

Passive Sunlight-Driven Remediation via Solar Photocatalysis

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Passive, naturally powered water treatment and emissions control technology.



SolarPass

Solar Advanced Oxidation

High strength, passive light-activated oxidation treatment.



Stratus

Reactive Emissions Barrier

Emissions and odor trapping and treatment for water.



Oasis

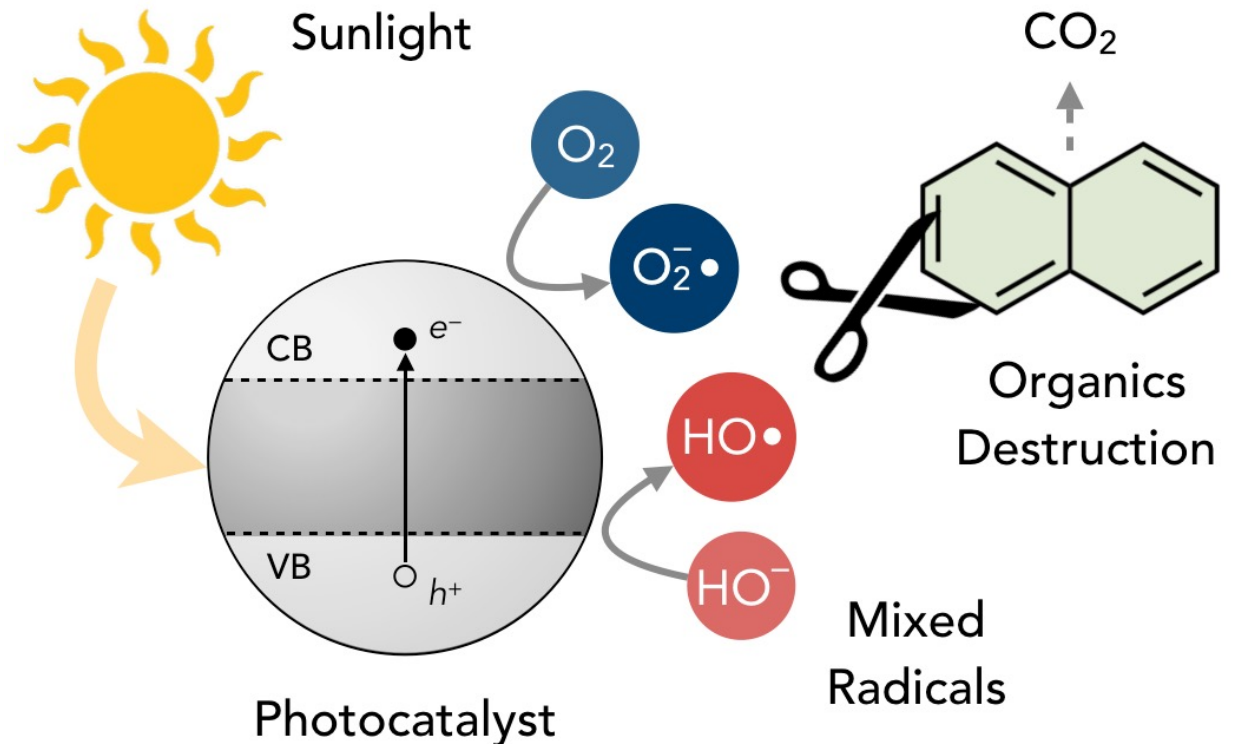
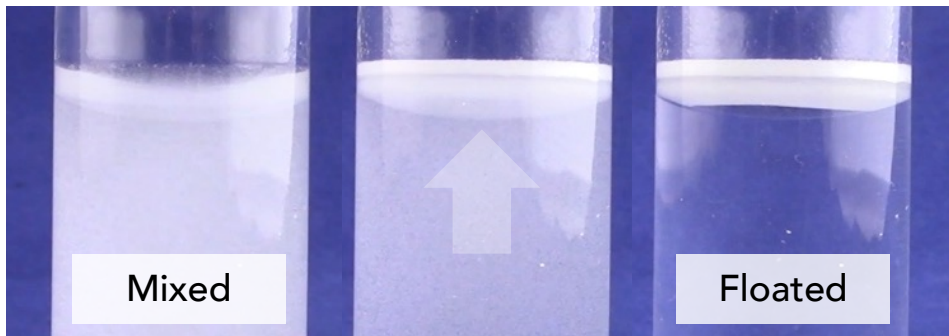
Enhanced Evaporation

Passive acceleration of solar-thermal evaporation.



