The Small Future of Urban Water Systems

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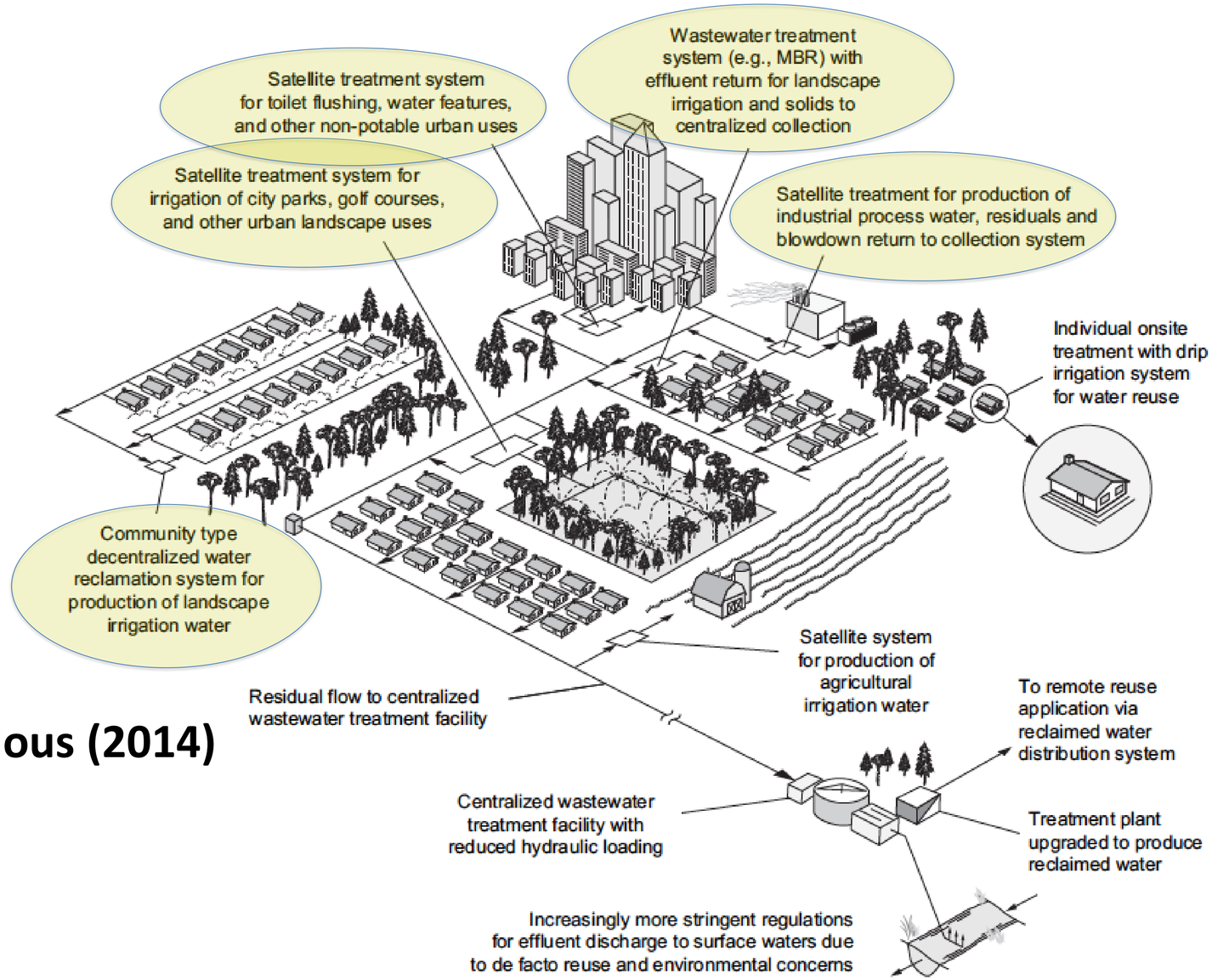
UC Berkeley

6th Sustainable Nanotechnology Organization Conference
November 5, 2017

Satellite & Decentralized Water



Gikas and Tchobanoglous (2014)

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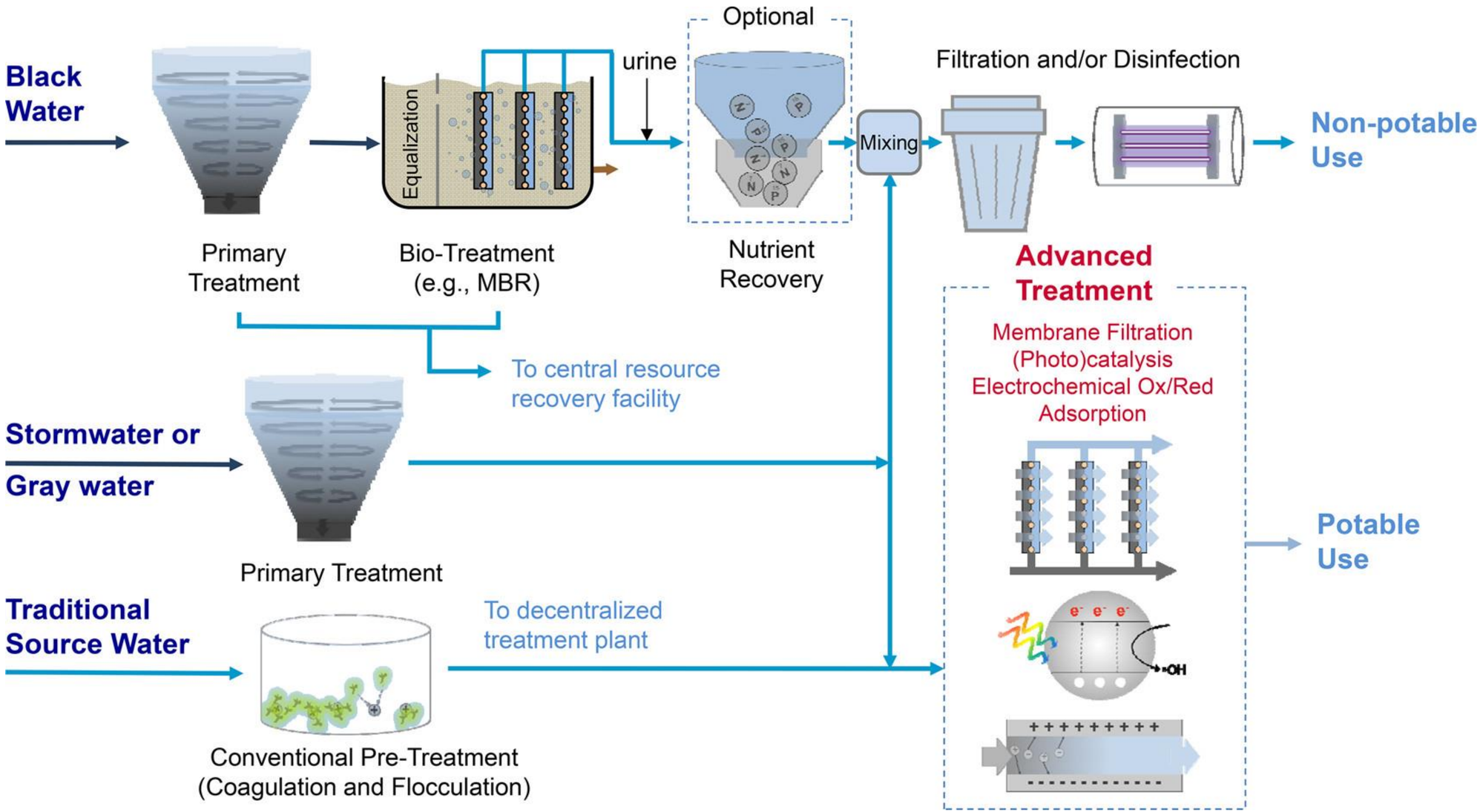
Supporting Technologies



