Research on Contaminants of Immediate and Emerging Concern

ISSUE SUMMARY:

Contaminants of immediate and emerging concern (CIEC) include materials that may cause ecological or human health impacts and are either new or existing contaminants of increased priority. CIECs include a wide array of potential pollutants, such as pharmaceuticals, some ingredients of personal care products, per-and polyfluoroalkyl substances (PFAS), surfactants, microorganisms, microplastics, and endocrine disrupting chemicals, among others. Factors such as shrinking water and financial resources, climate change, agricultural runoff, harmful algal blooms (HABs), and industrial land use increase the probability of CIECs found in the environment. This issue is likely to disproportionately affect small drinking water systems due to limited resources and treatment options, among other factors.

Contaminants of immediate and emerging concern can occur in wastewater, reused water, or other matrices and there is often an incomplete understanding of the risk posed by these potential pollutants. Often CIECs are difficult to measure and can be linked to many current and historic sources. EPA's research investigates analytical methods, occurrence, health effects, and treatment approaches to help inform decisions.

EPA's research on CIECs is based on a One Environment, One Health paradigm recommended by the National Academy of Science, Engineering and Medicine (NASEM, 2023) that addresses both human and ecological receptors. In general, EPA CIEC research focuses on:

- Developing methods and models to estimate and predict contaminant occurrence, toxicity, and risk in drinking water.
- Developing integrated models of multi-route and multi-contaminant exposures to improve assessment methods for detection and quantification of priority CIECs in drinking water.
- Filling key knowledge gaps to support and enhance regulatory decisions for chemical and microbial contaminants in drinking water, including the assessment of dermal impacts of chemical contaminants, measurement methods for priority CIEC contaminants, and evaluation of point-of-use (POU) filters for contaminant sampling.
- Developing innovative approaches for evaluating exposure to and toxicity from chemical mixtures including the use of gene-expression biomarkers to distinguish different mixtures and in vivo toxicity of mixtures of disinfection byproducts (DBPs) to predict proportional response.

RECENT/UPCOMING MILESTONES:

- The National Science and Technology Council's Joint Subcommittee on Environment, Innovation and Public Health ("JEEP"), which is co-led by EPA, NIEHS, and OSTP, released the *PFAS Federal Research and Development Strategic Plan*, which identifies goals, objectives, and tasks for PFAS research and development for the next five years that, through interagency coordination, would further the federal government's commitment to protecting Americans from the harmful effects of PFAS.

- The JEEP plans to release a follow up to the Sustainable Chemistry Strategic Plan in 2024. This is a follow up to the August 2023 *Sustainable Chemistry Report: Framing the Federal Landscape*.

BACKGROUND:

All of Government Approach

The Fiscal Year 2020 United States National Defense Authorization Act (NDAA) directed the White House Office of Science and Technology Policy (OSTP), in coordination with other federal agencies (led by EPA and NIEHS), to create a National Emerging Contaminants Research Initiative (NECRI) to improve the identification, analysis, monitoring, and treatment of Contaminants of Emerging Concern (CECs in drinking water (DW). In the NECRI, CECs are "are newly identified or reemerging manufactured or naturally occurring physical, chemical, biological, radiological, or nuclear materials that may cause adverse effects to human health or the environment and do not currently have a national primary DW regulation." While DW is the medium of focus for the NECRI, it is recognized that CECs exist in multiple media that may be relevant for addressing public and environmental health needs in varied settings. The capabilities and approaches developed under the NECRI are expected to lead to a holistic treatment of CECs.

In 2021, the Joint Subcommittee on Environment, Innovation and Public Health ("JEEP") was formed to provide coordination and guidance for three interagency Strategy Teams (one team each for PFAS, CECs, and Sustainable Chemistry) formed through two legislative actions: the FY2020 NDAA and FY 2021 NDAA. The JEEP works to address cross-cutting environmental concerns that require interdisciplinary and innovative approaches. EPA leads and is highly engaged in the development and implementation of strategy documents and activities that help guide our research.

EPA Research Highlight Areas

EPA is conducting research to help address several specific CIECs. Currently, PFAS, microplastics, and 6PPD-quinone are some of the highest profile CIECs that EPA is working to address.

PFAS

Addressing PFAS is a high priority for EPA, as outlined in the PFAS Strategic Roadmap. For information on EPA's research to address PFAS, please see the *ORD-4 PFAS Research* Briefing Paper.

Microplastics

Microplastics are defined as plastic particles, greater than one nanometer and less than 5,000 micrometers, that are manufactured for specific purposes or result from the degradation of larger plastics. Because of their global use, small size, and persistent nature, microplastics are found throughout the environment, including air, water, soil, organisms, and food. During the past decade, there has been growing national and international concern about the increased volume of plastic in the environment and increasing uncertainties about its potential health and environmental effects.

