

**March 2007**  
**Science Advisory Board (SAB) Review of**  
**Issues Related to Certain Chemical Mixtures**

**Background**

The Department of Ecology (Ecology or department) has begun a rulemaking process to amend the Model Toxics Control Act (MTCA) Cleanup Regulation (Chapter 173-340 WAC). This rulemaking will clarify the policies and procedures for establishing cleanup levels for mixtures of polychlorinated dibenzo-p-dioxins/ polychlorinated dibenzofurans (dioxins and furans), polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs).

**Revised Questions and SAB Responses (Through the 12/11/2006 Board Meeting)**

The department identified a series of questions for the Board's review prior to the September 15, 2007, Board meeting. Based on the Board's review, Ecology reorganized and modified the list of questions. The Board discussed the modified list of questions at the October 23 and December 11, 2007, Board meetings. The revised questions and the status of the Board's review are summarized below.

**Mechanism of Action/Mode of Action**

Ecology is planning to modify the MTCA rule to state that cleanup levels for certain types of mixtures (for example, dioxins/furans and PAHs) should be established using a cancer risk level of one-in-a-million ( $10^{-6}$ ). Under this approach, these mixtures would be treated as if they were a single hazardous substance when establishing cleanup levels and remediation levels. One of the foundations for this policy decision is the conclusion that individual members of different chemical families act through a common biological mechanism of action.

- **Dioxins/Furans**: Is the conclusion that dioxin and furan congeners in the 2,3,7 & 8 positions act through a common mechanism of action consistent with current scientific information?

***SAB's Response:*** *The Board stated that it is reasonable to conclude the 17 dioxin and furan congeners with chlorine atoms in the 2,3,7 & 8 positions act through a common biological mechanism of action (that is binding to the Ah receptor) (National Academy of Science (NAS), 2006; Van den Berg, et al. 2006; EPA, 2003). The Board noted that it was fortuitous that the Environmental Protection Agency (EPA), the NAS, and the World Health Organization (WHO) had recently completed reports that support this conclusion.*

- **Carcinogenic PAHs**: Is the conclusion that carcinogenic PAHs listed in the proposed rule act through a common mechanism of action consistent with current scientific information?

***SAB's Response:*** *The Board stated that it is reasonable to conclude that carcinogenic PAHs listed in the proposed rule act through a common biological mechanism of action (California EPA, 2005; EPA, 1993; NTP, 2005).*

- **Dioxin-Like PCBs**: Is the conclusion that dioxin-like (coplanar) PCBs act through a common mechanism of action consistent with current scientific information?

***SAB's Response:*** *The Board stated that it is reasonable to conclude that dioxin-like (coplanar) PCBs act through a common biological mechanism of action (such as binding to the Ah receptor) (NAS, 2006; Van den Berg, et al. 2006; EPA, 2003). The Board stated that it was fortuitous that the EPA, the NAS, and the WHO had recently completed reports that support this conclusion.*

- **Other Chemical Groups:** Are there other chemical groups where current scientific information supports a conclusion that individual members of the group act through a common mechanism of action, and for which there is enough information to establish Toxic Equivalency Factors (TEFs) for these chemical groups?

***SAB's Response:*** *The Board concluded that there is at least one other chemical group where individual members of the group appear to act through a common mode of action. For example, the Board noted that organophosphate pesticides are known to act on the nervous system through a common mode of action. However, the specific mechanism of action is unknown. The Board concluded that available scientific information is insufficient to support using a TEF approach at this time for other chemical groups<sup>1</sup>. In the future, the Board suggested that Ecology may want to consider additional rule language that anticipates the use of TEFs for other chemical groups should sufficient information be developed to support this approach.*

### **Toxic Equivalency Factors**

Ecology is planning to use the 2005 Toxicity Equivalency Factors recommended by the World Health Organization (WHO) (Van den Berg et al. 2006) when establishing and evaluating compliance with cleanup levels and remediation levels for dioxin and furan mixtures and dioxin-like PCBs.

- **TEFs for Dioxins/Furans:** Are the 2005 TEF values recommended by the WHO for dioxins and furans consistent with current scientific information?

***SAB's Response:*** *The Board stated that the 2005 TEF values for dioxin and furans recommended by the WHO are consistent with current scientific information. As noted above, the Board stated it was fortuitous the WHO had recently completed a review and evaluation of available scientific information which resulted in updated TEF values for dioxins and furans.*

- **TEFs for Dioxin-Like PCBs:** Are the 2005 TEF values recommended by the WHO for dioxin-like PCBs consistent with current scientific information?

***SAB's Response:*** *The Board stated the 2005 TEF values for dioxin-like PCBs recommended by the WHO are consistent with current scientific information. As noted above, the Board stated it was fortuitous the WHO had recently completed a review and evaluation of available scientific information which resulted in updated TEF values for dioxins and furans.*

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<sup>1</sup> Several other chemicals are capable of binding and activating the Ah receptor. These include industrial chemicals (for example polyhalogenated biphenyls, halogenated naphthalenes, chlorinated paraffins), pesticides (e.g. hexachlorobenzene) and flame retardants (brominated dioxins, dibenzofurans, biphenyls, diphenyl ethers and naphthalenes). Van den Berg et al. (2006) concluded that there is insufficient information to establish TEF for these compounds.