Zodrow et al. (2017)

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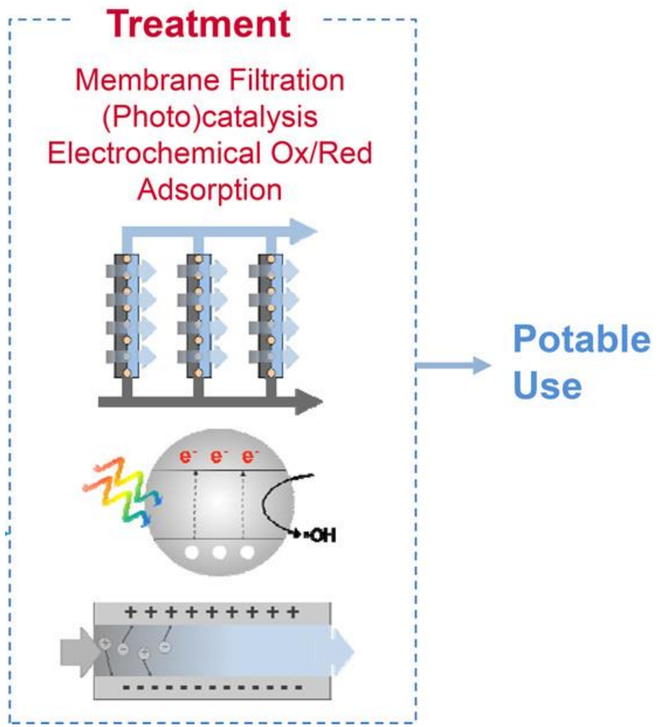
Advanced Treatment Technologies

Established

Polymeric RO

UV/H_2O_2

O_3/BAC



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Advanced Treatment Technologies

Established

Polymeric RO

UV/H_2O_2

O_3/BAC

Developing

New membranes

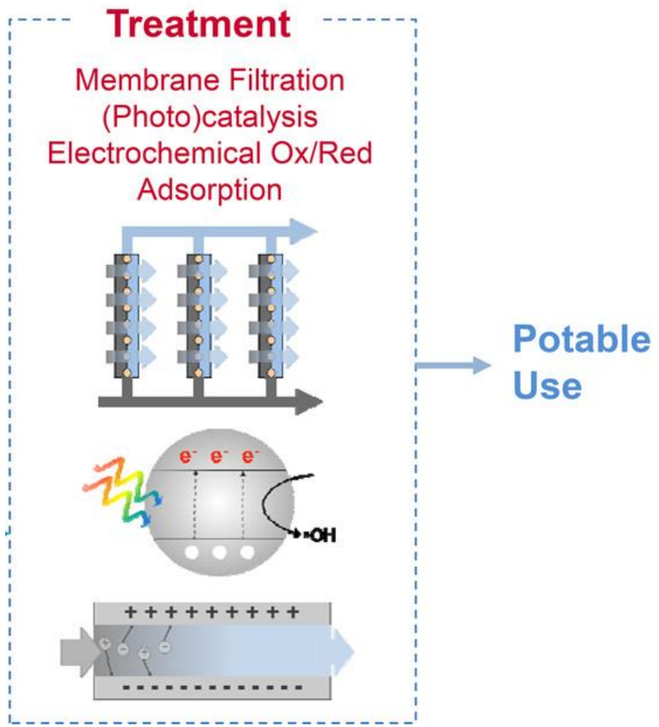
-graphene oxide

-carbon nanotubes

TiO_2 photocatalysis

Selective absorbents

Electrochemistry



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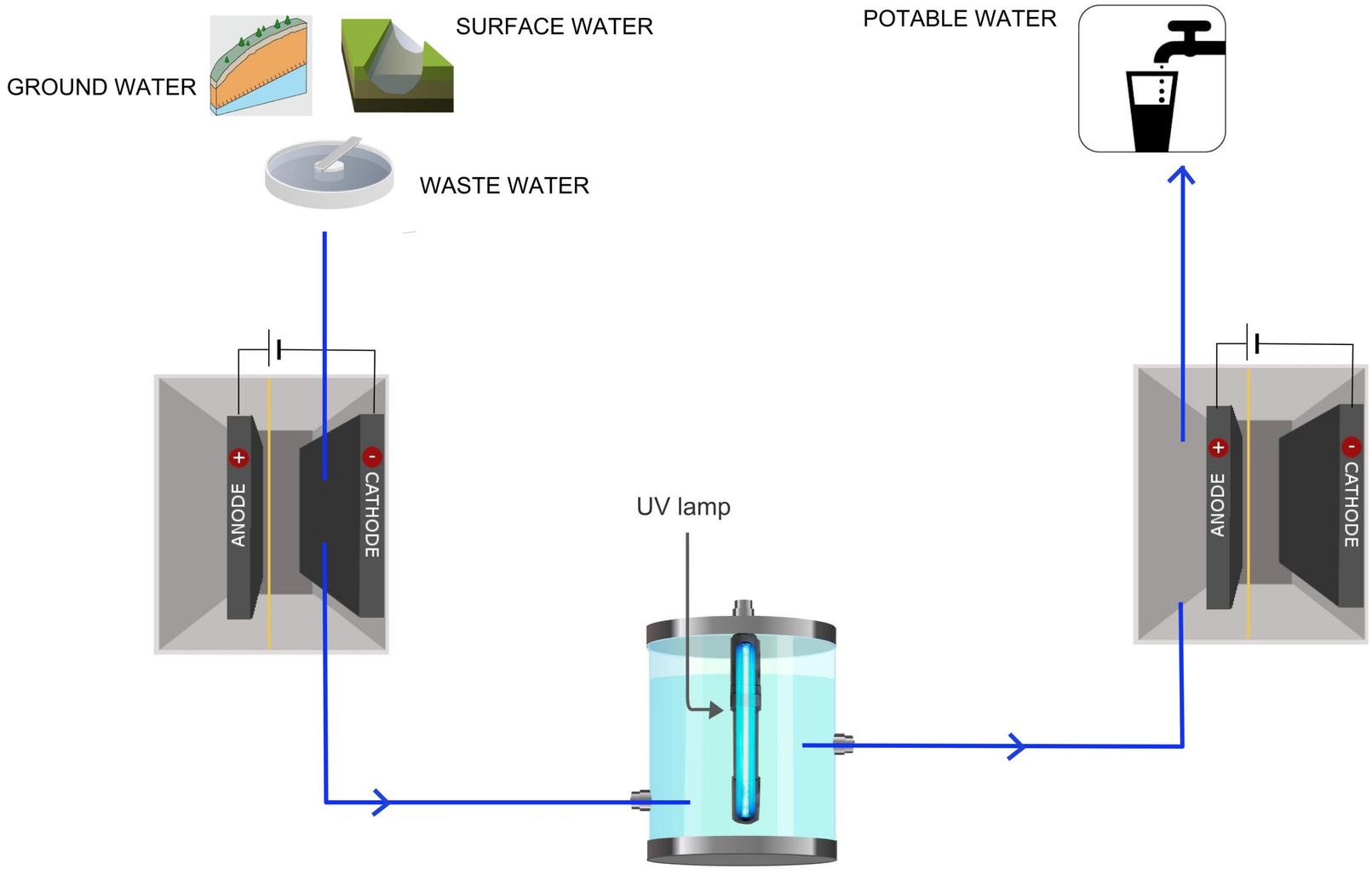
Modular Electrochemical UV/AOP



