



Biocides in Soils of Stormwater Infiltration Facilities - Occurrences and Source Types



Biocides used in facade renders and paints wash off from facades



Higher biocide wash off directly after painting



Stormwater infiltration facility

How much biocide is present in the soil of stormwater infiltration facilities (SIF)?

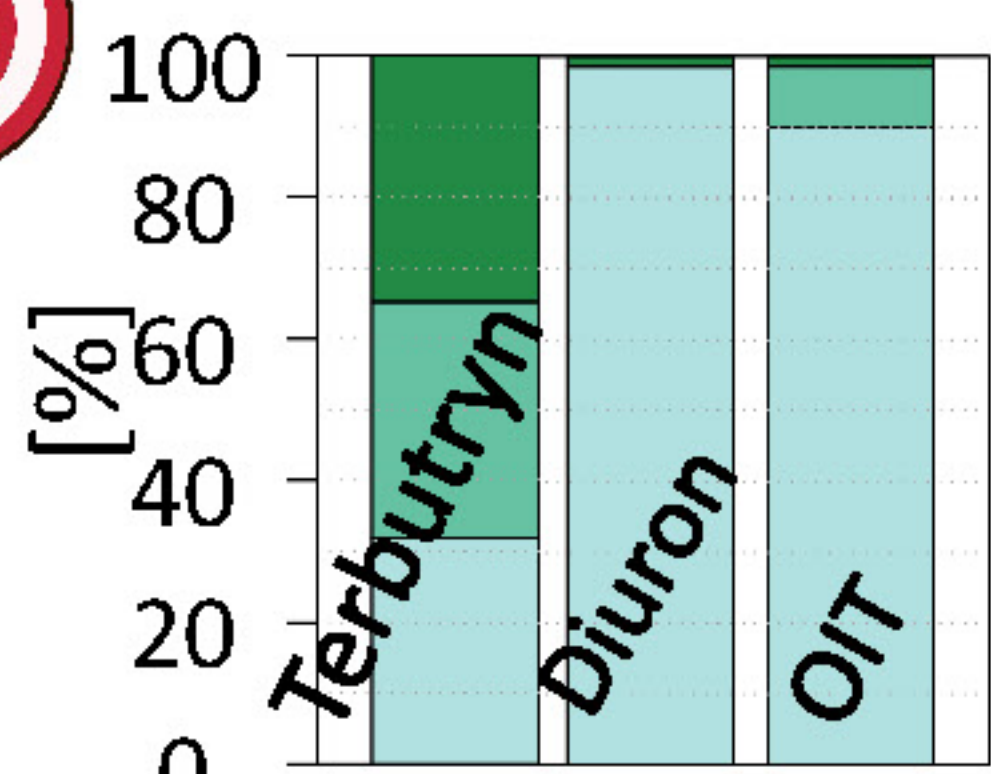
1. Are there indications of **point** (e.g. construction sites) and **non-point sources** (diffuse input) of biocides in SIF soils?
2. Are biocide **concentrations higher in soils of newer SIF** due to higher inputs and limited degradation?
3. Are biocide **concentrations higher in samples with higher organic content** and clay content due to higher sorption potential?



- Biocides wash off from facades during wind-driven rain events and can have adverse impacts on the environment
- Biocides can enter groundwater via stormwater infiltration facilities (Hensen et al. 2018)
- SIF temporarily retain and infiltrate stormwater
- limited knowledge about occurrence and temporal behavior of biocides in SIF soils

