United States Environmental Protection Agency | Office of Water (4305) | EPA-823-N-97-001 Number 18 Winter 1997

EPA Contaminated Sediments News

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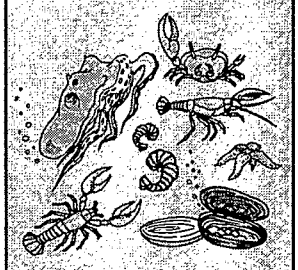


CS News is produced by the EPA Office of Science and Technology (OST) to exchange information on contaminated sediments and to increase communication among interested parties. To obtain copies of this report or to contribute information, contact Jane Marshall Farris, EPA OST, mail code 4305, 401 M Street S.W., Washington, DC 20460 at (202) 260-8897.

To be added to the mailing list or to make changes to your address, please fax your request to Jane Marshall Farris at (202) 260-9830.

EPA Holds National Conference on Sediment Bioaccumulation

More than 400 persons attended the National Sediment Bioaccumulation Conference, cosponsored by EPA's Office of Science and Technology and Office of Research and Development, on September 11-13, 1996 in Bethesda, Maryland.

The conference featured presentations by national experts in seven sessions. Attendees heard about recent advances in approaches for assessing bioaccumulative sediment contaminants and for integrating assessment results into EPA decision making. They also had the opportunity for dialogue with panelists during question-and-answer periods at the end of each session.

The first day of the conference focused on measuring bioaccumulation and on interpreting and applying the results of assessments. The second day included sessions on modeling the bioavailability of sediment contaminants and on conducting human health-based and environmentally based risk assessments. On the last day of the conference, an EPA program panel addressed how the results of bioaccumulation assessments are being used in Agency decision making. The panelists represented the Agency's Superfund, NPDES, and Dredged Material Programs, as well as programs in the EPA Office of Pollution Prevention and Toxics and the EPA Office of Science and Technology.

Conference Feedback

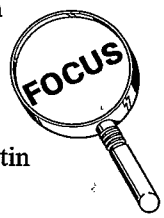
EPA received complimentary feedback from numerous conference attendees. Many appreciated the Agency's organizing and sponsoring the event on a national scale. They identified areas of interest for future conferences, such as sediment remediation, nonpoint source sediment contaminants, dredged material disposal, and environmental indicators of sediment quality.

Attendees said some session topics—particularly sediment test methods, bioavailability of sediment contaminants, bioaccumulation modeling, and ecologically based risk assessment—should be expanded into an entire conference.

Conference Proceedings

A conference proceedings should be available by late spring of 1997. Conference attendees will receive a copy. Once the proceedings are available, a notice on how to obtain the proceedings through NCEPI will be published in the newsletter. Other information on the proceedings may be obtained from Leanne Stahl, EPA Office of Science and Technology, 202 260-7055 (or stahl.leanne@epamail.epa.gov).

Screening Values for Tributyltin in Marine Sediments



The EPA Region 10 Superfund Program, with support from an interagency workgroup, recently completed an evaluation of various approaches for deriving an effects-based screening value or clean-up level for tributyltin (TBT) in marine sediments.

This effort was initiated to assist EPA in recommending a cleanup approach for TBT-contaminated sediments at Superfund

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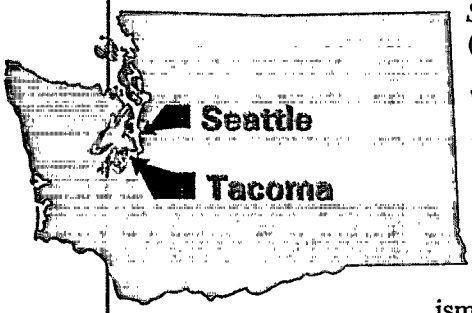
TBT VALUES *Continued from page 1*

sites in Puget Sound, Washington. Results are detailed in a final report, *Recommendations for Screening Values for Tributyltin in Sediments at Superfund Sites in Puget Sound, Washington* (EPA 1996).



What is TBT?

