

# Novel In-Ground Hybrid Adsorption Biological Treatment System (HABiTS) for Enhanced Onsite Wastewater Treatment

## Background

### Why Enhanced Onsite Wastewater Treatment Systems (OWTS)?

- ✓ Conventional septic systems remove ~ 30% of influent Nitrogen (N) and 60% of influent Phosphorus (P).
- ✓ **Florida House Bill 1379 (2023-169):** Residents near vulnerable watersheds must switch to advanced OWTS by 2030 or connect to sewers.
- ✓ Protect aquatic ecosystems and drinking water sources.
- ✓ Enhance water-related tourism in Florida.
- ✓ Produce high-quality effluent for reclaimed purposes.

### Why add adsorbents (Zeolite and Biochar)?



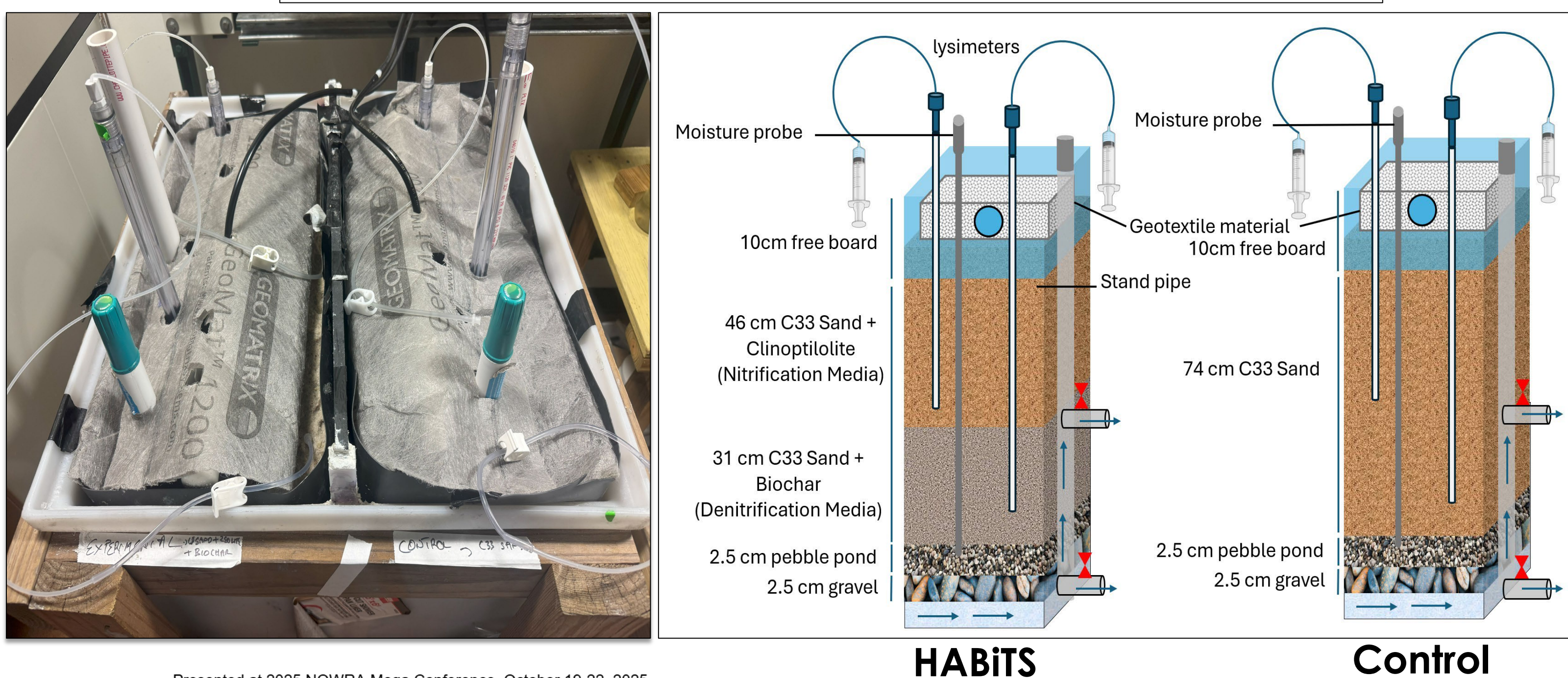
## Objectives

- ✓ Investigate the hydraulic effects of zeolite and biochar on biofilters.
- ✓ Investigate the effects of zeolite and biochar amendment on N removal.
- ✓ Assess adsorbent impact on Chemical Oxygen Demand (COD), color, organics, and Fecal Indicator Bacteria (FIB) in HABiTS.

