

ANNEX B

ENDOSULFAN

B - 5 : METHODS OF ANALYSIS

B.5 Methods of analysis (IIA, 4; IIIA, 5)**B.5.1 Analytical methods for formulation analysis (IIA, 4.1; IIIA, 5.1)****B.5.1.1 Technical active substance****AgrEvo**

Method 1: The sample is saponified in a methanolic alkaline solution (NaOH 1N, reflux 30 min), neutralised (H₂SO₄, 1N), and the sodium sulphite thus formed is determined iodometrically (iodine 0.1N) using a starch indicator.

Reference: Bathe, W.; Winterscheidt, 1980, (IIA, 4.1.1/1)

GLP: No

Evaluation and conclusions: No validation data are provided for this method. The method is not acceptable in the lack of validation data.

Method 2: The sample is dissolved in toluene and analysed by GC (packed glass column, 10% OV-210 on Chromosorb WHP, 1.5 m x 4 mm. i. d.) using a temperature program with TCD detection and bis(2-ethylhexyl)-phthalate as internal standard.

Basically, the method AL005/84.1 corresponds to the CIPAC 89/TC/M2/- (CIPAC handbook 1C, 2110 –2113, 1985) method and was validated by an international collaborative study with the following results:

- repeatability: r_{95} : 1.29 % at 95 % a.s. content.
- reproducibility: R_{95} : 2.53 % at 95 % a.s content.
- The isomers of endosulfan, α and β endosulfan are separated from impurities and formulation components by GC with good selectivity.

Reference: Hommel, K.; Sommer, D.; 1992 (IIA, 4.1.1/2).

GLP: No

Evaluation and conclusions: The method is a CIPAC method validated by an internationally collaborative study. **The method is acceptable.**

Calliope, S.A.

Two gas chromatographic methods are available for endosulfan. The GC chromatograms of each method showed two well separated isomer peaks.

Method 1: The sample is dissolved in toluene, and analysed by GC (CP-8Sil 8-CB column, He carrier) using ECD detection and α -hexachlorohexane as internal standard.

The method was validated for repeatability of injections, stability of the chromatographic system, stability of standard solutions and linearity within the range of 0.099×10^{-3} and 0.998×10^{-3} corresponding to samples with purity between 10 and 99 %.

Test material: ENDOSULFAN PURIFIED. Purity > 99 %. Batch CAL 95.6000 used to prepare standard solutions.

Method 2: The sample is dissolved in toluene, and analysed by GC (DB-1, 30 m x 0.32 mm I.D., 1 μ m) using FID detection and α -hexachlorohexane as internal standard.

The method was validated for repeatability of injections, stability of the chromatographic system, linearity within the range of 0.055×10^{-3} and 1.10×10^{-3} corresponding to samples with purity between 5 and 110 %. and limit of detection.

Test material: ENDOSULFAN PURIFIED. Purity > 99 %. Batch CAL 95.6000 used to prepare standard solutions.

Reference: Vogels, M.P.W., 1995 (IIA, 4.1)

GLP: Yes

Evaluation and conclusions: From the study it is clear that the response of ENDOSULFAN purified is not linear in the concentrations range tested. Therefore, the calibration of the analytical method must be performed in a very small concentration range. Furthermore, the method has not been tested for impurity interference with ENDOSULFAN Technical produced by Calliope. This is necessary for acceptability of the analytical method for the technical manufactured product. **The methods are not acceptable. Validation for interferences produced by impurities is required.**

B.5.1.2 Impurity analysis**Agrevo****Hoe 125577**

Method: Determination of Hoe 125577 (AL009/92-0). The sample is dissolved in dichloromethane and analysed by GC (packed column 10% OV-101, glass column, 1.5 m x 4 mm. I.D.) using a temperature program with TCD detection.

Validation data: The analytical method AL 009/92-0 was validated in the study Doc. No. A51217 (IIA, 4.1.2/3) with respect to linearity, LOQ, precision, accuracy (see table 4.1.2).

Reference: Weller, O.; Hommel, K.; Guebert, M., 1993 (Description of the method) (IIA, 4.1.2/1)

GLP: No.

Reference: Weller, O; Guebert, M.; Guebert, C., 1993 (Validation data) (IIA, 4.1.2/3)

GLP: Yes.

Evaluation and conclusions: The method is acceptable.

Secondary components

Determination of impurities (AL008/92-1). The sample is dissolved in dichloromethane with Silylation agent MSTFA and internal standard and analysed by GC (capillary column, CP-Sil-8, CB, 10 m. x 0.53 mm. I.D., 1.05 film thickness) with FID detection.

The quantitative evaluation is conducted using an internal standard and separately determined response factors of each impurity reference.

The analytical method AL008/92-1 was validated in the study CP93/041, with respect to linearity, LOD, precision, accuracy (see table 4.1.2).

Reference: Weller, O.; Hommel, K.; Guebert, M., 1993 (Description of the method)

GLP: No

Reference: Weller, O; Guebert, M.; Guebert, C., 1993 (Validation data) (IIA, 4.1.2/3)

GLP: Yes

Evaluation and conclusions: The method is acceptable.

Table 5.1.2: Validation data for impurities (AgrEvo)

Compound	Method	Linear work range	LOD	Precision C.V. [%]	Recovery
Hoe 125577	AL009/92-0	0.05 – 1.0	0.05	0.94	97.30
Hoe 071966	AL008/92-1	0.05 – 1.0	0.05	1.43	95.80
Hoe 066938	“	0.05 – 1.0	0.05	1.24	99.71
Hoe 051330	“	0.05 – 2.0	0.05	1.20	100.58
Hoe 051328	“	0.05 – 2.0	0.05	1.09	100.71
Hoe 051329	“	0.05 – 3.0	0.05	0.89	102.05
Hoe 051327	“	0.05 – 1.0	0.05	1.66	101.32

Note: see Annex C for identification of impurities.

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Determination of impurity 1 and purity of endosulfan technical

The sample is dissolved in dichloromethane and analysed by GC (CP-Sil 8-CB, 25 m x 0.32 mm I.D., 0.25 µm) using FID detection for the determination of impurity 1 and by GC (DB-1 (30m x 0.32 (I.D.) mm, df=0.25 µm)

Reference: Vogels, M.P.W., 1995, END/R036 (IIA, 4.1/02)

GLP: Yes

Evaluation and conclusions: The method is acceptable and fully validated for impurity 1. However, it is not fully validated for the determination of the purity of endosulfan technical since the possible interferences of other impurities than impurity 1 have not been tested. **Validation of the analytical method for endosulfan technical, to demonstrate that impurities do not interfere, is required.**

Secondary impurities

The impurities are determined by GC-DB5MS, 30 m x 0.25 mm I.D., 0.1 µm) using MS detection. No data on quantification non precision / accuracy data are available for this method. Using this technique, 24 minor components / impurities in Endosulfan are identified and tentatively identified from their mass spectra.

