Environmental Science & Technology

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Viewpoint

The Need to Adopt an International PMT Strategy to Protect Drinking Water Resources

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Cite This: *Environ. Sci. Technol.* 2020, 54, 11651−11653

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Protecting drinking water resources from chemical pollution is a transboundary, environmental, public health, and socio-economic concern. An expanding global chemicals market, combined with water resource stressors such as population growth and climate change, bring into sharp focus the need to manage and protect this vital resource globally, most acutely in locations consuming recycled wastewater.[1]

In Europe, regulations to assess, identify, control, or phase out environmentally damaging chemicals have been developed, including REACH (registration, evaluation, authorization, and restriction of chemicals) for industrial substances, and EU 1107-2009 specifically for plant protection products. These regulatory frameworks operate in concert with the European Chemicals Agency (ECHA) and utilize ongoing developments in chemical screening approaches, both in silico and experimental. These regulatory approaches have helped identify persistent, bioaccumulative and toxic (PBT) substances in regional and national inventories of industrial substances and plant protection products.[2,3] Additionally, they provide essential information to manage or phase out priority chemicals of high environmental risk.

Recent studies[4] have identified concerns regarding highly persistent chemicals that are not bioaccumulative but instead exhibit high aqueous solubility and mobility. These "persistent, mobile, and toxic" (PMT) substances are considered one of the major challenges in maintaining clean and safe drinking water resources.[4,5] Recently, the German Environment Agency led efforts to establish criteria to identify PMT substances and also "very persistent, very mobile" (vPvM) substances under the European Union's REACH framework.[5] The assessment of PMT/vPvM substances has also recently been identified for inclusion under the Chemicals Strategy for Sustainability within the European Green Deal.[6] Unlike PBT substances which sorb to soil and sediments and bioaccumulate in biota and the food chain, PMT substances are poorly sorbed to soil and sediments and can leach through the subsurface to contaminate groundwater, surface water, and aquatic ecosystems.[5] The high polarity and solubility of PMT substances, often present in ionic form in water, results in limited chromatographic retention and separation, and makes these substances challenging to analyze and include in water quality monitoring programs.[4,5]

PMT SUBSTANCES IN DRINKING WATER RESOURCES ARE AN INTERNATIONAL CONCERN

The concerns surrounding the ubiquitous contamination of water resources by PMT substances is not just restricted to Europe. Numerous water-soluble synthetic chemicals have been increasingly detected in natural waters around the globe, including organic solvents, agricultural chemicals, pharmaceuticals, and personal care products (PPCPs).[4,9] The United States Environmental Protection Agency (USEPA) recently enacted an action plan for soluble per- and poly fluoroalkyl substances (PFAS) detected in drinking water.[7] In the People's Republic of China in 2018, the Ministry of Ecology and Environment (MEE) and Ministry of Water Resources initiated a national survey on centralized source water areas

Received: June 30, 2020
Published: September 15, 2020

https://dx.doi.org/10.1021/acs.est.0c04281
Environ. Sci. Technol. 2020, 54, 11651−11653

to remediate contaminated drinking water sources and implement mitigation and protection strategies.[8]

A PMT WINDOW FOR CHINA

China is now the world's largest producer of chemicals, with the size of its chemical industry larger than the EU and U.S. combined.[10] Although this has been a positive development for China, there is concern of increased chemical emissions into natural aquatic environments and drinking water sources.[9,11] In 2019, MEE published a draft for public comments of the "Regulations on Chemical Substance Environmental Risk Assessment and Control". This is the very first piece of Chinese legislation to control emissions of hazardous chemicals into the environment, and it intends to assess the environmental risks of chemical substances which are manufactured and used in China. Under this regulation, new chemicals not yet included in the Inventory of Existing Chemical Substances of China (IECSC) must be evaluated. In addition, a prioritized list of controlled toxic and harmful chemicals has been released by MEE and the Chinese National Health Commission.[12] The goal is to prevent the environmental emission of high-risk chemicals which might harm aquatic environments and cause human health effects via drinking water. Despite currently lacking a requirement to assess the aqueous mobility of chemicals, drinking water has already been highlighted as an important exposure pathway of high production volume toxic substances. This may open an opportunity to include PMT substances in the prioritized list, in order to protect potable water in China. We feel this should be enacted.

AN INTERNATIONAL PMT STRATEGY

Many PMT substances have crossed international boundaries, either as commercial products via international shipping or via aqueous transport in fresh and marine waters. An international approach is needed to regulate and control the release of PMT substances, not only industrial substances considered under the REACH regulation in Europe, but all substances, including pharmaceuticals and plant protection products. To better control the release and avoid contamination by PMT substances in drinking water and aquatic ecosystems, additional research is needed to fill the many knowledge, data and regulatory gaps that exist. We propose the following steps for an international PMT strategy:

- Assess the aqueous mobility of persistent organic chemicals and their environmental transformation products based on the chemical inventories of Asia, Europe, North America, and internationally. This approach could be similar to that used in Europe for REACH registered substances, by basing mobility assessments on the experimental organic-carbon partition coefficient (K_{oc}) or the octanol–water distribution coefficient (D_{ow}).[4]
- Place more focus on the environmental transformation pathways and products of high volume chemicals or highly persistent synthetic chemicals, as it is often the case that transformation products are more mobile and persistent than their precursors.[13]
- Screen for PMT substances and transformation products identified in chemical inventories and through expected transformation pathways as part of large-scale water quality monitoring studies using state-of-the-art analytics and nontarget approaches. This step will be fundamental to identify and prioritize high-concentration PMT substances which require urgent remediation action on regional, national, and international scales.
- Identify industrial source areas of PMT substances and their transformation products, and if necessary regulate their use and release during manufacturing and their life-cycle.
- Add high-risk and high-volume PMT substances to the Chinese national prioritized list of harmful water pollutants,[12] as well as similar lists in other nations,[4] to help ensure active monitoring and management of these substances to protect drinking water resources.
- Actively develop an international response and regulatory framework. Such action could occur through the United Nation's Globally Harmonized System of Classification and Labeling of Chemicals (GHS), to explicitly require the assessment and identification of PMT substances and their environmental transformation products by the chemical manufacturers, with mandatory labeling of PMT substances or their metabolites (Figure 1). This would encourage international scientific and chemical-industry research toward more effectively identifying and managing the release of PMT substances to the environment.

Figure 1. Suggested warning label as part of an international strategy for PMT substances (design H.P.H.A).

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https://dx.doi.org/10.1021/acs.est.0c04281
Environ. Sci. Technol. 2020, 54, 11651–11653

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Notes

The authors declare no competing financial interest.

■ ACKNOWLEDGMENTS

We thank the Editors of *ES&T*, Julie Beth Zimmerman and Margaret Mills, for excellent suggestions, feedback, and input on this Viewpoint. B.J. acknowledges support from Guangdong Foundation for Science and Technology Research (2017B030314057; 2019A1515011035), and a grant from State Key Laboratory of Organic Geochemistry, Chinese Academy of Sciences (SKLOG2020-4). H.P.H.A. acknowledges Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety of Germany (FKZ3719654080).

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