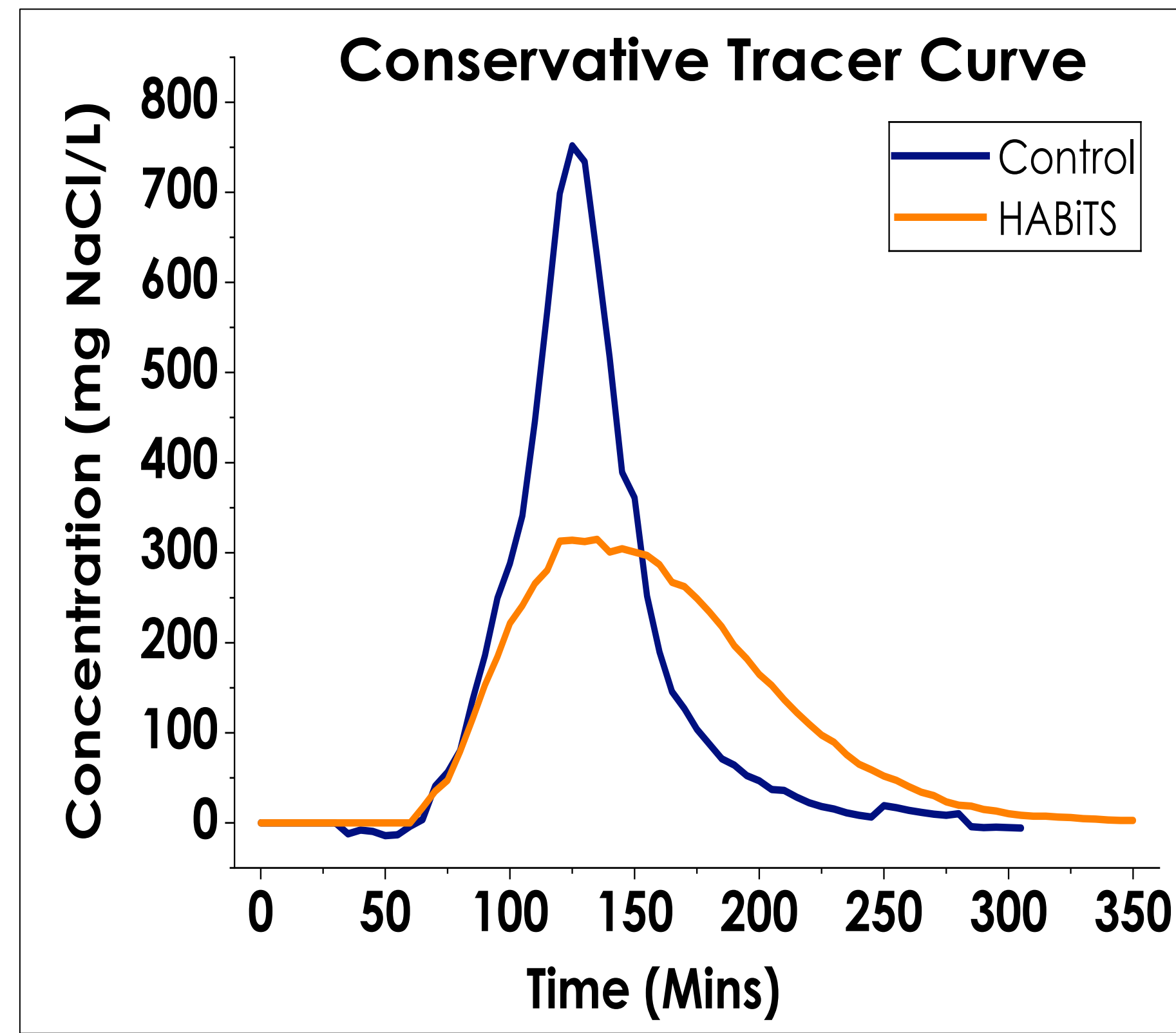
## Methods

- ✓ Two mesocosm reactors were constructed: a zeolite + biochar amended unit (**HABiTS**) and a sand-only **Control**, to evaluate the study objectives.