A man-made organotin compound, TBT has many commercial, industrial, and agricultural applications. TBT has been widely used in marine paints as an effective means of preventing or retarding the growth of fouling organisms such as barnacles and mussels on the hulls of boats and ships. It is this application that is thought to represent the main contribution of TBT to the marine and estuarine environments in Puget Sound. However, TBT compounds are also used as biocides in cooling towers, pulp and paper mills, and textile mills, and as active ingredients in wood preservatives, disinfectant and antimicrobial cleaners and shampoos, and toilet bowl cleaners.

Development of Agency TBT Screening Values

In the 1990s, EPA found TBT was extremely widespread in sediments at three Superfund sites located in highly industrialized urban embayments. To evaluate these bulk sediment chemistry data, the Agency developed a range of bulk sediment and interstitial water TBT screening values. Interstitial, or pore, water is extracted or centrifuged from whole bulk sediments.

Screening values were developed because there are no state or federal criteria for TBT, and it was necessary for Region 10 to move forward with sediment remedial design and remedial action at these sites. The range of screening values allows for the site-specific selection of a cleanup level based on the protectiveness that is considered appropriate for the given sediment management decision.

TBT Screening Values Selected for Sediments at Superfund Sites in Puget Sound

Screening Value	(a) Interstitial Water Concentration (ug TBT/L)	(b) Sediment Concentration (ug TBT/kg OC)
Lower Screening Value	0.05	1,255
Higher Screening Value	0.70	17,570

(a) Interstitial water is porewater extracted from whole sediments.

(b) Assuming 2% TOC, the lower screening value is approximately equivalent to 25.1 ug TBT/kg (dry weight) and the higher screening value is equivalent to 351 ug TBT/kg (dry weight). Bulk sediment analyses quantify the TBT concentrations in both porewater and the sediments.

The interstitial water screening values for TBT are based on chronic and acute water quality effects data reported in the literature for concentrations of TBT (as the ion). The report summarizes all available TBT water quality effects data, including test species, endpoints, and citations.

The sediment screening values for TBT are derived using a sediment-water partitioning approach. This approach is based on a mathematical relationship between TBT concentrations known to cause adverse effects in water and an organic carbon-based partitioning coefficient. (A K_{OC} value of 25,100 L/kg was used.) This mathematical relationship is shown here:

$$[Sed_{oc}] = [Water] * K_{oc}$$

where,

Sed_{oc} = organic-carbon normalized sediment concentration (µg/kg)

Water = effects concentration in water (µg/L)

K_{oc} = organic carbon based partitioning coefficient (L/kg)

This equation was used to calculate a range of organic-carbon normalized sediment TBT concentrations that would predict TBT concentrations associated with minor adverse effects. Note that this approach assumes that TBT is in equilibrium between sediment interstitial water and particulate organic carbon phases.

Results

Because there were no state or federal critieria for TBT, Bulk Sediment TBT concentrations normalized to organic carbon were developed as screening concentrations to predict minor or adverse effects. Two limited studies found that the screening values reflected interstitial water concentrations of TBT to within only one to two orders of magnitude of actual concentrations.

The organotin compounds are unique, and they partition between sediment and water differently from other organic compounds. For a number of organic compounds, organic carbon normilization has been shown to reliably reflect interstitial water concentrations. For TBT, however, the interstitial water should actually be collected and analyzed for TBT, instead of using the original predictive concentrations. (See Table of Screening Values.) A

disadvantage of this method is that relatively large amounts of sediment must be collected to obtain a large enough quantity of interstitial water for TBT analysis. However, for organotin compounds like TBT, this collection is necessary.

Results of Region 10's study suggest that bulk sediment, and organic carbon-normalized sediment TBT concentrations may be poor predictors of the bioavailable fraction of TBT. Thus, Region 10 strongly recommends that sediment cleanup decisions at Superfund sites in Puget Sound be based on TBT concentrations in interstitial water, and on any associated biological effects testing.

Two recent sampling efforts showed that measured concentrations of TBT in interstitial water were lower than would have been predicted using the sediment-water partitioning approach and existing bulk sediment data.

