



# Attenuation of Trace Organic Chemicals during Soil Treatment Unit associated with Onsite Wastewater Treatment Systems

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# Overview



- Introduction
- Objectives
- Methods
- Results and Discussion
- Conclusions

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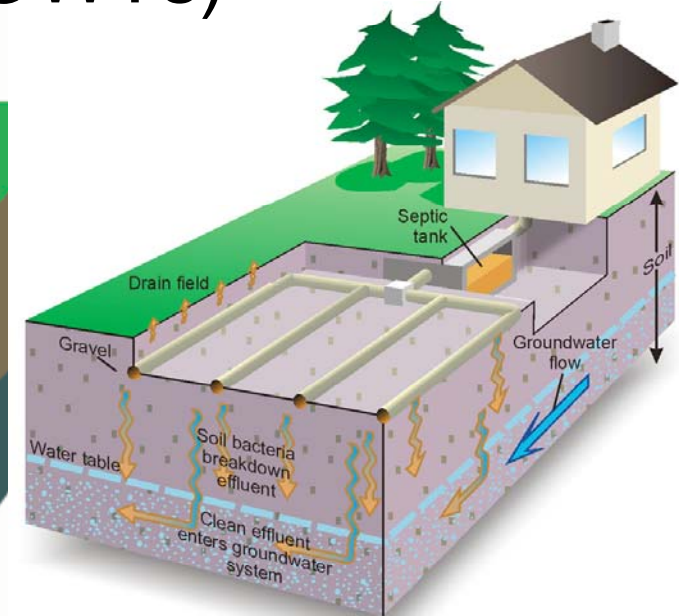
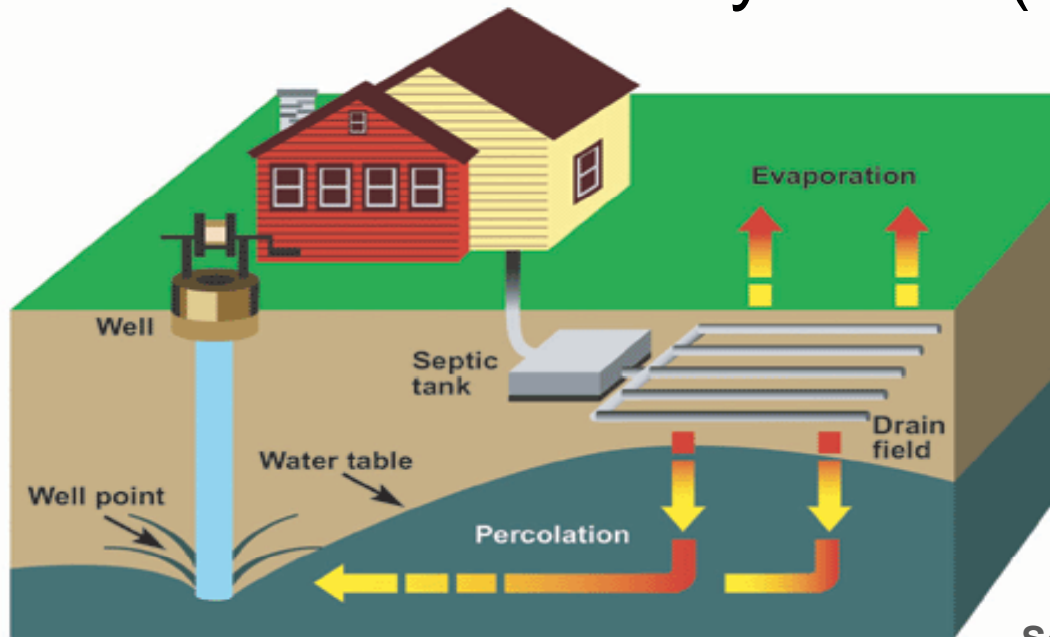
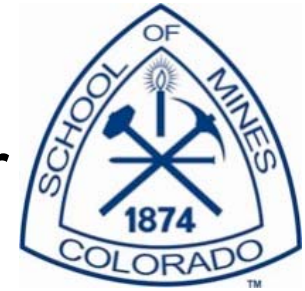