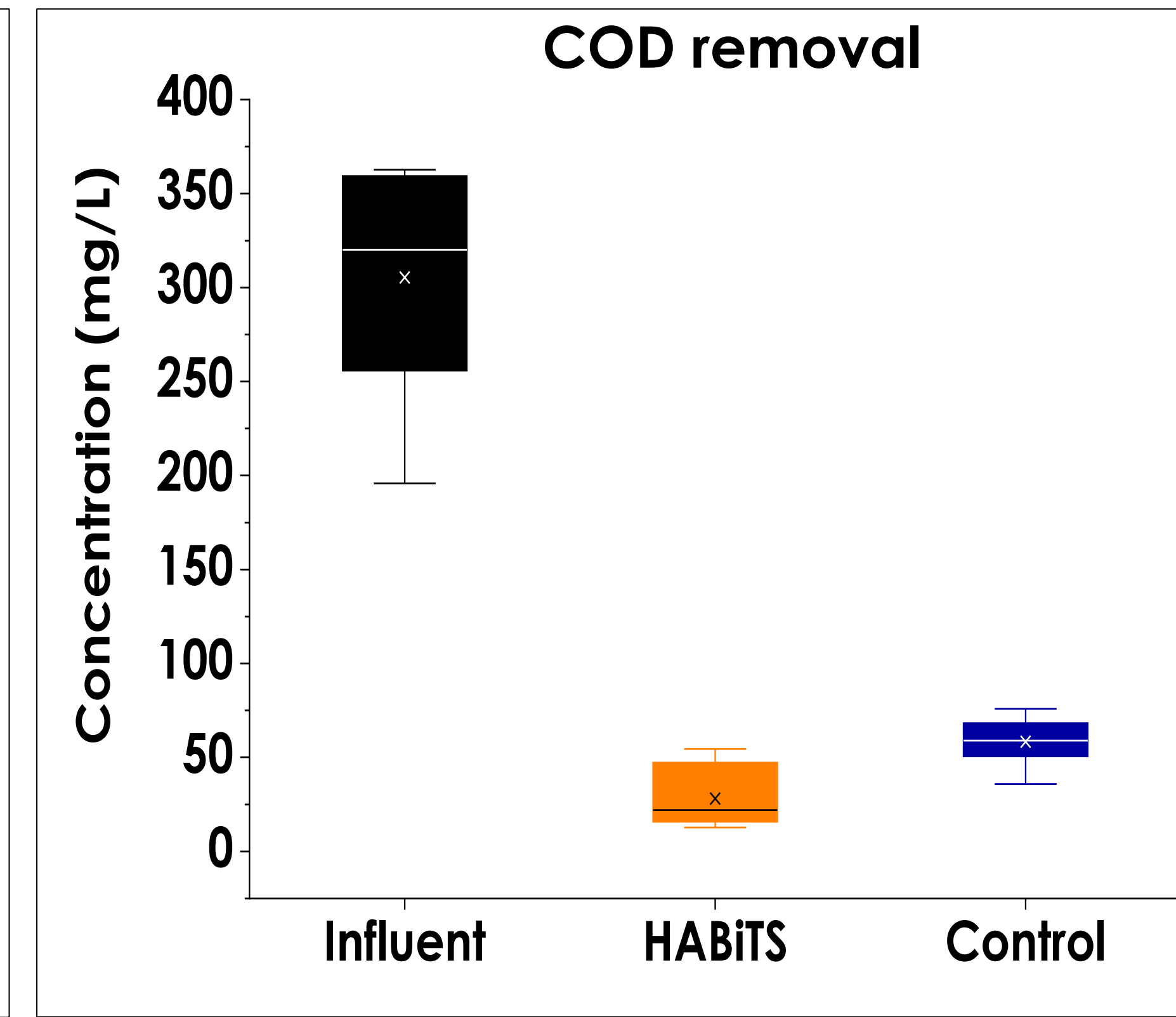
Side-by-side study with and without adsorbents



