FAO SPECIFICATIONS AND EVALUATIONS FOR PLANT PROTECTION PRODUCTS

METHOMYL

S-methyl N-[(methylcarbamoyl)oxy]thioacetimidate

2002

FOOD AND AGRICULTURE ORGANIZATION of THE UNITED NATIONS

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METHOMYL

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FAO specifications are developed with the basic objective of ensuring that pesticides complying with them are satisfactory for the purpose for which they are intended so that they may serve as an international point of reference. The specifications do not constitute an endorsement or warranty of the use of a particular pesticide for a particular purpose. Neither do they constitute a warranty that pesticides complying with these specifications are suitable for the control of any given pest, or for use in a particular area. Owing to the complexity of the problems involved, the suitability of pesticides for a particular application must be decided at the national or provincial level.

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INTRODUCTION

FAO establishes and publishes specifications* for technical material and related formulations of plant protection products with the objective that these specifications may be used to provide an international point of reference against which products can be judged either for regulatory purposes or in commercial dealings.

Since 1999 the development of FAO specifications follows the **New Procedure**, described in the 5th edition of the " Manual on the development and use of FAO specifications for plant protection products" (FAO Plant Production and Protection Page No. 149). This **New Procedure** follows a formal and transparent evaluation process. It describes the minimum data package, the procedure and evaluation applied by FAO and the Experts of the "FAO Panel of Experts on Pesticide Specifications, Registration Requirements, Application Standards and Prior Informed Consent."
FAO Specifications now only apply to products for which the technical materials have been evaluated. Consequently from the year 2000 onwards the publication of FAO specifications under the **New Procedure** has changed. Every specification consists now of two parts namely the specifications and the evaluation report(s):

Part One: The Specification of the technical material and the related formulations of the plant protection product in accordance with chapter 4, 5 and 6 of the 5th edition of the "Manual on the development and use of FAO specifications for plant protection products".

Part Two: The Evaluation Report(s) of the plant protection product reflecting the evaluation of the data package carried out by FAO and the Panel of Experts. The data are to be provided by the manufacturer(s) according to the requirements of Appendix A, annex 1 or 2 of the "Manual on the development and use of FAO specifications for plant protection products" and supported by other information sources. The Evaluation Report includes the name(s) of the manufacturer(s) whose technical material has been evaluated. Evaluation reports on specifications developed subsequently to the original set of specifications are added in a chronological order to this report.

FAO Specifications under the **New Procedure** do not necessarily apply to nominally similar products of other manufacturer(s), nor to those where the active ingredient is produced by other methods of synthesis. FAO has the possibility to extend the scope of the specifications to similar products, but only when the Panel of Experts has been satisfied that the additional products are equivalent to those which formed the basis of the reference specification.

* Footnote: The publications are available on the Internet under (http://www.fao.org/AG/AGP/AGPP/Pesticid/) or as hardcopy from the Plant Protection Information Officer.

PART ONE

SPECIFICATIONS

METHOMYL

METHOMYL INFORMATION
METHOMYL TECHNICAL MATERIAL
METHOMYL WATER SOLUBLE POWDERS
METHOMYL SOLUBLE CONCENTRATES

METHOMYL

INFORMATION

ISO common name
Methomyl (E-ISO, (m) F-ISO)

Synonyms
Methomyl (ANSI, BSI, ESA, JMAF)

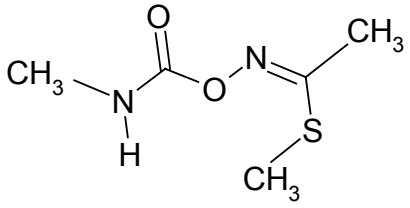
Chemical names

IUPAC S-methyl N-[(methylcarbamoyl)oxy]thioacetimidate

CA Methyl N-[[(methylamino)carbonyl]oxy]ethanimidothioate

Note: these names do not identify the configuration but the *cis*-isomer is so strongly favored thermodynamically that the *trans*-isomer is not detectable in practice.

