Interplay of Congeners and Total PCBs in Risk Assessment and Remedial Decisions

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ABSTRACT

Project Managers (PMs) at PCB contaminated sites are continuously evaluating the worth of congener-specific versus Aroclor sample analysis. As the project progresses, the available information and decision-making parameters change. Frequently at later stages of a project a PM wishes he/she would have done something different for analysis in the initial stages. Congener analysis during Aroclor analysis can be translated to congener concentrations. There are multiple RPs with distinguishable congener analysis for delineation and confirmation can be based on less specific analysis such as Aroclors summed total PCBs. Risk and allocation is best informed by congener analysis. There are means to translate between Aroclors and congeners given certain assumptions and uncertainties. Congener concentrations in Aroclor mixtures are reported by Rasch et al. 2004. Congener concentrations are best source of concentrations. Risk assessment to inform remediation decisions. Congeners = fewer assumptions = less uncertainty in risk potential which may reduce overall project cost. Use statistics to optimize sample numbers. Aroclor analysis for delineation. Selective split sample congener analysis. Congener data supports risk-based allocation and source fingerprinting. Congener analysis is best source of concentrations. Risk and allocation are best informed by congener analysis.

INTRODUCTION

TYPICAL PROJECT LIFE-CYCLE:

1. Define project scope, objectives, and goals.
2. Conduct site characterization.
3. Identified remedial goals.
4. Conduct remedial design.
5. Conduct remedial construction.
6. Post-construction monitoring.

1. Delineation and characterization of chemicals
2. Risk assessment to inform remediation decisions
3. Project design, implementation, and confirmation
4. Allocation of remediation costs

RESULTS

RISK DETERMINATION
CONGENER ANALYSIS INFORMS RISK:
• PCB congener toxicity due to ‘Dioxin-like’ mode of action
• 12 of 209 congeners are dioxin-like
• Potency of congeners varies
• WHO developed system for expressing toxicity of a mixture of congeners as a single number – the toxic equivalency factor (TEQ)

MASS AND TOXICITY ARE NOT EQUIVALENT:

CONCLUSIONS

CONGENERS = FEWER ASSUMPTIONS = LESS UNCERTAINTY IN RISK POTENTIAL WHICH MAY REDUCE OVERALL PROJECT COST

CONGENER DATA SUPPORTS TOXICITY-BASED ALLOCATION:

• Allocation can be mass or toxicity based
• Congener concentrations are needed to calculate dioxin-like toxicity
• Congener analysis is best source of concentrations
• Aroclor analysis can be translated to congener concentrations

SPLIT SAMPLE ANALYSIS FOR AROCLORS

• Use early risk calculations to inform risk assessment and allocation
• Use limited congener analysis from delineation to do calculations to frame decisions
• Expand split sample and congener analysis if warranted (may include biota sampling)
• High data density can be costly, but very little costs more than errors in remedy decisions
• Use statistics to optimize sample numbers
• Limit cost by using Aroclor analysis

Delineation and characterization of chemicals

- Found PCBs + Aroclors are fine for delineation. Consider also analyzing a subset of samples for congeners if risk assessment will be needed.

Risk assessment to inform remediation decisions

- Congeners = fewer assumptions = less uncertainty in risk potential which may reduce overall project cost.

Project design, implementation, and confirmation

- Aroclor-based total PCBs are sufficient for remediation activities, but how many samples?

Allocation of remediation costs

- Congener data supports risk-based allocation and source fingerprinting.

Optimizing Spend:

- Aroclor is the typical analysis
- Congener analysis done less frequently

- Aroclors can be summed to get Total PCBs
- Congeners can be summed to get Total PCBs

- Limits the understanding of toxicity
- Better basis for toxicity evaluation and source fingerprinting

Stats optimize sampling during PDM:

- Statistical analyses can be performed to understand decision errors associated with differing sample densities.

Key Messages

- Different project stages can be adequately informed by different PCB quantification methods.
- Delineation and confirmation can be based on less specific analysis such as Aroclors summed total PCBs.
- Risk and allocation is best informed by congener analysis.
- There are means to translate between Aroclors and congeners given certain assumptions and uncertainties.

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Figures:

- Zoomed in to show toxic congeners
- Bar graph showing toxic congeners

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