INTERNATIONAL PROGRAMME ON CHEMICAL SAFETY

Health and Safety Guide No. 75

METHYL PARATHION HEALTH AND SAFETY GUIDE

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WORLD HEALTH ORGANIZATION, GENEVA 1992

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7. *tert*-Butanol
8. Epichlorohydrin
9. Isobutanol
10. Tetrachloroethylene
11. Tetradifon
12. Tecnazene
13. Chlordane
14. Heptachlor
15. Propylene Oxide
16. Ethylene Oxide
17. Endosulfan
18. Dichlorvos
19. Pentachlorophenol
20. Dimethoate
21. Aldrin and Dieldrin
22. Cypermethrin
23. Quintozene
24. Allethrins
25. Resmethrins
26. Pyrrolizidine Alkaloids
27. Magnetic Fields
28. Phosphine
29. Dimethyl Sulfate
30. Deltamethrin
31. Tetramethrin
32. *d*-Phenothrin
33. Permethrin
34. Fenvalerate
35. Phosphorus Trichloride and Phosphorus Oxychloride
36. Vinylidene Chloride
37. Ammonia
38. Cyhalothrin and Lambda-Cyhalothrin
39. Mirex
40. Camphechlor
41. Chlordecone
42. Vanadium
43. Dimethylformamide
44. Beryllium
45. Acrylamide
46. Barium
47. Atrazine
48. Bentazone
49. Captafol
50. Captan
51. Paraquat
52. Diquat
53. Alpha- and Beta-Hexachloro-cyclohexanes
54. Lindane
55. 1,2-Dichloroethane
56. Hydrazine
57. Formaldehyde
58. Methyl Isobutyl Ketone
59. *n*-Hexane
60. Endrin
61. Isobenzan
62. Nickel, Nickel Carbonyl, and some Nickel Compounds
63. Hexachlorocyclopentadiene
64. Aldicarb
65. Fenitrothion
66. Trichlorfon
67. Acrolein
68. Polychlorinated biphenyls and polychlorinated terphenyls (PCBs and PCTs)
69. Dimethylarsinic acid, methanearsonic acid, and salts
70. Inorganic arsenic compounds other than arsine
71. Trimellitic anhydride
72. Folpet
73. Rotenone
74. Parathion

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Health and Safety Guide No. 75

METHYL PARATHION HEALTH AND SAFETY GUIDE

This is a companion volume to
Environmental Health Criteria 145: Methyl Parathion

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CONTENTS

CONTENTS

INTRODUCTION

The Environmental Health Criteria (EHC) documents produced by the International Programme on Chemical Safety include an assessment of the effects on the environment and on human health from exposure to a chemical or combinations 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. 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:

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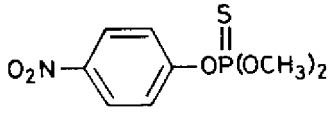
International Programme on Chemical Safety
World Health Organization
1211 Geneva 27
Switzerland

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

Chemical structure:



Common names:	parathion-methyl, methyl parathion, metaphos (USSR)
Molecular formula:	$C_8H_{10}NO_5PS$
IUPAC name:	*O,O*-dimethyl *O*-4-nitrophenyl phosphorothioate
CAS name:	*O,O*-dimethyl *O*-(4-nitrophenyl) phosphorothioate (9CI)
CAS registry number:	298-00-0
OMS number:	213
RTECS registry number:	TG0175000

1.2 Physical and chemical properties

Pure methyl parathion is crystalline and white. It is relatively insoluble in water, poorly soluble in petroleum ether and mineral oils, and readily soluble in most organic solvents. Methyl parathion is stable at pH 1–7, but undergoes rapid decomposition in alkaline media at pH 8–9. On heating, methyl parathion readily isomerizes to the *O,S*-dimethyl analogue.

PRODUCT IDENTITY AND USES

Technical methyl parathion, which is at least 90% pure, is a light to dark tan liquid.

Some physical properties of methyl parathion are given in Table 1.

Table 1. Physical properties

Relative molecular mass	263.2
Melting point (°C)	35-38
Boiling point (°C)	143
Density d_4^{25}	1.358
Vapour pressure (20 °C)	1.3 mPa
Water solubility (25 °C)	55-60 mg/litre
Partition coefficient (log P_{ow})	1.81-3.43 (reported range)

Conversion factors (25 °C, 1066 mbar): 1 ppm = 10.76 mg/m^3
1 mg/m^3 = 0.0929 ppm.

1.3 Analytical methods

The active ingredient of the formulated product is determined using gas chromatography, high pressure liquid chromatography, or hydrolysis to 4-nitrophenol followed by colorimetric determination. Similar methods and thin-layer chromatography are available for residue analysis. FAO/WHO recommended methods for the analysis of methyl parathion residues are given in FAO/WHO (1989).

1.4 Production and uses

Methyl parathion is produced throughout the world and has been registered for use on many crops. It is a non-systemic insecticide that controls numerous insects by contact and stomach action. It is generally applied as a spray, mainly from the emulsifiable concentrate formulation. It is recommended for application after mixing at 15–25 g active ingredient (a.i.) per 100 litres. In some countries, the dust and dispersible powder formulations are also available. On a global basis, the available emulsifiable concentrates contain 400, 480, and 600 g a.i./litre. The wettable

powder contains 40% a.i., while the dust formulations contain 1.5, 2, and 3% a.i.