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# Introduction

# Soil Treatment Unit (STU) associated with Onsite Wastewater Treatment Systems (OWTs)



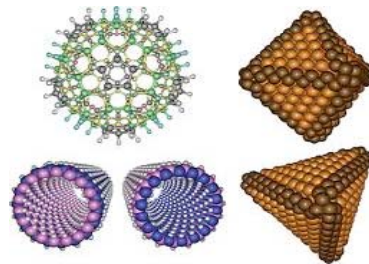
Source: Environment Canada, 2010

- Primary treatment (septic or imhoff tanks) followed by soil treatment unit (STU) commonly used in isolated areas, especially in communities with fewer than 500 people (Ortega et al., 2008)
- In Spain, more than 1.5 million people are considered to be located in isolated areas (Ortega et al., 2010).

# What are Trace Organic Chemicals (TOrCs)?



- Primarily introduced through wastewater
- Many have physiological effects even at very low concentrations.



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# Objectives

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- Understand the performance of STUs at different loading rates.
  - Nutrient transformation
  - Organic matter removal
  - TO<sub>r</sub>C attenuation



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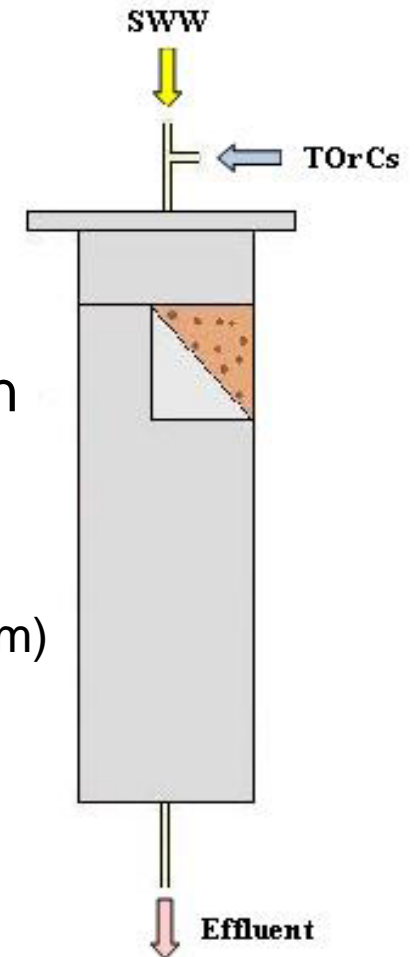


# Methods

# Methods



- Acrylic columns (30 cm x 8 cm ID) covered to avoid photodegradation
- Loading Rates: 30, 12, 8, 4 and 1 cm/day
- Triplicate columns per loading rate
- Synthetic WW spiked with TOrC
- Abiotic column
- **Nutrients:** Nitrogen species and Organic carbon
- **TOrC:**
  - Pharmaceutical and personal care products (cimetidine, carbamazepine, sulfamethoxazol, trimethoprim)
  - Herbicide (atrazine)
  - Stimulant drug (caffeine)



