights of chlorine. Chlorodiphenyl (42%) contains 42.0 ± 0.5 chlorine, an amount corresponding to three chlorine atoms in unassigned positions. Chlorodiphenyl (54%) contains 54.3% chlorine corresponding to five chlorine atoms in unassigned positions. Both compounds are insoluble in water, but soluble in benzene, kerosene, acetone, amyl alcohol, ether and chloroform.

	Chlorodiphenyl (42%)	Chlorodiphenyl (54%)
Molecular weight:	247.33	326.45
Flash point (Cleveland O. C.):	176°-180°C (349°-356°F)	None
Distillation range:	325°-366°C	365°-380°C
Specific gravity:	1.381-1.392 (25°/15.5°C)	1.495-1.505 (65°/15.5°C)
Vapor pressure:		
0°C	0.001 mm	0.00006 mm
25°C	0.006 mm (est)	0.00054 mm (est)
150°C	4.3 mm	1.4 mm
206°C	29.0 mm	9.0 mm
At 25°C and 760 mm Hg:		
Saturated air contains	0.080 mg/liter	0.009 mg/liter
1 mg/liter =	98.8 ppm	74.9 ppm
1 ppm =	0.010 mg/liter	0.013 mg/liter

1. Hygienic Standards

A. RECOMMENDED MAXIMAL ATMOSPHERIC CONCENTRATIONS (8 hours): One milligram chlorodiphenyl (42%) per cubic meter of air and 0.5 milligram chlorodiphenyl (54%) per cubic meter of air.² This is based on the results of

chronic animal inhalation studies.³

B. SHORT EXPOSURE TOLERANCE: Ten mg of a diphenyl of unspecified chlorine content per cubic meter of air has been reported as unbearably irritating.⁴

C. ATMOSPHERIC CONCENTRATION IMMEDIATELY HAZARDOUS TO LIFE: Not known for man. Irritation of the eyes, nose and throat at levels which have not caused acute illness preclude the likelihood of voluntary exposure to immediately hazardous concentrations.

¹The Committee wishes to acknowledge the preparation of the medical information section of this Guide by the Industrial Hygiene and Clinical Toxicology Committee of I. M. A., and to acknowledge also the assistance of Elmer P. Wheeler and Jack T. Garrett in the writing of this Guide.



Hygienic Guide Series

II. Toxic Properties

A. **INHALATION:** Experiments with chlorodiphenyl (42% chlorine) were run at concentrations of 8.6 $\mu\text{g/liter}$ and at 6.83 $\mu\text{g/liter}$ of air. Cats, mice, rabbits and rats were unaffected by the higher level while guinea pigs showed poor growth after seventeen 7-hour/day exposures over 24 days. Eighty-four 7-hour/day exposures at the lower concentration had essentially no effect on similar species of animals.²

In the case of chlorodiphenyl (54% chlorine) eighty-three 7-hour/day exposures over 121 days to a concentration of 5.4 $\mu\text{g/liter}$ resulted in injury to liver cells and increased liver weights in rats. At a concentration of 1.5 $\mu\text{g/liter}$ for one hundred and fifty 7-hour/day exposures over 213 days, the rats showed distinct microscopic changes in the liver.³

The literature contains many references to the potential toxic effects of chlorinated diphenyls in man and animals. The early work included investigations of chlorinated naphthalenes, chlorinated diphenyls, chlorinated diphenyl oxide and various mixtures of these. An early report indicated serious toxic effects from chlorodiphenyl chlorinated to the extent of 65%.⁴ A later report by the principal author properly identified the earlier sample as a mixture of chlorinated diphenyl and chlorinated diphenyl benzene.⁵ However, only a few authors of subsequent papers, bulletins or textbooks have noted this correction and the original data are cited repeatedly as relating to chlorinated diphenyl alone.

B. **SKIN CONTACT:** Both compounds are readily absorbed through the clipped, intact skin of rabbits. The minimum lethal dose when the undiluted materials were applied to the covered clipped, intact skin of rabbits for 24 hours was approximately 1.0 gm/kg for the 42% chlorinated and 1.5 gm/kg for the 54% chlorinated.²

Local action on the skin is similar to that of common organic solvents where contact leads to removal of natural fats and oils with subsequent drying and cracking of the skin.

Human cases of chloracne have not been reported from the use of these two specific chlorodiphenyls. The potential undoubtedly exists because of cases which were reported from the use of chlorodiphenyls with a higher chlorine content and from mixtures with other chlorinated aromatic compounds.^{6,7}

C. **EYE CONTACT:** The liquid products and their vapors are moderately irritating to eye tissues.

D. **INGESTION:** The acute oral toxicities of the undiluted compounds are not great as evidenced by oral LD_{50} 's in rats of approximately 8.65 gm (7.61 to 9.78 gm) per kilogram for the 42% chlorinated and 11.9 gm (10.48 to 13.45 gm) per kilogram for the 54% chlorinated.² Central atrophy of the liver appears to be the chief toxic effect.

III. Industrial Hygiene Practice

A. **INDUSTRIAL USES:** The chlorodiphenyls are used as dielectrics for condensers, capacitors and transformers, plasticizers in synthetic resins, in emulsion adhesives, as nonflammable hydraulic fluids and as transfer media.