2. SUMMARY AND EVALUATION

2.1 Environmental exposure

The distribution of methyl parathion in air, water, soil, and in organisms in the environment is influenced by several physical, chemical, and biological factors.

Studies using model ecosystems and mathematical modelling indicate that methyl parathion partitions mainly to air and soil in the environment, with lesser amounts in plants and animals. There is virtually no movement through soil and neither the parent compound nor its breakdown products will reach ground water. Methyl parathion in air is mainly derived from spraying of the compound, though some volatilization occurs with the evaporation of water from leaves and the soil surface. Background atmospheric levels of methyl parathion in agricultural areas range from not detectable to about 70 ng/m^3. Air concentrations after spraying declined rapidly over 3 days and returned to background levels after about 9 days. Levels in river water (in laboratory studies) declined to 80% of the initial concentration after 1 h and 10% after 1 week. Methyl parathion is retained longer in soil than in air or water, though retention is greatly influenced by soil type; sandy soil can lose residues of the compound more rapidly than loams. Residues on plant surfaces and within leaves decline rapidly with half-lives of the order of a few hours; complete loss of the methyl parathion occurs within about 6–7 days.

Animals can degrade methyl parathion and excrete the degradation products within a very short time. However, this occurs more slowly in lower vertebrates and invertebrates than in mammals and birds. Bioconcentration factors are low and the accumulated methyl parathion levels transitory.

By far the most important route for the environmental degradation of methyl parathion is microbial degradation. Loss of the compound in the field and in model ecosystems is more rapid than predicted from laboratory studies. This is because of the presence of a variety of microorganisms capable of degrading the compound in different habitats and circumstances. When sediment or plant surfaces are present, the microbial populations increase with a resulting increase in the rate of breakdown of methyl parathion.

SUMMARY AND EVALUATION

Methyl parathion can undergo oxidative degradation, to the less stable methylparaoxon, in the presence of ultraviolet radiation (UVR) or sunlight; sprayed films degrade under UVR with a half-life of about 40 h. However, the contribution of photolysis to total loss in an aquatic system was estimated to be only 4%. Hydrolysis of methyl parathion also occurs and is more rapid under alkaline conditions. High salinity also favours hydrolysis of the compound. Half-lives of a few minutes were recorded in strongly reducing sediments though methyl parathion is more stable when sorbed on other sediments.

In towns in the centre of agricultural areas of the USA, methyl parathion concentrations in air varied with season and peaked in August or September; maximum levels in surveys were mainly in the range of 100–800 ng/m^3, during the growing season. Concentrations in natural waters of agricultural areas in the USA ranged up to 0.46 μg/litre, with highest levels in summer. There is only a small number of published reports on the residues of methyl parathion in food throughout the world. In the USA, residues of methyl parathion in food have generally been reported at very low levels with few individual samples exceeding maximum residue limits (MRLs). Only trace residue levels of methyl parathion have been detected in the total dietary studies reported. Methyl parathion residues were highest in leafy (up to 2 mg/kg) and root vegetables (up to 1 mg/kg) in market basket surveys in the USA between 1966 and 1969. Food preparation, cooking, and storage all cause decomposition of methyl parathion residues further reducing human exposure. Raw vegetables and fruits may contain higher residues after misuse.

The production, formulation, handling, and use of methyl parathion as an insecticide are the main potential sources of human exposure. Skin contact and, to a lesser degree, inhalation are the main routes of exposure of workers. In a study of farm spray-men (with unprotected workers and ULV hand-spray) an intake of 0.4–13 mg methyl parathion (per 24 h) was calculated from the *p*-nitrophenol excreted in the urine.

Early re-entry into treated crops is a further source of exposure. The general population may be exposed to air-, water- and food-borne residues of methyl parathion as a consequence of agricultural or forestry practices, and the misuse of the agent resulting in contamination of fields, crops, water, and air through off-target spraying.

2.2 Uptake, metabolism, and excretion

Methyl parathion is readily absorbed via all routes of exposure (oral, dermal, and inhalation) and is rapidly distributed to the tissues of the body. Maximum concentrations in various organs were detected 1–2 h after treatment. Conversion of methyl parathion to methylparaoxon occurs within minutes following administration. In dogs, a mean terminal half-life of 7.2 h was determined following i.v. administration of methyl parathion. The liver is the primary organ of metabolism and detoxification. Methyl parathion or methylparaoxon are mainly detoxified in the liver by oxidation, hydrolysis, and demethylation or dearylation with reduced glutathione (GSH). The reaction products are *O*-methyl-*O*-*p*-nitrophenyl phosphorothioate or dimethyl phosphorothioic or dimethylphosphoric acids and *p*-nitrophenol. Therefore, it is possible to estimate the exposure by measuring the urinary excretion of *p*-nitrophenol. The urinary excretion of *p*-nitrophenol was 60% within 4 h and approximately 100% within 24 h. The metabolism of methyl parathion is important for species selective toxicity, and the development of resistance. The elimination of methyl parathion and metabolic products occurs primarily via the urine. Studies conducted with radiolabelled ^{32}P-methyl parathion revealed, after 72 h, 75% of radioactivity in the urine and up to 10% radioactivity in the faeces.