Barazesh et al. (2015)

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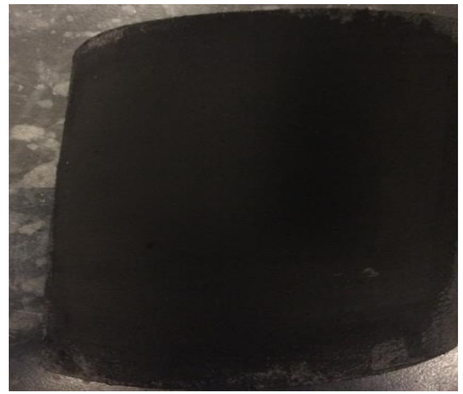
Open Air Cathode

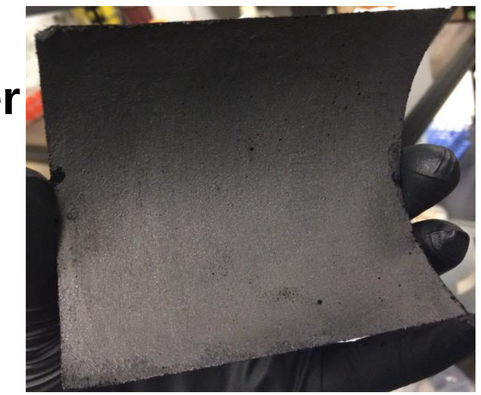
carbon black
PTFE

carbon fiber paper

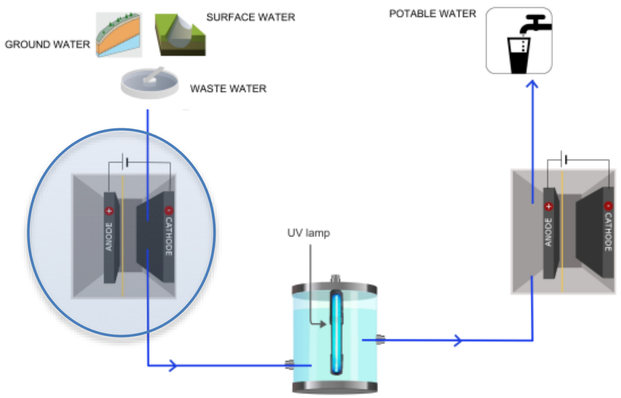


Liquid Side

graphite powder
PTFE



Gas Side



Barazesh et al. (2015)

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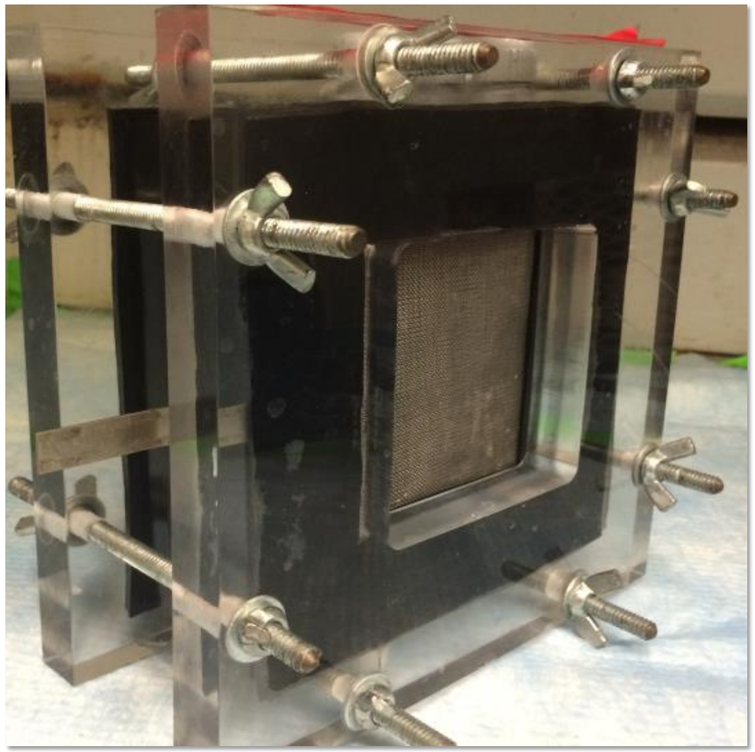
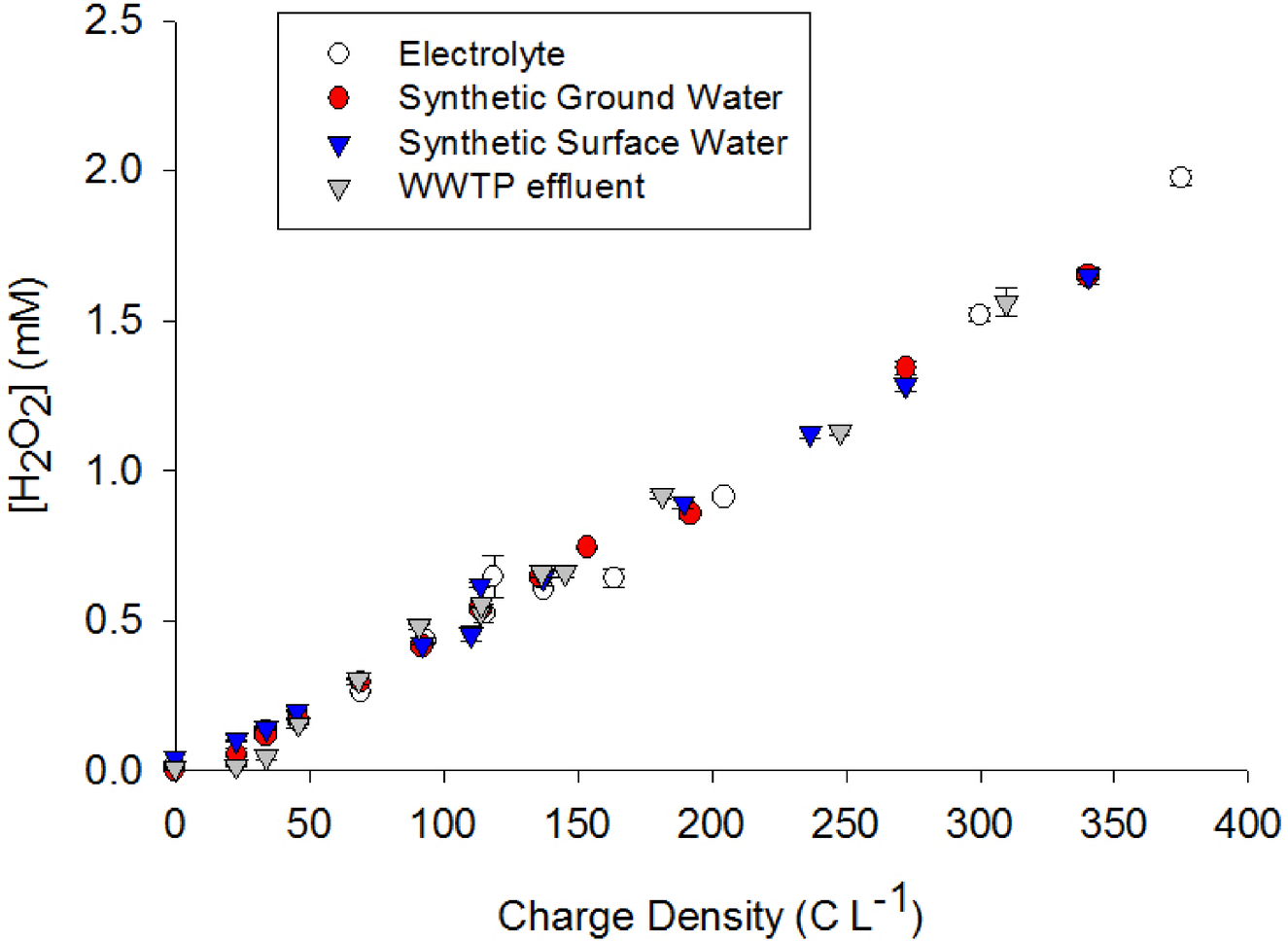
H_2O_2 Production