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# Results and Discussion

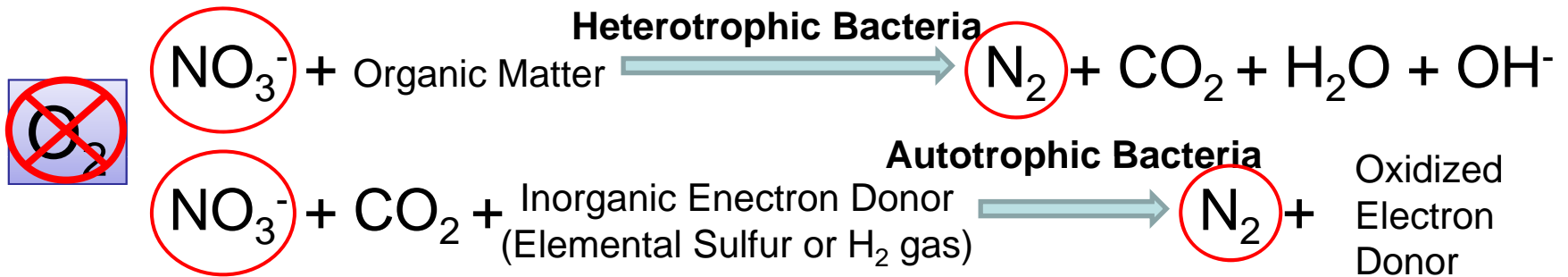
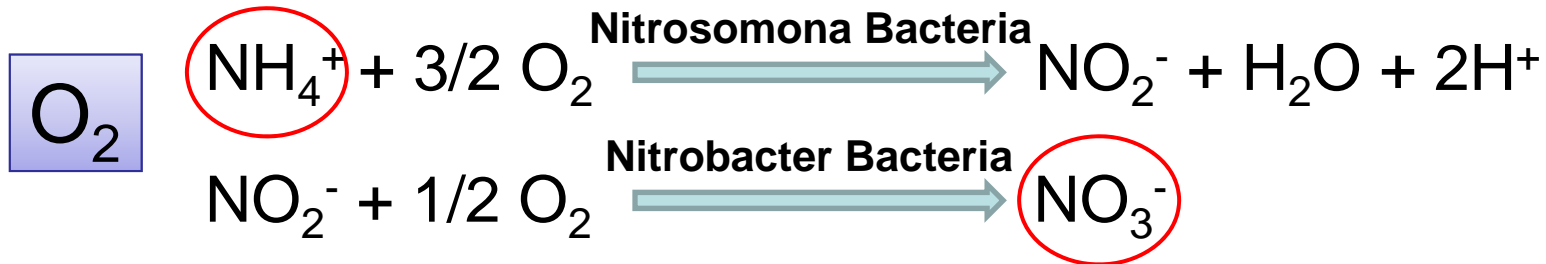
# Organic Matter Removal

