

Chemical Pollution and One Health – from Reactivity to Proactivity October 2023

Water quality in One Health: Managing chemical risks

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Background

Because chemicals are beneficial to modern society and daily life, the number and amount of produced chemicals has continued to increase over the past decades. Some of these chemicals are accumulating in water, often in complex mixtures with individual compounds in low concentrations. Clean water is a prerequisite for healthy ecosystems and safe drinking water as well as one of the United Nations' Sustainable Development Goals. Thus, regulatory bodies must take actions to ensure the availability of wholesome and clean water.

Previously, concerns about hazardous chemicals in the environment were focused on compounds with 'persistent, bioaccumulative and toxic' (PBT) properties. It has been shown that compounds with 'persistent, *mobile* and toxic' (PMT) properties constitute overlooked groups of chemicals that pose a threat to aquatic ecosystems and human health. Examples of such compounds are per- and polyfluoroalkyl substances (PFAS) and pharmaceuticals. Today's water treatment plants are not designed to remove PMT substances, which instead typically slip through technical and natural barriers from source to tap¹.

Thus, there is a clear, urgent need for action to safeguard our waters from PMTs. We adopted the EU Horizon project ZeroPM action model (zeropm.eu) and organized our efforts around the pillars "Awareness", "Prevention", and "Prioritization". An additional pillar, "Removal", was not explicitly addressed but still discussed to some extent.

Approach

The main objectives of the workshop were to: (i) increase awareness of PMT substances in water quality issues, (ii) identify knowledge gaps, and (iii) formulate recommendations for future research and policy work. Joining the workshop were approximately 40 people from academia, regulatory bodies

and non-governmental organizations – primarily with expertise in environmental, human, and animal health – along with people from the water services sector. The "Awareness" theme started with invited speaker Prof. Hans Peter H. Arp, who set the stage and gave ample examples of why and how to address PMT substances. Then, Daniel Hellström talked about the challenges associated with PMT substances at a major Swedish drinking water treatment plant. The "Prevention" and "Prioritization" themes were introduced by Lina Wendt Rasch, who talked about how new, emerging chemicals of concern are identified and reported in Sweden. Prof. of Practice, Elin Lavonen, then presented new effect-based testing methods to assure wholesome and clean drinking water. Round table and panel discussions were held. Finally, a Menti survey with four overarching questions was completed.

Conclusions and Recommendations

Based on our inspirational talks and discussions, we put forward the following conclusions and recommendations.

Topic I: Awareness

Improved awareness of the PMT substance issue is needed from the local to the global level, particularly in areas with less water treatment infrastructure. Two major challenges were identified: (i) to be able to communicate a very complex problem and (ii) to balance the need for raising awareness without causing excessive worry among the public. Public trust in the drinking water industry should be maintained so as to avoid a shift to non-sustainable alternatives, e.g., bottled water.

RECOMMENDATIONS FOR INCREASED AND WELL-BALANCED AWARENESS

- Ensure that scientific professionals are trained to communicate with the public and/or involve professionals with communication expertise.
- Focus on simplified communication to overcome the challenge of complex concepts, e.g., use existing issues the

public is already aware of (like PFAS) and related remediation costs to communicate, and emphasize the connection between PMT substances and other crises.

- Educate people about what PMT substances are and where they can be found, e.g., through education of children and environmental campaigns.
- Avoid overloading the public with information by planning the timing of and approach to raising awareness. Especially for youngsters, do not overload them with problems – with yet another crisis on top of the others.
- Water catchment network approaches are encouraged; this means that local actors (water sector, municipalities, industry representatives, NGOs and scientists) communicate on specific conditions to protect the local water supply and develop possibilities to adapt management accordingly.
- To avoid public mistrust: Emphasize actions drinking water providers are taking to ensure safety, such as investing more in infrastructure, monitoring and tracking pollution sources by using the best available detection methodology.
- Highlight the importance of acting on upstream contamination sources instead of water treatment plants, an approach that lowers costs, is more effective and allows concurrent protection of aquatic ecosystems.
- Increase communication from science to policymakers; provide education on how chemicals and drinking water are linked as well as information on potential effects.