Structural formula



Molecular formula
$C_5H_{10}N_2O_2S$

Relative molecular mass
162.20

CAS Registry number
16752-77-5

CIPAC number
264

Identity tests
HPLC retention time, IR spectrum

METHOMYL TECHNICAL MATERIAL

FAO Specification 264/TC (2002)

*This specification, which is PART ONE of this publication, is based on an evaluation of data submitted by the manufacturer whose name is listed in the evaluation report (*264/2002*). It should be applicable to relevant products of this manufacturer but it is not an endorsement of those products, nor a guarantee that they comply with the specifications. The specification may not be appropriate for the products of other manufacturers. The evaluation report (*264/2002*) as PART TWO forms an integral part of this publication.*

1 Description

The material shall consist of methomyl together with related manufacturing impurities and shall be a white to off-white, homogenous, crystalline solid, free from visible extraneous matter and added modifying agents.

2 Active ingredient

2.1 **Identity tests** (264/TC/(M)2, CIPAC handbook H, 1998, p200)

The active ingredient shall comply with an identity test and, where the identity remains in doubt, shall comply with at least one additional test.

2.2 **Methomyl content** (264/TC/(M)2, CIPAC handbook H, 1998, p200)

The methomyl content shall be declared (not less than 980 g/kg) and, when determined, the average measured content shall not be lower than the declared minimum content.

METHOMYL WATER SOLUBLE POWDERS

FAO Specification 264/SP and 264/SP-SB (2002)

*This specification, which is PART ONE of this publication, is based on an evaluation of data submitted by the manufacturer whose name is listed in the evaluation report (*264/2002*). It should be applicable to relevant products of this manufacturer but it is not an endorsement of those products, nor a guarantee that they comply with the specifications. The specification may not be appropriate for the products of other manufacturers. The evaluation report (*264/2002*) as PART TWO forms an integral part of this publication.*

1 Description

The material shall consist of a homogenous mixture of technical methomyl, complying with the requirements of FAO specification 264/TC (2002), together with filler(s) and any other necessary formulants (Note 1). It shall be in the form of a powder to be applied as a true solution of the active ingredient after solution in water, but which may contain insoluble inert ingredients.

Where the material is packaged in sealed water soluble bags, it shall be additionally described as a defined quantity of methomyl water soluble powder, contained in a sealed water soluble bag.

2 Active ingredient

2.1 **Identity tests** (264/TC/(M)3, CIPAC handbook H, 1998, p.200)

The active ingredient shall comply with an identity test and, where the identity remains in doubt, shall comply with at least one additional test.

2.2 **Methomyl content** (264/WP/(M)3, CIPAC handbook H, 1998, p.202)

The methomyl content shall be declared (g/kg) and, when determined, the content obtained shall not differ from that declared by more than the following amounts:

Declared content of active ingredient in g/kg	Permitted tolerance
above 100 up to 250	± 6% of the declared content
above 250 up to 500	± 5% of the declared content
above 500	± 25 g/kg
Note In each range the upper limit is included	

3 Physical properties

3.1 **pH range** (MT 75.3)

pH range: 4.0 to 8.0

3.2 **Wettability** (MT 53.3)

The formulation shall be completely wetted in 1 min., without swirling.

3.3 **Degree of dissolution and solution stability** (MT 179)(Note 2)

Residue of formulation retained on a 75µm test sieve after dissolution in CIPAC Standard Water D at 30 ± 2ºC (Note 3).

Maximum: 2.5% after 5 min.

Maximum: 1.5% after 18 hours.

3.4 **Persistent foam** (MT 47.2) (Note 4)

Maximum: 60 ml after 1 min.

4 **Storage stability**

4.1 **Stability at elevated temperature** (MT 46.3)

After storage at 54 ± 2ºC for 14 days (Note 5), the determined active ingredient must not be lower than 5% relative to the determined average content found before storage (Note 6) and the formulation shall continue to comply with the clauses for:
- pH range (3.1);
- wettability (3.2);
- degree of dissolution and solution stability (3.3).

In the case of water soluble bag packaging, the package should be enclosed in a watertight sachet, box or any other container at 45º C (Note 7) for 6 weeks. The determined average active ingredient content must not be lower than 5% relative to the determined average content found before storage, and the formulation shall continue to comply with the clauses for:
- pH range (3.1);
- wettability (3.2);
- dissolution of the bag (5.1);
- degree of dissolution and solution stability (5.2); and
- persistent foam (5.3).

