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CHLORDANE

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CLASSIFICATION:

Primary Use: Insecticide

Secondary Use: None

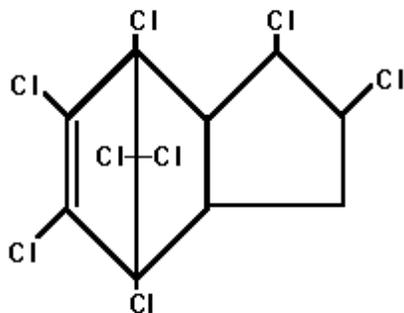
Chemical Group: Organochlorine compound

Date Issued: June, 1978

1. GENERAL INFORMATION

1.1 COMMON NAME: Chlordane (ISO)

1.1.1 Identity: 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methano-1H-indene



1.1.2 Synonyms:

M.140
 Velsicol 1068
 Ent 9932
 HCS 3260
 AG Chlordane
 OCTACHLOR (R)

Local synonyms:

1.2 SYNOPSIS

Chlordane is a persistent organochlorine insecticide of moderate toxicity that may be stored in body fats.

1.3 SELECTED PROPERTIES

- 1.3.1 Physical characteristics - The technical product is a viscous amber coloured liquid usually containing 70% cis-, 25% trans-isomers and less than 1% heptachlor, with a melting point of 103-105°C.
- 1.3.2 Solubility - Insoluble in water, but stable in most organic solvents, including petroleum oils.
- 1.3.3 Stability - Unstable in the presence of weak alkalis.
- 1.3.4 Vapour pressure - The refined product has a vapour pressure of 1×10^{-5} torr at 25°C.

1.4 AGRICULTURE, HORTICULTURE AND FORESTRY

- 1.4.1 Common formulations - Emulsifiable concentrates 50% and 70%, kerosin solutions 2% and 20%; dusts and granules 5% and 10%; wettable powders 40% and 50%; 20% oil solutions for dilution with petroleum distillate.
- 1.4.2 Pests mainly controlled - Earthworms in turf, ants, termites, wireworms, cutworms, thrips, grasshoppers, crickets.
- 1.4.3 Use pattern - Termites - 1% water emulsions, very good results. Wireworms - on medium loams use 3 lb per acre - less on light soils. All formulations satisfactory incorporate in soil.

Cutworms 5 lb to 10 lb of active ingredient per acre depending on soil type. Crickets 20 lb of 5% dust per acre. Army worm lb per 100 gallons of water spray.

- 1.4.4 Unintended effects - Should not be used on plants in bloom, because of toxicity to pollinating insects. Leafy vegetables may be tainted.

1.5 PUBLIC HEALTH PROGRAMMES

Has been used against mosquitos as a 2% residual spray in dwellings. Also used for flea control as 2-4% dust.

1.6 HOUSEHOLD USE

Against ants, cockroaches, silver fish, spiders, ticks, wasps use 2% to 3% spray or 5% dust.

2. TOXICOLOGY AND RISKS

2.1 TOXICOLOGY - MAMMALS

- 2.1.1 Absorption route - Chlordane may be absorbed from the gastrointestinal tract, by inhalation or through the intact skin.

- 2.1.2 Mode of action - The mechanism of toxic action of chlordane is not fully understood; it causes stimulation of the central nervous system.

- 2.1.3 Excretion products - Weekly doses of gamma-chlordane (the trans-isomer), administered by stomach tube to rabbits, resulted in 47.2% of the total administered dose being excreted in the urine

and 22.7% in the faeces, with only about 4% being retained in fatty tissues. Unchanged γ -chlordane could be detected only in subcutaneous fat, while all other tissues contained hydrophilic metabolites. Two hydrophilic metabolites have been isolated from urine, these include trans-1-hydroxy-2-chloro-dihydrochlordene and trans-1,2-dihydroxydihydrochlordene. A third metabolite, oxychlordane, has also been isolated from the fat and milk of several species.