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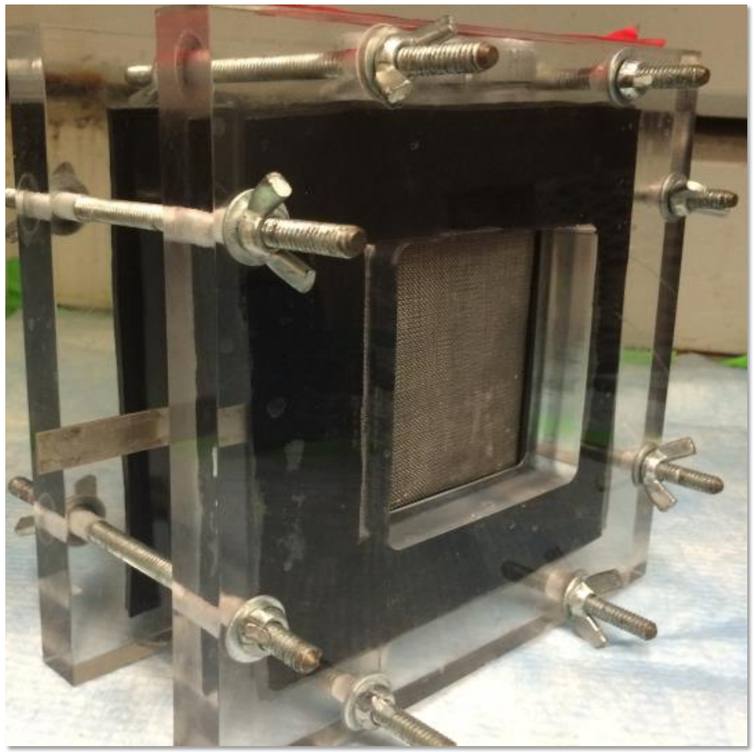