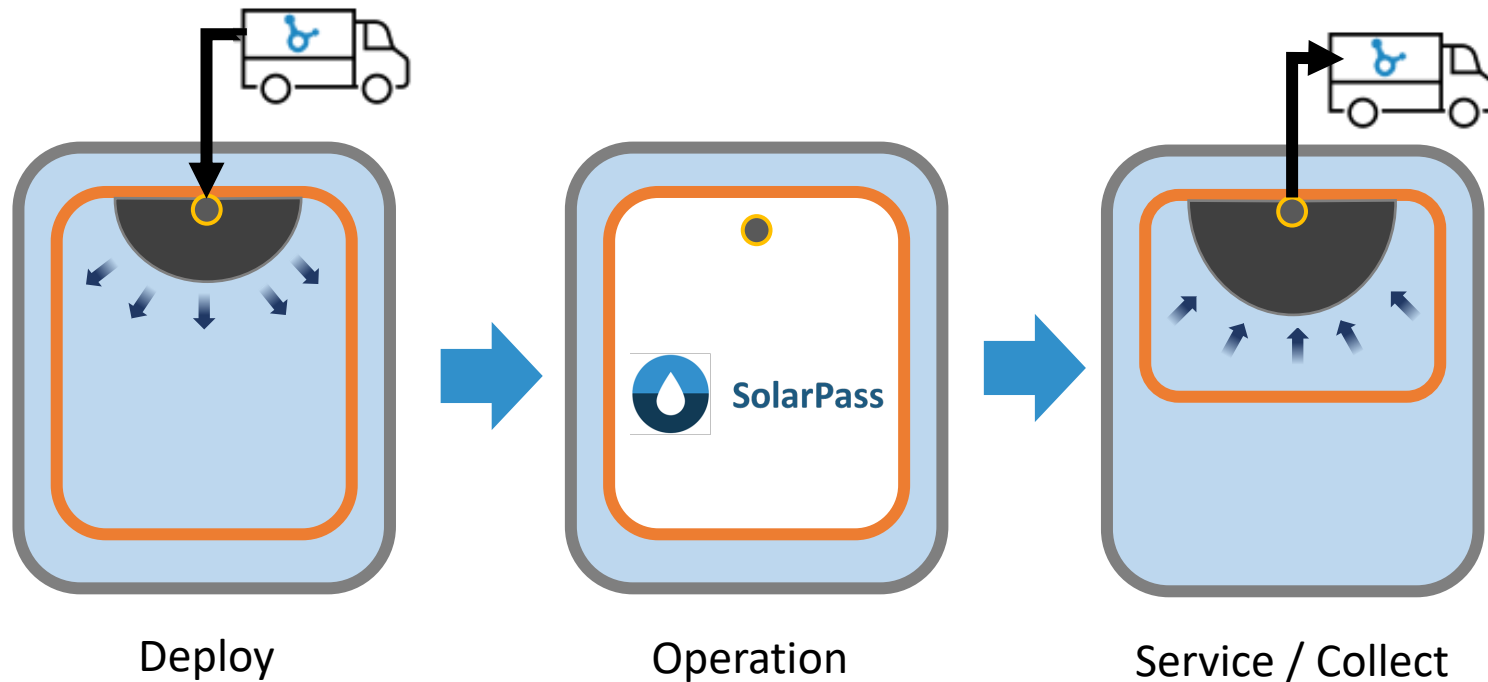
How Photocatalysis Works

- Photocatalyst produces oxidants from water
 - Hydroxyl radicals, HO^\bullet
 - Superoxide radicals, $\text{O}_2^{\bullet-}$
- Buoyant substrate for deployment and collection.



Technology Deployment

- H2nanO materials are deployed onto the surface as a slurry.
- Modular operation for expandable ponds, tanks, or lagoons.



Example Lagoon Operation



SolarPass



High-Strength Oxidation

Powerful, tailored treatment.



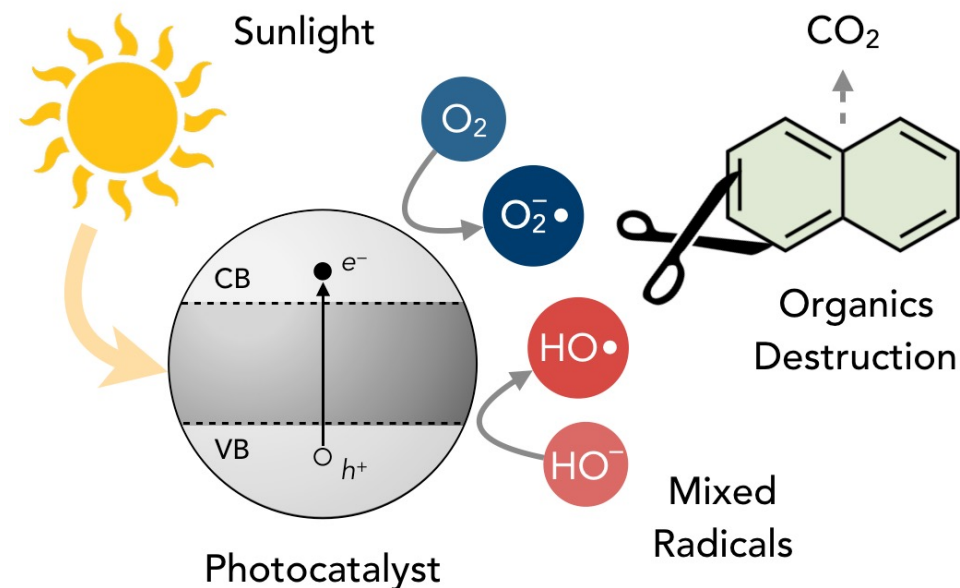
Sunlight Activated

Off-grid, direct sunlight power.



Passive & Low Input

No chemical inputs, sustainable.



Se Bio-availability

COD

TOC

BTEX

Phenols

PAHs

Ammonia

Manganese

H_2S



SolarPass



High-Strength Oxidation

Powerful, tailored treatment.



Sunlight Activated

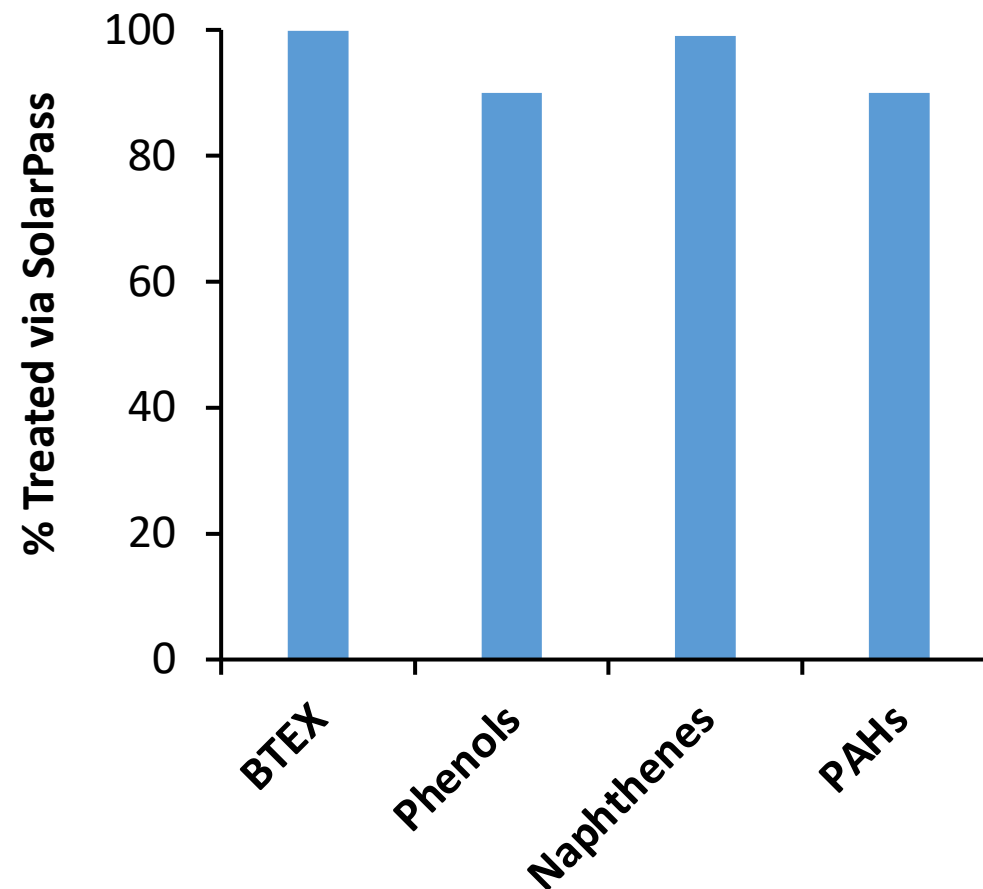
Off-grid, direct sunlight power.