2.3 Effects on organisms in the environment

Microorganisms can use methyl parathion as a carbon source and studies on a natural community showed that concentrations of up to 5 mg/litre increased biomass and reproductive activity. Bacteria and actinomycetes showed a positive effect of methyl parathion while fungi and yeasts were less able to utilize the compound. A 50% inhibition of growth of a diatom occurred at about 5 mg/litre. Cell growth of unicellular green algae was reduced by between 25 and 80 μg methyl parathion/litre. Populations of algae became tolerant after exposure for several weeks.

Methyl parathion is highly toxic for aquatic invertebrates, most LC_{50}s ranging from < 1 μg to about 40 μg/litre. A few arthropod species are less susceptible. The no-observed-effect level for the water flea (*Daphnia magna*) is 1.2 μg/litre. Molluscs are much less susceptible with LC_{50}s ranging between 12 and 25 mg/litre.

Most fish species in both fresh and sea water have LC_{50}s between 6 and 25 mg/litre, a few species being substantially more or less sensitive to methyl parathion. The acute toxicity of amphibians is similar to that of fish.

Population effects have been seen in communities of aquatic invertebrates in experimental ponds treated with methyl parathion. The concentrations needed to cause these effects would occur only with overspraying of water bodies and, even then, would last for only a short time. Population effects are, therefore, unlikely to be seen in the field. Kills of aquatic invertebrates would be unlikely to lead to lasting effects.

Care should be taken to avoid the overspraying of ponds, rivers, and lakes, when using methyl parathion. The compound should never be sprayed in windy conditions.

Methyl parathion is a non-selective insecticide that kills beneficial species as readily as pests. Kills of bees have been reported following the spraying of methyl parathion. Effects on bees in methyl parathion incidents were more severe than those of other insecticides. Africanized honey bees are more tolerant of methyl parathion than European strains.

Methyl parathion was moderately toxic for birds in laboratory studies, acute oral LD_{50}s ranging between 3 and 8 mg/kg body weight. Dietary LC_{50}s ranged from 70 to 680 mg/kg diet. There is no indication that birds would be adversely affected from the recommended usage of methyl parathion in the field.

Extreme care must be taken to time methyl parathion spraying to avoid adverse effects on honey bees.

2.4 Effects on experimental animals and *in vitro* test systems

Oral LD_{50} values of methyl parathion in rodents range from 3 to 35 mg/kg body weight, and dermal LD_{50} values from 44 to 67 mg/kg body weight.

Methyl parathion poisoning causes the usual organophosphate cholinergic signs attributed to accumulation of acetylcholine at nerve endings. Methyl parathion becomes toxic when it is metabolized to methylparaoxon. This conversion is very rapid. No indications of organophosphorus-induced delayed neuropathy (OPIDN) have been observed.

Technical methyl parathion was found not to have any primary eye or skin irritating potential.

In short-term toxicity studies using various routes of administration on the rat, dog, and rabbit, inhibition of plasma, red blood cells, and brain ChE and related cholinergic signs were observed. In a 12-week feeding study on dogs, the no-observed-adverse-effect level (NOAEL) was 5 mg/kg diet (equivalent to 0.1 mg/kg body weight per day). In a 3-week dermal toxicity study on rabbits, the no-observed-effect level (NOEL) was 10 mg/kg body weight per day. Inhalation exposure for 3weeks indicated a NOEL of 0.9 mg/m^3 air. At 2.6 mg/m^3, only slight inhibition of plasma ChE was observed.

Long-term toxicity/carcinogenicity studies were carried out on mice and rats. The NOEL in rats was 0.1 mg/kg body weight per day, based on ChE inhibition. There is no evidence of carcinogenicity in mice and rats, following long-term exposure. In another 2-year study on rats, however, there was evidence of a peripheral neurotoxic effect at a dose of 50 mg/kg diet.

Methyl parathion has been reported to have DNA alkylating properties *in vitro*.

Most of the results of *in vitro* genotoxicity studies on both bacterial and mammalian cells were positive, while 6 *in vivo* studies using 3 different test systems produced equivocal results.

In reproduction studies, at toxic dose levels (ChE inhibition), there were no consistent effects on litter sizes, number of litters, survival rates of pups, and lactation performance. .No primary teratogenic or embryotoxic effects were noted.

2.5 Effects on human beings

Several cases of acute methyl parathion poisoning have been reported. Signs and symptoms are those characteristic of systemic poisoning by cholinesterase-inhibiting organophosphorus compounds. They include peripheral and central cholinergic nervous system manifestations appearing as rapidly as a few minutes after exposure. In case of dermal exposure, symptoms may increase in severity for more than one day and may last for several days.

SUMMARY AND EVALUATION

The results of studies on volunteers, following repeated long-term exposures, suggest that there is a decrease in blood cholinesterase activity without clinical manifestations.

No cases of organophosphorus-induced delayed peripheral neuropathy (OPIDN) have been reported. Neuropsychiatric sequelae have been reported in cases of multiple exposures to pesticides including methyl parathion.