Recommendations for future work have also been identified. Additional research is needed on the environmental factors affecting TBT partitioning behavior and the degradation rates of TBT under varying conditions (e.g., anaerobic vs. aerobic conditions) and varying TBT concentrations (e.g., moderate vs. high concentrations). Also, to confirm the ecological significance of interstitial water "exceedances" of TBT screening values, appropriate biological effects tests should be developed to assess the bioavailability of TBT in sediments. Some data suggest that several bioassay species commonly used in effects test appear to be insensitive to TBT, and/or test durations may be too short. The uptake of TBT from sediments to tissue appears to be fairly complex, and there are limited studies on tissue residue effects data for TBT.

Additional information and copies of the EPA report are available from Karen Keeley, Superfund Site Manager, EPA Region 10 Office of Environmental Cleanup, ECL-111, Seattle, WA, 98101. 206 553-2141 (e-mail: keeley.karen@epamail.epa.gov).

ORD Activities

AED-Narragansett

Sediment Toxicity Test for the Ammonia Tolerance of the Marine Bivalve *Mulinia lateralis*

Ammonia is a naturally occurring, and often a eutrophication-enhanced, chemical constituent of many freshwater and marine sediments. At sufficiently high concentrations ammonia can also be an important sediment toxicant. Recent work at AED-Narragansett has focused on the ammonia tolerance of a new sediment toxicity test using the marine bivalve *Mulinia lateralis*.

Because this species is being considered for regulatory use by EPA Region 6, knowing its response to sediment ammonia concentrations is important. *M. lateralis* had LC_{50} and EC_{50} (growth) values of 0.6 and 0.3 mg/L unionized ammonia, respectively. These values indicate that the bivalve is among the most sensitive marine toxicity testing species.

A second study assessed whether ammonia concentrations in the *M. lateralis* exposure chambers that contained natural sediments with high interstitial water ammonia concentrations would approach effects levels. It was shown that the pre-test flushing procedure (i.e., overlying water replacement 24 hours after sediment addition to exposure chambers) reduced overlying water ammonia concentrations to well below the levels where toxicity would be expected.

For further details please contact Peg Pelletier (401 782-3131) or Rob Burgess (401 782-3106), EPA Office of Research and Development, Atlantic Ecology Division, Narragansett, RI.

Sediment Effect Concentrations Developed

A recent U.S. EPA publication, "Calculation and Evaluation of Sediment Effect Concentrations for the Amphipod *Hyalella Azteca* and the Midge

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ORD ACTIVITIES *Continued from page 3*

Chironomus Riparius," describes procedures for calculating and evaluating sediment effect concentrations (SECs) using laboratory data on the toxicity of contaminants associated with field-collected sediment to the amphipod *Hyalella azteca* and the midge *Chironomus riparius*.

The SEC is the concentration of a chemical that is associated with the effect. Once the probable cause(s) of sediment toxicity has been identified, better decisions can be made regarding remediation options.

SECs are the concentrations of individual contaminants in sediment below which toxicity is rarely observed and above which toxicity is frequently observed. SECs were used to classify toxicity data for Great Lake sediment samples tested as part of the U.S. EPA Great Lakes National Program Office (GLNPO) Assessment and Remediation of Contaminated Sediments (ARCS) Program (Fox and Tuchman 1996; Ingersoll *et al.* 1996).

Three types of SECs were calculated for *Hyalella azteca* and for *Chironomus riparius*: (1) Effect Range Low (ERL) and Effect Range Median (ERM), (2) Threshold Effect Level (TEL) and Probable Effect Level (PEL), and (3) No Effect Concentration (NEC; analogous to Apparent Effect Thresholds).

The SECs were calculated using: (1) dry-weight concentrations, (2) dry-weight concentrations normalized to total organic carbon concentrations (for non-ionic organics), or (3) dry-weight concentrations normalized to acid volatile sulfide concentrations (for divalent metals). SECs were calculated primarily for total metals, simultaneously extracted metals, polychlorinated biphenyls, and polycyclic aromatic hydrocarbons. The database's ranges of concentrations in sediment were too narrow to adequately evaluate SECs for butyltins, methyl mercury, polychlorinated dioxins and furans, or chlorinated pesticides.