Passive & Low Input

No chemical inputs, sustainable.

Effective Removal of Recalcitrant Organics



Se Bio-availability

COD

TOC

BTEX

Phenols

PAHs

Ammonia

Manganese

H₂S

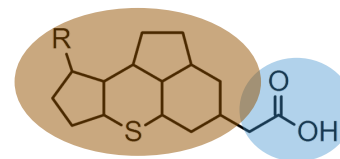
Treatment of Recalcitrant Organics in Oil Sands Process Water (OSPW)

Passive Treatment at Mine Scale

- >470M m³ of process water stored in these surface tailings ponds.
- The process water contains organics of environmental concern.
- Toxicity linked to long chain organic acids (i.e., naphthenic acids).
- Passive treatments are desired by operators.

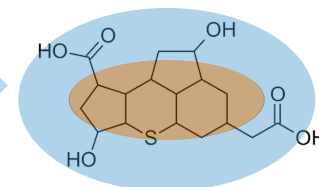


Untreated Compounds

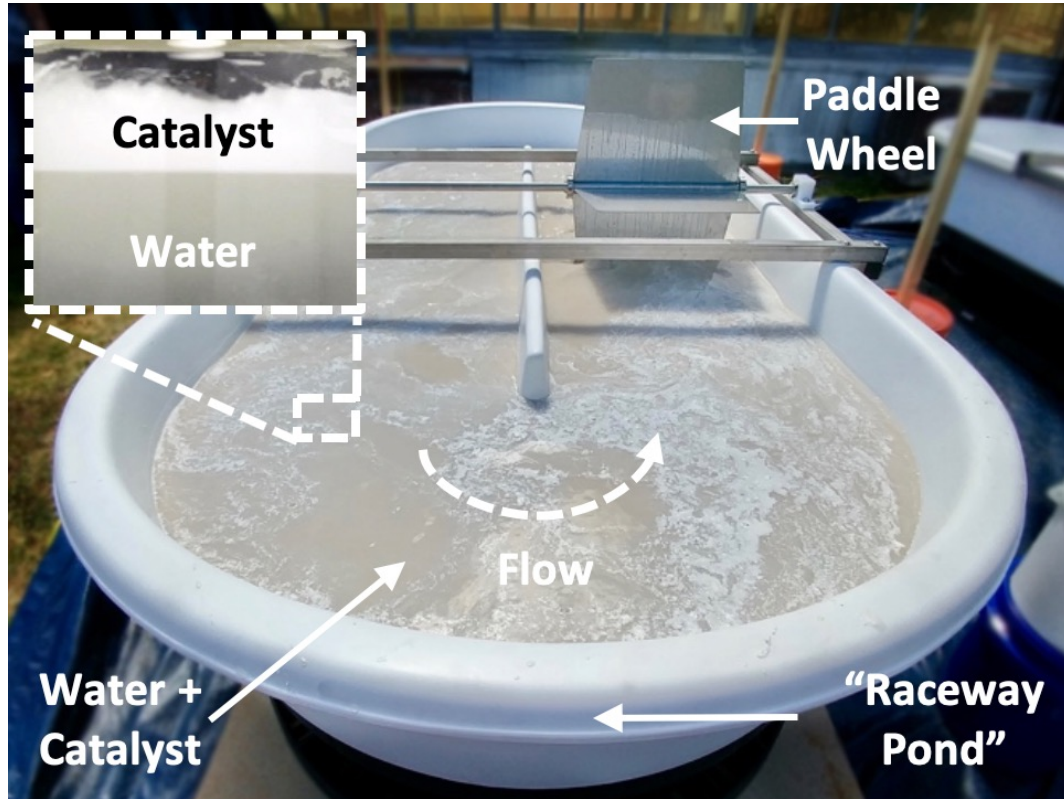


Oxidation

Treated Compounds

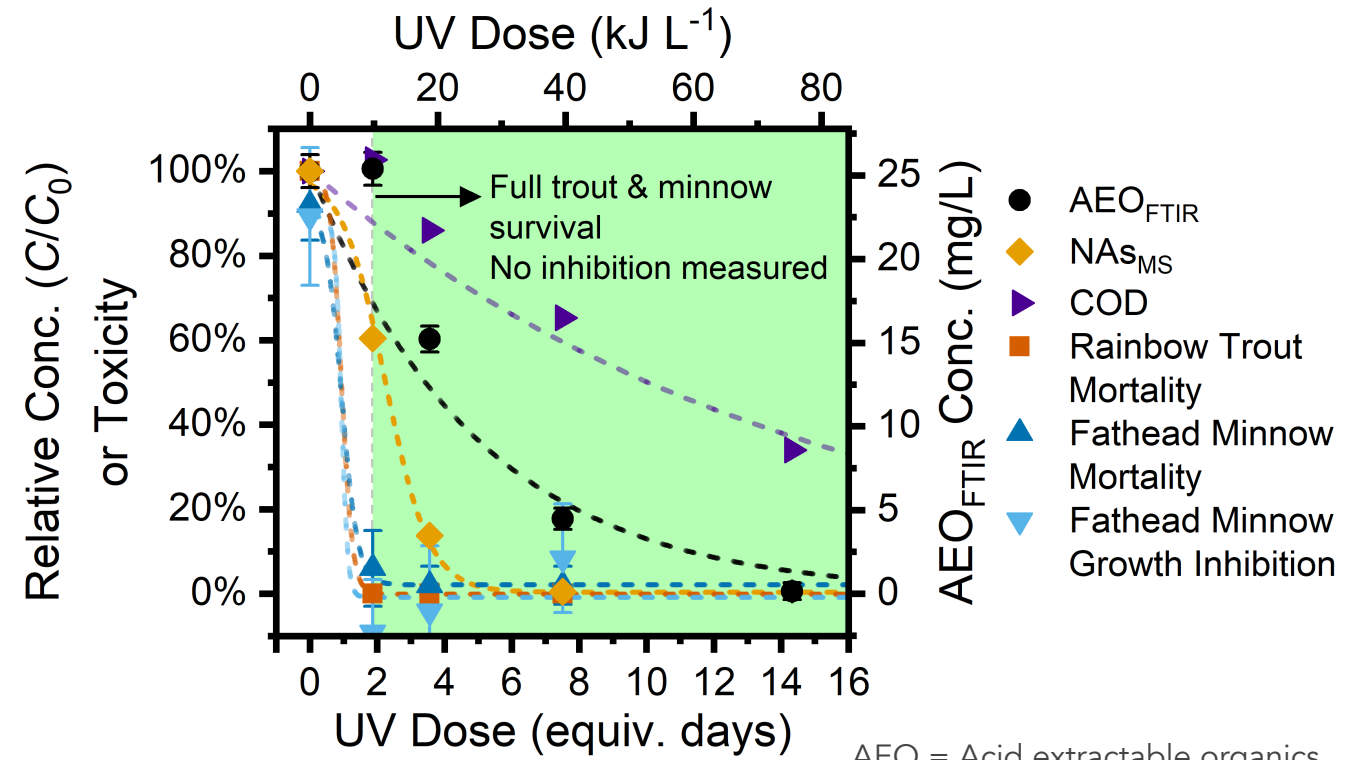


Prototype Trial Demonstrates OSPW Detoxification – 800 L



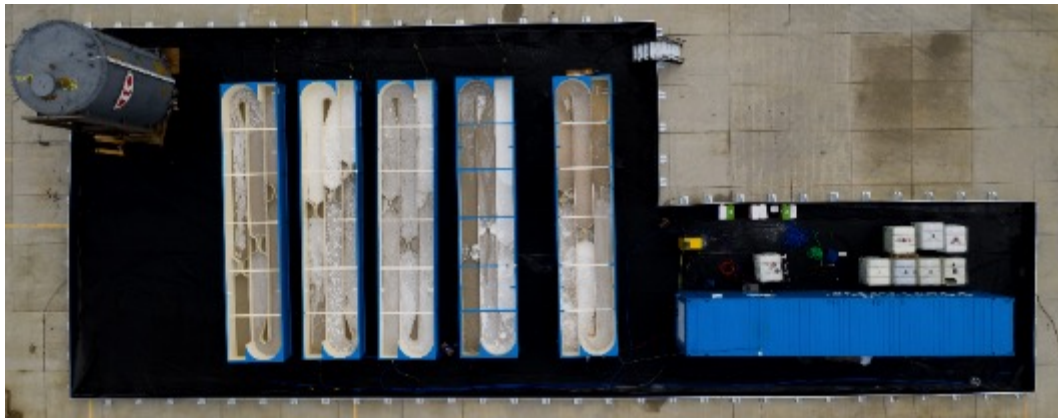
Pilot Trial: 800 L scale
Study Location: Waterloo, ON

100% organics elimination possible, but not necessary.



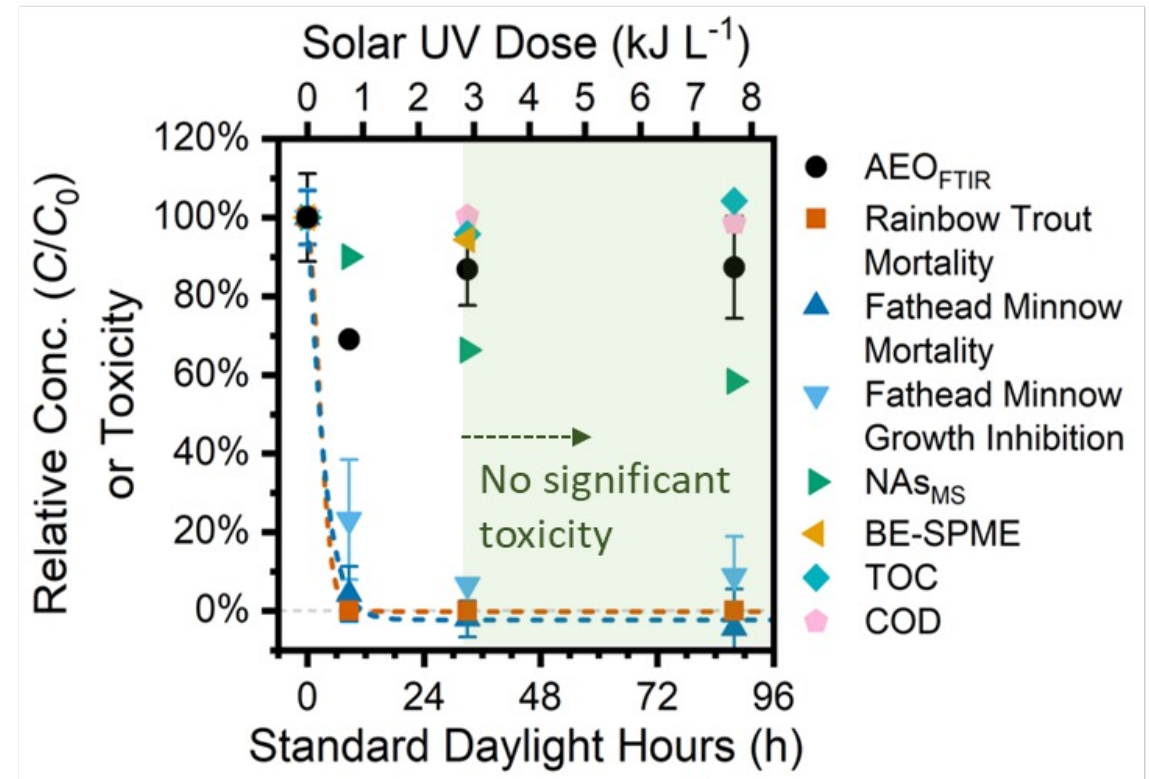
AEO = Acid extractable organics
NA = Naphthenic acids
COD = chemical oxygen demand