An increase in chromosomal aberrations has been reported in cases of acute intoxication.

No human data were available to evaluate the teratogenic and reproductive effects of methyl parathion.

The available epidemiological studies deal with multiple exposures to pesticides and it has not been possible to evaluate the effects of long-term exposure to methyl parathion.

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 Conclusions

Methyl parathion is a highly toxic organophosphorus ester insecticide. Overexposure from handling during manufacture or use, and/or accidental or intentional ingestion may cause severe or fatal poisoning. Methyl parathion formulations may, or may not, be irritating to the eyes or the skin, but they are readily absorbed. As a consequence, hazardous exposures may occur without warning.

Methyl parathion is not persistent in the environment. It is not bioconcentrated and is not transferred through food-chains and is degraded rapidly by many microorganisms and other forms of wildlife. It is only likely to cause damage to ecosystems in instances of heavy overexposure resulting from misuse or accidental spills. However, pollinators and other beneficial insects are at risk from spraying with methyl parathion.

Exposure of the general population to methyl parathion residues occurs predominantly via food. If good agricultural practice is followed, the Acceptable Daily Intake (0–0.02 mg/kg body weight) established by FAO/WHO will not be exceeded. Dermal exposure may occur through accidental contact with foliar residues in sprayed fields or in areas adjacent to spraying operations as a consequence of off-target spraying of the chemical.

With good work practices, hygienic measures and safety precautions, methyl parathion is unlikely to present a hazard for those occupationally exposed.

3.2 Recommendations

- For the health and welfare of workers and the general population, the handling and application of methyl parathion should be entrusted only to competently supervised and well-trained applicators, who must follow adequate safety measures and use the chemical according to good application practices.

- The manufacture, formulation, agricultural use, and disposal of methyl parathion should be carefully managed to minimize contamination of the environment.

- Regularly exposed workers should undergo appropriate monitoring and health evaluations.

- To minimize risks for all individuals, a 48-h interval between spraying and re-entry into any sprayed area is recommended.

- Pre-harvest intervals should be established and enforced by national authorities.

- In view of its high toxicity, methyl parathion should not be considered for use in hand-applied, ultra-low-volume (ULV) spraying practices.

- Do not overspray water bodies. Choose spraying time to avoid killing pollinating insects.

- Information on the health status of workers exposed only to methyl parathion (i.e., in its manufacture and formulation) should be published, in order to assist in a better evaluation of the risks of this chemical for human health.

CONCLUSIONS AND RECOMMENDATIONS

- More definitive studies should be conducted on the residues of methyl parathion in fresh foods.
- A more definitive genotoxic assessment of methyl parathion should be conducted.

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

4.1 Human health hazards, prevention and protection, first aid

The acute oral and dermal toxicities of methyl parathion are high and it is hazardous for human beings if incorrectly handled. With excessive exposure, typical signs and symptoms of organophosphorus poisoning may occur rapidly. The human health hazards associated with certain types of exposure to methyl parathion, together with preventive and protective measures and first aid, are listed in the Table 2.

4.1.1 *Advice to physicians*

For a more complete treatise on the effects of organophosphorus insecticides, especially their short- and long-term effects on the nervous system, please refer to EHC 63: *Organophosphorus insecticides—a general introduction* (WHO, 1986).

Methyl parathion is an indirect cholinesterase inhibitor in that the active cholinesterase inhibitor, methyl paraoxon, is formed in the liver. Signs and symptoms of toxicity appear rapidly.

4.1.1.1 Symptoms of poisoning

Signs and symptoms may include a feeling of exhaustion, headache, blurred vision, weakness, and confusion. Vomiting, abdominal pain, excessive sweating, and salivating may develop. The pupils may also be constricted. Difficulty in breathing may be experienced, due to congestion of the lungs and weakness of the respiratory muscles. Arrhythmias and cardiac failure have been reported. On severe poisoning, there will be muscle spasms, unconsciousness, and convulsions. Breathing may stop, followed by death.

4.1.1.2 Medical treatment

If ingested and the formulation does not contain petroleum distillates, induce vomiting, or preferably perform gastric lavage using 5% sodium bicarbonate. In the case of ingestion of liquid formulations containing hydrocarbon solvents, vomiting involves a risk of aspiration pneumonia. Instead, the stomach should be emptied as soon as possible by careful gastric

Table 2. Human health hazards, preventive and protective measures, first aid

HAZARDS/SYMPTOMS	PREVENTION AND PROTECTION	FIRST AID
GENERAL: Cholinesterase inhibitor	Avoid exposure	
SKIN: Contamination may cause organophosphate poisoning: weakness, headache, vomiting, excessive sweating and salivation, pin-point pupils; in severe cases: convulsions, unconsciousness and death due to respiratory paralysis may occur	Wear PVC or neoprene gloves, apron and rubber boots	Wash contaminated skin with soap and water; remove contaminated clothing and launder before reuse; obtain medical attention immediately
EYES: Irritation, redness	Wear face shield or goggles	Flush immediately with clean water for at least 15 min; if irritation persists, obtain medical attention immediately; launder contaminated clothing
INHALATION: Inhalation may cause poisoning (see skin)	Avoid breathing mist or dust; use proper (exhaust) ventilation or suitable respiratory protection	In case of signs of symptoms, remove from contaminated area and obtain medical attention immediately