- 2.1.4 Toxicity, single dose

Oral: LD₅₀ rats (M) 335 mg/kg
rats (F) 430 mg/kg

Dermal: LD₅₀ rats (M) 840 mg/kg
rats (F) 690 mg/kg

Most susceptible species: man and goat, approximate oral LD₅₀: 100 mg/kg.

- 2.1.5 Toxicity, repeated doses

Oral: Daily oral doses of 6.25, 25, 50 and 100 mg/kg were

given to rats for 15 days. 6.25 and 25 mg/kg produced no tremors or convulsions. 50 mg/kg produced toxic symptoms and two out of five animals died. At 100 mg/kg all animals died. Intracytoplasmic bodies in the liver cells were found at all levels and their number was in proportion to the dose given.

Inhalation: No information available on the more recent formulations. A high vapour toxicity to mice reported with earlier formulations was due to unreacted hexachloro-cyclopentadiene.

Cumulation of compound: Chlordane fed at 25 mg/kg diet to calves and sheep reached a maximum level in fat of 18 mg/kg and 12 mg/kg respectively. After feeding was stopped, the residue was eliminated from calves in 20 weeks and from sheep in four weeks.

Cumulation of effect: Chlordane has a cumulative effect on the liver, initially causing liver enlargement and microsomal enzyme induction and eventually causing liver damage and bile-duct proliferation. Damage to the optic nerve has been reported in animals.

2.1.6 Dietary studies

Long-term: Groups of 40 rats were given chlordane in their diet at 0, 2.5, 5, 10, 25, 50, 75, 150 or 300 mg/kg diet. Changes involving food consumption, growth and mortality were seen only in the 300 mg/kg diet group. Liver cell changes were not seen in the group given 2.5-25 mg/kg diet and at 50 mg/kg diet only "cytoplasmic peripheralization" was present. At higher doses liver damage was observed in the form of hypertrophy of centrolobular cells. Cytoplasmic oxyphyilia and hyalinization nuclear karyorhexis or cellular pyknosis, presence of fat in the cytoplasm and some bile-duct proliferation.

In a second experiment, groups of four to seven male and four to seven female dogs were fed chlordane for two years at levels of 0, 0.3, 3, 15 and 30 mg/kg diet. Abnormalities of clinical liver function tests were seen in the 15 and 30 mg/kg groups. In animals selected for necropsy at the end of the first year, increased liver weights and associated hepatocellular changes were found at 30 ppm. At the end of two years, similar changes were observed at 15 ppm. No adverse effects were seen on behaviour, appearance, survival, weight gain, blood picture or the results of periodic physical examination at any level.

2.1.7 Supplementary studies of toxicity

Carcinogenicity: In a number of long-term feeding experiments with chlordane there has been no evidence of increased tumorigenicity.

Teratogenicity: In a three generation feeding study in male and female rats with technical chlordane at levels of 0, 0.3, 3, 15, 30 and 60 mg/kg diet, levels up to and including 30 mg/kg had no effect on fertility, numbers of young, or litters,

weight, growth or mortality of the young animals up to weaning age. Autopsy of animals post weaning showed no gross or microscopic difference between the groups. At 60 mg/kg diet there was a high mortality in the second F3 generation litters during the latter part of the nursing period. These animals showed gross and microscopic pathology comparable to that characteristic for chlordane intoxication.

Mutagenicity: No information available.

2.1.8 Modification of toxicity - The toxicities of bihydroxycoumarin, phenylbutazone and parathion were reduced after pretreatment with chlordane. Rats were fed for 28 days from weaning on either (a) a diet containing 3.5% protein as casein, (b) a diet containing a normal amount of protein as casein, or (c) a standard laboratory diet. A single oral dose of chlordane was administered after the feeding period. The LD₅₀ values for the three groups were 137, 267 or 311 mg/kg body weight respectively. Clinical symptoms and pathology were the same in all groups.

2.2 TOXICOLOGY - MAN

2.2.1 Absorption - Chlordane may be absorbed from the gastrointestinal tract, by inhalation or through the intact skin.

2.2.2 Dangerous doses

Single: Convulsions followed by recovery occurred in an infant ingesting a dose of 10 mg/kg and in an adult following ingestion of 32 mg/kg. The fatal dose for man has been estimated between 6 and 60 g. A dose of 104 mg/kg proved fatal when taken with suicidal intent.