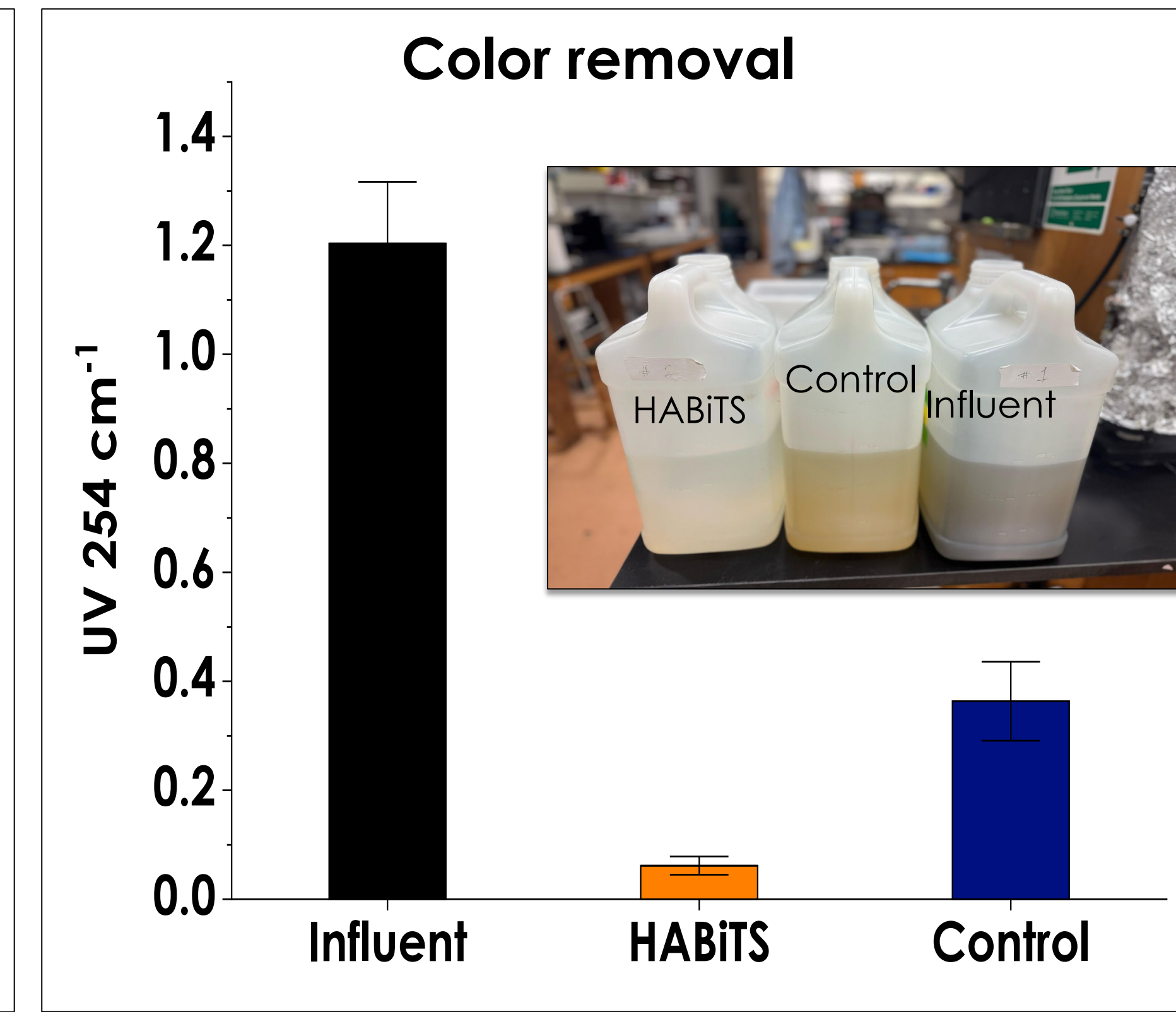
## Results and Discussion



- ✓ Zeolite + biochar amendment increased solute Mean Residence Time (MRT) by ~ 20%.

