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DMMP CLARIFICATION PAPER

CHLORDANE ANALYSIS AND REPORTING

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Introduction

Chlordane, an organochlorine insecticide, was used in the United States from 1948 to 1978 on agricultural crops, lawns, and gardens and as a fumigating agent. In 1978, EPA canceled the use of chlordane on food crops and phased out other above-ground uses for the next 5 years. From 1983 to 1988, chlordane's only approved use was to control termites in homes. In 1988, all approved uses of chlordane in the United States were terminated; however, manufacture for export still continues. Chlordane is a persistent, bioaccumulative, and toxic (PBT) pollutant targeted by EPA (EPA, 2007).

Chlordane was sold under numerous trade names, including Belt, Corodane, Dowchlor, Octachlor, Toxichlor and Velsicol 1068. These commercial products were actually a mixture of chemicals, the composition of which varied from product to product. Commonly referred to as "technical chlordane", the mixtures included at least 11 major components and 30 or more minor components (EPA, 1996).

Many of the components of chlordane are persistent in the environment and bioaccumulative. Additionally, metabolism of the principal components (cis-chlordane, trans-chlordane, and heptachlor) results in the formation of the stable products, oxychlordane and heptachlor epoxide. These metabolites have been detected in the tissues of humans and wildlife.

Problem Identification

Chlordane was included on the original list of Puget Sound Dredged Disposal Analysis (PSDDA) chemicals of concern, with both a screening level and bioaccumulation trigger established. However, PSDDA restricted the definition of chlordane to its cis- (or alpha-) isomer (PSDDA, 1988).

In 2003 the DMMP agencies included chlordane on a revised list of bioaccumulative chemicals of concern (BCOC). But in this case it was defined as including cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, alpha-chlordene, gamma-chlordene and heptachlor (DMMP, 2003).

There are a number of problems that need to be addressed:

1. There has been some confusion as to whether the updated definition of chlordane is to be applied to sediment analysis as well as tissue analysis.
2. Heptachlor is already listed separately on the DMMP chemicals-of-concern list for sediment analysis and was placed on BCOC List 4 (not currently considered bioaccumulative contaminants) (DMMP, 2007).
3. Oxychlordane was not included on the list of chlordane components to be analyzed, even though it is a highly toxic metabolite likely to be present in tissue samples of aquatic organisms exposed to chlordane-contaminated sediment.
4. The standard material necessary to analyze for alpha-chlordene is difficult to get, expensive, and degrades quickly. Also, alpha- and gamma-chlordene are not typically found in sediment samples in Washington State (Mandjikov, 2007).
5. The Department of Ecology's Manchester Lab reports that PCB congener 153 and cis-nonachlor are difficult to separate when doing electron-capture-detector analysis. In most cases the level of PCB 153 (a major component of Aroclor 1254) is present at much higher levels than cis-nonachlor, effectively obliterating any evidence of the latter. Therefore, cis-nonachlor is typically reported as a non-detect at a reporting limit which may be 20 times or more the level of the major chlordane peak (Mandjikov, 2007). Labs with other instrument configurations may experience PCB interference with other of the minor chlordane components. The King County Environmental Lab reports PCB interference (particularly congeners in Aroclor 1254 and 1260) with both cis- and trans-nonachlor (Walker and Elliott, 2007).

The DMMP agencies recognize the need to clarify and standardize the reporting requirement for chlordane and ensure the requirement is consistent with other DMMP guidance and current science. The reporting requirement must also be compatible with the currently used analytical method.

Proposed Clarification

EPA SW 8081A (gas chromatography/electron capture) is the most commonly used method for the analysis of organochlorine pesticides in both sediment and tissue. Method 8081A provides three options for reporting chlordane:

1. As "technical chlordane" (CAS 12789-03-6) if the gas chromatograph (GC) peaks match the pattern for technical chlordane.
2. As "chlordane (not otherwise specified)" (CAS 57-74-9) if the GC peaks do not match that of technical chlordane.

3. As the major individual components under their respective Chemical Abstracts Service (CAS) numbers.

The DMMP agencies propose the following:

1. Replace "alpha-chlordane" with "total chlordane" on the DMMP COC list for sediments. The screening level and bioaccumulation trigger will remain at 10 and 37 ug/kg respectively. There is no maximum level for chlordane.
2. Analyze the same list of chlordane components and metabolites in both sediment and tissue.
3. Report the following components and metabolites of chlordane under their respective CAS numbers: cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor and oxychlordane.
4. Report "total chlordane" as the sum of the detected concentrations of these five chlordane components and metabolites. If all chemicals are undetected, report the single highest reporting limit of the individual chemicals (with the possible exception of elevated reporting limits caused by PCB interference – see #5).
5. When PCB interference causes one or more of the minor components of chlordane (cis-nonachlor, trans-nonachlor, oxychlordane) to be reported as non-detected at a reporting limit significantly higher than that of the major chlordane constituents (cis- and trans-chlordane), the DMMP agencies may exclude these components from the "total chlordane" definition in #4.
6. Continue to quantify heptachlor separately from total chlordane for comparison to sediment screening levels. While heptachlor remains on the DMMP's COC list for sediment analysis, it was reclassified to BCOC List 4 and is not considered a contaminant of concern for bioaccumulation by the DMMP.

Note: The metabolite heptachlor epoxide is currently on List 3 of the BCOCs (potentially bioaccumulative contaminants). Analysis of List 3 chemicals is not required at this time.

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