None of the bags tested should show signs of leakage or rupture during normal handling before and after storage.

5 **Material packaged in a water soluble bag** (Notes 8, 9, 10)

5.1 **Dissolution of the bag** (MT176)

The dissolution of the bag shall be tested on a sample of the emptied and cleaned bag taken according to the procedure described in Note 9, together with an appropriate proportion of the SP.

Flow time of the suspension: Maximum of 60 seconds.

5.2 **Degree of dissolution and solution stability** (MT179) (Note 2)

The degree of dissolution and solution stability shall be tested on a solution containing the SP and the bag material in the actual ratio of application, prepared according to the procedure described in Note 10.

Residue of formulation retained on a 75 µm test sieve after dissolution in CIPAC Standard Water D at 30 ± 2ºC (Note 3).

Maximum: 3.0% after 5 min.

Maximum: 1.5% after 18 hours.

5.3 **Persistent foam** (MT47.2) (Note 4)

The persistent foam shall be tested on a solution containing the SP and the bag in the actual ratio of application, prepared according to the procedure described in Note 10.

Foam after 1 minute: Maximum of 60 ml.

Note 1 The formulation shall also contain an embittering agent. A dye may be added at the discretion of national or regional authorities. The colour of dye used should be determined by the authorities in the country or region in which the formulation is registered.

Note 2 The test will detect coarse particles which arise from impurities in the technical material and/or are present as inert ingredients, which could cause blockage of nozzles or filters in the application equipment.

Note 3 Unless another temperature and/or water is specified.

Note 4 The mass of the sample to be used in the test should be supplied at the highest rate recommended by the supplier.

Note 5 Unless other temperatures and times are specified.

Note 6 Samples taken before and after this test should be analyzed concurrently to reduce analytical error.

Note 7 Due to irreversible changes in the characteristics of the bag material at higher temperatures, the test temperature should not exceed 45°C.

Note 8 Sub-sampling

Lay the bag on a bench and carefully open one side of the bag with a cutter, taking care not to damage the seals.

Transfer the contents of the bag into a suitable flask. This material shall be used to carry out the tests for:

- active ingredient identity (6.21.2.1),
- active ingredient content (6.21.2.2),
- by-products of manufacture or storage (6.21.3.1),
- water content (6.21.3.2),
- acidity/alkalinity/pH range (6.21.4.1),
- wettability (6.21.4.2),
- dissolution of the bag (6.21.6.1),
- degree of dissolution and solution stability (6.21.6.2),
- persistent foam (6.21.6.3),

as required.

The bag is then opened on three sides, completely cleaned from adhering powder by brushing or suction and weighed to the nearest centigram. It shall be used to carry out the dissolution test (6.21.6.1). Aliquots of an aqueous solution of the bag material shall be used in the suspensibility (6.21.6.2) and persistent foam (6.21.6.3) tests.

In the case of delay of the above tests, the bag shall be stored in a watertight container (glass bottle or equivalent) to avoid any change in its properties.

Note 9 The sampling of the bag for the dissolution test should be as follows:

"Lay the empty cleaned bag in its original configuration (double layer). Delineate and then cut up a test sample including part of the upper seal (5 cm) and symmetrically including the vertical seal (10 cm)."

If the size of the bag is less than this dimension, use the whole bag.

Carry out the dissolution test immediately to avoid any modification of the sample.

Note 10 The procedure for adding the bag material to the solution for the rate of dissolution, solution stability and the persistent foam tests should be as follows:

"Prepare a stock solution of the bag material (1 mg/ml) by weighing approximately a 100 mg sample (n mg) of the bag (excluding sealed parts) to the nearest mg.

Dissolve this sample by stirring in the standard water used for the tests to give a final volume of n ml. Store the stock solution in a stoppered bottle before use.

Calculate the volume (V ml) of the stock solution of the bag to be added to the test suspension of the water soluble powder according to the following equation:

$$V\ (ml) = X \times \frac{1000B}{W}$$

where: B (g) = weight of the emptied and cleaned bag

W (g) = nominal weight of the SP contained in the bag

X (g) = weight of the SP sample used in the test."

