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OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

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MEMORANDUM

SUBJECT: Guidance for Residues of Concern in Ecological Risk Assessment

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TO: Environmental Fate and Effects Division (7507P)
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The purpose of this guidance, which is effective immediately, is to assist in determining residues of concern for pesticide ecological risk assessments. The guidance also discusses which additional data on pesticides and their degradates of concern may be needed to reduce uncertainty in these assessments. Implementing this guidance should result in more robust and consistent rationales for residues of concern and requests for additional data.

This guidance document was developed by the Environmental Fate and Effects Division's (EFED) representatives of the Health Effects Division's (HED) Residues of Concern Knowledgebase Subcommittee (ROCKS). For further information, please contact Greg Orrick or other EFED representatives of the ROCKS.

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1. Purpose

The purpose of this guidance is to assist in determining residues of concern for pesticide ecological risk assessments. This guidance also discusses additional data, regarding pesticides and their degradates of concern, that may be needed to reduce uncertainty in these assessments.

It is important to identify a pesticide's degradates of concern, taking into account the chemical structure of the products formed, their prevalence (based on the pesticide use patterns and environmental fate of the pesticide and its products), and their ecotoxicity to assessed organisms. A pesticide (*i.e.*, active ingredient) and its degradates of concern are collectively known as the residues of concern (ROC). The residues of concern may be different for each assessed taxa (*e.g.*, aquatic versus terrestrial organisms or plants versus invertebrates versus vertebrates) and for acute versus chronic exposure durations. However, assumptions made in the absence of data should focus on defining common residues of concern across taxa and exposure durations.

Residue of concern definitions may be conservative, including compounds for which additional data are needed to confirm whether concern for the compounds is founded. Therefore, specifying which residues are of concern can be an iterative or tiered process, where a limited set

of data is requested to reduce uncertainties. Based on these data, the number of residues of concern may be reduced or, if there are toxicity concerns, another set of data may be requested to reduce uncertainties that arise during the review process. Alternatively, conservative assumptions for residues of concern may be maintained and additional data may not be requested if the assessments they support do not need refinement.

Inert ingredients and formulation impurities may be of concern. However, they are not discussed further in this guidance because they are generally identified and regulated by the Registration Division. If they have been identified in association with an active ingredient, ecotoxicity studies on formulated end-use products, which contain the active ingredient and the inert or impurity, may be requested and used to assess the ecological risk.

2. Definitions

Terms and acronyms used in this guidance include:

Active ingredient—A pesticide; a plant regulator, defoliant, desiccant, nitrogen stabilizer, or ingredient that will prevent, destroy, repel, or mitigate any pest (FIFRA §2(a))
CFR—Code of Federal Regulations
Code of Federal Regulations—The codification of the general and permanent rules published in the Federal Register by the departments and agencies of the Federal Government
Degradate—A compound produced by another compound's transformation, such as an isomer, polymer, metabolite, or molecular addition or subtraction product; synonymous with transformation product
ECM—Environmental chemistry method
Ecological residues of concern—An active ingredient and its degradates for which ecological risk is assessed
ECOSAR—A computer program developed within the regulatory constraints of the Toxic Substances Control Act (TSCA) that uses structure-activity relationships, chemical class-specific regression equations between log K_{OW} and measured toxicity values, and acute-to-chronic ratios[1]
EFED—Environmental Fate and Effects Division
Environmental chemistry method—An analytical method for residues in an environmental medium such as soil or water
EROC—Ecological residues of concern
Formation/Decline (FD) method—An exposure modeling approach for a compound and its degradates in which the formation and decline kinetics of each compound is simultaneously modeled
HED—Health Effects Division
ILV—Independent laboratory validation
LOC—Risk level of concern
LOQ—Limit of quantitation
Major degradate—A product greater than or equal to 10% of the applied compound at any interval of an environmental fate study conducted in the laboratory
MARC—Metabolism Assessment Review Committee

[1] ECOSAR is found at: http://www.epa.gov/oppt/newchems/tools/21ecosar.htm

Mechanism of action—A description at the molecular and cellular levels of how a compound produces a biological effect

Metabolite—A compound produced via a metabolic process

Minor degradate—A product less than 10% of the applied compound at all intervals in an environmental fate study conducted in the laboratory