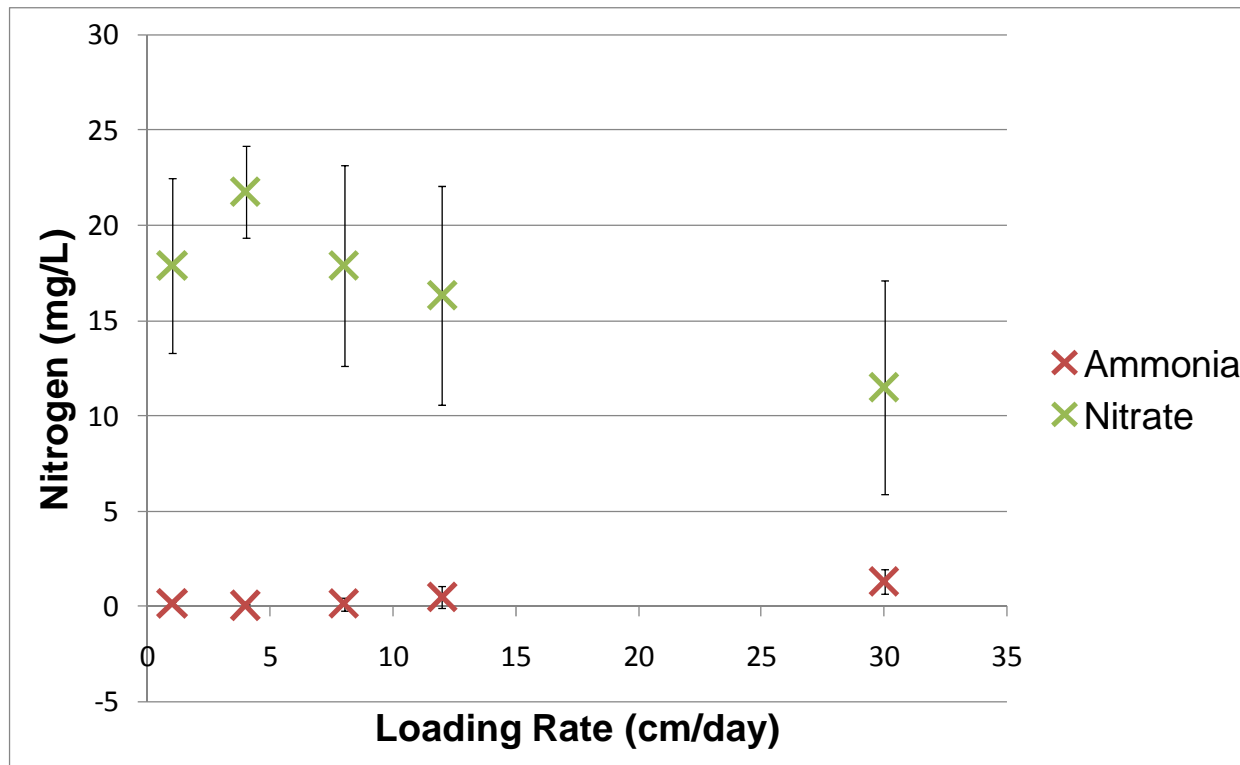


- The growth of the microbial community at the infiltrative surface of the STU relies on the DOC available in infiltrating water (Rauch and Drewes, 2005)  
→ microbial community established