Reference: Gramberg, L., 1995, END/R037

GLP: It is stated that the study was performed in compliance with Good Laboratory Practice but the laboratory is not Certified by any independent Accredited Organism.

Evaluation and conclusions: The study is only acceptable as preliminary. **Definitive identification of main impurities (> 1g/kg) and validation of the method with respect to response factor, interferences, accuracy and precision for these impurities is required.**

B.5.1.3 Plant Protection Product

AgrEvo

Method 1: The sample is saponified in a methanolic alkaline solution, neutralised and the sodium sulphite thus formed is determined iodometrically using a starch indicator. Formulations other than the emulsifiable concentrates are pre-treated by Soxhlet extraction with petroleum prior to saponification if analysis of the blank formulation exhibits interferences.

The method is applicable for formulations containing 3-70% of the active substance including emulsifiable concentrates, other concentrates, wettable powder, other powder granules and water dispersible formulations. The method is not applicable to formulations containing oils with unsaturated carbon-carbon bonds or thiophosphoric ester.

Reference: Bathe, W.; Winterscheidt, H., 1980 (IIA, 4.1.1/1)

Evaluation and conclusions: No validation data are provided for this method. The method is not acceptable in the lack of validation data.

Method 2: The sample is dissolved in toluene and analysed by GC (packed column, 10%, OV-210, 1.5 m. x 4 mm., I.D.) using a temperature program with TCD detection and internal standard.

Precision data is quoted. Basically the method AL005/84-1 corresponds to the CIPAC 89/TC/M2/- (CIPAC handbook 1C, 2110–2113, 1985) method and was validated by an international collaborative study.

Specificity is determined as part of the methods validation.

The isomers of endosulfan, α and β endosulfan are separated from impurities and formulation components by GC with good selectivity.

Reference: Hommel, K.; Sommer, D., 1992 (IIA, 4.1.1/2).

The method is a CIPAC method validated by an internationally collaborative study. **The method is acceptable.**

Table 5.1.3: Summary of method validation (active substance and Plant Protection Product) - AgrEvo

Analysis material Reference	Linearity	Precision	Accuracy %	Interference
<u>Technical active substance</u> Hommel, K.; Sommer, D., 1992, A49026	0.05-1.0 %	0.94 %	97.3	None
<u>Impurity</u> Weller, O.; Guebert, M.; Guebert, C., 1993, A51217 Hoe 125577 (AL009/92-0) Impurities (AL 008/92-1) (validated: Weller, Hommel, Guebert, 1993, A51150, A51151)	0.01319-0.42250 0.05-1.0 %	0.94 % 0.89-1.66 %	97.32 100.0	None None
<u>Plant Protection Product</u> Hommel, K.; Sommer, D., 1992, A49026	0.05-1.0 %	0.94 %	97.3 %	None

Calliope

There is no data on the analytical methods for the determination of the formulants.

B.5.2 Analytical methods (residues) for food and feed (IIA, 4.2.1, IIIA, 5.2.1)**B.5.2.1 Animal products****AgrEvo****Milk and cow tissues (fat, liver and kidney)**

Milk samples were extracted with a benzene / isopropanol mixture followed by clean up on Carbon Attaclay and liquid - liquid partition with hexane / acetonitrile. A first clean up was performed by liquid - liquid partition with benzene, in the following the clean up as described for the milk samples was used. Final determination was carried out on packed column GC using microvolumetric detection and fractionating column of silicone gum rubber (SE-30). The method was described in the metabolism study.

The extraction of tissues (fat, liver and kidney) was carried out by acetonitrile with sodium sulphate.

After acetonitrile phase redissolved in benzene. A clean up by HPLC on Si 60 columns and a derivatization step (MSTFA-silylation), for endosulfan diol.

Final determination was performed by capillary GC/ECD.

Above method used and validated over the range 0.05 – 1 mg/kg (milk), 0.1 mg/kg (fat), 1.0 mg/kg (muscle), 0.5 mg/kg (kidney) and 0.05 mg/kg (liver) with an average recovery of 83 % for milk and 90 % for tissue.

Reference: Stanovick, R.P.; 1965 (IIA, 4.2.5/1).

GLP: No

Evaluation and conclusion: The method is not acceptable. The use of benzene is not allowed for safety reasons.

Liver, kidney, blood of wistar rats

Endosulfan was extracted from homogenised tissue (10 g) with acetone (150 ml) with sodium sulphate (25 g) and sea sand (25 g) in a Soxhlet extractor (6-8 h) and acetone phase is evaporated and reconstituted with water methanol (30:12.5) and partitioned with dichloromethane. The organic extract is concentrated and the residue is rinsed with n-hexane into a 1 ml mixing flask. A clean up by HPLC on Si 60 column (3 solvent fractions 0.05 ml. 1st α - and β -endosulfan; 2nd endosulfan-sulphate and endosulfan-hydroxyether; 3rd endosulfan-lactone and endosulfan-diol) and derivatation step (MSTFA – silylation) for endosulfan diol.

Final determination for endosulfan and its metabolites was performed by capillary GC/ECD, with DB-1 column, 30 m. x 0.32 mm., 0.25 μ m.

Validation data are given as a bad quality printout of brute results from a toxicological study. It is stated that LOD = 0.02 mg / Kg.

Reference: Leist, K. H.; Mayer, M., 1984 (IIA, 4.2.5/2)

GLP: No.

Evaluation and conclusions: The method is acceptable but **validation by an independent laboratory is required.**

Calliope

No methodology was provided for the quantitative determination of endosulfan residues in animal and human body fluids and tissues.

Suitable methodology and validation is required.

B.5.2.2 Plant material

AgrEvo

Apples, pears, beans, peas, garlic, cabbage, nuts and other oil fruits, peach and other stone fruits, spinach, tomatoes, onions.

Method: The sample was extracted from homogenised tissue with benzene / isopropanol (2:1 v/v) and partition with sodium chloride in water. Following evaporation for stone fruit, the residue was shaking with Carbon - Attaclay and for fatty samples the residuum was purified with liquid - liquid partition (hexane, acetonitrile). For cabbage, onions and garlic, the purification was with thin layer chromatography. The residue was quantified by GC either microcoulometer detector or ECD packed column (20% silicone fat).

Reference: Gorbach, S., 1969, A01579, (IIA, 4.2.1/1).

GLP: No.

Evaluation and conclusions: No validation data are provided. **The method is not acceptable, benzene is not allowed for safety reasons.**

Dried-green-tea, Processed-tea and tea-infusions prepared there of

Endosulfan was extracted from dry tea with liquid - liquid partition, benzene/isopropanol 2:1, and after extraction with sodium chloride in water and tea infusion with hexane extraction.

After evaporation, the residue was passed through a column chromatograph on aluminium oxide and co-sweep distillation. The eluate was evaporated and the resultant dissolved in benzene for quantitation by GC using an electron capture detector.

Endosulfan was determined as alpha-beta-endosulfan and endosulfan sulphate.