Mode of action—A description at the cellular level of how a compound produces a biological effect

OP—Organophosphate

OPP—Office of Pesticide Programs

OPPIN—Office of Pesticide Programs Information Network

QSAR—Quantitative structure-activity relationship

Relative potency factor (RPF)—The ratio of the toxic potency of a given chemical to that of an index chemical with the same mechanism of action

Residue Summation (RS) method—An exposure modeling approach for a compound and its degradates in which model result distributions for the individual compounds are summed to create a total residue distribution

Residues of concern—An active ingredient and its degradates for which risk is assessed, based on known or assumed toxicological and exposure concerns

Risk level of concern—The risk quotient value at and above which risk is of concern for a given taxon and set of conditions; this concept allows effective adjustment of exposure values and/or toxicity values after risk quotients are calculated

ROC—Residues of concern

ROCKS—Residues of Concern Knowledgebase Subcommittee; an OPP committee run by HED to provide recommendations on residues of concern for human health in drinking water and food commodities and on residues included in tolerance expressions

SU—Sulfonylurea pesticide

Total Residue (TR) method—An exposure modeling approach for a compound and its degradates of similar toxicity for which the degradation half-lives used to estimate exposure are calculated by regressing the residue totals (rather than individual compounds) across the study intervals; the exposure estimates are then compared to the most sensitive toxicity values for the compounds

Total toxic residues—A synonym for residues of concern (ROC); this term is a misnomer when selected toxic residues are not included due to low exposure

Transformation product—A compound produced by another compound's transformation, such as an isomer, polymer, metabolite, or molecular addition or subtraction product; synonymous with degradate

TTR—Total toxic residues

Toxicity endpoint—A measurable biological effect that will or will not occur for a stated proportion of a species-specific population (*e.g.*, a mallard LD_{50})

Toxicity value—A chemical concentration associated with a toxicity endpoint

Toxicological level of concern—A toxicity value multiplied by a corresponding risk level of concern (*e.g.*, an aquatic life benchmark)

3. Specifying the Ecological Residues of Concern

3.1. Describe the Degradates

Information on an active ingredient's degradates should be collected from available study data. It is recommended that a table (*i.e.*, structure table) of the chemical names, SMILES strings, CAS numbers, structures of the test compound and all identified degradates, study MRIDs, and maximum and final concentrations of degradates plus their intervals be included in the ecological risk assessment. **Appendix A** provides one example table format that is recommended and consistent with the structure table format in EFED ROCKS memoranda (USEPA, 2011*a as amended*). Available information on degradate degradation, dissipation, mobility in soil, and ecotoxicity should also be collected and tabulated (typically tabulated separately).

Past ecological risk assessments, drinking water exposure assessments, and ROCKS and MARC memoranda should be reviewed to collect this information and to identify residues of concern previously assessed for ecological taxa and for human drinking water exposure. However, the residues of concern identified in past ecological risk assessments may need updating if environment fate or ecotoxicity studies have been submitted since these documents were written or if the rationale for the ecological residues of concern is unclear, no longer supported (*e.g.*, based on a limited set of seed treatment uses, with foliar uses currently pending), or both.

3.2. Identify Residues of Concern

Residues of concern include an active ingredient and its degradates for which risk is assessed, based on known or assumed ecotoxicological *and* exposure concerns. Before the residues of concern (*i.e.*, residues of risk concern) are defined, the available information on degradates is reviewed to evaluate the products' prevalence and ecotoxicity (*i.e.*, to identify exposure and ecotoxicological concerns). While this information is considered as a whole, the review process typically begins with exposure considerations and is iterative as ecotoxicity is also considered.

3.2.1. Exposure Considerations

To begin, environmental fate data and active ingredient use patterns are evaluated to identify degradates for which there is a complete and substantial exposure pathway. As a first step, minor degradates (those that form <10% of the applied compound) are typically excluded from the residues of concern, with the following possible exceptions:

- Minor degradates approaching 10% of the applied at the termination of an environmental fate laboratory study,
- Minor degradates with no observed degradation over an extended period in environmental fate studies, and
- Minor degradates of known or expected ecotoxicological concern:
    - When their toxicity is greater than that of the parent compound, or
    - When two or more degradates are formed, and their sum substantially changes exposure estimates modeled with the Total Residue (TR) method.