### **Potency Equivalency Factors**

Ecology is planning to use the 2005 Potency Equivalency Factors (PEFs) recommended by the California Environmental Protection Agency (Cal EPA, 2005) when establishing and evaluating compliance with cleanup levels and remediation levels for carcinogenic PAH mixtures. This would be an update of the Cal EPA factors previously addressed in a Board recommendation.

- **PEFs for Carcinogenic PAHs:** Are the 2005 PEF values recommended by the California Environmental Protection Agency consistent with current scientific information?

***SAB's Response:** The Board stated that 2005 PEF values for carcinogenic PAHs recommended by the Ca EPA are consistent with current scientific information. As with dioxins and furans, the Board stated it was fortuitous the California EPA had recently completed a review and evaluation of available scientific information and published updated PEF values for carcinogenic PAHs. The Board noted that Cal EPA considered a wide range of studies when establishing PEF values. The Board also observed the California document describing the methodology provides information useful for Ecology as it proceeds with the MTCA rule update.*

### **Relative Bioavailability of Dioxin and Furans in Soil**

The MTCA Cleanup Regulation establishes methods for calculating soil cleanup levels based on direct contact with contaminated soils. The methods include default assumptions for gastrointestinal absorption fraction, default assumptions for dermal absorption fraction, and provisions for modifying the default assumptions on a site-specific basis. In the current MTCA rule, the default assumptions for dioxin/furan mixtures are: (1) 100% of soil-bound dioxins and furans are absorbed into the body when soil is ingested; and (2) 1% of soil-bound dioxin and furans are absorbed through the skin when soil adheres to hands, arms or other parts of the body.

- **Default Gastrointestinal Absorption Fraction for Soil-Bound Dioxin/Furan Mixtures:** Ecology is considering establishing a default gastrointestinal absorption factor for dioxin/furan mixtures equal to 0.4. Is this default value consistent with current scientific information?

***SAB's Response:** The Board reviewed this question and reached these conclusions:*

- *It is important to consider the absorption of dioxins and furans in soils relative to the amount of absorption in the toxicological studies that were used to establish the cancer slope factors and reference doses.*
- *Based on available scientific information, it is reasonable to assume test animals absorbed 80% of the administered dose in the toxicological study used to establish the cancer slope factor for dioxins and furans.*

*However, the Board did not reach a conclusion on whether it was reasonable to use a 30% absorption value for soil-bound dioxins and furans. The Board requested that Ecology provide additional information on EPA's basis for recommending this value. (See separate discussion paper prepared for March 19, 2007, Board Meeting.)*

- Default Dermal Absorption Fraction for Soil-Bound Dioxin/Furan Mixtures: Ecology is considering establishing a default dermal absorption factor dioxin/furan mixture equal to 0.03. Is this value consistent with current scientific information?

***SAB's Response:*** *The Board concluded that using a default dermal absorption value was consistent with current scientific information and regulatory guidance (NRC, 2003; EPA 2003).*

### **Risk Characterization and Regulatory Implementation Issues**

- Application to Soil and other Abiotic Media: Ecology is planning to continue to use the TEF and PEF values when establishing and evaluating compliance with cleanup levels and remediation levels for abiotic media (such as soil). Is this approach consistent with current scientific information?

***SAB's Response:*** *The Board concluded it is appropriate to continue to use the TEF and PEF values when establishing and evaluating compliance with soil cleanup levels provided that Ecology considers the relative bioavailability of soil-bound contaminants (relative to bioavailability in relevant toxicological studies). The Board noted that this is consistent with the report and recommendations prepared by the World Health Organization (Van den Berg, et. al. 2006).*

- Cross-Media Transfer – Dioxin/Furans: Ecology is planning to require cleanup proponents use congener-specific physical/chemical properties when evaluating the cross-media transfer (such as soil to ground water) of mixtures of dioxins, furans and/or polychlorinated biphenyls. Is this approach consistent with current scientific information?

***SAB's Response:*** *The Board concluded it is appropriate and consistent with current scientific information to incorporate congener-specific physical/chemical properties when evaluating the cross-media transfer of dioxin/furan mixtures.*

- Cross-Media Transfer – Carcinogenic PAHs: Ecology is planning to require that cleanup proponents use PAH-specific physical/chemical properties when evaluating the cross-media transfer (such as soil to ground water) of carcinogenic PAH mixtures. Is this approach consistent with current scientific information?

***SAB's Response:*** *The Board concluded that it is appropriate and consistent with current scientific information to incorporate PAH-specific physical/chemical properties when evaluating the cross-media transfer of carcinogenic PAH mixtures.*

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## References

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