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To address these concerns, EPA and other interested parties are developing and standardizing collection, extraction, quantification, and identification methods for microplastics. Without reliable and consistent methods and the quality data generated from using these methods, EPA cannot effectively assess the presence, possible exposures, and, most importantly, potential risks associated with these materials.

EPA researchers are evaluating reliable and reproducible approaches for sampling microplastics, separating microplastics from other materials found in environmental samples, and extracting the microplastics for analysis without degrading their composition.

EPA researchers have also developed and evaluated methods to characterize and quantify total microplastics in sediment and water samples. Scientists have developed methods for detecting the most common plastic polymers, including polyethylene, polypropylene, polystyrene, polyester, and more. There are a wide variety of polymers that exist in the environment, and they often behave differently in various environmental matrices.

Recent research accomplishments include:

- Recommendations for sample collection methods for microplastics in sediments for the National Coastal Condition Assessment (NCCA) conducted as part of the EPA's Office of Water National Aquatic Resource Surveys
- Development of a hybrid sediment extraction method for microplastics used in EPA regional and NCCA samples
- Collaboration on methods testing with the Southern California Coastal Water Research Project (SCCWRP)
- Development of American Society for Testing and Materials (ASTM) standard methods for the collection and extraction of microplastics in water
- Development of methods for microplastic extraction and effects for coral

6PPD-quinone

Vehicle tires contain the chemical known as 6PPD to prevent tires from breaking down due to reactions with ozone and other reactive oxygen species in the air. When 6PPD reacts with ozone in the air, it forms 6PPD-quinone, a contaminant of emerging concern (CIEC) due to the linkage of coho salmon death to 6PPD-quinone in stormwater. The potential of 6PPD-quinone to have ecotoxic effects and impact salmon populations is a key issue. These fish species have cultural, commercial, and ecological importance, and some coho salmon populations are endangered and threatened. Many Tribes rely heavily on salmon and other aquatic resources for food and cultural practices.

To facilitate inter-program office coordination for 6PPD-quinone, EPA formed a cross-agency workgroup in November 2022. This senior-level workgroup is currently coordinating initiatives for addressing data gaps and commencing actions to address concerns regarding the use of 6PPD and adverse effects of the transformation product 6PPD-quinone, including coordinating with external entities such as other federal agencies, Tribes, states, industry, and academia.

EPA's research activities to address these data gaps include planned studies by ORD, continued collaboration with EPA regional partners, and potential research collaborations with external entities. In the current ORD Strategic Research Action Plan (2023-2026), there are multiple efforts that focus solely or in part on 6PPD-quinone, including work on fate and transport, ecotoxicity, and green infrastructure solutions for stormwater contamination. More information on EPA's research on 6PPD-quinoine is available at https://www.epa.gov/chemical-research/6ppd-quinone

Cross ORD Effort

CIECs is a cross-cutting issue for the National Research Programs at EPA:

- ACE: Develop and evaluate measurement methods and approaches to characterize sources of air pollutants and climate forcing pollutants, such as measurement of emissions of criteria pollutant precursors and air toxics, including emerging concerns, such PFAS and EtO (ethylene oxide).
- CSS: Continue to develop new approach methods for CIECs with a focus on applying these, as appropriate, for prioritization, screening, and risk assessment for decision making.
- HS: Predict the movement of chemical, biological, and radiological contaminants in the environment resulting from environmental contamination events and develop tools and methods for effective characterization, decontamination, and waste management.
- SHC: Advance site clean-ups of PFAS and lead to protect vulnerable groups, especially children.
- SSWR: Research on PFAS, including innovative drinking water and wastewater treatments, support for future drinking water regulations, the development of aquatic life criteria, management in water resources, and evaluation of land-applied biosolids; CIECs, lead, opportunistic pathogens, and DBPs in drinking water; cyanobacterial metabolites other than microcystin (e.g., anatoxin, saxitoxin, and nodularin); microplastics in sediments and surface water; and CIECs (non-PFAS) in wastewater treatment systems and biosolids.

KEY EXTERNAL STAKEHOLDERS:

☐ Congress ☒ Industry ☒States ☒ Tribes ☐ Media ☒ Other Federal Agency
☐ NGO ☒ Local Government ☐ Other (Local unions)

States, Tribes, and local governments need information to make decisions to address these contaminants. EPA is also working with industry for solutions.

MOVING FORWARD:

- EPA will continue its work to address CIECs.
- EPA plans to expands research efforts around 6PPD and microplastics given appropriate resources.

LEAD OFFICE/REGION: ORD OTHER KEY OFFICES/REGIONS: OCSPP, OW, REGIONS

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