SolarPass Proven for OSPW Detox. at Pilot Scale – 40,000 L



Pilot Trial: ~40 m³/day scale
 Study Location: Edmonton, AB

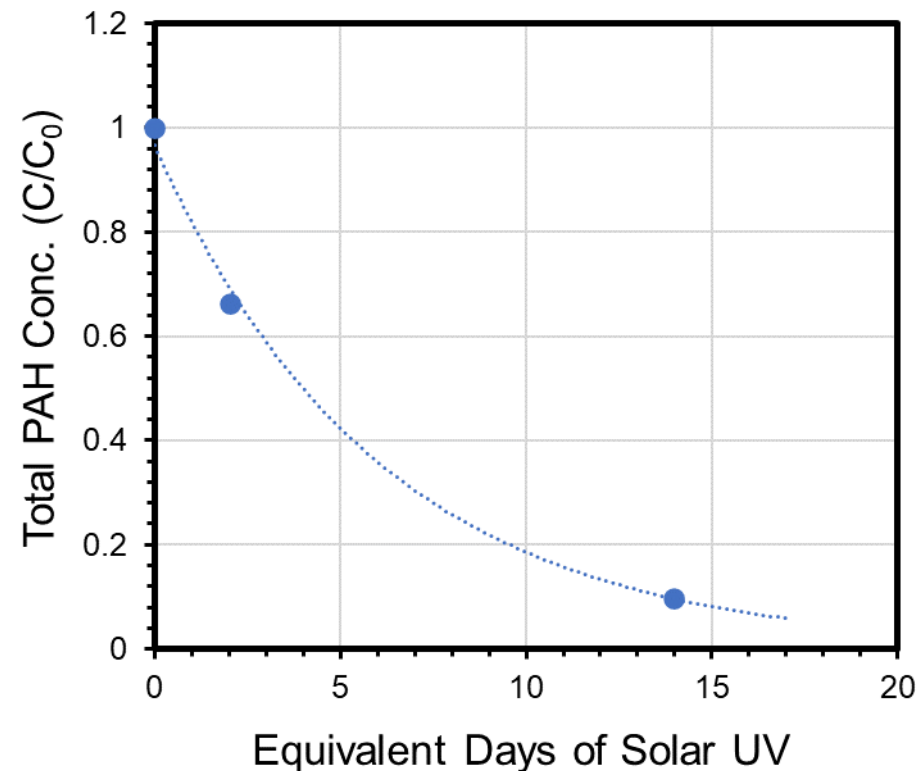
OSPW – 1 Day Treatment Threshold



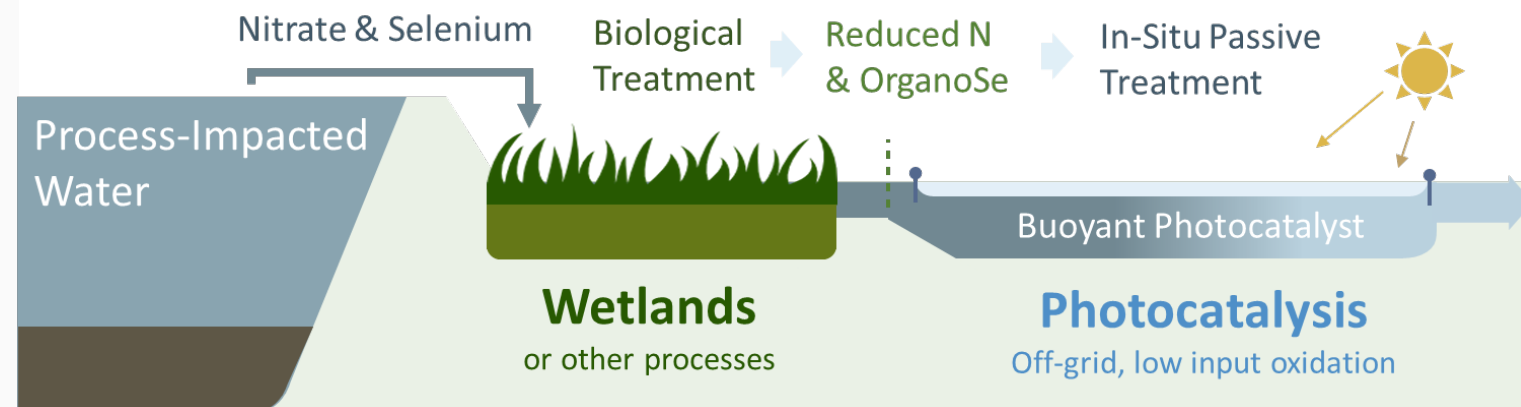
AEO = Acid extractable organics
 NA = Naphthenic acids
 BE-SPME = biomimetic solid-phase microextraction
 TOC = Total organic carbon
 COD = chemical oxygen demand