Reference: Gorbach, S., 1971 (IIA, 4.2.1/2)

GLP: No

Evaluation and conclusions: **The method is not acceptable, benzene is not allowed for safety reasons.** In many recovery studies recovery is below 50%. Validation data are not complete enough to evaluate the analytical method and to establish a limit of determination.

Biological material

Method: The sample material was extracted with acetonitrile. Depending on the matrix, clean up was performed by liquid - liquid partition with hexane (only for fatty samples), column chromatography on acidified aluminium oxide or just by shaking with Carbon Attaclay.

In some cases also co sweep distillation was used. Final determination was carried out by GC on packed 3% SE-30 columns with ECD detection.

Reference: Gorbach, S., 1972, A01262

GLP: No.

Evaluation and conclusions: No validation data are provided. **Validation data is required in case notifier wants to support this analytical method.**

Soybeans / seed

Method: After acetonitrile / water 2:1 extraction and clean up on aluminium oxide column GC-ECD determination was performed. This method was used only for soybean seeds and resulted in LODs of 0.02 mg/kg (endosulfan-sulphate 0.07 mg/kg) and recovery rates between 92 and 100%.

Reference: Hoppe, T.; Caricotte; Robert, P., 1974, A01812 (IIA, 4.2.1/4).

Evaluation and conclusions: No validation data are provided. **Validation data is required in case notifier wants to support this analytical method.**

Soybean Flour during Baking

Method: So after the acetone extraction with respect to the fatty sample materials a liquid, liquid partition step with acetonitrile - hexane was introduced. Then the standard steps of extraction with dichloromethane and clean up on FloriSil followed. Final determination was then carried out by GC/ECD.

Reference: Thier, W., 1979, A18653 (IIA, 4.2.1/6).

GLP: No

Evaluation and conclusions: No validation data are provided. **Validation data is required in case notifier wants to support this analytical method.**

Apples

Method: Extraction was already performed with acetone, followed by liquid – liquid partition with dichloromethane. A column clean up on Florisil/Carbowax and subsequently on aluminium oxide was applied. GC was performed using an electron capture detector. LOD stated to be 0.01 mg/kg with recoveries of 92 to 96%, however no validation data are provided.

Reference: Handelslab, Koerel, Specht, 1976, A10213, (IIA, 4.2.1/5)

GLP: No.

Evaluation and conclusions: No validation data are provided. **Validation data is required in case notifier wants to support this analytical method.**

Foods and Feeds

Apples, beans, cabbage, cacao, cauliflower, cherries, cucumbers, grapes, greengage, maize, peaches, plums, potatoes, rape, savoy cabbage, tomatoes and wheat.

Method: This **multimethod** published in 1980 was the immediate precursor of the later DFG S/9 method, the principle of the method is identical with those of the DFG S/9, extraction with acetone-water (2:1) and dichloromethane and clean up on gel-permeation chromatography on (GPC) Bio Beads S-X3 mini Silica gel column chromatography. Final determination was then carried out by GC-ECD.

Reference: Specht, W., Tillkes, M., *Fresenius Z. Anal. Chem.* **301**, 300-307, 1980 (*German*), (A20145), (IIA,4.2.1/7)

GLP: No

Evaluation and conclusions: This multimethod has been superseded by an improved one. See below Multi-residue Method S19.

Biological materials

Method 1: A further method now extracting with a methanol / water mixture instead of the standard acetone / water was used in 1981. For the analysis of citrus and tomatoes clean up was performed on Extrelut columns and determined with GC-ECD, packed column OV-1 (1.2 m x 2.5 mm. I.D.). LOD is stated to be 0.01 mg/kg with average recoveries 70-80%.

Künzler, K., Fechner, H., 1981, A23318 (IIA, 4.2.1/8)

GLP: No.

Evaluation and conclusions: No individual validation data and recoveries are provided. **Validation data is required in case notifier wants to support this analytical method.**

Method 2: The sample was extracted with acetone - water and after with dichloromethane. The clean up was performed on GPC, mini Silica gel column and the active ingredient determined by GC/ECD with packed column 3% OV-1 (1.2 m. x 2.5 mm. I.D.). LOD is stated to be 0.01 mg/kg with average recoveries 70-80%.

Reference: Künzler, K., Fechner, H., 1983, A26009 (IIA, 4.2.1/9).

GLP: No.

Evaluation and conclusions: No individual validation data and recoveries are provided. **Validation data is required in case notifier wants to support this analytical method.**

Feed for small animals

The active ingredient is extracted with acetone, from the small animal feed. The extract was concentrated and determined by GC/ECD with packed column OV-1 (1 m. x 2 mm. I.D.). LOD is stated to be 10 mg/kg with average recoveries 95-97%.

Reference: Thier, W.; Fischer, H., Merz, H.D., Junker, H., 1984, A32172 (IIA, 4.2.1/10)

GLP: No.

Evaluation and conclusions: No individual validation data and recoveries are provided. **Validation data is required in case notifier wants to support this analytical method.**

Soil, water, urine, plant

The active ingredient and its metabolites are extracted from the sample material with acetone. After dilution of the extract with sodium chloride solution, re-extraction is made by dichloromethane. After clean up on a Bio-Beads S-X3 and a mini Silica gel column, gas chromatographic determination is carried out using an electron capture detection with capillary column DB-5 (30 m. x 0.32 mm. I.D.) and 0.25 µm film. It is possible to monitor with this method further metabolites as endosulfan-lactone and endosulfan diol. For the sensitive determination of the latter compound a silylation derivatization step was introduced. LOD is stated to be 0.01 mg/kg with average recoveries 70-80%.

Reference: Werner, H.; Klante, G.; Merz, H.D., 1986, A34558 (IIA, 4.2.1/11)

GLP: No.

Evaluation and conclusions: No individual validation data and recoveries are provided. **Validation data is required in case notifier wants to support this analytical method.**

Multiresidue method for plants

Multimethod S19: The sample was extracted with acetone - water and liquid - liquid partition with dichloromethane. After clean up with gel permeation chromatography (GPC) on a Bio-Beads S-X3 column, gas chromatographic determination was carried out using an electron capture detector, packed column (3% OV-61 + 7.5% QF-1 + 3% X E-60) (1.8 m. x 4mm. I.D.). LOD = 0.1 mg/kg, average recoveries 80-100%.

Reference: DFG, Manual of Pesticide Residue Analysis. Vol 1. 1987, A50868 (4.2.1/12)

GLP: No.

Evaluation and conclusion: This method is an internationally accepted multi-residue method. **The method is acceptable.** However, an up dated method is recommended since many pesticides used nowadays are not covered by this method, whereas it covers many pesticides that are currently forbidden.

Hops (green hops, dried hops, spent hops, grain hops and beer)

Method: The plant sample was extracted with acetone - water 2:1 and dichloromethane. The beer sample was extracted with acetone, the solution is extracted twice with dichloromethane.

After GPC (gel permeation clean up) on Bio-Beads S-X3, the determination was carried out on packed column gas chromatography GC (3% X E 60, 1.8 m. 4 mm., I.D.) using an electron capture detector.