Using SECs, about 60 to 80 percent of the sediment samples in the database can be correctly classified as toxic or not toxic, depending on the type of SEC evaluated. ERMs and ERLs are generally as reliable as paired PELs and TELs at classifying both toxic and nontoxic samples in the database. Reliability of the SECs in terms of correctly classifying sediment samples is similar between ERMs and NECs; but ERMs minimize Type I errors (false positives) relative to ERLs, and minimize Type II errors (false negatives) relative to NECs. Correct sample classification can be improved by using only the most reliable SECs for chemicals (those with a higher percentage of correct classification).

Calculating SECs using dry-weight concentrations—instead of using sediment concentrations for PAHs and total PCBs that have been normalized to TOC concentrations—resulted in similar correct classification of toxicity and similar Type I and Type II error. The range of TOC concentrations in the database was relatively narrow compared to the ranges of contaminant concentrations. Therefore, normalizing dry-weight concentrations to a relatively narrow range of TOC concentrations had little influence on relative concentrations of contaminants among samples.

The SECs were calculated from toxicity tests with field-collected samples. Even if a chemical concentration exceeds an SEC generated from data derived from tests with field-collected samples, the chemical may not have caused the observed effect. Rather, the SEC is the concentration of a chemical that is associated with the effect.

Field-collected sediments typically contain complex mixtures of contaminants. Additional information is needed to identify the specific contaminants that were responsible for the toxicity.

Confirmation of sediment toxicity due to individual or groups of contaminants can be determined by using Toxicity Identification Evaluation procedures or by conducting toxicity tests with spiked sediments. Once the probable cause(s) of sediment toxicity has been identified, better decisions can be made regarding remediation options.

The SECs can be used as guidance for evaluating contaminated sediment, but there is no intent expressed or implied that they represent U.S. EPA or National Biological Service (NBS) criteria.

The SEC data discussed here (U.S. EPA, 1996), including the database on disk, are

available from Callie Bolattino, U.S. EPA, GLNPO, 77 W. Jackson, Chicago, IL (312 353-3490, fax -2018; email: Bolattino.callie@epamail.epa.gov).

An electronic copy of U.S. EPA (1996) including the database is also available on the internet at the NBS home page at: http://www.msc.nbs.govpubs.html.

References Cited

Fox, R.G., and M. Tuchman. 1996. The Assessment and Remediation of Contaminated Sediments (ARCS) Program. *J. Great Lakes Res.* 22:493-494.

Ingersoll, C.G., P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, and N.E. Kemble. 1996. Calculation and Evaluation of Sediment Effect Concentrations for the Amphipod *Hyalella azteca* and the Midge *Chironomus riparius*. *J. Great Lakes Res.* 22:602-623.

U.S. Environmental Protection Agency. 1996. Calculation and Evaluation of Sediment Effect Concentrations for the Amphipod *Hyalella azteca* and the Midge *Chironomus riparius*. EPA 905-R96-008, Chicago, IL.

Regional Activities

Region 5

Manistique River/Harbor Dredging Project

The Manistique River/Harbor Site, in northern Michigan, is 1 of 42 Areas of Concern, where Water Quality Objectives are not met. The site is in the City of Manistique on the southern shores of Lake Michigan's Upper Peninsula, where the Manistique River discharges into Lake Michigan.

PCBs are the major contaminant of concern, and three areas have PCB concentrations that exceed the 10 part per million (ppm) cleanup level. Concentrations generally are in the hundreds of parts per million in the contaminated areas, with concentrations as high as 2,510 ppm (see table at right).

Approximately 18,000 pounds of PCBs can be found within 127,000 cubic yards of contaminated sediments. Surface water sample analysis indicate that 105 pounds of PCBs are being discharged annually into Lake Michigan, and there is potential for erosion of a greater volume of contaminated sediments during a large storm or floods.