METHOMYL SOLUBLE CONCENTRATES

FAO Specification 264/SL (2002)

*This specification, which is PART ONE of this publication, is based on an evaluation of data submitted by the manufacturer whose name is listed in the evaluation report (*264/2002*). It should be applicable to relevant products of this manufacturer but it is not an endorsement of those products, nor a guarantee that they comply with the specifications. The specification may not be appropriate for the products of other manufacturers. The evaluation report (*264/2002*) as PART TWO forms an integral part of this publication.*

1 Description

The material shall consist of technical methomyl, complying with the requirements of FAO specification 264/TC (2002), dissolved in suitable solvents, together with any necessary formulants (Note 1). It shall be in the form of a clear to opalescent liquid, free from visible suspended matter and sediment, to be applied as a true solution of the active ingredient in water.

2 Active ingredient

2.1 Identity tests (264/SL/(M)2, CIPAC handbook H, 1998, p200)

The active ingredient shall comply with an identity test, and where the identity of the active ingredient is in doubt, shall comply with at least one additional test.

2.2 Methomyl content (264/SL/(M)2, CIPAC handbook H, 1998, p203) (Note 2)

The methomyl content shall be declared (g/kg or g/l at 20 ± 2ºC) and, when determined, the content obtained shall not differ from that declared by the appropriate tolerance:

Declared content of active ingredient in g/kg	Permitted Tolerance
above 100 up to 250	± 6% of the declared content
above 250 up to 500	± 5% of the declared content
Note In each range the upper limit is included	

3 Physical properties

3.1 pH range (MT 75)

pH range: 4 to 8

3.2 Solution stability (MT 41)

The formulation, after the stability test at 54ºC (see 4.2) and following dilution (Note 3) with CIPAC standard water D and standing at 30 ± 2º C for 18 hours, shall give a clear or opalescent solution, free from more than a trace of sediment and visible solid particles. Any visible sediment or particles produced shall pass through a 45 µm test sieve.

3.3 Persistent foam (MT47.2) (Note 4)

Maximum: 60 ml after 1 minute.

4 Storage stability

4.1 Stability at 0 ºC (MT 39.3)

After storage 0 ± 2ºC for 7 days, the volume of solid and/or liquid which separates shall not be more than 0.3 ml.

4.2 Stability at elevated temperature (MT 46.3)

After storage at 54 ± 2ºC for 14 days, the determined active ingredient must not be lower than 5% relative to the determined average content found before storage (Note 5) and the formulation shall continue to comply with the clause for:
- pH range (3.1).

Note 1 The formulation shall also contain an embittering agent. A dye may be added at the discretion of national or regional authorities. The colour of dye used should be determined by the authorities in the country or region in which the formulation is registered.

Note 2 If the buyer requires both g/kg and g/l at 20ºC, then in case of dispute the analytical results shall be calculated as g/kg.

Note 3 The concentration used for the test should not be higher than the highest concentration recommended in the instructions for use.

Note 4 The mass of the sample to be used in the test should correspond to the highest rate of use recommended by the supplier.

Note 5 Samples of the formulation taken before and after the storage stability should be analyzed concurrently after the test in order to reduce the analytical error.

PART TWO

EVALUATION REPORT(S)

METHOMYL

2002 Evaluation report based on submission of data from E.I. du Pont de Nemours and Company (TC, SP, SL)

FAO SPECIFICATIONS AND EVALUATIONS FOR
PLANT PROTECTION PRODUCTS

METHOMYL

EVALUATION REPORT 264/2002

Explanation

The data for Methomyl were evaluated in support of the review of existing FAO specifications for the technical material (TC), water soluble powders (SP), and soluble concentrates (SL), published in 1997 (AGP:CP/350).

Methomyl is not under patent in any country.

Methomyl has been evaluated by the WHO IPCS (1995) and by the FAO/WHO JMPR (1975, 1976, 1977, 1978, 1986, 1987, 1988, 1989, 1990, 1991, 2001). It was reviewed by the US EPA in 1998. It is a List 2 compound in the EU and will be evaluated/reviewed by the European Commission after May 1, 2002.