Limit of detection: 0.01 mg/kg. Limit of determination not given.

Reference: Fuchsbichler, G., 1988, A40159 (IIA, 4.2.1/13).

GLP: No

Evaluation and conclusions: No individual validation data and recoveries are provided. **Validation data is required in case notifier wants to support this analytical method.**

Melons and vines

Method: The samples are extracted by homogenisation with acetone followed by dilution with sodium chloride solution and partition into dichloromethane. After drying, extracts are concentrated before further clean up through a Silica solid phase extraction cartridge and determination by GC (SPB 5, 30 m. x 0.25 mm. I.D.) 0.32 μ m, using ECD detection.

Validated in melon peel, melon flesh and grapes over the range 0.05-0.5 mg/kg, with overall average recoveries 95.3% to 92.8%, and standard deviation from 4.3% to 7.4%. LOD = 0.05 mg/kg.

Reference: Garner, M.A.; Snowdon, P.J., 1995, A55596, (IIA, 4.2.1/14).

GLP: Yes.

Evaluation and conclusions: The method allows the determination of α -endosulfan, β -endosulfan and endosulfan sulphate. **The method is acceptable.**

Potatoes

Method: Based on DFG Multimethod 19, the analytical material is slurried in water and extracted with acetone (acetone / water 2:1 V/V). After filtration, the extract is saturated with dichloromethane. After repeated concentration with ethyl acetate (azeotropic exsiccation) and reconstitution in acetone / cyclohexane 1:1, clean up is performed by GPC. Final quantification is carried out by GC/ECD with capillary column DB-1, 30 m. x 0.32 mm., I.D., 0.25 μ m).

Validated over the range 0.01-0.05 mg/kg with an overall recovery \pm standard deviation of 73.8% \pm 5.3% for α endosulfan, 80.9% \pm 9.5% for β endosulfan and 83.7% \pm 8.3% for endosulfan sulphate. LOD = 0.01 mg/kg.

Reference: Idstein, H.; Junker, H.; Becker, D., 1995, A55564, (IIA, 4.2.1/15)

GLP: Yes

Evaluation and conclusions: The method allows the determination of α -endosulfan, β -endosulfan and endosulfan sulphate. **The method is acceptable.**

Apples and apples juice, Mandarines

Determination of endosulfan residues in apples in order to generate data required for establishing MRLS for the registration purposes.

Reference: Idstein, H.; Junker, H.; Klein, E., 1996; A55213, A55874 (IIA, 4.2.1/17); Sonder, H., Idstein, H.; Junker, H., 1996, A54359 (IIA, 4.2.1/18)

Tomatoes

Determination of endosulfan residues in tomatoes in order to generate data as required for establishing maximum residue level (MRL) for registration purposes.

Reference: Idstein, H.; Junker, H.; Sonder, K., 1996, A54360 (IIA, 4.2.1/16); Sonder, H.; Idstein, H.; Junker, H., 1996, A54362, A54363 (IIA, 4.2.1/24); Hees, M.; Idstein, H.; Junker, H., 1996, A54361 (IIA, 4.2.1/21)

Oranges

Determination of endosulfan residues in oranges fruit, peel and pulp following tree applications of endosulfan to generate data as required for establishing a maximum residue level (MRL) for registration purposes.

Reference: Klein, E.; Idstein, H.; Becker, D., 1996, A55226 (IIA, 4.2.1/23)

Multi-residue method 1

Fatty and non-fatty matrices

For non-fatty samples two different extraction procedures are available. One method makes use of ethyl acetate and performs extraction of analytes by blending the sample with the solvent and sodium sulphate.

The other method originally present by Luke, uses acetone for sample extraction followed by a liquid - liquid partition with another organic solvent (e.g. dichloromethane and petroleum ether).

For fatty products several extraction methods are available depending on the type of matrix, it is necessary to determine the percentage of fat in the product (animal products, cheese, eggs, butter, avocado, oil seeds, milk).

No single clean up method is able to cope with the entire pesticide - matrix range. Gel permeation chromatography, or open column chromatography, or HPLC, or liquid - liquid partition can be used. The determination was by GC, using capillary column and either ECD, or NPD, or FPD, or mass spectrometric detection.

Validated over range 0.05-0.4 mg/kg with overall average recoveries 99-114% and RSD 3.2-15% for various substrates.

Reference: Working group for the Development and Improvement of Residue - analytical Methods, 1996, A57245 (IIA, 4.2.1/20).

Evaluation and conclusions: This is a the multi-residue method 1 published by the General Inspectorate for Health Protection. (Ministry of Public Health. The Netherlands). **The method is acceptable.**

Calliope

Crops

Crops were divided into two groups:

- I. containing less than 2% fat
- II. containing more than 2% fat

Crops of group I were e.g., alfalfa, bur clover, corn stalks, cotton stalks, green boll and miscellaneous hay.

Crops of group II were e.g., corn kernels, cotton seeds and soy beans.

GROUP I - The sample was extracted with acetonitrile. After, the extract was concentrated and hexane was added.

GROUP II – The sample was prewashed with isopropanol and hexane, and blending with acetonitrile. After drying through Na₂SO₄, the hexane extract under went clean up on a Florisil column. The residue was determined by GC (5% OV-210, 3% DC-200, 1.5% OV-17 and 1.95% OF-1, 1.83 m x 4 mm I.D.) using ECD detection.

Reference: Carey *et. al.* , 1979 (END/L0049) (IIA, 4.2.1/01)

GLP: No

Evaluation and conclusions: The method may be regarded as a very old multi-residue method employed within EPA National Soil Monitoring program in USA at 1972 and is not acceptable for registration purposes in 1999 as apparatus and technology employed have evolved very much since then and will be difficult even to reproduce the method. **The method is not acceptable.**

Strawberries

The sample is extracted with acetone. After drying over anhydrous sodium sulphate, the acetone was removed by evaporation and replaced by hexane and clean up on a Florisil column. The residue was determined by GC (3% SE-30, 1 m x 4 mm I.D.), using ECD detection.

Validated over the range 6.3-53.9 ppm for α -endosulfan with average recovery of $91 \pm 14\%$ and validated over the range 9.8-29.4 ppm for the β endosulfan with average recovery of $87 \pm 24\%$

Reference: Zanini, *et. al.*, 1980 (END/L0008) (IIA, 4.2.1/02)

GLP: No.

Evaluation and conclusions: The method is very old and does not include Endosulfan-sulphate that forms part of the residue definition. **The method is not acceptable.**

Broccoli and Portuguese cabbage

For the extraction and clean up procedures, reference was made to published methods (Goodwin, *et. al.*, Analyst, 86 (1961), 697) with the following modifications in order to quantitatively recover the α and β isomers and the sulphate metabolite: Partition with n-hexane (20+10+10 ml) and elution of the alumina column with acetone – hexane (4+96 by volume, 50 ml).

Quantification was carried out by GC (5% OV-101, 1 m x 2 mm I.D.) using ECD detection.