There is a fish advisory for carp, in which PCB concentrations average approximately 6 ppm. Sport fish are affected by PCB contamination.

Potentially responsible parties (PRPs) consist of a paper company, an electric utility, a local salvage yard, and companies that sent materials to the scrap yard.

Recent Site History & Investigations

After an Engineering Evaluation/Cost Analysis (EE/CA) was conducted by the paper company and the electric utility, EPA recommended that the contaminated sediments be dredged and disposed of at a nearby PCB landfill. This recommendation quickly became controversial, with the community and PRPs voicing strong opposition to dredging. They asserted that dredging was not protective because PCB-contaminated sediment would be resuspended in the water during dredging, leaving contaminated materials behind. The opponents to EPA's recommendation countered that capping contaminated sediments in the river and harbor would be the most protective and cost-effective remedy.

Manistique River/Harbor Drainage Project PCB Contamination Levels

Area	Cubic Yards of Sediment Exceeding 10 ppm	Maximum Concentration (ppm)
Near Manistique Papers Facility	0	----
North Bay/U.S. 2 Highway Bridge	23,000	2,510
1,000 Feet Upstream From River Mouth	7,000	460
Harbor	97,000	810
TOTAL	127,000	2,510

After considering community input and remedial alternatives, EPA selected a "hybrid" remedy whereby the Agency would conduct and pay for dredging a relatively small area in the river, and the PRPs would implement a capping remedy. EPA began its dredging project dur-

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MANISTIQUE RIVER *Continued from page 5*

ing 1995, while negotiations for the PRPs to implement capping were conducted.

EPA's project demonstrated that, by using diver-assisted dredging techniques on the sediment, which was described as "light and fluffy," resuspension during dredging was minimized. And by separating the sawdust and woodchips that accounted for the highest PCB concentrations— about 1,000 ppm—from the sediments that had PCB concentrations less than 1- ppm, disposal costs were reduced. This is because the sawdust and woodchips accounted for only about 3 percent of the total volume of contaminated material.

EPA will continue to improve the efficiency of dredging and water treatment, employing such techniques as hydrocycloning to enhance the separation of PCB-contaminated materials from noncontaminated sediments.

The Agency therefore reproposed a total dredging remedy, which was supported by the PRPs and community. The PRPs agreed to pay $6.4 million for EPA to finish dredging all the river and harbor sediments whose contamination exceeded the cleanup level.

Before beginning its dredging activities in 1995, EPA designed and built or installed:

- Sheet piling and silt barriers to prevent any releases of resuspended sediments.
- An on-site water treatment plant to dewater dredged sediments and treat dredge water prior to its discharge back into the Manistique River.
- Two 1.2 million gallon lagoons for storage of treated dredge water.

The Agency also upgraded a pad for storage and additional sediment dewatering that was owned by the paper company and previously used to store recycled paper.

Dredging Progress

During 1995 and through August 1996, EPA focused its dredging activities in the North Bay/ U.S. 2 Highway area of the Manistique River.

Since September 1995, approximately 18,000 cubic yards of contaminated sediments have been removed, dewatered and disposed of. Approximately 30 million gallons of dredge water have also been treated and discharged to the Manistique River.

Short-term adverse impacts from dredging were found to be negligible. Turbidity measurements of surface water immediately downstream of the dredging area have remained at background levels during all dredging activities.

Future Activities

EPA will continue to improve the efficiency of dredging and water treatment, employing such techniques as hydrocycloning to enhance the separation of PCB-contaminated materials from noncontaminated sediments.

The Agency has completed dredging Area B (North Bay/U.S. 2 Highway area) and will dredge Area C. Dredging of Area C is scheduled to begin in May 1997.

For additional information, contact James Hahnenberg, Remedial Project Manager, Superfund Division, EPA Region 5, 77 West Jackson Blvd. SR-6J, Chicago, IL 60604 (312 353-4213, e-mail: hahnenberg.james@epamail.epa.gov).