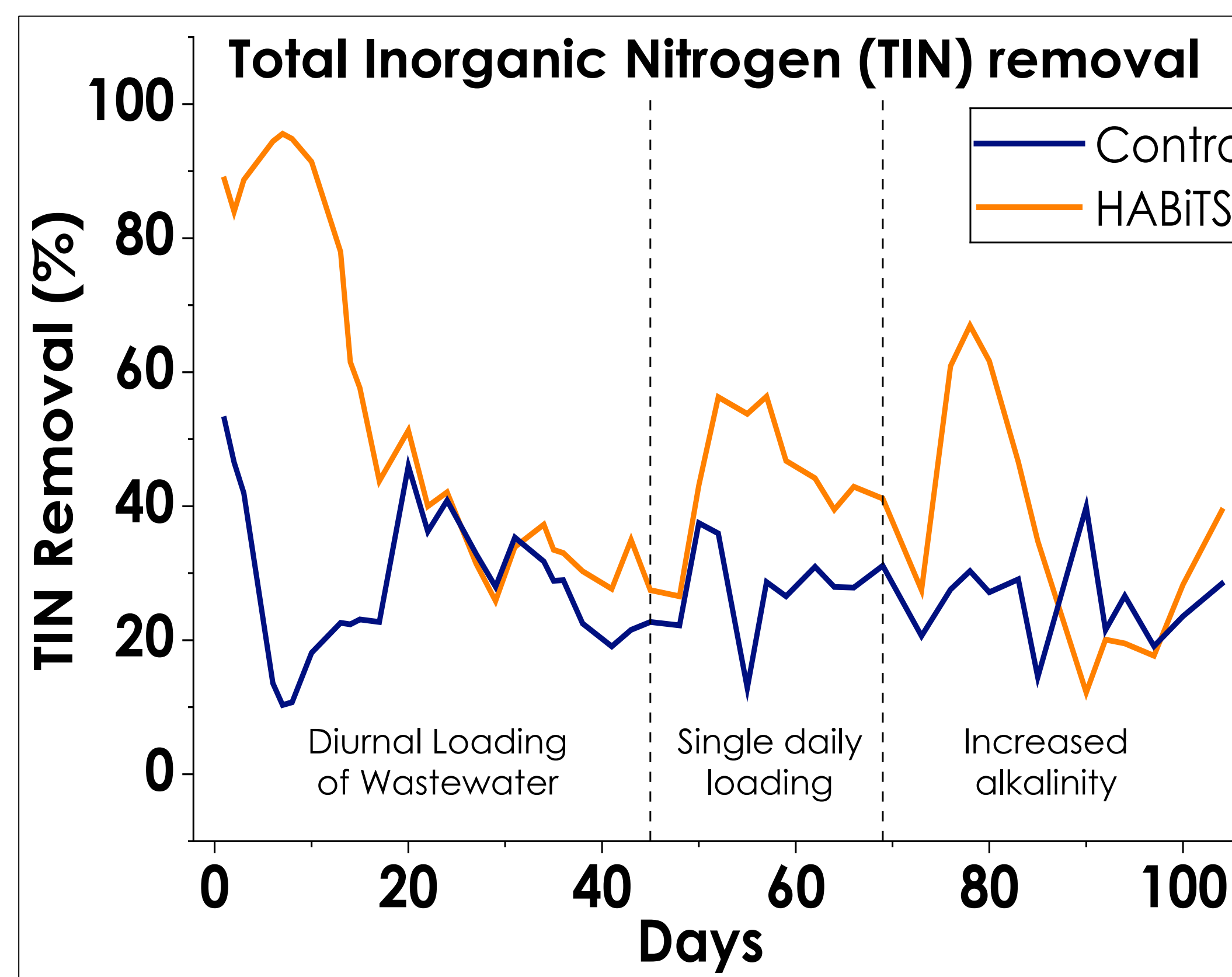


- ✓ HABiTS achieved ~91% COD removal vs. ~81% in Control.



- ✓ HABiTS removed 25% more color/organics.