The draft specification and the supporting data were provided by E. I. du Pont de Nemours and Company in 2001.

Uses

Methomyl is a broad spectrum insecticide that inhibits cholinesterase activity. It is used in vegetables, fruits, cereals and orchard crops for the control of a wide range of insect species.

Identity

ISO common name

Methomyl (E-ISO, (m) F-ISO)

Synonyms

Methomyl (ANSI, BSI, ESA, JMAF)

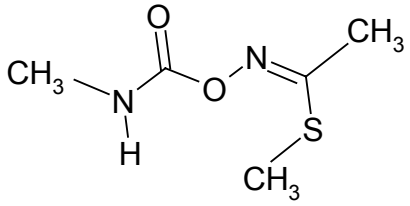
Chemical names

IUPAC S-methyl N-[(methylcarbamoyl)oxy]thioacetimidate

CA Methyl N-[[(methylamino)carbonyl]oxy]ethanimidothioate

Note: these names do not identify the configuration but the *cis*-isomer is so strongly favoured thermodynamically that the *trans*-isomer is not detectable in practice.

Structural formula



Molecular formula

$C_5H_{10}N_2O_2S$

Relative molecular mass

162.20

CAS Registry number

16752-77-5

CIPAC number

264

Identity tests

HPLC Retention Time, IR

Physico-chemical properties of pure methomyl (*Table 1*)

Parameter	Value(s) and conditions	Purity %	Method reference
Vapour pressure	0.72 mPa (at 25°C)	99	OECD 104
Melting point, boiling point and/or temperature of decomposition[1]	Melting point: 79.6°C Boiling point: decomposes Decomposition temperature: 192 ± 3.1°C	98.02 - 98.02	OECD 102 - EEC A1
Solubility in water	54.7g/l (at 25°C)	99.4	OECD 105
Octanol/water partition coefficient	K_{ow} 1.24 ± 0.12 (at 25°C) Log P_{ow} = 0.093	97.45	OECD 107
Hydrolysis characteristics	Half-life = hydrolytically stable at 25 °C at pH 5 and 7 Half-life = 30 days at 25 °C at pH 9	99%	EPA Pesticide Assessment Guidelines, Subdivision N, Chemistry: Environmental Fate 161-1
Photolysis characteristics	No direct photolysis observed when exposed to 365 nm artificial sunlight.	99%	EPA Pesticide Assessment Guidelines, Subdivision N, Chemistry: Environmental Fate 161-2
Dissociation characteristics	Does not ionize in the environment.	-	-

[1] The melting point and decomposition temperature are results from a recently completed study submitted to the United Kingdom regulatory authorities in November, 2002.

Chemical composition and properties of methomyl technical material (TC) (*Table 2*)

Manufacturing process, maximum limits for impurities ≥ 1 g/kg, 5 batch analysis data	Confidential information supplied and held on file by FAO. Mass balances were 99.19 – 99.57%.
Declared minimum [a.i.] content	980 g/kg
Relevant impurities ≥ 1 g/kg and maximum limits for them	None
Relevant impurities < 1 g/kg and maximum limits for them:	None
Stabilisers or other additives and maximum limits for them:	None
Melting range	77 - 80°C

Toxicological summaries

Notes.

(i) The proposer confirmed that the toxicological and ecotoxicological data included in the summary below were derived from methomyl having impurity profiles similar to those referred to in the table above.

(ii) The conclusions expressed in the summary below are those of the proposer, unless otherwise specified.

Table 3. Toxicology profile of methomyl technical or formulated material, based on acute toxicity, irritation and sensitization.