Validated the range 0.05-10 mg/kg the recoveries for α , β and sulphate endosulfan were > 85%.

Reference: Magalhães, *et. al.*, 1989 (END/L0005) (IIA., 4.2.1/03).

GLP: No

Evaluation and conclusion: The copy of the article submitted into the dossier is not complete. The method could be acceptable for the determination of endosulfan residues in Broccoli and Portuguese cabbage. **The complete report and validation by an independent laboratory is required if the notifier wants to support this method.**

Apple, pear, beans, peas, fruit (oil-bearing, e.g. nuts, olives), hops, garlic, cabbage, maize, seeds (oil bearing, e.g. sun flower seed) spinach, stone fruit, tobacco, tea, tomato, onion.

The sample is blended with acetonitrile and shaken with hexane and water. The acetonitrile/water phase, was extracted with hexane. Further clean up follows, if required, on an aluminium oxide column (for fat containing samples) or by mixing it with Nuchar-Attaclay (for moderate/strong polluted crops).

The determination was carried out by GC (3% SE-30, 1.5 m x 2 mm I.D.) using ECD detection.

Reference: Gorbach, 1991 Ruckstandsanalytik von Pflanzenschutzmitteln. (END/L0053) (IIA, 4.2.2/04).

Evaluation and conclusions: Only a German copy has been provided into the dossier. No individual validation data for the different crops are provided. **Validation data are required if the notifier wants to support this method.**

B.5.3 Analytical methods (residues) soil, water, air (IIA, 4.2.2 to 4.2.4; IIIA, 5.2.2)**AgrEvo****Soil**

Method: The active ingredient and its metabolites were extracted from the soil with acetone. After dilution of the extract with sodium chloride solution, re-extraction is made by dichloromethane. After clean up on a mini Silica gel column, gas chromatography determination is carried out using an electron capture detection using capillary columns, HP-5 (25 m. x 0.2 mm., I.D., 0.33 μm .)

LOD stated to be 0.01 mg/kg with average recoveries to 76-100%.

Reference: Seefeld, F. V., 1990, A46890 (IIA, 4.2.2.1)

GLP: No.

Evaluation and conclusions: Only a German version of the original document has been provided.

Validation are necessary to consider acceptable the method.

Water (including drinking water)

Method: The active ingredient (α and β endosulfan) and its metabolite endosulfan sulphate are extracted with n-hexane from the water sample. The flask is filled with water via a microseparator and an aliquot of the supernadant hexane phase is removed for examination. The determination is carried out by GC/ECD with capillary column DB-5 (30 m. x 0.32 mm., I.D., 0.25 μm).

Limit of determination is stated to be 0.025 $\mu\text{g/l}$, the average recoveries 87-110%.

Reference: Merz, H.D., 1998, A39226 (IIA, 4.2.3.1/1).

GLP: No.

Evaluation and conclusions: No validation data are provided. **Validation of the method for drinking water is required. A method for surface water is required.**

Air

Method: Endosulfan is absorbed by drawing air through Tenax tubes and desorbed again with ethyl acetate. The applicability of the method for air of different temperature (20 and 35°C) and humidity (30 and 80% relative humidity) was validated in report RCC 419308. Quantitation was carried out by GC/ECD capillary column (DB-5, 15 m x 0.32 mm I.D., 0.25 μm).

Using sampling volumes of about 480 L within a 4 h sampling period, a limit of determination of 0.5 µg/m³ air could be established. A working range up to 100 µg/m³ was covered. Recoveries were in the expected range 70-110% with RSD ≤ 20%.

Reference: Idstein, H.; Merz, H.; Klug, R., 1993, A51944 (IIA, 4.2.4/1)

GLP: No

Evaluation and conclusions: Insufficient validation data are provided. **The method is not acceptable.**

Method: Endosulfan was adsorbed when air was drawn through a test tube filled with Tenax and then eluted with ethyl-acetate. The air stream was conducted through the test tubes for 4 hours at a flow of 2 l/min and under 2 different climatic conditions. The sample was made up to a defined volume and the active ingredients determined by means of GC (HP-5, 25 m x 0.32 mm, 0.17 µm), using electron capture electron detection.

The adsorption properties were determined at the lower validation limit, Limit of determination (LOD) = 0.5 µg/m³. Recoveries were in the expected range 89.9–101.6% with RSD < 5%.

Reference: Reichert, N., 1993, A52486 (IIA,4.2.4/2)

GLP: yes

Evaluation and conclusions: The method has been sufficiently validated under two climatic conditions (20°C, 30 % rel. humidity and 35°C, 80 % rel. humidity). Recoveries from stability test of samples for 17 days at 4°C and –20°C are between 92 and 101 %. **The method is acceptable.**

Calliope

Soil

Method 1: The soil was moistened with water and extracted with hexane: isopropanol (3:1). The isopropanol was removed by washing with water and the hexane extract was dried through anhydrous sodium sulphate before GC analysis. The determination was carried out by GC (5% OV-210, 3% DC-200, 1.5% OV-17 and 1.95% QF-1, 183 cm x 4 mm I.D.) using ECD detection.

Reference: Carey, *et. al.*, 1979 (END/L0049) (IIA, 4.2..2/01).

The method may be regarded as a very old multi-residue method employed within EPA National Soil Monitoring program in USA at 1972 and is not acceptable for registration purposes in 1999 as apparatus and technology employed have evolved very much since then and will be even hardly to found them to reproduce the method. **The method is not acceptable.**

Method 2: Soil was blended with acetonitrile and shaken with hexane and then with water. The acetonitrile/water phase was extracted with hexane. The determination was carried out by GC (3% SE-30, 1.5 m x 2 mm I.D.) using ECD detection.

Reference: Gorbach, 1991 (Rueckstandsanalytik von Pflanzenschutzmitteln. (END/L0053) (IIA, 4.2.2/02)

Evaluation and conclusions: Only a German copy has been provided into the dossier. No individual validation data for soil is provided. **Validation data are required if the notifier wants to support this method.**

River water and drinking water

The sample was extracted with petroleum ether. The solvent was concentrated before clean up on a silicagel column employing a hexane/benzene mixture as eluent. The determination was carried out by GC (5% DC-200, 1.5 m x 0.3 cm I.D.) using ECD detection.

Validated over the range 0.2-0.3 ppb. The recovery was 92% for both, α and β endosulfan.

Confirmation was carried out by mass spectrometry.

Reference: Greve and Wit, 1971 (END/L0050) (IIA, 4.2.3./01)

Evaluation and conclusions: The study is very old but of good quality. **The method is not acceptable because the use of benzene is not allowed for safety reasons.** The method should be adapted to nowadays technology. Furthermore, endosulfan sulphate is not measured. **A method for the determination of endosulfan sulphate and validation down to the level of 0.1 $\mu\text{g/l}$ is required.**

Air

The air samples were trapped by polyurethane foam. The foam plugs were Soxhlet-extracted with petroleum-ether. The glass fiber filters were refluxed with dichloromethane and the chlorinated solvent was removed by refluxing with hexane. The sample was diluted before further clean up over silicic acid. The determination was carried out by GC using a packed column.

