Simplified and Now User-Friendly! Updating bio-met for better risk assessment

Iain Wilson[1], Graham Merrington[1], Adam Peters[1], Elizabeth Middleton[2], Chris Cooper[3], David Boyle[4], Stijn Baken[5], Jasim Chowdury[6] and Charlotte Nys[7]

[1]wca environment Ltd., UK, [2]NiPERA Inc, USA; [3]International Zinc Association, Belgium; [4]Cobalt Institute, UK; [5]VITO nv, Belgium; [6]International Lead Association, USA; [7]ARCHE Consulting

Introduction

A tiered approach under the European Water Framework Directive has been developed for implementing bioavailability-based Environmental Quality Standards (EQS) for metals, as detailed in Technical Guidance for implementing Environmental Quality Standards (EQS) for metals (no. 38), published by the EU Commission. Tier 2 of the approach prescribes the use of simplified tools, often based on the full and complex biotic ligand models (BLMs), to account for bioavailability. Simplified tools are designed to be less data intensive and easier to use in routine regulatory activities. bio-met is one such simplified tool that only requires pH, dissolved organic carbon and calcium (Ca) concentrations to assess the potential freshwater risks and compliance with $EQS_{bioavailable}$ for cobalt (Co), copper (Cu), nickel (Ni), lead (Pb) and zinc (Zn). While Tier 2 provides an opportunity for the use of 'simplified tools' it the usability has been improved thanks to feedback from member state regulators and risk assessors.

Usability updates in bio-met v6.4

- Ability to select metal(s) to be assessed.
- Inclusion of export of results functionality and a clear "results only" option.
- Inclusion of the previously stand-alone hardness calculator within the tool to assist when Ca concentration data is unavailable.
- Implementation of the "out-of-bounds" analysis so that conditions outside of the validated range of a metal are provided only for realistic water chemistry scenarios and when expected to be conservative based on full BLM calculations (**Figure 1**).
- Review and update of all warning and guidance text to allow for easier interpretation by users (**Figure 1**).
- Inclusion of "pop-up" tabs that provide further information on the warning and potential next steps (**Figure 1**).
- Update to the introductory page, including addition of glossary section and improved cross-functionality with the bio-met website.

Scientific Updates in bio-met v6.4

- Look-up tables have been updated for Ni, Zn, Pb and Co to reflect the most recent bioavailability normalisation approaches.
- "Out-of-bounds" analysis conducted using full BLMs to determine where bio-met predictions become less conservative than the full BLM providing an added degree of protection in the simplified tool.
- The updated validated and prediction ranges are presented in **Table 1**.

Figure 1: Results (Copper) with $EQS_{bioavailable}$ = 1 µg/L

	Required	Required	Required	Optional	RESULTS (Copper) with $EQS_{bioavailable}$ = 1 µg/L					
Measured Copper Conc (dissolved) [µg/L]	pH	DOC [mg/L]	Ca [mg/L]	Hardness [mg/L]	Local HC5 (dissolved) [µg/L]	BioF	Bioavailable Copper Conc [µg/L]	RCR	Warnings	Guidance
1.4	6.00	1.00	1.0						Ca is below the lower end of the validated range for Cu	Guidance
5	6.50	2.00	20.0		4.89	0.20	1.02	1.02		
9	7.00	3.00	55.0		11.37	0.09	0.79	0.79		
8	7.20	5.00	170.0						Ca is above the higher end of the validated range for Cu	Guidance
7	7.40	6.00	66.0		28.92	0.03	0.24	0.24		
5	7.80	7.00	55.0		27.29	0.04	0.18	0.18		
12	8.40	9.00	40.0		17.65	0.06	0.68	0.68		
4	8.00	1.00	1.6		4.19	0.24	0.95	0.95	Ca is below the lower end of the validated range for Cu	Guidance
3	9.00	5.00	30.0						pH is above the higher end of the validated range for Cu	Guidance

Table 1: Validated and Prediction Ranges in bio-met v6.4.

Metal	Validated Range		Prediction Range	
	pH	Ca (mg L^{-1})	pH	Ca (mg L^{-1})
Cu	6.0 – 8.5	3.1 – 129	6.0 – 8.5	1.55 – 129
Ni	5.9 – 8.7	0.5 – 110	5.9 – 8.7	0.5 – 220
Zn	5.5 – 8.5	0.8 – 160	5.5 – 8.5	0.4 – 300
Pb	6.3 – 8.4	3.6 – 204	6.3 – 8.9	3.6 – 204
Co	6.4 – 8.4	4.0 – 147	5.9 – 8.4	2.0 - 294

General guidance for waters that are outside the range of bio-met

This water has a pH that is outside the range of bio-met. No bio-met prediction has been made due to the uncertainty in providing a prediction in high pH conditions.

General guidance for waters that are outside the range of bio-met; full BLM analysis of waters outside bio-met applicability domain

Several options for treating conditions which are outside of the applicability range of the BLMs are available.

1. For waters with extreme pH conditions, check the pH of the water.
2. Apply the Full BLM model if appropriate.
3. Consider 100% bioavailability of the metal (i.e. apply the EQS-bioavailable).
4. Extrapolation (e.g. consider complexation of metal by DOC only).
5. Bioassays (including ecotox. tests, WER and ecological community monitoring).
6. Derive a site-specific Local EQS.

Summary

Bio-met has undergone a thorough scientific and usability review and update to make the tool as fit-for-purpose as possible for use as part of Tier 2 of the tiered approach for implementing bioavailability-based Environmental Quality Standards (EQS) for metals.

Updates included increasing the validated ranges of some metals, clearer guidance, export functionality and embedding of hardness conversion equations.

bio-met

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