Loading Rate (cm/day)	DOC removal (%)
30	91,1
12	94,5
8	90,9
4	93,9
1	90,1
Abiotic column	1,8

# Nitrification and Denitrification

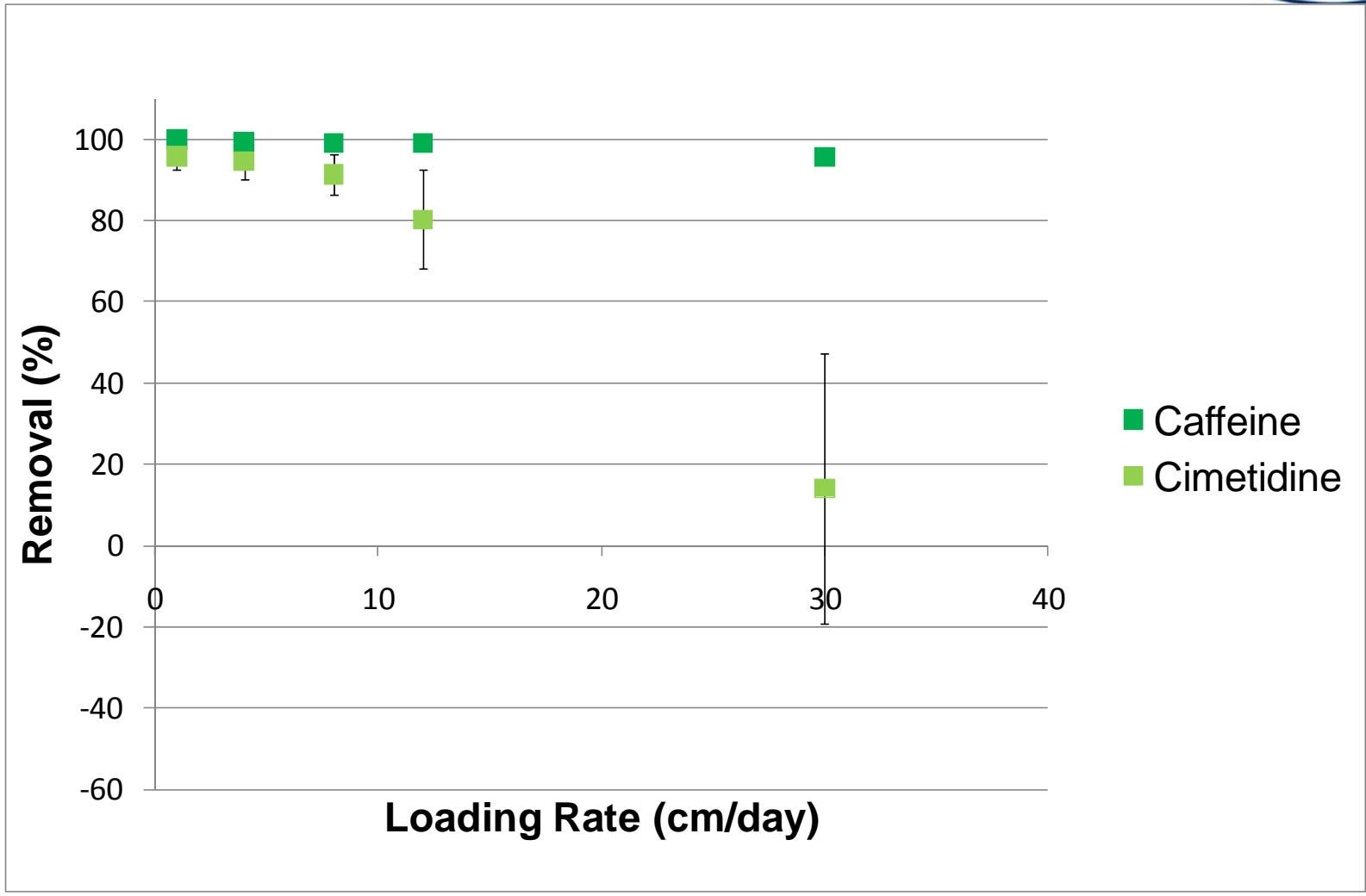
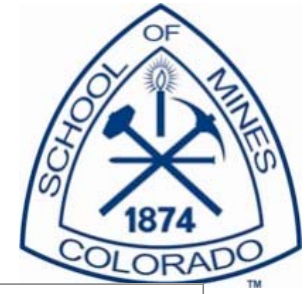