Reference: Biedleman, 1981 (END/L0051) (IIA, 4.2.4/01)

Evaluation and conclusions: The method is reported in a published interlaboratory analysis of high molecular weight organochlorines in ambient air in USA where fortuitously one of the endosulfan isomers is also detected by some of the participant laboratories. The method is not specifically validated for endosulfan. **The method is not acceptable.**

B.5.4 Analytical methods (residues) wildlife and for use in support of diagnostic and therapeutic regimes (IIA, 4.2.5; IIIA, 5.2)

B.5.4.1 Human plasma

AgrEvo

For the determination of endosulfan in human body fluids and its metabolites as Animal products method A14210 and A37112.

B.5.4.2 Wildlife

No methods provided. **A method for the determination of endosulfan and relevant metabolites in fish is required.**

B.5.5 Evaluation and assessment

AgrEvo

AgrEvo submitted fully validated analytical methods for the analysis of the technical active substance, impurities and active ingredient in plant protection product.

For animal products only an acceptable method for liver, kidney and blood of Wistar rats has been submitted. Validation by an independent laboratory is required for this method.

For plant material many old methods, poorly validated, have been submitted. Only the analytical method for melons and vines and the method for potatoes are fully validated. For the rest of the methods no validation data are provided; these data are required to support residue trials that use those methods. Validation by an independent laboratory is also required for plant methods.

Two acceptable multi-residue methods where endosulfan is analysed are provided. One of them covers many pesticides not in use nowadays but the other is an up-dated method.

For soil method validation data and an English translation of the original report is required.

For drinking water validation data are required.

For surface water no method is provided and it is required.

A fully validated method for the analysis of air samples has been submitted.

No specific method for human plasma and body fluids is submitted. The use of the method for animal tissues validated for rats is proposed instead.

For wildlife an analytical method to determine endosulfan and its metabolites in fish is required.

Calliope

Methods provided by Calliope for technical active ingredient, purity, impurities (except impurity 1) and plant protection product are not acceptable.

A method for the determination of technical active ingredient purity and a method for impurities is required for inclusion of Calliope product in Annex 1 of Directive 91/414/EEC because are necessary to establish technical specifications of Calliope product.

No methodology was provided by Calliope for the quantitative determination of endosulfan residues in animal and human body fluids and tissues.

Methods for analysis of residue in plants provided by Calliope are not sufficiently validated. Validation and validation by an independent laboratory is required for these methods. It is pointed out that Data Protection is required for the only two fully validated methods submitted by AgrEvo.

Validation data are required to support the method for analysis of soil submitted by Calliope.

A validated method for the determination of endosulfan and its metabolite endosulfan sulphate in surface and drinking water is required to Calliope since the method submitted is not acceptable.

A method for the determination of endosulfan in air is required since the method submitted is not acceptable and Data Protection has been claimed for the method submitted by AgrEvo. A method for the determination of endosulfan in fish tissues is required.

B.5.6 References relied on

Annex IIA, or Annex IIIA point(s)	Year	Author (s) Title Company (insert name) Report No. Source (where different)	GLP GEP Y / N	Published Y / N	Owner	Data Protection
IIA, 4.0/01	1968	Maier-Bode, H. Properties, effect, residues and analytic of the insecticide endosulfan Residue Reviews, vol. 22; item VI	No	Yes	Publ.	No
IIA, 4.0/02		Endosulfan: its effects on environmental quality, National Research Council Canada Report No.: 11, annex 1-8; 77-84	No	Yes	Publ.	No
IIA, 4.0/03	1982	Goebel, H., <i>et. al</i> Properties, effect, residues and analytcs of the insecticide endosulfan. Residue reviews, vol. 83, item 2	No	Yes	Publ.	No
IIA, 4.0/04		Endosulfan Technical - Gas Chromatographic Metod	No	Yes	Publ.	No
IIA, 4.1	1984	WHO Environmental Health criteria 40, endosulfan. WHO Geneva, Item 2	No	Yes	Publ.	No
IIA, 4.1/02	1995	Vogels, M.P.W. Development and validation of an Analytical Method for Endosulfan purified. Report No.: R035	Yes	No	Calliope	Yes
IIA, 4.1/02	1995	Vogels, M.P.W. Determination of the Toluene content and purity of Endosulfan Technical Report No.: R036	Yes	No	Calliope	Yes
IIA, 4.1/03	1995	Gramberg, L.; Tas, A.C. Primary screening GC-MS of endosulfan technical. Report No.: R037	Yes	No	Calliope	Yes
IIA, 4.1.1; IIIA, 5.5.1	1980	Bathe, W.; Winterscheidt, H. Hoe 02671 (Endosulfan). Analytical method for determination in the technical grade active principle and in formulations Hoechst Analyt.Labor., Germany. Report No.: A19664	No	No	AgrEvo	No

Annex IIA, or Annex IIIA point(s)	Year	Author (s) Title Company (insert name) Report No. Source (where different)	GLP GEP Y / N	Published Y / N	Owner	Data Protection
IIA, 4.1.1; IIIA, 5.1.1	1992	Hommel, K.; Sommer, D. Hoe 002671 (endosulfan) Determination in the technical grade active ingredient and formulations by gaschromatography, using internal standard calibration Hoechst C Produktentwicklung Oekologie 1, Germany. Report No.: A49026	No	No	AgrEvo	No
IIA, 4.1.2	1993	Weller, O.; Guebert, M.; Guebert, C: Validation of the analytical methods AL008/92-1 and AL009/92-0 for the determination of organic impurities and toluene in technical endosulfan (Hoe 002671) Hoechst C Produktentwicklung Oekologie 1, Germany. Report No.: A51217	No	No	AgrEvo	Yes
IIA, 4.1.2	1993	Weller, O.; Hommel, K.; Guebert, C: Determination of toluene in endosulfan (Hoe 002671) using gas chromatography with an internal standard Hoechst C Produktentwicklung Oekologie 1, Germany. Report No.: A51150	No	No	AgrEvo	Yes
IIA, 4.1.2	1993	Weller, O.; Hommel, K.; Guebert, C: Determination of secondary components in Hoe 002671 (endosulfan) Hoechst C Produktentwicklung Oekologie 1, Germany. Report No.: A51151	No	No	AgrEvo	Yes
IIA, 4.2	1976	Musial, C.J., <i>et. al.</i> A simple procedure for the confirmation of residues of alfa- and beta-endosulfan, dieldrin, endrin and heptachlor epoxide Bull. Environ. Contam. & Toxicol. Vol. 16, No 1, 98-100	No	Yes	Publ.	No
IIA, 4.2.1	1987	DFG Organochlorine, Organophosphorus, Nitrogen-Containing and Other Pesticides - Multimethod S19 Report file No: A50868 Thier and Zeumer, 1987/1992, DFG/ Dt. Forschungsgemeinschaft, Manual of pesticide residue analysis, Volume I/II pages 383-400, 317-323	No	Yes	Publ.	No
IIA, 4.2.1	1988	Fuchsbichler, G. Residue determination in hops (green hops, dried hops, spent hops/grain and beer) Hoechst Analyt.Labor., Germany. Report No.: A40159	No	No	AgrEvo	No