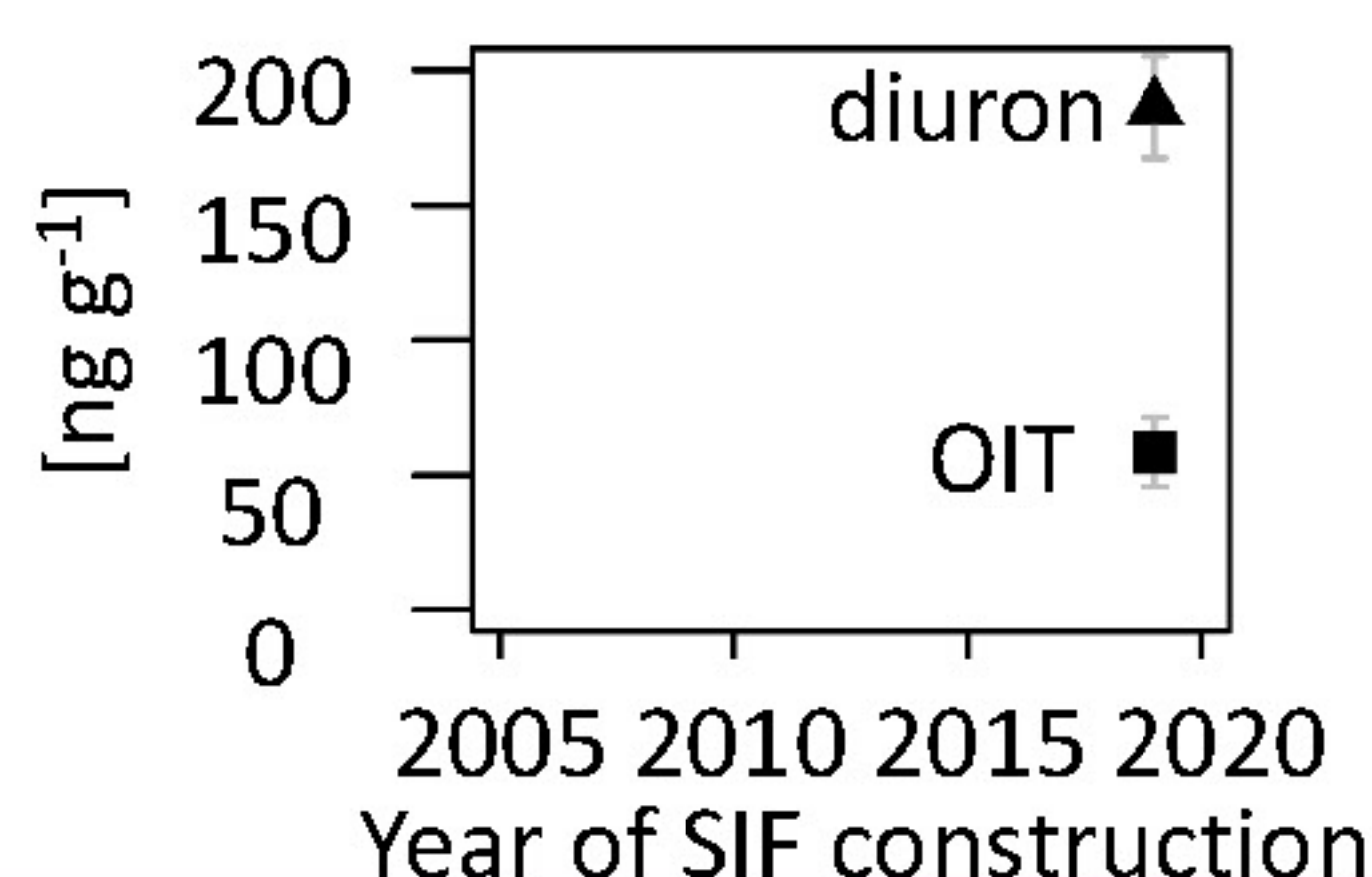


1. Point and non-point sources



- Terbutryn in 78% of sampled SIF
 - Two transformation products of terbutryn (terbutryn-sulfoxide and desethyl-terbutryn) detected in 11% and 8% of samples that also contained terbutryn imply degradation
- Findings suggest non-point sources for terbutryn from diffuse inputs

- Biocides octylisothiazolinone (OIT) and diuron quantified in only one sample
- High concentrations suggest point source contamination such as