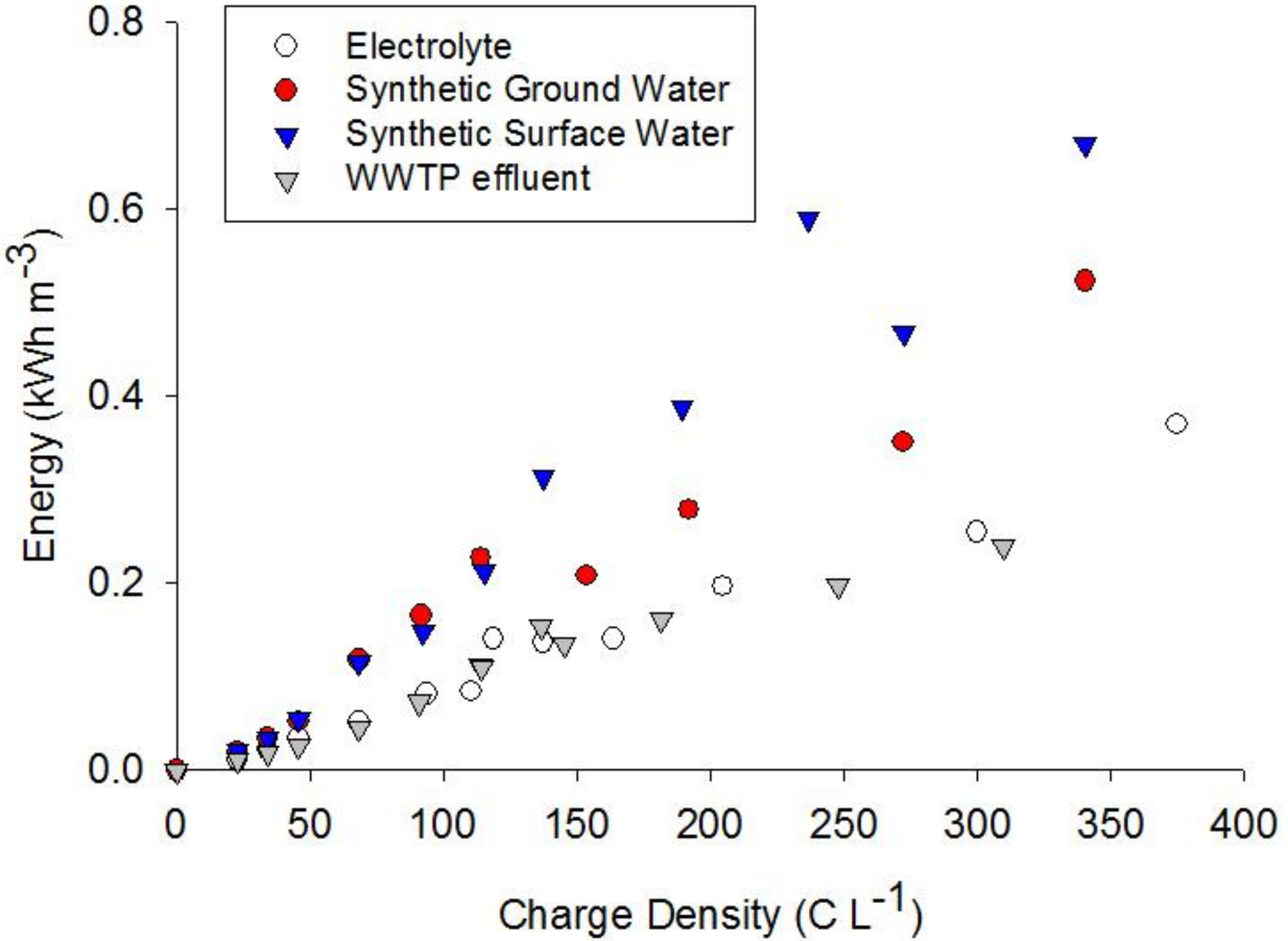

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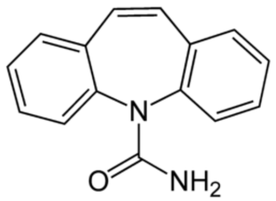
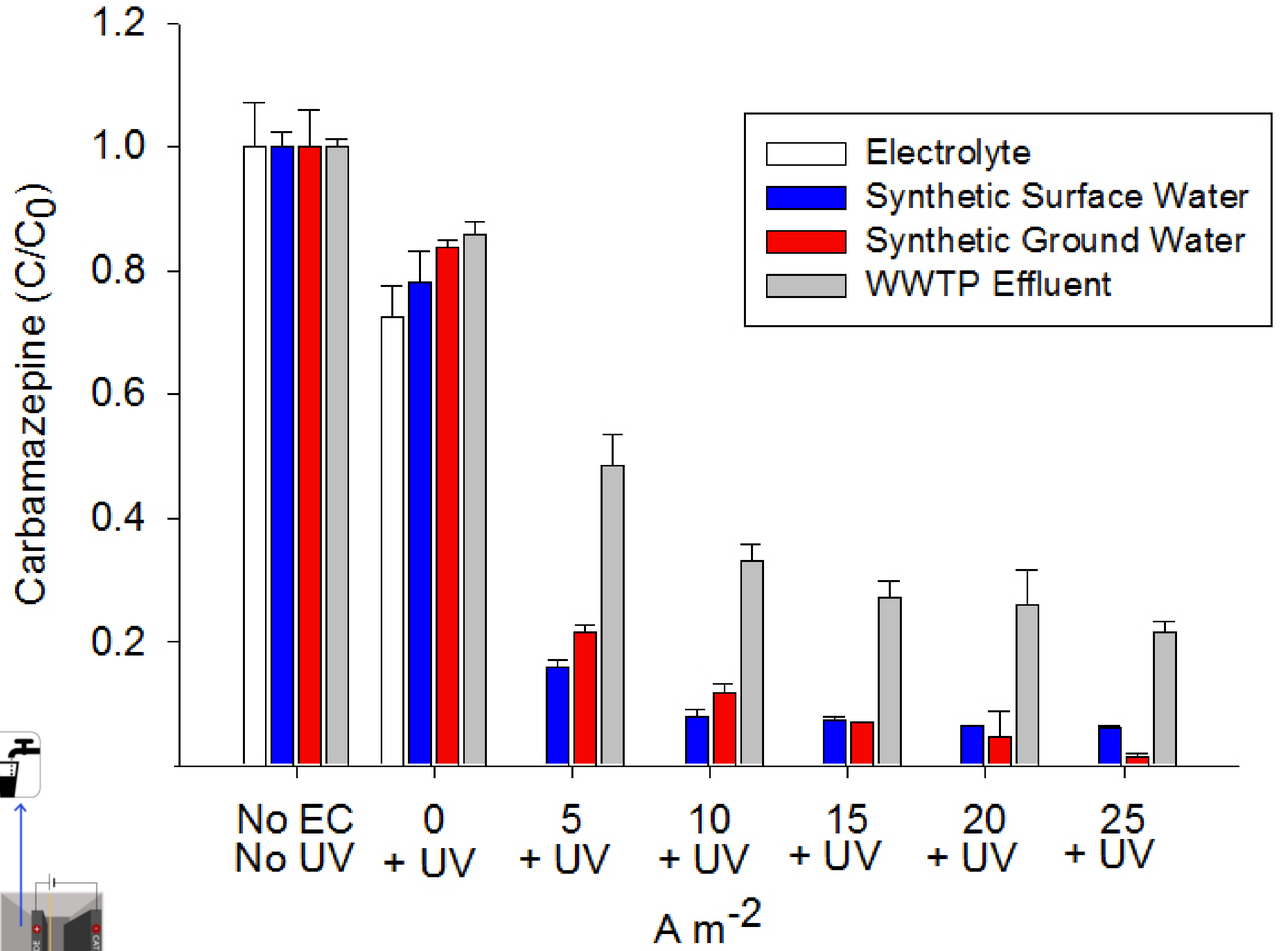
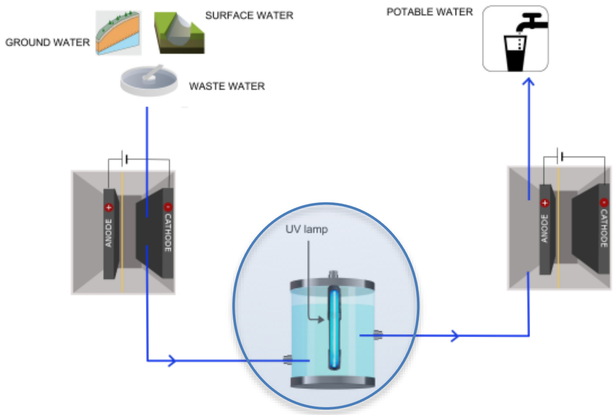
UV/H_2O_2 Treatment







