Evaluation of the Interstate Chemicals Clearinghouse (IC2) Alternatives Assessment Guide

April 21, 2015

Washington State Department of Ecology
ToxServices LLC
In January 2014, the Interstate Chemicals Clearinghouse (IC2) completed the IC2 Alternatives Assessment Guide (the IC2 Guide).

In order to evaluate the effectiveness of the IC2 Guide, the Washington Dept. of Ecology funded a project to conduct alternatives assessments using the three frameworks described in the Guide.

A team led by ToxServices (ToxServices, Massachusetts Toxics Use Reduction Institute (“TURI”), and Abt Associates) completed three independent alternatives assessments using each of the frameworks described in the IC2 Guide.

These alternatives assessments were designed to evaluate the usability of the Guide and provide recommendations for improvements.

In this webinar, Dr. Alex Stone (Washington State Department of Ecology) and Dr. Margaret Whittaker (ToxServices LLC) will present the results of the pilot project.
Today’s Objectives

- Understand the purpose of the Ecology pilot project
- Review IC2 Alternatives Assessment Guide
- Understand the process for conducting the Ecology pilot project
- Review results of the pilot project
- Review challenges and lessons learned
- Become familiar with recommended improvements to the IC2 Guide
Goals of Project

• Evaluate the usability of the IC2 Guide while developing a basis for a future, detailed assessment of alternatives to copper anti-fouling paint

• Provide feedback on usability and recommend improvements to the IC2 Guide

• Create Uniform Data Set for use in Alternative Assessments and conduct GreenScreen® Chemical Hazard Assessments that will be publically available through the IC2 website
Background for Project

• Copper contamination is a major concern in the Puget Sound region


• Alternatives to copper containing boat paints include both zinc and organic biocide paints, as well as nonbiocide paints
Framework: Core Elements of a Chemical Alternatives Assessment (CAA)

- CAAs focus on finding alternative chemicals, materials and/or product designs to substitute for the use of hazardous chemicals

- **Goal of CAA**: To find a science-based solution that identifies and completely characterizes chemical hazards, promoting the selection of less hazardous chemical ingredients, in addition to avoiding unintended consequences of switching to a poorly characterized chemical substitute
Ecology Project Scope

• Task 1 – Prepare Uniform Data Set of chemicals to feed into an AA

• Tasks 2-4 – Apply IC2 AA frameworks to select alternative(s) paints in lieu of copper based anti-fouling paint

• Task 5 – Provide feedback on usability and recommendations for improvement to IC2 Guide
Overview of the IC2 Guide

• The IC2 Guide was issued in 2014 and provides guidance on how to perform an Alternatives Assessment (AA)

• The IC2 Guide includes three AA models:
  – Sequential AA Framework
  – Simultaneous AA Framework
  – Hybrid AA Framework

• The IC2 Guide can be downloaded from the IC2 website at no charge:
  www.theic2.org
Overview of the IC2 Guide, ctd.

- Five Steps to an IC2 AA

1. Identify Chemical of Concern (outside scope)
2. Initial Evaluation
3. Scope AA
   - Stakeholder
   - Decision Framework
4. Identification of Alternatives
5. Assess Alternatives
   - Recommended Modules
   - Optional Modules
Overview of the IC2 Guide, ctd.

• Each IC2 AA framework includes four basic modules
  – Hazard
  – Performance
  – Cost and Availability
  – Exposure Assessment

• Additional framework modules are also available and can be incorporated at the discretion of the user, e.g.,
  – Materials Management
  – Social Impact
  – Life Cycle

• IC2 “Golden Rule”: Regardless of which framework is used, AA objectives must be met – to replace chemicals of concern used in products or processes with safer alternatives
Scope of ToxServices Pilot Project

• The pilot is designed to test the usability of the IC2 Guide while developing a basis for a future, detailed assessment of alternatives to copper antifouling paints