Degradates formed in the laboratory under conditions unrepresentative of actual use conditions may also be excluded from the residues of concern. For example, photolytic products may be excluded for compounds only used as seed treatments. Products found in soil but not in aquatic systems may be excluded for compounds limited to aquatic uses. On the other hand, aquatic study degradates are relevant to active ingredients with no aquatic uses because residues may be transported via spray drift, runoff, or other routes to nearby water bodies.

Generally, degradates detected in the field or in monitoring are candidates for the residues of concern regardless of their concentration, as long as they are not rapidly degraded. "Major" and "minor" degradate designations apply to laboratory studies only.

Rapidly degraded degradates detected in field or laboratory studies are generally excluded from the residues of concern.

Unidentified major degradates are typically included in the residues of concern.

Unextracted residues from laboratory soil or sediment studies may be considered residues of concern if the extraction procedure is not regarded as exhaustive and it is uncertain whether residues of concern were present in the unextracted residues. Guidance on evaluating extraction procedures and unextracted residues is expected to be released separately. Additional guidance may be sought by consulting the EFED Environmental Fate Technology Team (FTT).

3.2.2. Ecotoxicity Considerations

At this stage, ecotoxicity information on the potential residues of concern, identified with exposure information, is considered in refining the definition of the residues of concern. The amount of research conducted to collect ecotoxicity information and characterize effects should be balanced against the impact the information is expected to have on the risk assessment and its conclusions. While it is ideal to have the mechanism(s) of action of the residues of concern fully described at the molecular level, this information is typically incomplete. In these cases, best professional judgment is used to classify the assumed mechanism(s) of action for the residues using information on the mode(s) of action, the chemical class(es), and/or the structural similarity (*i.e.*, toxic moiety retained) between the parent compound and its degradates. As this information is collected, each degradate will fall into one of the following four groups (for each mechanism of action if the product has more than one):

- Degradates that are less toxic than the parent compound by an order of magnitude or greater (or the confidence intervals do not overlap or both)
    - These compounds are typically excluded from the residues of concern unless they present a substantial exposure concern, such as being particularly persistent and/or demonstrating a potential to accumulate in the environment.

- Degradates of similar toxicity and mechanism of action as the parent compound
    - Exposure to these compounds is assessed typically with the Total Residue (TR) modeling method. For terrestrial exposure, this means that the foliar dissipation rate reflects the residues of concern, not just the parent compound.

- Degradates of similar mechanism of action as and higher toxicity than the parent compound (an order of magnitude or greater more toxic or the confidence intervals do not overlap or both)
    - Aquatic exposure to these compounds may be assessed with the Residue Summation (RS) modeling method using a relative potency factor (RPF) adjustment.
    - Terrestrial exposure to these compounds is typically assessed separately due to current exposure model limitations.
    - A search of the public ECOTOX database[2] may be conducted for additional information.

- Degradates with a mechanism of toxicity different from that of the parent compound
    - These compounds are typically assessed separately and are often not of concern unless persistent or more toxic than the parent compound.

The general reliability for sources of ecological residue of concern data in declining order is as follows: **1)** submitted ecotoxicity studies on the residues of concern; **2)** open literature studies on the residues of concern; **3)** rationales from previous assessments (ecological and human health); **4)** read across from degradates of similar structure, often from active ingredients within the same chemical class; and **5)** chemical structure considerations, unsourced data from other agencies' databases, and ECOSAR or other QSAR program results. The actual reliability of sources depends on the quality of the data and may not follow this general relationship. The following subsections discuss these data sources.

3.2.2.1. Study Data

Degradate ecotoxicity values from submitted studies or the open literature should be tabulated, expressed in parent compound equivalents, and compared to the ecotoxicity values of the parent compound for the same endpoints. Any open literature information obtained should be used in accordance with the standard procedures for its use (USEPA, 2011*b*). A search of the public ECOTOX database for degradate information does not typically include requesting a literature search from the Office of Research and Development (ORD). The amount of research conducted to collect ecotoxicity information should be balanced against the impact the information is expected to have on the risk assessment and its conclusions.

3.2.2.2. Previous Rationales

As previously stated, previous ecological risk assessments may define the ecological residues of concern. However, the ecological residues of concern may need to be redefined if environmental fate or ecotoxicity studies have been submitted since these documents were written or if the rationales for the ecological residues of concern are unclear, no longer supported, or both.