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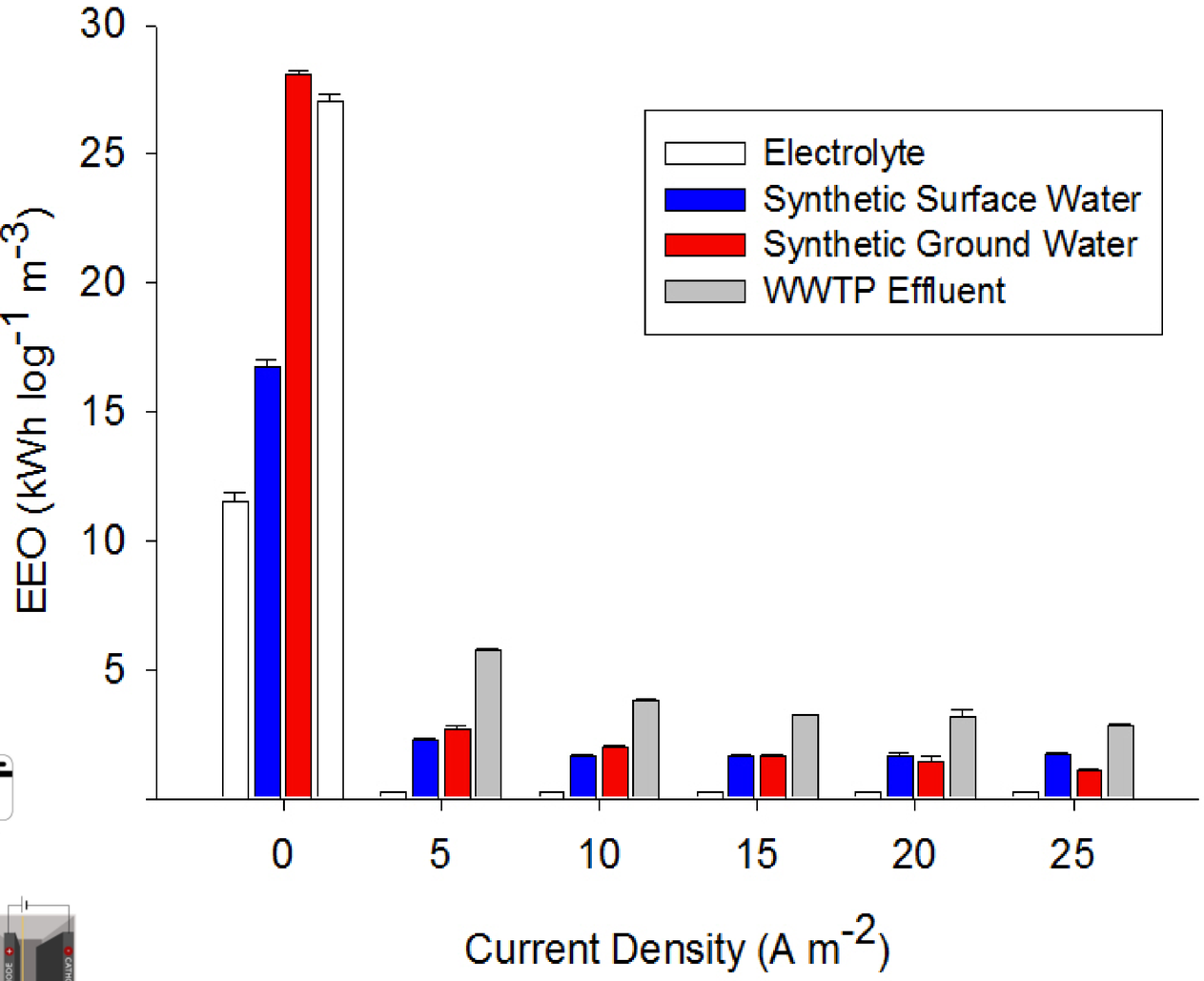
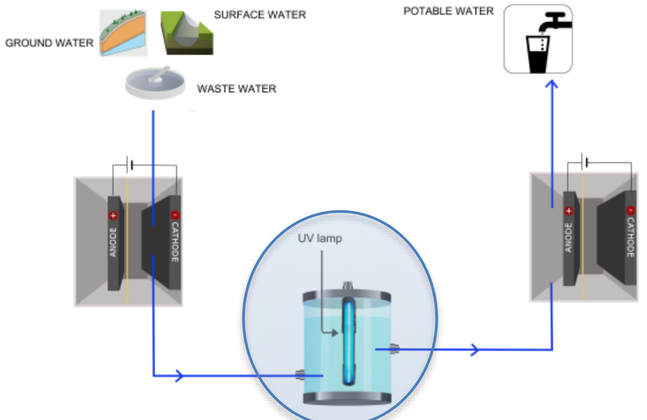
Treatment Efficiency