• The Pilot Project comprised five major tasks that the ToxServices’ Team completed for Washington State Department of Ecology
  – Under Task 1, ToxServices created a Uniform Data Set (UDS) and assessed hazards posed by individual chemicals in seven paint formulations
  – Under Tasks 2, 3, and 4, three independent groups completed an AA using the three AA frameworks described in the IC2 Guide
  – Under Task 5, three independent organizations met to share results and challenges and worked collaboratively to offer recommendations for improving the IC2 Guide

• Caveat: These AAs were not created with the intention of being used as standalone AAs for copper antifouling paint, and the results of each framework AA should not be interpreted as a comprehensive AA

• The ToxServices Pilot Project Report can be accessed via the IC2 website:
  http://theic2.org/alternatives_assessment_guide
### Project Scope, ctd.

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| Tasks 2 through 4: Draft Alternatives Assessments of Copper Boat Paint Using the Uniform Data Set and Three Frameworks |
|====================================================================================================================|
| Task 2: Conduct AA using the Sequential Framework               | Task 3: Conduct AA using the Simultaneous Framework               | Task 4: Conduct AA using the Hybrid Framework                   |
| ToxServices                                                     | Abt Associates                                                   | Abt Associates                                                  |
| **October - December 2014**                                    | **December 2014**                                               | **February 2015**                                              |

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Creation of the Uniform Data Set (UDS) (Task 1)

To identify alternative paints to assess, ToxServices referenced two reports:

1. **Safer Alternatives to Copper Antifouling Paints: Nonbiocide Paint Options (CalEPA 2011)**
   - Prepared by Institute for Research and Technical Assistance (IRTA) for CalEPA’s Department of Toxic Substances Control
   - 46 paints were evaluated, which included biocide paints based on copper and zinc, as well as nonbiocide paints

2. **Safer Alternatives to Copper Antifouling Paints for Marine Vessels (U.S. EPA 2011)**
   - Prepared by IRTA and the Unified Port of San Diego for the U.S. EPA
   - A few nonbiocide paints from the U.S. EPA (2011) report were further evaluated on panels and boat hulls, and the results were documented in the CalEPA (2011) report

Hazard assessment was **not** part of the scope of the above reports; therefore, ToxServices conducted hazard assessments for use in the three AAs.
The six paints chosen by the ToxServices’ Team as viable alternatives were those that had the best performance in the two reports:

- **Control Paint**: Kop-Coat, Inc.’s Pettit Marine Paint Trinidad Pro Antifouling Bottom Paint 1082 Blue
- **Alternative 1**: Kop-Coat, Inc.’s Klear N’ Klean Plus XP-A101 White Topcoat
- **Alternative 2**: International Paint LLC’s Intersleek 900 System
- **Alternative 3**: International Paint LLC’s XZM480 International
- **Alternative 4**: BottomSpeed Coating System’s BottomSpeed TC Base Coat/Top Coat Clear
- **Alternative 5**: Hempel (USA), Inc.’s Hempasil XA278
- **Alternative 6**: FUJIFILM Hunt Smart Surfaces, LLC’s Surface Coat Part A – Black

All 6 alternative paints were soft, nonbiocide paints

- Nonbiocide paints fall into one of two categories: soft nonbiocide or hard nonbiocide. A soft nonbiocide is described as a silicon or fluoropolymer paint, vs. a hard nonbiocide that is defined as a ceramic or epoxy type paint

Ingredients in five other paint formulations were disclosed through Material Safety Data Sheets (MSDS).

### Seven Paint Formulations Comprising ToxServices’ Uniform Data Set

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Creation of the Uniform Data Set (Task 1), ctd.