INGESTION: Unlikely to be a significant occupational hazard	Wash hands before eating, drinking, using the toilet, and after work; do not keep food in areas with potential exposure	
Accidental or deliberate ingestion may rapidly lead to severe poisoning (see skin)		Obtain medical attention immediately; induce vomiting, if subject is conscious, except in the case of an emulsifiable concentrate; if breathing has stopped apply artificial respiration

lavage (using a cuffed endotracheal tube). If possible, identify the solvents present in the formulation and observe the victim for additional toxic effects. As early as possible, administer 2 mg atropine sulfate intravenously (i.v.) and 1000–2000 mg of pralidoxime chloride or 250 mg of obidoxime chloride (adult dose) i.v., to patients suffering from severe respiratory difficulties, convulsions, and unconsciousness. Repeated doses of 2 mg of atropine sulfate should be given, as required, based on the respiration, blood pressure, pulse frequency, salivation, and convulsion conditions. Diazepam should be given in all but the mildest cases in doses of 10 mg s.c. or i.v., repeated as required.

For children, the doses are 0.04–0.08 mg atropine/kg body weight, 250 mg pralidoxime chloride per child, or 4–8 mg obidoxime chloride per kg body weight.

Artificial respiration should be applied, if required.

Note: Contraindications: morphine, barbiturates, phenothiazine derivatives, tranquillizers, and all kinds of central stimulants

The diagnosis of intoxication should be confirmed as soon as possible by determination of the cholinesterase activity in venous blood.

For more information on the treatment of organophosphorus insecticides see EHC 63: *Organophosphorus insecticides—a general introduction* (WHO, 1986). The section from this publication on therapy is attached as Annex 1 of this guide.

4.1.1.3 Health surveillance advice

In human beings exposed to methyl parathion, the cholinesterase activity of the blood should be monitored regularly. Measurement of whole blood AChE is the most widely adopted method. Because physiological variations of blood ChE levels occur in a healthy person and amongst populations, results should preferably be compared with pre-exposure ChE levels.

Depressions of AChE or ChE of 20–25% are considered diagnostic of exposure, but not necessarily indicative of hazard. Depressions of 30–50% or more are considered indicators for removal of an exposed individual from further contact with pesticides until levels return to normal. Work

procedures and hygiene should also be checked. Exposure can also be monitored by measuring the urinary excretion of *p*-nitrophenol.

4.2 Explosion and fire hazards

Liquid formulations may be flammable. With sufficient burning or external heat, methyl parathion will decompose, emitting toxic fumes. Fire-fighters must wear protective clothing and self-contained breathing apparatus. Extinguish fires with alcohol resistant foam or powder. Confine the use of water spray to the cooling of unaffected stock, thus avoiding polluted run-off from the site.

4.3 Storage

Technical methyl parathion and its formulations should be stored in the original labelled containers in locked, well-ventilated storage areas, preferably dedicated to insecticides. Do not expose to direct sunlight. Keep products out of reach of children and unauthorized personnel. Do not store near food or animal feed.

4.4 Transport

Comply with any local regulations regarding movement of hazardous goods. Do not transport with food or animal feed. Food and feed should not be transported in vehicles that have been used for the transport of pesticides. Make sure that containers are in good condition and the labels are undamaged before dispatch.

4.5 Spillage and Disposal

4.5.1 *Spillage*

Avoid skin contamination and inhalation of vapour. Absorb spilled liquid and cover contaminated areas with a 1:3 mixture of sodium carbonate crystals and damp sawdust, lime, sand, or earth. Sweep up and place it in an impervious container. Ensure that the container is tightly closed and labelled before transfer to a safe place for disposal.

Prevent liquid from spreading and contaminating other cargo, vegetation, or waterways by using a barrier of the most suitable and readily available material, e.g., earth or sand.

Empty any of the product remaining in the damaged/leaking container into a clean empty container, which should then be tightly closed and suitably labelled. Decontaminate emptied leaking containers with a 10% sodium carbonate (washing soda) solution, added at a rate of at least 1 litre/20-litre drum. Swirl round to rinse walls, empty, and add rinsings to sawdust. Do not reuse containers for any other purpose. Puncture and crush the container to prevent reuse.

4.5.2 *Disposal*

Large amounts should be incinerated at high temperature in a unit with effluent gas scrubbing or should be adsorbed on vermiculite and disposed of in a landfill, if incineration is impossible. When no incinerator is available, bury in an approved dump, or in an area where there is no risk of contamination of surface or ground water. Before burying, mix liberally with sodium carbonate (washing soda) crystals to help neutralize the product and with soil rich in organic matter. Comply with any local legislation.

5. HAZARDS FOR THE ENVIRONMENT AND THEIR PREVENTION

Methyl parathion is readily degraded and non-persistent in the environment. It is highly toxic for aquatic invertebrates, birds, bees, and wild mammals. It is moderately toxic for fish and non-toxic for soil microorganisms.

Do not overspray water; time spraying to avoid killing of pollinators.

Avoid contamination of soil, water, and the atmosphere by proper methods of use, storage, transport, handling, and waste disposal. In case of spillage, use the methods advised in section 4.5.1.