If the residues of concern for drinking water have been determined for human health dietary risk assessment, then the rationales may be useful to consider. This information may be available in

[2] The public ECOTOX database is found at: http://cfpub.epa.gov/ecotox/

ROCKS or MARC decision memoranda (found in the OPPIN Chemical Documents database) or in previous drinking water exposure or dietary risk assessments (found in EFED's or HED's archives, respectively). Increasing care should be taken when extrapolating the rationales from the residues of concern for human health to the residues of concern for other organisms of increasing distant relation to humans (*e.g.*, birds, fish, invertebrates, or plants).

3.2.2.3. Databases

If ecotoxicity data are not submitted for degradates, TOXNET[3], the public ECOTOX database, or the European Union FOOTPRINT database[4] may be searched (preferably using the CAS number, if available) for more information. The source study for database information that is useful for risk assessment should be located. If the source study cannot be found for reported database information, then the information may not be used to quantify risk estimates; however, the data may be used to characterize whether risk can be precluded and to support a request for study data, which are needed to support a final determination.

3.2.2.4. Read Across

Risk assessments for chemicals in the active ingredient's chemical class may be reviewed to determine whether common degradates are shared with any chemical in the chemical class and whether data are available for the common degradates. Some chemical classes have a standard set of degradates of concern that should be considered (*e.g.*, oxons for organophosphates and 1,2,4-triazoles for triazole fungicides). The toxicity values of common or similar degradates may be "read across," with caution, in the absence of toxicity data on the assessed degradates.

"Read across" may also be done between degradates that are in a different chemical class than the parent compound and other compounds in the different chemical class. For example, ecotoxicity data for urea herbicides may be informative for urea degradates of a sulfonylurea when ecotoxicity data on the urea degradates are not available. Additional guidance on the use of "read across" techniques is provided in USEPA, 2010.

3.2.2.5. Chemical Structure Considerations

In the absence of ecotoxicity or other data, the chemical structures of degradates may be evaluated for ecotoxicity concern using best professional judgment. For example, degradates with a similar structural "backbone" to the parent compound (*e.g.*, a demethylated pyrethroid) may be considered to be no more or less toxic than the parent. However, if the parent compound's functional group believed to be responsible for pesticidal activity is cleaved to form degradates of unknown toxicity (*e.g.*, a sulfonylurea bridge is hydrolyzed), then the cleavage products may be considered to be much less toxic than the parent in the absence of QSAR flags or other ecotoxicological data of concern.

Questions on the environmental fate and ecotoxicity of degradates can be addressed to the appropriate Technology Team. Technology Team members may have additional information on

[3] TOXNET is found at: http://toxnet.nlm.nih.gov/
[4] The European Union FOOTPRINT database is found at: http://sitem.herts.ac.uk/aeru/footprint/index2.htm

whether degradates are of concern, such as information on biological activity, on compounds with similar structure or known binding sites, and on compounds that are too large for active transport into cells.

3.2.2.6. Structure-Activity Relationships

If no toxicity data are available, quantitative structure-activity relationships (QSAR) such as those in ECOSAR may be used to characterize the toxicity of degradates, to characterize whether risk can be precluded, and to support a request for study data. However, the information may not be used to quantify risk estimates. Guidance on the use of QSARs in EFED is provided separately in Appendix A of USEPA, 2010.

Generally, ECOSAR estimates for the parent compound and degradates of concern are compared to measured data from laboratory studies. ECOSAR will be of limited use for degradates in the same chemical class as the parent compound if the estimates for the parent compound or these products are not accurate. ECOSAR estimates for degradates in a different chemical class than the parent compound should be compared as well to any available laboratory data for these products. When ECOSAR estimates are accurate with respect to laboratory data, then estimates for endpoints for which laboratory data are not available are preliminarily evaluated for potential risk. If their use in risk assessment would result in risk level of concern (LOC) exceedances, then confirmatory laboratory studies should be requested to determine whether LOCs are exceeded. **Appendix B** provides one example of a table of ECOSAR toxicity estimates and corresponding laboratory study values.