Repeated: Multiple doses of 2.4 g are stated to be dangerous.

2.2.3 Observations of occupationally exposed workers - Workers engaged in the manufacture and formulation of chlordane for periods of up to 15 years, have exhibited no evidence of harmful effects attributable to this insecticide.

In a survey of more than 1105 persons who had been engaged in pest control operations for 1-30 years, three cases of chlordane poisoning were reported, the only symptoms specified being dizziness and headache. Isolated cases of poisoning have resulted from careless handling of chlordane and one death has been recorded in a fomulator. In these cases exposure was by inhalation of sprays or by the dermal route.

2.2.4 Observations on exposure of the general population - Dietary intake of chlordane in the United States of America, England and Wales has been shown to be negligible. In most cases the residues were less than the analytical detection limits of 0.02-0.002 mg/kg material.

2.2.5 Observations of volunteers - No information available.

2.2.6 Reported mishaps - Poisoning with chlordane has occurred by

dermal, inhalation and gastrointestinal absorption. Generalized congestion, oedema, haemorrhage, irritation and chemical burns of the gastrointestinal tract have been observed in poisoned people.

2.3 TOXICITY TO NON-MAMMALIAN SPECIES

2.3.1 Fish - Harmful.

2.3.2 Birds - Moderately toxic.

2.3.3 Other species - Harmful to livestock; toxic to pollinating insects.

3. FOR REGULATORY AUTHORITIES - RECOMMENDATIONS ON REGULATION OF COMPOUND

3.1 RECOMMENDED RESTRICTIONS ON AVAILABILITY

(for definition of categories, [see introduction](#))

All formulations above 10%, Category 3.

All formulations 10% or less, Category 5.

3.2 TRANSPORTATION AND STORAGE

Formulations in Category 3 - Should be transported or stored in clearly labelled impermeable containers, under lock and key, secure from access by unauthorized persons and children. No food or drink should be stored in the same compartment.

Formulations in Category 5 - Should be transported or stored in clearly labelled, leakproof containers, out of reach of children and away from food and drink.

3.3 HANDLING

Formulations in Category 3 - Full protective clothing (see Part 4) should be used by all those handling the compound. Adequate washing facilities should be available at all times during handling and should be close to the site of handling. Eating, drinking and smoking should be prohibited during handling and before washing after handling.

Formulations in Category 5 - No facilities other than those needed for the handling of any chemical need be required.

3.4 DISPOSAL AND/OR DECONTAMINATION OF CONTAINER

Containers may be decontaminated (for method, see para. 4.2 in Part 4). Decontaminated containers should not be used for food and drink. Containers that are not decontaminated should be burned or should be crushed and buried below the topsoil. Care must be taken to avoid subsequent contamination of water sources.

3.5 SELECTION, TRAINING AND MEDICAL SUPERVISION OF WORKERS

Formulations in Category 3 - Pre-employment and periodic medical examination of workers desirable. Workers suffering from active hepatic or renal disease should be excluded from contact. Special account should be taken of the workers' mental ability to comprehend and follow instructions. Training of workers in techniques to avoid contact essential.

Formulations in Category 5 - Warning of workers to minimize contact essential.

3.6 ADDITIONAL REGULATIONS RECOMMENDED IF DISTRIBUTED BY AIRCRAFT

All formulations - Pilots and loaders should have special training in application methods and early symptoms of poisoning and must wear a suitable respirator. Use of flagmen not recommended. Flagmen, if used, should wear protective clothing and be located well away from the dropping zone.

3.7 LABELLING

Formulations in Category 3 - Minimum cautionary statement: "Chlordane is a toxic substance. Avoid contamination of foodstuffs, empty foodstuff containers and animal feed; and excessive inhalation of dusts and mists containing this insecticide. In case of spillage on skin, wash with soap and water. Keep out of reach of children."