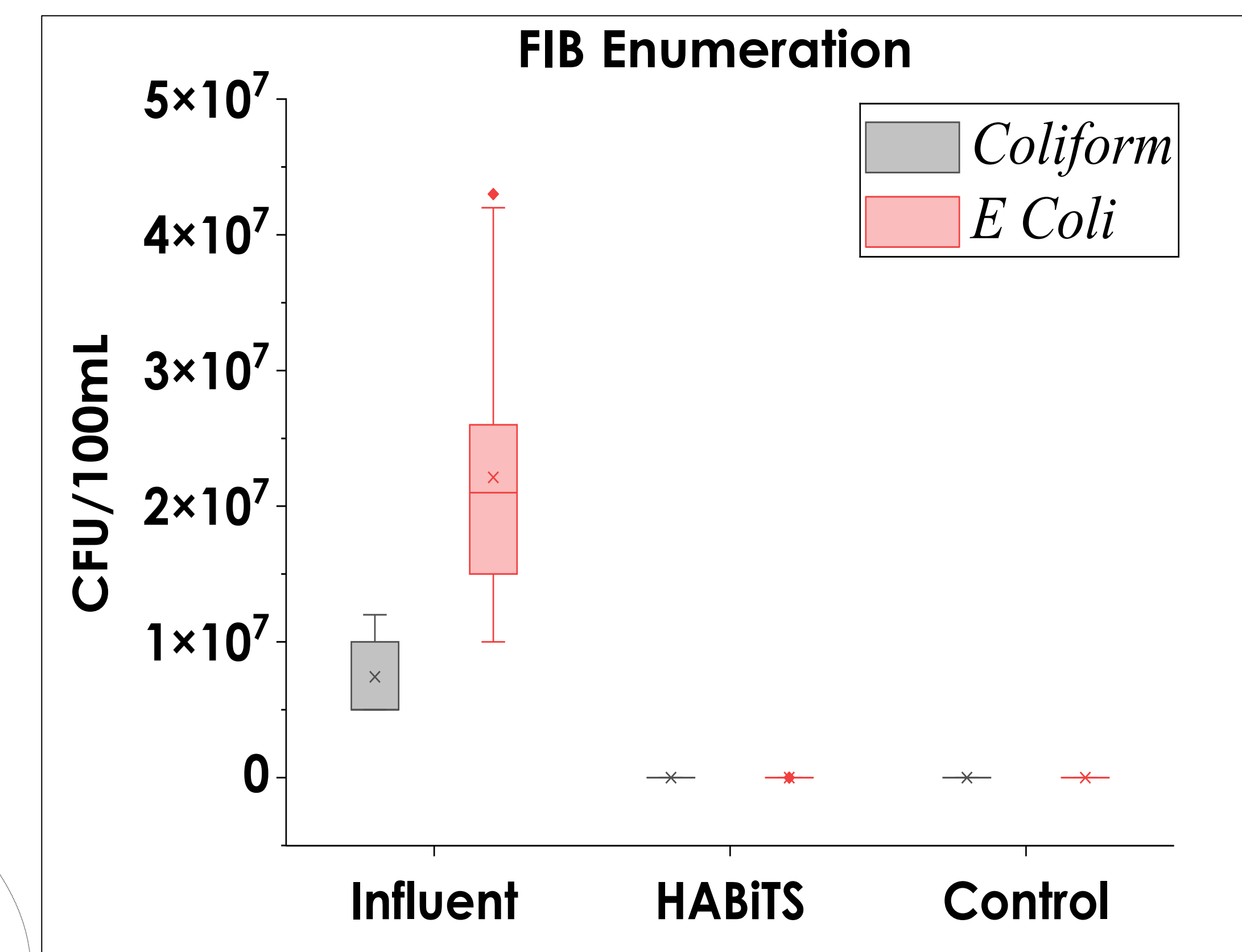
## Results and Discussion Cont'd



- ✓ HABiTS had a faster start-up.
- ✓ Insufficient alkalinity supply inhibited nitrification and TIN removal.

✓ TIN removal (%) was significantly higher ( $p < 0.05$ ) in **HABiTS** (46) than in the **CONTROL** (28)

✓ Excellent removal of FIB



- ✓ *E. coli* Log removal – **HABiTS** 3.5, **Control** - 3.1
- ✓ *Coliform* Log removal – **HABiTS** 3.8, **Control** - 3.6

## Conclusions

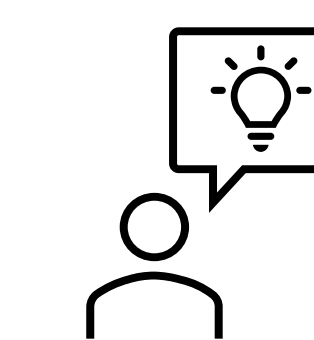
- ✓ Adsorbent addition enhanced N, FIB, and organics removal.
- ✓ Adsorbent increased solute MRT, giving microorganisms more time to degrade pollutants.

## Ongoing Research

- ✓ Oyster shells added to the reactors as a source of slow-release alkalinity.
- ✓ Early data indicate complete nitrification (~100%) after 30 days of reactor operation despite reduced media depth.

## Acknowledgment

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**Key Take-Home Message:**  
Zeolite and biochar amendments enhance the removal of N, COD, color, and organic matter from wastewater.



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