- Hazard data were taken from ToxServices GreenScreens®
- Performance, cost/availability, and exposure data were drawn from the CalEPA and U.S. EPA reports
- The combination of all data resulted in the creation of the ToxServices’ Uniform Data Set, a >1,000 page report
  - The UDS was then fed into subsequent AAs
ToxServices performed a series of hazard evaluations of all 50+ chemicals in the copper-based and 6 alternative paint formulations to create the Uniform Data Set:

- Step 1: Apply GreenScreen® List Translator (Initial Screen)
- Step 2: Perform hazard assessment based on GreenScreen® methodology (Level 2)
- Step 3: Expand hazard assessment based on GreenScreen® methodology (Level 3)
- These hazard assessments were compiled into the ToxServices UDS report.
Results of UDS Hazard Evaluation

GreenScreen® List Translator Evaluation of Each Chemical

Outcome: LT-1
Score: Benchmark-1* (Hazard table with scores from LT search and environmental toxicity and fate endpoints)
Environmental Toxicity and Fate Evaluation

Outcome: LT-P1
Score: Benchmark-1* (Hazard table with scores from LT search and environmental toxicity and fate endpoints)
Environmental Toxicity and Fate Evaluation

Outcome: LT-U
Score: Benchmark-U, 1, 2, 3, or 4 (Hazard table with scores for all endpoints)

Targeted GreenScreen®

IC2 Guide calls for progressively more rigorous hazard screening
Tasks 2 through 4 of the Project: Conducting AAs

- Results of Task 1 were “fed” into Tasks 2, 3, and 4 AAs
- Under Tasks 2, 3, and 4, three groups completed an AA:
  - The three IC2 AA frameworks share 4 modules: Hazard, Performance Evaluation, Cost and Availability, and Exposure Assessment
  - Three additional IC2 modules (Materials Management, Social Impacts, and Life Cycle) were implemented in the Hybrid Framework to see whether they affected results of an AA
Overview of IC2 Sequential Framework

• Performed in a linear order
• After each module, alternative paint formulations binned as:
  • Unfavorable
  • Less favorable
  • Favorable
• Less favorable and favorable formulations proceed to next module
The IC2 Sequential Framework resulted in the selection of 3 of 6 paints being viable alternatives to the copper-based control paint:

- Intersleek 900 System
- BottomSpeed TC Base Coat/ Top Coat clear
- Surface Coat Part A – Black
Overview of IC2 Simultaneous Framework

- Data are collected and assessed for all formulations using all 4 modules
- Modules performed simultaneously
- Modules weighted by alternatives assessors
  - Hazard = highest weight
  - Performance, Cost & Availability, Exposure = weighted equally
- Directly compared results of each module
Results of IC2 Simultaneous Framework

- One paint was selected as viable alternative:
  - Surface Coat Part A – Black

- Two caveats:
  - The Surface Coat Part A – Black formulation poses significant environmental hazards (12% of ingredients are BM-1 or LT-1)
  - Secondly, there are significant gaps in formulation (<100% disclosure)

### Key Findings

<table>
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<th>Module</th>
<th>Findings</th>
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| Hazard Module | Compared the percent of Benchmark 1 chemicals in formulation among all paints  
- **Surface Coat Part A**: Lowest percentage of Benchmark 1 chemicals  
- **BottomSpeed & XZM480**: Large range in the total percent of Benchmark 1 chemicals  
- **Intersleek 900 & Hempasil**: Roughly equal or potentially greater percentage of Benchmark 1 chemicals compared to the control paint. Both have a large amount of undisclosed ingredients  
- **Klear N’Klean**: Similar percentage of Benchmark 1 chemicals to the control paint |
| Performance Evaluation Module | **Klear N’ Klean, Intersleek 900, BottomSpeed, Hempasil, Surface Coat Part A**: Performance is roughly equivalent (or non-differentiating) among the control paint and these alternatives  
- **XZM480**: Did not perform as well relative to the control paint and other alternatives |
| Cost and Availability Module | **Intersleek 900, BottomSpeed**: Commercially available, favorable in terms of cost compared to copper paint  
- **Klear N’ Klean, XZM480, Hempasil**: Not commercially available  
- **Surface Coat Part A**: Commercially available, unfavorable in regards to cost and availability because there is little to no cost data |
| Exposure Assessment Module | All Alternatives: Difference among the use and physical characteristics are not substantive  
- All Alternatives: Preferred in regards to exposure given they are not designed to release chemicals the way copper paint is designed.  
- A Level 1 assessment was not conducted. |

### Decision Analysis

- Results of Hazard Module are given the highest priority  
- Performance, Cost and Availability, and Exposure Assessment are equally prioritized