3.3. Provide Rationales for the Residues of Concern

The task at this point is to concisely describe the residues of concern and provide clear justification. It is often useful to also explain why any major degradates are not included in the residues of concern. **Appendix C** provides example tables for summarizing the residues of concern per organism class. These tables are helpful for summarizing complex residue-of-concern definitions (justifications are not typically tabulated).

4. Data Needs for Ecological Residues of Concern

Additional environmental fate and ecotoxicity data may be needed to assess risk from ecological residues of concern and to reduce assessment uncertainty. However, best professional judgment should be used to limit data requests to include a minimal amount of studies that may substantially reduce uncertainty in assessments and exclude data of low relevance to assessments. Generally, data that are expected to have little to no impact on risk conclusions are not needed.

4.1. Parent Compound Data Needs

Parent compounds are always residues of concern. The Code of Federal Regulations (CFR) specifies the use pattern-specific minimal sets of studies needed for registered active ingredients. However, not every study required by the CFR may be needed for risk assessments conducted

for registration review. For example, environmental fate studies not used in exposure modeling are unnecessary typically for registration review unless the additional data could substantially change the environmental fate characterization. As an example, the anaerobic soil metabolism study (835.4200) is rarely needed. Also, if acceptable field dissipation data are available, studies of additional sites are not often needed. As another example, ecotoxicity studies on saltwater species are not needed typically when a sufficient margin of safety exists based on freshwater species data. On the other hand, studies not listed in the CFR, such as water treatment studies, may be needed.

In other words, studies are requested during registration review only to address data gaps that may change risk conclusions or may substantially change the exposure or effects assessment. While any needed data may be requested, studies that have been typically requested for registration review include the following:

- **Passerine acute toxicity (non-guideline)** is a recently required study
- **Environmental chemistry method (ECM) in water (850.6100)** (and an associated independent laboratory validation (ILV)) is needed for potential monitoring efforts, with a limit of quantitation (LOQ) below toxicological levels of concern

4.2. Degradate Data Needs

Studies needed for degradates of ecological risk concern should be limited to those that confirm whether there are potential risks of concern. Requested studies should be targeted to address ecotoxicity concerns based on estimation methods such as read across and QSAR. More specifically, if a degradate is unlikely to pose a risk of concern to a taxon, then an ecotoxicity study for that taxon is not requested. Furthermore, in most cases, a full suite of ecotoxicity studies is not needed for each degradate of concern because reasonable ecotoxicity considerations can be made with a limited set of studies that are targeted to reduce the largest uncertainties. Because studies needed for degradates of concern are based on what is needed for risk assessment, this guidance cannot provide a static list of studies to request in every instance. The following paragraphs provide considerations for developing a list of studies to request that is appropriate for the residues of concern.

4.2.1. Environmental Fate Data

Environmental fate and/or physical/chemical property studies are not typically requested for degradates, with the exceptions of batch equilibrium studies and ECMs in water that are explained below. Generally, environmental fate and physical/chemical property studies for degradates are only requested when the data are needed to estimate exposure (*e.g.*, for exposure modeling with the formation/decline method) or to fill a critical gap in the environmental fate characterization. For example, an aqueous photolysis (835.2240) study is needed for the main acid of an ester when the acid persists in aquatic biodegradation studies and is not formed in substantial amounts in the aqueous photolysis study of the ester. If the physical/chemical properties of degradates are needed, they can be estimated typically with EPI Suite[5].

[5] EPI Suite is found at: http://www.epa.gov/oppt/exposure/pubs/episuite.htm

A **batch equilibrium study (835.1230)** is needed typically if any degradates are of concern. If a total residue approach is used, this study is needed typically for the compound expected to be the most mobile in soil rather than for all of the residues of concern. EPI Suite estimates of soil absorption coefficients and other information (*e.g.*, pKa and structural considerations) are used to identify the residue of concern likely to be most mobile in soil. Whether this study is needed for other degradates of concern depends on whether the exposure assessment will deviate from the typical approach of conservatively assuming that the soil mobility of the most mobile compound represents that of the residues of concern. If a degradate of concern is more toxic than the parent compound or has a different mechanism of action, then a batch equilibrium study is needed typically for its separate exposure assessment.

An **environmental chemistry method (ECM) in water (850.6100)** (and an associated independent laboratory validation (ILV)) should be available for the major residues of concern for aquatic taxa (and any minor degradates more toxic than the parent compound), with a limit of quantitation (LOQ) below toxicological levels of concern.

