Environmental Chemistry Method (ECM) and Independent Laboratory Validation (ILV) for Determination of Terbufos, Terbufos Sulfoxide and Terbufos Sulfone Residues in Water

Reports:	ECM: Terbufos, Terbufos Sulfoxide and Terbufos Sulfone: Validation of Analytical Methodology for the Determination of Residues in Water ILV: Independent Laboratory Validation of Methodology for the Determination of Residues of Terbufos, Terbufos Sulfoxide and Terbufos Sulfone in Water (Surface and Ground Water)
Document No.:	[MRIDs 49127101 & 48978102]
Guideline:	850.6100 [U.S.], 8.2.2.3 [Water];
Statements:	The study was conducted in compliance with the following Good Laboratory Practice (GLP) Standards: UK (1999 No. 3106 and amended in 2004 No. 994), OECD (as revised in 1997) and EC Commission Directive (2004/10/EC, Official Journal No. L 50/44). These principles of GLP are accepted by the regulatory authorities of the USA and Japan on the basis of intergovernment agreements. No claim of confidentiality is made for any information contained in this study on the basis of its falling within the scope of FIFRA § 10(d)(I)(A), (B), or (C).
Classification:	The ECM and ILV methods are classified as **Supplemental** for monitoring Terbufos, Terbufos Sulfoxide and Terbufos Sulfone in water. Both methods are upgradable upon provision of the correction of the deficiencies. Deficiencies: 1). ECM needs to clarify parent and daughter ions for each compound. 2). ILV report does not provide the mass spectrum confirmation image
PC Code:	105001
Reviewer:	He Zhong, Ph.D. Biologist
	Signature: Date: 9/19/2013

Executive Summary

This analytical method (MRID **49127101)** is for the quantitative determination of parent Terbufos, and two degradates, Terbufos Sulfoxide and Terbufos Sulfone in water using LC-MS/MS. The method limit of detection (LOD) is 0.02 µg/L and limit of quantification (LOQ) is 0.1µg/L for parent Terbufos, Terbufos Sulfoxide and Terbufos Sulfone (Table 1). The LOD is below the level of concerns (LOCs) for freshwater invertebrate life cycle (NOAEC = 0.03 ppb, MRID 00162525). The ILV (MRID **48978102)** has confirmed the ECM's LOD and LOQ limits. No ECM study deficiency was identified by the ILV, independent laboratory.

Table 1. Analytical Method Summary

Analyte(s) by Pesticide	MRID		Matrix	Method Date **(m/d/y)**	Registrant	Analysis	Limit of Detection (µg/L)	Limit of Quantitation (µg/L)
	Environmental Chemistry Method	Independent Laboratory Validation						
Terbufos	49127101	48978102	Soil and Sediment	22/5/2012	AMVAC	LC-MS/MS	0.02	0.1
Terbufos Sulfoxide	49127101	48978102	Soil and Sediment	22/5/2012	AMVAC	LC-MS/MS	0.02	0.1
Terbufos Sulfone	49127101	48978102	Soil and Sediment	22/5/2012	AMVAC	LC-MS/MS	0.02	0.1

I. Principle of the Method

Water samples fortified with known amount of terbufos, terbufos sulfoxide and terbufos sulfone (0.1 and 1 µg/L) were extracted and cleaned up using solid phase extraction (SPE) cartridges. Quantitation was performed using liquid chromatography with tandem mass spectrometric detection (LC-MS/MS). The ion transition monitored were m/z 289>103, m/z 305>187 and m/z 321>171 for terbufos, terbufos sulfoxide and terbufos sulfone respectively, which were monitored for quantitation purpose. For residue confirmation, alternative ion transitions, m/z 289>233, m/z 305>243 and m/z 321>265 were also monitored respectively.

II. Recovery Findings

The mean recoveries and the relative standard deviations (RSD) of terbufos and two degradates were within guideline requirements (mean 70-120%; RSD ≤20%) for ECM (**Table 2**) and ILV (**Table 3**).

Table 2. Initial Validation Method Recoveries for Terbufos, Terbufos Sulfoxide and Terbufos Sulfone in Ground and Surface Water

Analyte	Matrix	Fortification Level (µg/L)	Number of Tests	Recovery Range (%)	Mean Recovery (%)	CV (%)
Terbufos Quantitation	Surface Water	0.1	5	70-81	77	6.4
		1	5	77-87	81	4.5
	Ground Water	0.1	5	76-86	80	4.9
		1	5	70-83	77	7.1
Terbufos Confirmation	Surface Water	0.1	5	76-94	84	8.9
		1	5	73-85	79	6.5
	Ground Water	0.1	5	72-97	86	11.8
		1	5	75-86	81	6.3
Terbufos Sulfoxide Quantitation	Surface Water	0.1	5	84-95	90	5.7
		1	5	91-95	93	1.6
	Ground Water	0.1	5	91-99	94	3.2
		1	5	95-100	97	2.4
Terbufos Sulfoxide Confirmation	Surface Water	0.1	5	89-93	94	3.7
		1	5	91-97	94	2.5
	Ground Water	0.1	5	85-94	89	3.8
		1	5	96-101	99	2.1
Terbufos Sulfone Quantitation	Surface Water	0.1	5	86-93	89	3.7
		1	5	92-95	93	1.4
	Ground Water	0.1	5	90-96	93	2.5
		1	5	93-96	95	1.4
Terbufos Sulfone Confirmation	Surface Water	0.1	5	77-89	85	5.8
		1	5	93-97	95	1.7
	Ground Water	0.1	5	87-100	94	6.0
		1	5	93-97	95	1.6