**Result:** Surface Coat Part A is selected as the preferred alternative
Overview of IC2 Hybrid Framework

- Combines elements of Sequential and Simultaneous Framework
  - Hazard and Performance Evaluation Modules performed sequentially
  - Cost and Availability and Exposure Assessment Modules performed simultaneously
- Three optional modules conducted:
  - Materials Management Module
  - Social Impacts Module
  - Life Cycle Module
Results of Hybrid Framework

One paint was selected as viable alternative:

- BottomSpeed TC Base-Coat/ Top-Coat Clear
**Task 5: Comparison of Results from All IC2 AAs**

Under Task 5, the three independent groups comprising the ToxServices Team met to share results and challenges in completing the AAs and worked collaboratively to summarize findings and offer recommendations for improving usability of the IC2 Guide.

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Comparison of AA Frameworks: Similarities

• Hazard
  – GreenScreen® Benchmark 1 Chemicals eliminated as part of all AAs

• Performance Evaluation
  – Similar results were obtained in all three frameworks for the Performance Evaluation Modules with the exception of one alternative due to peeling (XZM480 International)

• Cost and Availability
  – Cost was roughly equivalent for all paint formulations when considering annualized costs

• Exposure Assessment
  – Exposure potential was also non-differentiating among the alternatives
Comparison of IC2 AA Frameworks: Differences

• **Hazard**
  – Decision-making approaches
    • Additional decision-making rules had to be applied
    • Approaches varied by assessor
  – While each assessor used the UDS when completing the Hazard Module, they used different approaches to assess hazard for decision-making
    • Because all alternatives contained Benchmark 1 chemicals, assessors could not use Benchmark 1 chemicals as a way to differentiate alternatives
  – For example, Assessors of the Sequential Framework considered drivers behind the Benchmark 1 score
    – Chemicals with Benchmark 1 scores driven by environmental toxicity and fate were considered, followed by Benchmark 1 scores driven by human health
Comparison of IC2 AA Frameworks: Differences

• Data Gaps
  – Alternatives Assessors handled data gaps differently
    • This is the primary reason for the different results between the Sequential and Simultaneous Frameworks
    • Under the Sequential Framework, data gaps were noted, but alternatives were not penalized if they lacked complete information
    • Under the Simultaneous Framework, unidentified chemicals and Benchmark U chemicals in each formulation were assigned Benchmark 1 scores
    • Assessors of the Hybrid Framework implemented their own method as a first step in the Hazard Module to remove any formulations without adequate disclosure
Comparison of Results from all IC2 AA Frameworks: Framework-Level Challenges

• Framework-level challenges
  • Sequential Framework:
    • How to deal with multiple alternatives remaining after assessment?
    • Binning/ ranking alternatives after each module vs. end of the AA framework
  • Sequential and Hybrid Framework:
    • How to implement Decision Methods?
Comparison of Results from all AA Frameworks: IC2 Guide Module-Level Challenges

- Hazard Module:
  - The greatest number of challenges was associated with the Hazard Module, which consists of two parts: hazard evaluation and assessing hazard for decision-making
  - No guidance for assessing hazard for decision-making if all chemicals are GreenScreen® Benchmark 1 (meaning “avoid”)
  - IC2 Guide does not address incomplete formulation disclosure
  - Lack of guidance in all core modules for product-level AAs

