

Introduction

Emerging substances of very high concern (SVHC) such as PFAS, organophosphates, benzene derivatives, heavy metals, and cyanotoxins are increasingly being detected in Dutch wastewater and surface water. Due to their persistence, toxicity, and potential for bioaccumulation, these substances pose risks to ecosystems, public health, and compliance with national and international legislation. TOXmini is a portable, easy-to-use qualitative screening system for a broad spectrum of toxic substances, reducing the number of samples requiring quantitative analysis. In this project, a protocol for monitoring and analysis of substances of high concern has been developed, implementing the TOXmini as the central step.

Methods

The monitoring protocol was developed based on OptiSenseData's standardized sample measurement and analytical workflow dedicated to the TOXmini system, incorporating compliance-check tools with predefined toxicity response thresholds. A policy analysis was conducted to define a compliance structure that aligns with regulatory requirements for SVHC emission limits and sampling frequency.

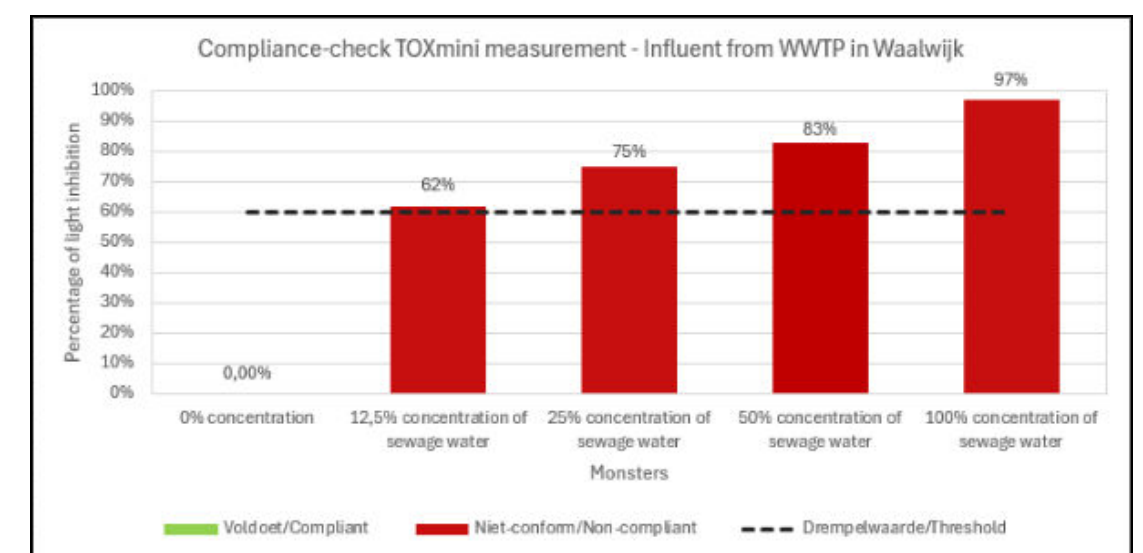
EU Directives reviewed:

- Water Framework Directive and Amending Directive.
- Urban Wastewater Treatment Directive

National law reviewed:

- Besluit activiteiten leefomgeving (Bal)
- RIVM-rapport 2023-0397

Monstype / Sample type	TOXmini rapporteren/Report	TOXmini		Drempelwaarde/Threshold
		Voldeet/Compliant	Niet-conform/Non-compliant	
0% concentration	0%	0,00%	#N/A	60%
12,5% concentration of sewage water	62%	#N/A	62%	60%
25% concentration of sewage water	75%	#N/A	75%	60%
50% concentration of sewage water	83%	#N/A	83%	60%
100% concentration of sewage water	97%	#N/A	97%	60%



Results

Most core parameters relevant to the monitoring protocol are already regulated under European or national legislation, or will be regulated through the Amending Directive 2000/60/EC, which defines clear environmental protection thresholds.

Substance	Emission limit [$\mu\text{g/l}$]
n-Propyl benzene	4
tert-Butylbenzene	4
Bisphenol A (BPA)	2,5
4,4'-Sulfonyl diphenol	2,5
Ammonium	400
Cadmium and its compounds (depending on water hardness classes)	≤ 0.45 (Class 1)
	0.45 (Class 2)
	0.6 (Class 3)
	0.9 (Class 4)
	1.5 (Class 5)
Mercury and its compounds	0,07
Zinc	65
Phosphorus	500
Sum of 25 PFAs	0,077
Benzene	50
1,2,3-Trichlorobenzene	0,4
1,2,4-Trichlorobenzene	0,4
1,2,4-Trimethylbenzene	4
1,2-Dichlorobenzene	0,4
1,3,5-Trichlorobenzene	0,4
1,3-Dichlorobenzene	0,4
1-Chloro-3-nitrobenzene	0,4
Ethylbenzene	4
Chlorobenzene	0,4
n-Butylbenzenesulfonamide	0,007
Nitrobenzene	0,4

Where specific emission limits were unavailable, conservative proxy values were derived from structurally similar regulated parameters. In addition, sampling frequencies and reporting obligations were recommended in line with mandatory monitoring requirements under the Besluit activiteiten leefomgeving.

Conclusion/Discussion

The protocol presented in this study was designed to define clear requirements, sampling schedules, and regulatory emission limits for SVHCs when the TOXmini identifies a pollution event. Although some substances remain unregulated and uncertainties persist regarding industry-specific sampling frequencies, the study met its objectives by deriving conservative proxy values from regulated substances and identifying the relevant regulatory frameworks that must be consulted to determine whether parties are required to measure and report emissions to the competent authority.

References

- <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52022PC0540>
- <https://iplo.nl/regelgeving/omgevingswet/inhoud/besluit-activiteiten-leefomgeving/#h2dd8243a-cf89-638d-afd8-08f4014e6172>
- <https://eur-lex.europa.eu/eli/dir/2024/3019/oj/eng>
- <https://www.rivm.nl/publicaties/beoordelingskader-voor-gebruik-stedelijk-afvalwater-in-landbouw-fase-1-wettelijke>