6. 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 and other United Nations sources. A full reference to the original national document from which the information was extracted can be obtained from IRPTC.

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 the appropriate regulatory authorities before application.

6.1 Previous evaluations by international bodies

The Joint FAO/WHO Meeting on Pesticide Residues (JMPR) evaluated methyl parathion in 1968, 1972, 1975, 1979, 1980, and 1984 (FAO/WHO, 1969, 1973, 1976, 1980, 1981, and 1985). The acceptable daily intake for humans (ADI) was estimated at 0–0.02 mg/kg body weight in 1984. This was based on the following levels causing no toxicological effects:

- 2 mg/kg diet, equivalent to 0.1 mg/kg body weight in the rat; and
- 0.3 mg/kg body weight per day in man.

The FAO/WHO Codex Alimentarius Commission (FAO/WHO, 1986) recommended Maximum Residue Limits (MRLs) in several food commodities, ranging from 0.05 to 0.2 mg/kg, including:

Commodity	MRL (mg/kg)	Commodity	MRL (mg/kg)
cantaloupes	0.2	hops (dry cones)	0.05[a]
cole crops	0.2	melons	0.2
cottonseed oil	0.05	sugar beets	0.05[a]
cucumbers	0.2	tea (fermented and dried)	0.2
fruit, other	0.2	tomatoes	0.2

[a] Levels at or about the limit of determination.

CURRENT REGULATIONS, GUIDELINES, AND STANDARDS

The International Agency for Research on Cancer (IARC) classified methyl parathion in Group 3 in 1982 and in 1987 (IARC, 1983, vol. 30, 1987, suppl. 7), and concluded that the available data do not provide evidence that methyl parathion is carcinogenic to experimental animals. No data on humans were available. The available data provide no evidence that methyl parathion is likely to present a carcinogenic risk to humans.

WHO (1990) classified technical methyl parathion as "extremely hazardous" in normal use, on the basis of the oral LD_{50} in the rat of 14 mg/kg. WHO/FAO (1975) issued a data sheet on methyl parathion (No. 7).

6.2 Exposure limit values

Some exposure limit values are given on pp. 28-29

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Pre-harvest intervals (the time between the last application of methyl parathion and the harvest of the treated plants) have been set in many countries. These intervals vary from 1 to 60 days (most of them between 14 and 21 days), depending on the crop, the harvesting technique, and the country, and can be verified with the competent national authority.

6.3 Specific restrictions

In many countries where methyl parathion is approved as a pesticide, specific uses, restrictions, and precautions are listed in national regulatory documents, e.g., no liquid methyl parathion formulations have been approved for registration in Finland because of their high acute toxicity. In the USSR, the agricultural use of methyl parathion has been restricted. In Hungary, it may only be applied in agriculture by properly trained staff, using protective equipment.

Methyl parathion has either not been registered or has been banned in: Bangladesh, Belgium, Bulgaria, Canada, China, Ecuador, Egypt, Hong Kong, Ireland, Japan, Sri Lanka, and the United Kingdom.

In Japan and the USA, methyl parathion and its preparations may only be handled by certified operators. In Germany, it may not be handled by adolescents or pregnant and nursing women.

CURRENT RUGULATIONS, GUIDELINES, AND STANDARDS

Exposure limit values

Medium	Specification	Country/ organization	Exposure limit description	Value	Effective date
AIR	Workplace	Argentina	Maximum permissible concentration - Time-weighted average (TWA) [a] - Short-term exposure limit (STEL)	 0.2 mg/m^3 0.6 mg/m^3	1984
		Finland	Maximum permissible concentration - Time-weighted average (TWA) - Short-term exposure limit	 0.2 mg/m^3 0.6 mg/m^3	1987
		United Kingdom	Occupational exposure standard (TWA) [a] - Short-term exposure limit (STEL)	0.2 mg/m^3 0.6 mg/m^3	1989
		USA (ACGIH)	Threshold limit value (TLV) - Time-weighted average (TWA) - Short-term exposure limit (STEL = 10 minutes)	 0.2 mg/m^3 [b] deleted	1986
		USSR	Maximum allowable concentration (MAC) - Ceiling value (vapour + aerosol)	 0.1 mg/m^3	1977

AIR	Ambient	USSR	Maximum allowable concentration (MAC) (once per day)	0.008 mg/m^3	1984
FOOD	Uptake from	FAO/WHO	Acceptable daily intake (ADI)	0-0.02 mg/kg body weight	1984
	Residues	FAO/WHO	Maximum residue limit (MRL) (in specified products)	0.05-0.2 mg/kg	1986
WATER	Ambient	Japan	Environmental water quality standard	not detectable	1981
	Surface	USSR	Maximum acceptable concentration	0.02 mg/litre	1983
	Effluent	Japan	Emission of total organophosphorus compounds	1 mg/litre	1981
SOIL		USSR	Maximum acceptable concentration	0.1 mg/kg	1981

[a] TWA usually 8 h.
[b] Skin absorption possible.