Formulations in Category 5 - Minimum cautionary statement: "This formulation contains chlordane, a toxic substance. It is poisonous if swallowed and may cause convulsions. Keep the material out of reach of children and well away from foodstuffs, animal feed and their containers."

3.8 RESIDUES IN FOOD - Maximum residue limits have been recommended for chlordane by the Joint FAO/WHO Meeting on Pesticide Residues. These are subject to change at annual reviews.

4. PREVENTION OF POISONING IN MAN AND EMERGENCY AID

4.1 PRECAUTIONS IN USE

4.1.1 General - Chlordane is an organochlorine insecticide of moderate toxicity that may be absorbed from the gastrointestinal tract, by inhalation or through the intact skin. It is persistent and may be stored in body tissue.

4.1.2 Manufacture and formulation - TLV: (ACGIH) 0.5 mg/m³, (USSR) 0.01 mg/m³. Closed systems and forced ventilation may be required to reduce as much as possible the exposure of workers to the chemical.

4.1.3 Mixers and applicators - When opening the container and when mixing, protective impermeable boots, clean overalls, gloves and respirator should be worn. Mixing, if not mechanical should always be carried out with a paddle of appropriate length. When

spraying tall crops or during aerial application a face mask should be worn as well as an impermeable hood, clothing, boots, and gloves. The applicator should avoid working in a spray mist and avoid contact with the mouth.

Particular care is needed when equipment is being washed after use. All protective clothing should be washed immediately after use, including the insides of gloves. Splashes must be washed immediately from the skin or eyes with large quantities of water. Before eating, drinking or smoking, hands and other exposed skin should be washed.

4.1.4 Other associated workers (including flagmen in aerial operations) - Persons exposed to chlordane and associated with its application should wear protective clothing and observe the precautions described above in 4.1.3 under "mixers and applicators".

4.1.5 Other populations likely to be affected - With good agricultural practice subject to 4.2 below, other populations should not be exposed to hazardous amounts of chlordane.

4.2 **ENTRY OF PERSONS INTO TREATED AREAS** - Unprotected persons should be kept out of treated areas for at least one day.

4.3 **DECONTAMINATION OF SPILLAGE AND CONTAINERS** - Residues in containers should be emptied in a diluted form into a deep pit, taking care to avoid contamination of groundwaters. The

empty container may be decontaminated by rinsing two or three times with water and scrubbing the sides. An additional rinse should be carried out with 5% sodium hydroxide solution which should remain in the container overnight. Impermeable gauntlets should be worn during this work and a soakage pit should be provided for the rinsings. Decontaminated containers should not be used for food and drink.

Spillage of chlordane and its formulations should be removed by washing with 5% sodium hydroxide solution and then rinsing with large quantities of water.

4.4 **EMERGENCY AID**

4.4.1 Early symptoms of poisoning - Early symptoms of poisoning may include apprehension and agitation, abdominal pain, vomiting with blood, coughing, hoarseness, blurred vision, noisy respiration, incoherent speech and irrational behaviour, muscle twitching may also occur.

4.4.2 Treatment before person is seen by a physician, if these symptoms appear following exposure - The person should stop work immediately, remove contaminated clothing and wash the affected skin with soap and water, if available, and flush the area with large quantities of water. If swallowed, vomiting should be induced, if the person is conscious.