$$EEO = \frac{P}{Q \log\left(\frac{C_0}{C}\right)}$$





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pH Changes

Cathode

$$O_2 + 2H^+ + 2e^- \rightarrow H_2O_2$$

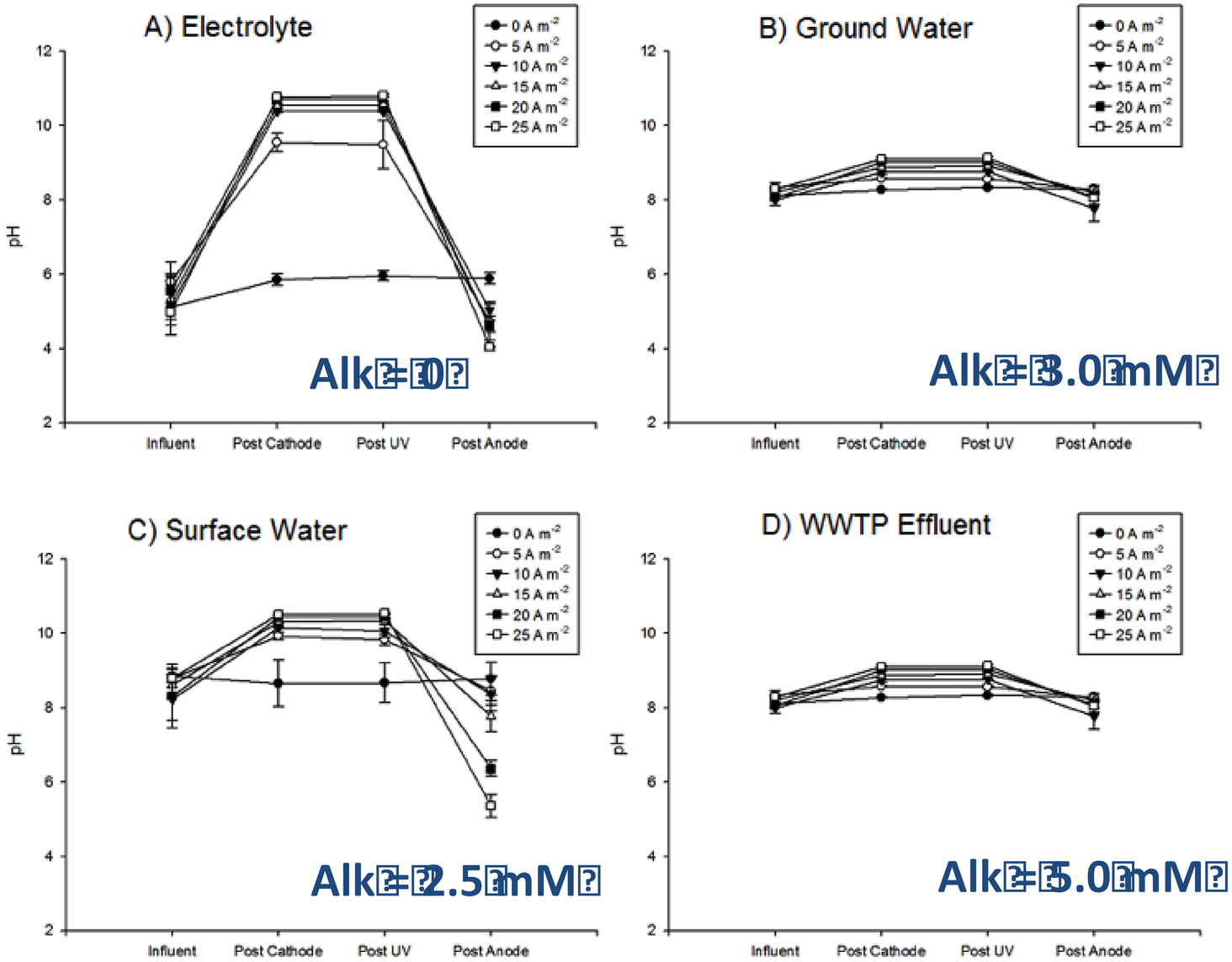
Anode

$$H_2O \rightarrow 0.5O_2 + 2H^+ + 2e^-$$

$$2Cl^- \rightarrow Cl_2 + 2e^-$$

$$Cl_2 + H_2O \rightarrow HOCl + H^+ + Cl^-$$

$$HOCl + H_2O_2 \rightarrow Cl^- + O_2 + H_2O + H^+$$



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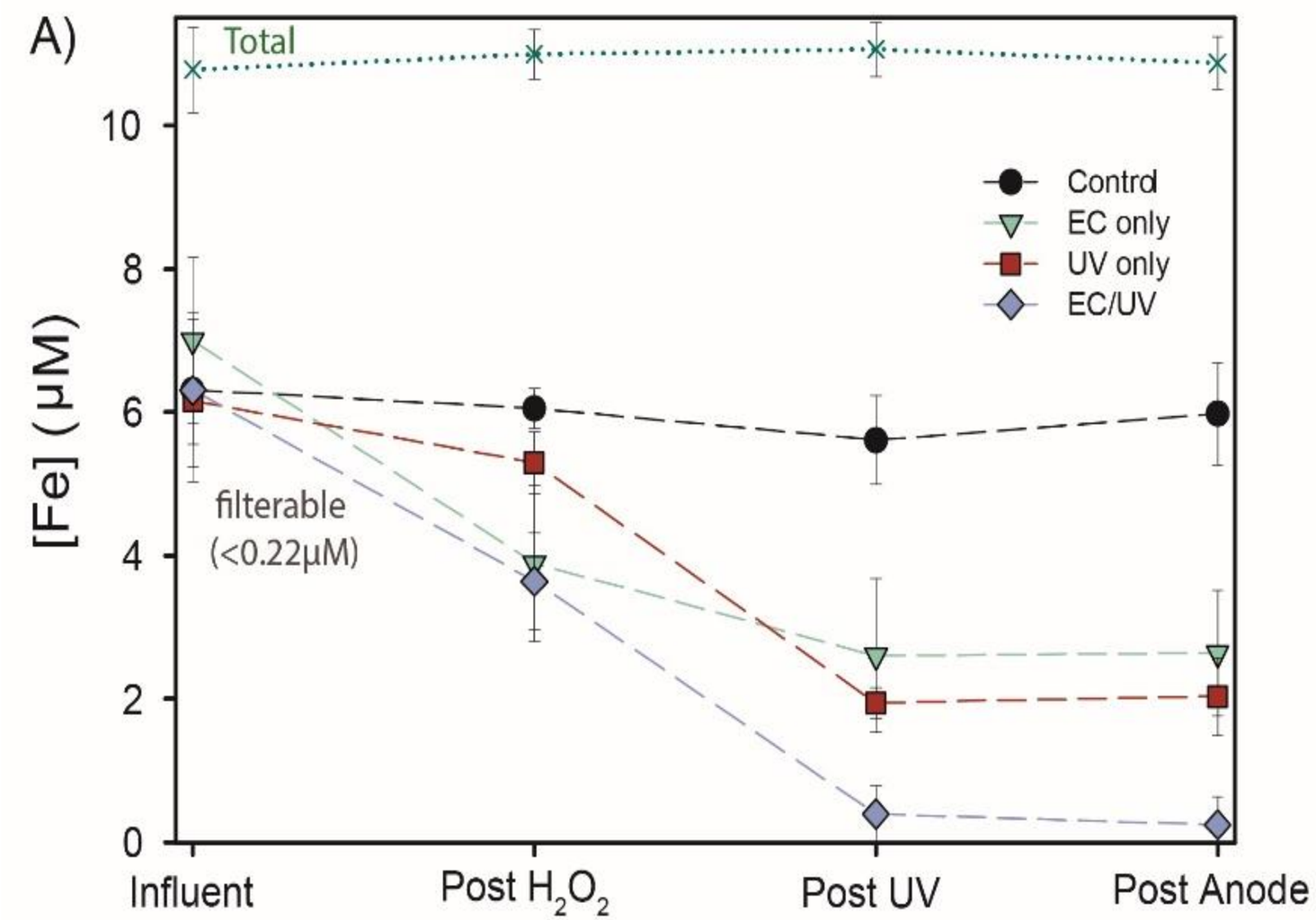
Iron Removal