Passive Polycyclic Aromatic Hydrocarbon (PAH) Treatment

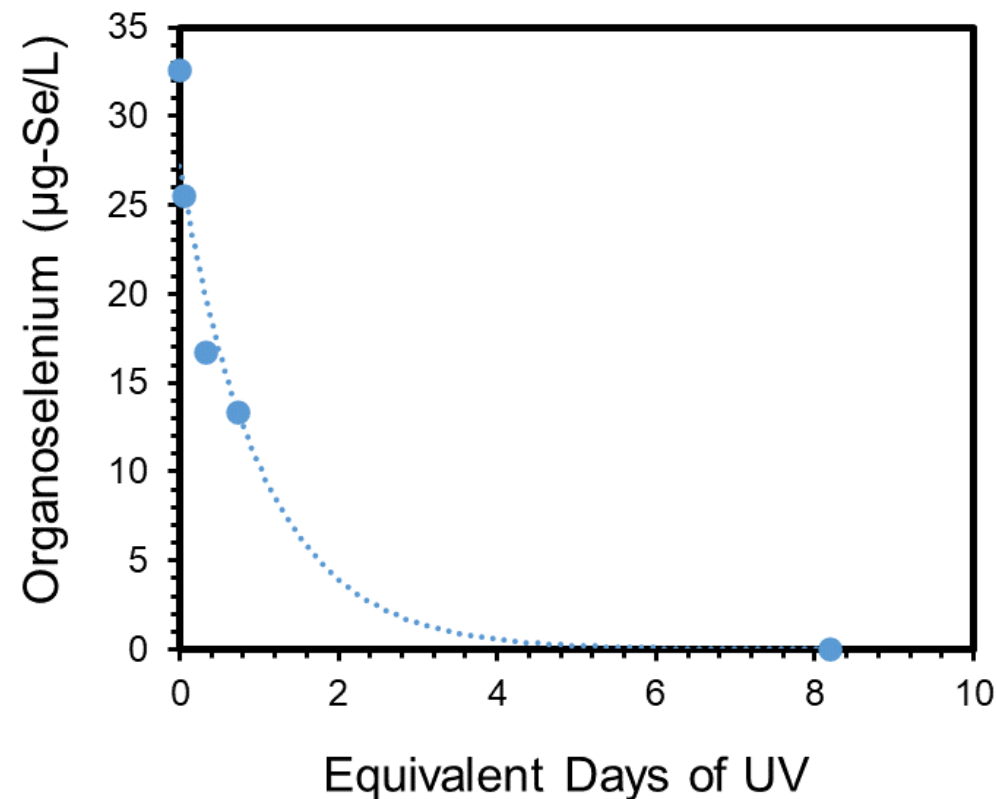
90% PAH removal after 2 weeks passive treatment (ppb level conc.)



Photocatalysis Enhances Existing Treatment Systems – Se Removal



- Photocatalysis evaluated for wetland polishing to remove organoselenium by-products
- Organoselenium compounds are up to **10,000x more bio-available** than selenate
- Rapid removal of OrgSe to <10 ppt using SolarPass



Photocatalysis Applications for Trace Elements

Oxidative Precipitation



Demonstrated using SolarPass



Demonstrated, mechanism under investigation



Demonstrated in literature

Mn/Fe Co-precipitation



Reduction/Adsorption



Aqueous Mn(II) Effectively Removed via Photocatalysis (PC)

Mine-Water Sample	Mn Initial (mg/L)	Removal Rate (g/m ² /d)	Removal %
Sample 1	345	0.82 ± 0.16	35
Sample 2	9.3	0.35 ± 0.09	90