Methods

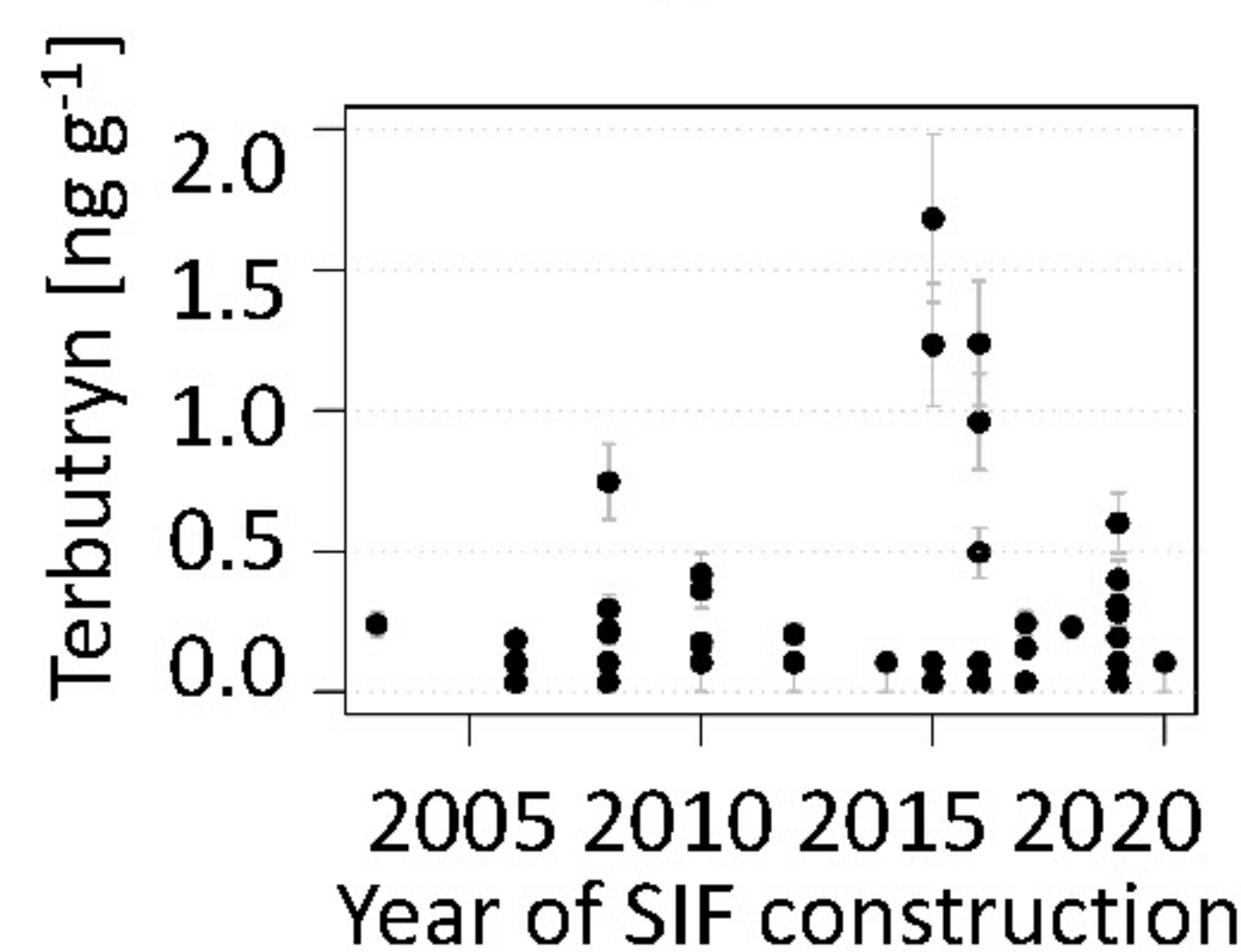
- Sampling of 55 SIF soils
- SIF located in Freiburg, Germany and Strasbourg, France
- Analysis of 3 biocides and 4 transformation products used in facade paints and renders
- Analysis of organic content and clay content



Sampling of soil in a stormwater infiltration facility



2. Influence of age



- Higher concentrations of terbutryn in recently built SIF
- suggests input amount of biocides most important



3. Soil clay and organic matter content

- No correlation of soil clay and organic matter content with terbutryn concentration
- Indicates that factors other than sorption are more important, such as biocide input

Implications



1. Terbutryn can be used as a non-point marker



2. Input of biocides drives concentrations in SIF



3. Leaching to groundwater via SIF may take place

→ Micropollutants such as biocides should be considered in SIF design and monitoring



Abstract

✉ felicia.linke@hydrology.uni-freiburg.de



Authors: **Felicia Linke**^{1, 2}, Omoyemi Edun¹, Tobias Junginger^{3, 4}, Sylvain Payraudeau³, Frank Preusser², Gwenaël Imfeld³, and Jens Lange¹

¹Hydrology, Faculty of Environment and Natural Resources, University of Freiburg, 79098 Freiburg, Germany

²soilary Geology and Quaternary Research, Faculty of Environment and Natural Resources, University of Freiburg, 79104 Freiburg, Germany

³Institut Terre et Environnement de Strasbourg, Université de Strasbourg/ EOST/ ENGESS, CNRS, UMR 7063, F-67084, Strasbourg, France

⁴VEGAS, Institute for Modelling Hydraulic and Environmental Systems, University of Stuttgart, 70569 Stuttgart, Germany

Literature:

- Hensen, B., Lange, J., Jackisch, N., Zieger, F., Olsson, O., and Kümmerer, K.: Entry of biocides and their transformation products into groundwater via urban stormwater infiltration systems, *Water research*, 144, 413–423, doi:10.1016/j.watres.2018.07.046, 2018.
- Linke, F., Edun, O., Junginger, T., Payraudeau, S., Preusser, F., Lange, J.: Biocides in soils of urban stormwater infiltration systems – indications of non-point and point source inputs Submitted to *Water, Air & Soil Pollution*, 2023.