B. EVALUATION OF EXPOSURES:

1. Air sampling and analysis:

a. Direct field methods: None

b. Laboratory methods:

(1) Collect in secondary butyl alcohol in fritted bubbler or two large impingers in series; concentrate sample and complete analysis by one of various methods for chlorinated hydrocarbons.⁸

(2) Sample air through combustion furnace, collect chloride ion from decomposed chlorodiphenyl in suitable alkaline solution and determine chloride ion concentration.⁹

C. HAZARDS AND THEIR RECOMMENDED CONTROL:

1. **Inhalation:** Absorption is chiefly by inhalation. Concentrations in the workroom atmosphere should be maintained below the recommended levels. Where the chlorinated diphenyls are used at room tempera-

tures, the hazard of inhalation is considered slight or absent. When these materials are subjected to elevated temperatures, the process either should be completely enclosed or other adequate mechanical exhaust ventilation must be provided to reduce concentrations to safe levels. In heat transfer media applications, the system must be designed and constructed so that it is leak-proof. Special gasket materials and pump seals are available to prevent leakage. The reservoir tank should be airtight except for a vent to the outdoors. In the event of spills or leaks of hot fluids, use chemical cartridge respirators or gas masks approved by the U. S. Bureau of Mines for protection against organic vapors. These will provide good protection up to the concentrations shown on the approval labels and the odor will give ample warning if it comes through the device.

2. **Skin contact:** Operations and handling procedures should be such as to avoid the possibility of prolonged or repeated skin contact. Contaminated clothing must be laundered before reuse.
3. **Eye contact:** Eye protection should be used where there is a possibility of liquid splashes.
4. **Ingestion:** Ingestion of these materials is not a problem in industry.
5. **Fire and explosion:** The chlorodiphenyls are fire-resistant or essentially nonflammable liquids. When exposed to flame or hot surfaces they may decompose to form CO, CO₂, HCl, phenols and aldehydes depending on the temperature, availability of oxygen, area of the heated surface, rate of application of the liquid to the surface and other variables.

IV. Medical Information

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

If exposure to a high vapor concentration occurs, as in the case of spills at

elevated temperatures, the patient should be moved from exposure and kept at rest until seen by a physician. Oxygen should be administered if breathing is difficult.

Eyes contaminated with chlorodiphenyl should be irrigated with water for at least 15 minutes and the patient should be seen by a physician. Depending on the amount of inflammation and pain present, drugs like Cortisporin® ointment and topical Pontocaine® may be indicated.

- B. **SPECIAL PROCEDURES:** Persons who are regularly or repeatedly exposed to chlorodiphenyls should be examined periodically to detect early evidence of skin irritation and/or liver damage. Persons with known liver disease should not be exposed to repeated contact with the chlorodiphenyls.

V. References

1. Monsanto Company, Organic Chemicals Division: *Tech. Bulletin #PL-306, Aroclor Plasticizers* (Dec. 1960).
2. American Conference of Governmental Industrial Hygienists: *Threshold Limit Values for 1964. AMA Arch. Environ. Health* 9: 545 (1964).
3. Trcon, J. F., F. P. Cleveland, J. Cappel, and R. W. Atchley: *The Toxicity of the Vapors of Aroclor 1242 and Aroclor 1254. Amer. Ind. Hyg. Assoc. Quart.* 17: 204 (1956).
4. Elkins, H. B.: *The Chemistry of Industrial Toxicology*. John Wiley and Sons, Inc., New York (1959).
5. Drinker, C. K., M. F. Warren, and G. A. Bennet: *The Problem of Possible Systemic Effects from Certain Chlorinated Hydrocarbons. J. Ind. Hyg. Toxicol.* 19: 283 (1937).
6. Drinker, C. K.: *Further Observations on the Possible Systemic Toxicity of Certain of the Chlorinated Hydrocarbons. J. Ind. Hyg. Toxicol.* 21: 155 (1939).
7. Wheeler, E. P.: *Personal Communication*, Monsanto Company, St. Louis, Missouri 63166.
8. Greenburg, L., M. R. Mayers, and A. R. Smith: *The Systemic Effects Resulting from Exposure to Certain Chlorinated Hydrocarbons. J. Ind. Hyg. Toxicol.* 21: 29 (1939).

HYGIENIC GUIDES COMMITTEE

C. P. CARPENTER, <i>Chairman</i>	MARK HITE	E. A. FITZGER
N. E. BOLTON	J. A. HOUGHTON	U. C. FORZANI
E. E. CAMPBELL	D. R. McPHER	R. L. RALPH
J. W. CLAYTON	J. M. McNEANEY, JR.	W. L. SUTTON
H. B. ELKINS	J. E. PETERSON	R. C. WANDS
P. D. HALLEY	J. B. OLIPHANT	G. L. WILSON

Hygienic Guide sheets may be obtained from the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION, 14125 Frevo, Detroit 27, Michigan, at 25 cents each for two-page reprints; 30 cents each for four-page reprints. All orders for less than \$2.00 must be prepaid. Discount of 20% on orders of five or more Guides; 40% discount on orders of 100 or more Guides. Special loose-leaf binders for the Guides may also be ordered from the Association office for \$1.25 each.