Species	Test	Duration and conditions or guideline adopted	Result
Rat, male and female Crl:CD®	oral	US EPA, Subdivision F, 81-1 Methomyl technical (98.35% a.i.)	LD_{50} = 32 mg/kg bw.
New Zealand White rabbit, males and female	dermal	US EPA, Subdivision F, 81-2 Methomyl technical (98.35% a.i.)	LD_{50} = >2000 mg/kg bw
Rat, male and female Crl:CD®	inhalation	OECD 403 US EPA, Subdivision F, 81-2 Methomyl technical (97.7% a.i.)	LD_{50} = 0.258 mg/l

Species	Test	Duration and conditions or guideline adopted	Result
New Zealand White rabbit, male and female	skin irritation	OECD 404 US EPA, Subdivision F, 81-5 EEC 84/49, Annex V, Method B4 Methomyl technical (98.35% a.i.)	Non-irritant (according to EEC Directive 93/21)
New Zealand White rabbit, female	eye irritation	OECD 405 US EPA Subdivision F, 81-4 EEC 84/449 Annex V, Method B5 Methomyl 90 SP (92.4% a.i.)	Ocular non-irritant (according to EEC Directive 93/21)
Duncan-Hartley albino Guinea pig, male and female)	skin sensitization	OECD 406 US EPA Subdivision F, 81-6 Methomyl technical (98.35% a.i.)	No delayed hypersensitivity or allergic reactions

Table 4. Toxicology profile of the technical material based on repeated administration (sub-acute to chronic)

Species	Test	Duration and conditions or guideline adopted	Result
Rat, male and female	Sub-chronic 90-day feeding study	Methomyl (assumed by the proposer to be 100% a.i.)	NOAEL = 50 ppm (3.56 mg/kg bw/day
Mouse, male and female	Sub-chronic 90-day feeding study	Methomyl (assumed by the proposer to be 100% a.i.)	NOAEL = 150 ppm (26.6 mg/kg bw/day) in males; 75 ppm (15.6 mg/kg bw/day) in females
Beagle dog, male and female	Sub-chronic 90-day feeding study	Methomyl (97.5% a.i.)	NOAEL > 400 ppm (12.5 mg/kg bw/day)
Rat, male and female	Chronic toxicity and potential oncogenicity	24 months Methomyl(>99% a.i.)	Methomyl was not oncogenic in male or female rats. NOAEL for chronic toxicity was 100 ppm (5 mg/kg bw/day)
Beagle dog, male and female	Chronic toxicity	52 weeks Methomyl (purity not stated)	NOEL = 100 ppm (3 mg/kg bw day)
Mouse, male and female	Chronic toxicity/oncogencity	24 months Methomyl (>99% a.i.)	Methomyl was not oncogenic in male or female mice. NOEL = 50ppm (10 mg/kg bw/day)
Rat, male and female	Effect of methomyl on reproduction and lactation.	3 generation Methomyl technical (97% a.i.)	Parental NOAEL was **5 mg/kg bw/day** Pup growth NOAEL was **2.5 mg/kg bw/day** No reproductive effects.
Rat, male and female	Effect of methomyl on reproduction and lactation.	2 generation Methomyl technical (purity not stated)	Parental NOAEL was 75 ppm (4.6 mg/kg bw/day) Pup NOAEL was 75 ppm No reproductive effects
Rat, female	teratogenicity and developmental toxicity	Methomyl technical (>99% a.i.)	Maternal NOAEL was 100 ppm (9.4 mg/kg bw/day) Not embyrotoxic or teratogenic at $\geq$ 400 ppm

Species	Test	Duration and conditions or guideline adopted	Result
Rabbit, female	teratogenicity and developmental toxicity	EPA Pesticide Programs proposed guidelines for registering pesticides in the U.S.; Hazard Evaluation: humans and domestic animals, Federal Register Section Series 163.83, Subpart F. Methomyl technical (98.7% a.i.)	Maternal NOAEL was 6 mg/kg bw/day. Not teratogenic or embryotoxic.

Table 5. Mutagenicity profile of the technical material based on in vitro and in vivo tests

Species	Test	Conditions	Result [(isomer/form)]
Salmonella typhimurium	*In vitro* mutagenicity Ames assay	OECD 471 and 472. US EPA Subdivision F, 84-2. EEC 92/69 Annex V, Method B.13, B.14. Activated and non-activated rat liver (S9) metabolic systems. Methomyl technical (98.35% a.i.)	Non-mutagenic
CHO cells	Mutagenicity CHO/HGPRT Assay	Study conducted prior to OECD guideline 476 and US EPA guideline 40 CFR 798.5300, but meets current guidelines Methomyl technical (92.9% a.i.)	Not mutagenic
Rat primary hepatocytes	*In vitro* unscheduled DNA synthesis (UDS)	Study is scientifically valid but there is no guideline for *in vitro* assessment of UDS. Methomyl technical (99% a.i.)	Negative