Annex IIA, or Annex IIIA point(s)	Year	Author (s) Title Company (insert name) Report No. Source (where different)	GLP GEP Y / N	Published Y / N	Owner	Data Protection
IIA, 4.2.1	1995	Garner, M.A.; Snowdon, P.J. Endosulfan; analytical grade; active ingredient; Code : Hoe 002 671; Validation of analytical method; crops; gas chromatography AgrEvo UK Limited; England. Report No.: A55596	Yes	No	AgrEvo	Yes
IIA, 4.2.1	1971	Gorbach, S. Determination of Endosulfan (alpha- und beta- Isomer) and Endosulfansulfate in Dried-green-tea, Processed-tea and Tea-infusions Prepared Thereof Hoechst Analyt.Labor., Germany. Report No.: A31719	No	No	AgrEvo	No
IIA, 4.2.1	1972	Gorbach, S. Analytical method for the determination of Endosulfan in biological material (active substance in the sales product Thiodan (R)) Hoechst Analyt.Labor., Germany. Report No.: A31262	No	No	AgrEvo	No
IIA, 4.2.1	1969	Gorbach, S. Endosulfan. Apples, pears, beans, peas, garlic, cabbage, nuts and other oily fruits, peach and other stone fruit, spinach, tomatoes, onions Gaschromatographical determination. Hoechst Analyt.Labor., Germany, Report No.: A01579 1969, Rückstandsanalytik von Pflanzenschutzmitteln (DFG-Sonderdruck), Mitt. VI, pages 50-1 to 50-6.	No	Yes	Publ.	No
IIA, 4.2.1		Handelslab. Koerl/Spocht Pflanzenschutzmittel-Rueckstaende Repot No.: A10213	No	No	AgrEvo	No
IIA, 4.2.1	1996	Hees, M.; Idstein, H.; Junker, H. Endosulfan, emulsifiable concentrate 352 g/l, Code: Hoe 002671 00 EC33 B324 Determination of residues of Hoe 002671 to establish a maximum residue level following 2 applications in tomatoes under greenhouse conditions Hoechst Schering AgrEvo GmbH, Residues and User Safety, Frankfurt, Germany. Report No.: A54361	Yes	No	AgrEvo	Yes
IIA, 4.2.1	1974	Hoppe, T.; Carincotte; Robert, P. Residues of Plant Protection Chemicals Hoechst Analyt.Labor., DEU; Hoechst do Brasil, Brazil. Report No.: A01812	No	No	AgrEvo	No

Annex IIA, or Annex IIIA point(s)	Year	Author (s) Title Company (insert name) Report No. Source (where different)	GLP GEP Y / N	Published Y / N	Owner	Data Protection
IIA, 4.2.1	1996	Idstein, H.; Junker, H.; Klein, E.H.J. Endosulfan; Emulsifiable concentrate 352 g/l; Code: Hoe 002671 00 EC33 B325 - Determination of residues of Hoe 002671 to establish a maximum residue level following 3 applications in mandarines Hoechst Schering AgrEvo GmbH, Residues and User Safety, Frankfurt. Report No.: A55213	Yes	No	AgrEvo	Yes
IIA, 4.2.1	1996	Idstein, H.; Junker, H.; Klein, E.H.J. Endosulfan, emulsifiable concentrate, 352 g/l Code: Hoe 002671 00 EC33 B325 Residue trials in apples to establish a Maximum Residue Level. Determination of active substances and the metabolite decline following 2 applications in apples and processing to apple puree and apple juice Hoechst Schering AgrEvo GmbH, Development Residues and Consumer Safety, Germany. Report No.: A55874	Yes	No	AgrEvo	Yes
IIA, 4.2.1	1996	Idstein, H.; Junker, H.; Sonder, K.H. Endosulfan, emulsifiable concentrate, 352 g/L Code: Hoe 002671 00 EC33 B325 Determination of Residues of Hoe 002671 to establish a Maximum Residue Level following 2 Applications in Tomatoes under Greenhouse Conditions Hoechst Schering AgrEvo GmbH, Development Residues and User Safety, Germany. Report No.: A54360	Yes	No	AgrEvo	Yes
IIA, 4.2.1	1995	Idstein, H.; Junker, H.; Becker, D. Determination of Hoe 002671 (endosulfan) and Hoe 051327 (endosulfan-sulfate) in potatoes by gas chromatography (modified DFG S19 method) Hoechst Schering AgrEvo GmbH; Germany. Report No.: A55564	No	No	AgrEvo	Yes
IIA, 4.2.1	1996	Klein, E.H.J.; Idstein, H.; Becker, D. Endosulfan; Emulsifiable concentrate 352 g/l; Code: Hoe 002671 00 EC33 B325 Determination of residues of Hoe 002671 to establish a maximum residue level following 3 applications in oranges Hoechst Schering AgrEvo GmbH, Residues and User Safety, Frankfurt. Report No.: A55226	Yes	No	AgrEvo	Yes
IIA, 4.2.1	1981	Kuenzler, K.; Fechner, H. Hoe 02671 (endosulfan) in biological materials, residue determination by gas chromatography Hoechst Analyt.Labor., Germany. Report No.: A23318	No	No	AgrEvo	No

Annex IIA, or Annex IIIA point(s)	Year	Author (s) Title Company (insert name) Report No. Source (where different)	GLP GEP Y / N	Published Y / N	Owner	Data Protection
IIA, 4.2.1	1983	Kuenzler, K.; Fechner, H. Hoe 002671 (endosulfan) in biological materials, residue determination by gas chromatography Hoechst Analyt.Labor., Germany. Report No.: A26009	No	No	AgrEvo	No
IIA, 4.2.1	1996	Sonder, K. H., Idstein, H.; Junker, H. Endosulfan; Emulsifiable concentrate 352 g/l; Code: Hoe 002671 00 EC33 B324 - Determination of residues of Hoe 002671 to establish a maximum residue level following 2 applications in tomatoes for industrial use under field conditions Hoechst Schering AgrEvo GmbH, Residues and User Safety, Frankfurt. Report no. A54363	Yes	No	AgrEvo	Yes
IIA, 4.2.1	1996	Sonder, K.H.; Idstein, H.; Junker, H. Endosulfan, emulsifiable concentrate, 352 g/l Code: Hoe 002671 00 EC33 B325 Determination of Residues of Hoe 002671 to establish a Maximum Residue Level following 2 Applications in Tomatoes for Industrial Use under Field conditions Hoechst Schering AgrEvo GmbH, Development Residues and User Safety, Germany. Report No. A54362	Yes	No	AgrEvo	Yes
IIA, 4.2.1	1996	Sonder, K.H.; Idstein, H.; Junker, H. Endosulfan, emulsifiable concentrate, 352 g/l Code: Hoe 002671 00 EC33 B324 Determination of Residues of Hoe 002671 to establish a Maximum Residue Level following 2 Applications in Apples Hoechst Schering AgrEvo GmbH, Development Residues and Consumer Safety, Germany. Report No.: A54359	Yes	No	AgrEvo	Yes
IIA, 4.2.1	1980	Specht, Wolfgang, Tillkes, Monika Gas-chromatographische Bestimmung von Rueckstaenden an Pflanzenbehandlungsmitteln nach Clean-up ueber Gel-Chromatographie und Mini-Kieselgel-Saeulen-Chromatographie, 3. Mitt. - Sammelmethode Handelslab.Koerl/Specht, Germany. Report No.: A20145 Fresenius Z. Anal. Chem. 301, 300-307 (1980)	No	Yes	Publ.	No
IIA, 4.2.1	1979	Thier, W. Change in the ENDOSULFAN Content of Soybean Flour During Baking Hoechst Analyt.Labor., Germany. Report No.: A18653	No	No	AgrEvo	No