- **Nitrification** achieved at all loading rates.
- **Denitrification** appears greater at higher loading rates
  - REDOX state may have implications to TOrC attenuation
- No nitrogen transformation processes in the **abiotic column**

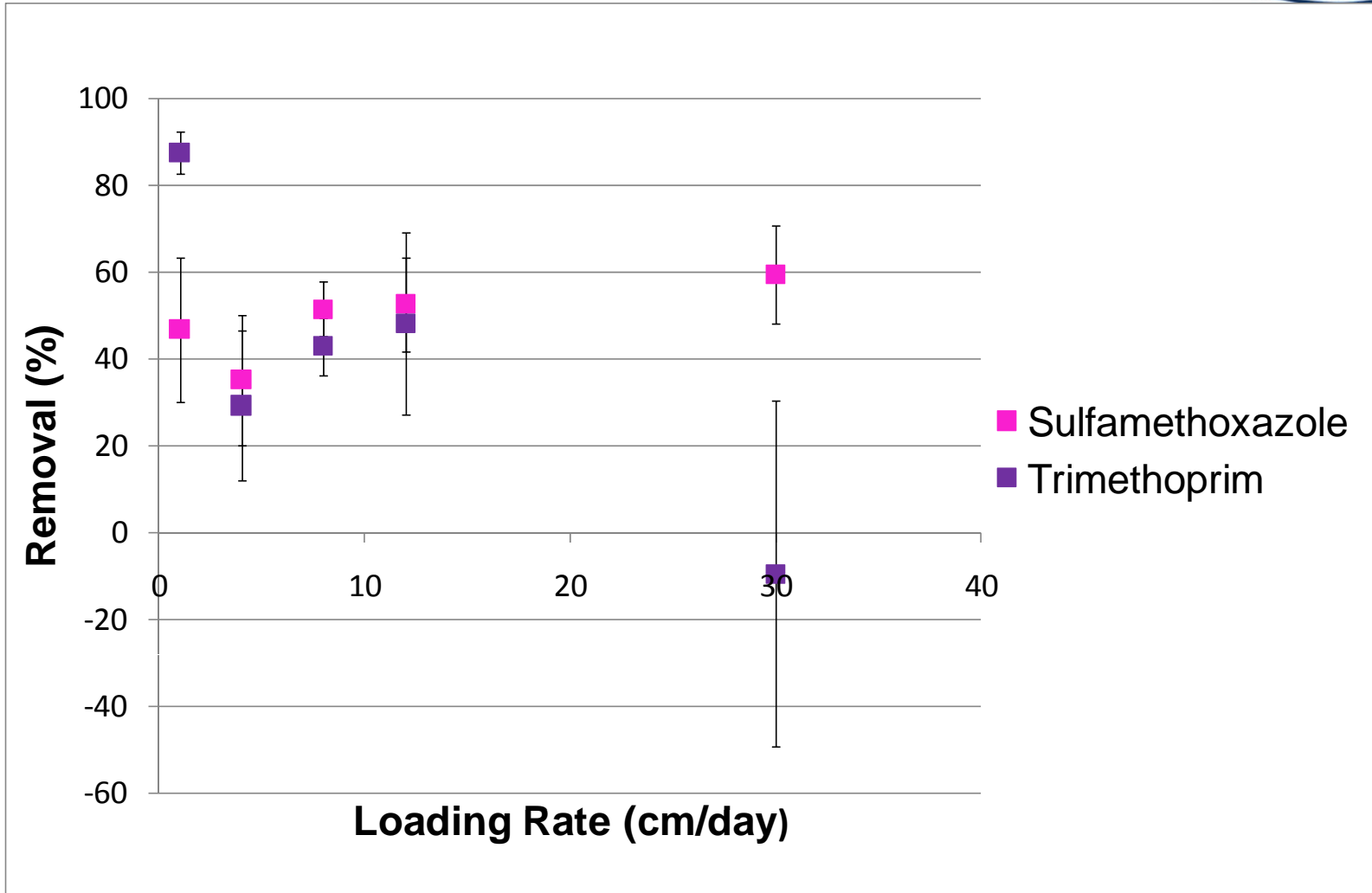
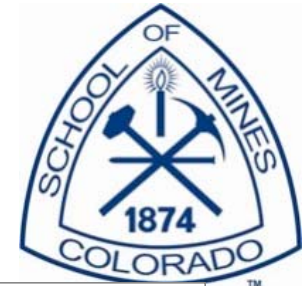