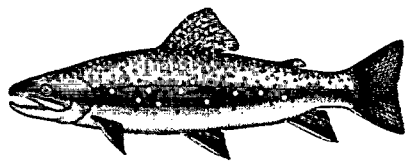
Region 9

Contaminated Sediment Management in Hawaii

Most dredging in the Hawaiian Islands has been conducted by the Navy at Pearl Harbor. Operating under a general permit (GP) from the U.S. Army Corps of Engineers, the Navy had disposed of all sediments at the EPA-designated south Oahu ocean dredged material disposal site (or earlier ocean disposal sites in the vicinity). Under the old GP, the Corps had determined the suitability of all Pearl Harbor sediments for ocean disposal based on broad, one-time regional sampling.

The old GP has expired, and today

Creature Feature



This popular sport fish isn't a salmonid, but a char. Can you identify it?

The Creature Feature is a Brook Trout (*Salvelinus fontinalis*).

project-specific sampling and analyses (chemistry and bioassays) are required by EPA and the Corps. This testing of the specific sediments to be dredged is beginning to identify areas of contamination within Pearl Harbor that require alternate disposal methods. (Contaminants found include metals and organics such as PAHs and PCBs.) However, no Confined Disposal Facilities (CDFs) or other sites capable of managing sediments deemed unsuitable for unconfined ocean disposal have been constructed in Hawaii. A regional dredging team for the Hawaiian Islands formed by EPA and the Corps has begun discussions and planning for managing contaminated sediments.

Planning Hawaii's First CDF

The first project-specific CDF to manage contaminated sediments in Hawaii is being planned. The Navy proposes to contain unsuitable sediments, from the reconstruction of a submarine base, in a sheet pile-lined fill to be incorporated into new piers being built as part of this project. Preliminary plans have been presented to EPA and the Corps, and the Navy plans to evaluate maximizing the CDF's capacity to accommodate contaminated sediments from other planned projects.

Managing Other Contaminated Sediments

Advanced planning also has begun for the management of expected contaminated sediments from the Ala Wai canal in Waikiki. Based on recent sediment studies that show elevated chemical concentrations, EPA and the Corps have determined that significant volumes of sediment in the proposed design may be found unsuitable for unconfined ocean disposal. The state and local agencies have been urged by EPA and the Corps to re-evaluate the engineering of the project to minimize the amount of dredged material generated and to begin exploring options for alternative disposal sites as part of the environment assessment of this project. In particular, EPA and the Corps are working with the agencies to coordinate the Ala Wai's dredging needs with other potential projects that may have a need for fill, and whose sites may be engineered to appropriately manage the contaminants present in the Ala Wai sediments. Limited availability of potential upland sites on the Hawaiian Islands, however, makes developing appropriate facilities difficult. Therefore, there is growing interest in Hawaii in management concepts such as Confined Aquatic Disposal and containerization techniques (e.g., with geotextile bags).

For more information, contact Allan Ota, U.S. EPA Region 9, San Francisco, CA 94105 (415 744-1980).

CSN Activities Timeline

February 9-12, 1997
1997 International Containment Technology Conference
St. Petersburg, Florida
Sponsors: U.S. Department of Energy, DuPont Company, U.S. EPA

For further information, contact:
Loreen Kollar, Conference Coordinator
Florida State University
2035 East Paul Dirac Drive, 226 HMB
Tallahassee, Florida
Phone: 904 644-5524
Fax: 904 574-6704
e-mail: ICTCE@mailer.fsu.edu

April 9-11, 1997
Third Environmental Monitoring and Assessment Program (EMAP) Research Symposium "Developing New Tools to Meet the Nation's Monitoring Needs: The Evolution of EMAP."
Albany, New York
Sponsor: U.S. EPA

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April 9-11, 1997
Seventeenth Annual Hydrology Days
Sponsored by American Geophysical Union, Hydrology Section & the Front Range Branch American Society of Civil Engineers (ASCE), Water Resources Engineering Division, and the Colorado Section American Water Resources Association
Colorado State University, Fort Collins, Colorado
Abstract Submittal Deadline: March 7, 1997

For registration/general information, contact:
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