Topic II: Prevention

Preventing emissions of PMT substances addresses the triple crises of climate, biodiversity and pollution, and will eventually reduce the costs to society. Climate effects include the substantial costs of increasing water treatment infrastructure or shifting to imported bottled water. Biodiversity impacts occur due to (eco)toxicological effects. Prevention leads to societal cost reduction, by preventing increased health costs and more expensive drinking water production. Three major challenges were identified: (i) existing legislation is lagging behind and is slow to address emerging issues, (ii) high costs associated with measures of reduction in emission, and (iii) gaps in available technologies for pollution control and feasibility of implementing new technologies at treatment plants.

RECOMMENDATIONS FOR POLLUTION PREVENTION

- Speed up regulation and policy development for pollution prevention by dedicating more resources to research on safe levels of PMT substances.
- Activate Polluter Pays Principle for PMT substances introduced for various uses (e.g., pharmaceuticals or agricultural chemicals), where fee revenues are distributed to water treatment infrastructure.
- Introduce stricter regulation and control at upstream sources to prevent direct emissions.
- Acknowledge the challenge of limited choices, as substitute chemicals may also pose risks and increase costs.
- More resources to research and development of cost-efficient treatment technologies.

- Recognize the need for increased public awareness but place even more emphasis on regulation.
- Call for more data-driven and precautionary approaches in the regulatory framework.
- The drinking water industry should not be obliged to use precautionary strategies but acknowledged for their voluntary measures.

Topic III: Prioritization

The presence of unwanted chemicals in raw and drinking water calls for scientifically sound risk assessment and prioritization methodology. The presence of hazardous compounds can be shown by targeted chemical analysis and/or effect-based methods (such as bioassays and whole organism tests) that measure specific responses from all substances present in a sample. Four major challenges were identified: (i) there is a lack of risk assessment methods for drinking water, (ii) risk assessment based on chemical analysis and exposure to individual compounds is often hampered due to lack of toxicity data, (iii) chemical analysis does not fully describe the presence/absence of hazardous substances in water samples, and (iv) effect-based methods are used as a complement to detect unknown substances and mixture effects; however, regulatory guidelines are lacking and would promote use of these methods.

RECOMMENDATIONS TO PRIORITIZE BASED

ON EXPOSURE AND RISK

- Develop the next generation of risk assessment methods for drinking water, where chemical methods are integrated with effect-based methods.
- Provide regulatory guidelines for risk assessment based on effect-based methods. Start by defining knowledge gaps and other obstacles to providing scientifically sound guidelines.
- Develop existing effect-based methods. New assays are needed to capture a broader range of hazards, especially for endpoints like immune toxicity.

Main take-home messages from the workshop

- Globally, there is an extremely wide gap in chemical legislation (including industrial chemicals, pharmaceuticals, pesticides, industrial emissions, etc.) to address the issue of PMT substances in drinking water. Europe is currently taking initial steps, such as with the revised classification, labelling and packaging (CLP) regulation (EC) (no. 1272/2008), but this has not yet occurred in other global regions, especially low- and middle-income countries.
- Such legislation should be based on the precautionary principle and the Polluter Pays Principle.
- The best way to close the gap in water remediation infrastructure is to develop Water Catchment Networks, comprising the water authorities, municipal authorities and industry representatives, that can work together to prevent emissions upstream.
- The best way to increase awareness of these complex issues is to involve more experts in diverse sectors of society.



Sampling of an aqueous film forming foam (AFFF) contaminated pond.
IMAGE CREDIT: BJÖRN BONNET

- PMT substance pollution is a global concern, but it is only being addressed in some regions in the world. Thus, international efforts are needed to:
- Inform politicians on environmental effects and costs associated with water treatment and embrace the precautionary principle in policymaking as a cost-saving measure.
- Address ethical dilemmas, such as cost allocation and responsibility in pollution prevention.
- Advocate for industry awareness of the environmental effects of their chemicals on water resources.
- Recognize the importance of long-term and mixture effects and the One Health concept.
- Assess toxicity for wildlife, humans and ecosystems using appropriate (sentinel) species.
- Involve the public in a transparent way that is informative without causing fear or loss of trust.

References

1. Arp H.P.H & Hale S.E. (2022) Assessing the persistence and mobility of organic substances to protect freshwater resources, ACS Environ. Au 2022, 2, 6, 482–509. <https://pubs.acs.org/doi/10.1021/acsenvironau.2c00024>

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