5. FOR MEDICAL AND LABORATORY PERSONNEL

5.1 MEDICAL DIAGNOSIS AND TREATMENT IN CASES OF POISONING

- 5.1.1 General information - An organochlorine insecticide of moderate toxicity which may be absorbed through the intact skin quite rapidly, as well as by inhalation and from the gastrointestinal tract. Poisoning incidents have occurred by all routes of exposure. Its mode of action is stimulation of the central nervous system. Tremors and convulsions are typical signs of poisoning with this compound. The metabolite oxychlordan which may be formed in animal tissues is considerably more toxic than the parent compound. Chlordane may persist in body fats.
- 5.1.2 Symptoms and signs - Symptoms of poisoning may include apprehension and agitation, coughing, hoarseness, noisy respiration and moist rales, abdominal pain, diarrhoea, blood stained vomiting, incoherent speech and irrational behaviour. Inflammation of the mucus membranes of the mouth and pharynx may follow oral ingestion. More advanced signs may include tremor, tonic and clonic convulsions, diffuse broncho-pneumonia, delirium and mania.
- 5.1.3 Laboratory - Blood levels of chlordane associated with poisoning are not known. The finding of chlordane or its metabolites in urine will confirm exposure. After exposure there may be changes in both EEG and ECG recordings. Changes in liver function, as measured by plasma enzyme levels, may occur if liver damage is present.
- 5.1.4 Treatment - If the pesticide has been ingested, gastric lavage should be performed with two to four litres of water, followed by saline purgatives. Barbiturates (preferably phenobarbitone or phentobarbitone) or diazepam should be given intramuscularly or intravenously in sufficient dosage to control restlessness or convulsions. Mechanical respiratory assistance with oxygen may be required. Calcium gluconate, 10% in 10 ml injected intramuscularly four-hourly may be helpful. Contraindicated are oily purgatives, epinephrine and other adrenergic drugs and central stimulants of all types.
- 5.1.5 Prognosis - If the acute effects are survived the prognosis is reasonably good, however, complications such as bronchopneumonia, liver damage and optic nerve damage might occur.
- 5.1.6 References of previously reported cases - Stormont, R. T. & Clonley, B. E. (1955) Jour. Amer. Med. Ass., 158 (15), 1364; Derbes, V. J. et al. (1955) Jour. Amer. Med. Ass., 158 (15), 1367; Hayes, W. J. (1963) Clinical Handbook on Economic Poisons, US Dept. Hlth, Educ. & Welfare, Atlanta, Georgia.
- 5.2 SURVEILLANCE TESTS - There are no readily available surveillance methods. Monitoring of the excretion of chlordane and its metabolites in urine may give some indication of the degree of exposure, although anuria has occurred in some cases of chlordane poisoning.

5.3 LABORATORY METHODS

5.3.1 Detection and assay of compound - References only are given.

Chlordane residues may be estimated colorimetrically by the reaction of chlordane, methanolic KOH and diethanolamine with heat to yield a red colour with an absorbance maximum at 550 mu. The sensitivity by this method is in the order of 0.006-0.04 ppm.

Ordas et al. (1956) J. Ag. Food Che., 4, 444, or Analytical methods for pesticides plant growth regulators and food additives. Edited by G. Zweig, Vol. II, Insecticides, Academic Press, New York and London (1964) Bowery, T.G., p. 49.

Methods involving GLC are given in Analytical methods for pesticides and plant growth regulators, Vol. VI, Gas chromatographic analysis, edited by G. Zweig and J. Sherma, Academic Press, New York and London, 1972, p. 315; and Yeo & Bevenue (1969) J. Ass. Off. Anal. Chem., 52, 1206.

5.3.2 Other tests in cases of poisoning - No specific tests, see 5.1.3 - Laboratory.

See Also:

[Toxicological Abbreviations](#)

[Chlordane \(EHC 34, 1984\)](#)

[Chlordane \(HSG 13, 1988\)](#)

[Chlordane \(PIM 574\)](#)

[Chlordane \(FAO Meeting Report PL/1965/10/1\)](#)

[Chlordane \(FAO/PL:1967/M/11/1\)](#)

[Chlordane \(FAO/PL:1969/M/17/1\)](#)

[Chlordane \(AGP:1970/M/12/1\)](#)

[Chlordane \(WHO Pesticide Residues Series 2\)](#)

[Chlordane \(WHO Pesticide Residues Series 4\)](#)

[Chlordane \(Pesticide residues in food: 1977 evaluations\)](#)

[Chlordane \(Pesticide residues in food: 1982 evaluations\)](#)

[Chlordane \(Pesticide residues in food: 1984 evaluations\)](#)

[Chlordane \(Pesticide residues in food: 1986 evaluations Part II](#)

[Toxicology\)](#)