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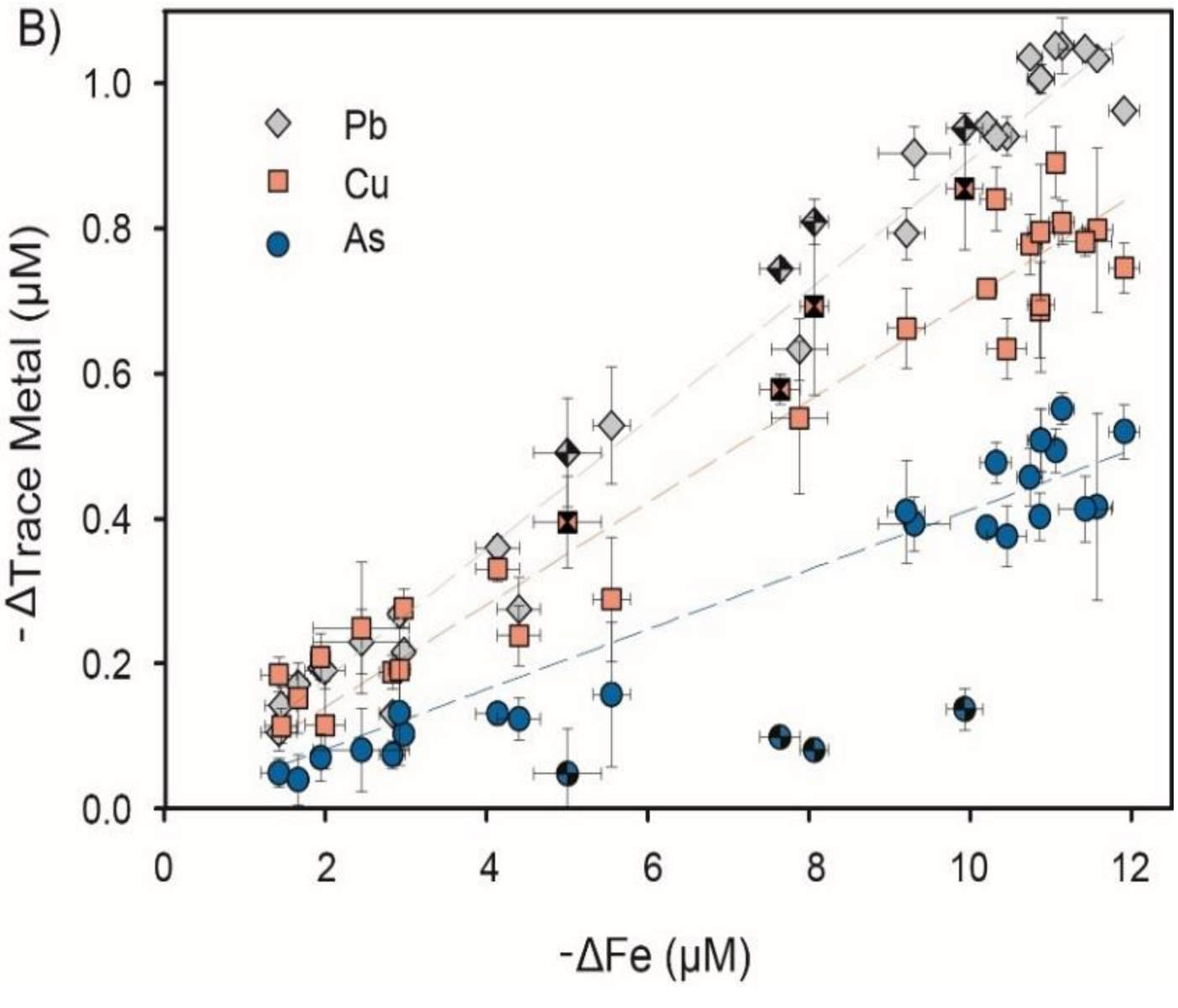
Metal Removal



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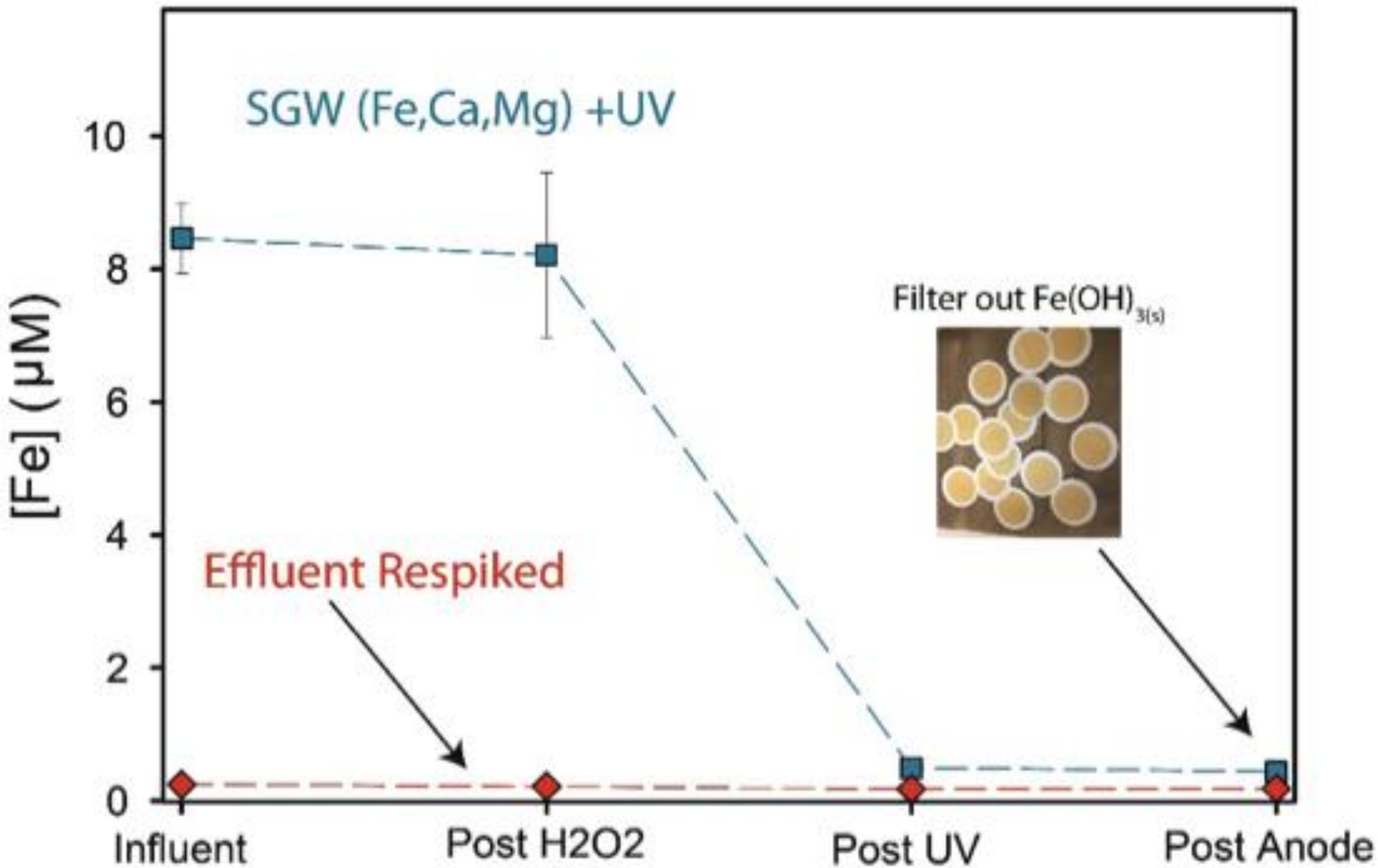

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Lessons for Small Thinkers

Distributed Advanced Water Treatment

- Important to Revolutionizing Urban Water
- Need for Inexpensive, Reliable Systems

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Lessons for Small Thinkers

Distributed Advanced Water Treatment

- Important to Revolutionizing Urban Water
- Need for Inexpensive, Reliable Systems

Cathodic H_2O_2/UV/Anode Prototype

- Employs Proven Technologies
- Robust and Inexpensive
- Many Challenges Remain

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