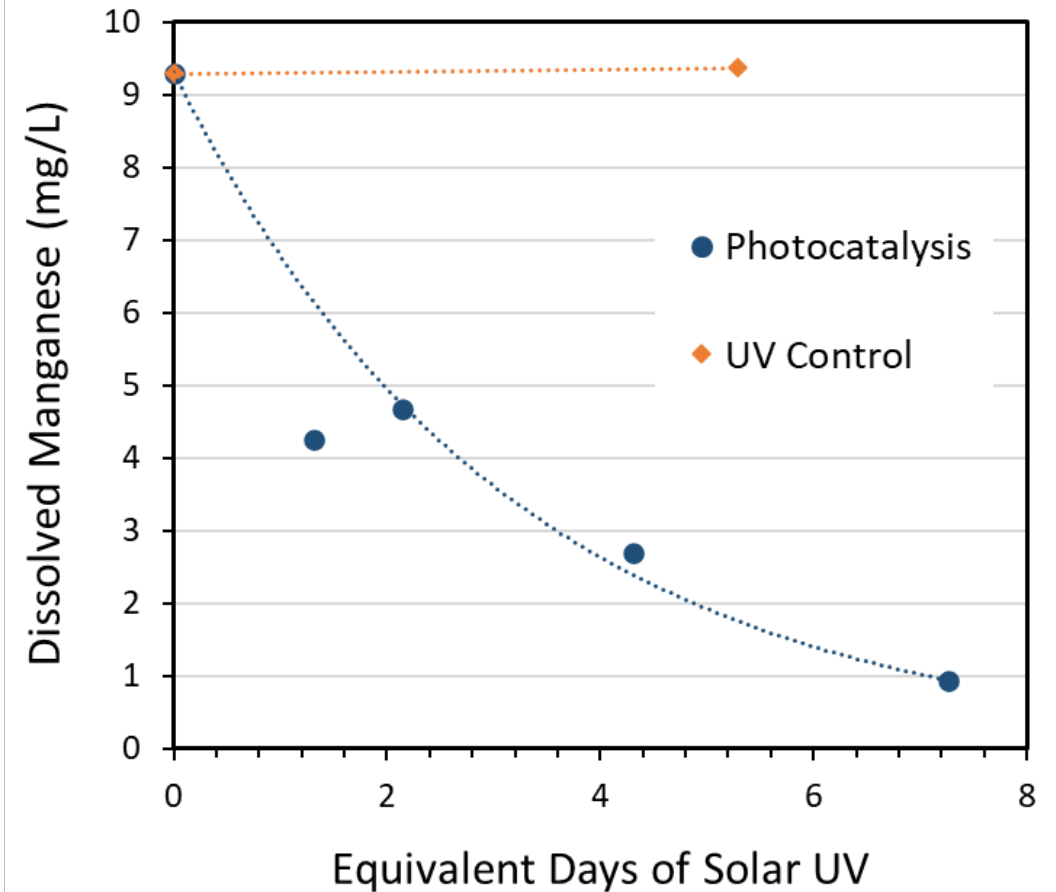
Initial



PC Final



UV Control Final

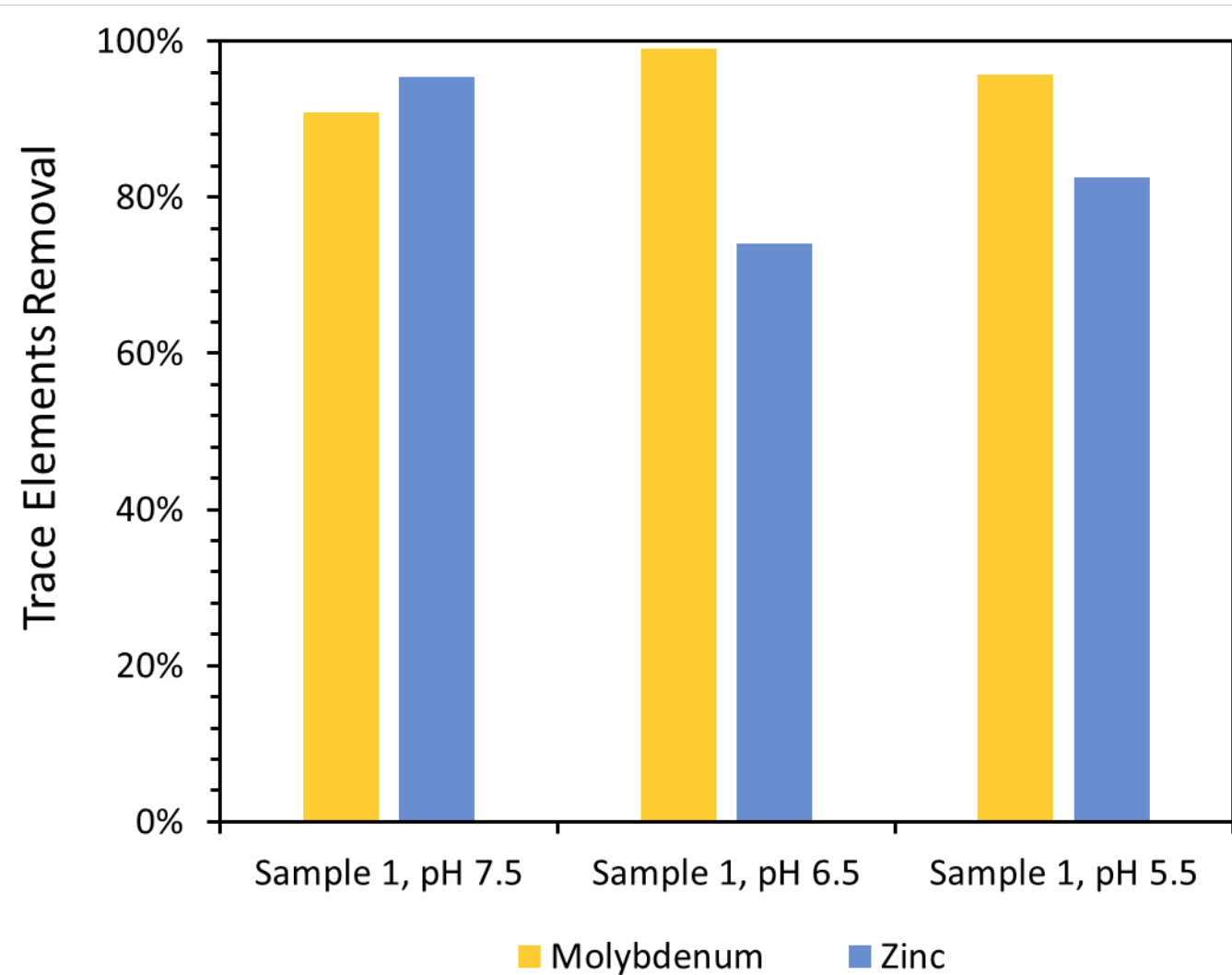
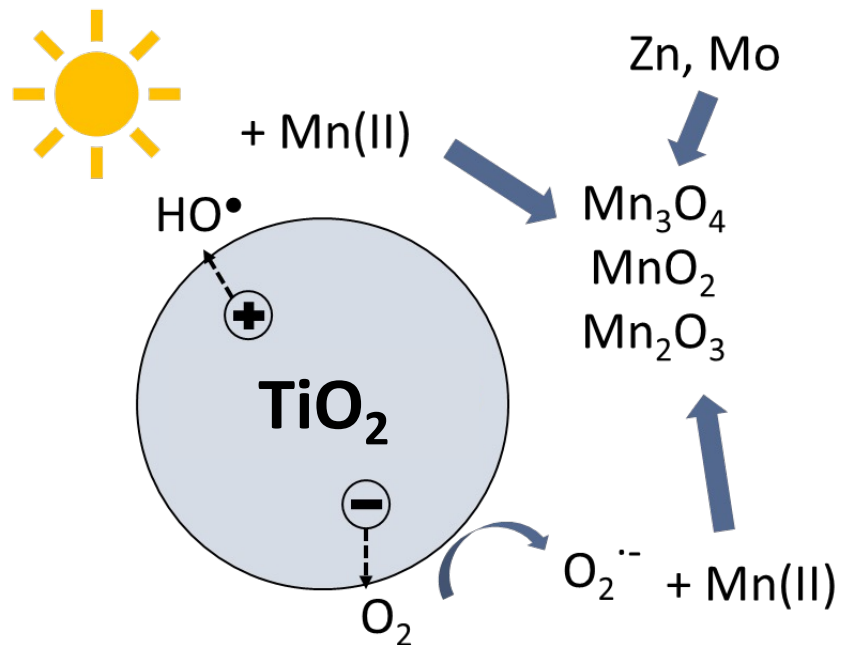


Sample 2 treatment results at pH 6.5. Control performed under similar UV and mixing without photocatalyst.