4.2.2. Ecotoxicity Data

If a total residue approach is used and the residues of concern are assumed to have equal toxicity to the parent compound (*e.g.*, sulfonylurea products with an intact sulfonylurea bridge), it is unlikely that additional ecotoxicity studies are necessary.

If a degradate is expected to be more toxic than the parent compound or is expected to have a different mechanism of toxicity than the parent compound and there is a potential for a risk concern based on estimated exposure and a complete exposure pathway, ecotoxicity studies for the taxa associated with the risk concern should be requested. Only one study per guideline is typically requested. Each ecotoxicity study is conducted on the species most sensitive to the parent compound, if the parent and product share a similar (often assumed) mechanism of action. Fewer taxa (maybe one taxon) may be targeted if available data (*e.g.*, parent data, read across, ECOSAR) indicate that the other taxa are not sensitive. Acute studies often requested in the absence of these data include the following, although the types of studies requested should be informed by the environmental fate profile, exposure pathways, and known ecotoxicity profile:

- **Acute freshwater fish toxicity (850.1075)**
- **Acute freshwater invertebrate toxicity (850.1010)**
- **Aquatic plant toxicity (850.4400 or 850.5400)**, especially if the active ingredient is an herbicide.
- **Avian acute oral toxicity (850.2100)** only for soil degradates; *e.g.*, if the foliar dissipation half-life of the parent is <35 days or if available data suggest the product may be more toxic than the parent and exposure estimates approach risk levels of concern.

The design of submitted ecotoxicity studies on the parent compound should be considered when identifying data needs for degradates. For example, aquatic studies that are static rather than flow-through may capture the effects of some degradates of the test compound if renewal periods are sufficiently long to allow formation of degradates.

Exposure considerations, such as preliminary exposure modeling, are often used to explore whether additional data are expected to change risk conclusions. If preliminary exposure estimates for a degradate of concern are orders of magnitude less than the toxicological level of concern, then additional data are not requested for the compound in most cases. Likewise, if addition of a degradate of concern to the total residues modeled with the TR method does not appreciably change exposure estimates, then additional data are not requested in most cases. Note that these are reasons not to request additional data and not reasons to exclude the compound from the residues of concern. It is common for a compound, such as those detected in the field or in soil photolysis studies, to be of concern and not change modeled exposure estimates that are based on specific laboratory studies. Inclusion of these compounds as residues of concern highlights the potential need to monitor the residues and increases the likelihood that ECMs are available with which to do so.

Any study considered by the assessor to be critical for risk assessment may be requested. Some commonly requested studies include the following:

- **Whole sediment, acute freshwater invertebrate (850.1735)** may be needed for residues of concern that meet the data requirements for sediment studies.
- **Chronic ecotoxicity studies** may be needed when the degradate(s) of concern is/are sufficiently persistent and:
    - chronic toxicity for a taxon is expected due to chronic toxicity concerns for the parent compound of similar mechanism of action; or
    - in addition to the acute ecotoxicity studies when the parent compound degrades quickly.

4.2.3. Existing Guidance

Guidance on residues of concern exists for two chemical groups, and is discussed in the following subsections. It is noted that the residues of concern for all chemical classes and groups are evaluated regardless of whether there is chemical-specific guidance.

4.2.3.1. Organophosphates

Phosphothionate organophosphates (OP) may form oxons of toxicological concern, some of which are more potent acetylcholinesterase inhibitors than their parent compounds. The oxons may degrade into additional residues of toxicological concern, including sulfoxides and sulfones. Ecotoxicity and environmental fate studies needed for these compounds are discussed separately in *Guidance for Registration Review Data Requests for Oxon Degradates of Organophosphate Insecticides (OP)* (USEPA, 2009). In general, the guidance indicates that animal toxicity studies of the oxons are needed to determine their toxicity. If the toxicity is sufficient, a suite of studies on the parent compound are needed to determine the extent of oxon formation. A batch equilibrium, an aerobic soil metabolism, and other studies on the oxon may be needed as well.