6.4 Labelling, packaging, and transport

The United Nations Committee of Experts on the Transportation of Dangerous Goods classifies methyl parathion in:

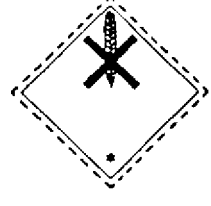
- Hazard Class 6.1: poisonous substance;
- Packing Group 2: substances and preparations presenting a serious risk of poisoning, for formulations containing 12–100% methyl parathion.
- Packing Group 3: harmful substances and preparations presenting a serious risk of poisoning, for solid formulations containing 3–12% active material, and liquid formulations containing 1.2–12% active material.

The label should be as follows:

Packaging Group I and II:

Symbol (skull and crossbones): black
Background: white

Packaging Group III:



The bottom half of the label should bear the inscriptions
HARMFUL
Stow away from foodstuffs
Symbol (St Andrew's Cross over an ear of wheat): black
Background: white

CURRENT REGULATIONS, GUIDELINES, AND STANDARDS

In the International Maritime Dangerous Goods (IMDG) Code, methyl parathion is classified as a marine pollutant with a severe pollution potential. It should bear the following mark on the label:

For flammable formulations, the following subsidiary label is required, when the flashpoint of the solution is below, or equal to, 61 °C (closed cup):

Background: red

There is no WHO specification on methyl parathion as the material is not used in public health. However, specifications for technical material and some formulations have been agreed upon between FAO and the manufacturers.

All packages should bear, durably and legibly marked on the container, the following:

- Manufacturer's name
- Technical parathion to specification
- Batch or reference number, and date of test
- Net weight of contents
- Date of manufacture

and, in the case of the formulated products:

- Manufacturer's name
- Methyl parathion to specification
- Methyl parathion ... g/kg
- Batch or reference number, and date of test
- Net weight of contents
- Instructions for dilution
- Date of formulation

and the following minimum cautionary notice:

Methyl parathion is an organophosphorus compound that inhibits cholinesterase. It is poisonous if swallowed or inhaled. It may be absorbed through the skin. Avoid skin contact; wear protective gloves, clean protective clothing and a respirator when handling the material. Wash thoroughly with soap and water after using.

Keep the material out of the reach of children and well away from foodstuffs and animal feed and their containers.

If poisoning occurs, call a physician. Atropine and pralidoxime are specific antidotes, and artificial respiration may be needed.

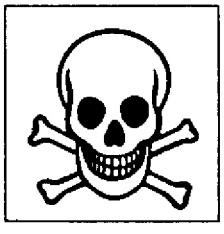
The methyl parathion content should be declared (minimum 90% for the technical product) and should not differ from the declared percentage by more than 2% for the technical product and 5–10% for its formulations.

Containers should be suitable, clean, dry, and as specified in the order, and should not adversely affect, or be affected by, the product, but should adequately protect it from external conditions. They should comply with pertinent national and international transport and safety regulations.

Specifications for storage stability are given.

The European Economic Community legislation requires labelling as dangerous substance using the symbol:

T



* ES: Tóxico
DA: Giftig
DE: Giftig
EL: Τοξικό
EN: Toxic
FR: Toxique
IT: Tossico
NL: Vergiftig
* PT: Tóxico

The label must read:

Very toxic by inhalation, in contact with skin and if swallowed; keep locked up; keep away from food, drink and animal feeding stuffs; after contact with skin, wash immediately with plenty of ——- (to be specified by the manufacturer); in case of accident or if you feel unwell, seek medical advice immediately (show the label where possible)

The European Economic Community legislation on labelling of pesticide preparations classifies pesticide preparations that contain methyl parathion in Class 1A, as toxic at concentrations > 1% and as harmful at > 0.05–1%. Member States should ensure that pesticides cannot be placed on the market unless their packaging, fastenings, and labels comply with the requirements laid down.

6.5 Waste disposal

In the USA, any non-domestic waste containing methyl parathion is considered a hazardous waste and the competent authority should be notified. Permits are required for its handling, transport, treatment, storage, or disposal. Waste incinerators must achieve 99.99% destruction and removal of this substance.

6.6 Other measures

The European Economic Community legislation has listed methyl parathion as a dangerous substance at quantities ≥ 100 kg in the directive on the major accident hazards of certain industrial activities. Any person in charge of an industrial activity involving, or possibly involving, one or more dangerous substances is obliged to take all the measures necessary to prevent major accidents, to limit their consequences for man and the environment, and to notify the competent authority about the industrial activity.

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ANNEX 1.
TREATMENT OF ORGANOPHOSPHATE INSECTICIDE POISONING IN MAN [a]

All cases of organophosphorus poisoning should be dealt with as an emergency and the patient sent to hospital as quickly as possible. Although symptoms may develop rapidly, delay in onset or a steady increase in severity may be seen up to 48 h after ingestion of some formulated organophosphorus insecticides.

Extensive descriptions of treatment of poisoning by organophosphorus insecticides are given in several major references (Kagan, 1977; Taylor, 1980; UK DHSS, 1983; Plestina, 1984) and will also be included in the IPCS Health and Safety Guides to be prepared for selected organophosphorus insecticides.

The treatment is based on:

(a) minimizing the absorption;
(b) general supportive treatment; and
(c) specific pharmacological treatment.

