Advances in Bioaccumulation Assessment: Cross-sector Development of a Tiered Approach

Background

Challenging the paradigm**: "Bioaccumulation potential ('B') can be estimated by a chemical's Kow value."**

There are more than 100,000 chemicals in commerce globally. How many fit into that paradigm? What about lipophilic chemicals that are negatively charged, or large? Biotransformable substances? Molecules with weird groups on them that look nothing like the chemicals we in SETAC usually study? Recent efforts through the chemical management program in Canada surprised us all by revealing that many of the world's commercial chemicals do not fit into this paradigm, so it's harder to label the substance as a concern, or not. 'B' has become a huge and urgent challenge for the scientific and regulatory community to tackle, and new partnerships across disciplines, and entities like SETAC and HESI,,are focusing on advancing "B" science and keeping connected.

Although regulators and manufacturers use aquatic bioaccumulation potential to prioritize chemicals for risk evaluation and management, the resources involved with getting the data appear insurmountable, unless we can reasonably revise what we think we need. New national laws resulting from enactment of the United Nations Stockholm Convention (a.k.a. The POPs Protocol) in 2005 have led to significant new activity in the assessment of Persistent, Bioaccumulative, Toxic substances (PBTs). Canada is the first country to review its ~22,000 existing commercial substances for PBTs characteristics; they must publicly post their final list of substances that will undergo screening level risk assessment by September 2006. The REACh effort in Europe, although not fully dimensioned, is likely to expand this effort, as will the integration of PBT evaluation into reviews of new substances in the US, Japan, and Australia. Because bioaccumulation data are scarce relative to toxicity and biodegradation data, 99% of the preliminary bioaccumulation assessments in Canada have had to rely on QSAR and K_{OW}-based model estimates for fish. There is uncertainty in the assessments, as some chemical classes are outside the domain of some models used for evaluations, and others models do not have known domains. For example, initial results from the BCF models used in Canada found either 700 or 3000 discrete organics are potentially 'B', depending on the model used. Based on a pilot exercise, just collecting the data for 3000 categorized chemicals will require approximately 200 man years of effort. If we conduct the only internationally accepted B test (OECD 305) on the anticipated 3,025 PBTs in Europe, costs could exceed $378 million and 326,700 fish. The push for more data to understand PBT profiles is being met by animal welfare organizations, actively working to reduce or eliminate testing of vertebrates, including fish.

Therefore, there is a critical need to develop alternative approaches to investigate thousands of chemicals that require evaluation in the next 5 to 15 years. Methods using aquatic and mammalian species that focus on absorption, distribution, metabolism and excretion (ADME) are being explored, because bioaccumulation is the culmination of these multiple physiological processes and not solely based on a chemical's lipophilicity. New approaches under evaluation need to be verified and standardized. Development of, and international consensus on, a framework for using tiers of information will be critical to the advancement of a 'B' assessment. Determining what pieces of information are necessary and how they fit together to build a weight of evidence that guides further testing, and integration of data across tiers, is also important long term to meet regulatory deadlines, cost, and animal welfare concerns.

ILSI-HESI Emerging Issues Committee on Bioaccumulation Assessments

3 Workshops: Organizing Committee members
Annie Weisbrod (co-chair), Procter & Gamble
Mark Bonnell (co-chair), Environment Canada, New Substances
Jon Arnot, Trent University
Todd Bridges, US Army Corps of Engineers
Lawrence Burkhardt, US EPA Env Effects Research
Watze deWolf, DuPont
Scott Dyer, Procter & Gamble
*Susan Erhardt, Dow Chemicals
Phil Howard, Syracuse Research Corporation
Duane Huggett, Pfizer
Scott Jackson, BASF
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*John Nichols, US EPA Env Effects Research Lab
*Tom Parkerton, ExxonMobil Biomedical Sciences
Dan Salvito, Research Institute for Fragrance Materials
Irv Schultz, Pacific Northwest National Laboratory (Battelle)
Helmut Segner, University of Bern, Switzerland
Jose Tarazona, INIA (National Institute for Agriculture, Spain)
Roy Thompson, AstraZeneca
*Theo Traas, RIVM (Dutch Institute for Public Health & Enviror
*Kent Woodburn, Dow Chemicals
Andrew Worth, EU Chemicals Bureau - Joint Research Center

*Workshop co-chairs.

Tiered approach for 'B' assessment: *future* systems need work

Low Tier : BCF models (BCFWIN, POPs, Gobas)

Huge gap

future

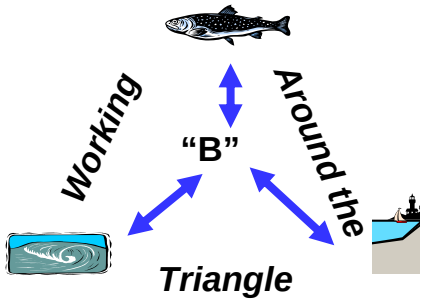
Low Tier : a) phys-chem analyses; literature searches: reapply fish & mammal data, b) ADME, BCF, BAF, BSAF models

Mid Tier : *In vitro* methods to evaluate ADME properties & cell accumulation

High Tier: Modified *in vivo* methods to measure BCF, BAF, BMF, BSAF

High Tier: Standard OECD 305 Bioconcentration factor (BCF) test

Reality: Field monitoring of "B", trophic transfer, biodilution



The "B" SAG: SETAC Advisory Group on Bioaccumulation Assessments

The purpose of the global 'B' SAG is to advance the state of bioaccumulation science, and increase the use of sound science in decision-making through the use of models, *in vitro*, and *in vivo* data for bench-scale, site-specific and regional bioaccumulation assessments.

Considered by SETAC World Council, 13 November 2005.
Organizers.
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Annie Weisbrod, Procter & Gamble, USA

Some Next Steps

- **Identify more collaborations for method development**
- **Publish posters & platforms from SETAC-NA Annual Meeting in "Advances in Bioaccumulation Assessment"**
- **Contribute to manuscript on alternative 'B' testing from ECETOC PBT task force.**
- **Publish Workshop Report from ILSI-HESI *In Vivo* Bioaccumulation Database Workshop (Nov 11-12, 2005, Baltimore, MD with SETAC)**
- **Hold ILSI-HESI ADME / *In Vitro* Tests for Bioaccumulation Assessments Workshop (Mar 3-4, 2006, San Diego, CA with SOT)**
- **Hold ILSI-HESI Tiered Approach for Bioaccumulation Assessments Workshop (May 2006, Netherlands with RIVM and ECB)**
- **Present at PBT Session (ER13) at SETAC-EU Annual Meeting (May 2006, The Hague)**

2005 SETAC-NA Annual Meeting, Baltimore MD USA