Table 3. Independent Lab Validation Method Recoveries for Terbufos, Terbufos Sulfoxide and Terbufos Sulfone in Ground and Surface Water

Analyte	Matrix	Fortification Level (µg/L)	Number of Tests	Recovery Range (%)	Mean Recovery (%)	CV (%)
Terbufos Quantitation	Surface Water	0.1	5	64.6-75.5	71.0	6.2
		1	5	71.7-89.0	81.1	7.7
	Ground Water	0.1	5	63.2-78.2	72.4	8.2
		1	5	70.2-83.6	76.0	7.5
Terbufos Confirmation	Surface Water	0.1	5	65.0-83.4	75.0	9.2
		1	5	79.0-96.9	89.2	8.4
	Ground Water	0.1	5	67.4-95.9	76.2	16.7
		1	5	68.3-82.4	76.6	8.7
Terbufos Sulfoxide Quantitation	Surface Water	0.1	5	100.1-108.0	104.3	3.1
		1	5	90.3-100.7	97.8	3.9
	Ground Water	0.1	5	103.0-107.5	105.4	2.0
		1	5	91.6-105.0	99.5	5.1
Terbufos Sulfoxide Confirmation	Surface Water	0.1	5	98.5-104.9	102.5	2.8
		1	5	88.2-103.1	97.6	6.0
	Ground Water	0.1	5	100.1-108.6	108.0	7.2
		1	5	92.1-107.9	100.1	6.0
Terbufos Sulfone Quantitation	Surface Water	0.1	5	94.8-106.6	100.1	4.7
		1	5	94.4-103.8	99.8	3.2
	Ground Water	0.1	5	94.3-114.4	101.6	7.5
		1	5	86.2-103.3	99.5	7.5
Terbufos Sulfone Confirmation	Surface Water	0.1	5	90.8-102.4	95.9	4.5
		1	5	84.2-103.4	95.6	7.5
	Ground Water	0.1	5	91.1-102.2	98.5	4.6
		1	5	90.7-106.1	99.1	5.8

III. Method Characteristics

The ECM method characteristics and ILV confirmation are listed in Tables 4 and 5.

Table 4. ECM Method Characteristics

	Terbufos	Terbufos Sulfoxide	Terbufos Sulfone
Limit of Quantitation (LOQ)	0.1 µg/L	0.1 µg/L	0.1 µg/L
Limit of Detection (LOD)	0.02 µg/L	0.02 µg/L	0.02 µg/L
Linearity ([1]calibration curve r^2 and concentration range)	r^2 = 0.999 0.1 – 10 µg/L	r^2 = 0.999 0.1 – 10 µg/L	r^2 = 0.999 0.1 – 10 µg/L
Repeatable	Yes	Yes	Yes
Reproducible	Yes	Yes	Yes
Specific	Yes	Yes	Yes

[1]calibration curve is based on linear regression (y=a+bx) and r-values are reported in ECM method and r^2-values are calculated based on the r-values.

Table 5. ILV Method Characteristics Confirmation

	Terbufos	Terbufos Sulfoxide	Terbufos Sulfone
Limit of Quantitation (LOQ)	0.1 µg/L	0.1 µg/L	0.1 µg/L
Limit of Detection (LOD)	0.02 µg/L	0.02 µg/L	0.02 µg/L
Linearity ([1]calibration curve r^2 and concentration range)	r^2 = 0.999 0.1 – 10 µg/L	r^2 = 0.998 0.1 – 10 µg/L	r^2 = 0.994 0.1 – 10 µg/L
Repeatable	Yes	Yes	Yes
Reproducible	Yes	Yes	Yes
Specific	Yes	Yes	Yes

[1]calibration curve is based on linear regression (y=a+bx) and r-values are reported in ILV method and r^2-values are calculated based on the r-values.

Linearity is established in the calibration (y=a+bx) using external standards. The correlation coefficient of the calibration curves was above 0.999. The **limit of quantification** (LOQ) is 0.1 µg/L. The method in general satisfies the **repeatability** criteria with mean recoveries are in the range of 70-120% and RSDs are ≤20%. **Reproducibility** is satisfactory with the independent validation confirmed the LOQ(s) established by the initial validation. This method using LCMS/MS demonstrated excellent **specificity** by selecting the following daughter and parent ions (Table 6). However, ILV method did not include the Mass Spectrum Graph to confirm the method specificity for the parent and daughter ions

Table 6. Method Specificity—LC-MS/MS Parent and Daughter ions

Analyte	Parent ion	Daughter ion
Terbufos	103	233
Terbufos Sulfoxide	187	243
Terbufos Sulfone	171	265

IV. Method Deficiencies and Reviewer's Comments

1). The ECM does not clearly specify the parent ions (or primary ions) and daughter ions (or secondary ions) for terbufos (Fig 7), terbufos sulfoxide (Fig 8) and terbufos sulfone (Fig 9). A clarification is needed.

3). ILV does not include the mass spectrum confirmation image in the report.

V. References

Brewin, S. 2012. Terbufos, Terbufos Sulfoxide and Terbufos Sulfone: Validation of Analytical Methodology for the Determination of Residues in Water MRID 49127101

Pawula, M. 2012. Independent Laboratory Validation of Methodology for the Determination of Residues of Terbufos, Terbufos Sulfoxide and Terbufos Sulfone in Water (Surface and Ground Water) MRID 48978102