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| **Performance Evaluation** | Lacks direct guidance for product-level Alternatives Assessments  
Unclear why availability is considered in this module (versus in Cost and Availability Module)  
Unclear in Question 2 if alternatives no longer commercially available should continue through the module |
| **Cost and Availability** | Lacks direct guidance for product-level Alternatives Assessments  
Unclear on how to address gaps in cost and availability data |
| **Exposure Assessment** | Lacks direct guidance for product-level Alternatives Assessments  
Unclear in Question 1 in Initial Screen on which criteria to include and from where to gather the necessary information  
Unclear in Questions 2 and 3 in Initial Screen on what is meant by “manufacturing criteria” – Assessors are told to refer to the Performance Evaluation Module but this term is not used or defined there |
| **Materials Management** | Unclear on how to integrate and assess data obtained through the process of answering the questions |
| **Social Impact** | Incorrect table numbers are referenced in the text  
Unclear on the scope of the Level 1 assessment. The Level 1 assessment fluctuates from the “area surrounding the factory or facility producing the product” to “across the product life cycle”  
Difficult to understand concerns associated with all items listed in tables (e.g., demographics) |
| **Life Cycle** | Duplicative in content of other optional modules – e.g., assessing climate change-related impacts which are included in the Materials Management Module  
Difficult to complete as standalone module since questions often refer to other modules  
Unclear when to exit the module |
Lessons Learned from Pilot Project

• Although preferred alternatives were identified – the pilot did not identify a good alternative to copper antifouling paint
  • All paints contained chemicals that pose human health and environmental concerns
  • Uncertainty in data due to incomplete formulation disclosure

• Key question: What constitutes a preferable alternative?

• IC2 Guide is valuable resource and flexible meet needs of a range of users
  • Requires some degree of technical expertise, particularly Hazard and Exposure Assessment modules
ToxServices Team’s Recommendations to Improve Usability of IC2 Guide

• Technical edits
  – Focus the text, reduce repetition, and improve readability

• Terminology consistency and expanded glossary
  – Different terminology is often used to describe the same thing: Examples include the use of “framework” vs. “method,” “decision method” vs. “decision criteria” vs “multi-parameter analysis”
  – Same terminology is used to describe different things: For example, use of the term “favorable” in relation to the binning of alternatives across modules implies equivalence in some cases and superiority in others when compared to the control

• Improve organization of the IC2 Guide
  – Currently, it is difficult to know what sections to read in the IC2 Guide and in what order
  – We recommend that the 5 steps of an AA drive the organization of the IC2 Guide so that the process is logical and orderly: Identify chemicals of concern, Initial evaluation, Scoping, Identification of alternatives, and Evaluation of alternatives

• Navigation improvements
  – Insert more hyperlinks and Improve maneuverability of document
    • Flow charts, appendices, and figures should be interactive (e.g., with hyperlinks to each module within the framework flow charts)
Technical Recommendations

- Clarify scope of IC2 Guide
  - Additional guidance on defining scope of an AA
- Evaluate availability of alternatives up-front
- Additional guidance on framework selection
  - Pros and cons of each AA framework should be presented and explained
- Additional guidance on decision-making modules need to be applicable to both chemical and product-level assessments
- Improve independence of additional modules
  - If an AA is completed using the four core modules, other users within the member states should be able to implement additional modules on the same assessment without needing to repeat the four core modules
  - This would be challenging following the current IC2 Guide
    - For example, there is repetition in the Life Cycle Module, which refers the assessor back to the Cost and Availability, Social Impact, and Materials Management Modules
    - For example, in Pilot’s Hybrid Framework AA, which included the three optional modules, the assessor found that once the Social Impact and Materials Management Modules were completed, the Life Cycle Module was largely repetitive
1. **Enhance effectiveness of Hazard Module**
   - Provide guidance on how to use GreenScreen® Benchmark scores and the hazard data that support the scores to differentiate among alternatives
   - Opportunities for green chemistry innovation should be called out in the Hazard Module for scenarios where the design of safer alternatives is warranted

2. **Expand guidance on decision-making**
   - Provide guidance on how to create decision rules
   - How to prioritize trade-offs applicable to both chemical and product-level assessments

3. **Improve organization and flow of the IC2 Guide**
   - Reorganize and enhance content based on 5 distinct steps of an alternatives assessment
Next Steps for the IC2 AA Guide

- IC2 AA Sub-committee will discuss recommendations
- Separate recommendations into three groups
  1. Easily implemented
  2. Outside of ability to implement
  3. Presented to Technical Advisory Group to discuss implementation
- Discuss recommendations with IC2 Governing Council
- Reconvene Technical Advisory Group later this summer
- Update document to reflect changes tentatively by end of 2015
Thank You!

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