4.2.3.2. Sulfonylureas

Guidance on which data are needed for degradates of sulfonylureas (SU) is also provided separately in USEPA, 2011*c*. This guidance is provisional at the time of writing; the final guidance should be consulted when it is released. In general, the provisional guidance indicates that degradates with an intact SU bridge are included in the residues of concern (ROC). Aquatic and terrestrial plant toxicity studies may be needed for degradates that are substituted ureas, unless estimated exposures are lower than would cause a risk concern for a known urea herbicide (like diuron or linuron). Freshwater fish and invertebrate toxicity studies are needed for products that are aromatic amines, unless exposures are lower than would cause a risk concern for analogous aromatic amines (such as a chloro- or dichloro-aniline).

5. References

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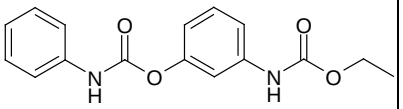
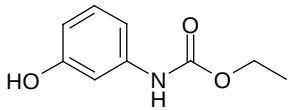
USEPA. 2011*a*. *Guidance for Determining Pesticide Residues of Concern in Drinking Water in Coordination with the HED ROCKS*. U.S. Environmental Protection Agency, Office of Pesticide Programs, Environmental Fate and Effects Division. Internal memorandum. May 10, 2011.

USEPA. 2011*b*. *Evaluation Guidelines for Ecological Toxicity Data in the Open Literature.* U.S. Environmental Protection Agency, Office of Pesticide Programs, Environmental Fate and Effects Division. May 16, 2011.

USEPA. 2011*c*. *PROVISIONAL Interim EFED Guidance on Sulfonylurea Degradates in Registration Review.* U.S. Environmental Protection Agency, Office of Pesticide Programs, Environmental Fate and Effects Division. *Draft Guidance.* Sep. 13, 2011.

APPENDIX A. Example Structure Table

Table A.1. Desmedipham and Its Environmental Degradates.

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	Ref. [A] (MRID)	Maximum %AR (day)	Final %AR (study length)
PARENT						
Desmedipham **AE B038107**	**IUPAC:** Ethyl 3-phenylcarbamoyloxycarbanilate **CAS:** Ethyl N-[3-[[(phenylamino)carbonyl]oxy] phenyl]carbamate **CAS No.:** 13684-56-5 **Formula:** $C_{16}H_{16}N_2O_4$ **MW:** 300.32 g/mol					
DEGRADATES						
EHPC **AE F132319**	Ethyl-N-(3-hydroxyphenyl)carbamate **Formula:** $C_9H_{11}NO_3$ **MW:** 181.19 g/mol		Hydrolysis –pH 4 Hydrolysis –pH 5 Hydrolysis –pH 7 Hydrolysis –pH 9	46040201	8.7% (30 d) **45%** (28 d) **99%** (3 d) **96%** (30 min)	8.7% (30 d) 42% (30 d) 99% (3 d) 96% (30 min)
			Soil photolysis	00098608	8.9% (12 d)	7.4% (20 d)
			Aerobic soil	(41998601/ 45604501)	4.5% (14 d)	0.9% (100 d)
			Field studies	(42180501)	0.25 ppm (1 d)	<0.025 ppm (270 d)
Unextracted residues	(not applicable)	(not applicable)	Soil photolysis	00098608	**27%** (20 d)	27% (20 d)
			Aerobic soil	(41998601/ 45604501)	**66%** (30 d)	59% (100 d)
Volatiles	(not applicable)	(not applicable)	Soil photolysis	00098608	**29%** (20 d)	29% (20 d)
			Aerobic soil	(41998601/ 45604501)	2.7% (100 d)	2.7% (100 d)
Carbon dioxide	Carbon dioxide **Formula:** CO_2 **MW:** 44.1 g/mol	O=C=O	Hydrolysis	46040201	not detected	
			Soil photolysis	00098608	not analyzed	
			Aerobic soil	(41998601/ 45604501)	**29%** (100 d)	29% (100 d)

[A] Studies in parentheses are not acceptable but may be upgraded with additional data.
[B] nd means "not detected." na means "not analyzed."