Species	Test	Conditions	Result [(isomer/form)]
Mouse (bone marrow cells)	*In vivo* micronucleus assay	OECD 474. US EPA Subdivision F, 84-2. EEC 92/69 Annex V, Method B.12. Methomyl technical (98.35% a.i.)	Did not induce micronuclei in mouse bone marrow polychromatic erythrocytes when administered orally at dose rates up to 12 mg/kg bw.
Rat (bone marrow cells)	*In vivo* cytogenetic assay	Study conducted prior to OECD guidelines but meets the principles of current guidelines. Methomyl technical (99% a.i.)	Did not induce chromosome aberrations in rat bone marrow when administered by oral intubation at dose rates up to 20 mg/kg bw.

Table 6. Ecotoxicology profile of the technical material

Species	Test	Duration and conditions	Result
Daphnia magna (water flea)	Acute toxicity	Methomyl technical (>99% a.i.)	48hr LC_{50} = 0.0317 mg/l
Lepomis macrochirus (bluegill sunfish)	Acute toxicity	Methomyl technical (>99% a.i.)	96 hr. LC_{50} = 0.72 mg/l
Oncorhynchus mykiss (rainbow trout)	Acute toxicity	OECD Guideline for testing of chemicals 203. US EPA Subdivision E, 72-1 EEC 92/69 Annex V, Method C.1 Methonyl technical, (98.6% a.i.)	96 hr. LC_{50} = 2.49 mg/l
Cyprindon variegates (sheepshead minnow)	Flow-though early life-stage toxicity test	US EPA Subdivision E, 72-4 Methonyl technical, (98.6% a.i.)	LOEC = 0.49 mg/l NOEC = 0.26 mg/l
Salenastrum capricornutum (green alga)	Effect on growth and cell count	OECD Guideline for testing of chemicals 201. US EPA Subdivision J, 122-2 Methonyl technical, (99% a.i.)	NOEC = 6.25 mg/l EC_{50} (120 h) = 60 mg/l
Eisenia foetida (Earthworm)	Acute toxicity	OECD 207. Methonyl technical, (98.6% a.i.)	LC_{50} = 19 mg/kg
Apis mellifera (honey bee)	Acute oral, and contact toxicity	EPPO Guideline No. 170(1992). US EPA Subdivision L, 141-1. Methonyl technical, (98.6% a.i.)	Acute oral LD_{50} = 0.28 µg a.i./bee Acute contact LD_{50} = 0.26 µg a.i./bee
Colinus virginianus (Bobwhite quail)	Acute toxicity	US EPA Subdivision E, 71-2. Methonyl technical, (98.6% a.i.)	LC_{50} = 24.2 mg/kg
Anas platyrhynchos (Mallard duck)	Short term toxicity	OECD 205. US EPA Subdivision E, 71-2. Methonyl technical, (98.7% a.i.)	LC_{50} = 3952 mg a.i./kg diet NOEC (for mortality) = 1780 mg ai/kg diet
Colinus virginianus (Bobwhite quail)	Short-term toxicity	OECD 205. US EPA Subdivision E, 71-2. Methonyl technical, (98.7% a.i.)	LC_{50} > 5620 mg ai/kg diet NOEC (for mortality) = 5620 mg ai/kg diet

Methomyl has been evaluated by the WHO IPCS (1995) and by the FAO/WHO JMPR (1975, 1976, 1977, 1978, 1986, 1987, 1988, 1989, 1990, 1991). The WHO IPCS concluded the following: "Considering the toxicological characteristics of methomyl, both qualitatively and quantitatively, it is concluded, on the basis of the no-observed-effect level of 3 mg/kg body weight per day in the 2-year toxicity study on dogs and applying a 100-fold uncertainty factor, that 0.03 mg/kg body weight per day will probably not cause adverse effects in humans by any route of exposure."

The WHO/PCS hazard classifcation of methomyl is: Class 1B

Formulations

The main formulation types available are water soluble powders (SP) and soluble concentrates (SL).

