Concentrations of HHCB in Sediment from 2006 to 2019 in U.S. Receiving Water Bodies and Implications for Environmental Risk

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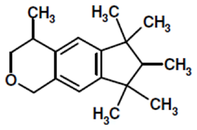
Introduction

- In 2014, the U.S. Environmental Protection Agency (EPA) completed a risk assessment that indicated no concern for the use of 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylcyclopenta[*g*]-2-benzopyran (HHCB) as a fragrance ingredient in commercial and consumer products in the U.S.



Chemical structure of HHCB (HSDB 2007)

- However, in December 2019, EPA designated HHCB as a high-priority substance warranting risk evaluation under the Toxic Substances Control Act.
- A comparison of recent (2006–2019) and older sediment monitoring data improves understanding of whether HHCB concentrations pose a risk to the benthic environment.

Calculated Risk Quotients (RQs) for HHCB, Excerpted from USEPA (2014)

Sediment Concentration Source	Concentration	Concentration of Concern for Chronic Toxicity	Chronic RQ
Maximum Published Concentration	388 µg/kg dry weight	1,080 µg/kg dry weight	0.36
Range of Mean Published Concentrations	1.1 - 144 µg/kg dry weight	1,080 µg/kg dry weight	0.001 - 0.13
95th Percentile USGS NWIS	213 µg/kg dry weight	1,080 µg/kg dry weight	0.20
Mean USGS NWIS	87 µg/kg dry weight	1,080 µg/kg dry weight	0.08

Source: USEPA (2014)
Notes: USGS = U.S. Geological Survey

Methods

Data Collection

- Retrieve water quality data for HHCB from the National Water Information System (NWIS)

Data Cleanup

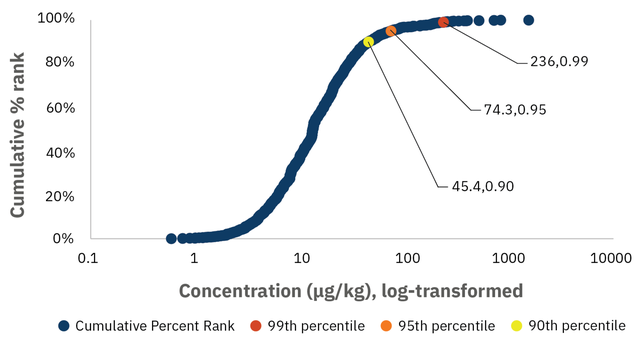
- Select only the sediment data based on parameter codes: solids, recoverable samples (PC 63209 and 63629 were the two sediment relevant parameter codes)
  - Only PC 63209 was selected because it was the only one with data
  - A total of 1,649 sediment sample results were associated with PC 63209

Data Analysis

- Create cumulative distribution plots to characterize spread of the data
- Examine analytical detection limits over time

Findings

HHCB Monitoring Data 2006–2019



Cumulative Distribution of HHCB Concentrations in Bottom Material (Sediment) Samples, with Nondetect Concentrations Substituted with the Lognormal-Imputed Concentrations, per EPA's ProUCL

Conclusions

- HHCB is not present in the freshwater sediment environment at significant concentrations.
- More than 80 percent of sediment samples did not have detectable concentrations of HHCB.
- Within the most recent 5 years of data (samples collected from 2015 to 2019), the maximum detected concentration was 215 µg/kg. Four samples during this period exceeded 200 µg/kg.
- These results for sediment supplement the surface water results presented by the Fragrance Creators Association (FCA) and Research Institute for Fragrance Materials (RIFM) at SETAC NA in 2021. They found that for surface water samples collected from 2015 to 2020, more than 60 percent of samples were nondetect for HHCB (limits of detection of 0.04 µg/L or 0.16 µg/L), and only two of the samples with detectable levels of HHCB had concentrations greater than EPA's surface water concentration of concern of 1 µg/L. Additional freshwater exposure studies are not necessary given the data available.
- Currently, HHCB does not pose a significant risk to organisms in freshwater environments, given that EPA's chronic concentration of concern for sediment-dwelling organisms is 1,080 µg/kg dry weight.

References available upon request.

Although EPA has recently designated HHCB as a high priority chemical, current concentrations in sediment suggest it does not pose a risk to freshwater aquatic environments.

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