Annex IIA, or Annex IIIA point(s)	Year	Author (s) Title Company (insert name) Report No. Source (where different)	GLP GEP Y / N	Published Y / N	Owner	Data Protection
IIA, 4.2.1	1984	Thier, W.; Fisher, H.; Merz, H.D. Hoe 002671 (endosulfan), content determination in feed for small animals by gas chromatography (tested in Altromin feed) Hoechst Analyt.Labor., Germany. Report No.: A32172	No	No	AgrEvo	No
IIA, 4.2.1		Working group for the development and improvement of residue-analytical methods. Multi-residue Method 1. Pesticides amenable to gas chromatography Report file No: A57245 General Inspectorate for Health Protection, Ministry of Public Health, Welfare and Sport, The Netherlands, 1996, Analytical Methods for Pesticide Residues in Foodstuffs, Sixth Edition, Part 1, Pages 1-22.	No	Yes	Publ.	No
IIA, 4.2.1; IIIA, 4.2.5	1986	Werner, H. J.; Klante, G.; Merz, H.D. Residue determination of the active ingredient and Endosulfan-sulfate in soil, water, urine and plant- -material as well as of Endosulfan-diol and Endosulfan- -lactone in soil, water and urine Hoechst Analyt.Labor., Germany. Report No.: A34558	No	No	AgrEvo	No
IIA, 4.2.1/01; 4.2.2/01	1979	Carey; A.E.; Gowen, J.A.; Tai, H.; Mitchell, W.G.; Wiersma, G.B. Pesticide residue levels in soil and crops from 37 states, 1972 National soils monitoring program (IV), Pest. Monitor. Journal (12) 4: 209-229	No	Yes	Publ.	No
IIA, 4.2.1/01/02	1980	Zanini, E.; <i>et. al.</i> Gas chromatographic determination of Vinclozolin and endosulfan in strawberries J. Agric. Food Chem. Vol 28, 464-466	No	Yes	Publ.	No
IIA, 4.2.1/02	1976	Mitchell, L.R. Collaborative study of the determination of endosulfan, endosulfan sulfate, tetrasul and tetradifon residues in fresh fruits and vegetables Journ. Of the AOAC, vol. 59, No. 1, 209-212	No	Yes	Publ.	No

Annex IIA, or Annex IIIA point(s)	Year	Author (s) Title Company (insert name) Report No. Source (where different)	GLP GEP Y / N	Published Y / N	Owner	Data Protection
IIA, 4.2.1/03	1989	Malgahaes, M.J.A; Ferreira, J.R.; Fructuoso, L.; Tainha, A.A. Study of the disappearance of endosulfan, parathion, trichlorfon and pirimicarb from broccoli and Portuguese cabbage. Pest. Sci. 27: 23-31	No	Yes	Publ.	No
IIA, 4.2.1/04; 4.2.2/02	1991	Gorbach, S. Rückstandsanalytik von Pflanzenschutzmitteln: Endosulfan. Mitteilung VI der Senatskommission für Pflanzenschutz, Pflanzbehandlungs und Vorratsschutzmittel, 11. Lieferung	No	Yes	Publ.	No
IIA, 4.2.2.1	1990	Seefeld, F. Validierungsbericht. Rueckstandsanalytik von Endosulfan in Boden Akad.Landwirtschaftswiss., Germany. Report No. A46890	No	No	AgrEvo	No
IIA, 4.2.2.1		Werner, H.J.; Klante, G.; Merz, H.D. Residue determination of the active ingredient and Endosulfan-sulfate in soil, water, urine and plant- -material as well as of Endosulfan-diol and Endosulfan- -lactone in soil, water and urine Hoechst Analyt.Labor., Germany. Report No.: A34558	No	No	AgrEvo	No
IIA, 4.2.3/01	1971	Greve, P.A.; Wilt, S.L. Endosulfan in the Rhine water. Journal WPCF (43) 12: 2338-2348	No	Yes	Publ.	No
IIA, 4.2.3.1	1988	Merz, H.D. Hoe 002671 (endosulfan), determination of alpha-endo-sulfan, beta-endosulfan and endosulfan sulphate in drinking water by gas chromatography Hoechst Analyt.Labor., Germany. Report No.: A39226	No	No	AgrEvo	No
IIA, 4.2.4	1993	Idstein, H.; Merz, H.D.; Klug, R. Determination of endosulfan (Hoe 002671) in air by gas chromatography Hoechst C Produktentwicklung Oekologie 2, Germany. Report No.: A51944	No	No	AgrEvo	Yes

Annex IIA, or Annex IIIA point(s)	Year	Author (s) Title Company (insert name) Report No. Source (where different)	GLP GEP Y / N	Published Y / N	Owner	Data Protection
IIA, 4.2.4	1993	Reichert, N. Validation of an Analytical Method for the Determination of Hoe 002671 (Thiodan) in Air RCC Umweltchemie GmbH & Co. KG, Germany. Report No.: A52486	Yes	No	AgrEvo	Yes
IIA, 4.2.4/01	1981	Bidleman, T.F. Interlaboratory analysis og high molecular weight organochlorines in ambient air. Atmospheric environment 15: 619-624	No	Yes	Publ.	No
IIA, 4.2.5/2	1985	Leist, K. H.; Mayer, M. 30-day feeding study in adult male Wistar rats Pharma Research Toxicology. Report No.: A37112	No	No	AgrEvo	No
IIA, 4.2.5/1	1965	Stanovick, R.P. Determination of Thiodan I, II and Sulfate residues in milk and cow tissues Niagara Chemical Division FMC Corporation, USA. Report No.: A14210	No	No	AgrEvo	No
	1984	World Health Organisation IPCS (International Programme on Chemical Safety) Environmental Health Criteria, 40. Endosulfan World Health Organosation, Geneva		Yes	Publ.	No

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