These formulations are registered and sold in the United States, Japan, Brazil, Spain and many other countries throughout the world.

Methods of analysis and testing

The analytical method for the methomyl (including identity tests) in the technical and formulated materials has been published in CIPAC Handbook H, 1998, pages 200-203. The sample is dissolved in methanol and methomyl and the benzamide internal standard are separated by reversed-phase HPLC. The active ingredient is detected by UV absorbance at 254 nm and quantified using a calibration curve or least-squares regression.

Test methods for determination of physico-chemical properties of the technical active ingredient were OECD, CIPAC, EPA, and EEC, while those for the formulations were CIPAC methods, as indicated in the specifications.

Physical properties

The physical properties, the methods for testing them and the limits proposed for the SP and SL formulations, comply with the requirements of the FAO Manual (5th edition).

Containers and packaging

No special requirements for containers and packaging have been identified.

Expression of the active ingredient

The active ingredient is expressed as methomyl.

Appraisal

Methomyl specifications were previously developed under the old procedure (TC, SP, SL and UL) and published by FAO in 1997. Revised FAO specifications (TC, SP and SL) have been proposed under the new procedure by Du Pont.

Methomyl could, in principle, exist as both *cis*- and *trans*-isomers about the C=N double bond. However, the *cis*-isomer is so strongly favoured thermodynamically that the *trans*-isomer is not detectable in practice.

Methomyl is a systemic oxime carbamate insecticide, of moderate solubility in water, and is a cholinesterase inhibitor having contact and stomach action. It is stable in water at pH 5 and 7 but hydrolyses slowly at pH 9. Photolysis did not occur at 25°C when exposed to 365 nm artificial sunlight. Its octanol/water partition coefficient is very low, with little expected accumulation in fish.

The proposer provided the meeting with confidential information on the manufacturing process and impurities, along with the results of analysis for purity and impurities in 5 batches of TC. Mass balances were high, 991.9 – 995.7 g/kg, with methomyl present at 986.0 – 990.0 g/kg, and no unknown impurities were detected. These data support the declared minimum manufacturing purity for the TC of 98%. The proposer confirmed that the toxicological and eco-toxicological summary data reported were derived from methomyl having impurity profiles similar to those represented by the five batch data provided. The purity of the methomyl used in the toxicological summaries was given in most cases but, in a few studies, the purity was not known. The meeting agreed that none of the impurities in the methomyl TC was considered relevant.

Methods of analysis for methomyl TC and the SP and SL formulations were adopted as AOAC First Action Official Methods in 1995 and as provisional CIPAC methods in 1996. These methods are published in the AOAC Methods of Analysis, 16th edition onward, and in CIPAC Handbook H, 1998. Analysis of methomyl is carried out using an internal standard in a HPLC method with detection at 254 nm. Methomyl may be identified by HPLC by retention time, and if required, verified by infra-red spectroscopy. The test methods for physical properties are CIPAC methods.

Data provided to FAO for development of the specifications were similar or equivalent to data submitted for registration by the proposer with the United States Environmental Protection Agency and to the European Union.

FAO/WHO at its September 2001 JMPR Meeting agreed an acceptable daily intake (ADI) for methomyl of 0-0.02 mg/kg bw. The WHO recommended Classification of Pesticides by Hazard and Guidelines to Classification, 1998-99, lists methomyl as class 1b (acute oral), highly hazardous. In EPA's December 1998 Re-registration Eligibility Decision (RED), methomyl is indicated as having little or no carcinogenic potential and was not found to be active in various tests for mutagenicity.

EPA, in its RED on methomyl, indicated methomyl is highly toxic to birds and mammals on an acute oral basis but only slightly toxic to birds on a sub-acute, dietary basis. The EPA's RED evaluation indicated that methomyl is highly toxic to aquatic organisms.

Recommendations

The meeting recommended that the proposed specifications for methomyl TC, SP and SL, presented by DuPont and reviewed under the new procedure, should be adopted as FAO specifications.

References

Manual on Development and Use of FAO Specifications for Plant Protection Products, 5th edition, 1999. FAO, Rome.

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