# TOrC attenuation

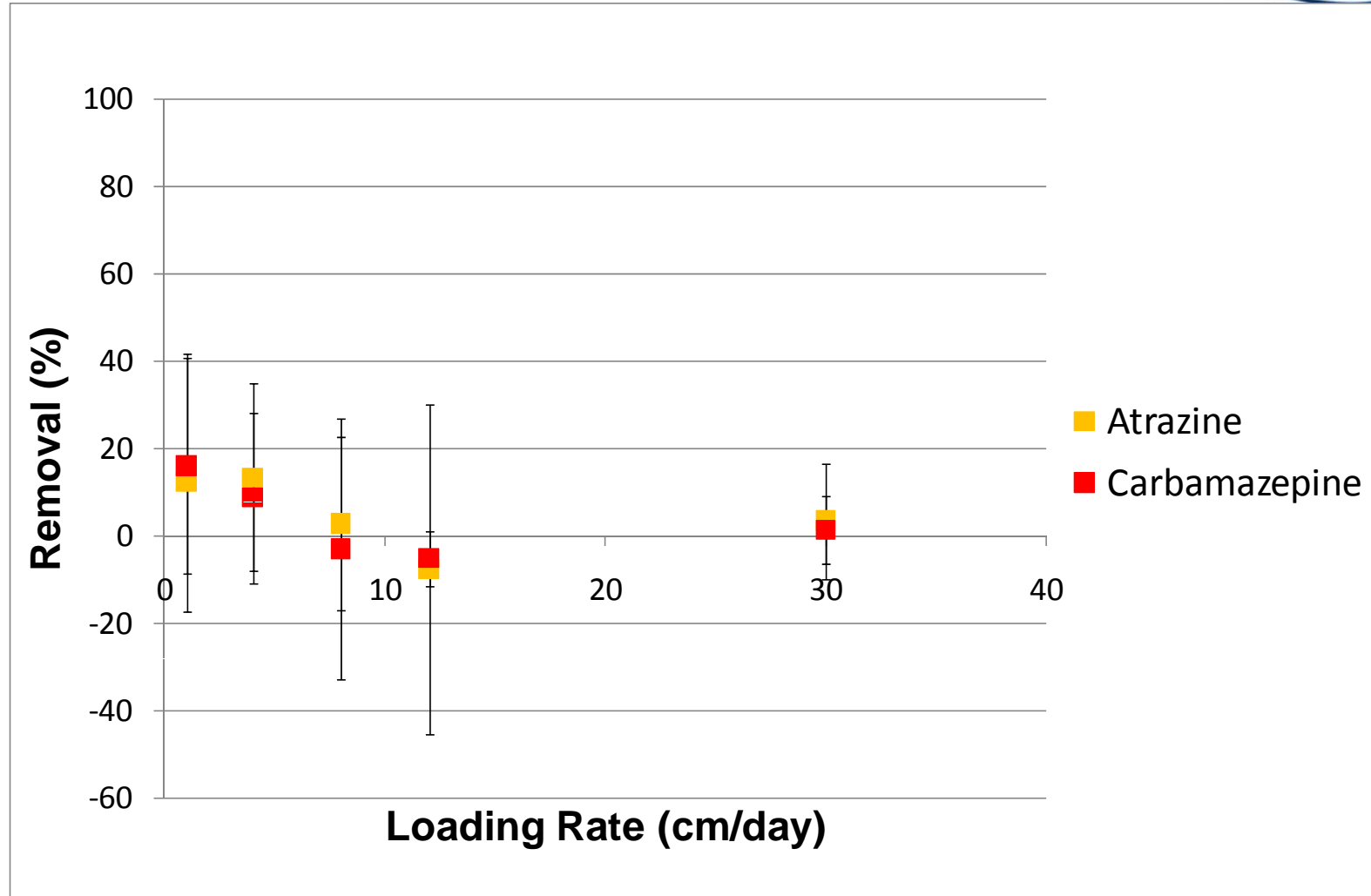




# TOrC attenuation



# TOrC attenuation



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# Conclusions

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- Active nitrification and dissolve organic carbon removal at all loading rates.
- TOrC attenuation compound specific, and in some cases loading rate specific.
  - Caffeine is well-attenuated at all loading rates.
  - Cimetidine mostly well degraded, loading rate dependent.
  - Sulfamethoxazole intermediate removal.
  - Trimethoprim intermediate removal with best removal at the lowest loading rate.
  - Almost no attenuation of carbamazepine and atrazine during infiltration.

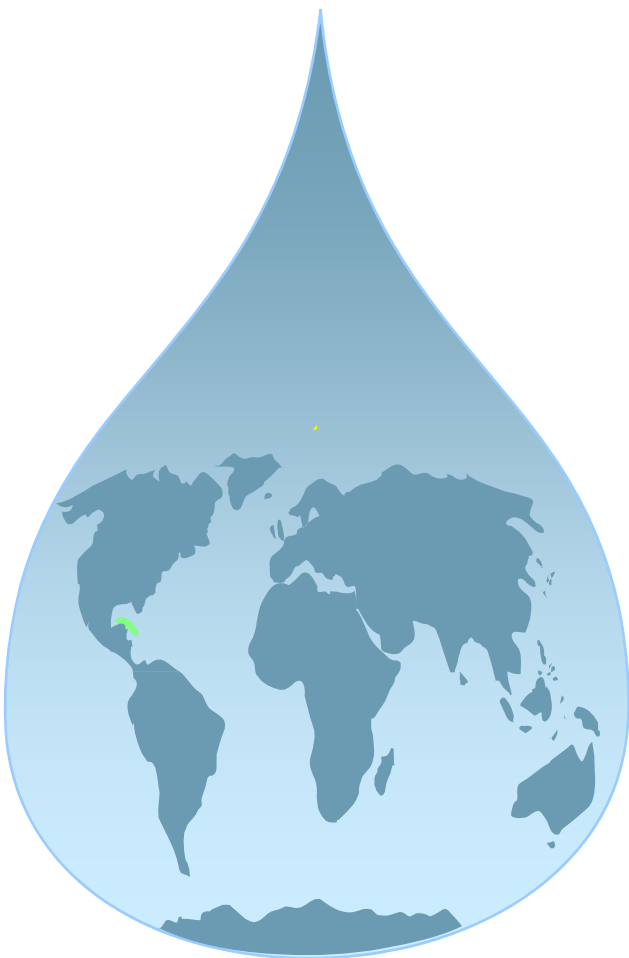
# Implications



- TOrC attenuation and STU effluent water quality comparable to tertiary treated effluent.
- Operating onsite systems at lower loading rates will result in greatest overall TOrC attenuation.

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**Thank you**