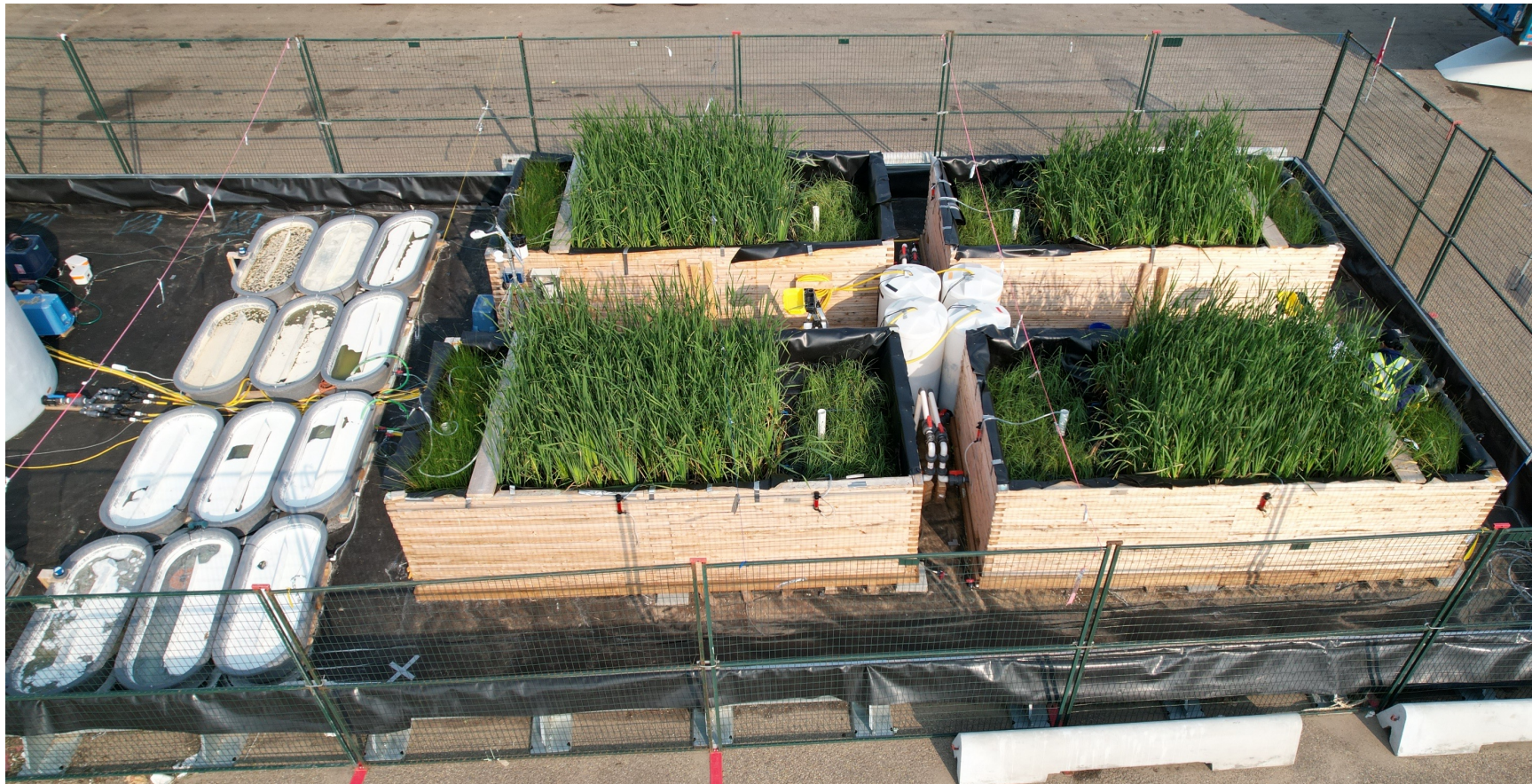
Co-Treatment of Additional Trace Elements Demonstrated

98% Zn removal at pH 7.5 (23 mg/L initial)

99% Mo removal at pH 6.5 (1 mg/L initial)

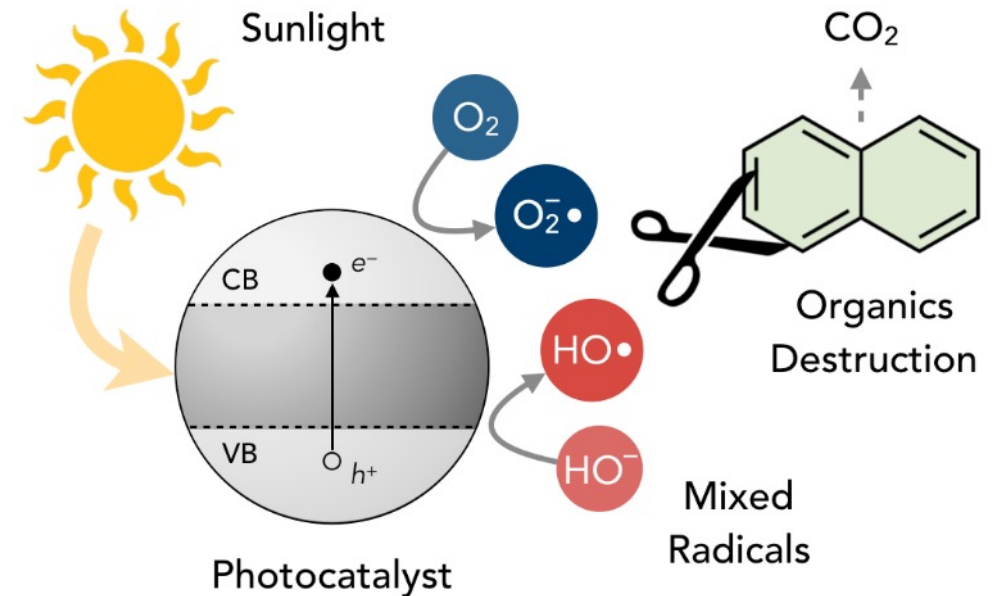


Photocatalysis and Biological Treatment at Pilot Scale



Solar Photocatalysis Summary

- Photocatalysis is an effective treatment solution for organics
 - Demonstrated at scale (40 m³, >500 m²).
- Floating photocatalytic barrier effective for volatiles containment and treatment.
- High strength oxidation comparable to ozone or UV/H₂O₂
- Reduced CAPEX and OPEX.



Thank you – Questions?



Applications

Petroleum Hydrocarbons

Polycyclic Aromatic Hydrocarbons (PAHs)

BTEX & Volatile Organic Carbons (VOCs)

Trace Elements

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