I.1 Minimizing the absorption

When dermal exposure occurs, decontamination procedures include removal of contaminated clothes and washing of the skin with alkaline soap or with a sodium bicarbonate solution. Particular care should be taken in cleaning the skin area where venepuncture is performed. Blood might be contaminated with direct-acting organophosphorus esters and, therefore, inaccurate measures of ChE inhibition might result. Extensive eye irrigation with water or saline should also be performed. In the case of ingestion, vomiting might be induced, if the patient is conscious, by the administration of ipecacuanha syrup (10-30 ml) followed by 200 ml water. This treatment is, however, contraindicated in the case of pesticides dissolved in hydrocarbon solvents. Gastric lavage (with addition of bicarbonate solution or activated charcoal) can also be performed, particularly in unconscious patients, taking care to prevent aspiration of fluids into the lungs (i.e., only after a tracheal tube has been put into place).

[a] From EHC 63: Organophosphorus insecticides - a general introduction. Geneva, World Health Organization, 1986.

ANNEX 1

The volume of fluid introduced into the stomach should be recorded and samples of gastric lavage frozen and stored for subsequent chemical analysis. If the formulation of the pesticide involved is available, it should also be stored for further analysis (i.e., detection of toxicologically relevant impurities). A purgative can be administered to remove the ingested compound.

I.2 General supportive treatment

Artificial respiration (via a tracheal tube) should be started at the first sign of respiratory failure and maintained for as long as necessary.

Cautious administration of fluids is advised, as well as general supportive and symptomatic pharmacological treatment and absolute rest.

I.3 Specific pharmacological treatment

I.3.1 *Atropine*

Atropine should be given, beginning with 2 mg iv and given at 15–30-min intervals. The dose and the frequency of atropine treatment varies from case to case, but should maintain the patient fully atropinized (dilated pupils, dry mouth, skin flushing, etc.). Continuous infusion of atropine may be necessary in extreme cases and total daily doses up to several hundred mg may be necessary during the first few days of treatment.

I.3.2 *Oxime reactivators*

Cholinesterase reactivators (e.g., pralidoxime, obidoxime) specifically restore AChE activity inhibited by organophosphates. This is not the case with enzymes inhibited by carbamates. The treatment should begin as soon as possible, because oximes are not effective on "aged" phosphorylated ChEs. However, if absorption, distribution, and metabolism are thought to be delayed for any reasons, oximes can be administered for several days after intoxication. Effective treatment with oximes reduces the required dose of atropine. Pralidoxime is the most widely available oxime. A dose of 1 g pralidoxime can be given either im or iv and repeated 2–3 times per day or, in extreme cases, more often. If possible, blood samples should be taken for AChE determinations before and during treatment. Skin should be carefully cleansed before sampling. Results of the assays should

influence the decision whether to continue oxime therapy after the first 2 days.

There are indications that oxime therapy may possibly have beneficial effects on CNS-derived symptoms.

I.3.3 *Diazepam*

Diazepam should be included in the therapy of all but the mildest cases. Besides relieving anxiety, it appears to counteract some aspects of CNS-derived symptoms that are not affected by atropine. Doses of 10 mg sc or iv are appropriate and may be repeated as required (Vale & Scott, 1974). Other centrally acting drugs and drugs that may depress respiration are not recommended in the absence of artificial respiration procedures.

I.3.4 *Notes on the recommended treatment*

I.3.4.1 Effects of atropine and oxime

The combined effect far exceeds the benefit of either drug singly.

I.3.4.2 Response to atropine

The response of the eye pupil may be unreliable in cases of organophosphorus poisoning. A flushed skin and drying of secretions are the best guide to the effectiveness of atropinization. Although repeated dosing may well be necessary, excessive doses at any one time may cause toxic side-effects. Pulse-rate should not exceed 120/min.

I.3.4.3 Persistence of treatment

Some organophosphorus pesticides are very lipophilic and may be taken into, and then released from, fat depots over a period of many days. It is therefore quite incorrect to abandon oxime treatment after 1–2 days on the supposition that all inhibited enzyme will be aged. Ecobichon et al. (1977) noted prompt improvement in both condition and blood-ChEs in response to pralidoxime given on the 11th–15th days after major symptoms of poisoning appeared due to extended exposure to fenitrothion (a dimethyl phosphate with a short half-life for aging of inhibited AChE).

ANNEX 1

I.3.4.4 Dosage of atropine and oxime

The recommended doses above pertain to exposures, usually for an occupational setting, but, in the case of very severe exposure or massive ingestion (accidental or deliberate), the therapeutic doses may be extended considerably. Warriner et al. (1977) reported the case of a patient who drank a large quantity of dicrotophos, in error, while drunk. Therapeutic dosages were progressively increased up to 6 mg atropine iv every 15 min together with continuous iv infusion of pralidoxime chloride at 0.5 g/h for 72 h, from days 3 to 6 after intoxication. After considerable improvement, the patient relapsed and further aggressive therapy was given at a declining rate from days 10 to 16 (atropine) and to day 23 (oxime), respectively. In total, 92 g of pralidoxime chloride and 3912 mg of atropine were given and the patient was discharged on the thirty-third day with no apparent sequelae.

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Price: Sw. fr. 5.-
Price in developing countries: Sw. fr. 3.50

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