

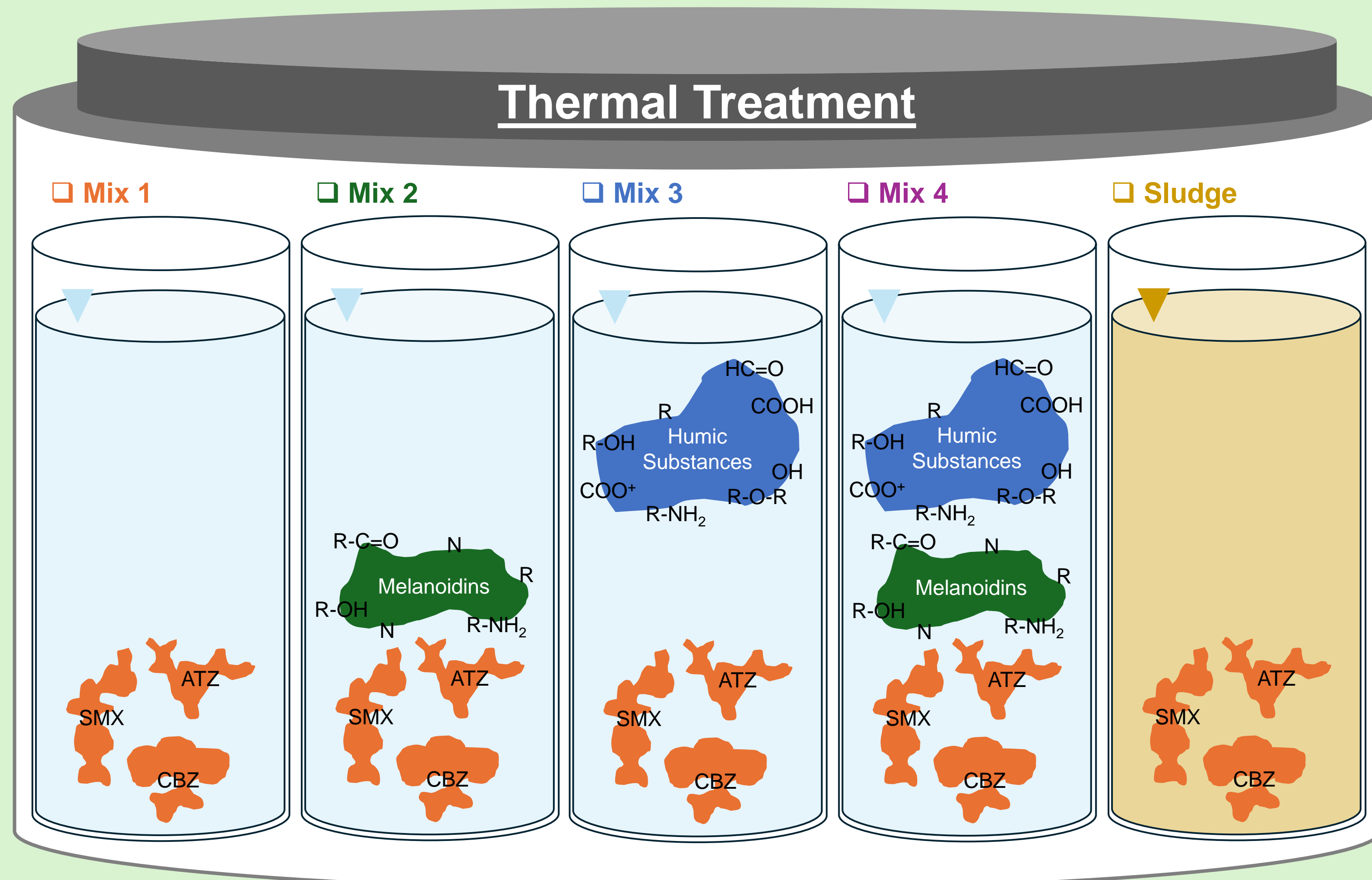
Is Thermal Hydrolysis of sludge really removing Organic Micro-Pollutants?

Andrea Deiana, Jules van Lier, Merle de Kreuk (TU Delft, Watermanagement Department)

The persistent **Atrazine (ATZ)**, **Carbamazepine (CBZ)** and **Sulfamethoxazole (SMX)** occur in **wastewater sludge**, limiting its safe reuse. Thermal hydrolysis processes could remove OMP from sludge: unravelling interactions with organic compounds present (**Humic Substances**) and formed (**Melanoidins**) during treatment is crucial to understand **OMP removal in Thermal Hydrolysis Processes (THP)**. By progressively increasing matrix complexity where they are **spiked**, we aim to show the mechanism behind the compounds' **apparent removal**, comparing masses before and after treatment.

Materials and Methods

Thermal Treatment



Sample Preparation & LC-MS Analysis

Experimental Sample Types	1	2	3	4	5
500 µg/L ATZ or CBZ or SMX	X	X	X	X	X
~1 g/L TOC Glycine+Glucose solution*		X		X	
~1 g/L TOC Humic Acid (HA) Na-salt			X	X	
Lab-grown Waste Activated Sludge (WAS)					X

*to form Melanoidins (ML) during thermal treatment

Liquid samples (1, 2, 3, 4):

1. Filtration: 0.2 µm GF filter; 2. Dilution; 3. Adding Internal Standard.

WAS samples (5):

1. WAS fractionation: Centrifugation 14 kG, 15 min;
→ WAS Supernatant: treated as liquid samples.

→ WAS Pellets to MeOH extraction:

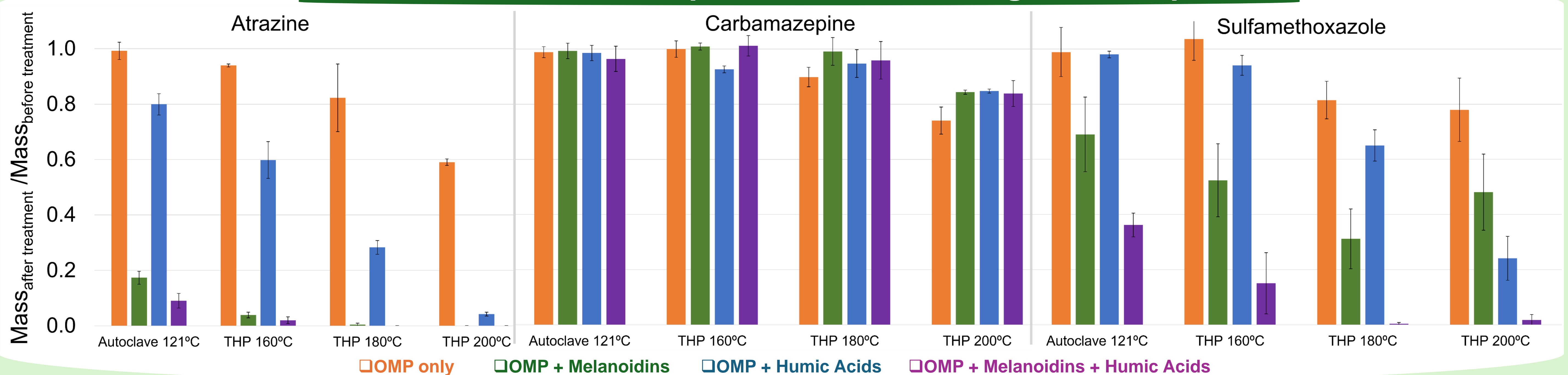
→ MeOH extraction supernatant: treated as liquid samples.

Target Measurement:

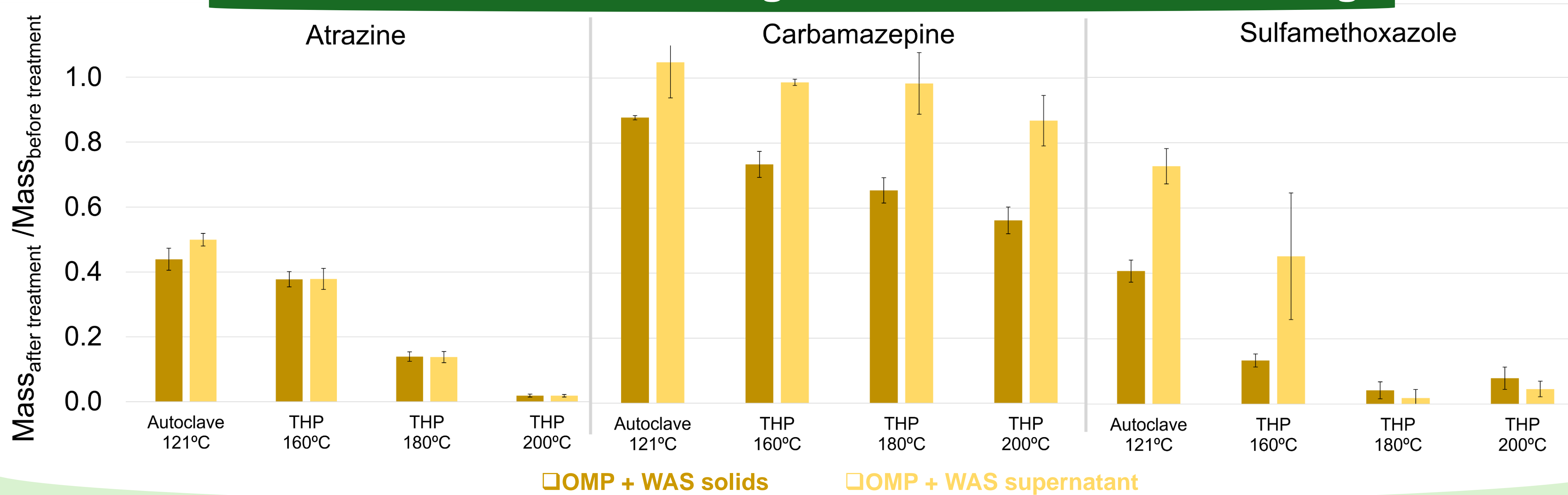
ACQUITY UPLC® BEH C18 (Waters) column 2.1 x 50 mm, 1.7 µm
Mobile phase: water (A) and MeCN (B) (0.1% formic acid), 0.35 mL/min
Detection: Xevo TQ-S micro MS, electrospray ionisation +/- mode
Quantification: Isotope dilution

Results

Thermal Treatment of Liquid Matrices with Organic Compounds



Thermal Treatment of Lab-grown Waste Activated Sludge



Key Discussion

- Melanoidins** form during thermal treatment when precursors are present (browning).
- ATZ binds to ML**, causing **apparent removal**.
- ATZ and SMX** become undetectable with ML and HA, likely due to complexation.
- Partial OMP degradation** occurs; removal at 200 °C: ATZ (40%), CBZ (30%), SMX (20%).
- CBZ** shows **weaker interaction** with organics than ATZ and SMX.
- OMP behaviour in WAS liquid phase mirrors** that in simpler ML/HA matrices.

Main Takeaways

- ATZ** and **SMX** became more **undetectable** with increased matrix complexity, showing **apparent removal** due to the **interaction** with **organic compounds**.
- CBZ** stayed **more detectable** in **liquid fractions** than in **WAS solids**.
- Positive **effect of temperature** observed in the mechanism resulting in the **apparent removal** of the OMPs.

The MSCA ITN Project