APPENDIX B. Example ECOSAR Toxicity Table

Table B.1. ECOSAR Toxicity Predictions for Acetamiprid and Degradates

Compound (compounds class used by ECOSAR)	Estimated Toxicity Value (mg/L)				
	96-hr FW Fish LC_{50}	48-hr Daphnid LC_{50}	96-hr EC_{50} Green Algae	Fish Chronic Value	Daphnid Chronic Value
Acetamiprid (Parent)					
Empirical (*Measured*)	>100	50	>1.3	19.2	5.0
Halopyridines	0.21	0.73	--	0.30	0.97
Neutral SAR	59	36	19	5.5	3.7
IM 1-2					
Empirical (*Measured*)	--	>99.8	--	--	--
Amides	771	236	1.6	4.6	--
Halopyridines	0.225	1.4	--	8.9	--
Neutral SAR	5774	2692	563	570	182
IM 1-3					
Amides	284	101	1.0	1.7	--
Halopyridines	0.19	1.0	--	3.9	--
Neutral SAR	2008	988	248	196	72
IM 1-4					
Empirical (*Measured*)	>98.1	43.9	--	--	--
Aliphatic Amines	182	14	3.8	2.8	0.025
Halopyridines	0.15	0.80	--	3.3	--
Neutral SAR	1724	843	208	169	61
IM 1-5					
Empirical (*Measured*)	--	--	--	--	25
Halopyridines	0.184	1.369	--	27.067	0.752
Neutral Organic	28011	11695	1682	2821	673
IC-0					
Empirical (*Measured*)	--	>95.1	--	--	--
Halopyridines-acid	1.5	6.9	--	12	1.1
Neutral SAR	447	238	78	43	20
IM-0					
Halopyridines	0.13	0.75	--	--	--
Benzyl Alcohols	360	194	--	--	--
Neutral SAR	1934	934	221	190	67

APPENDIX C. Example Residue of Concern Tables

Table C.1. Residues of Concern and Exposure Estimation Method per Taxon

Taxon	Residues of Concern[1]	Toxicity Assumption/ Exposure Assumption	Method of Estimating Exposure
Aquatic Animals	Acetamiprid, IM 1-4, unextracted residues	Similar Toxicity TR	PRZM/EXAMs, unextracted residues will influence results
Aquatic Plants			
Terrestrial Vertebrates[2]	Parent and Unextracted Residues	Similar Toxicity TR	T-REX , unextracted residues will not influence results
Human Drinking Water	Parent and Unextracted Residues	Similar Toxicity TR	PRZM/EXAMs, unextracted residues will influence results
Terrestrial Invertebrates	Parent and Unextracted Residues	Similar Toxicity TR	Exposure not currently estimated
Terrestrial Plants	Parent and unextracted residues	Similar Toxicity TR	TERRPLANT, unextracted residues will not influence results SCIGROW and PRZM/EXAMs for irrigation water, unextracted residues will influence results

Abbreviation: TR= Total residue approach

[1] Unextracted residues are only relevant residues of concern for terrestrial organisms when exposure is estimated for drinking water or for residues in irrigation water.

[2] Residues included in the TR approach for these taxa are based on HED analysis of residues of concern for humans and analysis of available toxicity data on degradates for birds.

Table C.2. Residues of Concern per Taxon

Degradate	Is the degradate a residue of concern? If yes, what approach will be used to evaluate potential risk due to exposure to degradate				
	Aquatic Animals	Aquatic Plants	Terrestrial Vertebrates	Terrestrial Invertebrates	Terrestrial Plants
o-desmethyl orthosulfamuron	Yes-TR[1]	Yes-TR[1]	Yes-TR[1]		Yes-TR[1]
DBS acid	No	No	Yes-TR[2]		No
DB amine	No, at current exposure levels	No	Yes-TR[2]		No
DBS amide	No	No	No	No	No
DOP amine	No, at current exposure levels	No	No	No	No
DOP urea	Yes – EECs estimated for ureas and compared to toxicity values for DOP urea or urea herbicides			No	No
o-desmethyl DOP urea					

Abbreviation: TR= Total residue approach

[1] Residues included in the TR approach for these taxa are the parent and o-desmethyl orthosulfamuron.

[2] Residues included in the TR approach for these taxa are the parent, DBS acid, and DB amine based on HED analysis of residues of concern for humans. As these degradates are assumed to have similar toxicity to the parent and exposure estimates are not related to the fate data, the presence of these degradates does not alter the estimate of risk for these taxa from that estimated for the parent alone. If one of these degradates is found to be more toxic than the parent or if the presence of these degradates could influence the estimate of exposure, this approach will be revisited.